GOVERNMENT'S ROLE IN

ADVERSE EVENTS ASSISTANCE

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PREFACE

Primary sector production is characterised by the limited extent of production control possible. The major factor limiting the control of production is climate. Management of an agricultural or horticultural production system involves the manipulation of resources within a given climatic environment; this factor has the potential to drastically alter the outcome of management decisions.

This paper addresses the question of the impact of adverse climatic events, the role of farmer management in handling such events, the possibilities for private sector insurance schemes and the potential impact of government intervention in the supply of risk reducing systems. Given the historical New Zealand demand for government relief measures on a seemingly annual basis as a result of climatic fluctuations, this paper presents a review of the likely impact of such relief measures and suggests that there may be better ways to handle such events.

All business activities take place within an environment involving risk. Business management includes the management of risk; the effect of government in modifying the risk management systems needs to be carefully considered.

R.G. Lattimore,
DIRECTOR.

SUMMARY

Despite the many factors that contribute to the annual variations in agricultural production, climatic fluctuations explain much of the variability. Although these fluctuations include flood, snow, hail and wind damages, the report concentrates on drought. Given that droughts occur with varying frequency to many parts of the country, the important question from an efficiency perspective is how to ameliorate the cost of these droughts. We are not concerned with measuring the "cost" of drought by making comparisons with a perfect world - that is the so-called nirvana fallacy. We are concerned with finding a least-cost solution to the whole issue of adverse events.

Historically, one of the justifications for government involvement has been that adverse events relief is a so-called "public good" which cannot be accommodated within the private sector. Externalities are said to exist when costs of an action are borne by persons other than those able to be directly affected by the outcome of that action, and it is considered that an externality exists because people other than farmers are affected by droughts or floods. However, recent literature in welfare economics suggests that the existence of externalities do not necessarily require government action. Does the private sector offer a "better" solution, and, if so, what are the impediments to transferring the role of adverse events relief to the private sector?

Government has provided grants and subsidies to mitigate the effects of both droughts and floods in recent years. These schemes, as well as other government policies, are shown to alter the private solution to adverse events. Farmers alter management strategies if it is considered that ad hoc drought relief packages will be available from government. Irrigation is not considered to present an economically viable option for drought risk management, as the costs of "premiums" are too high. The futures market has little potential for handling climatic risk, as yield and not price is generally affected by droughts and floods.

The role of insurance schemes is investigated in detail. Among American, Canadian, Australian and New Zealand programs for adverse events insurance, the Canadian forage crop programs, although in the early stage of development, would appear to have most relevance to New Zealand. All the schemes reviewed, however, lack financial viability without government subsidies.

The justification for subsidisation of insurance schemes is that it allows government to withdraw completely from providing solutions on an ad hoc basis and the associated cost involved with these policies. The responsibility passes from a public to a private solution, even though some form of subsidisation would be necessary.

SECTION 1 - INTRODUCTION

Adverse events such as droughts, floods, hail, and storms are a constant problem in countries all over the world. When there is an adverse event, pleas are made to government for direct or indirect assistance. As the New Zealand Government is re-evaluating its role in supporting and stabilising the economy, it is relevant to investigate both efficiency and equity issues involved in government programs concerned with adverse events. It is likely that often the government intervention is undertaken on political grounds rather than economic grounds. Decisions made for political reasons should be clearly identified and not justified as being for economic efficiency or equity.

While snowstorms and floods affect some pastoral areas of New Zealand, emphasis in this paper will be given to the role of government assistance in times of drought. In recent years the area around Hawke's Bay and South Canterbury - North Otago have sustained significant droughts due to an overall shortage of moisture at critical times of the year. The problems for cash crop and horticultural regions are viewed as frost and hail, and to a lesser extent, wind and flood. There have been several programs developed in New Zealand to deal with the specific risks for this type of farming. These programs are discussed later.

In New Zealand, the issue of appropriate mechanisms for ameliorating the effects of climatic events has been the subject of previous inquiries. J.G. Pryde in 1966 investigated the range of existing programs and possibilities. It still remains true that some producers do not fully understand the probability of loss due to adverse events or choose to ignore them with the expectation that the public sector will "bail them out if things go bad."

The purpose of this report is to examine the role of government in adverse events relief in New Zealand, with emphasis given to drought relief. The paper starts with a discussion establishing a definition of drought. This is followed by a review of the theoretical literature relating to collective action and a discussion of the effects of short term adverse events assistance.

Previous policies which have been introduced by government to assist in adverse climatic events are discussed, along with a section on how these public policies may amend private management strategies. This leads to a discussion on the use and usefulness of computer models, including both aggregate and farm level decision models and weather models. Following on from management strategies designed to alleviate the impacts of drought is a major section looking at alternative options, both individual and collective, of reducing the cost of a drought situation.

This section starts with a look at the futures market as a potential vehicle and then concentrates on the issue of risk and insurance. Both the theoretical issues and a review of the literature on existing adverse events insurance schemes are covered. Examples of the current United States, Canada, Australia and New Zealand programs are provided, with limitations and potential applications of these schemes presented.

SECTION 2 - <u>COLLECTIVE ACTION - LOGIC AND REASON</u>

The first issue in evaluating the role of government in adverse events assistance is to examine the theoretical justification for government involvement. This section will review the literature on collective action to set the stage for determining the government's role in providing assistance.

There are at least two broad avenues open for society to modify the performance of an economy. One is to have the government organise public activity to produce the desired product in the most efficient manner. This provision can take the form of the public agency actually supplying the product, or by using subsidies or penalties, it can encourage the private sector to provide the product. The second is to modify private property rights which lie behind market transactions.

It has been agreed in the literature that there is a class of products entitled "public goods" which will only be provided if done so by government. A variety of definitions have been developed as to what constitutes a "public good". The modern view of economists' is that this particular set of goods usually involve the attenuation (reduction) of property rights which means that the benefits of the good cannot be appropriated totally and/or problems of inefficiencies in pricing. It is possible to extend this public good analysis to activities which exhibit decreasing costs to scale.

Goods which are publicly provided could be supplied by the private sector. Traditionally services such as education, resource based recreation, mass transit, and fire and police protection have been viewed as the domain of the public sector, but there have always existed examples of these products being supplied privately. Buchanan and Tullock (1962) developed a logical construct to explain why activities should be in the public sphere. Their system displays a continuum. They allow for action to be taken on the basis of <u>purely private individualistic action</u>, by <u>voluntary private collective bargaining</u> or <u>public sector collective action</u>. "The individual should choose to shift to the public sector all activities in which the cost of collective decision making is less than the cost of voluntary private collective bargaining which is less than the costs resulting from purely individualistic behaviour." The decision rule is predicated on the original assignment of property rights.

The costs of individualistic behaviour are seen by Buchanan and Tullock as "externalities", costs imposed on others by one's action. The classic examples are air, water, and noise pollution. Pigou purported to show that in

the case of a polluting factory, there would arise a divergence between the social optimum rate of output and the private optimum rate. He develops his thesis on the basis that the factory owner need not take into account all of the costs of his action. The result is that other individuals in society bear external costs. Since in his analysis the damaged parties are unable to enter into "contracting", the factory owner produces at the short and long run optimum where SRMC (short run marginal cost) equals LRMC (long run marginal cost) which equals MR (marginal revenue) excluding the costs imposed by his pollution. This deviation is called "social cost."

Cheung (1978) sees Pigou's analysis as merely "muddying the waters" and therefore obstructing useful research into means of achieving optimum resource allocation. He summarises his analysis as follows:

> "The presence of uncontracted effects such as pollution may result in an imbalance, but this is viewed simply as a situation where the marginal cost of an action deviates from its marginal returns, without regard to any divergence between private and social cost."

If "social cost" is not the relevant issue, then what is? The most promising of areas is that of property rights and their assignment. Coase (1960) showed convincingly that external effects need not necessarily lead to resource misallocation. All that is necessary is that trade be able to occur. Under Coase's system there must be no transaction costs and property rights must be well defined and enforceable. Burton (1978) summarises Coase by saying:

> "The Coase analysis knocked the supports from under the Pigovian analysis, and pointed to entirely different implications for public policy. First, where there are no barriers to trade between the producer and the consumer of an externality, government intervention is not called for because a bargaining solution would emerge.
>
> Second, it implied that the real trouble with social cost is not externalities (uncontracted effects) per se, but rather barriers to trade in the form of high transactions costs and attenuations of property rights that prevent a bargaining solution from emerging."

The major problem then as seen by writers such as Chueng, Coase, and Buchanan is that of transaction costs. Transaction costs are those encountered in moving in the Buchanan and Tullock framework from individualistic action to either collective action or voluntary private collective bargaining. These costs include acquiring information,

negotiating the price to be paid, charging for the use of the resource, and excluding 'free riders' from consuming resources they have not provided or paid for.

A special set of problems arise with common property resources, notably, the air and oceans. These resources are the direct opposite of private property. Here access is not restricted but rather open to all. The solution may be to establish a private property solution such as the Individual Transferable Quota System proposed for the inshore fisheries. Again the problem is in the assignment of private property rights and their enforcement.

Excluded from the discussion of pure reasons for collective action are non-market benefits. Non-market benefits are sometimes referred to as intangibles - a set of returns which cannot be directly measured or evaluated in economic terms. They may be assigned a high or an infinite value. The difficulty of accepting such benefits at these values is that political decisions are made which have significant economic consequences. In order to facilitate better decision making, it is necessary to establish reasonable proxies for such values.

A corollary issue is the ability to bear risk. In fact risk bearing is based on a foundation of information and wealth. There are certainly some cases where a product or activity cannot be left to individualistic action, but rather must be dealt with by a private voluntary organisation or by collective action. Again the Buchanan and Tullock criteria is a useful framework. An excellent example would be public action to deal with preventing the introduction of foot and mouth disease. While the probability of an occurence is low, the damage caused would be tremendous and effects would be felt by a substantial portion of the rural and urban population.

In summary, several points bear making. First, the existence of externalities does not necessarily require government action. As Buchanan and Tullock point out, compulsory collective action is only justified when costs are less than those from voluntary private collective bargaining or individual action. Politically, it is often expedient to ignore the high costs involved in government intervention, particularly the distortions in economic signals sent to producers.

Second, the costs of government intervention may exceed the benefits achieved. These costs include transaction costs as well as the costs associated with distortions introduced to the economy if the intervention is not warranted.

