The prospects for whole-farm risk management: evaluating the impact of a deregulation of agricultural markets

Marcel A.P.M. van Asseldonk[1], Miranda P.M. Meuwissen [1], Ruud B.M. Huirne[1,2], J. Brian Hardaker[3]

[1] Institute for Risk Management in Agriculture, Wageningen University, Hollandseweg 1, 6706 KN, Wageningen, The Netherlands

[2] Business Economics, Wageningen University, The Netherlands

[3] Emeritus professor Graduate School of Agriculture and Resource Economics, University of New England, Armidale, Australia

Abstract

Risk management in agriculture is an increasingly important topic. At the farm level, it has received little attention in Europe despite the fact that deregulation of agricultural markets in EU member states (and acceding countries) will expose farmers to more risks. The opportunities to study the impact of these emerging risks are elaborated on by introducing the concept of farm-specific whole-farm analysis. We state that, analyzing the impact of deregulation of agricultural markets and evaluating the merits of new risk reducing instruments requires a method of farm-specific whole-farm analysis. The paper concludes by identifying areas for further research in the field of whole-farm risk management.

Keywords: risk management, whole-farm approach, multiple risks

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1 Introduction

The actual and projected deregulation of agricultural markets in EU member states will result in, amongst other things, the fact that agricultural firms will increasingly be confronted with price–making in international markets, such as the world market. This generally means lower and definitely more fluctuating prices (Huirne et al., 1997; Meuwissen et al., 1999). These projected impacts of policy changes are also important for those countries joining the EU in the near future. In such a liberalized and complex world, new types of farming will develop facing new kinds of risk, some of which being catastrophic and disruptive. These emerging risks combined with the growing 'securitization' of financial markets and risk-sharing instruments, has created an awareness of the need and scope for better management of agricultural risks, not only for individual farmers, but for all firms in the agricultural supply chain. This implies that risk consideration will become more important and should be addressed in a more formal way.

A considerable amount of general work had been done on issues such as on-farm risk management and the use of some well-established risk-sharing instruments such as commodity futures and conventional insurance. There are, however, three limitations to this accumulated body of knowledge. First, new instruments are being developed apace, creating a need for better and quicker ways of analyzing their worth. Second, and more seriously, a large proportion of the past work on financial instruments for risk management has been done using partial analysis, i.e. assessing the merits of using each particular risk/risk instrument alone. However, such partial analyses may be flawed, perhaps misleading, especially (but not solely) where the instruments or strategies analyzed are strongly negatively correlated with other parts of the farm firm.[1] Third, the analyses were very general in nature and not tailored to individual (farm) production

[1] Doherty and Schlesinger (1983) showed that the interactions between portfolio elements have significant implications for insurance strategies which might explain apparently 'irrational' behaviour whereby individuals insure some risks fully and others not at all.

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circumstances. It is hardly recognized that the farm manager himself has a potential to influence and improve his own risk situation through on-farm risk management strategies.

Given this changing risk environment, decision makers in agriculture need to find ways to cope with the new risks they are confronted with. In this context, we will present the concept of whole-farm risk management. This paper first discusses risk management in general (definition, sources of risk, and risk-management strategies). Next, opportunities for broadening the scope of risk management is elaborated on by introducing the concept of whole-farm risk management. The paper concludes by identifying areas for further research in the field of whole-farm risk management.

2 Risk management

The terms of 'risk' and 'uncertainty' can be defined in various ways (Hardaker et al., 2004). Uncertainty is the result of incomplete knowledge. Risk can be defined as uncertain consequences or results at the moment of making decisions. Risk particularly concerns exposure to unwanted, negative consequences. Risk management, as depicted in Figure 1, is the systematic application of management policies, procedures and practices to the tasks of 1) identifying, 2) analyzing, 3) evaluating and decision making and finally 4) monitoring and reviewing risk (Hardaker et al., 2004).

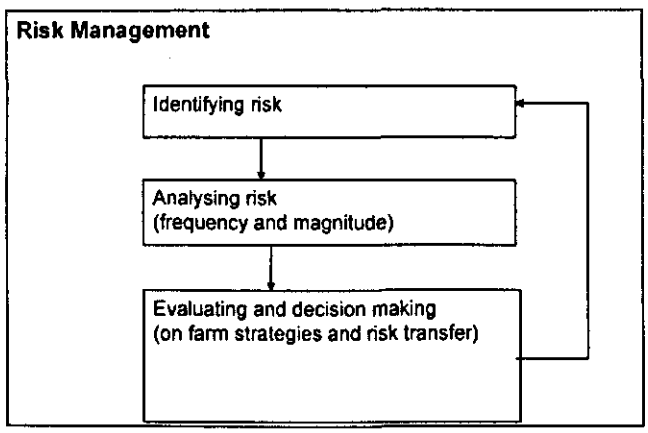

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Figure 1: An outline of the steps in risk management.

