Are We Risking Too Much?

Perspectives on Risk in Farm Modelling and Farm Management

David J. Pannell, Bill Malcolm and Ross S. Kingwell*

Risk and uncertainty have been extensively studied by agricultural economists. In this paper we question some practices and beliefs which are common among agricultural economists. The most important of these are (a) the predominant use of static (strategic) frameworks to formally analyse risk, (b) the predominant focus on risk aversion as the motivation for considering risk, (c) the idea that stochastic (i.e. explicitly probabilistic) models are likely to be helpful to farmers in their decision making and (d) the idea that study of risk in agriculture is likely to be an area of especially high social returns.

1. Introduction

Farming is one of the least reliable ways of making a living. Whatever farmers do, they are uncertain about the economic consequences due to their limited ability to predict things such as interest rates, weather, prices, pests, diseases, input costs and biological responses to different practices. Uncertainty in farming is "widespread in its origins and pervasive in its impacts" (Hardaker *et al.* 1991).

In recognition of this feature of agriculture, agricultural economists have devoted a lot of energy to the study of risk and uncertainty[1]. Risk is seen by most agricultural economists as an issue of critical importance to farmers' decision making. For example, Boussard (1979) states that

> Neglect of risk and uncertainty is a good cause of obtaining irrelevant plans. In a normative study, it would be pure nonsense to advise an investor to buy only the riskiest asset on the ground that it will also yield the highest expected gains. But this is exactly what is done in many agricultural management studies, where advisors propose "improved" plans (either at the farm or regional level) without any consideration of uncertainty problems (p.81).

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* Pannell is Senior Lecturer, Agricultural and Resource Economics, University of Western Australia. Malcolm is Senior Lecturer, Agricultural Economics and Extension, University of Melbourne. Kingwell is Senior Advisor, Department of Agriculture, Western Australia and a PhD student in Agricultural and Resource Economics, University of Western Australia. The authors appreciate contributions to this paper by various people: notably Jack Makeham but also Alistair Watson, Chris Lightfoot, Steven Schilizzi, Rod Gill, Donald MacLaren and Bob Lindner.

[1]In this paper we use the terms "risk" and "uncertainty" interchangably to mean "uncertainty in consequences" (Antle 1983; Hardaker *et al.* 1991).

In Australia, the study of risk in agriculture owes much to the teaching and research of Anderson, Dillon and Hardaker (1977) at the University of New England. Many current researchers and teachers in the field of agricultural risk have benefited directly or indirectly from their influence.

Like most major areas of academic endeavour, the study of risk has generated a body of conventional wisdom which is substantially correct but which is tainted to at least some extent by sacred cows, dogmas and vested interests. Our aim in this paper is to criticise some areas of the conventional wisdom in the context of farm modelling and farm management. This is not another critique of subjective expected utility theory and its various alternatives. Rather our focus is more generally on the use of risk models to analyse farming problems. We will examine firstly, some aspects of the approaches used most commonly in modelling of risk. Secondly we will challenge the apparently common view on the uses and usefulness of these approaches in agriculture.

As outlined in the next section, we stress that the appropriate level of detail and sophistication in the modelling of agricultural risks depends very much on the intended uses of the model. We then discuss three such uses in detail and highlight differences in the appropriate modelling approach. This is followed by a discussion of the appropriate role for government in agricultural risk management.

2. Objectives of Farm Modelling

The question of which approach (modelling technique, level of detail) should be used to analyse a particular farming issue is itself a problem of constrained optimisation under uncertainty. As in farming, the best thing to do depends on the constraints (e.g. deadlines), the opportunity costs of resources used (to construct and apply the model), the marginal benefits of extra effort, the uncertainties (e.g. over the extent to which detail and technique will influence the results of the study) and the objectives of the decision maker (i.e. the modeller choosing an approach). In this light, there is no "best" approach to modelling. In fact if farm modelling is like farming, the optimal choice of approach may be highly sensitive to the parameters of the problem.

