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PROSPECTS FOR MANAGING PRODUCTION RISK IN NEW ZEALAND AGRICULTURE

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The objective of this paper is to evaluate the effectiveness of the currently available management options and those which have the potential to provide relief to New Zealand farmers from income variability associated with production risk. This preliminary analysis is carried out in view of the recent changes in Government policy on income stabilisation and the emergence of new pastoral and horticultural industries as commercially viable enterprises, and focuses on the nature of production risk in these new activities in relation to the established ones.

Variations in livestock numbers and livestock productivity is studied for pastoral industries, beef, lamb, sheep, and dairy at the national level, along with the variability and correlation in aggregate production, while taking into account the price induced effects. In the arable sector, variability and correlation of wheat and barley yields and production is investigated, while the nautre of the apple and kiwifruit production is considered in relation to the horticultural sector.

The management options covered are diversification, irrigation and drought management strategies along with the potential benefits of comprehensive crop and livestock insurance schemes. In this context, the merits of adverse events relief provided by the Government, usually on an ad hoc basis is compared with the positive aspects of a participatory insurance scheme, including the issues related to the nature of participation in such schemes and the potential role for the Government.

It is concluded that continuous monitoring of the nature of production risk at the aggregate, regional, and farm level is required in relation to the available private and co-operative risk management options as well as the potential role for the government in facilitating the development or strengthening of new options for handling both production and market risk, either separately or in combination. The enhanced concern with the market risk should not overshadow or diminish the problems arising from production variability.

The views expressed in this paper are those of the author and do not necessarily reflect the official views of the New Zealand Ministry of Agriculture and Fisheries.

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1 Introduction

Agricultural production is typically a risky business. The types and severity of the risks confronting farmers vary with the farming system and with the climatological, policy, yield, and resource risks, which make their incomes unstable from year to year (Hazell et al, 1986a). Incomes in New Zealand agriculture, as in the Australian case, are especially unstable because of high level of climatic variability, and because a high proportion of farm output is sold overseas at world prices which are typically volatile (IAC, 1986). Problems associated with risks in agriculture are one of the reasons that many governments have intervened directly in agricultural product and factor markets.

On the more private side, on farm risk management has long become a part of modern day farm management. It has also commanded substantial resources from farmers as the current risk environment is more complex and demanding on managerial skills than in the past (Barry, 1984). Management of production risk on farms can take two main forms:

(a) measures to reduce the probability of and/or the severity of adverse events; and

(b) measures that increase the farmers' capability of handling the consequences of adverse events.

Irrigation, diversification of enterprises, flexibility in farm operations and management practices fall in the first category where the degree of success varies with the farming region, farming systems and the farming skills of operators. An important example of the second kind in managing production risk in agriculture is insurance, which is not available in New Zealand for most farming enterprises and against most sources of production risk.

In this context, the objectives of this paper are threefold. It will first focus on the nature of agricultural production risk in New Zealand, then discuss both the public and private risk management methods available to the New Zealand producers, and finally evaluate the effectiveness of these methods in relation to the two broad means of production risk management referred to above. Their effectiveness will also be assessed in relation to the nature of risk faced by the different producers, their level of risk preferences, the relative cost of implementation of different options, the extent of complementarity or otherwise between public and private risk management options, and the potential role for the government in strengthening or facilitating the development of private measures.

2 Nature of Agricultural Production Risk

In this section, the major production activities in New Zealand agriculture relative to the pastoral, arable and horticultural sectors will be examined, along with the incidence of risk in the form of drought or moisture stress, floods/inundation as well as pest and disease outbreaks on both

crops and livestock. The extent of production variability, on a per animal or per acre basis for livestock and crop enterprises respectively, will be discussed at a national level and contrasted with available information on price variability for the same activities. Correlation and co-variance of production of these activities is also reported and the implications of the results for risk management explored.

In the pastoral sector the activities covered are beef, sheep and dairy production. Both lamb and mutton production are considered in the case of sheep farming. The arable activites included are wheat and barley, while the horticultural enterprises studied are apples and kiwifruit. All the activities are examined at the national level, even though some of them are predominantly regional in nature and majority of production takes place in two or three specific locations such as the Bay of Plenty in the North Island and Nelson region in the South Island in the case of kiwifruit production.

2.1 Production Variability

Aggregate production variability at the national level was studied in a previous effort in relation to beef, dairy, mutton and lamb production in the pastoral sector (SriRamaratnam, 1987). The variability of production at the aggregate level, however, includes those induced mainly by past government policies in relation to prices, such as the supplementary minimum price (SMP) scheme in effect in New Zealand from 1978-1984, in the case of sheep and dairy activities. Besides the price induced variability in aggregate pastoral production reflected through livestock numbers slaughtered, some variability is obviously the effects of productivity increases (Scobie, 1985) in the pastoral sector, often the indirect effect of price itself.

In order to isolate the variability in production arising from climatic factors, which are outside the control of farm operators, from those which are the producer responses to prices and technology, this paper will consider the variability in livestock numbers and animal productivity separately for the pastoral sectors. It will also discuss the variability of yields for wheat and barley in the arable sector, and apples and kiwifruit in the horticultural sector. Another important consideration is to recognise the growth phase of the kiwifruit industry in this analysis, as the study period considered (1975-1986) is during which time almost all the expansion in this new industry took place. Some of the other newly emerging pastoral industries in New Zealand such as deers and goats for both meat and fibre production were not included in the detailed analysis due to the lack of necessary data for a sufficiently long period. Wool production was not considered due to the relative stability of wool yield per animal, where about 90 percent of income variation in the production of wool was found to be the result of price variation (Rastamizadeh, 1985a).