2.1 Types of risk

Risks can be classified into various types of risk. For most agricultural risks the classification of Hardaker et al. (4004) can be used, who distinguish between business risks and financial risks. Business risks include production risks and price risks. Business risks furthermore include personal risks and institutional risk. The other type of risk, financial risk, refers to the risks related to the way a farm is financed. In the following paragraphs the various types of risks will be elaborated on.

Production risks in agriculture refer to the uncertainty of physical yield of animals and crops which come from the unpredictable nature of the weather and uncertainty about the performance of crops and livestock as result of for example diseases and infestations. Because of this the sector is an outstanding example of being exposed to production risks (Anderson et al., 1977; Barry et al., 2000; Van Asseldonk et al., 2001; Hardaker et al., 2004).

Moreover, the prices of production that are purchased (such as concentrates, fertilizer, pesticides and machines) and of products sold (such as milk, tomatoes and cut flowers) are not known, at least not at the moment decisions on these have to be taken. As already mentioned, farmers are increasingly exposed to price-making forces in unpredictable markets. Thus, market and price risks are important factors.

Governments form another source of risk to farmers. Changes in laws and regulations with respect to running the farm can have far-reaching consequences for farm results.

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Examples are the continuing changes in the regulations as to environment, pesticides, animal diseases and animal welfare. On the other hand, governments have also set off particular risks (up to now).

Farmers working on their farms are a risk themselves to the profitability and continuity of the farm. The farm's survival may be threatened by death of the owner, or by divorce of a couple together running the farm. Long-term illness of the owner or employees can also cause considerable losses or can increase the costs considerably. Such risks are called human or personal risks.

There are also financial risks involved (Belli et al., 2001). These are related to the financing of the farm. Using borrowed capital (such as mortgages and the like) means that first the interest needs to be paid before increasing one's equity capital. For farms with relatively much debt capital (for example, as a result of large investments), little will be left as a reward to one's equity capital at times of high interest rates. Only farms that are entirely equity-financed are not subject to such financial risks, but yet can sustain capital loss. Other risks connected to use of credit and loans are uncertain interest rates and not being able to obtain a loan or mortgage.

2.2 Reducing and sharing risk

Risks are thus unavoidable and influence almost any decision the farmer takes. That is to say risks are there, but can be counteracted. The farmer should anticipate such risks by his management. There are two categories of measures to reduce risks: taking measures within the farm and sharing risks with others (Huirne et al., 1997; Belli et al., 2001; Huirne, 2002; Hardaker et al., 2004).

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On many uncertain events (extra) information can be obtained easily. For example, asking for the weather forecast, analyzing feed or soil samples and consulting experts. Also particular risks can possibly be avoided or prevented. It is known that certain activities carry more risks than other. Another good strategy to minimize risks is not to put all one's money on a single farm activity. By selecting a mixture of activities, risks can be considerably reduced. The same holds for having various suppliers and buyers. Flexibility can be mentioned as a last measure at farm level. Flexibility refers to how well a farm can anticipate changing conditions. For example, by investing in multi-purpose machines and buildings.

The second set of measures refers to sharing risks with others (Huirne et al., 1997; Hardaker et al., 2004). One possibility here is buying insurance. At the moment there are several types of insurance available, with which, by payment of a premium, risks can be reduced or even eliminated. The farmer can also conclude contracts for example with suppliers and buyers in which price agreements are laid down. Agreements can be made on the duty to deliver and to buy as well as on the quality of the products or raw materials. Lastly, by using the futures market, price risks can largely be eliminated. The futures market is not yet very well known in the EU member states, but in the US it is popular for a number of agricultural products.

3 Prospect for whole-farm risk management

As described in the introduction the actual and projected deregulation of agricultural markets in EU member states and acceding countries will most likely result in more fluctuating prices. Most farmers will try to reduce this risk if this has a considerable influence on their income or wealth (Anderson et al., 1977; Belli et al., 2001; Hardaker et al., 2004). The opportunities to evaluate this decision making problem is elaborated on by introducing the concept of whole-farm risk management.