Third, governments and politicians generally have an agenda to maximise their own objectives such as power, prestige, and income. Rare are the cases where a

bureaucracy has willingly reduced its power. Regulation tends to be a one way street. Producers, in particular, adjust to an institutional framework and optimise subject to it.

Fourth, no reason exists a *priori* that government commands more knowledge than do individuals. It is in the best interests of the participants in an economic sector to inform themselves so as to maximise their returns.

SECTION 3 — ADVERSE EVENTS — PUBLIC POLICY ISSUES

3.1 THE LOGIC OF ASSISTANCE FOR ADVERSE EVENTS

Here we will not be concerned with long term government intervention, but rather this section will inquire into the effectiveness of temporary assistance. Into this category fall programs to offset the impact of droughts, floods, and other acts of nature. In the recent past such programs have included transportation grants, freight subsidies, concessional loans, and regrassing grants such as for the North Otago and Hakataramea Valley districts.

In the case of adverse events, claims are made that significant costs are imposed. There is no question that to an individual the costs may be dramatic — even catastrophic. Ritchie (1982) reports that in the 1977/78 drought, gross income loss was $21 million. This estimate was derived in the following manner:

	Cost (mill of $)
— 25 million lambs killed for export at .5kg less than 1976/77	$ 8.0
— 1.7 million beef cattle killed at 10kg less than 1976/77	$10.7
— 5 million ewes killed at 2kg less than 1976/77	$ 2.8

In addition the estimate was made that another $29 million of lost income occurred in 1978/79 due to lower lambing percentages and loss of wool production. If an adverse event affected the entire country, this type of analysis might be valid. However, it appears that no recognition is taken of market price responses to supply shifts. The question should be asked whether the income of firms not affected by the event went up. The correct answer is to evaluate the net loss to all firms not simply the gross loss to those affected.

As well as economic effects, the human cost is recounted in the popular press with the onset of every disaster. Anecdotal evidence is given to justify government intervention. Stories are recounted of farmers feeding lines of stock in the burning sun while pastures shrivel, recede and disappear. "These bare paddocks grew nothing but dung." (Little, cited in Ritchie). The June 1985 issue of the New Zealand Journal of Agriculture is replete with articles portraying the plight of the drought stricken farmer. The conclusion seems to be that government must supply the props to provide equity.

Analyses such as the above are examples of the "Nirvana fallacy" (Demsetz, 1969). This fallacy arises when economic reality which includes climatic problems, price instability, and yield variability is compared with some "perfect" situation devoid of any problems. Such deviations (downwards) from optimal conditions will always exist, and it is rather academic to compare reality with "Nirvana." Also, as Anderson (1985) points out, with respect to weather, the costs receive much more discussion than the benefits.

There seems to be little or no thought or recognition given to a Buchanan and Tullock type analysis of the necessity of government action. It appears to be enough that an environmental change in the form of adverse weather exists. The justification for government intervention should be that private solutions are not as efficient in alleviating adverse events problems.

3.2 ADVERSE EVENTS ASSISTANCE POLICIES

It is instructive to examine the experience in other countries when evaluating adverse events intervention policies. Freebairn (1983) analysed the measures utilised by the Australian Government to deal with the 1982-83 drought. He notes that subsidisation of purchased fodder caused farmers to retain more stock and increase the feeding rate. This behaviour tended to even out the supply of wool and meat over the drought and post-drought period. He concluded that at best no more than 50 per cent of drought affected sheep and cattle producers received benefit from feed subsidies. Also, some of the benefits went to overseas consumers in the form of lower meat prices and to domestic fodder producers due to higher prices. Perhaps most important was that farmers in non-drought areas and drought area farmers who employed alternative strategies suffered losses due to adverse price changes.

As well as fodder subsidies, the Australian Government have also provided interest rate subsidies. This took two forms - concessional carry-on loans and debt interest subsidies. Freebairn suggests that as with fodder subsidies the interest rate program was discriminatory and led to distortion in resource allocation. The interest rate subsidy programs tended to benefit only that subset of farmers who were judged to be "viable prospects for the long term," but who were unable to obtain a commercial loan. They received a loan at 4 per cent. However, an adjacent farmer might have to pay 14.5 per cent through regular commercial channels. Farmers who were viewed as not standing a good chance to succeed were denied a concessional loan. Freebairn summed up the result of temporary assistance as follows:

> "Both fodder and interest rate subsidies provide incentives for farmers to lessen their efforts to cope with future droughts from their own resources. They discourage the conservation of fodder, use of conservation stocking rates and building up of financial reserves because these strategies receive no subsidies."

It seems reasonable to conclude that if an industry assumes assistance will be provided, the incentive to undertake alternative private measures will be reduced. These alternatives could include non-governmental collective action as well as individual measures.

Climatic relief loans have been issued by the Rural Bank to New Zealand farmers at concessionary rates over the last few years. Figures obtained from the Bank (Table 1) show the followoing amounts have been issued for the last three years.

Table 1
Rural Bank Climatic Relief Loans

| | National | | Canterbury District | |
Year	No.	Total $Mill	No.	Total $Mill
1985	583	14.92	109	2.39
1984	1351	26.34	389	6.97
1983	369	5.75	153	2.61

Source: Rural Bank Annual Report and Christchurch Branch figures from Alan Searle, pers com.

Interest rates are seven and a half per cent for the 1983-84 years, and 9 per cent for 1985. This would indicate a concession of at least 10 per cent on the later loans. Suspensory loans have been announced for North Otago - South Canterbury farmers. By early April 1986 some 245 loan applications had been lodged with the Rural Bank in Dunedin. These loans were for a maximum of $50,000 per farm, and averaged just over $30,000. The terms are interest and principal free until June 1988, and then on "commercial" interest rates. If the property is sold before that date, the loans then become grants for farmers. In an environment of high interest rates, a substantial concessionary element exists in these loans.

Following the 1985 Gisborne floods, the government set a relief operation in place. Some 448 people, mostly farmers, registered under the relief scheme. The two major components of this scheme were a restoration grant and an employment grant. The restoration grant is budgeted for an estimated cost of $620,000 to the government, excluding administration and helicopter costs. Some 80 per cent of restoration costs (regrassing, restoring water supplies, etc.) is paid out of this scheme. The P.E.P. employment scheme initially employed some 148 workers, but by February 1986 had scaled down to between 40 and 50 workers. Estimated direct costs of this scheme were $436,000 (Peter Andrews, MAF Gisborne, pers com.).

Harris and Stevenson (1979) concluded that the 1978 Southland flood relief temporary employment program was a cost-effective operation - "With a benefit: cost ratio of 1.98 it is clear that the programme's short run benefits to the nation considerably exceeded its short run costs." Thus, from a short run efficiency perspective the employment

program is a good scheme. From an equity perspective, as Harris and Stevenson conclude with respect to Southland, "The group in society actually receiving the resource benefit were farmers."

Medium-to-long term costs are difficult to measure, but these will probably accrue to farmers as owners of the land resource at the time of the floods. MAF officers estimated that some 5 per cent of stocking capacity was lost on the average farm as a result of the floods and land slips. Multiplier effects will translate this into a regional loss.

However, some medium to long term costs will also accrue to the nation as we set up this general expectation that adverse events are the responsibility of the taxpayer. Given a series of precedents it would be unusual for Governments in the emotive atmosphere of an adverse event to announce that it would no longer grant adverse events assistance.

3.3 DROUGHT MANAGEMENT STRATEGIES AND RELATED ISSUES

Much has been written about both light land and drought
management strategies.   Recent   publications   in this area
include the MAF reports by Crump and Ritchie (1982) and the
Lincoln College   report   edited   by Crabb (1983).   These
reports contain   little   information   that   is   not already
incorporated into the management   philosophy and strategy of
most New Zealand farmers who are faced with periodic
droughts.   However, what has possibly changed in the last
few years   is   the   impact   of   government   policies on farm
management strategies, with several almost perverse outcomes
eventuating   from   the   cumulative   effects   of   different
policies.   Thus the   private   response to adverse events may
be modified by public action in the   form of government
policies.   This   section   will   briefly   summarise drought
management   strategies   and   then   discuss   some government
policy implications for these strategies.

We   will   eschew   a   general   discussion   of   drought
management strategies and refer   readers   to the references
cited at the beginning of this section. The traditional
drought management strategies   revolve around flexibility in
the system and the ability of the   manager   to adapt to a
changing   environment.   Early   lambing and weaning, a
conservative stocking policy, the purchase of replacement
stock, the use of a   "buffer" or "flying" flock, the use of
specialist   pastures   (lucerne),   and   feed conservation
techniques such as grain, hay, and silage carry-overs are
all   accepted   management   techniques   for   light land and
drought prone   areas.   Additionally,   medium to long term
strategies such as   the   breed   of   sheep, the sheep-cattle
livestock ratios,   and possible cropping programs may be
influenced by the farmers' perception of drought.

Farmers are generally considered   to be risk averse in
their management   decisions,   and most of the strategies
outlined above are used to   reduce risk in addition to being
accepted drought-prone   area management   strategies.   For
example, a higher stocking rate may well have a greater
expected return, but will   tend   to   increase the loss in an
adverse climatic season. As Dent and Beck (1983) point out,
as a general rule   the   more   risk   averse a farmer is, the
lower his stocking rate should be.   They then go on to point
out that this, and other drought strategies (breed of sheep,
for example) are,   in effect,   an insurance policy.   The
premium is in the   form of a "cost" in good years from a
lower than optimal stocking   rate (opportunity cost), lower
production from the   "wrong" breed of sheep, or reduced
returns   from   a   conservative   cropping   program.   The
"dividend" is in the form of a lower expected loss during a
drought period.

Care   must   be   taken   when   estimating   the   "cost" of
drought to   ensure   that   losses   to   individual farmers in
drought areas   are   treated   as   transfer payments if other

farmers gain from these losses. An example of this is the forced selling of store lambs. If these animals are fattened in another district or on an irrigated farm then the net loss to the nation may only be the transaction costs involved. Another example is a farmer selling hay or feed barley - these transactions contain an element of transfer payment.