2.1.1 Pastoral Sector

During the study period 1975-86, both the number of beef animals slaughtered and the number of dairy cows in production averaged around 2 million heads, but the variability in beef slaughter measured as the co-efficient of variation (0.103) was more than twice as much as in the case of dairy animals (0.045) (table 1). While the number of beef animals slaughtered had been on the decline since the mid 1970s, the size of the dairy herd in production has risen marginally during the first half of 1980. The corresponding figures for sheep slaughter indicates that while mutton and lamb slaughter has risen considerably during the study period, and exhibit about the same level of variability (0.161), lamb slaughter on the average has been about four times as much as adult sheep slaughter (table 1). The significantly higher level of variability in sheep slaughter over beef slaughter, even though along opposite trends, and the size of dairy cow herd is generally the reflection of government policy measures in effect during the study period, which favoured sheepmeat production.

The nature of pastoral production variability of greater interest from the point of view of climatic effects, however, is that related to the level of animal productivity. In table 1, the average productivity levels for the pastoral activities under consideration are reported along with the variability measured in terms of the co-efficient of variation of per animal production levels. Results show that while beef and lamb productivity exhibit similar levels of variability at around 0.025, beef productivity has risen considerably during the study period and lamb productivity declined somewhat. Mutton production, on the other hand, has been slightly more variable (0.037), but with less trend effects. Dairy production was considerably more variable with a co-efficient of variation of 0.062, which is more than twice as the level of variation in both beef and lamb production. This is a general affirmation of the common knowledge that dairy production is much more sensitive to climatic effects than is meat production.

2.1.2 Arable Sector

Aggregate production and acreage variability for wheat and barley in the arable sector along with per hectare yield variability is reported in table 2, for the study period 1975-86. As with livestock numbers in the pastoral sector, the variability in aggregate production and more particularly area variability in the arable industries is generally the result of price induced effects arising from government policy measures as well as world market movements to a lesser extent. It appears that aggregate barley production has exhibited much greater variability than wheat production at the aggregate level during the study period with co-efficients of variation of 53 and 9 respectively. But area variability appears to have accounted for most of this difference with barley area (8.0) about four times as variable as wheat area (2.2). Even yield variability for barley (0.075) was greater than for wheat (0.042), and compares with the co-efficients of variation of 0.062 for dairy and 0.037 for mutton productivity among the

pastoral industries (table 1).

2.1.3 Horticultural Sector

In table 3, aggregate production, acreage, yield as well as real price variability is reported for the two main industries in the New Zealand horticultural sector. Both apples and kiwifruit exhibit a very high level of production, and area variability in comparison to the arable industries, wheat and barley, which is evidently the result of significant expansion in these horticultural exterprises in recent years, particularly the kiwifruit industry. Yield variability, however, was substantially greater in the case of apples (0.66) than for kiwifruit (0.24) with both crops being quite highly variable in contrast to dairy (0.062) and beef (0.025) among the pastoral industry extremes (table 1) and also wheat (0.042) and barley (0.075) in the arable sector (table 2). The complexity arising from the age composition of orchards, at different level of maturity and fruit bearing potential, during the growth phase of these horticultural ventures nevertheless is likely to be a contributing factor for this significant difference in variability. Variability in real prices, however, was found to be significantly higher for kiwifruit (191) than for apples (3.9).

2.2 Correlation and Co-variances of Production

An assessment of the extent of production variability on a per hectare yield basis in the case of cropping activities, and on a per animal productivity basis in the case of livestock enterprises is essential to evaluate the nature of production risk inherent in the agricultural industries most prevalent in New Zealand. Of equal, if not greater, significance from a risk management point of view is an investigation of the extent of correlation and co-variance among these agricultural activities usually carried out in combination under a range of farming systems practiced in New Zealand. The importance of such analysis for evaluating the effectiveness of measures to handle production risk, namely diversification and insurance, has been well recognised (Hazell et al, 1986b).

2.2.1 Pastoral Sector

The correlation co-efficients between the livestock slaughter numbers of the different pastoral industries reported in table 4 suggest that number of beef slaughtered was negatively correlated with both mutton (-0.396) and lamb (-0.637) slaughter as well as the dairy cow herd size (-0.565). Lamb slaughter numbers, however, was positively correlated with both the number of mutton slaughtered (0.789) and the size of dairy cow population (0.707), and so was mutton slaughter numbers and the size of dairy herd (0.256), but to a much lesser degree.

As noted before, the strong negative correlation between beef and lamb slaughter numbers during the study period is the result of the government policies in effect which tended to favour sheep production in relation to beef production. High positive correlation between lamb and mutton

slaughter again reflects the expansion in sheep numbers during this period, while the relationship to the size of the dairy cow herd is not very clear.

Of greater interest for risk management, however, is the nature of correlation between animal productivity among the different pastoral industries, which is also reported in table 4. This correlation was found to be positive in all cases, and quite high between beef and dairy (0.895). It was also substantial in the case of mutton and lamb (0.437) as well as lamb and dairy (0.309). It was however, quite low in the beef and mutton combination (0.100), but somewhat higher between beef and lamb (0.242), and also mutton and dairy (0.221). Positive correlation observed between productivity levels of all the pastoral industries is the result of widespread impact of weather conditions on both pasture growth as well as livestock performance.