Consider a newly introduced form of insurance that indemnifies farmer policy-holders against low income from a particular crop. By taking up such a policy a farmer will normally be accepting a small reduction of expected net returns from the crop (mainly due to the premium paid), but is guarding against very unfavorable outcomes. On the face of it, it seems that only a risk-averse farmer would consider buying such a policy and the decision would depend on the cost of the premium relative to the benefit perceived from the reduction in down-side risk, as well as on the degree of risk aversion. With information about the farmer's attitude to risk and about the probability distribution of returns from the crop, a choice to insure or not can apparently be rationalized.

However, that is not the whole story. First, our farmer has now 'locked out' one source of risk of a bad overall outcome, so he or she can now be rather more adventurous in making other risky decisions about next year's production. These more adventurous decisions are likely to increase expected returns at the cost of some increase in the risk of a bad result. Moreover, almost by definition, an insurance instrument is a risky prospect that is negatively correlated with the risk insured. Yet in farming there is often a positive correlation between risky production prospects – most crop yields are positively correlated, and so too are many product prices. A negative correlation of the insurance with the returns from crops and livestock might mean that, by purchasing the insurance, the farmer can in effect 'trade away' not only some of the risk in the specific production insured, but also some part of the risk in other production activities. Moreover, with this additional risk reduction, he or she is still better placed to be more adventurous in choice of production options. For example, the availability of a new risk management instrument may allow the farmer to borrow more to invest in improving productivity.

In general, it will be impossible to say whether the net effect of the introduction of a new risk management instrument will increase or reduce either the mean or the variance of net returns. It depends on how the interactions with other risks on the farm and with other

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risk management instruments work out. All we can be sure of is that, if the decisions are taken rationally, the farmer's utility should not go down and would normally remain the same only if he or she found the new instrument unattractive.

In summary, the merit of adding any risky prospect into an existing farm business cannot be assessed without considering the potential impact on the risk-efficiency of net returns from the ***whole portfolio of farm-specific risky prospects*** (including any off-farm investments or income-earning ventures). This is true whether the added prospect is in the form of a new production activity, a new method of financing, or a new risk management instrument. And, in making an evaluation, it is necessary to take account of the stochastic dependencies, such as the correlations, between the new activity and the existing ones. Indeed, there is no difference in principle in the form of analysis needed to examine the impact of deregulation of agricultural markets on the one hand or the merits of insuring or hedging on the futures market on the other.

Evidently, analyzing the impact of deregulation of agricultural markets in combination with the merits of new risk instruments or, indeed of any new production or marketing initiative on a farm, requires a method of ***farm-specific whole-farm analysis*** that will accommodate all these interactions. A general method for this has been known for a long time – since the pioneering *portfolio selection* work of Markowitz published in 1959 and the even earlier work of Freund (1956), who showed how *quadratic risk programming* (QRP) could be used to maximize the expected utility of a risk averse decision maker subject to a set of resource and other constraints.

The possible farm plans (i.e., alternatives) can be divided into an efficient set and an inefficient set. The inefficient set contains those alternatives that are dominated (e.g., by an alternative results in a higher expected return with the same level of risk) by alternatives in the efficient set. The optimal alternative for the decision-maker will lie among the alternatives on the efficiency frontier. As can be seen from a hypothetical example presented in Figure 2, alternatives A and B are not dominated by any other

alternative and are therefore efficient. Alternative C is inefficient because A and C are indifferent with respect to the amount of risk but the expected return is lower for C. Alternatively formulated, B and C are indifferent with respect to the expected return but C is riskier. Within this concept, risk is included to discriminate amongst risky alternatives. Risk as variability can be approximated by some statistic of dispersion of the distribution of economic outcomes. Variance is the most-commonly used risk parameter resulting in expected value-variance (EV) based efficiency frontiers.