The importance of these drought management strategies becomes apparent when a drought-prone region becomes part of an irrigation system. One such area is the Amuri Plains district. Greer (1984) reporting on this project states:

"Of the farmers surveyed only one believed that irrigation was responsible for a change in the sheep replacement policy. However, within the same farming framework several major management changes were apparent. Almost all farmers had adopted, or intended to adopt a later lambing date. In the past the high risk of drought necessitated early lambing and early drafting. With irrigation most flocks will lamb in early to mid-September and lambs will also be carried longer and drafted at heavier weights.

While the Corriedale remains the dominant sheep breed in the area, irrigation has resulted in a swing towards Coopworths, Romney and Border Leicester-Romney crosses." (p.32)

While there have been changes in the management with the advent of irrigation, few changes appear to have taken place in the farming systems: "It is surprising that a greater swing to keep cattle is not intended" (Greer, p.32) and "few of them [farmers] have definite plans to change from traditional farming enterprises" (Greer, p.33). The distinction must be made between management strategies and farming systems. Management strategies are marginal changes, while a change in farming systems involves a non-marginal change such as a change from sheep to dairying. If farmers do not make a change in farming systems, this indicates they do not consider it economically efficient to make a change. More importantly, others do not consider it worthwhile to bid resources (the farm) away from current owners and then change the farming systems. Proponents possessing religious zeal in advocating the benefits of irrigation schemes manifested by changes in farming systems would do well to consider this point.

Irrigation may be regarded by some farmers as being a risk reducing strategy. This is when, as Dent and Beck point out, an irrigation system is not used to increase production but rather to avoid a serious loss in low rainfall years. Changes in the irrigation subsidy, coupled with higher interest rates (increasing opportunity cost of capital) and an expectation of government adverse events

relief in the event of a drought, make this strategy more
expensive, thus raising the "premium" price of irrigation
"insurance". It is doubtful that partial irrigation ever
has presented an economically viable option for drought risk
management. The recent Oamaru experience suggests (Ian
Warren, MAF, pers com.) that farmers with "some irrigation"
may have been worse off than dry land farmers during the
1984-85 drought. He considers a false sense of security,
combined with higher stocking rates and increased loan
commitments resulting from the development costs of
irrigation, has eroded the so-called "safety margin."

Interestingly, one of the justifications often put
forward for irrigation is the increase in on-farm employment
opportunities (Brown, 1984). Research on the Amuri scheme
in Canterbury tends to refute this - "relatively few of
these jobs have eventuated" (Greer, 1984, p.34).

An issue related to on-farm employment opportunities is
the regional multiplier argument. This is also put forward
as justification for government involvement in both adverse
events assistance and irrigation development. These
multipliers are, of course, regionally important. In an
Australian study, Anderson (1985) considers agricultural-to-
regional output multipliers as typically being of the order
2, so that a $10 million loss in regional farm output will
result in a total regional output loss of some $20 million.
Regional income multipliers are often even higher than
output multipliers, so that impacts on income and employment
off-farm can be substantial. He considers it is in
recognition of the extent of these income and employment
impacts that governments intervene with policy instruments
such as regional employment schemes. The relevant issue, as
Berthold points out, is the question of whether irrigation
multipliers are greater than other projects:

> "Assuming for a moment that it is in the
> nation's interest to develop one region at the
> expense of all other regions, it is then
> necessary to ask whether there is any reason to
> believe that multiplier effects from large-scale
> community irrigation would exceed those arising
> from a similar sized investment in another form
> - in particular a project with direct returns
> greater than from irrigation and which would
> proceed with no subsidy or with lower levels of
> subsidy."

The role of irrigation as a drought management strategy
represents an important area of future research, both from
an individual and regional basis. The changes in both
management strategies and farming systems with the advent of
an irrigation scheme should be investigated further. An
evaluation and comparison of irrigated versus non-irrigated

farms in North Otago and the cost to and recovery from drought in that area would provide some answers to the first question. The second issue of changes in farming systems could be investigated by looking at an established irrigation area (mid-Canterbury) and a newly developed area (Amuri).

SECTION 4 - <u>DROUGHT MODELS - EMPIRICAL APPROACHES</u>

The need for an improved information base for farmers to develop appropriate drought strategies has led to the worldwide development of computer programs to assist in the modelling of drought situations. Critical to these efforts is the clear definition of precisely what constitutes a "drought" (an issue previously discussed).

These models can be loosely separated into three categories, although the classifications are somewhat arbitrary as interactions exist between the types of models discussed. Firstly, macro models can be used to simulate both regional and national effects. Given a change in climatic conditions, an estimate can be made of future output and income impacts and hence the "cost" of drought in a wider sense. Secondly, micro or on-farm models can be used to assist in formulating management strategies for individual farmers to adopt. Subjective evaluations on the likely length and severity of a drought are required for ex-ante evaluations of alternative strategies, and this type of decision making involves a "what if" approach. Finally, an historical analysis of past weather patterns may provide some help in suggesting future climatic patterns. This type of modelling is categorised as "weather models", and information from these can be used to dynamically update on-farm micro models.

Using the collective action framework discussed earlier in the report, macro models have strong elements of a public good while the on-farm micro models are more of a private good. Those developers of a micro model could privatise the software by the usual copyright process and expect to capture a percentage of the rent accruing to the model itself. However, the distinction is a little blurred, as macro models do have a privatisation value in the commercial field. An example of this would be a Meat Company developing a stock projecting model. Weather information has many of the characteristics of a public good and is usually provided by the government.

4.1 **MACRO MODELS**

Wallace and Evans (1985), using econometric techniques, aggregate individual farm data to assess the impact of climate on farm production, revenue, and costs. A profit function is derived, and from this function weather elasticities are computed. These elasticities provide an estimate of the effect of changes in this year's soil moisture deficit conditions on next year's planned outputs, variable input purchases and profit for an average Class VI farm. This information enables an estimate of the impact of climatic events to be forecast one year in advance. The model can, in the author's words (p.22) "be used to work out[1] the various combinations of changes in expected netput prices which would be necessary to alleviate the adverse effects on next year's output and variable input plans from current adverse weather conditions, for example a drought, for the average Class VI farm." This statement, coupled with the preceding sentence "prices are amenable to government policy initiatives; recent examples have included the supplementary minimum prices scheme and fertiliser subsidies" suggest the policy object of the paper is to justify interventionism. No justification or reason is provided by Wallace and Evans as to why it "would be necessary to alleviate the adverse effects ... from current adverse weather conditions" by government policy initiatives.

The model is, as the authors concede, a first-round effects model only. Opening livestock units are not changed at the start of the year, and both input and output prices are held to be unaffected by weather. Notwithstanding this limitation, the model does enable some important forecasting of profits, outputs and selected inputs to be made one season in advance. For example, in Canterbury an increase of two soil moisture deficit days in a year - from 100 to 102 days[2] - will reduce profits of the following year by 0.3 per cent. Similar calculations can be made for output vectors, and the data disaggregated to a county level. One major feature which the model highlights is the importance of wet weather in the previous year for production and profits in the current year.

No evidence can be found to suggest that first-order serial correlation between the Dry and Wet variables exists.

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1   Following Varian (1984), p.8, a netput vector is where inputs are accorded a negative sign and output a positive sign. The set of all netput vectors constitutes a production possibilities set.

2   Wallace and Evans warn that the response in profit should not be directly extrapolated to large changes in the previous year's weather because of the non-linearity of the elasticity.

This suggests that this (or any other) model may be limited in its ability to forecast weather conditions. However, the Wallace and Evans model should have value in enabling both on-farm and regional changes to be estimated following an adverse event.

One major issue of concern at a macro level is the effects of adverse events on employment opportunities, both on and off farm. The Wallace and Evans model (p.16) shows positive elasticities for on-farm hired labour. The second round off-farm employment multipliers calculated from changes in sheep, cattle, and crop outputs following an abnormal year should be of value to both regional and national planners. Australian research (Powell and Anthony, 1985) supports the view that farm employment is not greatly affected by drought – "the conclusion would be that the drought [1982-83] did not lead to any large reduction in employment on farms and this particular source would not have been a significant contributor to unemployment" (p.8). The authors do concede that jobs are lost in the off-farm service and processing sectors.

Probably the most complete livestock model used in New Zealand is the Laing and Zwart model (Laing, 1982). The weather variable was measured by days of soil moisture deficit, weighted by the distribution of sheep and beef and dairy cattle populations. This variable had a statistically significant negative impact on ewe and ewe hogget numbers, and wool, lamb, and milkfat production. Mutton production and the numbers of both dairy and beef cows were negatively impacted, although not significantly so. Beef production, both prime and manufacturing, was significantly increased by days of soil moisture deficit. This is probably because dry weather inhibits pasture growth, requiring a reduction in stock numbers (as indicated by a negative impact on both dairy and beef cattle numbers). Laing reports neither impacts of lagged soil moisture deficit nor weather elasticities comparable to the Wallace and Evans results, but the model has the potential to estimate these parameters.

The New Zealand Meat and Wool Boards' Economic Service (Brook and Riley, 1981) also uses an econoclimatic model for national forecasting purposes. Using soil moisture deficit days, weighted by sheep populations, a prediction can be made of the next year's national wool clip. The model is valuable for explanatory purposes, but both data and aggregation problems do exist.

Macro models have the potential to be used for estimation of regional impacts following an adverse event. Unless the event is widespread, this would be more valuable than a national evaluation. Changes in individual farm incomes on a regional basis have an aggregation problem, and an individual or micro model would be of more interest to farmers.

4.2 ON-FARM MODELS

With the advent of the micro computer many farmers and farm advisors are becoming familiar with the use and usefulness of these machines. The discussion paper by Stent et al. (1983) describes a simulation model being developed by the University of Otago for these small computers. Economic consequences of various strategies available to a farmer can be investigated under alternative assumptions, and this "what if" approach is particularly useful in a drought situation. Stock class and numbers, supplementary feeds, target liveweights, and drafting policies are treated as the variables which a farmer has control over. Climatic variables and economic variables are treated as uncertain, with their range of possibilities defined. The model is dynamic in that each decision commits the farmer to a course of action, and a decision tree approach is followed (see Anderson et al. 1977). Once the programming model is defined and fine - tuned to a particular farm the expected cash flow implications of alternative decisions can be simulated. However, little progress and limited results appear to have eventuated from the project at this stage.

