# Fifty Years of Farm Management in Australia: Survey and Review

L.R. Malcolm[1]

Fifty years of Australian academic literature about farm management is surveyed and reviewed chronologically and methodologically. Farm management started as a field of academic inquiry during the 1940s, and at the end of the first decade most of the major emphases which were to predominate over the ensuing decades had made their debut in the literature. Major emphases over the fifty years have been records and accounts, production economic thinking, linear programming, decision theory and systems simulation approaches. Over time came increasing doubt about the usefulness of each of these emphases, and in the 1980s journal writings about farm management declined greatly. Much academic work about farm management during the past fifty years lacked relevance because of a 'partial-farm management' orientation. This derives in part from a methodological focus which is too narrowly disciplinary, and insufficiently dynamic, and also from the imperative of specialization for progress to be made in particular disciplines. The human element, the technology, the financial and taxation aspects, the dynamic, complex and uncertain nature of farming, factors beyond the farm gate, the processes of farm management, and the need for sound judgements about 'the numbers' are more important aspects of farm management than was implied by the emphases on records, production economics, optimal plans, quantitative decision analysis and systems modelling. The balance of the emphases on the various disciplines has to be appropriate for work in farm management to be relevant to problem solving. The traditional, relatively simple, farm management budgets have stood up well to tests of time because they enable the full dimensions of the problem to be brought into consideration. Further the computer spreadsheet has enhanced the analytical power and problem-solving relevance of the traditional farm management budgets. Thus there is plenty to be going on with.

## 1. Introduction

A record of farm management as a field of academic enquiry is a record of the prevalence, testing and application of various theoretical models and methodologies which emerged from the discipline of economics or agricultural economics, as well as from various other disciplines such as agricultural science, sociology and psychology. Academic study of farm management in Australia and the related journal literature commenced around 1940, increased in the 1950s, boomed and peaked in the 1960s and early 1970s, and declined through the late 1970s and the 1980s. Much development of farm management can be charted from writings in four journals: the *Journal of the Australian Institute of Agricultural Science*, the *Review of Marketing and Agricultural Economics*, the *Australian Journal of Agricultural Economics*, and the now-defunct *Farm Policy*.

Mathias (1971, p.1) observed about studying the past 'from an infinite population of facts some conceptual filter is required for selection'.[2] In this record, two types of filter apply. First, the field of investigation is restricted to a survey of the above-mentioned relevant professional journals, plus the slightly wider range of relevant literature drawn on in the review section of this paper. The second filter on this work, albeit of a different type, is that enquiries into the past are inevitably influenced by currently prevailing ideas about farm management. That is, history of the time is seen from the perspective of this time, when the development of farm management during the past fifty years is the product of unique historical experience.

## 2. Getting a Start

The effects of the Great Depression were still reverberating throughout the industrial world in 1939 when the then Principal of Roseworthy Agricultural College, the agriculturalist Alan Callaghan wrote of Australia's need for trained agricultural economists. Callaghan (1939, p.189-192) noted the historical contribution of agriculture to national development and asserted that rural producers should learn about economic laws as they affected

[1] Senior Lecturer in Agricultural Economics, School of Agriculture and Forestry, University of Melbourne. Enlightening advice from an anonymous referee and Don Williams, Jack Makeham, Doug Cocks and Alan Lloyd is much appreciated.
* Review coordinated by Bob Batterham.

[2] In this record the theoretical and methodological developments in farm management over the past fifty years are not related explicitly to the wider economic, political and social phenomena which make up the historical experience of farming and the economy. When these links are made, as is necessary for the purposes of economic history, the more complete picture better supports the plausible conjecture which characterizes not only this but all works about the past.

farm management, pointing out the 'strange but nonetheless true anomaly' that 'there are very few economists in Australia...who have a proper understanding of agricultural and pastoral problems'. He posed a series of questions and inadvertently set much of the agenda for inquiries into agricultural economics and farm management for the next half century, viz:

> Where are our agricultural economists to advise the governments of the day on the wheat question, the wool question, the wine question or whatever the problem may be? Who is there in Australia to tell the farmer the relative and economic advantages of ownership of land? Who is there to decide the economic virtues or otherwise of combined harvesters over strippers or horses? Who is there to point the economic lessons of employing labour to place the pig raising, poultry farming and other so-called (and economically ill-advisedly called) sidelines on the basis of a proper enterprise? Who is there to guide the farmer in the fundamental and economic problem of treating his farm as his greatest asset? Who is there to convince the farmer with figures that he can conserve fodder cheaper by employing labour than he can buy it? Who is there to show the farmer that depreciation costs on farm machinery may quite easily cancel out the advantages of time and convenience it offers? Who is there to guide the farmers with facts and figures towards a permanent system of agriculture based on soil economy and the long term utilization of land? Who is there to protect with facts the vulnerable farmer from astute salesmanship, and cunningly devised selling propaganda? Who is there to defend the rightful claims of the rural community for equitable economic treatment when artificial forces interfere with normal economic laws? Who is there to link-up the problems of economic production in one commodity with all other branches of rural production?

The answer to these questions, it seems, was no-one. Work in farm management in the 1900-1940 period was characterized by an orientation towards agricultural science and the absence of economics (Dillon 1965). Certainly, Callaghan (1939, p.193) claimed 'never before has the need for basic knowledge of the forces of agricultural economics been so glaringly patent as at the present time', and made the ringing call to arms, 'Australia is ready for the concerted efforts of trained agricultural economists'. He hoped that a 'spirited effort would be made to answer the challenge of the present state of affairs and assist bewildered producers who have always, and will always, maintain the solvency of Australia'. These sentiments were to be a recurring theme in Australian writings about agricultural economics and farm management through the 1940s. Numerous writers noted an urgent need for people trained in agricultural economics and the apparent backwardness of the profession in comparison with the United States of America (USA) the United Kingdom (UK), Europe, and New Zealand (Callaghan 1939, Moodie 1941, Pawley 1941, Aird 1941, Callaghan *et al.* 1942, Owen 1948).

A response to the pleas for the development of agricultural economics in Australia occurred in 1941 when the New South Wales (NSW) Department of Agriculture established a Division of Agricultural Economics (which amalgamated with the Division of Marketing (State Marketing Bureau) in 1943). Most significantly, the Division was led by J. G. Crawford whose contribution to agricultural economics in Australia was to be monumental in breadth and depth (Williams 1987). A subsequent, extremely significant outcome was the establishment of the *Review of Marketing and Agricultural Economics* (RMAE). It developed into a major professional journal. Moreover, establishment of a Departmental Division of Agricultural Economics gave official recognition to the importance of economic aspects of agriculture and to the need for publicly sponsored economic research into agricultural production (Pawley 1941). A severe early problem the Division faced was the shortage of qualified workers[3].

Aird (1941) argued that economists had generally failed to realise that the economics of agriculture needed special study, and that training in the economics of industrial and financial organisation did not make a competent agricultural economist. He (p.95) urged members of the Australian Institute of Agricultural Science (AIAS) to study and interest themselves in economics, 'so that they will be able and competent to display such knowledge of agricultural economics that they, and not economists

[3] The initial staff consisted of two officers trained in general economics, an agriculturalist who had specialised in economic and social aspects of agriculture, and an economic geographer, all under the direction of Crawford, economist to the Rural Bank of NSW and advisory economist to the Department of Agriculture.

trained in the business world, will be considered the authorities on this subject'. Pawley (1941) disagreed with this view, emphasising that agricultural economics was primarily economics, not agriculture. He (pp.140-141) conceded that the economics of agriculture warranted special study, and that the agricultural economist should have some knowledge of agriculture, but:

> I am unable to concede that persons trained primarily as technical men in agriculture instead of persons trained primarily in general economic theory are best fitted to become the authorities on this subject. As the name states, it is agricultural economics - not economic agriculture, and the concepts, the analytical techniques and tools of thought used are derived from economics not agricultural science. In order to realise this, one has to think only of such concepts as elasticity of demand or supply, marginal costs, prime and supplementary costs, diminishing marginal returns, rigidity of the price mechanics, indifference curves; or to consider the general theory of price, of competition and monopoly, of the exchange of commodities and international trade or of population theory. Each of these analytical weapons and systems of thought, which are essential to the agricultural economist, has been forged in the smithy of general economics.

Early in 1942 the AIAS prepared a statement on Rural Economics (Callaghan *et al.* 1942). Up to this time, agricultural research, education and extension had been concerned mainly with technical aspects of production. The loss of markets and the financial straits of the Depression had enhanced interest in the economics of agricultural production. A dichotomy was noted immediately (p.1): some authorities emphasised the importance of national aspects of agricultural economics as a basis of advice to governments, whilst to others the important matter was 'economics as it directly concerns farm management and advice to the farmers themselves'. Pawley (1941) stressed the need for agricultural economics in university curricula. Up to the 1940s the university faculties had 'for the most part, failed to anticipate the need for trained rural economists' (Callaghan *et al.* 1942, p.2). The University of Melbourne's faculty of agricultural science had some rural economics in the agricultural course and had done rural sociological surveys. The University of Western Australia's faculty of agricultural science had done surveys on the economics of production. At Sydney University's faculty of agricultural science a general course in economics had been given since 1928, and a special course in rural economics had been given since 1933. In the early 1940s J. G. Crawford had lectured at Sydney University in economics and agricultural economics (Williams 1987). At the agricultural colleges, especially Hawkesbury and Roseworthy, farm bookkeeping along with some rural economics had been taught. Furthermore the Council for Scientific and Industrial Research had avoided rural economics because, Callaghan *et al.* (1942, p.2) suggested, the results and recommendations would have been 'less exact, more controversial, and more subject to political interpretation' than the results of scientific research.

Callaghan *et al.* (1942) thought agricultural production was best served by land use surveys and farm management studies. Rural economics should have a strong bias towards rural sociology because agriculture was (p.4) 'a way of life as well as being a way of making a living'. As well, the technical efficiency of a farmer partly depended upon social and institutional arrangements. This AIAS committee (p.4) observed that 'farm management investigation is concerned with improving net income, whereas the natural sciences are more particularly concerned with the increase in gross output'. They concluded that development of research and advisory services in rural economics was needed; that the orderly development in Australia of rural economics research was the main problem at present; and that there was a lack of trained personnel. This meant that few had much idea about where to start to get the called-for study of rural economics underway. Finally this AIAS committee (p.5) concluded that the matter 'ought not be left to the pure economist' because 'it is easier for an agriculturalist to develop proper economic thought than it is for the economist to develop the right agricultural thought'.

Around this time the problems of production were commonly seen as being essentially technical problems, which were generally well in hand. The major problems were in distribution or marketing and this was where agricultural economics could help. Pawley (1941) criticised this view, stressing that problems of productivity and costs, thus eco-

nomic organisation both within farms and within industries, needed to be tackled by agricultural economists. To him (p.134), economic problems of farming were the major problems encountered by field officers:

> ...not because technical problems had diminished in importance, but because whilst the technical problems have been and are being tackled...economic troubles have been free to breed and multiply and spread without any expert analysis of their nature and therefore without any concerted attempt to eliminate or control them, since scientific control must necessarily be based upon prior analysis.

The most pressing constraint on meeting requests for economic study into farming at this time was the paucity of the necessary data (Pawley 1941). Farm record keeping schemes facilitated the detailed cost surveys which characterised agricultural economics in the countries in which the profession was considered to be more advanced than in Australia. Thus in the 1940s land use and farm management studies were commenced by the NSW Department of Agriculture's Division of Agricultural Economics. The major early difficulty anticipated was the inadequacy and inaccuracy of farm records, something it was hoped could be corrected in the future by 'supplying farmers with a simple single-entry system of farm book-keeping and records' (Pawley 1941, p.138). Moodie (1941) had advocated establishment of a unit to investigate the economics of farm management, in particular, the effects of technology on production costs. He had in mind more than simply identifying costs of production, envisaging an organisation which could give more assistance to farmers than they were being given by providing record sheets for the analysis of operations, and by doing comparative analyses of methods and costs between different farms. As well, the results of surveys of farm costs would be useful for price setting arrangements based on cost of production. This first NSW farm record keeping scheme continued through most of the 1940s, and wound down at the end of the decade.

Cost studies had a long history, dating back to Germany in 1872 and the USA in 1902. They were primarily done to provide a basis for price fixing, though the limitations of cost of production estimates for price setting had been long recognized (Bennett 1928). Roberts (1943) focused on practical difficulties of estimating average costs of production. There were problems with the lack of representativeness of cost estimates, problems with the allocation of costs between activities, problems with what items to include and exclude, and problems handling the dynamic effects of technological change and seasonal changes. Showing some perspicacity Roberts observed that despite the many deficiencies of cost of production data, these studies would still be done in the agricultural industries. Campbell (1944, p.31) was quite unambiguous about the issue: attempts to estimate the costs of production of specific agricultural commodities was 'misdirected effort' because the results were 'well-nigh' meaningless. Cost accounting analyses had been stimulated by the wartime practice of the Government of using cost-plus contracts for industry. To Campbell, whatever the merits of this practice may have been for industry, agricultural production was very different to other industries, and cost accounting was not a relevant analytical technique. Surveying thirty years of overseas experience with cost of production studies, Campbell found that most investigators doubted the usefulness of cost of production research for any purpose. Though agricultural economics in the USA may well have begun with cost of production studies, from the 1920s onwards it was increasingly evident that average cost of production was a fallacious basis for price fixing. Since then the emphasis in the USA on cost of production studies had been on their use in farm management. A similar pattern of initiation of cost studies occurred in the UK and Western Europe, with similar conclusions being reached eventually in those countries about their futility for price setting, and their subsequent discovery for farm management. By the early 1940s Australia had yet to go through this experience, but the fledgling agricultural economic and farm management profession was not going to miss out.