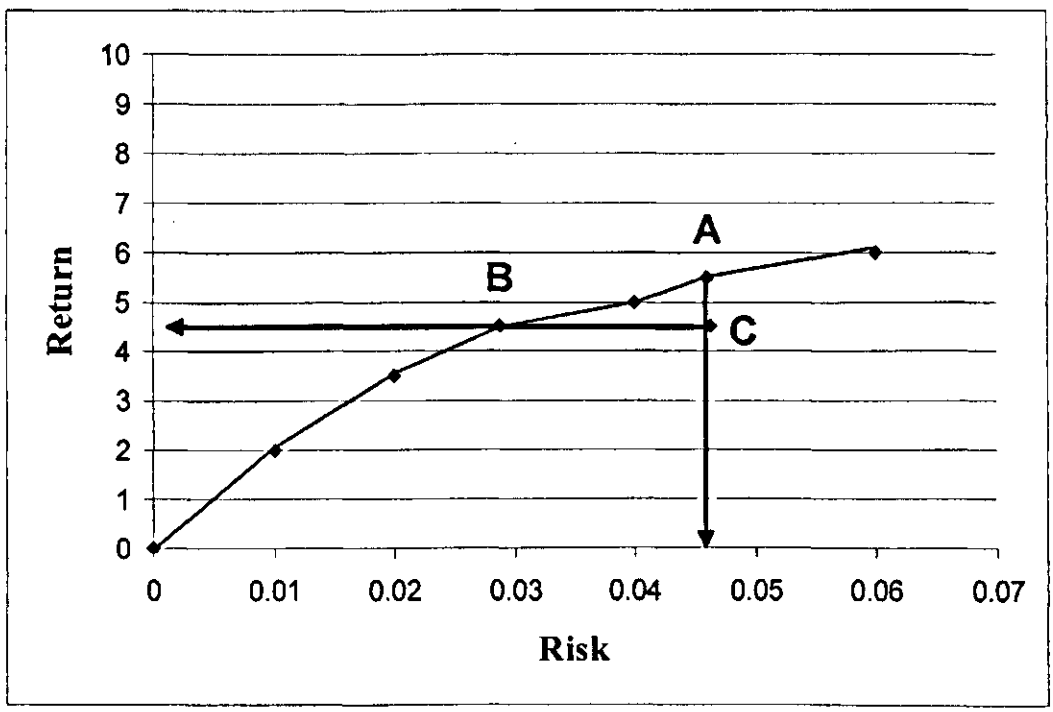

Figure 2: Efficient frontier in a portfolio selection model.

Notwithstanding the short classification of models attempted above, the reality is that the combination of the ingenuity of analysts and the new computing power and capacity is leading to the emergence of such farm-specific (new risk) models that better match a particular purpose (such as scenario analysis). Perhaps the main challenge in putting the powerful risk methods to work in farm system portfolio analysis is to find a way of

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appropriately specifying the stochastic structure of the model. Getting the joint distribution of all the main uncertain variables adequately specified is nearly always a very tough job. Usually, a comprehensive, long-run set of relevant farm-level historical data will not be available. Even when there is a good data set, the world has become such a turbulent place that the relevance of such historical data to modeling the future is dubious. With some imagination, it may be possible to make use of such data and to 'adapt' them to represent the future being modeled (Hardaker et al., 2004). More often, however, the available historical data will be too irrelevant in time and space, or too limited in scope, to be useful. By definition, there are no data available for analyzing future risk scenarios.

In that case, the need is to capture the stochastic structure in some other plausible way. This is an area of active research, but perhaps the most promising line is to develop a computer simulation model, as simple as is judged adequate to meet the case, that will embody within it the main cause and effect relationships creating the stochastic dependencies among the variables of interest. Parts of the simulation model may be based of regression estimates of key relationships. Other parts may comprise 'engineering' formulae reflecting the accumulated knowledge of agricultural scientists or other experts about how some aspects of the world work, or they may be based on the best expert guesses available at that time. Once constructed and, so far as possible, verified and validated, Monte Carlo sampling methods can be used to produce as large a sample as required drawn from the implied joint distribution of the stochastic coefficients of interest.

Different models of the kind indicated above would be needed for different types of farm. Within a general farming type in a particular region, it should be possible to initialize a developed model and to adapt the associated stochastic simulation to suit the circumstances of particular farms or the special needs of a particular analysis. Such a farm-specific development of the models would generally include the normal range of on-farm production activities with their associated resource constraints. Also included

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would be the range or risk-sharing instruments currently available, such as various forms of insurance, different financing arrangements.

4 Conclusion

From the above, we conclude and define a number of areas for further research in the field of whole-farm risk management. It makes sense to do a careful analysis of risky prospects, at least for important decisions, entailing:

- thoughtful assembly and assessment of available information to assess probabilities;
- careful and consistent assessment of degree of risk aversion;
- integration of the components in a systematic analysis leading to a recommendation for action.

However, decision analysis is neither easy nor cheap, which is only partly why it is not used more often. But it is wrong and misleading to put risk analysis in a box on its own and it should really be part of almost any professional analysis of almost any important issue. To account for all risk in all that we do would be impossible, even dealing systematically with major risks is a huge task. So we must be realistic and concentrate what really matters. In such cases, surely some risk analysis, even if superficial, will often be better than ignoring risk altogether. The latter is especially the case for risks introduced by the actual and projected deregulation of agricultural markets in EU member states and those countries joining the EU in the near future.

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