For effective enterprise diversification combinations, however, strong negative correlation is ideally required. This is also true for setting up insurance pools of producers which will be self-sustainable and ensure the maintenance of sufficient reserve funds. The implications of this empirical relationship for the prospects for managing production risk within the pastoral industry therefore, is not very promising, and will be discussed in detail in a subsequent section.

A related matter is the nature of correlation between the number of livestock slaughtered and the level of animal productivity within and among the different pastoral industries. As to be anticipated, this correlation within individual industries was negative in the case of beef (-0.577), mutton (-0.625), and also lamb (-0.296) but to a lesser degree, due to the additional demand on available pasture under higher stocking rates in the short run. In contrast, productivity in the dairy industry appear to be positively correlated (0.512) with the number of dairy cows in production.

Between the different industries the cross correlations which were significant were those between lamb slaughter numbers and mutton productivity (-0.527) as well as adult sheep slaughtered and lamb productivity (-0.485), both negative for reasons discussed above. But interestingly, beef numbers slaughtered were positively correlated to both mutton (0.274) and lamb (0.089) productivity levels. This was true in the reverse case as well, where the correlations of beef productivity to adult sheep and lamb numbers slaughtered were 0.182 and 0.545, respectively. This latter finding along with the low correlation between beef, mutton, and lamb productivity discussed before, indicates the preferred complementary nature of the beef sheep combination among the enterprise mixtures available within the pastoral sector.

2.2.2 Arable Sector

In table 2, correlation of aggregate production, area, and yields is also reported within and between the arable industries wheat and barley, in addition to production variability discussed in section 2.1.2. While aggregate production of wheat and barley was correlated at a low level of

0.20, yields were highly correlated at 0.90, and area negatively correlated (-0.25) due to the substitutable nature of these two arable crops in cultivation. But high yield correlation between wheat and barley, much higher than most pastoral industry combinations besides beef and dairy (0.895), is evidently the result of direct effects of climatic factors on crop growth vis a vis their effects on animal productivity indirectly through pasture growth.

Considering the correlation of aggregate production, area and yields within the individual arable industries, wheat production and area was found to be highly correlated (0.83) and so was barley production and area (0.95). Wheat production and wheat yields were not highly correlated (0.31), but barley production and barley yields were (0.71). While wheat area and wheat yields were negatively correlated (-0.26), barley area and barley yields were positively correlated (0.49) during the study period, suggesting different nature of trade-offs between area and productivity for these two arable crops.

2.2.3 Horticultural Sector

Table 3 also reports the results on aggregate production, area, and yield correlation for the two horticultural industries apples and kiwifruit, along with production, area, and yield variability covered in section 2.1.3. Aggregate production of apples and kiwifruit was highly correlated (0.962), and so was apple and kiwifruit area (0.922), but the yields of apples and kiwifruit were not highly correlated (0.185). This is in contrast to a negative correlation between wheat and barley area (-0.25), and a high positive correlation between wheat and barley yields (0.90) discussed in the previous section. The differing nature of the major growing regions for the horticultural crops, apples (Hawkes Bay) and kiwifruit (Bay of Plenty), as opposed to the arable crops, wheat and barley (Canterbury), explains this empirical observation to some degree. Apple and kiwifruit prices, on the other hand, were high correlated (0.861), and while the correlation between yields and prices was positive and high for apples (0.811), it was negative and low in the case of kiwifruit (-0.119).

3 Risk Management Methods and Their Effectiveness

Measures available for New Zealand agricultural producers for risk management and income stabilisation have been reviewed in the recent past by Dent and Beck (1983) and Rostamizadeh (1985b). These included measures to handle production, financial, and market risk as well as those which are provided through government programmes or by means of private management methods. The focus of this paper, however, is on those risk management methods which are directed towards overcoming the effects of production variability mainly through private options. Some aspects of market risk as they relate to production risk along with the role for public policy to initiate or motivate private measures will nevertheless be discussed.

3.1 Risk Management Measures

Commonly recognised private strategies of production risk management are enterprise selection and diversification, organisational flexibility, irrigation, chemical pest and disease control, conservative selection of enterprises and rotations with low costs or low variability, as well as the use of excessive levels of inputs considered to be risk reducing. Another important means of coping with production risk is through participation in insurance schemes, if available. A distinction was made by Dent and Beck (1983) between implicit (or non-formal) and explicit (or formal) risk planning to handle production risk in New Zealand agriculture. It was suggested that more formal risk planning considered to be lacking was needed to rationalise more effectively the risks perceived by farmers in relation to their goals in farming.

The income stabilisation schemes covered (Rastamizadeh, 1985b) included Voluntary schemes, such as the Farm Income Equalisation (deposit) schemes (IES), Statutory schemes, such as the wool, dairy and meat industry income stabilisation arrangements as well as Government operated schemes covering output subsidies such as SMP's, input (e.g. fertiliser) subsidies, and export incentives. These stabilisation measures have been differentiated into those which are termed 'mixed' schemes, which provide a means of securing taxpayer subsidy in general, and those which are 'pure' stabilisation schemes, where the government's role in assisting farmers and others to handle the risk involved in agriculture is viewed to be justified (Rostamizadeh and Bushnell, 1984).