Campbell (1944) was mainly concerned about the inadequacy of cost of production estimates as a basis for price fixing. However, he correctly perceived that once their limitations for this purpose were widely recognised in Australia then cost studies would be used for farm management purposes. So he pointed out the limitations of cost studies for these purposes as well. The commonest miscon-

ception about the use of cost studies in farm management was that unit costs of production could be compared with the price received to indicate the best combination of activities to use on individual farms, or to reveal how much to expand an activity. This was fallacious because basic features of agricultural production were the interdependence between activities, the unavoidable arbitrariness of cost allocations and values, and the fact that changes in per unit profitability occur as the size of activities is changed. Changes in farm plans had to be based on the effects on the whole farm, not simply effects on the returns from a single activity. Budgeting based on expected future costs and prices was the way to evaluate combinations of activities. As Campbell (1944, p.37) said, budgeting did not violate 'commonsense principles', while cost of production studies did. Cost of production studies were virtually valueless for any purpose, and he added that whilst economic facts about Australia's rural industries were badly needed 'we want those of a type which can be used'. Druce (1947) further attacked estimates of unit costs of producing agricultural products, citing the case of an enterprise which contributes to net profit but which will be shown by cost accounting procedures to be making a book loss.

Early in the 1940s an approach to the analysis of farm production decisions appeared which Geddes (1942) said used fundamental economic principles which had been around for many years but were not widely used. He calculated least-cost feed mixes for milking cows by using starch and protein equivalents, substitution, the costs of various feed components, and solving a number of simultaneous equations. The least-cost feed question was resolved effectively in the next decade by linear programming. Advocating 'the economic approach' Geddes (p.42) threw in some practical advice as well:

> There are pitfalls in the purely economic approach to dairy cow rationing. Any scheme which disregards the fact that the cow is a biological organism and seeks to put her on the unvarying plane of efficiency of the machine, is likely to break down. The old steam engine analogy is not yet out of date; a lot depends on the stoker. Yet the economic approach, properly adapted, has a useful contribution to make to dairy cow feeding.

Another piece of conceptual armoury which was to have a major influence on the direction of work in agricultural economics and farm management, systems thinking and systems approaches to the analysis of farm production, was also evident early in the piece. Trumble (1943) introduced the philosophy of holism. He saw the progress of agricultural science being limited by it being a conglomeration of separate narrow subjects which do not get welded into an integrated whole, citing (p.53) holism as enunciated by Smuts with the 'whole' to be regarded as a basic concept in biology, viz:

> As applied to agriculture, an endeavour needs to be made to regard each problem in all its completeness, as well as to study the separated parts, the interrelations of which are frequently all-important...There are few agricultural problems in which one of many single factors, some of them quite unsuspected, may not eventually upset the whole to an overwhelming degree.

Management received attention towards the end of the first decade. For example, Gruen (1948) reviewed the financial position of a sample of dairy farmers involved in the NSW Department of Agriculture Farm Record Scheme. The larger farms, employing more capital and with the most cows, had the lowest unit costs of production and largest net farm income. The relationship whereby farms with large amounts of capital achieved large farm income was complicated because large farm incomes were also to a certain extent a cause of large farm capital. Gruen considered that managerial efficiency was probably the most important factor of all when it came to variations in farm incomes; and concluded (p.155):

> 'Farms are not of uniform size or quality and each one has its own problems. Efficient farm management may perhaps be best described as the ability to recognise these problems and tackle them successfully.

Similarly, Owen (1948) suggested that poor management contributed most to low incomes on farms. Most farm workers were automatically farm managers and the drift to the city tended (p.299) 'to take with it the more talented of the potential rural labour force'. There was an urgent need for research into management factors. A major priority was the

need for farmers to keep farm records to facilitate planning of the farm business. Anticipating developments in the next couple of decades, Owen (p.299) suggested co-operative farm management services for farmers provided by people with practical knowledge of farming and 'trained in the analysis and interpretation of farm records to improve farmers' efficiency'.

The story so far, and which subsequently unfolds, is notable for the confusion that existed between the macro and micro aspects of farm management inquiry. Much of the impetus in the early years for work in farm management came from the effort to provide a firmer base of knowledge for macro-economic policy, and not just from the pleadings of agriculturalists for more help in improving efficiency on farms. In the ensuing four decades since the decade in which farm management 'got a start', many fashions and emphases came and went, and farm management as a field of academic enquiry flourished, peaked and declined. Emphases in farm management changed with different states of knowledge and theory; also with developments in analytical techniques, and technology. By the mid-1970s past emphases of both methodology and technique were being questioned seriously and some reorientations were being contemplated. Although by the end of the 1940s key ideas which were to be at the heart of academic work in farm management for the ensuing decades had made their appearance, the profession was still casting around for some unifying theory, still looking for 'a home'. Thus in the literature there was much discussion and comment on methodological issues. A record of some of this work follows.

## 3. Methodological Concerns and Development

In the early 1950s Williams (1953a) (then with the newly-established Bureau of Agricultural Economics) saw farm management research in Australia resulting from the emergence of agricultural economics as a separate social science, major post-war changes in economic conditions, and increasing emphasis on extension work. There was much to be learned from overseas experience, though it was important to avoid the tendency in Australia to copy the USA developments, which were the result of the particular circumstances and problems of that time and place. In the USA farm management had grown out of the aim of providing extension services to farmers, and had developed along separate lines followed by agriculturalists and along lines followed by economists. According to Williams, Australian agriculture did not have the same farm management-extension link as had occurred in the USA. The outstanding feature of Williams' (1953a, 1953b) writings was concern with the individual management function. In the past much extension advice had focused on the physical things which needed to be done to increase output. Too seldom was account taken of how the farmer's financial state of affairs might be affected or might affect the implementation of prescribed actions. A further major shortcoming of extension was insufficient appreciation of uncertainty. Following Knight (1921) and Heady (1952), Williams (1953a) suggested that without uncertainty there would be no management problem at all. Farm management was really about adjusting the operation of a farm to uncertainty and to changes.

The complexities of the analysis of the operation of a family farm business were being acknowledged in the literature in the early 1950s. For instance, Campbell (1953) discussed the economic content of extension information and the adoption of new technology by farmers. He mentioned *inter alia* the importance of scientists generating production data over a wide range of inputs so that economists had a good idea of the production function for estimating costs and returns and giving advice; a point stressed also by Lloyd (1958). This concern has remained. Campbell too emphasised the importance of uncertainty in Australian agriculture, with farmers having to act on estimates about the prices, costs and the nature of the production functions which were likely to operate in the coming production period. He added that impediments to the adoption of new practices on farms were not just economic forces, but included psychological, sociological, cultural and historical factors, which were all expressed in the farmers' attitudes, values, motivations, expectations and prejudices. Importantly the economic aspects of the adoption of any new technology had to be worked out for individual farms, because each farm was unique. Schapper (1953, p.207) said 'I am in complete agreement

with the farm management approach he (Campbell 1953) advocates, and the value of which, if realised at all by Australian Universities and Departments of Agriculture, has not yet commended itself to the point at which they are prepared to take action'.

By 1954 Heady's book *Economics of Agricultural Production and Resource Use* had arrived, and in many ways the farm management profession had found a home. Schapper (1954) described Heady's book as the first satisfactory single text in agricultural economics. To Schapper (p.40) the outstanding feature of Heady's book was the way the current economic theory was incorporated into the analysis of agricultural production and resource use, and how 'at every opportunity' the implications of the analysis for agricultural advisers and extension programmes were identified. This was particularly useful for Australia because the agricultural economics and farm management approach in university course-work in agriculture, and in agricultural extension, had not been adopted to nearly the same extent as in the USA, New Zealand and the UK. The problem was that many so-called agricultural economists were either agriculturalists with a smattering of economics, or economists with a smattering of agriculture. To Schapper (1954, p.40) Heady was 'obviously an economist and an agriculturalist'.

In the mid-1950s Campbell (1955, p.255) was concerned with the slow rate of progress in 'the science of farm management'. Australia had lagged behind other advanced countries in the emphasis it had placed on farm management work, although 'there were now some signs of increasing interest'. The aim of farm management analysis was to provide guides for farmers to maximise profits. Farm management had not received greater attention in Australia because (pp.255-256):

> (i) By training, our agriculturalists have been conditioned to look at the farm business in terms of - 'morselisation' - the splintering of farm activities into distinct parts - rather than as an integrated entity functioning within defined resource limitations.
>
> (ii) The existence of a very high degree of production uncertainty in Australia limits the usefulness of the farm management approach which, until very recently, has been developed in an essentially static frame of reference.
>
> (iii) Under conditions of extensive agriculture based on pastures, and where enterprises, though diversified are not highly integrated, detailed problems of management are not so pressing as under more intensive systems of agriculture.
>
> (iv) It may be, as Bradford and Johnson (1953) suggest, that where technological advances are forthcoming at a high rate, questions of technical method tend to overshadow questions of more efficient use of existing technology.

At the inaugural Australian Agricultural Economics Society (AAES) conference Campbell (1957) evaluated agricultural economics research, which up to this date had meant research in agricultural production economics, an undesirable degree of exclusiveness. His (p.27) major criticism had an enduring ring to it, at least as far as farm management work goes:

> If I were asked to diagnose the major deficiency of agricultural economics research in Australia in the past decade, I would say that it lacked analytical orientation. I realise that this is a rather serious indictment, because to my mind, the essence of research is the attempt to confirm or deny hypotheses about the nature of reality. In the absence of clearly-formulated hypotheses or models, it is arguable whether what is done is research in the strict sense at all. Many field surveys have been undertaken in this country simply with the hazy idea of getting 'the facts about a specific region'. Too often when these studies have been completed, we have witnessed (to paraphrase Lionel Robbins) the disconcerting spectacle of research workers rediscovering the crashing truisms of agriculture and economics and leaping from the bath, so to speak, with Archimedean enthusiasm running naked through the city recommending them stridently to all and sundry.

Campbell believed that what was needed then instead of rampant empiricism was a more analytical approach to agricultural economic problems. Even today it is not hard to find examples of Campbell's Archimedean enthusiasm by State government departments charged with doing something in farm management. Furthermore, Campbell (1957, p.27) noted and cautiously agreed with a criticism of Australian agricultural economics which had been expressed by the renowned Melbourne University agriculturalist, Sir Samuel Wadham, viz:

> I have never known whether I deserve to be called an agricultural economist because my concept of an economist is one who is much more interested in the processes of investigating economic problems than I am, and further, one who is often so wrapped up in building up an academic facade around the problems that he becomes less interested in the problems themselves.

Perceptively Campbell (p.28) concluded that progress in farm management would depend on farmers getting individual farm management advice by hiring farm management consultant services operated by private enterprise or possibly by universities and agricultural colleges. Public agencies could not afford to provide the highly specialised attention to individual farm businesses required for effective farm management. This has come to pass in Australia.

Druce (1957, p.42) argued that farm management had been largely neglected in Australia. One of the impediments to farm management work had been 'the almost complete lack of training by either universities or agricultural colleges in farm management'. Penny (1957, p.43) believed too few people were working in farm-management, and State Departments of Agriculture advisory services still regarded farm problems as solely technical problems. He also presaged an emphasis which was to dominate the agricultural economics profession during the 1960s when he commented that a way around the 'problem' of inadequate farm record keeping would be for accountants to standardize the basis on which farmers financial and tax records are presented.

Schapper (1957) raised the importance of non-economic aspects of production and reasons for the gap between theoretical optimum and actual use of farm resources. This gap resulted from imperfect knowledge, uncertainties, capital rationing, price distortions, and social and psychological factors. Basic studies into these problems had not yet occurred in Australia nor had studies into the decision making processes of farm managers. He cited (p.59) Johnson's (1952) observation:

> The potential importance of this [decision making] is brought out when one realizes that both the evolving body of managerial theory and empirical work indicate that deductive thinking is an important part of the management process; this is in sharp contrast with the emphasis of extension and vocational agriculture workers on inductive teaching, i.e. learning by doing rather than by reasoning - going from problem to principle, rather than from principle to problem.

Williams (1959) was concerned that the problems of definition of capital and identification of capital values were usually ignored. However, the effects of expected capital gains on management decisions in a dynamic economy were crucial. He also expressed disquiet about the static nature of production theory. Continued technological change meant (p.32) 'it is far more important to be doing the right thing than to be worrying too much about fine adjustments in accord with changes in cost-price relationships'. He commented incisively (pp.32-33):

> This leads one to say that the aim in extension work should be to get on to the right production surface and not worry too much about location on that surface, especially when this is subject to uncertainty anyway. Some changes can be made to the farm organisation in the balance of different farm enterprises as cost-price relationships change between those enterprises. But we are worshipping a false and transient image, in the present state of our knowledge, if we try to base extension programmes on changes in input levels, up and down, in accord with changes in cost-price ratios. W.W. Wilcox expressed this view in these terms: 'This analysis also suggests that the manipulation of existing data using formulas based on our equilibrium models gives us answers which cannot be useful, because the assumptions of the equilibrium models are not approximated in real life. And the writer at least is sceptical about the practical value of the current emphasis on refinement of the static production and resource substitution functions for existing technologies. The pressing economic problems in production in this generation are associated with and grow out of the social process of incorporating the continuing stream of new technologies into the farm production process'. In similar vein, pointing towards the inadequacy of too much emphasis on the ideal of optimum resource use, T.W. Schultz has recorded the following viewpoint: 'The misallocations in resources in agriculture associated with economic development are in the main not the consequence of bad farm management *per se* but of particular imperfections in the way the factor

> markets work when subjected to the strains and stresses of economic development.'