Explicit representation of risk is one level of detail which may or may not be included in the optimal approach, depending on circumstances. If it is included, there are various ways of doing it. We suggest that optimal decisions about the inclusion of risk and the method of inclusion will be sensitive to the objective of the analysis. Possible objectives of the modeller include: (a) to publish in a refereed journal, (b) to predict farmer behaviour in response to particular conditions (e.g. government policy, research outcomes, prices or weather), (c) to evaluate the welfare impact of a change (e.g. government policy, research outcomes, prices), and (d) to help farmers make decisions. In the rest of this section we consider these objectives in more detail and discuss their relevance to the modelling of agricultural risks.

3. Publishing

If the objective is to publish, the optimal solution to the modellers' decision problem is clear. They should develop a formal algebraic model of the farming problem and include explicit representation of uncertainty. The model should represent risk aversion as the decision maker's objective and it should preferably be possible to draw "general" conclusions from the model (i.e. to formally prove something). This last requirement means that it is essential to simplify the problem substantially and treat it separately from the whole-farm complexities of real farming and to limit the number of sources of uncertainty to one or at most two.

Despite the acknowledged limitations of "subjective expected utility" (SEU) (e.g. Machina 1981, 1982; Quiggin 1982; Schoemaker 1982; Just *et al.* 1990), it continues to be used widely with general acceptance (Hardaker *et al.* 1991). As Bar-Shira (1992) observes: "In the face of evidence against the expected utility hypothesis, expected-utility-based models usually are justified by appeals to tractability and unambiguity of results" (p533). SEU is still the best (perhaps the only) way to publish a risk paper with allusions to being "applied". Depending on the journal, it might also be beneficial to include a numerical example.

4. Predicting or Evaluating Change

In practice, determining optimal responses to risk is primarily a numbers game (Preckel and De Vuyst 1992). It is not possible to generalise about the desirability or otherwise of a particular farming strategy, since the numbers vary widely from one situation to another. For example, in Western Australia, production of cereal and legume crops is far more risky than livestock production. In other farming systems, the difference may be smaller or even reversed. The shape of yield distributions can differ across soil types, varieties, regions and crop types. For example, in parts of Western Australia, South Australia and Queensland, wheat crop yields are highly positively skewed (Stanford *et al.* 1994), so that it is very important for farmers to fully exploit occasional bumper years to make it through the more common lean years (Kingwell *et al.* 1993). In other regions of Australia wheat yield distributions are either not skewed or are negatively skewed (Stanford *et al.* 1994), with important implications for management. Furthermore, the relative importance of price risk and production risk varies widely between different enterprises and different farming systems. Although, in general, production risk is more important than price risk in Australian agriculture (e.g. Harris *et al.* 1974) these risks can differ across time, regions and enterprises. These risk relativities depend on a host of factors such as climate, crop diseases, soil types, crop species, irrigation, marketing policies and technology.

Another practical modelling issue is that most decision problems involve numerous sources of risk, interacting in complex ways. Ignoring this complexity can lead to false conclusions. For example, Pannell (1991) has argued that the reputation of pesticides as "risk-reducing" inputs was based primarily on studies which had considered only uncertainty about pest density and/or pesticide effectiveness (e.g. Carlson 1984; Feder 1979). However, if the full range of uncertainties was

considered (e.g. price, potential yield), pesticides could be either risk-reducing or risk-increasing, depending on which sources of risk were most important in a particular situation. Pannell's argument has been supported in subsequent analysis by Horowitz and Lichtenberg (1994a) and in empirical evidence that, for farmers in the United States, pesticides and insurance are gross complements (Horowitz and Lichtenberg 1994b), rather than substitutes as would be expected if pesticides were risk-reducing.

Given the numerous sources of risk affecting a farmer and the very different situations faced by different farmers, there is little or no value in formal algebraic models for prediction or evaluation of changes in agriculture. Robison and Barry (1987) note that "two random variables .. quickly complicate our analysis, forcing us into numeric rather than analytic approaches" (p. 110). Realistic models with multiple random variables are entirely intractable to analytical solutions. Even if this were not so, they would almost always produce indeterminate results. Simplifying a problem to the extent necessary to achieve tractability can produce misleading results, as occurred with pesticides.

There are still choices to be made about the characteristics of the numerical model. Here we focus on three of them: whether the model should adopt a static or dynamic time frame, whether it should explicitly represent risk aversion, and whether it should include explicit, probability-based representation of risk.