Australian authors have developed similar types of models. Toft and O'Hanlon (1979) discuss a dynamic programming model to derive the optimal choice of within drought tactics for a stock class on any particular property. To those not familiar with dynamic programming, the technique is a formalisation of the decision tree approach, and each "branch" is calculated recursively. Actions are examined for each stock class every time period and decisions made on selling or grazing stock and buying in fodder. The major drawback of these models is the so-called "curse of the dimensionality" - the very large numbers of small "twigs" emulating from the initial decision "branch". These models do have, as the authors state, "real world relevance." Field testing of the model, discussed by Henderson and Toft (1979), was carried out in the Glen Innes district of New South Wales. Results suggested an average reduction in the expected costs to the graziers from a drought could be in the order of 30 percent if the optimal strategy is followed. Even when the simulated drought continues for the "longest possible period" (based on historical probabilities) the model offered an average improvement of 18 percent reduction in costs.

Both the Australian model and the model proposed by Stent are somewhat sophisticated models, and need an operator familiar with the model to gain full advantage of the power of the new micro computers. This may limit the use of the approach, but they appear to have considerable potential for farm advisors and farmers.

4.3 WEATHER MODELS

Metereological forecasting models are becoming more
sophisticated and offer scope for medium to long range
projections. The value of such forecasted information can
be assessed as the difference between the expected outcomes
both with and without the forecast. A risk neutral person
would be prepared to pay up to that expected value of the
information, with a risk averse producer incorporating a
premium. Governments usually provide such services, as a
classic externality case exists - the good (the forecast)
lacks the conditions for non-attenuated property rights[3].

How useful are such medium to long term forecasts?
Recent reports in the Christchurch Press reinforce the
sceptics' belief that one of the major benefits of weather
forecasters is to make economic forecasts look respectable.

"Damp summer likely - New Zealand could be in for a
wet, warm summer and a drought is highly unlikely" (Press 9
October) followed the next day by:

"The official line of the service is still that there
is no guarantee of an early return to more rainfall" (Press,
10 October).

On a more serious note, Maunder (1982) contains a
discussion on Canterbury weather patterns and the prospects
for long-range forecasting in New Zealand. The historical
records indicate there is considerable persistence in
Canterbury's dry periods. However, Maunder considers there
are few positive results which suggest that either long term
forecasting or weather modification could provide any real
help to the farming community in Canterbury:

"For many years the larger meteorological agencies of
the world have put substantial research effort into long-
range forecasting. The limited success they have had shows
that there is no quick or easy solution to the problem."
(Maunder, 1982).

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3   Cheung (1978) admonished economists for making
     statements about classic externality cases before
     checking the facts. Having written this section, we
     read in Christchurch Press (27th December 1985) that
     airlines will be charged for weather forecasting
     services by the government. While it may be difficult
     to discourage arbitrage, the point is that
     meteorological forecasting may have elements of a
     private good which is traditionally supplied free of
     charge because of supposed externalities. This
     underscores much of the discussion in the Collective
     Action - Logic and Reason section.

Revfeim (1985) points out that drought is a difficult to define quantitative term, and represents one natural extremity of the rainfall process. Occurrence and severity of drought are relative to the species which might be affected and "to the adaptability to stress depending on age, season and management practice." This difficulty of definition is highlighted by two observations - (1) the 1981/82 growing season in Canterbury had the lowest total rainfall recorded while at the same time recording the second highest wheat yields; and (2), the Marlborough pastoral drought of 1982/83 was not relieved by 148 mm of rain in April 1983, as the rain fell mostly in one flash-flood type of situation. The distribution of rainfall totals is amenable to the estimation of Poisson process recurrence rates and exponential distribution mean amounts. This can provide the expected risk of many precisely defined situations - for example, the probability of no rain in any given month in Canterbury is 0.01 percent, or one in every 100 years. This would appear to be of academic interest only for short-term forecasting. The method can be used (based on historical data) to predict the probability of rainfall intensities and duration, and thereby the recurrence of "drought."

Climatic events are often thought to be influenced by the solar mechanisms, and Tomlinson (1980) statistically analyses solar influence on New Zealand rainfall. Observations from 1900-1978 were filtered, and from the response functions an extrapolation for the period 1980 to 1990 was simulated. The feature of this extrapolation is a dip in rainfall for 1983 not previously reached since 1932, and the comment "it seems possible then, that a very dry period may occur throughout much of New Zealand in the mid 1980's." The graph indicates an "extended dry spell" early in the 1980's, with a return to normality later in the decade. Granted, an ex-post discussion of predictions enables one to benefit from hindsight, but the accuracy suggests this type of long term forecasting may present some help for drought predictions.

An application of a simulation model which may be applicable to New Zealand should a rainfall or forage type of insurance scheme be considered is discussed by Selirio and Brown (1979). This model was developed to provide an estimate of dry matter production for the Ontario (Canada) hay and pasture drought scheme. The approach was considered unique, in that a weather-based simulation yield is used rather than actual measured dry matter yield. Precipitation, hours of sunshine, and temperatures are entered into the model from actual measurements, and a crop growth pattern estimated over the season. Results indicated that the seasonal production of alfalfa (lucerne) was estimated "with reasonable accuracy." The advantage of the model is that a difficult to measure yield such as a hay crop can be estimated from actual climatic data, and the insurance scheme conducted from these estimates. Problems

may arise in New Zealand, as several different soil types can exist over a relatively small area. However, should New Zealand policy makers consider an insurance plan along the Canadian lines (as discussed later), then a model of this type may be valuable.

As Anderson (1979) points out, droughts recur and must be seen as part of the environment of the industries on which they have impacts. While agriculture and agricultural based industries are obviously the major New Zealand sectors affected, other actors such as tourists and recreationists may appear on the stage as beneficiaries from "droughts." Medium to long term forecasting appears to offer limited immediate help to planners, although probabilities can be placed around specific outcomes occurring. Finally, a simulation model of the Canadian type using actual weather data may be applicable in lessening the administrative and transactions costs involved in a crop insurance scheme, should such a scheme be considered.

SECTION 5 — <u>OTHER SOLUTIONS TO ADVERSE EVENTS</u>

5.1 <u>FUTURES TRADING AS A MEANS OF RISK MANAGEMENT</u>

Recent policy changes in New Zealand have freed up the economy. One result of these changes has been an increased interest in the use of futures markets. The major futures markets in New Zealand are Wool, U.S. dollars and Prime Commercial Paper (P.C.P.). At present these markets are used primarily by importers and exporters to "lock in" prices and returns.

Several factors suggest that futures do not provide good prospects for mitigating the effects of droughts, floods, or snowstorms. The first is that futures markets are very "thin" in New Zealand. There are simply not many participants actively involved. The major agricultural beneficiaries of the futures markets would continue to be the large marketing entities who are "hedging."

The second factor, as Bardsley <u>et al</u>. point out, is that the average farmer is likely to be less well informed than the professional trader. There exists little or no reason for an individual producer to enter the futures market as long as the major marketing boards maintain their near monopoly power in the purchase of agricultural produce.

The third is that in other countries, especially the U.S., only about 10 per cent of contracts actually result in delivery of the product. If a contract is forward sold, the seller must either deliver the crop or engage in an offsetting contract.

The futures market is a useful tool to reduce price risk but it is not very satisfactory for handling yield risk.

5.2 STABILISATION - RISK AND INSURANCE

Stabilisation and Insurance schemes are a means of spreading and potentially transferring risk. Traditionally stabilisation schemes have been directed toward price rather than yield instability, e.g. the Meat Board or the Wheat Board. Insurance schemes, on the other hand, are designed to mitigate the effects of yield variation.

Quiggin and Anderson (1979) consider that the case for transferring risk to government rests on the answer to three principal questions:

(a) Are the risks independent of national income as a whole?

(b) Is the private capital market incapable of optimally spreading risks, so that individual producers (or consumers) must bear substantial risks? or

(c) Does stabilisation offer a mechanism which enables the government to bear risks at costs lower than those either of leaving individual producers to bear the risks or of shifting risks to the private capital market?

We might also add: Should the government bear the cost? What are the efficiency and equity issues associated with government involved in an insurance scheme? These are the questions which need to be considered in evaluating the role of government in adverse events relief.

The basis of the national crop and forage insurance schemes discussed later in this paper seem to be predicated on points (b) and (c). There is an implicit assumption in all of these programs that individual producers face price risk (based on world supply and demand), supply risk on their own output (weather, mismanagement, lack of inputs), and total output risk for the nation (drought, floods, disease). Adverse events insurance is really only aimed at the two output risks.

Bardsley, Abey and Davenport (1984) indicate that five conditions must be met for an insurance scheme to be financially viable. First, the benefits to the insured must be sufficiently large relative to benefits from other investments and liquidity costs must not be too great. Second, there must be enough individuals in the pool so as to maximise risk spreading. Third, the risks faced by individuals must be independent, and this is a major problem, at least locally, in insuring against adverse events. Fourth, the risks faced by each individual must be known to each party and should not be open to manipulation by the insured. Fifth, the administration costs must be low.

The major problems in any broad based adverse events insurance program are moral hazard and adverse selection. It is obviously in a producer's best interests financially to conceal from the insurer relevant information. The result is that he/she pays a lower premium than risks require - the problem of adverse selection. If the insured is able by his/her actions (such as being careless) to increase the probability of a successful claim, he/she will be unduly subsidised by other members of the pool - the problem of moral hazard.

Pauly [1977] and Ahsan, Ali and Kurian [1982] feel that the solution to these problems is to equalise the distribution of information. They feel it is difficult for a private firm to perform this function as economically as the government can. Therefore, based on either the Buchanan and Tullock or the Quiggin and Anderson criteria the job has fallen to the public sector. This does not imply subsidised insurance though.

For any insurance program to function the producers must be aware of risks they face and be able to assign probabilities to their occurrance. Research has shown in numerous cases that individuals either are unaware of the risks or choose to ignore them (Patrick, Lloyd and Cary 1985, Cahill, 1985). The existance of other programs such as ad hoc drought and flood relief programs reduces grower willingness to participate. Thus the political response to adverse events impinges on a potential private solution, that of insurance.

An additional problem arises with drought insurance schemes, and this is the problem of definition and measurement of drought. There have been numerous attempts to provide an operational definition of drought. Seymour and Quested (1982) present three possibilities and conclude that it is difficult to establish a universal criterion. One Australian definition states a drought is "A period of rainfall deficiency extending over months or years, of such nature that crops are seriously affected." A British definition sees a drought as, "15 consecutive days each with less than 0.254 mm of rain". Finally an American definition of an agricultural drought is when "soil moisture and rainfall are inadequate during the growing season to support healthy crop growth to maturity and to prevent extreme crop stress and wilt".