In a similarly critical vein the newly-appointed Professor of Agricultural Economics in the Faculty of Agricultural Economics at the University of New England (UNE), Lewis (1958, p. 268), commented somewhat despairingly:

> Unfortunately, much current work in farm management is totally lacking in an effective analytical framework. Often what passes for farm management work is little better than a placebo yielding nothing in the shape of useful conclusions on how to improve the organization and operation of farms. In too many places the lessons of the past are ignored and each new problem tends to be approached with a naive empiricism altogether unmindful of the immense stock of methodological capital bequeathed to us by the pioneers of the subject.

Lewis (1960, p.146) praised the work of a major contributor to the agricultural economics profession in the USA, J.D. Black, for marshalling the basic concepts and tools and pointing the agricultural economics profession in the direction of the synthetic model building approach:

> Budgeting, or as he originally termed it the 'method of substitution', was shown...[by Black]...to be a most flexible tool usable in farm management analysis, land development planning, marketing research, farm loan appraisal, normative approaches to the estimation of supply functions and many other lines of enquiry. The importance of his contribution to methodology can be gained only by contrasting the analytical edge of the synthetic method with the 'naive empiricism' and disregard of elementary economic principles characteristic of much of the work being carried on at the time.

Just as the agricultural economics profession in Australia had been regarded as being backward in the collection of farm costing data, this was true also of the provision of public extension services which had a farm management and not just a technical orientation, and in the development of private farm management advisory services (Druce 1959, McFarlane 1958). An AIAS sub-Committee comprising Schapper, Beale and Roberts (1961) had inquired into and reported on the role and development of farm management clubs and the private consulting profession. Lewis (1961, p.216) called the phenomena of private farm management consulting an example of the familiar proposition 'with your money and my brains we could go places', but which was really an application of complementarities between capital and technical knowledge. A farm management section of the AIAS had been established in 1963, with the aim of formalizing the profession of providing farm management consulting services.

Johnson (1963) wrote a major critique of agricultural economics and reviewed developments in production economics since the publication of Heady's (1952) *Economics of Agricultural Production and Resource Use*. In the USA the discipline of agricultural economics had grown out of interest by agricultural scientists in farm management. Thus a discipline of farm management developed initially without economics. Then agriculturalists with some training in economics introduced ideas from economic theory into farm management. However, traditional farm management workers in the field, whose roots were in the technical agricultural disciplines, with sometimes some accounting, had resisted farm management being transferred to economics. Their philosophy of science was positivistic and this approach had been relevant to solving practical problems. However, as Johnson put it, positivism avoids purpose and leads eventually to difficulties in defining and solving problems. Thus over time the positivistic traditional farm management workers focused less on problems and ended up concentrating on certain accounting ratios and repetitive surveys and reports. As farm management was something which underwent continuous change these early approaches to farm management problems became irrelevant to solving those problems.

The traditional positivistic, technological approaches contrasted with the more specialized, more purposeful approach represented by production economics which involved using static theory to define equilibria. Johnson (1963) added that it was this end, not theory *per se*, which attracted those who believed in the use of more theory in farm management. He ( p.15) noted an irony however:

> Though the new orientation concentrated on problems and, in this sense, differed significantly from

> the immediately preceding fact-finding research in the field of farm management, it contained a serious flaw...The flaw involved the narrowness of the problems considered which tended to be defined in terms of the disequilibria of static, production economic theory. This concentration made farm management a narrow problem-solving subfield of production economics which, in turn, was a subfield of general economics. Thus, even the problematic interests of the new theoretical farm management workers were narrower than those of the early, more traditional farm management workers whose interest had ranged from the technological and institutional through accounting to the sociological.

There had been many developments since Heady's book. These included a marked increase in farm management research; greater use of computers, mathematics and advanced statistics; production economics based farm management research which focused less on the practical problems of managing farms and more on methodological and theoretical issues; and less use of farm management research by extension workers. But, the results did not live up to expectations of the times (Johnson 1963, pp.17-18):

> There has been no major rush of farmers to obtain the results of agronomic-economic research or of similar research in animal husbandry. Production function and linear programming analyses of farm businesses have produced no major break-through. T.W. Schultz has stated: 'It will be said that much progress has been made in production economics. Simple, old-fashioned budgeting has been replaced by sophisticated production functions. The journals runneth over with 'results' from linear programming, a new apparatus that is turning out thus far an undigested mixture of a few insights and many 'numbers' that do not make sense.'

In 1965 the inaugural lecture of the first Professor of Farm Management in Australia was given, titled 'Farm Management in Australia as an Academic Discipline' (Dillon 1965a). Dillon called the pre-1940 first stage of farm management in Australia the forerunner stage. The title of the second stage, 1940 to 1965, was 'Enter Economics'. This stage was characterised by Dillon (1965a, p.183) as involving:

> (i) institutional developments such as the establishment of farm economics sections in State Departments and teaching of farm management in the Universities;
> (ii) increasing recognition of the role of economic principles in farm management; and
> (iii) the development of full-time career opportunities in farm management teaching, research and consulting.

Dillon (1965a) questioned the traditional assumptions of production economics, particularly the assumptions that entrepreneurs have perfect knowledge and aim to maximize profit. In reality producers' sets of preferences are unique and shift over time between profit and other goals, all with uncertainty about outcomes. Consequently, said Dillon (p.187), 'prescription based on these traditional assumptions of riskless choice and a non-complex objective can hardly be called scientific in the sense of yielding correct manipulations of Nature'. Dillon turned his attention to getting around this difficulty. One possibility was to develop behavioural understanding and theory to replace the assumption of profit maximizing behaviour. The second approach was conditional normativism. This involved farmers defining objectives (in terms of something which can be manipulated such as money or utility) and farmers specifying their approaches to risk and uncertainty. Both these pieces of information (p.187) can then be put together to 'make scientific predictions within the given conditional normative framework'. To do this, both agriculture and economics were essential (p.188); 'agriculture to recognize and understand a problem, economics to solve it'.

Dillon perceived that in 1965 farm management in Australia was entering the third stage of development. This stage was characterised by an emerging institutional framework for teaching and research, and wider recognition of the role economic principles play in farm management analysis. State government farm management extension services and commercial farm management services and available computer services were developing. There were more trained personnel around. He thought (p.189) that economic principles would continue to be 'the analytical superstructure' for farm management training and was confident that farm management research and training 'has at least begun to be recognised in relevant circles as a pertinent element in our economic development'.

Dillon (p.189) concluded '...there seems little risk in predicting the continued expansion of farm management as an academic and professional discipline...farm management with its charms and challenges has an assured future'.

Somewhat later, Burns (1973) was to note that research in farm management was becoming more involved in methodological and theoretical issues and little of it was relevant to practical farm management and farm management extension. He (pp.96-97) repeated Johnson's (1963) observation that 'on the one hand, researchers were concentrating on less relevant problem situations, and at the same time, extension workers had lagged behind research personnel in increasing their competence in production economics'.

In 1971 Makeham produced the textbook *Farm Management Economics*. The objective of this book was to illustrate the application of business management principles and tools to practical farm management. *Farm Management Economics* was well-received in the literature. McFarlane (1972, pp.147-148) concluded:

> Those who...study the principles and follow the procedures set out...could hardly fail to find ways of increasing profits.

Maccallum (1972, pp.139-141) noted that Makeham had 'achieved a very useful combination of the economic and technical aspects directly related to typical current Australian problems'. Rance (1974, pp.51-52), commenting on the second edition, described *Farm Management Economics* as 'one of the most comprehensive and practical treatments of farm management available today in Australia'. Dillon (1978, p.26) described Makeham's book quite simply as 'the best text on farm business management yet produced'. Makeham (1965, p.3) had described working in farm management as being a 'professional goal adjuster'. This involved working with the farm family towards the achievement of their short and long term goals, starting with the human element, given the technical, economic, financial, and institutional limitations of the situation. The strengths of Makeham's approach to questions of farm management have been firstly, mastery of the technology, followed by emphasis on the human or 'parish priest' element, the incorporation of the important economic and financial aspects into a decision on a technically thorough and sound basis, and importantly, great emphasis on the dynamic and risky nature of the management task. The essence of Makeham's (1971, p.9) approach is encapsulated in the following extract from *Farm Management Economics*:

> Two major challenges facing today's farmer are:
> (a) how to incorporate new technology profitably into his existing business organization;
> (b) how to be sufficiently flexible, mentally and financially, to adjust his resource management to meet both changed economic circumstances and widely varying climatic conditions.

That is, farm management is a very dynamic and uncertain process, and the theoretical foundations of analyses into farm management have to fully allow for this fact. Makeham's contribution to farm management in Australia continued through the 1980s with the succeeding book *The Farming Game* (Makeham and Malcolm 1981).

In the mid-1970s in a wide-ranging methodological review Musgrave (1976, p.138) noted that 'farm management barely existed as a branch of agricultural economics providing advice which influenced the decisions of farmers'. This was partly due to problems with the methodology of production economics, partly due to rewards being greater in non-farm management fields, and partly the result of there being quite separate practical and theoretical orientations amongst people working in farm management. Dillon (1972, p.78) had been sanguine about this dichotomy provided sufficient people 'had a foot in both camps'. As it happened the management theoreticians' contribution was mainly in the development and refinement of techniques, and practical farm management was still mainly about budgeting and accounting. Musgrave (1976, p.139) warmed to the theme:

> In the field of farm management many techniques have been called but most have been found wanting. Superficially the impression could be gained that, after the first ecstatic breakthrough with the application of budgeting procedures, there has been a sustained rummaging through a job lot of techniques, mainly of a programming nature, which, while producing many Masters and Ph.D. theses and perhaps a few unthinking technicians, has not produced many useful farm management recommendations of either a general or a specific nature.

Although the conceptual basis which production economics brought to decisions on resource allocation had been useful, eventually, Musgrave claimed, it was realized that production economics techniques and concepts were insufficient for complete analysis of farm management problems. Information from deterministic models which had no consideration of time, or technological, management and human factors was not worth much to decision-makers. Recognition of these deficiencies of production economics led to a greater focus on uncertainty. Despite this, recognition of the importance of uncertainty had not led to useful applied techniques for including uncertainty in decision analysis. Musgrave (p.139) said that to do so may be too difficult and 'as Anderson and Hardaker (1975) suggested, the scope for intuition will always be high in farm management and that our techniques will be restricted to the definition of efficient solution sets'.

Eventually Dillon (1978) was to recommend that training in farm management ought to be reoriented away from the traditional production economic, joint farm and national policy focus of the agricultural economists, to a farm systems approach oriented solely to farmers, retaining the essentially useful bits of the production economic way of thinking.

Farm management writings did not feature much in the journals in the 1980s, except for some important works critical of production economics by Longworth and Menz (1980), and of decision theory by Wright (1983). These 1980s works are dealt with in the following section where the major approaches to farm management over the period are reviewed.

## 4. Review of Analytical Approaches

Analytical approaches to farm management problems in the fifty year period under review can be categorized as emphasizing records and comparative analysis, production economics theory, programming methods, decision theory (subjective expected utility analysis), and systems simulation. 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.

### 4.1 Records, accounts, comparative analysis

Pushes for farm recording and accounting systems and for comparative analysis of farm standards, which recurred regularly throughout the period under review, can be seen as being linked in a general way. The use of farm averages, or standards, was essentially the process of appraising what ought be done on one farm by comparing what is done on other farms. Despite the powerful intellectual and practical arguments against the use of farm cost records and comparative analysis put up by Campbell (1944), and then at regular intervals by Druce (1947), Candler and Sargent (1962), Cooke-Yarborough (1967), Cozens (1965), Mauldon, Schapper and Treloar (1969), Mauldon and Schapper (1970, 1971) and Hardaker and Anderson (1981), farm recording, accounting and comparative analysis has always been advocated as having a big role in farm management analysis.

By 1964 all states had made moves to train their technical extension services to some extent in basic farm management economic techniques. The Queensland Department of Primary Industry (DPI) had a strong accounting and recording emphasis in its developing farm management extension work. As well, the UNE and the Queensland DPI were attempting to involve farm accountants in farm management extension work. Druce (1964) favoured the idea of setting up farm accounting groups, mainly because the approach of accountants was not compatible with the requirements of farm management. He cited Waring who had suggested that a standardization of accounting procedures, with appropriate coding of data, could enable farm business analyses to be produced. Waring (cited in Druce 1964, p.121) considered that with a standardization of the recording of farm business data an agricultural economist working through groups of accountants could service 200-300 clients per year by providing 'comparative performance schedules...and individual management advice based on standards, programming for homogeneous groups and budgeting'. Druce, who had expressed doubts about the use of comparative cost accounting during the 1940s, repeated his doubts

about the usefulness of comparative analysis for farm management extension.

Schapper (1964) had advocated specialized recording services which could meet the requirements of both taxation and management. The farm management service laboratory of the University of Western Australia developed with this as one of its aims. By the mid 1960s farm management service centres, clubs, and private consultants were getting established. As well there were tertiary teaching programmes in farm management, and computers which were making possible previously unheard of achievements in data analysis (Dillon 1968b). The aims of the farm management service centre at the UNE were record analysis, forward planning, and teaching and research (Dillon 1965a). Dillon stressed the limitations of farm records and comparative analysis, and the value of budgets and cash flow projections in proper analyses for farm management purposes. Candler (1965) credited the idea of farm management service centres to Schapper, and saw their role as assisting extension workers by identifying profitable practices, carrying out project appraisal, and evaluating technical research results. Schapper (1966) considered that the only way farm management advisers would be able to do their job in the future would be to be serviced by a farm management laboratory or centre. The information farm management advisers needed could be collected and disseminated by a central agency, which would also provide data processing such as interfarm comparisons of efficiency and programming to identify optimal whole farm plans. The linking of farmers to universities through their accountants and farm management advisers represented the most exciting agricultural possibility of the decade. Although farm record keeping had failed in the past, Schapper expected that it would not be long before demand for data for accounting and farm management extension and research would cause efficient recording systems to be designed and installed.