4.1 Static Versus Dynamic Time Frame

As we abandon formal algebraic models, we may also need to abandon another convenient and common assumption: the static time frame. Antle (1983) argued cogently for greater recognition of the dynamic nature of farm decision making under risk but he appears to have had little impact on the contents of the agricultural economics literature. Most studies consider only strategic (static or long run) responses to price and/or production risk (e.g. Sandmo 1971). These are responses taken to reduce the psychic cost of uncertainty in outcomes by moving away from strategies with relatively high variance of income toward strategies with relatively low variance.

Most farmers would be puzzled that we as a discipline should focus so much on this aspect of risk management. For them, the biggest issue raised by price and production variability is how best to vary their management from year to year in response to the conditions at hand; their focus is tactical rather than strategic. Risk aversion may influence their choice of tactics, but it is not the main influence. The main influence is the greater profit which can be made by responding appropriately to exploit opportunities and avoid losses. Thus there are tactical decisions to be made even by risk-neutral farmers.

There is some numerical evidence in the literature to support this focus by farmers on tactical decision making. For example, Kingwell *et al.* (1993) using their MUDAS model found that by tactically adjusting the farm strategy (choice of rotations, stocking rates, etc.) it is possible for farmers in the eastern wheatbelt of

Western Australia to increase their expected profit by over 20 percent. By contrast, Kingwell (1994) showed that when risk aversion is included in analyses of this farming system, optimal adjustments to the farming strategy cause falls in expected profit of between two and six percent. An example from MUDAS is shown in Table 1. The results are based on strategies selected by MUDAS as being optimal in different circumstances: with or without representation of risk aversion and with or without representation of tactical options. The utility maximising solutions in this example are for a risk aversion coefficient of 3.0×10^{-6} which would be considered very high based on the findings of Bond and Wonder (1980) and Bardsley and Harris (1987). In this example the increase in expected returns from tactical adjustments is 10 to 12 perecent whereas the reduction in expected profit due to risk aversion is less than three percent.

Table 1. Expected value of annual income from different farming strategies (utility maximising strategies based on absolute risk aversion = 3.0×10^{-6}).

	Tactical adjustments			Percentage
	Excluded	Included	Difference	difference
Profit maximising solution	153,688	168,576	14,888	9.69%
Utility maximising solution	150,060	168,038	17,978	11.98%
Difference	-3,628	-538		
Percentage difference	-2.36%	-0.32%		

These changes in expected profit are useful indicators, but for this discussion a more relevant comparison is the change in certainty equivalent value of the distribution of returns. Table 2 shows a set of four certainty equivalent values for the strategies represented in Table 1. In calculating these certainty equivalents, it is assumed that the farmer is risk averse (absolute risk aversion = 3.0×10^{-6}). The impact of risk aversion is even less than suggested in Table 1, with certainty equivalents changing by less than one percent. Compared to the ideal model (including risk aversion and tactical adjustment options), a model which fails to represent tactical adjustments would identify a solution which is around $12,000 per year less valuable to the farmer. By contrast, the loss of certainty equivalent from failing to represent risk aversion (and thus of selecting a profit maximising solution) is $1,000 or less.

Table 2. Certainty equivalent value ($) of the distribution of income from different farming strategies for a risk averse farmer (absolute risk aversion = 3.0×10^{-6}).

	Tactical adjustments			Percentage
	Excluded	Included	Difference	difference
Profit maximising solution	130,797	143,147	12,351	9.44%
Utility maximising solution	131,912	143,597	11,685	8.86%
Difference	1,115	449		
Percentage difference	0.85%	0.31%		

We stress that these results are based on a very high level of risk aversion which would be relevant to only a small minority of farmers. Despite biasing the results by selecting a scenario most favourable to the inclusion of risk aversion, its impact is minor. For lower (more widely relevant) levels of risk aversion, the impacts of risk aversion on expected profit and certainty equivalents would be even lower, whereas the value of tactical adjustments would be little affected.