A New Zealand definition developed by Crump suggests that drought refers to the balance between pasture production and the livestock's feed demand from pasture. For most of New Zealand at some time during the year daily pasture production falls below daily demand. If the deficit is due to a lack in soil moisture, it is referred to as a drought. In Northland and the Waikato this period may last from three to four weeks without farmers expressing great concern. Conversely, in parts of Hawke's Bay and Canterbury

eight to ten weeks would be the norm. In those years when the period exceeds these levels, problems occur which require superior planning and management. From a pasture production perspective then, a drought begins when the plant reaches the wilting point. Crump defines the number of drought days as precisely the number of days when soil moisture falls below wilting point.

As attractive as Crump's definition appears to be, there may be a problem of circularity. The higher the stocking rate the more likely it is that feed demand will exceed pasture production. The analyst needs to be aware of the interactive problems. It is also important to note at this juncture that the time of the year when the deficit occurs is as important as the length of the deficit. Patrick, Lloyd and Cary (1985) note that for Australian wheat growing regions "more than adequate rainfall late in the growing season will generally not compensate for inadequate rainfall earlier." For the pastoral industry in New Zealand the same may be true. A shortage at an abnormal time, e.g. July to September in Canterbury, will not be compensated for by rains the following January and February.

5.2.1 CURRENT PROGRAMS IN THE UNITED STATES

The basis of most crop insurance programs found worldwide are those developed in the United States. Early attempts by private insurers to write crop insurance were unsuccessful. The U.S. Federal Government entered the crop insurance business in the 1930s as part of the New Deal. The continuing extreme drought of the "Dust Bowl" created public awareness of the problems facing American grain farmers. The widespread nature of the problem combined with low internal and international product prices eliminated the possibility of individual farmers contracting with the private sector for insurance. In 1938 the Federal Crop Insurance Corporation was set-up and began a wheat program in 1939. Between 1939 and 1969 the program was modified several times including elimination of coverage in some high risk areas. According to Patrick (1985), while unfavourable experiences led to the suspension of the crop insurance[4] program in 1947, by 1969 coverage had grown to $920 million. However, from 1967 to 1969 losses had exceeded premiums.

The 1970s saw the development of a federal disaster program. Those producers who participated in commodity programs were eligible for compensation for delayed plantings and/or unusually low yields. Over this period federal programs also included subsidized disaster loans, emergency feed schemes and indemnity programs for dairy and beef farmers. As Patrick (1985) notes, "The disaster programs were popular with producers because they provided no-cost disaster protection."

The situation shifted rather dramatically with the passage of the Federal Crop Insurance Act of 1980. The Federal Crop Insurance Corporation (F.C.I.C.) works with the private insurance industry. The government's role is one of marketing and reinsuring policies which are issued by private companies. Although called multi-peril or all risk insurance, the policies do not cover mismanagement, poor farming practices or theft. Covered events include droughts, floods, insects, hail, frost, wind, fire and earthquakes. Further, low quality due to a covered cause is compensatable.

The program presently provides only limited coverage for hay and forage crops except for corn used for silage. Also at present there exists no coverage for pastures or rangeland. Research has begun on the feasibility of including these in the program.

According to the United States Department of Agriculture, for the period 1948 to 1982 the major causes of

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4   All dollars are in the terms of the country under discussion, expressed in current dollars.

low yields were drought (41.9 per cent of indemnities),
flood or excessive moisture (17.7 per cent), cold weather
(14.0 per cent), and hail (13.2 per cent). [From Patrick,
1985.]

A major problem facing crop insurance programs
worldwide is the inability to deal with individual
conditions of producers. The U.S. program has been shifting
calculation of premiums and indemnities away from area wide
average to calculations of Actual Program History (APH) and
Individual Yield Coverage (IYC). The changes allow for
above average producers to be encouraged to participate in
the program since they are now able to have their higher
level of production recognised for insurance purposes.

Patrick (1985) reports that producer participation has
been limited. In 1980 the United States Department of
Agriculture (USDA) estimated that 8 percent of crop land was
covered by all risk insurance. By 1983 covered acreage had
risen to 16.5 per cent. Unpublished data from the FCIC
indicated that 23 per cent of eligible acreage was covered.

Studies by Guither et al. (1984) and Patrick (1985)
suggest that while producers generally prefer the present
crop insurance program to a return to the disaster programs
of the 1970s a substantial percentage of growers interviewed
felt that insurance was expensive. More growers found the
program complicated to understand. Both authors found a
number of growers thought the coverage "inadequate." A
significant education effort would be needed to explain the
program to potential participants.

The Congress has established the premium; 90 per cent
is to cover ordinary losses with the remaining 10 percent
for a reserve fund for catastrophic losses. Administrative
costs are covered by government appropriation. Federal
monies provide a premium subsidy of between 19 and 30 per
cent (Patrick and Pershing (1985) and U.S.D.A. (1984)).

Patrick (1985) has found the program to suffer from low
participation and problems of adverse selection. This may
be due to producers' perceptions that the coverage is
inadequate, premiums are high, and the program is too
complex. Even with the changes to individualise the
program, better producers, especially those who are
financially secure, do not participate. Rather they tend to
self insure. Producers with financial problems will view
crop insurance as yet another cost which they prefer not to
incur. These individuals tend to be younger farmers who are
still on the increasing range of the learning curve. It
also verifies the high discount rate normally ascribed to
this group of people.

5.2.2 CURRENT CANADIAN PROGRAMS

The Canadian provinces of Alberta, Saskatchewan and Manitoba have set up test programs to provide insurance for forage crops. The Alberta program has been in place since 1979 and is based on soil moisture measurements taken one per township (approximately 10km by 10km). As discussed in our section on meterological models, it appears that it is possible to estimate pasture and hay production from rainfall data (Selirio). The program compensates growers when estimated yields fall below 80 per cent of normal.

The Saskatchewan program is a refinement and an expansion of the Alberta program. Using a computer model forage production is simulated, based on soil moisture at the start of the season and daily rainfall reported by forage producers. Temperature data is obtained from local weather stations. This data is utilised to estimate daily soil moisture through to the first cutting stage. Using the same climatic inputs, long term average production is calculated from historical records. The estimated annual production is expressed as a percentage of the calculated historial average, thereby reflecting that year's growing conditions as compared to the long term production situation.

When the estimated annual production falls below 70 per cent of the long term average, payments are made to producers. All individuals covered by the program within the township are assigned the same production and are compensated the same percentage. The payment scale provides for compensation at twice the rate of decrease in yield. This is to recognise the higher cost of replacing lost forage. For example, an estimated yield of 50 per cent would result in a payment of 40 per cent of coverage while an estimated yield of 20 per cent would provide a 100 per cent payment.

Premiums have been set at 8.6 per cent for producers, and this is matched by the Federal Government. All administrative costs are borne by the provincial government. For the 1984 program, producers and the Canadian government each paid $62.5 million while Saskatchewan paid $6.3 million.

The province of Manitoba has implemented two schemes to insure forage. The first program follows the U.S. model for grains and other crops. An individual's coverage level is based on the producers yields. Premiums vary according to soil type and management practices. The level of premiums have run between 18 to 20 per cent of coverage level with the average coverage of $45-$50 per acre. As with most major Canadian programs, this premium is paid 50 per cent by the producer and 50 per cent by the Federal Government with administration costs being borne by the provincial

government. This means the full cost of coverage is around 40 per cent of the amount of coverage.

The second program entitled "The Manitoba Livestock Feed Security Program" is a test program begun in 1984. It is based on livestock rather than on area. Producers buy coverage at between $60 and $220 per cow. Premiums are set at 7.34 per cent of coverage and shared 50/50 by the producers and the Federal Government.

Base yields are measured in Total Digestable Nutrients (TDN) per acre for each of the major sources of forage area established for the municipality. The records of a sample of growers (approximately 10 per cent) are evaluated to determine the average TDN per acre for each forage crop for that year. Utilising the acres of each forage crop, an annual production estimate is calculated. The payout schedule as with the Saskatchewan program starts when production falls below 70 per cent.

Saskatchewan has a low level of producers' participation, despite the fact that producers pay only 47.65 per cent of the program's total cost. This is a problem shared by other Canadian provincial programs as well as programs in other countries.

The Manitoba Feed Security Program is unique in concept and is still experimental. Henry Nelson (1985), the administrator of the program indicates that the need to collect data and sell the concept to producers makes the program expensive to run. A major concern is that TDN is only a partial measure of forage quality and a program has begun to compare TDN measurements with actual production and clipping programs in order to obtain better base data (Patrick pers comm.).

The payout experience for 1984 was unsatisfactory because of a major drought in the test area. Overall indemnities exceeded farmer premiums by 8.6 times (Nelson, 1985). While estimated production in the seven municipalities ranged from 124 per cent to 43 per cent of normal, five of the seven recorded estimated yields of 61 per cent or below. It will be necessary to have the program run for a longer time before it is possible to determine whether or not it will be actuarially sound.

5.2.3 CURRENT AUSTRALIAN PROGRAMS

After an extensive effort including discussion papers, hearings, and reports on government involvement in provision of natural disaster insurance, John Howard, M.P. and Treasurer issued a report in May, 1979 concluding:

"On 17 January 1979 I announced that the government had decided not to proceed with the implementation of a natural disaster insurance scheme of the kind that had previously been mooted."

"To sum up, the provision of reinsurance cover by the government would not solve such problems as may be considered to exist - it would merely shift them from the commercial to the political arena."

Howard's report points out in lay terms problems of moral hazard and adverse selection. The most telling comment was "the government also believes that such a scheme would be inconsistent with a basic tenet in its political philosophy - namely, that governments and government authorities should, to the maximum extent possible, seek to avoid intervention in matters that can be left to the private sector."

It should be noted that the proposal rejected was a broad based program of the nature provided by the Earthquake and War Damages Commission in New Zealand. The concept was to be carried at least one step further by forming a pool of general insurers.

The practical problems became apparent quite quickly. In order to make the program work, it was obvious that participation would likely need to be compulsory. Otherwise if a disaster occurred, calls would be made on government for relief programs. A second major problem was that not all adverse events were covered and further those covered had little or no relevance to the needs and risks of some States. Both of these issues are important in the development of any insurance program as will be seen in the discussion of current New Zealand programs.