Burns (1966) was a major protagonist of comparative analysis of farm accounts for the purposes of farm management. The usual criticism of the use of comparative analysis, the uniqueness of each farm, was turned into a virtue by Burns. That is, the analyst seeking out the reason for differences in performance of the farm will discover the reason and better appreciate the situation of the farm. Burns lamented that very little comparative accounting had been done in Australia, though the Queensland DPI and the UNE's farm management service centre conducted mail-in comparative analysis programs. He (p.173) defended the use of comparative accounting on the basis that instead of giving optimum advice to the isolated few it was better to provide 'something rather more rough and ready for a larger number'. Comparative analysis provided survey data for extension purposes, and for the farmer, comparative results indicated directions in which the farm organization and practices may be changed. Burns advocated a large scale system of recording and comparative analysis. Each State needed an institution to collect farm accounting data and prepare annual averages and standards on a district and industry basis for feedback to all users. This would require standardization of accounting terminology and presentation. To this end the report *Accounting and Planning for Farm Management* had been published (Joint Committee on the Standardization of Farm Management Accounting 1966).

The Committee's approach was to standardize farm accounting and to develop comparative analysis as the cornerstone of farm management accounting. The Committee's recommended system was based on a profit statement, a statement of assets and liabilities and a statement of sources and uses of cash. The Committee expected accountants to prepare the statements, estimate the efficiency factors and help interpret them, and prepare partial budgets and cash budgets for the farm business operations. The greatest benefit for farm management was to come from the preparation and analysis of efficiency factors to measure performance against certain standards of results. Cooke-Yarborough (1967) claimed that most Australian and New Zealand agricultural economists were by this time sceptical of the use of comparative analysis. The danger was that comparative analysis would end up as a means of comparing gross margins and a source of standards for use in farm planning. The main criticism of comparative analysis was that recommendations based on anything less than a full exploration of the interrelationships between input and output were inadequate. Similarly Cozens

(1965, p.128) had said standards can merely suggest the kinds of budgets about changes which might be worth making. Standards were largely 'monuments to past folly'.

Mauldon, Schapper and Treloar (1969) rejected the Committee's emphasis on the gross margin as the basis for calculating profit. Working out farm profits to make comparisons between farms was of doubtful usefulness. Also, they rejected the idea that planning for management was a periodic event instead of a continuous function, and particularly, the notion that it could be done by the farm accountant. Mauldon and Schapper (1970) argued convincingly that comparisons of efficiency ratios and historical gross margins were useless for planning, budgeting or diagnosing strengths and weaknesses in farm management. This view represented a major turnaround from the stance these authors had taken in the mid-1960s. Their arguments posed a direct challenge at the time to the proposed adoption by some state departments of agriculture of inter-farm comparisons as a major component of their extension programmes in farm management; and still do so.

Mauldon and Schapper (1970) noted Candler and Sargent's (1962) demolition of the idea of comparative analysis of technical ratios. Candler and Sargent proved that farm efficiency ratios which were used as the basis of inter-farm comparisons were capable of logically opposite conclusions. Furthermore, profit maximization required that marginal productivities per dollar spent on inputs were equal, if capital was limited, or marginal productivity of inputs equalled their price if capital was not limiting. However, inter-farm comparisons of efficiency and inter- and intra-farm comparisons were all based on calculations of average productivities. Despite this, recommendations and demands for the use of comparative analysis and historical gross margins continued to be made in Australia, and still are. To Mauldon and Schapper, efficiency ratios were compounds of dozens of factors and their use led to conflicting diagnoses and decisions. Further, technical ratios were not measures of economic efficiency. Frequently efficiency ratios were grouped according to whether they were from farms with above average, below average or average net farm income. This implied (i) that there was a causal relationship between the selected technical efficiency ratio and the net farm income, and (ii) that the average and below-average farmer could reach the higher income group by achieving the same values for his efficiency ratios. In fact, some below-average farms could be performing at maximum income and some above-average farms could be performing below maximum income. The application of cost-price ratios to factor-product, factor-factor, and product-product relationships could not be avoided if good economic decisions were to be made. Despite the claims about what a skilled analyst could do with comparative analysis, from such information there was no way of knowing marginal productivities, nor how well any particular business was performing relative to its potential.

Mauldon and Schapper (1971) further damned comparative analysis when they wrote about the sensitivity of inter-farm comparisons to inaccuracies of measurement and valuation. Inter-farm comparisons of ratios and margins were so 'untimely, expensive, inaccurate, historical, and inherently ambiguous in their economic meaning' that they were virtually useless for anything to do with farm management. Focussing on the tacit assumption which underlay comparative analysis, viz, that the source data are perfectly accurate or insignificantly inaccurate, they noted such correctness implied (i) that recorded sources and uses reconciled with actual sources and uses for both physical and financial flows; (ii) that valuations were known for certain, and objectively; and (iii) that farmers in the comparisons allocated items to activities in the same manner. When these above-mentioned conditions did not hold, which they never could, comparisons were meaningless. Furthermore if measurement errors were not random but were biased by the methods of selection and valuation which were adopted, or if the errors exceeded the differences between farms, then the errors effected the comparisons between farms. As well, values of some items, such as land, plant, stock, and inventories were (p.108) 'inevitably the expected values of subjective probability distributions'. These values were often meaninglessly mixed up with objectively valued items such as cash balances. Various adjustments to figures for failure to reconcile or for differences in valuation altered

the average level and the rankings of performances within groups of farms. If differences in gross margins were small the rankings were not necessarily valid and could not be trusted. If large, the reasons and conclusions are obvious to any competent analyst. Their assault on comparative analysis was formidable.

During the 1960s the agricultural economics and farm management profession had instigated a major attempt to develop a standardized farm accounting system, known as the Australian Chart and Code for Rural Accounting (ACCRA) system. This was partly in response to the perceived potential for more elaborate record keeping and analysis made possible by the developments in computers during the 1960s, allied to the belief that accounting, recording and comparative analysis were highly useful to the management of farms. Also, there was widespread recognition that the taxation accounts prepared for farm businesses by accountants were inadequate for farm management uses. Hopes had been high regarding the possibilities unleashed by accountants being able to standardize farm data and prepare farm management oriented net worth statements, profit budgets, cash budgets, and even partial budgets and investment analyses for farmer clients. Eventually a few variations of the ACCRA coding system were adopted by a few accountants (Burns 1983), but the hopes held for it during the 1960s and early 1970s did not materialize. Hoskins (1972, p.9) had noted that with rural accounting systems in other countries 'failure has been more common than success' and identified three major potential problems with the ACCRA system. Firstly, there was the lack of interest of farmers in record keeping. Secondly, there was accountants' predilection for concentrating almost exclusively on tax accounting. Thirdly, there was the existence of alternative competing accounting systems. A flaw in the ACCRA system was that the usefulness of historical records to farm management remained as limited as had always been the case. Further, when it came to forward-looking analyses for management and planning, technical matters were left out of or inadequately included in the analysis. That is, accountants with little knowledge of farm technology could not carry out useful farm management analyses. This initial extremely limiting factor seemed to be largely overlooked in the excitement about the potential for computers to undertake large scale data recording and analysis.

Hardaker and Anderson (1981) observed that even though farm recording systems had been around a long time they were hardly used at all in practice. Historical records had very little relevance for farm planning. Much management was routine and big decisions were infrequent. Even with big decisions, they thought that (p.201) 'less formal, highly intuitive information may suffice nearly as well as the fancy records of the accountant on the computer'. Farm recording systems were 'doomed to failure' because they were something which the majority of farmers did not need. Richardson (1982) reasonably considered that Hardaker and Anderson (1981) overstated the case slightly as farmers needed to budget and plan and thus needed information. He said though that having good information and budgeting and planning did not require the services of a computer.

In summary, though the theoretical and practical limitations with farm recording, accounting and comparative analysis are well documented in the literature, these techniques are likely to be resurrected in the near future, as is the nature of fashions.[4] Some things remain true. Historical accounting records are of quite limited usefulness to decisions about future developments and directions of the farm business. Comparative performance measures between farms are also virtually useless as guides to action. Farm technical standards or technical efficiency measures alone are not a sound guide to farm management action. The resilience

[4] The Farm Cheque program of the NSW Department of Agriculture and Fisheries developed recently would appear to verify this point. Other than an old 'solution' being discovered by a new generation of workers in farm management to an old 'problem', has anything changed sufficiently to invalidate the arguments about records, accounts and comparative analysis for farm management? The Farm Cheque program may well find out. Some changes stand out. Emphasis in Farm Cheque is on the essential bits of farm management information: technology and cash flows; farmers commit some money to it; farm secretarial services apply the principle of comparative advantage to the recording and processing; and technical extension officers have more involvement than in past attempts at such schemes. But the focus *may* still be awry (comparative analysis) and the program needs subsidizing. More generally, farm secretarial services, using portable computers, are increasingly meeting the needs of the small proportion of farmers, and the larger proportion of advisors, who are keen on farm records. Farm secretarial services would seem to provide valuable introduction to computers and teaching roles for those farmers so inclined.

of the appeal of farm recording and comparative analysis after the production economists' early critique was closely tied in with the development of the capability for computerized collection and analysis of data which occurred during the 1960s, and the potential this was perceived to hold for the standardization of accounting processes. Partly the continuation of the recording and comparative analysis push during the 1960s (and later) can be explained in terms of the increase in computer availability making large scale data processing possible, all of which made the commercial prospects for records analysis by farm management laboratories and service centres seem very attractive. Left out of comparative analyses and recording approaches were the keys to farm management analysis: case by case detail, accurate problem identification, riskiness, uncertainty, and important technological, human, financial and taxation aspects of the business. The data collectors and analysers of the 1940s-1970s were emphasising an inappropriate balance between the many disciplines involved in the successful management of farms.

### 4.2 The production economic emphasis in inquiries into farm management

Very early, T.W. Schultz (1939, p.572) following Kaldor (1934) and Hicks (1939), writing in the US literature, saw limitations of production economic theory and optimum-combination approaches for farm management which stemmed 'from gaps in the theoretical apparatus of formal economics'. Interestingly, Campbell (1978) regarded this contribution by Schultz in 1939 as being the start of the modern era of farm management. The validity of this view does not seem to have been sufficiently widely recognized to prevent workers in academic farm management travelling down many other relatively unproductive routes. The essence of Schultz' (1939, p.574) view of relevant farm management research is captured in the following extract:

> If...(a)...pending change involves in addition an element of uncertainty, which is usually the case, the firm also assumes the additional function of uncertainty bearing. In the real world the production processes of the firm are being altered continuously. Routine procedure will not suffice. Change born out of dynamic circumstances, is ever present. Adjustments are called for. It is the entrepreneur who decides what must be done. The decisions of the entrepreneur are carried out within the framework of the firm. Two interrelated decisions must be made, (a) the amount of adjustment that is necessary, (b) the method for making the adjustment; that is, what to do and how to do it.
>
> It is these adjustments of the firm that give us the key to what we need to look for in our farm management research. To understand the basic nature of these adjustments is to know what is fundamental to the entrepreneurial problem in farming. Since the existence of the firm of necessity arises out of and is dependent upon dynamic conditions, it would appear that both the size of the firm and the success of the firm must be determined within a framework that allows for 'time' and 'change'.

The 1950s was the first decade of widespread application of production economics to the analysis of farm management and production problems in Australia. The first applications of the production economic and econometric methodologies were the estimation of production functions, though the limits to the usefulness of aspects of the production function approaches were readily recognized. Parish and Dillon (1955) estimated production functions from cost data, claiming that econometric studies had 'supplemented and even supplanted' the accountancy procedures usually used in the average productivity approach to farm management. The production function method estimated the productivities of all resources simultaneously, and indicated both the marginal productivity and the scale response involved for increases in production. The marginal value product of an input could also be compared to its marginal cost, giving an indication of the economic efficiency of factor use. The production function approach had difficulties however. Inputs such as land and labour which are highly heterogeneous were treated as homogeneous. There was no satisfactory way of measuring management input to production. Parish and Dillon noted that if production functions derived from sample data were able to be interpreted as describing the physical production possibilities facing the manager, then there would not be any problem with leaving out management from the analysis. But, this could not be done because each of the separate combinations of inputs had been made by each individual

farm manager. The managerial skills of farmers varied widely, and management needed to be included somehow as an input to production.

Jarrett (1957) also used the production function methodology to estimate farm resource productivity, even though admittedly 'heroic' assumptions were involved and there were important limitations to using the results. He (p.75) explained why estimates of marginal value products of resources which were not equal to factor prices were not clear cut guides to decision making on the individual farm, viz:

> (i) the effects of year-by-year differences in climate and thus resource productivity in any particular time;
> (ii) production functions fitted to farm data are of a short run nature whereby farms generally work on the basis of a longer term objective;
> (iii) the limits of applying static and certain concepts to a dynamic and uncertain activity such as farming;
> (iv) farms are also households, and farmers have complex objectives relating to both profitability and lifestyle.

The existence of a gap between production economic theory and farm management practice was directly tackled by Longworth and Menz (1980). A gap existed because production theory was based on continuous functions which assumed away technical efficiency and timing of inputs, and focused on marginal allocative efficiency. Traditional production economics approaches to farm management analysis had little relevance to practical farm management because in production economic theory technical efficiency was assumed. In practice the major problem faced by management was the identification of technically efficient combinations and the adoption of new technically efficient combinations. Further, if profit is insensitive to the degree of allocative efficiency, then according to Longworth and Menz (p.16), 'neoclassical marginalism which assumes away technical efficiency to focus fully on allocative efficiency is an elaborate hoax'. One useful thing that farm standards did was to focus attention on technical efficiency. Activity budgets enabled both considerations of technical efficiency and production economic theory to be incorporated into the analysis.