While the voluntary IES scheme, which is still available, is considered to be a 'pure' stabilisation scheme, the statutory schemes and SMP's are clasified as 'mixed' schemes. The Government operated output and input subsidies as well as export incentives, however, have been phased out since 1984, and the Statutory schemes operated by the different Producer Boards do not enjoy some of the special privileges anymore (Bushnell and Durbin, 1986). It has been argued that proposals for stabilisation interventions should be evaluated solely in terms of the efficiency with which they contribute towards risk management.

Another form of government assistance available for New Zealand producers provides relief from the effects of adverse events such as droughts, floods, hail, and storms (Dickinson and Sandrey, 1986). These are generally provided on an adhoc basis, based on the occurrence of the catastrophic events on a regional basis, without any requirement for farmer participation or payment to the relief fund. The continued availability of such relief measures have important implications on the development of private participatory insurance schemes in New Zealand, and will be discussed in a subsequent section.

3.2 Effectiveness of Measures

The economic feasibility and the effectiveness of private production risk management methods identified in the previous section have to be evaluated in relation to the nature of production risk discussed in an earlier section, with respect to the extent of variability and correlation of production among the different pastoral, arable, and horticultural industries. While detailed regional and farm level time series data on crop and livestock production is required to study the extent of production risk and the potential for specific risk management strategies, aggregate data at the national level used in this study does provide an indication of the nature of risk by sectors and industries and the relationships among them.

Other factors which also require attention in this evaluation are the risk attitudes of producers involved in the different agricultural activities, the costs and benefits of implementation of the different measures at the national or regional level, the relationship between available public and private initiatives of risk management, the consideration of different suitable combinations of private options as a package of on-farm risk management rather than being viewed always as alternatives to be selected from, and finally the role of government in facilitating the development or strengthening of already available private measures.

3.2.1 Enterprise Selection and Diversification

The variability of yields and animal productivity differs among enterprises (tables 1-3) as well as regions, an aspect not addressed in this study. The risk averse farmers might select a more stable region if they had a choice, and also enterprises in order to reduce production as well as income variability. But risk reduction is only one of several factors affecting enterprise selection. Among the pastoral industries of New Zealand, dairy production was found to exhibit greater yield variability (co-efficient of variation of 0.062) than both beef and lamb production (co-efficient of variation of 0.025), during the study period on the basis of animal productivity (table 1). Barley yields (0.075), on the other hand, was more variable than wheat yields (0.042) in the case of arable crops (table 2), and apple yields (0.66) more variable than kiwifruit yields (0.24) among the horticultural industries (table 3) considered.

Another strategy involved in enterprise selection is diversification. Diversification of activities within a farming enterprise can significantly reduce the riskiness of the operation as a whole, since prices and yields for different activities are not perfectly correlated. Although the greatest reduction in total variability occurs if this correlation co-efficient, which can vary between plus and minus one, is negative, some reduction of risk will generally occur from diversification unless enterprise yields are nearly perfectly correlated (Sonka and Patrick, 1984). Generally, risk is further reduced by diversification as the correlation between enterprises takes on lower values. Adding more such enterprises would commonly further reduce risk, but the marginal risk

reduction becomes smaller as the number of enterprises increases.

Among the New Zealand pastoral industries, the correlation of animal productivity was found to be positive in all cases considered (table 4), even though it was quite high only between beef and dairy enterprises (0.895). The correlation co-efficient between mutton and lamb, as well as lamb and dairy also was fairly substantial, while beef and lamb, and mutton and dairy were correlated somewhat less. The beef and mutton combination, however, was found to exhibit very little correlation (0.100), low enough to be negligible, and suggests the significant advantage of this farming system which is fairly prevalent in various parts of New Zealand for managing production risk.

In the case of arable industries, wheat and barley yields were highly correlated (0.90) as a result of the widespread direct effects of climatic factors on crop growth for crops usually grown in the same region. Thus the scope for diversification between these two crops in the arable sector is obviously very limited for managing production variability. It has also been found that almost all income variation in the wheat industry during the 1956-83 period was production oriented (Rostamizadeh, 1985a), which was probably true for barley as well. Changes in the wheat industry following the abolition of the Wheat Board in 1985, and associated with it the price stabilisation schemes operated by the Board would, however, have changed this relationship to some extent.

In Australia, fluctuations in the output of cereal crops has been found to account for most of the variation in the gross value of cereal production (IAC, 1986). Their analysis also showed that changes in yields have been relatively important in explaining fluctuations in cereal crops output volume. Furthermore, crop yields between regions in each state and between states in Australia were highly correlated, except for Western Australia. Gross value of production for cereal crops have also been most variable, with export oriented livestock products such as wool and cattle somewhat less variable, and the domestic oriented livestock products (e.g., lamb) and fruits, grapes, and vegetables exhibiting least production variability. Price instability has been the dominant influence on gross income variability for wool as well as milk products (IAC, 1986). In New Zealand 90 percent of income variation in wool production was found to be price related, while 70 percent and 85 percent of income variation in lamb and beef activities respectively, was reported to be production oriented (Rostamizadeh, 1985a). This analysis, however, was undertaken for the 1960-1984 period, which includes the years in which (1978-84) the supplementary minimum price (SMP) scheme was in operation for most pastoral products, along with some other statutory stabilisation schemes.