Even though a comprehensive natural disaster insurance program was rejected, interest was expressed in investigating potential programs for crops and livestock. The interest in crop and rainfall insurance has resulted in the Industry Assistance Commission being charged by the Minister of Industry, Technology and Commerce to consider whether the availability of such insurance to agricultural industries should be assisted. The commission in its Crop and Rainfall Insurance Information Paper (Cahill, 1985) pointed to previous studies which had suggested that "A general conclusion was that some government intervention may

be justifiable on efficiency grounds to assist producers in undertaking their risk managment ...." With regard to insurance the Commission recommended that there should be an investigation of forms of insurance which may be more cost effective than other measures in meeting certain objectives.

In the Commission's paper, the recurring issue of the impact of existing government programs on the demand for insurance is raised. The authors point to such arrangements as marketing boards, drought relief, income equalisation accounts, and quarantine regulations as potential barriers to wider use of insurance programs. The Commission hypothesized probably quite correctly, that individual producers would prefer to have the general public bear a proportion of their risk through programs paid for by general fund sources.

In response to the IAC request for information, Patrick et al. (1985) carried out a pilot study in Victoria to determine producer attitudes toward a crop and rainfall insurance program. The authors began by evaluating a hypothetical program based on average individual farmers' yields for the test area. Their conclusion was that had such a program been in place from 1957-58 to 1977-78, claims would have equalled 48 to 84 percent of the pure insurance premium (the level of premium necessary to make the program actuarially sound). The level of claims was dependant on the coverage desired and yield experienced.

A more interesting possibility from Patrick et al. is a rainfall insurance program. Payments would be based on the amount of rain rather than on yields. Such a program would avoid the problem of moral hazards and adverse selection. In order to implement such a program physical response models would be needed. The work of French and Schultz (1984) is thought to provide such a base for Australia (also see the section on Canadian programs for rainfall programs).

The results of Patrick et al.'s work are not very encouraging for government provision or assistance of either crop or rainfall insurance. They found that most farmers felt they were forced to carry hail and fire insurances by their lending agency and did so only under duress. In general, insurance was not highly ranked as a response to risk.

As a drought protection method, crop insurance was preferred to a rainfall insurance program. This may be due to the respondents not having heard of such a program previously. For a traditional crop program (U.S. style) participation is estimated at between 70 and 75 per cent. Respondents were generally unwilling to pay the full cost (25 per cent for 50 per cent coverage and 30 per cent for 75 per cent coverage). Patrick et al. feels that actual participation would be lower; many producers (60 per cent)

said they would pay \$12.35/hectare for 75 per cent coverage,
however they would balk at writing out a cheque for \$4,300
to cover 350 hectares of wheat.

The prospects for rainfall programs are even bleaker.
Over 50 per cent of respondents indicated that they would
not participate. Since rainfall is seen as being patchy, a
centrally measured level might not reflect the amount on an
individual's farm; a problem possibly overcome in the
Canadian program. There was little or no concern for the
relationship between timing of precipitation and yields.

Patrick et al. sums up the study as follows:

"The results of this survey indicate that
farmers have some interest in a crop insurance
program with indemnities based on their yields.
However, relatively few farmers would pay the
costs associated with this type of program.
Area rainfall insurance is not of interest to
most farmers. This suggests little basis for
the government to establish or provide
incentives for crop and area rainfall
insurance."

5.2.4 CURRENT PROGRAMS IN NEW ZEALAND

There exist currently to industry-wide insurance schemes which are worthy of discussion - the United Wheatgrowers' (N.Z.) Multi Peril Program and the Apple and Pear Boards' Hail Program. Both of the programs are with the Farmers' Mutual Insurance Group. The Wheatgrowers' program replaced a self-funded scheme of compensatoin for a limited number of events. This program was funded by levies payable by all wheatgrowers. As the Wheat Board Act required purchase of all wheat by one agency the collection of these levies was a simple matter.

A number of limitations of the self-funded scheme led to the establishment of a full insurance scheme commencing with the 1980/81 season. The actual discussions about such a program began in 1978. Since the risks to be covered had to be agreed upon and it was felt necessary to obtain 100 per cent grower participation to keep premiums as low as possible, the implementation was delayed. While it is stated by a representative of the insurer that there has been no government role in either the self-funded scheme or the current insurance program, the fact remains that all wheat sold in New Zealand is covered by the Wheat Board Act and all wheat sold incurs a mandatory levy. When the current program was implemented the Wheat Board Act was amended to allow the levy to be collected by the United Wheatgrowers N.Z. Ltd rather than by the Wheat Board. At the very least the government has enforced the implementation of the program.

The current program's coverage is interesting in its exclusions. There is no provision to cover drought. In an evaluation of a claim, an assessor determines the difference between actual yield and expected yield without the covered event. Adjustments in yield are made for non-insured contingencies such as drought (Papesch pers comm).

There does exist limited coverage for damage due to floods. To quote from the contract in insurance, floods are excluded: "If the loss or damage being caused by flood was the result of negligent farming (which expression shall be deemed to include the growing of wheat in recognised flood prone areas), neglect of water courses or negligence on the part of the Insured." A flood prone area is one where a flood has occurred more than once in the preceding ten years and where a claim has been made under any insurance or compensation policy. Clearly then the United Wheatgrowers' policy is not intended to cover the major adverse events as perceived by most New Zealand farmers.

The importance of government involvement even in only a tacit sense can be appreciated by comparison of the wheat program with insurance for another major grain crop, barley. Barley coverage is provided through private insurance companies on an individual grower basis. The farmer covers

those risks which he feels are appropriate for the length of
time he chooses.   Currently   for   similar   coverage it would
cost over twice as much to insure a barley crop as it does a
wheat crop.   Furthermore,   in   many   insurance policies on
barley, claims are paid only   if the insured loss exceeds 50
per cent.

Loss   experience   under   the   Wheatgrowers'   program is
unavailable   for   confidentiality   reasons.   The   contract
allows for premium   increases   "In   the   event of the claims
ratio under this   Contract   of   Insurance producing a yearly
ratio of claims   paid   and   outstanding   to   annual premium
received in excess   of   50%   over   a   period   of two or more
consectutive years...".   The insurer exercised its option to
do so for 1984/85 and again for 1985/86.

The second industry-wide scheme is administered by the
Apple and Pear Marketing Board.   All apple marketings are
under conditions set down   by the   Apple and Pear Marketing
Board.   As   part   of   the   Board's   program apple and pear
producers receive coverage   against   hail damage. Currently
the policy calls for   growers   to   be   compensated at 40 per
cent of their estimated   loss.   However, the insured bears
the first 10 per cent of any amount that would otherwise be
payable under the policy.

Data provided by the Apple and Pear Marketing Board for
the period 1981/82   through   1984/85   shows   the program has
undergone significant   changes.   First,   starting   with
1984/85, assessment of loss   is   done   on the basis of fruit
submitted to the Board   rather   than   on actual production.
This change will   most   likely   result   in a lower level of
claims. Second, the   price   used for establishing the value
of the crop shifts from   a   seasonal average to the price as
of March 1.   Third, the percentage payout has fallen from 43
per cent to   40   per   cent   while   the deductible amount has
risen to a   current   10   per   cent   of the claimable amount.
Fourth, the premium has risen   fom 1.35 per cent for 1981/82
and 1982/83 to 1.966 per cent   in 1984/85.   It seems fair to
say that the administrators of   the program have been making
adjustments in an attempt   to establish the parameters which
will result in an   acceptable   loss   ratio.   In 1981/82 and
1982/83 with premiums at 1.35   per   cent the loss ration was
201.30 per cent   and   215.22   per   cent respectively. With
higher   premiums   and   deductibility   in   1983/84,   the loss
ration was a more acceptable 55.4 per cent.   It is generally
accepted that for a sound   insurance program the loss ration
should be less that   70   per   cent.   Possibly the Apple and
Pear Board scheme has been fine   tuned to the point where it
will meet this criterion.

The two New Zealand programs discussed are both limited
in the risks which are   covered.   They are not voluntary to
the producer but   rather   are   mandatory.   The trade-off is
undoubtedly that premium levels are lower than they would be

otherwise. Clearly since premiums and excesses are
constant, producers in less risky areas are subsidising
those in more marginal areas. Therefore, from a theoretical
standpoint they may be questionable on efficiency grounds.
One solution is to establish different levels of excesses
based on historical claims.

One other program is worth mentioning even though it
has been discounted. Until August 1, 1985 flood damage was
covered under the Earthquake and War Damage Commission. The
Commission's program is funded by a levy added to all fire
insurance policies written in New Zealand. The program was
intended as supplemental not primary coverage. A
recommendation of the Commission of Inquiry into the
Abbotsford Landslip Disaster was that the Earthquake and War
Damages Commission be relieved of liability for flood
damage. They noted that such coverage was available from
private carriers. Many large companies were substituting
the coverage under the Earthquake and War Damage Commission
programs. Further, in the case of a major disaster, these
firms were relying on the prospect of additional government
assistance programs. [Report of Earthquake and War Damage
Commission, 1984]. An example of the problem was the
Southland Flood of January 1984. The Commission estimated
that 25 per cent of the claims were payable to fewer that
five industrial/commercial concerns - several of which had
not taken coverage with regular insurers.

5.2.5 SUMMARY OF INSURANCE PROGRAMS

Many governments intervene and provide a comprehensive multiple-risk crop insurance policy. This is a special purpose policy, in that it addresses yield risk resulting from adverse events. However, most policies cover only some adverse events and specifically do not cover others. Other forms of yield risk such as crop disease and pests constitute an important part of yield risk, and these are not covered by most insurance programs.

The experience from both overseas programs and New Zealand examples is quite clear - some form of government involvement is necessary before adverse events yield risk insurance schemes become acceptable to producers. In practice, many schemes have not fulfilled their supposed objectives. One major reason for this is that administration costs are generally high. Hazell et al (1986) found this type of insurance policy has costs of about 6 per cent of the value of coverage, compared to normal life insurance at 1 to 1.5 per cent of coverage. This means that premiums, in the absence of government support, would need to be between 10 and 20 per cent of coverage if schemes are to be self funding. Thus governments intervene, either in the form of a direct subsidy such as the Canadian schemes, or in the form of compulsory cover with the New Zealand wheat multi-peril program (which specifically excludes drought) or some combination of both.