A number of deficiencies of production economics, as it relates to farm management, stand out. Economics, like farm management, is about decisions but economics is about the outcomes of decisions whereas farm management concerns both the process of decision making and the outcomes. The neoclassical theory of the firm is an abstract model for predicting the overall results of the sum of decisions of individual producers, and explaining and predicting changes in observed prices. Economics thus has limited relevance to the decision-making process within firms. Static production economic theory has limited relevance to the processes of management in a dynamic agriculture. A further limit to the relevance of production economic theory is that it deals with quantities of inputs and outputs, production relations and costs, revenues and profit, whereas one of the major factors in farm management is cash. As well of course production theory left out the human element, the technology, risk, and much else.

Limits to the usefulness of production economics for agricultural economic research and for farm management purposes were recognized relatively early in the piece (Schultz 1939; Parish and Dillon 1955; Williams 1959; Cozens 1965, 1967; Anderson 1972). Dillon (1971a, 1978) pronounced the production economic and econometric approaches as having been of little value. Perhaps the major criticism of the production economic model of production in terms of farm management is that it emphasised the allocation of resources at an assumed level of technical efficiency, when as noted by Harle (1974, p.156), and Longworth and Menz (1980), farming is really about 'moving towards a continually improving and adjusting efficiency'. The major relevance of production economic theory to Australian agriculture in practice seems to have been to provide a fairly formalized way of thinking for making decisions in keeping with goals of economic efficiency. Dillon (1978, p.23) put it plainly when he said that an increasingly accepted view was that 'training in farm management based on production economics has lost or must inevitably lose touch with farmers' needs and the practicality of farming because of its emphasis on logically attractive but largely inapplicable theory'.

### 4.3 Linear programming

Linear programming (LP) made its debut in the Australian literature in the mid 1950s, introduced by McFarlane and Dillon (1956). LP used the same information and did the same task as budgeting but McFarlane and Dillon (p.33) claimed that it did it better because the profit maximising combination of resources was identified 'automatically, precisely, quickly and accurately'. Mauldon (1958) noted efforts to use LP to formulate generalised results for extension workers. Extension workers could use these results of LP solutions as long as they understood the limitations of applying such generalisations to individual farms. Mauldon saw useful roles for both budgeting and LP in farm management. The danger with budgeting was that more profitable plans could be overlooked. LP was most appropriate where there were a large number of potentially limiting factors which could be put to a large number of alternative uses. But where there were few potential alternatives and they competed for resources in approximately the same proportions, LP probably would not be necessary and budgeting would enable the planning task to be done adequately. In the pastoral areas climatic uncertainty reduced the role of planning alternatives. In cropping areas production followed such a definite seasonal pattern that alternative crops competed for the same factors of production at around the same times of the year. In such cases gross margin budgets were adequate to select the most profitable activities. The same applied generally for livestock activities too. Also, budgeting handled the fact that some resources are fixed and some are variable better than did LP. With budgeting a plan was selected for the most fixed resources and then modified to fit the less fixed resources. Budgeting thus had more flexibility in this regard than did LP, in the early days at least (Mauldon 1958).

Towards the end of the 1950s the idea of farm management service laboratories to carry out LP analysis for representative farms was gaining currency. Parker (1959) saw great prospects for setting up farm management laboratories to use LP to develop farm plans for representative farms. Candler (1959) considered that LP had gone a long way towards replacing budgeting as the production economists most useful tool, and that budgeting had a number of disadvantages when compared with LP. For instance LP automatically found the highest income, and budgeting could overlook important research questions. He said that budgeting was well suited to solving simple farm management problems but often the term 'simple problem' really meant a situation in which the full range of possibilities was not to be considered. The range considered depends of course on whether a farm management or research orientation is relevant. LP benchmark results could act as guides to extension personnel about which plans to budget for individual farms. He concluded that LP was not likely to supersede budgeting in extension work, and that parametric techniques could improve the budgeting method. Jarrett (1959) disagreed with Candler's proposition that LP had become the most useful research tool for production economists. He considered that marginal analysis was still useful for problems involving decreasing marginal returns. Further good 'budgeteers' ought to know all about limiting resources and thus could devise plans as well as could be done with LP. The greatest contribution LP could make to solving practical farm problems was in providing benchmark plans to narrow the range of alternatives on which budgets need to be done.

A major review of LP was done by Musgrave (1963), particularly on refinements to the standard static model. The use of non-linear segments and integer programming were refinements needed for situations where the assumption of constant returns was too wrong. Quadratic risk programming enabled some of the variability of coefficients of objective functions to be included in analyses. The problem of variable input-output relationships remained complicated and mostly unresolved, largely because of covariance problems with the use of probability estimates. The major part of an LP study was the specification of the problem. There were particular difficulties with LP such as assuming that rigid joint relationships prevail over the whole range of possibilities and assuming a flexibility which was not feasible due to asset fixity. There was some scope for the use of representative benchmark type studies to give guides to changes from which extension workers could extrapolate, with appropriate budgeting, to individual farms.

The use of LP as a research tool was beyond dispute, and there was potential for the establishment of a centralized farm management laboratory as one means by which LP could be more useful for farm management extension.

Cocks (1963, p.80) argued that farm management was an applied science which was never subject to definite tests of efficiency, and that 'even the most elaborately formulated model is only a partial description of the possible and actual cause-effect relationship on a particular farm'. The development of (p.131) 'programming attitude' was 'a spin off from LP which would become part of the budgeting methods of farm planning'. Programming attitude meant the approach of expanding enterprises with fixed gross margins until a resource restraint was met. While LP could give a more 'correct' solution than other applications of the programming attitude, there was still a need for farm planning methods which advisers (p.131) 'could work through in a day with the farmer by his side making intuitive judgements'. Cocks considered that programming may be less apt for Australian than for European agriculture because there were usually more enterprises on European farms, and the enterprises were on a smaller scale. This meant that the absolute and relative costs of resource misallocations within an enterprise in European farming were greater than in Australian farming. Livestock changes were more likely to generate proportional changes in Europe than in Australia. Cropping could show approximate constant returns to scale but a major part of the planning of livestock-pasture enterprises involved predicting the results of changing the areas grazed and stocking rates. Hence, a method was needed which could cope with incremental changes within enterprises, that is some form of partial budgeting. Cocks advocated a method he called 'Creep Budgeting'. This involved developing full capacity plans and then substituting at the margin. That is, 'creeping around' the production surface in attempts to increase net income with the feasibility of the changes able to be checked at each stage by the farmer. Traditional budgets on the modern spreadsheet suit this approach admirably.

Static deterministic LP may be sufficiently operational and provide sufficient information in some situations to occasionally take its place alongside the traditional farm management budgeting tools for farm management planning. Most often though farming in Australia is too variable and risky, or has such limited choices, or involves choices between activities competing fairly strictly for the same resources at the same time, that the potential role of the formal programming techniques in practical farm management is very limited. Programming methods can be criticised for their focus on optimizing combinations of activities. There are always a range of farm plans which are similar in total gross margin but differ in technical requirements, or cash flow and gearing implications, so decisions on product combinations are then made on other criteria. The technical proficiency with which any of the often small number of options which are feasible are carried out is more important to improving net farm income than having any particular optimum combination of activities. Also the implicit goal of maximising total gross margin in any single year does not fit well with farmers' objectives, which generally involve many dimensions over a span of time longer than one year. With multi-period programming, the information generated can be useful only at the start of the plan (Anderson 1972, Trebeck and Hardaker 1972). Even though the information generated by multi-period techniques makes for better decisions about the first period of the plan, the marginal gain from such better information is not likely to compare well with the marginal cost of generating that information. Further, making programming techniques more realistic and relevant by attempting to allow for real world dynamics, for stochasticity, and for the multiplicity of decision-makers' objectives becomes such a complex procedure that such techniques are not operational or economical enough to be tools for farm management, useful as they may be for research. Interestingly, in the context of farming in the UK, where LP had a big run for over 20 years, Nix (1987) concluded that reduced scope for changing enterprise mix, increases in specialization, and greater uncertainty of prices meant that LP is very little used nowadays for individual whole farm planning. In Nix's view, LP remains a valuable research tool, whilst the more elaborate programming techniques had no likelihood of practical use and very little theoretical application. This is all equally true of farm management and agricultural economic research in

Australia.

### 4.4 Decision theory: expected utility analysis

The next major category of work in farm management is the decision theory approach. This refers largely to subjective expected utility analysis. Decision theory approaches prevailed in the literature from the mid-1960s to the mid-1970s. The decision theory approach to farm management is an attempt to correct for the neglect of uncertainty and attitudes to risk, and the emphasis on maximizing net monetary returns, found in the production economic theory and traditional approaches to decision analysis for farm management. The decision theory approach aims to incorporate explicitly the reality that decisions have to be made under uncertainty, and the decision-maker will have a particular attitude to the degree of uncertainty, as well as having a range of related objectives to try and meet.

Officer, Halter and Dillon (1967) argued that risk was the big consideration overlooked as a factor in farmer resistance to the adoption of a new technique. The contention was that risk was an important influence on farmers' decisions and that degrees of risk aversion or preference can be quantified using utility analysis. The criterion used was that of maximizing expected utility. These authors also put forward the quaint notion that once measured, a farmer's utility function would be put on file by a farm adviser, who could then make rational decisions for and on behalf of the farmer! Though the criteria of maximization of expected profit fitted with economic theory and held for conditions of certainty, it was found wanting when considerations of risk were introduced (Officer and Anderson 1968). The only major alternative criterion to maximizing expected income was the criterion of maximizing expected utility. To Officer and Anderson utility analysis was the most satisfactory method available for handling risky decision problems, but it was not widely used because it was difficult to use and it had not been given a fair trial. The major criticism of the utility approach was the assumption that the decision-maker's goals can be reduced to a single utility function of money, something which went against ideas about the 'universal irreducibility of human wants'.

Dillon (1971a, p.5) queried whether utility analysis was, perhaps, futility analysis. He was somewhat optimistic about utility analysis, at least in comparison to prior, less than useful, emphases; viz: 'With good sense, however, the seventies should see decision theory blossoming both within and beyond the farm gate; a flowering which will in turn lead to a more fruitful harvest from the vigorous but rather unproductive sproutings of production economics, linear and non-linear programming, benefit-cost analysis and systems simulation over the last two decades'. As Dillon saw it, rational decision makers aim to achieve as well as possible whatever goals they might have. Goals need to be chosen, and if multiple, ranked so that decisions can be made. With uncertainty the decision maker has to decide what outcomes could happen and specify the relative strengths of belief held about the likelihood of uncertain outcomes happening. Choices are between probability distributions of outcomes, with the associated uncertainty affecting the choices which are made. Though this may sound all too difficult, farm managers manage to make decisions in the face of great uncertainties and limited information. A more formal system of organizing as much relevant information as can be gathered ought to be all for the better. So utility, which measured degrees of preference about outcomes and made up one half of Bernoullian decision theory, had to be combined with degrees of belief about the likelihood of the outcomes, which were subjective, personal and subject to Bayesian revisions, and which made up the other half of decision theory. A person's utility function expressed the relative value to them of different amounts of gain or loss, and enabled alternative risky prospects to be ranked according to the expected utility associated with them. Difficulties included the ability of people to assess probabilities and to order their feelings about alternative outcomes in accordance with the Bernoullian postulates. Dillon (p.59) concluded his review of utility as follows:

> Is utility futility? The answer, definitely, is No!...what other decision procedure so well takes account of what we believe, what we know, and what we want. This is not to say that all the various rigmaroles and recipes covered in this review have to or can be followed through in practical application of Bernoulli's Principle. For many problems, indeed

> the day-to-day majority of those requiring some consideration, the certainty equivalent approach will suffice with no need for thinking of a utility function. Even sketching the roughest of decision trees will often powerfully augment a decision maker's choices. Only in important problems, where complexities are such that choice is best formalized and extensive calculations are worth paying for, will it be worthwhile attempting to apply the formal Bernoulli model. Even then, the payoff may often only be clearer thinking and guidance rather than outright answers. Nor, if the best decision is taken, is a 'good' outcome guaranteed...None the less it is still early days in the application of Bernoulli's Principle and the real 'test of usefulness of decision theory lies mainly in the future, and it will be made by those who learn about decision theory early enough in their lives that practical experience will not yet have made them feel that orderly, careful thinking about human decisions is futile'.

Trebeck (1971) responded that the estimation and use of utility functions was not as straight-forward as Dillon (1971a) claimed. Using the most common utility eliciting procedure, the Neumann-Morgenstern method, graziers' answers to questions about the relevant dollar ranges in deriving certainty equivalents showed considerable inaccuracies. Second, if a utility function could be identified as underlying a grazier's decision-making behaviour, it was dubious whether it could be elicited by a few questions about hypothetical 50:50 gambles. A problem was the unreality associated with the responses to questions about hypothetical happenings; happenings which may or may not be within the experience of the subject whose utility function is being elicited. There were also problems with the size of the particular dollar sums involved, and with the reason for the size of these sums impinging on the subjects utility. Trebeck (p.110) concluded:

> the derivation and use of utility functions to facilitate decision making (proxy or otherwise) is not the rosy concept it has sometimes been painted. Rather, there are severe operational shortcomings which have often been glossed over in an endeavour to highlight theoretical niceties.