For the horticultural sector, the level of correlation of yields between apples and kiwifruit was quite low (0.185), while prices were highly correlated (0.861). There was also much greater variability of yields for apples, and relatively higher real price variability for kiwifruit during the study period. While yields and prices were positively correlated (0.811) in the case of apples, they were negatively correlated for

kiwifruit (-0.119). These results are quite interesting from the viewpoint of the prospects for risk management through enterprise diversification. While low yield correlation implies successful diversification possibilities between apples and kiwifruit, the high price correlation observed appear to offset some of this advantage. There is also some indication that kiwifruit may be preferred to apples for production risk management due to its lower yield variability and because kiwifruit yields and prices were negatively correlated. Higher real prices variability for kiwifruit is to some extent the result of declining price in recent years while being transformed from a specialty fruit to a common table fruit in the major consuming nations.

Opportunities for enterprise diversification, however, are often limited by resources, climatic conditions as well as market outlets. Relatively high positive correlations among enterprise returns in local areas may also diminish the gains in risk efficiency from diversification (Sonka and Patrick, 1984). It has also been pointed out that adding a relatively risky activity into a farming enterprise may not increase overall risk, if the risky addition is on a small scale (McArthur, 1970). Dent and Beck (1983) observed that small risky activities such as deer farming or intensive horticulture can be included in larger, traditional mixed cropping and grazing (pastoral) enterprises. A problem with diversification, however, is that the farmer may miss out on possible economies of scale from specialisation. A possible solution to combine the advantages of diversification and specialisation is through syndication (Bartholomaeus and Hardaker, 1981). A good example of an organisation in New Zealand capable of combining these advantages is the Land Corporation.

3.2.2 Flexibility in Farming

Another important risk reducing strategy available to farmers is to maintain a high degree of flexibility in the farming operation (organisational and operational flexibility), in order to respond quickly to changes in both seasonal climatic conditions, including adverse climatic events (Ritchie, 1982), as well as market signals. Those strategies available for New Zealand producers have been discussed extensively as both short-term and longterm flexibility measures (Dent and Beck, 1983) and also as year to year and within year strategies (Ritchie, 1982).

Some of the year to year strategies identified in sheep farming are changes in stocking rates, early lambing, flexible stock system, advance contracts for additional feed supply, and higher crop and animal husbandry levels. Within year strategies include grazing management, changes to feeding and feed conservation policy, oversowing of pastures as well as additional use of fertilisers. Flexibility allows the farmer to use short-term measures to moderate the effects of adverse conditions and to exploit opportunities to profitable production both in the short-term and in the longterm. Even though these strategies when executed are effective as temporary contingent measures, they involve a significant opportunity cost and loss of efficiency as well.

3.2.3 Irrigation

Irrigation can remove a large proportion of the production variability in arable, horticultural as well as pastoral farming. However, unlike other strategies, substantial capital investment and financing is required. It also involves a specialised farming practice requiring considerable managerial skills and experience. Due to these capital and managerial requirements, irrigation requires careful analysis as a risk response (Sonka and Patrick, 1984).

Effects of irrigation on pasture and animal production have been studied extensively in New Zealand, and the benefits of irrigation in ensuring a more reliable supply of late spring, summer and early autumn feed well recognised (Ritchie, 1982). The estimates of irrigable land in New Zealand varies, but of about 500,000 hectares of such land mainly in the South Island, about 50 percent or 245,000 hectares are reported to be irrigated at present (Ministry of Works and Development, 1986).

The profitability of irrigation for pastoral farming (165,000 hectares irrigated) has been estimated to be good with an internal rate of return of about 10 percent, and the variation in pasture production under relatively frequent irrigation reported to be about 10-14 percent compared to 48 percent under no irrigation (Ritchie, 1982). Since 1984, however, irrigation and water supply subsidies have been reduced and the application of water charges on a user pays principle is likely to further reduce the prospects of irrigation as a feasible risk management option in the future.

3.2.4 Insurance of Crops and Livestock

The risk management measures considered so far for managing production variability have scope for providing adequate relief for some New Zealand producers, based on the description of the nature of production risk faced by certain industries and farming systems, such as the beef/sheep combination. Nevertheless, for most others production variability is likely to continue as a major source of income variability, even after the recent changes in government policy related to price and income stabilisation schemes discussed before. While low and variable prices for New Zealand products are likely to be of concern for farmers in the new policy environment, the characteristics of production variability and correlation outlined in this paper for the important agricultural industries suggest that, for most of them, the available management options are likely to be either ineffective or infeasible as viable alternatives.

Agricultural insurance is an important means of managing production risk in several countries around the world. In countries such as Australia and New Zealand, comprehensive insurance schemes have not evolved either through public provision or through private insurance markets. It is, however, an issue debated to some extent, and the subject of several studies (Quiggin and Anderson, 1979; Bardsley et al, 1984; IAC, 1986; Dickinson and Sandrey, 1986).

There is of course some insurance coverage for certain agricultural activities against specific sources of production risk such as hail, either on a state wide basis as in Australia, or through statutory arrangements. In New Zealand, industry wide insurance schemes currently available for wheat through United Wheatgrowers NZ Ltd, and the Apple and Pear Boards' Hail Programme are mandatory insurance schemes, and have been in operation for a few years.