The issue of moral hazard is a very real problem. Actions of producers increase the risk facing the insurer, and this in turn increases the cost of administration of the scheme. Additionally, adverse selection becomes a problem where allowance is not made for differing probabilities of risk between more favourable areas and disaster prone areas. Low risk producers have less need to insure and can, in effect, be subsiding high risk producers if the scheme is compulsory. If the scheme is not compulsory, low risk producers (and others) may opt to not insure, thus increasing costs for the remainder.

Many of the schemes reviewed are either very recent or are undergoing major changes. This suggests administrative costs are high because managers may be on a learning curve with new schemes. The Canadian approach, with a simulation model applied to whole areas, provides a way of reducing administration and monitoring costs and possibly should be investigated for New Zealand.

SECTION 6 – DISCUSSION & IMPLICATION FOR GOVERNMENT POLICY

The objective of this report has been to examine the role of government in adverse climatic events relief in New Zealand, with specific reference to drought relief. This examination started from a review of the literature on collective action and the theoretical role of government intervention where so-called "externalities" exist. Many writers have outlined the problems of intervention.

Intervention can be justified only if benefits outweigh the costs. Costs are often difficult to measure. These costs include the impact which a public policy may have upon a private solution to a particular problem. Temporary relief programs are often made on the grounds that an externality exists, and little or no attention is paid to either the costs associated with intervention or alternative forms of government assistance.

It is suggested that previous government policies may be altering producers' perceptions of risk and having some unforeseen impacts. Freebairn (1983) analysed Australian drought policies and showed both efficiency and equity distortions which have resulted from these policies. This report discusses the private response of producers to drought in New Zealand and raises the question of inefficiencies created when public policies alter the private solution.

Farmers are generally considered to be risk averse and policies which have been designed to stabilize income by setting price floors have caused producers to move further along the supply curve than they otherwise would have. This minimisation of price risk may well have been at the expense of environmental risk, as producers trade one form of risk for another. The net result may have aggrevated financial losses from drought, as well as increasing the chances of a "drought" happening, depending upon which definition of drought one accepts.

Adverse events will always occur, and it must be made clear the relevant issue is not the cost of these events per se, but the cost of dealing with them in a sub-optimal manner.

Previous drought assistance policies build an expectation of future assistance, and accentuate the problem by altering risk management strategies of producers. For example, financial assistance in the form of concessionary loans would not encourage a producer to minimise risk by

spreading the investment portfolio to include off-farm investments and hay and grain subsidies do not encourage farmers to carry feed over from one year to the next. Public policy has altered the private response to adverse events.

Insurance schemes may need some government involvement if they are to be accepted by producers. However, subsidisation of insurance schemes may present a least-cost solution to the problem of adverse events. Government can withdraw, to a large extent, from providing solutions on an ad hoc basis and avoid the direct and indirect costs involved with temporary assistance. The responsibility passes from a public to a private solution, and producers are free to make decisions within a private framework. Care must be taken to minimise the problems of moral hazard and adverse events.

The worldwide experience of insurance schemes which may be applicable to New Zealand to cover adverse events is not particularly promising. Still, governments may have other objectives which can be met by adverse events insurance schemes. For example, in the issue of rural income stability, insurance is a means of transferring income to farming families, albeit an inefficient means. More carefully targetted schemes may be better if rural income is a concern. The question still needs to be asked as to why government should become involved at all in insurance schemes. The first point is that the private sector is able to handle insurance schemes. The second point is that if the private sector costs are too high to make a scheme operational, then why should government subsidise the scheme? Problems of adverse selection may mean that government involvement is crucial, as producers in more favoured areas withdraw otherwise, thus eroding the insurance "lase" and increasing overheads to those remaining. Also, given the political realities of the emotive atmosphere associated with an adverse event, government may feel they are obliged to intervene. The major point to be made is that government involvement by subsidising insurance schemes has minimal impact upon private solutions to adverse events, provided care is taken to minimise moral hazard and adverse selection and the schemes are made attractive to producers to join. Costs of administration and subsidisation can be clearly identified, unlike costs of many other government interventionist policies. The clear policy implication is to fully consider effects which agricultural policies seemingly unrelated to adverse events may have upon the private response to adverse events when these events inevitably occur.

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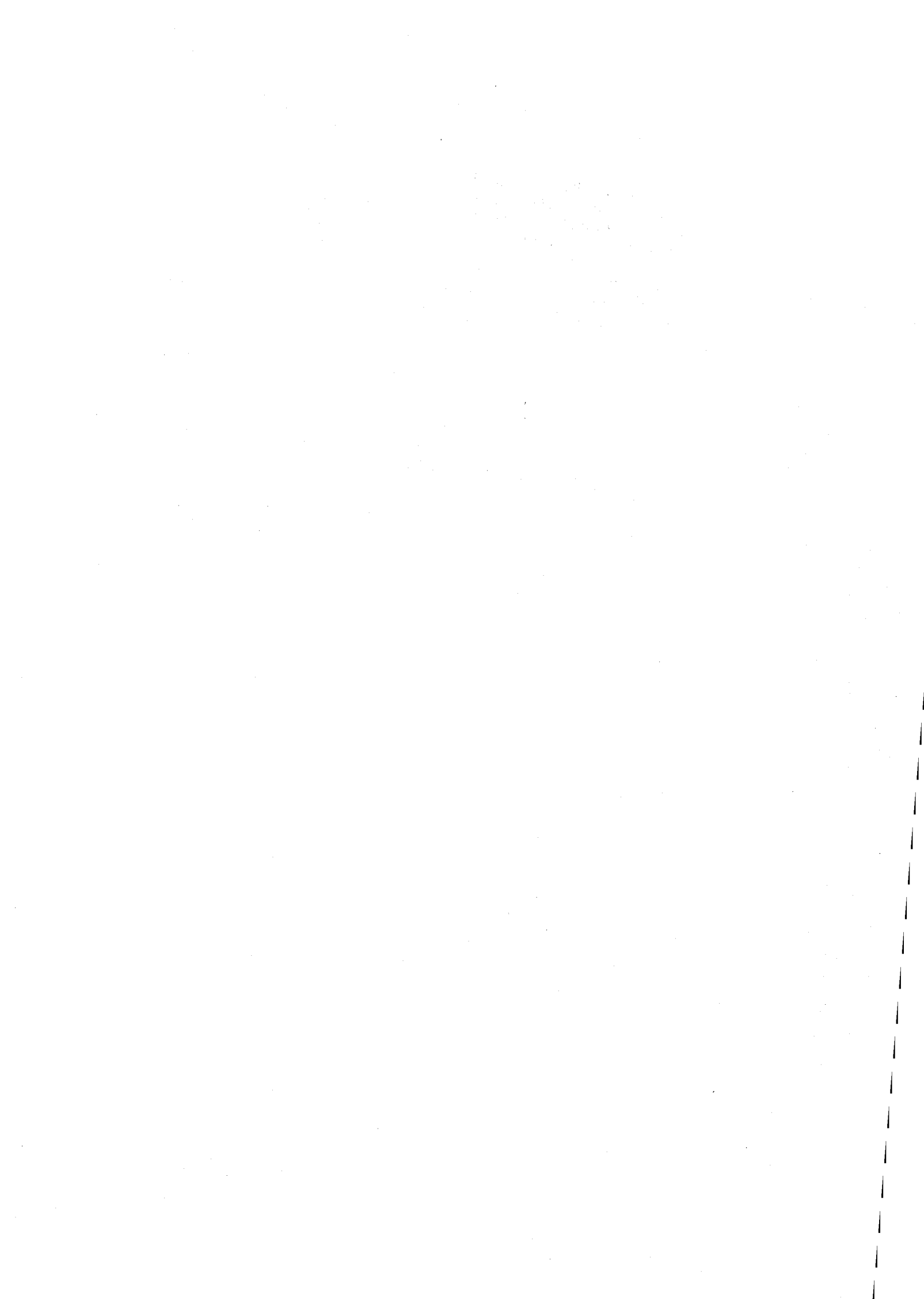
APPENDIX I

GOVERNMENT POLICY EFFECTS

One of the major features of the New Zealand economy, and especially the agricultural sector, has been the degree of government intervention in recent years. This interventionism entails a cost, and the indirect costs of intervention are relevant to this analysis. Adverse events will always occur, and the relevant cost is not the "cost" of adverse events per se (the Nirvana fallacy), but the cost of adopting a sub-optimal management strategy to deal with adverse events. This is in part an ex-ante problem influenced by the strategy adopted by farmers before an adverse event and in part an adaptive strategy adopted by farmers to alleviate the cost of the event during or after an adverse event. The second aspect, the adaptive management strategies, was discussed in the main report and it was suggested that information gathering and assimilation could be enhanced by computer modelling, thus reducing this cost. The purpose of this Appendix is to look at the first aspect, the influence of government intervention on the individual farmers' production decisions and how these decisions may accentuate the cost of adverse events when these events inevitably occur.