The results here are directly comparable to the well known (indeed the classic) result of response analysis that variations in management practices within the region of the optimum make very little difference to the level of net benefits because the profit function is flat near the optimum. In the example above, the optimum is the utility-maximising solution, and the changes in management for the profit-maximising solution are still within the region where certainty equivalent is unresponsive to marginal changes. On the other hand, the main benefits of tactical adjustments occur in the extreme years, both good and bad, when the optimal management practices are very different to the optimal practices for most years. For this reason, failing to allow for tactical adjustments does make a substantial difference to certainty equivalents (mainly through its impact on profit) whereas failing to allow for risk averse attitudes when selecting plans for a risk averse farmer is not nearly so serious an omission.

Similarly, in a study of optimal herbicide dosage, Pannell (1994) found that tactical adjustments to the dose in response to weather and weed density would increase farmer welfare by substantially more than would strategic adjustments to the dose to reduce risk.

Although we have presented only a single example, our hypothesis is that this is a very common, if not a general trend. Does this mean that the model should include tactical response options? Their inclusion increases the size of the model and the cost and time required for model development. In our experience, the costs are greater than the costs of representing risk aversion. Nevertheless, in our view, the benefits are likely to be greater too. If resources are limited so that it comes to a choice between these two complexities, we would follow the advice of Antle (1983) and opt for inclusion of tactical response options.

4.2 Risk Aversion Versus Risk Neutrality

Given the foregoing discussion, one may ask whether the model even needs to include risk aversion. In Kingwell's (1994) study, inclusion of risk aversion made little difference to expected returns from a farm. However, it did more noticeably affect land use and resource allocations across enterprises, indicating that risk aversion is more important in studies for which the objective is prediction of behaviour, rather than assessment of welfare. If it is ever optimal to represent risk aversion in applied numerical models, it is probably in cases where the most important use of the model is prediction of farmer behaviour.

Nonetheless, even in these cases, the effect of risk aversion on behaviour is small relative to the effects of other factors such as resource endowments (e.g. areas and types of soil, machinery inventories), relative prices, technology change, seasonal conditions and farmers' abilities and knowledge. In short, inclusion of risk aversion is necessarily a second-order issue in establishing farm planning directions. By inference, we would question the wisdom of devoting any substantial proportion of research expenditure on the sophisticated incorporation of risk aversion in farm planning tools. Often better representation of the biology, production alternatives, technology and taxation ramifications of the farming system will yield more valuable information than a sophisticated inclusion of risk aversion.

This is not to say that farmers are risk neutral (most are not; Bond and Wonder 1980; Bardsley and Harris 1987, 1991), nor that risk aversion has no impact on welfare or behaviour. Rather our view is that if we wish to evaluate a model by its social value and impact, then in many (although not all) situations the net benefits of using modelling resources to represent risk aversion are less that the net benefits of using the resources to improve other aspects of the model. We would suggest that it is more desirable to construct models that more realistically describe the complexities of the farming system than to append risk aversion to an overly simplistic model Kingwell (1995) shows how important are specification errors in a farming system model. Failure to adequately represent the biology or production alternatives of the farming system can result in the model selecting farm plans that are far from optimal. Such specification errors are likely to be much more serious that failure to include risk aversion in the modelling framework.

One cost of excluding risk aversion from the model would be that the model would not give due weight to the risk-reducing benefits of diversification. A traditional view is that diversification is a key risk management strategy (e.g. Samuelson 1967). By generating income from several activities whose returns are not perfectly correlated a farmer can reduce the overall variance of his or her income. Sometimes the failure to represent risk is cited as a reason why outputs from some mathematical programming models of farms are not as diversified as the actual farms they represent. However, risk aversion is not the only possible incentive for diversification.

Kingwell (1994) found that optimal farm plans for risk-neutral and risk-averse farmers in a region of Western Australia are similarly diversified (Kingwell 1994). Reasons for diversification by the risk-neutral farmer include:

(a) Non-uniformity of resource quality. The different areas and types of soil alter the profitability of rotation alternatives leading to a preference for pasture dominant rotations on some soils while others have cereal-grain legume rotations (Morrison *et al.* 1986; Kingwell *et al.* 1992).

(b) Resource constraints. In the short run limits on machinery capacity coupled with yield reductions from later sowing affect the optimal size of cropping programmes and necessitate a mixture of enterprises.