Dillon (1971b, p.111) answered Trebeck (1971) as follows:

> ...it may sometimes be difficult, even impossible, to plot a utility curve U - U($x) for some people. For this there may be a variety of reasons related to: (a) non-acceptance of the relevant axioms; (b) the existence of non-substitutable goals so that utility is lexiographic; (c) difficulty in handling hypothetical questions; or (d) inefficient questioning procedures...Mr. Trebeck sees them as occurring more frequently than I do. So long as their possible existence is recognized and due care exercised, I believe the operational impact of these difficulties can be adequately controlled.

Anderson and Hardaker (1972) appreciated decision analysis. Setting themselves the task of judging the relevance and practical difficulties of decision analysis in management they concluded that the validity of Bernoullian decision theory depended on whether the basic axioms were reasonable and whether the operational theory derived from these axioms was logical and valid. These writers believed these requirements were met satisfactorily. The practical value of the theory in decision analysis, depended on whether the real-world managers could be convinced this approach was worthwhile. Jackson (1975) criticized the decision theory approaches to farm management decision making for the lack of application of decision theory to real-world situations, noting that it was up to those academic proponents of decision theory to put the theory into practice in a useful way. Furthermore, he saw a gap between theory and practice as it related to farm management decision-making, which had become wider over time. The decision theorists' applications of decision analysis had been based on hypothetical situations not real ones, noting that there had been too much interest in 'mathematical virtuosity' and not enough emphasis on solving basic problems. The idea of decision theory as not just another 'gadget', but as a part of a philosophy of management, had not been well propagated.

Wider scrutiny of decision theory followed publication of the book *Agricultural Decision Analysis* by Anderson, Dillon and Hardaker (1977). Petit's (1978, p.141) description of the book as 'an excellent text on the state of the art in a difficult field' was broadly indicative of many favourable reviews this book received. Petit (p.140) suggested though that for decision making, less sophisticated analysis may still lead to similar conclusions, and that the main problem in agricultural decision analysis 'is

not so much to find the 'best decision' but rather to understand how decisions are actually made, for what reasons, on the basis of which information and with which consequences'. Sturgess (1978, p.159) noted that decision analysis is something in which you believe (or do not), and said further that 'the major article of faith which must be embraced is the concept of personal probability'. The most critical review of this book came from McInerney (1979, p.80) who observed that risk seemed to hold a fascination for Australian agricultural economists and that the literature 'contains masses of this sort of material of value to anyone planning an advanced farm management course (as opposed to an actual farm)'. Noting that Anderson *et al.* argued that utility is really the only logical and rational approach to use in risky situations, McInerney (pp.80-82), added sceptically 'We shall see', and continued:

> One gets a slight suspicion that, with each passing chapter, the authors gradually become a little less sure that operational salvation lies exclusively (or at all) in their chosen approach; for they allow themselves to start describing models that are not direct descendants of utility theory, and increasingly resort to the kind of caveats and question-begging statements that are typically attached to all the other decision models ('assuming such and such conditions are satisfied, then...'; 'if it is appropriate to work with a multidimensional utility function...'; 'alternatively a benchmark approach could be used'; 'the use of this approach implies a utility function of the form...' *etc*). This brings us back to the 'horses for courses' situation we were led to believe their singular approach was going to make redundant.

McInerney's (p.82) most substantive criticism concerned the unworldliness of trying to 'deal with the unpredictability of future events by concentrating on the search for 'better' pre-decision optimization procedures', and he concluded:

> What they (the authors) really mean is that the reality of agricultural management is not easily handled analytically in their (or any one else's) formal decision-making framework. Quite obviously it is handled in practice, and often quite successfully, by people not well versed in decision analysis. Their secret seems to lie not just in making a considered choice based on a rational interpretation of the available information and consistent with their preferences and beliefs about the risks involved. Rather, having made a decision, whatever it is, they then make it work and keep things on an acceptable track. Their management is a matter of continually reacting to where they are, rather than periodically trying to pre-determine where they are going. Making a good fist of those initial planning decisions is important, sure, but let's also see some emphasis on management as a reactive, rather than a solely proactive, process.

Expected utility was scrutinised further in the 1980s. Cary and Holmes (1982) raised the possibility that means and ends were not independent. That is, the utility derived from particular actions can come from reaching the desired objective, or from the process of reaching the desired objective. Wright (1983) too cast doubt on the relevance of the decision theory approaches. He said that management scientists dissented from the view that decision theory had wide normative usefulness. Decision theory approaches were unable to describe behaviour well and there was a widespread tendency of people to breach the underlying axioms. There were serious problems with the elicitation of subjective probability distributions and utility functions, and particularly the use of the gambling device to represent real decision choices. Decision theory had the assumption that all relevant beliefs an individual held about an uncertain parameter could be summarized in a single probability distribution. If this was not so and there existed ambiguity about probability estimates then this ought to be taken into consideration. If all relevant beliefs were not captured in a single probability distribution then the application of decision theory could lead to irrational action simply because relevant information would be left out of the decision analysis. If so, then expected utility analysis would not lead to the appropriate action. Simon (1983, p.315) was sceptical, concluding that 'subjective expected utility theory does not provide a good prediction - not even a good approximation - of actual behaviour'.

One prosaic test of the value of a technique for farm management decision making is whether it gets used in farm management decision making. Utility analysis has rarely been used seriously for research, and probably never for a genuine farm management decision. With utility approaches to farm management decision making you are either 'of the faith', accept the axioms and believe that a

monotonic utility index can be defined sensibly which reflects completely a person's preferences among risky alternatives, or you do not. If the axioms are accepted, and the theoretical and practical controversies surrounding them are resolved to the believers satisfaction, then expected utility approaches to decision problems can be seen as a valid if not very operational decision technique. However, where doubt, both theoretical and practical, seems proper, and the faith is missing, assessment of the usefulness of utility analysis will be less generous (Shoemaker 1982, Stigum and Wenstop 1983). Maybe expected utility analysis is more sensibly about the theory of producer behaviour in the micro-economic sense, and is thus relevant to agricultural economics but not farm management (Hardaker 1979). Protagonists of utility analysis may have taken an overly singular view of the role of decision-making and risk in farm management. In practice, the process of decision making is the beginning of a journey in a general direction. Much will happen along the way! They may have overstated the case in their belief that utility functions can, both theoretically and practically, be sensibly elicited. They may have underestimated the importance of the interdependence between desired ends and means and the fluctuations of hope. Perhaps most importantly, the utility theorists devised a technique the use of which could only be worth considering for major decisions, but which failed to focus attention directly on all the critical practical considerations in major decisions, such as the technology, gearing, growth, time, cash flows, debt servicing ability, the tax angle (there is always a tax angle) and farmers' skills and long term goals.

The importance given to risk, and the use of probabilities in farm management decisions may be the most important and enduring contribution of the decision theory approaches to decision analysis. Even then, though the necessary mathematics of probabilistic analysis are well established, the essential information is usually missing! Difficulties with specifying probability distributions in the first place, along with the *ad infinitum* aspects of the probability of the probability (Menz 1976) and ambiguity (Wright 1983) about such distributions, as well as the many-probabilities problem, and interdependence and covariance problems, all have the effect of limiting the application of formal probabilistic decision theory to decision problems. An axiom of formal decision theory is that probability distributions can be derived about the uncertain factors which will help shape the ultimate outcome of a decision (Wright 1983). As with the axioms of utility analysis, the advocacy and acceptance of the use of probabilities in farm management decisions are matters of belief. Regardless, in practice decision makers have to take a gamble and bear the consequences. Probabilistic judgements have to be made, either explicitly or implicitly (Officer and Anderson 1968). Decision makers are thus conscripts to the faith of probabilistic approaches to decision making. Therefore the structured approach to decisions which accompany formal attempts to incorporate probabilities into decisions is useful in practice. Some things endure. First, farmers take a range of actions to set themselves and their businesses up in a way which will enable them to cope with risks, whilst planning to maintain their winning chances over the long haul. Second, risk remains the big hidden factor which goes a long way to ratifying farmers behaviour and attitude to changes. Third, risk remains the factor most commonly overlooked by subscribers to 'the fallacy of the foolish farmer' (Williams 1958) bewildered about farmer behaviour, and destined to remain so.

### 4.5 Systems approaches

The term systems approaches is used in a broad sense here, ranging from General Systems Theory to partial-systems attempts at simulating aspects of the operations of farm businesses in detail. As workers in academic farm management came to realize that traditional production economics did not and could not deliver the goods for farm management, some started to cast around for an alternative approach which might do so. Hence the appeal of systems approaches. Dillon (1978) made it official. Production economics was not much use to farm management other than as a sensible way of thinking. Systems as a conceptual construct was potentially the way to go. But as there was no systems theory established then (p. 28) 'much hard slogging will be necessary and I see no quick resolutions in terms of fancy mathematical or computer modelling...the farm system and its

management are too complex for that'. In particular, farm management was far 'too human' a process.

Inquiries into farm management require a particular interdisciplinary balance if they are to be truly about farm management. The key to understanding the outcome of the interactions between the technology, the economic, financial-taxation and institutional factors, and the human behaviour, which comprise the process of farm management, and to understanding the interactions themselves, is to have a good understanding of relevant elements of each discipline involved. Of these elements, economic ways of thinking by management link the many diverse components that determine the outputs of a farm business.

Farm management comes within the realm of what Von Bertalanffy (1951, 1968) called General Systems Theory. Boulding (1956, p.197) asserted that General Systems Theory is not a:

> single self contained general theory of practically everything, to replace all the special theories of particular disciplines. Such a theory would be almost without content, for we always pay for generality by sacrificing content, and all we can say about practically everything is almost nothing.

Boulding said that somewhere between the specific that had no meaning (mathematical abstractions) and the general that had no content, there must be optimum degrees of generality, for particular purposes. It was the contention of the general systems theorists that this optimum degree of generality in theory was not always reached by the particular sciences. Advocates of systems approaches to the analysis of questions maintain that increasing specialization within disciplines inhibits communication between disciplines and increases the danger of specialization into irrelevancies. Thus systems approaches to farm management problem solving would *prima facie* appear to have the potential to be more relevant than more disciplinary-specialist inquiries to problem-solving in farm management. Despite the merits of systems approaches as theoretical constructs for understanding and solving problems in farm management, the results of much farming systems research appear not to be very relevant to the process of farm management (for example see the journal *Agricultural Systems*).

Systems simulation approaches to farm management problems started to appear in the agricultural economics literature towards the end of the 1960s. Wright and Dent (1969) noted the fragmented nature of research which resulted from specialization. Efficient research required that results are evaluated in relation to the operational goals of the system to which the research is directed. The most likely way to achieve this was by an integrated approach to agricultural research. They directed their attention to the most complex system of all, the grazing system, and concluded (p.152) that while simulation could be a valuable research technique 'methodological and data problems may restrict its application to decision problems'. Anderson (1972) expressed the hope that with better computing capability, and more problem-oriented than technique-oriented efforts, modelling would become more useful to solving real planning problems. A couple of years later Anderson (1974) and Dalton (1974) recognized the possible, even probable, inappropriateness of decision analysis using systems simulation as a basis for individual farm management decision making. Anderson (1974, p.35) cautioned against the 'overselling' of the prospects for simulation in agricultural economics, reminding us that 'simulation can be an expensive tool for solving simple problems'.

Blackie and Dent (1974) asserted that, despite sophisticated simulation methodology being developed to assist analysis and planning of the farm business, the impact had been limited because the real information requirements of the farmer had not been met. That is, the necessary requirements for feedback between performance and the established plan had generally been missing. They hoped that skeleton models would become a useful method whereby simulation models could be cheaply useful to individual farm analyses (Dent and Blackie 1974, 1979; Dent 1975). A widely held, typical view is that simulation, at least, provides a general planning facility for 'typical' farms which advisory personnel can use to 'develop a feel for management action' (Richie, Dent and Blackie 1978, p.67). This conclusion parallelled the conclusion about the value of LP in farm management: 'good for modelling representative farm plans to educate advis-

ers!'. 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.

Attempts to model representative whole-farm systems, as distinct from modelling discrete parts of a system, for farm management purposes, run into the problem that the operation of farm businesses is so dynamic, stochastic, complex and unique that even very elaborate models of the operation of representative whole farm businesses are still too general to be used to give sensible advice about the management of individual farms. Further, once timing of inputs is recognized as an input itself, and the variability of inputs and the subsequent output response to them is considered, it becomes evident that there is an infinite array of different potential farm systems. In fact, systems approaches have made little progress at the farm level because attempts to model the particular on-farm complexities sufficiently realistically to be able to analyse decisions and give farm-by-farm management advice results in an intractable model (Dent 1975). Sound, practical farm management analyses will continue to have to be built on deterministic approximations of stochastic response functions which are based on broad groupings of inputs and outputs, allied to good judgements and well-founded expectations about imperfectly known factors, giving as full account as can be done to management's objectives, skills and willingness to bear different risks. The inadequacy of the farm-systems modelling approaches for farm management purposes is compounded when the focus is essentially agricultural science-systems, with important economic, behavioural and technical factors either unheard of, caricatured or considered as an after-thought. The opposite case, economic models which are inadequate on technical and behavioural aspects, are just as irrelevant for farm management decision making purposes. Partial-systems approaches which attach 'some economics' at the end, and then become deductive, overlook the reality that economic thinking is involved throughout the operation of the system; from first playing a major role in setting much of the agenda for the operation of the farm business to being involved in almost every input decision within the system.

Thus, farm management may well be 'farming systems' but 'farming systems' is not farm management. Farm management practitioners and farming systems researchers differ in their view as to what is 'the optimal degree of generality'. An unappealing reality to many systems researchers is that the 'optimal degree of generality' may well be very general indeed. The other unappealing reality to farming systems devotees is that each farm business system is absolutely unique. Arguably, a major reason for continued use of the traditional budgeting methods in farm management is that they allow a sufficiently comprehensive view of the problems, in sufficient interdisciplinary depth and breadth, to enable sound judgements to be made about sensible farm management actions. It is better to solve the whole problem roughly than to model elaborately and 'solve' a part of the problem extremely well.