Under a Voluntary insurance scheme, insurance purchase is an individual decision, who when faced with an uncertain loss has to consider the actual loss itself as well as the cost of risk bearing. For financially viable and effective insurance schemes, the conditions required impact through the factors determining the demand for and the supply of insurance (Bardsley et al, 1984). The correlation between the returns from insurance and the income stream of insured producers should be sufficiently high to ensure adequate participation in insurance schemes. The size and nature of the insurance pool is another factor determining the financial viability and liquidity of the insurance fund. While the pool has to be large for maximising the gains from risk bearing, it should also consist of insureds whose risks are similar but not highly correlated. The insurance schemes in New Zealand, while having ensured a sufficiently large insurance pool due to their mandatory nature are, however, at a disadvantage due to the high correlation of risks faced by farmers involved in the same production activity and usually in the same region. Ideally, the insurance pool should spread the risk over space, among different enterprises and sectors in the different regions, as well as over time. This is therefore, possible only through comprehensive insurance schemes.

Another important consideration for the successful operation of insurance schemes is the ability for minimising the problems related to adverse selection and moral hazard. Both of them are issues related to the information needs of establishing insurance schemes, and result in high administrative costs. While adverse selection adds to the information costs of formulating an appropriate insurance contract, with the complete knowledge of the risk characteristics of the insured, moral hazard adds to the cost of enforcing the contract, due to the need to monitor the actions of the insured (IAC, 1978).

An issue that requires critical evaluation in this context is the potential role for the government in both adverse events relief (Dickinson and Sandrey, 1986) as well as insurance schemes such as crop and rainfall insurance (IAC, 1986). The theoretical arguments relevant in evaluating the role of governments in providing natural disaster relief on a cost free basis to the producers are somewhat different from those made in relation to the provision of participatory insurance schemes. The public good, externality and transaction costs arguments are used to rationalise the public provision of adverse event relief measures, while market failure, incapability of private capital markets to spread risks and provide liquidity, as well as high administrative and operative costs for the private insurer have been cited as reasons for the government to play a role in the insurance market. In assessing the relative merits of adverse

events relief measures to proposed insurance schemes from both efficiency and equity points of view, most studies have come out in favour of a participatory insurance scheme.

It has been argued that insurance introduces a concept of market signal as well as a principle of self help (IAC, 1986). There is also evidence that past public policy in relation to adverse events relief has led to the expectations of future assistance, altered the private response to risk management, and also hindered the development of insurance markets (Dickinson and Sandrey, 1986). Even the partial subsidisation of insurance schemes by governments to enhance participation has therefore, been considered by these studies preferable to the continuation of adverse events relief. A recent study, however, suggests that information collection and the application of contract design principles may achieve the benefits of insurance at less cost than through public subsidies (Nelson and Loehman, 1987).

But the recommendation of the study in Australia was not in favour of government assistance to insurance schemes for reasons such as, practical problems in administering the comprehensive scheme on a nationwide basis, uncertainty about participation levels even under a subsidised scheme, no clear evidence of impediments to the evolution of private schemes, and no apparent benefits to the community at large (IAC, 1986). The findings of the study in New Zealand was that, eventhough insurance schemes may need some government involvement to be accepted by producers and subsidisation may be a least-cost solution to the problem of adverse events, a private solution has to be encouraged (Dickinson and Sandrey, 1986). But one way of minimising the efficiency costs of ad-hoc measures was to put in a tightly prescribed insurance scheme (Bushnell and Durbin, 1986).

The method of participation and the extent of coverage of natural hazards in insurance schemes is therefore, an important consideration and will determine their success. While many overseas programmes are available on a voluntary basis, those in New Zealand are compulsory and have the advantages of full participation, lower administrative costs and minimal adverse selection except for that introduced by the compulsory nature which requires known high risk producers also to be insured at the same premium level. This results in cross subsidisation between high and low risk farmers as well as the inability to provide a varied insurance coverage.

The basis for traditional livestock insurance is to ensure the financial success of livestock operations by mitigating the factors outside the control of operators which affect animal health and mortality (Kasten, 1986). Insurance schemes covering factors influencing the availability of pasture and/or forage, and thus fluctuations in animal productivity discussed in this paper, are not currently available in most countries, including those which have operated conventional crop insurance schemes for several years. An exception is Canada, where forage crop insurance is being operated on a trial basis and are based on weather based crop growth models.

4 Summary and Conclusions

The nature of production risk among major agricultraul industries in New Zealand was evaluated in this paper and the effectiveness of both available and potential risk management measures was considered. The extent of production variability among the pastoral industries was lower than among the arable and also the horticultural enterprises studied. But dairy production was an exception and exhibited considerable variability. Barley yields were much more variable than wheat, while apple production was found to be much more riskier than the arable crops. Among the pastoral industries, with the exception of beef and sheep (both lamb and mutton) productivity levels, other enterprises were fairly highly correlated. The correlation between beef and dairy production in particular was quite high. While wheat and barley yields were also very highly correlated, apple and kiwifruit yields were not.