(c) Complementarities or positive interactions between enterprises. These include benefits of particular rotational sequences (e.g. nitrogen fixation by legumes, disease control, weed control, soil structure and soil organic matter content), and contributions of crop residues to livestock diets (Pannell 1987).

Hence, the characteristics of at least some farming systems provide substantial encouragement for enterprise diversification, even for risk-neutral farmers. Our hypothesis is that the additional incentive for diversification provided by risk aversion is often of much less importance. We suggest that the failure of some MP models to select diversified farm plans is usually more a result of their failure to adequately represent the above characteristics than their exclusion of risk aversion.

4.3 Stochastic Versus Deterministic Models

If risk aversion is not to be represented in the model, one must consider the possibility of developing a deterministic model (i.e. one without explicit representation of probabilities of outcomes). Whether this is optimal will depend primarily on how important are tactical aspects of the problem. If they are judged not to be critical, it may be perfectly adequate to exclude all stochastic elements from the model. Two of us have been associated with the development of the MIDAS models, the deterministic cousins of MUDAS. Our experience in comparing the two approaches has been that they usually agree quite closely on strategic questions such as the total average area of crops, optimal rotations for different soil types and average stocking rates. Even where there are differences in the optimal farm strategies selected, the differences between estimated welfare effects of a change (such as a new technology) are often much less.

It is our judgement that for many purposes, it is adequate to use the deterministic MIDAS models with sensitivity analysis to investigate the impacts of uncertainties. With the resources we save by not explicitly representing risk, we were able to (a) represent other, more important, aspects of the farming system, (b) improve the quality of data in the model, (c) conduct more extensive model testing, (d) apply the model sooner and more often, and (e) construct additional versions of the model for different regions. An additional advantage was that the MIDAS models are much easier to test and maintain by virtue of their smaller size.

We stress that we do perceive a need for the inclusion of risk considerations in farm-level analyses but because risk is likely to be a second-order issue we believe that it should not attract an inordinate effort. We advocate the use initially of simple approaches to capture the main effects of risk and uncertainty. By this we mean the use of sensitivity analysis to investigate discrete key scenarios, to identify the uncertain variables to which the model is most sensitive and to identify the break-even values of these key parameters.

One situation which may override our conclusions here is where the intended audience for the modelling results perceive that risk is an issue of critical importance. In this case explicit representation of risk, risk aversion and/or tactical responses to risk may increase the credibility of the model by enough to warrant the

effort involved (even if what you gain is false credibility). In our own experience, the failure of MIDAS to represent risk was the most frequent and trenchant criticism made of the model, eventually prompting the construction of MUDAS.

5. Aiding Farmer Decision Making

5.1 The Main Game

The main game in farming is staying in business despite the shocks of price and weather and the changes in policy, technology and social conditions that typify agriculture. In casting his eye over this long haul, Malcolm (1994a) commented that:

> The keys to continuing to be a farmer is to get the big decisions on land purchase, machinery investment and resource improvement right (p.19).

Certainly, Malcolm's view is supported by farm survey (Ripley and Kingwell 1984) and anecdotal evidence. The farmers most likely to be under acute financial strain at any time are those who bought land or machinery at the wrong time or at the wrong price. An unfavourable weather-year or unanticipated reductions in commodity prices lead these businesses into financial difficulties and, in some cases, they are forced from farming. Hence it is not the everyday or even annual risk management decisions that are likely to crucially affect farm viability. Longevity in farming has more to do with making a few major correct decisions that importantly affect financial risk than the annual gamut of decisions on management of production risk and price risk.

Kingwell (1992) and Kingwell *et al.* (1993) examined the value of various sub-sets of tactical decisions in response to climatic or weather-year risk. They found that tactical changes to crop and pasture areas in the best and worst types of weather years were particularly important determinants of expected utility and farm profit. Although these types of weather years occurred with relatively low probability, nonetheless the land allocation decisions in those years importantly influenced farm profitability. In short, it was the few decisions made in a handful of years that particularly affected farm performance. Such findings, although not exactly echoing the quoted sentiment of Malcolm, nonetheless support his view that farm survival and prosperity may have more to do with making a few correct and important decisions than slaving assiduously over a myriad of sequential risk management decisions.