A problem with academic work in farming systems which goes into greater depth about part of the system than does the whole farm work of the farm management professionals, concerns where the boundaries of the system are drawn. Technically oriented farming systems work is generally characterized by boundaries of the system being drawn which exclude some or all of the human, economic, financial, taxation and institutional considerations. In a similar fashion much past academic work in farm management drew boundaries which excluded the human component, the technology, the finance and taxation and the institutional factors. Further problems common to all such work arise from the inadequate incorporation of the possible effects of the passing of time, the dynamics, and the risk and uncertainty in farming.

Questions about farming systems approaches to research raise the philosophical issue of how such research relates to traditional academic research which delves into narrower fields at greater depth to derive some generally applicable principles and build on theory. It may be that both farm management and systems research which manages to generate information about general principles and

theory relating to the management of farms is more about research in one of the disciplines involved in the management of farms such as agronomy, agricultural economics, animal science, (rural) sociology, psychology, engineering, than it is about farm management. This view has the merit of making explicit the gap which inevitably exists between the findings of research and the management of farms, and reminding researchers that agricultural science and agricultural economics are not directly about farming.

By the late 1970s academic work in farm management had largely run its course. Most of the trails blazed in the long boom of activity in academic farm management since 1940 had been followed at some length. These journeys had produced useful insights which had directed the ways of thinking of those engaged in farm management at a more applied level. But, 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.

## 5. Overview

Farm management is usefully seen as an intricately interdisciplinary, uncertain and changing process. Importantly, in analysing farm management the balance of emphases on the many parts which constitute this process has to lead to accurate identification of and solution of practical problems. The literature of the Australian agricultural economic and farm management profession of the past fifty years reveals several emphases which have prevailed at various times. These emphases reflect different weightings applied to the components of the farm management mixture. It was inevitable that developments in any of these areas could only come about from increasing specialization. Thus much of the academic work in farm management is best described as partial-farm management. In practice, the agricultural technology is much more important to improvements to farm income than is generally evident in the farm management work of the agricultural economists. The same comment applies to the human, financial and beyond the farm gate factors. The partial-farm management nature of farm management work in the academic literature leaves the impression, as is common for past work seen from the viewpoint of today, of a relatively 'amateurish' approach to farm management; a notion which if it were to be accepted as true would add a whole new interpretation to Dillon's (1965a) description of farm management as a professional and an academic discipline. He could perhaps have referred to there being a 'professional and amateur' discipline.

Stent (1976) argued that to a great extent economists have to choose to believe in a particular theoretical construct, and the components within it, whether they admit it to themselves or not. The field of econometrics was cited as a fine example of this phenomenon. So too was the validation of systems simulation models (Anderson 1974). It could have been that having assumed many important things away or constant for the purposes of neo-classical economic analysis and being well-conditioned to the necessity of having to choose to believe in a methodology, academic workers in farm management were led to mistake the agricultural economic and farm management research they were doing for the process of farm management. However the outstanding characteristic of the academic work in farm management was that the limitations and inappropriateness of the various approaches were almost always clearly acknowledged in the writings. Certainly nearly all of the modern-day criticisms of the approaches and emphases in academic farm management of the past fifty years get a mention in the literature close to where these approaches and emphases were first touted. Maybe, having nodded towards the weaknesses of their approaches for the purposes of farm management, contributors to the literature then chose to believe that the limitations of the approaches they were advocating were less significant than they were in reality. The corollory of this of course is that the strengths of their approaches were, at the same time, greatly overstated. Such misjudgements may be the inevitable consequence of specialization, as inevitably specialization limits the ability to make good judgements about *all* of the important considerations involved in understanding the whole

farm system.

There are other reasons why academic work in farm management ended up so many pathways, some of which Candler (1962) described as 'blind alleys'. Some reasons are to do with the nature of the farming environment. The operation of a farm business is complex, subject to many combinations and permutations of inputs and outputs, many of which are unknown and uncertain. The quantitative decision techniques are inadequate for analysis of most of the important farm management decisions because these methods tend to be too narrow in focus. These methods tend to define the problem, when the real skill in farm management is in identifying the nature and scope of the problem and devising solutions, all things considered. As well, farmers have little scope for control over outcomes, so planning and decision analysis is relatively of less importance in a heirarchy of management needs and objectives (Wright 1985). It seems highly probable that institutional factors beyond the farmer's control are more significant determinants of the state of the farm business than is farm management (Schultz 1953). It may be that the most important factor in management success is having technical skills, mastery of information (Menz and Longworth 1976), plenty of equity, brains (Buggie 1976), shrewdness and luck. Campbell (1957) judged that farm management as a science had not made much headway in Australia because there was insufficient whole-farm emphasis, the essentially static theory was inadequate for Australia's highly uncertain agriculture, the farming activities were so extensive and diverse, and significant technological improvements had occurred regularly and reduced the importance of making more efficient use of current technology. These judgements still hold today.

Throughout this time the farm 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 solution(s) to be weighed in the decision. Indeed the validity of the traditional budgeting techniques used in farm management analysis have not only stood tests of time but their usefulness and analytical power has 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.

After the fascinating, exciting journey through fifty years, academic work in farm management has reaffirmed the 'enduring truths' about farming, and has demonstrated the limited value of a number of initially appealing methodological techniques. More than this though the academic literature has attempted to show the way to better things. The major legacy of this work is the body of key and enduring ideas which have been emphasised and illuminated, and can be found in any competent modern farm management investigation, and the better understanding of the many issues which need to be considered, and measured if possible, in farming practice. The hope however, is that having done this journey, it is now more likely that in the future workers in farm management will more appropriately weight, and choose to believe in the importance of, the very wide range of factors complicating the analysis of farm business management. With little farm management work being published in the academic literature over the past decade future academic workers in farm management can start (relatively) afresh; not with a clean slate but even better, with a slate on which the lessons from the past are clearly etched. Although much of the past academic work in farm management has been judged to have not been highly relevant or directly useful as theoretical or practical contributions to farm management, such work still has a role to play as part of rigorous and well-rounded studies in agricultural economics and agricultural science. That role is in the production of better agricultural economists and scientists through highlighting the limitations of their models of reality. So, academic work in farm management can contribute, even if almost accidentally at times, to the process of farm management. For those so inclined, there is plenty to be going on with.

## References

AIRD, J. A. (1941), 'The productivity of primary industry: a critical analysis', *Journal of the Australian Institute of Agricultural Science* 7(3), 91-95.

ANDERSON, J. R. (1972), 'An overview of modelling in agricultural management', *Review of Marketing and Agricultural Economics* 40(3), 111-123.

ANDERSON, J. R. (1974), 'Simulation: methodology and application in agricultural economics', *Review of Marketing and Agricultural Economics* 42(1), 3-55.

ANDERSON, J. R. and HARDAKER, J. B. (1972), 'An appreciation of decision analysis in management', *Review of Marketing and Agricultural Economics* 40(4), 171-184.

ANDERSON, J.R. and HARDAKER, J. B. (1975), 'Economic analysis in the design of new technologies for small farmers', unpublished manuscript, University of New England, Armidale, referred to in Musgrave (1976) and later published in 1979 in A. Valdes, G. M. Scobie and J. L. Dillon (eds), *Economics and the Design of Small-Farmer Technology*, Iowa State University Press, Ames, 11-26.

ANDERSON, J. R., DILLON, J. L. and HARDAKER, J. B. (1977), *Agricultural Decision Analysis*, Iowa State University Press, Ames.

BECK, G. W. and McCARTHY, W. O. (eds) (1971), *Accounting and Planning for Farm Management* (2nd edition), Queensland Department of Primary Industries, Brisbane.

BENNETT, M. K. (1928), *Farm Cost Studies in the United States: Their Development, Applications and Limitations*, Stanford University Press, Stanford.

BLACKIE, M. J. and DENT, J. B. (1974), 'The concept and application of skeleton models in farm business analysis and planning', *Journal of Agricultural Economics* 25, 165-73.

BOULDING, K. E. (1956), 'General systems theory: The skeleton of science', *Management Science* 2(3), 197-208.

BUGGIE, G. (1977), 'Allocative ability and farm management: A comment', *Review of Marketing and Agricultural Economics* 45 (1-2), 51-55.

BURNS, E. O. (1966), 'Comparative analysis of farm accounts', *Australian Journal of Agricultural Economics* 10(2), 169-182.

BURNS, E. O. (1973), 'Random thoughts on some problems of professional communication', *Australian Journal of Agricultural Economics* 17(2), 93-102.

BURNS, E. O. (1983), 'From a way of life to a business: Farm management and the Queensland DPI', *Journal of the Australian Institute of Agricultural Science* 50 (1), 22-27.

CALLAGHAN, A. R. (1939), 'Economic problems in agriculture: The need for trained agricultural economists', *Journal of the Australian Institute of Agricultural Science* 5(4), 188-193.

CALLAGHAN, A. R. , ANDREWARTHA, H. G. and WOODROFFE, K. (1942), 'Rural economics', *Journal of the Australian Institute of Agricultural Science* 8(1), 1-5.

CAMPBELL, K. O. (1944), 'Production cost studies as a field of research in agricultural economics', *Journal of the Australian Institute of Agricultural Science* 10(1), 31-37.

CAMPBELL, K. O. (1953), 'The conditions of increased productivity in agriculture', *Journal of the Australian Institute of Agricultural Science* 19(2), 66-76.

CAMPBELL, K. O. (1955), 'The determinants of agricultural efficiency', *Journal of the Australian Institute of Agricultural Science* 21(4), 256-259.

CAMPBELL, K. O. (1957), 'Contemporary agricultural economics in Australia', *Review of Marketing and Agricultural Economics* 25(1-2), 24-33.

CAMPBELL, K. O. (1960), 'Agricultural economics', *Journal of the Australian Institute of Agricultural Science* 26(2), 206-216.

CAMPBELL, K. O. (1978), 'Review of *Survey of Agricultural Economics Literature. Volume 1.* edited by Martin, L. R.', *Australian Journal of Agricultural Economics* 22(1), 76-77.

CANDLER, W. (1959), 'A new look at budgeting from the standpoint of linear programming', *Australian Journal of Agricultural Economics* 3(1), 46-54.

CANDLER, W. (1962), 'Production economics and problems of animal production', *Proceedings of the New Zealand Society of Animal Production* 22, 142-158.

CANDLER, W. (1965), 'The need for a farm management centre as seen from New Zealand', *Farm Policy* 4(1), 109-114.

CANDLER, W. and SARGENT, D. (1962), 'Farm standards and the theory of production', *Journal of Agricultural Economics* 15(2), 282-290.

CARY, J. W. (1980), Towards an Understanding of Management Education in Agriculture, unpublished paper, School of Agriculture and Forestry, University of Melbourne.

CARY, J. W. and HOLMES, W. E. (1982), 'Relationships among farmers' goals and farm adjustment strategies: Some empirics of a multidimensional approach', *Australian Journal of Agricultural Economics* 26(2), 114-130.

COCKS, K. D. (1963), 'Review of *Farm Business Management: The Decision Making Process* by E. N. Castle and M. M. Becker, MacMillan, New York', *Australian Journal of Agricultural Economics* 7(1), 80-81.

COCKS, K. D. (1964), 'Creep budgeting', *Review of Marketing and Agricultural Economics* 32(3), 137-148.

COOKE-YARBOROUGH, R. E. (1967), 'Accounting and planning for farm management: A review article', *Review of Marketing and Agricultural Economics* 35(1), 178-192.

COZENS, L. E. (1965), 'Production economics, averages and standards in research and extension', *Australian Journal of Agricultural Economics* 9(2), 111-128.

COZENS, L. E. (1967), 'Management advice, production functions and small farm groups', *Australian Journal of Agricultural Economics* 11(1), 198-203.

DALTON, G. E. (ed) (1974), *Study of Agricultural Systems*, Applied Science Publishers Ltd., London.

DENT, J. B. (1975), 'The application of systems theory in agriculture', Chapter 3 in Dalton, G. E. (ed), *Study of Agricultural Systems*, Applied Science Publishers Ltd., London.

DENT, J. B. and BLACKIE, M. J. (1979), *Systems Simulation in Agriculture*, Applied Science Publishers Ltd., London.

DILLON, J. L. (1965a), 'Farm management in Australia as an academic discipline', *Review of Marketing and Agricultural Economics* 33(3), 175-189.

DILLON, J. L. (1965b), 'New England's farm management service centre', *Farm Policy* 5(3), 115-121.

DILLON, J. L. (1971a), 'An expository review of Bernoullian decision theory in agriculture', *Review of Marketing and Agricultural Economics* 39(1), 3-80.

DILLON, J. L. (1971b), 'Comment on Trebeck', *Review of Marketing and Agricultural Economics* 39(4), 111.

DILLON, J. L. (1972), 'The outlook for agricultural economics', *Australian Journal of Agricultural Economics* 16(2), 73-81.

DILLON, J. L. (1978), An Evaluation of the State of Affairs in Farm Management, Paper to Annual Conference of the Agricultural Economics Society of South Africa, Stellenbosch.

DRUCE, P. C. (1947), 'The unit cost of producing agricultural products', *Review of Marketing and Agricultural Economics* 16(1), 5-8.

DRUCE, P. C. (1957), 'Contemporary agricultural economics in Australia', *Review of Marketing and Agricultural Economics* 25(1-2), 43-45.

DRUCE, P. C. (1959), 'Farm management advisory services in England', *Review of Marketing and Agricultural Economics* 27(3), 121-136.

DRUCE, P. C. (1964), 'Some developments in farm management extension in Australia', *Australian Journal of Agricultural Economics* 8(2), 112-123.