Since the effects of weather on both crop and animal productivity usually results in similar consequences as far as the variations in production is concerned, the high correlations observed were to be expected. Thus the prospects for successful diversification ventures, especially within the sectors, appear to be limited with the exception of the beef and sheep farming system. Moreover, for many industries in New Zealand agriculture (e.g. beef, sheep, wheat), production variation has accounted for more than 70 percent of income variation in the past, and this is likely to remain quite high eventhough some of the price stabilisation schemes have been discontinued. Private initiatives on the part of farmers have become more important for handling both production and price variability in the new policy regime in New Zealand. The availability of some ad-hoc government measures such as adverse events relief, however, has been partly responsible for the lack of interest in and the development of participatory schemes, such as insurance as well as the futures market for many New Zealand agricultural commodities.

The insurance schemes currently available in New Zealand for wheat and apples as well as pears do not cover most risks faced by the producers. They also require participation to be compulsory and operate on a mutual insurance basis rather than on a reserve basis. The ability to pool the risks across different enterprises, however, has been constrained due to their commodity orientation and the statutory organisation. There is currently no insurance coverage available for livestock enterprises against fluctuations in pasture and forage availability, due to the effects of weather. Some irrigation of pasture mainly in the South Island, and the practice of flexibility in farming operations which is quite prevalent throughout, provides some relief, but is undertaken at a high investment and opportunity cost respectively. It is therefore, necessary to monitor the nature of production risk also at the regional as well as farm level and in relation to the available private risk management options. In addition, the potential role for the government in facilitating the development of new options for handling both production and market risk also requires continuous assessment. Concerns with market and exchange rate risks at the present time, while justified, cannot diminish the problems associated with production variability.

REFERENCES

Bardsley, P., Abey, A., and Davenport, S. (1984), "The Economics of Insuring Crops Against Drought", Australian Journal of Agricultural Economics 28(1), 1-14.

Barry, P.J. (1984), Risk Management in Agriculture. Iowa State University Press, Ames, Iowa.

Bushnell, P.G., and Durbin, S.I. (1986), "Farming in Transition: Implications for Risk Management", paper presented at the Agricultural Insurance Seminar organised by the Munich Reinsurance Company, Wellington, November 1986.

Bartholomaeus, M.K., and Hardaker, J.B. (1981), "Farm Synidcation and Risk Sharing: A Case Study". Australian Journal of Agricultural Economics 25(3), 233-247.

Dent, J.B., and Beck, A.C. (1983). "Risk Planning For Farmers". The Agricultural Economist 4(2), 22-26.

Dickinson, T.E., and Sandrey, R.A. (1986), "Government's Role in Adverse Events Assistance". AERU-Lincoln College Discussion Paper No. 102.

Hazell, P.B.R., Pomareda, C., and Valdes, A. (1986), "Introduction", Chapter 1 in Crop Insurance for Agricultural Development - Issues and Experience The Johns Hopkins University Press, Baltimore, Maryland.

Hazell, P.B.R., Bassoco, L.M., and Arcia, G. (1986), "A Model for Evaluating Farmers' Demand for Insurance: Applications in Mexico and Panama". Chapter 3 in Crop Insurance for Agricultural Development - Issues and Experience The Johns Hopkins University Press, Baltimore, Maryland.

Industries Assistance Commission (1978), Rural Income Fluctuations Report No. 161, Australian Government Publishing Service, Canberra.

Industries Assistance Commission (1986), Crop and Rainfall Insurance Report No. 393, Australian Government Publishing Service, Canberra.

Kasten, E. (1986), "Underwriting and Claims Management in Livestock Insurance", paper presented at the Agricultural Insurance Seminar organised by the Munich Reinsurance Company, Wellington, November 1986.

McArthur, A.T.G. (1970), "Influence of Diversification on Risk in Mixed Cropping", NZ Agricultural Science, July 1970.

Ministry of Works and Development (1986), Informtion on New Zealand Irrigated Areas, Wellington.

Nelson, C.H., and Loehman, E.L. (1987), "Further Toward a Theory of Agricultural Insurance", American Journal of Agricultural Economics 69(3), 523-531.

Quiggin, J., and Anderson, J.R. (1979), "Stabilisation and Risk Reduction in Australian Agriculture", Australian Journal of Agricultural Economics 23(3), 191-206.

Ritchie, I.J. (1982), "Combatting the Risks of Drought and Floods", paper presented at the Australian Agricultural Economics Society - NZ Branch Conference, Dunedin.

Rostamizadeh, A. (1985a), "Decomposition of Gross Income Variation for New Zealand Wool, Lamb, Beef, and Wheat", MAF Discussion Paper 4/85, Wellington.

Rostamizadeh, A. (1985b), "Strategies for Risk Management in New Zealand Agriculture", MAF Discussion Paper 3/83, Wellington.

Scobie, G.M. (1985), "On Closing the Technological Frontier", paper presented at the Australian Agricultural Economics Society - NZ Branch Conference, Picton.

Sonka, S.T., and Patrick, G.F. (1984), "Risk Management and Decision Making in Agricultural Firms", Chapter 8 in Risk Management in Agriculture Barry, P.J., (Ed), Iowa State University Press, Ames, Iowa.

SirRamaratnam, S. (1987), "Feasibility of Insurance as a Risk Management Option in New Zealand Agriculture", paper presented at the Australian Agricultural Economics Society - NZ Branch Conference, Blenheim.