A ramification of this view is that the primary focus in farm management analysis ought to be on techniques which enable good decisions to be made about the major decisions that farmers have to make periodically. Poor decisions about these major issues make a farm business very vulnerable to external factors (e.g. weather-years) that can lead to disastrous production or financial outcomes from which the farm business never recovers.

5.2 Holism Versus Reductionism

Just (1993) laments the "poor state of positive modelling of farm-level decision making" and indicates that econometric and programming models thus far have performed poorly in reflecting individual farm behaviour. He also observes how:

> ... a false sense of precision can be perceived when reduced or partial systems are estimated and reported (p.27).

The emphasis on reduced or partial analyses seems to arise from two sources. Firstly, journal referees and editors favour the publication of studies containing hypothesis tests that display a statistical significance. One way to increase the likelihood of statistical significance of a hypothesis test is to have a narrow maintained hypothesis (or model specification). Hence, one often finds articles that describe the impact of risk aversion being underpinned by simplistic models of the farming system. Secondly, as the complexity and flexibility of analytical methods has improved many academics have been encouraged to specialise as a way of generating additional insights about some feature of management behaviour and the farming environment. There are thus clear incentives for reductionism as opposed to holism.

The reality of farm management, however, is holism. It involves dynamic, stochastic, biological, technical, financial and human complexities that, in concert, will never be incorporated in any formal model of agricultural decision analysis. Even currently elaborate models of representative farm businesses remain too incomplete to be prescriptive about the management of an individual farm business. The complexity of the farm decision environment and the deficiencies of even elaborate decision tools led Malcolm (1994a) to conclude:

> It is something of an irony that the elaborate decision analytical methods such as those espoused in the decision theory and systems literature are not much use in practice in the very complex and uncertain situation of the farm business, whilst the straight-forward farm management budgets are extremely useful (p.21).

and that

> In the highly uncertain, subjective and constantly changing world of the farmer and the farm, elaborately fine-tuned analysis of any decision is unwarranted (p.19).

The reality of farm management, which farmers understand well, is that it is better to solve the whole problem roughly than to attempt to solve part of the problem extremely well. The advantage of simple budgeting approaches to farm planning is that, at least at some level, it allows consideration of all relevant characteristics of the unique farm business (e.g. enterprise interactions, constraints, personal preferences, attitudes, competencies and experiences). Use of sensitivity analysis to examine discrete key scenarios and identify break-even circumstances are simple but

valuable methods of incorporating risk in this decision process. These approaches help to identify the key variables in the decision and to facilitate focussed discussion on the nature and impact of various risks. These techniques are unsophisticated and "old", yet they provide the farmer with an opportunity to discern the nature and potential impact of uncertainties in a way that promotes sensible management of risk. Hence, we would conclude that these budgeting tools which already enjoy wide use by farmers, are an appropriate methodology for capturing a farmer's decision options in the face of risk and uncertainty.

Let us stress that we are not arguing for use of simple whole-farm budgeting tools for use by farmers just because they are cheaper, easier and quicker to set up and use. In our view, the value of the information they generate for individual farmers is higher than could be generated by a sophisticated risk model in any realistic time. They key advantage is that they are don't obscure or swamp the key individual circumstances of a particular farmer but rather they facilitate the farmer making decisions which account for their circumstances. That is, in comparing simple and complex models for farmer use, there is no trade off between costs and benefits; simple models are better on both counts.

5.3 Diversification Again

We discussed the benefits of diversification for risk management earlier. Less often recognised is that is that specialisation, rather than diversification, may also be a form of risk management. Specialisation can result in greater efficiency of production, better marketing, better quality and reliability of product, thus providing some insurance against some of the price and weather-year risks a farmer faces. In an equally contrary way, diversification can cause an increase in risk if the diversification is to a field outside the competencies of the farm manager. Diversification can expose a farm business to a new set of business and financial risks for which the farm manager may not be adequately prepared or is competent to handle.

Models which formally represent risk aversion suggest that diversification is desirable for risk-averse management. However, these models often ignore other important characteristics of the farm manager such as their particular technical competencies and knowledge base. Hence, for helping farmers, we would suggest it is more desirable to construct models which better capture their particular competencies rather than to append risk aversion to overly simplistic or deficient decision models. Including risk aversion in the latter cases is unlikely to improve the credibility of output from these models.