GEDDES, H. J. (1942), 'The economic approach to dairy cow rationing', *Journal of the Australian Institute of Agricultural Science* 8(2), 62-68.

GRUEN, F. H. (1948), 'Dairy farming as a business', *Review of Marketing and Agricultural Economics* 16(4), 151-154.

GRUEN, F. H. (1959), 'Pasture improvement - the farmer's economic choice', *Australian Journal of Agricultural Economics* 3(2), 19-37.

HARDAKER, J. B. and ANDERSON, J. R. (1981), 'Why farm recording systems are doomed to failure', *Review of Marketing and Agricultural Economics* 49(3), 199-201.

HARLE, J. T. (1974), 'Further towards a more dynamic approach to farm planning - a technically based model of the farm firm', *Journal of Agricultural Economics* 25(1), 153-164.

HEADY, E. O. (1952), *Economics of Agricultural Production and Resource Use*, Prentice-Hall, New York.

HICKS, J. R. (1939), *Value and Capital*, Oxford University Press, London.

HOSKINS, W. R. (1972), The ACCRA System - Progress and Promise, Paper to the 16th Annual Conference of the Australian Agricultural Economics Society, Sydney.

JACKSON, R. (1975), 'Decision analysis and farm management: The need for a new perspective', *Review of Marketing and Agricultural Economics* 43(3), 146-150.

JARRETT, F. G. (1957), 'Resource productivities and production functions', *Review of Marketing and Agricultural Economics* 25(1-2), 67-78.

JARRETT, F. G. (1959), 'Discussion: A new look at budgeting from the standpoint of linear programming', *Australian Journal of Agricultural Economics* 3(1), 54-55.

JOHNSON, G. L. (1952), 'Handling problems of risk and uncertainty in farm management analysis', *Journal of Farm Economics* 34(5), 807-817.

JOHNSON, G. L. (1963), 'Stress on production economics', *Australian Journal of Agricultural Economics* 7(1), 12-26.

JOINT COMMITTEE ON THE STANDARDIZATION OF FARM MANAGEMENT ACCOUNTING (1966), *Accounting and Planning for Farm Management*, Queensland Department of Primary Industry, Brisbane.

KALDOR, N. (1934), 'The equilibrium of the firm', *The Economic Journal* 44, 60-67.

KENNEDY, J. O. S. (1981), 'Applications of dynamic programming to agriculture, forestry and fisheries: Review and prognosis', *Review of Marketing and Agricultural Economics* 49(3), 141-173.

KNIGHT, F. H. (1921), *Risk, Uncertainty and Profit*, Houghton Mifflin Co., Boston.

LEWIS, J. N. (1958), 'Is agricultural economics a serious subject?', *Journal of the Australian Institute of Agricultural Science* 24(3), 268.

LEWIS, J. N. (1960), 'John D. Black (1883-1960)', *Australian Journal of Agricultural Economics* 4(1), 145-146.

LEWIS, J. N. (1961), 'Agricultural adjustment in a changing institutional setting', *Journal of the Australian Institute of Agricultural Science* 27(4), 213-219.

LEWIS, J. N. (1962), 'Agricultural science and productivity in the next decade: Economics', *Journal of the Australian Institute of Agricultural Science* 28(2), 108-116.

LLOYD, A. G. (1958), 'Agricultural experiments and their economic significance', *Australian Journal of Agricultural Economics* 2, 33-44.

LONGWORTH, J. and MENZ, K. (1980), 'Activity analysis: Bridging the gap between production economic theory and practical farm management procedures', *Review of Marketing and Agricultural Economics* 48(1), 7-20.

MACCALLUM, D. E. (1972), 'Review of *Farm Management Economics*', *Review of Marketing and Agricultural Economics* 40(3), 139-141.

MAKEHAM, J. P. (1965), 'Farmers goals', *Farm Management* 1(2), 3-4.

MAKEHAM, J. P. (1971), *Farm Management Economics*, Gill Publications, Armidale.

MAKEHAM, J. P. and MALCOLM, L. R. (1981), *The Farming Game*, Gill Publications, Armidale.

MALCOLM, L. R. (1987), Farm Management Research: Watersheds and Widdershins, Invited Paper to 31st Annual Australian Agricultural Economics Conference, Adelaide.

MASON, G. (1960), 'Resource productivities from a sample of light plains farms, Canterbury, New Zealand', *Australian Journal of Agricultural Economics* 4(1), 121-128.

MATHIAS, P. (1970), *Living with the Neighbours: The Role of Economic History*, Clarendon Press, Oxford.

MAULDON, R. (1958), 'An introduction to the application of linear programming to farming problems', *Journal of the Australian Institute of Agricultural Science* 24(3), 191-198.

MAULDON, R. and SCHAPPER, H. (1970), 'Random numbers for farmers', *Journal of the Australian Institute of Agricultural Science* 36(4), 279-284.

MAULDON, R. and SCHAPPER, H. (1971), 'The sensitivity of interfarm comparisons to inaccuracies of measurement and valuation', *Review of Marketing and Agricultural Economics* 39(2), 107-118.

MAULDON, R., SCHAPPER, H. and TRELOAR, D. (1969), 'Operational accounting for farm management', *Australian Journal of Agricultural Economics* 13(1), 47-57.

McCARTHY, W. O. (1961), 'Recent advances in agricultural economics and their significance for agriculture', *Journal of the Australian Institute of Agricultural Science* 27(3), 173.

McCARTHY, W. O. (1962), 'Farm management clubs and consultants', *Journal of the Australian Institute of Agricultural Science* 28(3), 238-239.

McFARLANE, G. C. (1958), 'A note on the United Kingdom farm management survey', *Review of Marketing and Agricultural Economics* 24(1), 33-43.

McFARLANE, G. C. (1972), 'Review of *Farm Management Economics*', *Australian Journal of Agricultural Economics* 16(2), 146-148.

McFARLANE, G. C. and DILLON, J. L. (1956), 'Linear programming - an example', *Review of Marketing and Agricultural Economics* 24(1), 33-43.

McINERNEY, J. P. (1979), 'Review of *Agricultural Decision Analysis* by J. R. Anderson, J. L. Dillon and J. B. Hardaker, Iowa State University Press, Iowa 1977', *Journal of Agricultural Economics* 30, 80-82.

MENZ, K. (1976), 'Risk, Uncertainty and Ambiguity', Agricultural Economics Discussion Paper 1/76, University of Queensland, Brisbane.

MENZ, K. and LONGWORTH, J. (1976), 'Allocative ability, information processing and farm management', *Review of Marketing and Agricultural Economics* 44(4), 203-205.

MOODIE, A. W. S. (1941), 'Agricultural efficiency and its relationship to production costs', *Journal of the Australian Institute of Agricultural Science* 7(2), 50-55.

MUSGRAVE, W. F. (1963), 'Linear programming: An evaluation', *Australian Journal of Agricultural Economics* 7(1), 35-41.

MUSGRAVE, W. F. (1976), 'Problems of change in Australian agricultural economics', *Australian Journal of Agricultural Economics* 20(3), 133-143.

NIX, J. (1987), 'Appraisal of current and future challenges facing the farm management specialist', *Canadian Journal of Agricultural Economics* 35, 675-690.

OFFICER, R. R. and ANDERSON, J. R. (1968), 'Risk, uncertainty and management decisions', *Review of Marketing and Agricultural Economics* 36(1), 3-19.

OFFICER, R. R. and HALTER, A. N. (1968), 'Utility analysis in a practical setting', *American Journal of Agricultural Economics* 50, 257-277.

OFFICER, R. R., HALTER, A. N. and DILLON, J. L. (1967), 'Risk, utility and the palatability of extension advice to farmer groups', *Australian Journal of Agricultural Economics* 11(2), 171-183.

OWEN, W. (1948), 'Some aspects of agricultural policy', *Review of Marketing and Agricultural Economics* 16(7), 296-313.

PARISH, R. M. and DILLON, J. L. (1955), 'Recent applications of the production function in farm management research', *Review of Marketing and Agricultural Economics* 23(4), 215-236.

PARKER, M. L. (1959), 'Programming for farm management extension', *Journal of the Australian Institute of Agricultural Science* 25(4), 267-272.

PAWLEY, W. H. (1941), 'The New South Wales Division of Agricultural Economics', *Review of Marketing and Agricultural Economics* 7(4), 131-142.

PAWLEY, W. H. (1945), 'Farm records - what the Department is doing', *Review of Marketing and Agricultural Economics* 13(1), 2-3.

PENNY, D. H. (1957), 'Contemporary agricultural economics in Australia', *Review of Marketing and Agricultural Economics* 25(1-2), 45-46.

PETIT, M. (1978), 'Review of *Agricultural Decision Analysis* by J. R. Anderson *et al.*', *Australian Journal of Agricultural Economics* 22(2), 140-141.

RANCE, G. A. (1976), 'Review of *Farm Management Economics*', *Review of Marketing and Agricultural Economics* 44 (1-2), 51-52.

RICHARDSON, J. H. (1982), 'Why farm recording systems are doomed to failure: A comment', *Review of Marketing and Agricultural Economics* 50(2), 211-214.

RICHIE, I. J., DENT, J. B. and BLACKIE, M. J. (1978), 'Irrigation management: An information approach', *Agricultural Systems* 3, 67-74.

ROBERTS, R. P. (1943), 'Agricultural production costs', *Review of Marketing and Agricultural Economics* 9(3), 112-114.

SCHAPPER, H. P. (1953), 'Letter to editor', *Journal of the Australian Institute of Agricultural Science* 19(3), 206-207.

SCHAPPER, H. P. (1954), 'Review of *Economics of Agricultural Production and Resource Use* by E. O. Heady', *Journal of the Australian Institute of Agricultural Science* 20(1), 40.

SCHAPPER, H. P. (1961), 'Farm management advisory services and the AIAS', *Journal of the Australian Institute of Agricultural Science* 27(2), 96.

SCHAPPER, H. P. (1964), 'Needed developments in farm accounting', *Farm Policy* 4(1), 21-27.

SCHAPPER, H. P. (1966), 'Information and computer planning for farm management extension', *Farm Policy* 6(1), 3-11.

SCHAPPER, H. P., BEALE, C. I. A. and ROBERTS, J. A. (1961), 'Report on farm management clubs and private consultants', *Journal of the Australian Institute of Agricultural Science* 27(4), 234-243.

SCHULTZ, T. W. (1953), *The Economic Organization of Agriculture*, McGraw-Hill, New York.

SCHULTZ, T. W. (1939), 'Theory of the firm and farm management research', *American Journal of Agricultural Economics* 21, 570-586.

SHOEMAKER, P. (1982), 'The expected utility model: Its variants, purposes, evidence and limitations', *Journal of Economic Literature* 20, 529-563.

SIMON, H. A. (1983), 'Rational decision making in business organizations', Chapter 15 in Marr, W. L. and Baldey, R., (ed) *How Economists Explain*, University of America Press, New York, 281-315.

STENT, W. R. (1976), 'Critique of the methodology of Australian agricultural economics', *Australian Journal of Agricultural Economics* 20(1), 1-18.

STIGUM, B. P. and WERSTOP, F. (1983), *Foundations of Utility and Risk: Theory with Applications*, D. Reidel Publishing Co., Holland.

STURGESS, N. H. (1972), Bernoullian Decision Theory: Some Personal Beliefs, Paper to the 16th Annual Conference of the Australian Agricultural Economics Society, Sydney.

STURGESS, N. H. (1978), 'Review of *Agricultural Decision Analysis* by Anderson, J. R. *et al.*', *Review of Marketing and Agricultural Economics* 46(2), 157-159.

TREBECK, D. B. (1971), 'On the utility of futility', *Review of Marketing and Agricultural Economics* 39(4), 109-110.

TREBECK, D. B. and HARDAKER, J. (1972), 'The integrated use of simulation and stochastic programming for whole farm planning under risk', *Australian Journal of Agricultural Economics* 16(2), 115-126.

TRUMBLE, H. C. (1943), 'Some reflections on the rural problem', *Journal of the Australian Institute of Agricultural Science* 9(2), 49-55.

VON BERTALANFFY, L. (1951), 'General systems theory: a new approach to unity of science,' *Human Biology* 23, 303-361.

VON BERTALANFFY, L. (1968), *General System Theory: Foundations, Development, Applications*, George Braziller, New York.

WILLIAMS, D. B. A. (1953a), 'Farm management research in Australia', *Journal of the Australian Institute of Agricultural Science* 19(3), 158-166.

WILLIAMS, D. B. (1953b), 'Farm management in Australia (ii)', *Journal of the Australian Institute of Agricultural Science* 19(4), 229-237.

WILLIAMS, D. B. (1957), 'Contemporary agricultural economics in Australia', *Review of Marketing and Agricultural Economics* 25(1-2), 34-43.

WILLIAMS, D. B. (1959), 'Extension economics in Australian extension services', *Australian Journal of Agricultural Economics* 3, 24-34.

WILLIAMS, D. B. (1968), *Agricultural Extension*, Melbourne University Press, Melbourne.

WILLIAMS, D. B. (1969), 'Production economics, farm management and extension', *Journal of Farm Economics* 51(1), 57-70.

WILLIAMS, D. B. (1987), 'Contributions to agricultural economics,' Chapter 2 in L.T. Evans and J.B.D. Miller (eds), *Policy and Practice: Essays in Honour of Sir John Crawford,* Australian National University Press, Sydney.

WRIGHT, A. and DENT, J. (1969), 'The application of simulation techniques to the study of grazing systems', *Australian Journal of Agricultural Economics* 13(1), 144-152.

WRIGHT, V. E. (1985), Farm Planning: A Farm Business Perspective, unpublished Ph.D. thesis, University of New England, Armidale.