Table 1: Variability of Livestock numbers and animal productivity in the pastoral sector: 1975-86

	Livestock (slaughter) Numbers (000's) [1]				Animal productivity (k.g.) [2]			
	Beef	Mutton	Lamb	Dairy	Beef	Mutton	Lamb	Dairy
Mean:	2,131	8,075	30,642	2,070	231.77	22.02	13.30	142.71
Co-efficient of Variation:	0.103	0.161	0.162	0.045	0.025	0.037	0.027	0.062
Range:								
Low (Year)	1,771 (1984)	6,592 (1976)	25,428 (1975)	1,976 (1981)	221.67 (1978)	20.71 (1978)	12.53 (1985)	124.26 (1978)
High (Year)	2,573 (1976)	10,740 (1985)	39,961 (1985)	2,252 (1986)	239.04 (1986)	22.59 (1980)	13.77 (1976)	155.42 (1986)

Source: New Zealand Department of Statistics, Information Network for Official Statistics (INFOS).

1 Livestock numbers in the case of Dairy refer to cows in production.

2 Animal productivity in the case of Dairy refers to butter fat production per cow in Milk; whereas for others it is Carcass Weight per animal.

Table 2: Production Variability and Correlation Levels among Arable Industries: Wheat & Barley (1975-86)

	Wheat			Barley		
	PRODN '000' (Tonnes)	AREA '000' (Hectares)	YIELDS (T/Ha)	PRODN '000' (Tonnes)	AREA '000' (Hectares)	YIELDS (T/Ha)
Industry Mean:	315.5	89.6	3.86	359.2	93.6	3.78
Industry Coefficient of Variation:	8.6	2.2	0.042	53.2	7.8	0.075
Rank Correlation Coefficients[1]						
Wheat:						
PRODN		0.83	0.31	0.20	0.08	0.47
AREA		-	-0.26	-0.21	-0.25	-0.02
YIELDS			-	0.74	0.57	0.90
Barley:						
PRODN				-	0.95	0.71
AREA					-	0.49
YIELDS						-

Source : New Zealand Department of Statistics

1 Only within period correlations were investigated and not intertemporal correlations, as the relationship between the effects of climate on production for the two arable industries in a year, was the focus and not the cause and effect relationships between climate, price, technology etc and production variability.

Table 4: Correlation of Livestock numbers and animal productivity in the Pastoral Sector: 1975-86

	Livestock (slaughter) Numbers				Animal productivity			
	Beef	Mutton	Lamb	Dairy[1]	Beef	Mutton	Lamb	Dairy[2]
	(Rank Correlation Coefficients)							
Numbers:								
Beef	-	-0.396	-0.037	-0.565	-0.577	0.274	0.089	-0.469
Mutton		-	0.789	0.256	0.182	-0.625	-0.485	0.050
Lamb			-	0.707	0.545	-0.527	-0.296	0.454
Dairy				-	0.511	-0.231	-0.272	0.512
Productivity:								
Beef					-	0.100	0.242	0.895
Mutton						-	0.437	0.221
Lamb							-	0.309
Dairy								-

1 Livestock numbers in the case of Dairy refers to cows in production.

2 Animal productivity in the case of Dairy refers to butter fat production per cow in milk; for others it is carcass weight per animal.

Table 4: Production Variability and Correlation Levels among Horticultural Industries: Apple & Kiwi Fruit (1975-86)

	Apple				Kiwifruit			
	PRODN (Tonnes)	AREA (Hectares)	YIELDS (T/Ha)	REAL PRICES (83$/T)	PRODN (Tonnes)	AREA (Hectares)	YIELDS (T/Ha)	REAL PRICES (83$/T)
Industry Mean:	218,742	6128	35.24	239	34,096	8068	4.22	2813
Industry Coefficient of Variation:	13,826	96	0.66	2.39	31,945	4952	0.24	98
			Rank Correlation Coefficients[1]					
APPLE:								
PRODN		0.033	0.939	0.953	0.962	0.948	0.183	0.792
AREA		-	0.760	0.980	0.922	0.982	0.053	0.787
YIELDS			-	0.811	0.853	0.810	0.185	0.724
PRICES				-	0.932	0.969	0.064	0.861
KIWIFRUIT:								
PRODN					-	0.916	0.378	0.723
AREA						-	0.002	0.794
YIELDS							-	-0.119
PRICES								-

Source: New Zealand Department of Statistics

1 Only within period correlations were investigated and not intertemporal correlations, as the relationship between the effects of climate on production for the two horticultural industries in a year, was the focus and not the cause and effect relationships between climate, price, technology etc and production variability.

Table 5: Covariance of Livestock numbers and animal productivity in the Pastoral Sector: 1975-86

	Livestock (slaughter) Numbers				Animal productivity			
	Beef	Mutton	Lamb	Dairy[1]	Beef	Mutton	Lamb	Dairy[2]
Numbers:								
Beef	48,377	-113,106	-697,355	-11,623	-731	50	7	-906
Mutton		1,683,706	5,096,821	31,085	1361	-665	-228	572
Lamb			24,776,668	328,868	15,646	-2156	-533	19,838
Dairy				8,741	275	-18	-9	421
Productivity:								
Beef					33.2	0.48	0.51	45.3
Mutton						0.6	0.13	1.6
Lamb							0.13	0.98
Dairy								77.2

1 Livestock numbers in the case of Dairy refers to cows in production.

2 Animal productivity in the case of Dairy refers to butter fat production per cow in milk; for others it is carcass weight per animal.