5.4 The Role of Government

In association with a recent changes in policies for drought assistance (Simmons 1993; Malcolm 1994b) and marketing of wheat and wool away from subsidies and towards "self reliance", Australian governments have recently taken upon themselves the task of training farmers in risk management. A cynic would see this as nothing more than a sweetener to offset the withdrawal of subsidies. Here we

address the question of whether there is a more legitimate justification for governments adopting this role.

One argument is that risk management is a normal part of the private enterprise which is farming and so there is no justification for a public role in this any more than in any other risky private enterprise (such as retailing). On the other hand, it might be argued that farmer ignorance of risk management practices results is an example of market failure, reducing overall efficiency. Because of previous government policies, farmers were able to survive with socially inefficient risk management practices and so there is temporary justification for a training role while farmers learn how to cope with the new rules. The range of instruments available to manage price risks are particularly complex. Now that the minimum reserve price scheme for wool and the guaranteed minimum price scheme for wheat have ceased, it is probably socially efficient for government to provide public extension to accelerate farmer awareness of the options for price risk management.

However the government justifies its new policy, it is a fallacy to think that government departments, or private consultants for that matter, can provide specific financial advice to groups of farmers (as they can with technical advice). The financial situations of farm businesses are unique and so farmers need individual financial advice. We are concerned that by using the (increasingly) scarce resources of departments of agriculture to do what they cannot do, there will be even less available to do what they can do effectively: provide good technical information to all farmers and some basic instruction in financial risk management for those farmers who do not know much about such matters.

Overall the case for anything much in the way of public assistance in risk management to individual farmers is weak. This is not to say that our advocated approaches to decision making for risk management are irrelevant - only that the application of these techniques and approaches to individual farms ought to be in the hands of private, entrepreneurial, risk-taking farmers and their privately employed advisors.

6. Concluding Comments

Our experiences have been that it easy for people to misinterpret our possibly unpalatable message. In this regard it may be helpful if we highlight what we are *not* saying. We are not saying that farmers are risk neutral, that farming is free of risk, or that diversification doesn't reduce risk. We are also not saying that decision theory, subjective expected utility theory or any other technique or theory is faulty (or good).

We acknowledge that the study of risk and its implications for farm management is intrinsically interesting, challenging, and currently often publishable. Among researchers there remains the private incentive of kudos to continue to research and publish on agricultural risk. However, it is our judgement that the aspects of agricultural risk most commonly researched and published are issues of secondary importance in determining how farms are managed. The models and outcomes of

much current risk management research are rarely applicable to decision makers in agriculture and may distract decision makers in government from more important issues. For these reasons, the publishing incentives are poorly correlated with the social returns of the research. One of our aims has been to highlight ways in which the social returns from resources used in modelling of agricultural risks might be increased. In some cases this means doing things differently (adopting a dynamic framework which allows for tactical decisions, employing a simpler modelling framework) while in others we feel that researchers should divert their energies to issues for which social returns are likely to may be greater.

Because of changes to drought policy and the cessation of price support schemes for wheat and wool, farmers increasingly need to undertake their own production and price risk management. Price risk management is likely to be novel for many farmers and there seems to be a case for farmers being better educated about the nature, costs and benefits of existing and emerging instruments for price risk management. However, farmers need to be wary of being enticed into an over-investment of their time and resources in risk management. A farm business will profit more from its manager boosting farm productivity by improving the technical efficiency of production than explicitly including risk averse sentiments in planning decisions.

Farmers should also be aware that risk management need not just mean responding to the likelihood of a down side in yield, price or revenue distributions. Through strategic and tactical decision-making farmers can boost expected profits by responding better to opportunities that reside in the upsides of these distributions (Kingwell *et al.* 1993).

Currently, some research funding bodies (e.g. GRDC 1994) are reviewing their commitment to research on risk management. We suggest there are clear opportunities, particularly for farmer education regarding price risk management and research on appropriate price risk management instruments. However, unless these and other risk research opportunities can demonstrate a likely high ranking of their social returns, we caution against great increases in funding.

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