It is instructive to begin the analysis by looking at a representative individual farmer's production decision. Following the basic managerial economics response of operating where marginal costs (MC) are equated to marginal revenue (P1) each farmer will initially produce at point Q1
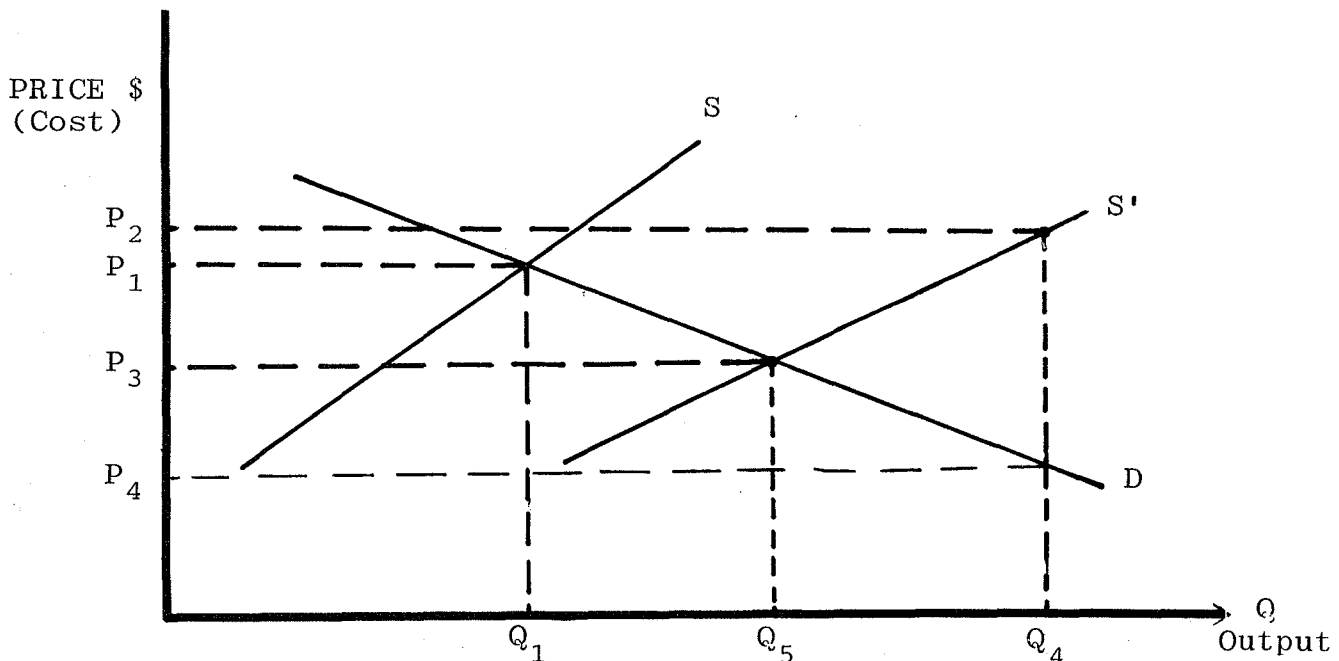
Figure 1
Individual Farmers' Cost Curve
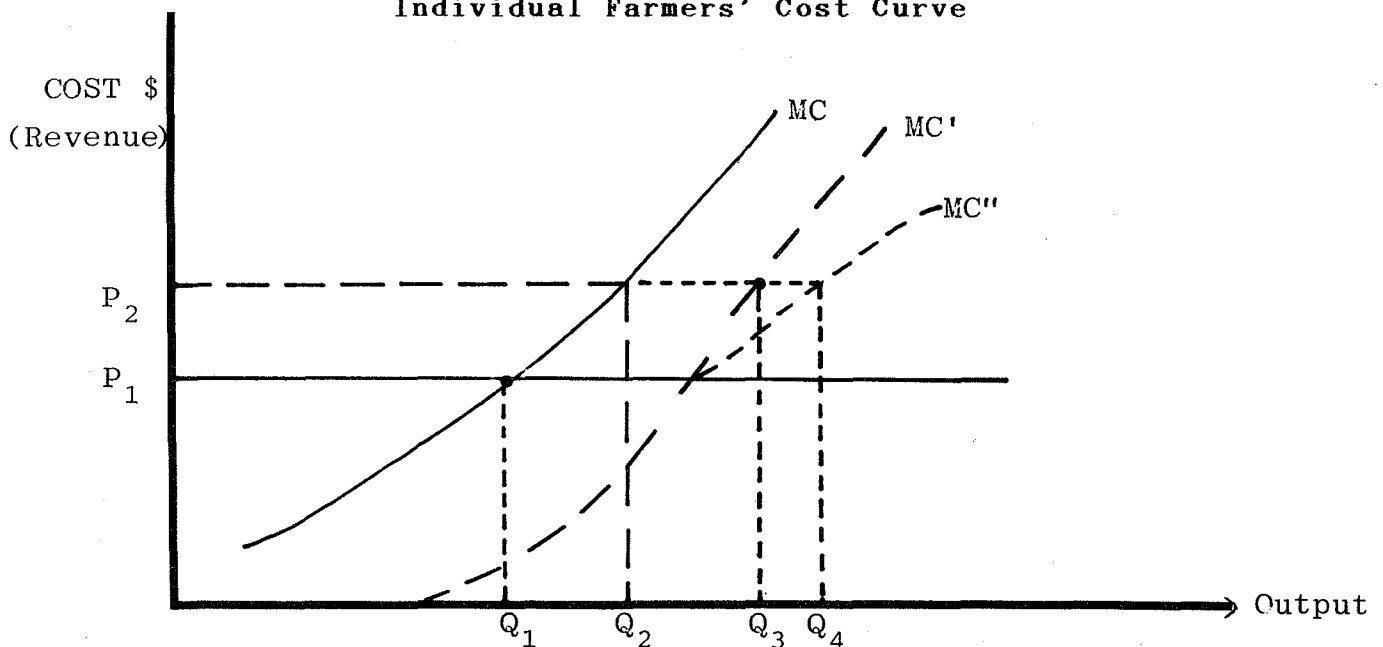
as shown in Figure 1. The marginal cost curve is rising, and the contribution to revenue of each unit of output (price) is constant for an individual farmer. Should output prices be raised (SMP's) to P2, the normal supply response is to expect producers to produce at Q2. If at the same time the cost structure of the industry is lowered [Land Development Encouragement Loans (LDEL), Livestock Incentive Scheme (LIS), interest rate concessions] the marginal cost curve will move outwards to MC^1. Additionally, given that producers are risk adverse, a further rightward shift in the marginal cost curve (supply curve) can be expected if the change in output prices reduces the price risk associated with that particular industry. This is shown as MC". The cumulative effect of all three changes is to move the individual's supply curve (marginal cost curve) from MC to MC", producing at Q4. Thus reducing price risk has increased supply, but producers may have increased environmental risk.

Now let us examine the collective response, or the industry supply curve. This can be found by aggregating all the participants in the industry. Some new entrants may now be producing this particular commodity, and this is the substitution effect induced by a change in costs and/or prices. Thus the industry supply response is very similar, and differs only in the exaggeration of the size of the shift from new entrants. Industry supply response is shown as the shift from S to S' in Figure 2. These two curves are

Figure 2
Industry Supply and Demand Relationships

not parallel for two reasons. (a) Proportionally more new
entrants may be encouraged into the industry as the price
increases (cost decreases), and (b) the "risk aversion"
response (MC") discussed earlier.

Figure 2 differs from Figure 1 in that a demand curve
(D) has been introduced, and is assumed to be downward
sloping. The elasticity of demand is the measure of the
relative slope of this demand curve. Prices received by
producers are at P2, while the prices on the "market" are at
P3. Output is at Q4, corresponding to Q4 in Figure 1, while
stocks are at Q4 minus Q5, where Q5 is the market supply
clearing quantity when D is the relevant demand curve. To
sell all the extra output, a market clearing price of P4
would have to prevail, with an effective subsidy of the
difference between P2 and P4. Alternatively, P3 could be
kept as the market price and Q4 minus Q5 taken off the
market[5].

Time is introduced into the analysis by changing the
slope of the supply curve, with a long-run curve being less
steep than a short-run curve. Also, the demand curve may be
shifting over time, with perhaps a change away from red
meats representing a leftwards shift while a marketing
campaign may represent a rightwards shift. Empirically it
is difficult to isolate and measure the responses from
different programs, especially when the demand curve may
also be changing. However, the prices P2, P3 and P4 (Figure
2), are often known, as may the quantities Q5 and Q4.

Several changes have occurred over the past few seasons
which may influence farmers' supply decisions. These
changes range from output subsidies through climatic relief
loans from the Rural Bank to the effects of fiscal and
monetary policies such as taxation changes and high interest
rates raising the opportunity cost of maintaining fodder
reserves.

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5   An excellent example of subsidies is manifested in New
     Zealand sheepmeat policies. Berryman (1985) features
     an account of the rendering down of some 40,000 tonnes
     of sheepmeat during the 1984-85 season. Had this meat
     been sold, Berryman estimates it would have "fetched
     more than $100 Million," but instead the meat meal,
     bone meal and tallow was worth about $6.5 Million. The
     rendered down meat amounted to two thirds of the
     increased sheepmeat production brought on by the $330
     million in government subsidies paid to farmers during
     the season. The Meat Board would have paid annually
     about $5 a carcass for up to three years in storage
     fees, plus interest charges. Although this analysis
     completely ignores the role of marginal pricing between
     different markets the point remains that, as seen
     later, a considerable taxpayer cost was involved.

Supplementary Minimum Prices (SMP's) probably increased output of sheep products for two reasons – the obvious supply response from a price increase, and the effects (possibly including substitution effects) of changes in the perception of risk associated with a minimum price. The SMP's were preceded by, and to some extent necessitated because of, the output inducing programs of the late 1970's such as the LDEL and the LIS. Retrospectively, much of the increase in production happened during a period of adverse climatic events. An ex-post evaluation of the LDEL and LIS schemes should consider the extent to which they accentuated drought problems. Laing (1982) confirms the effects of this supply response by showing "a dummy variable representing government policy such as LDEL and LIS" as having a positive and statistically significant effect on sheep numbers in New Zealand.

The important message is that all possible costs of a change in policy should be considered before the change is effected. Conversely, the removal of SMP's and some other subsidies can be expected to reduce supply, thus lowering the cost (regardless of the incidence of that cost) of droughts in the medium term future.

One of the most important implications of government policies affecting agriculture is the resultant impact on farm land prices. The same supply shifts discussed earlier are manifested in changes in farmland values. With most policies, two issues are involved – equity and efficiency. The equity issue is the transfer of wealth, either realised or unrealised, resulting from the changes in residual value of the factor input of land. Recent changes in land values demonstrate clearly that these changes can be negative as well as positive. Efficiency becomes an issue when financial resources are not allocated to their best use in society; an example of this is increased land values resulting from the previously mentioned government policies.

What has been the impact of changes in government policies on farmland values and how is this related to adverse events relief? One of the features of the New Zealand agricultural scene has been the increase in farmland values during the late 1970's and early 1980's. From 1960 to 1984 the price of land that may be called grazing or fattening land increased by over 800 per cent, compared to an increase in the general price index of around 500 per cent (Seed and Sandrey, 1985). This becomes an issue with adverse events relief, as new entrants to farming have little or no cash reserves to buffer droughts. To the extent that risk-reducing policies such as climatic relief and supply inducing policies such as SMP's have accentuated these increases in farmland prices, the income problem

becomes a simultaneous one[6]. Because some of the private cost of adverse events is borne by the public sector, farmers pay higher prices to obtain drought-prone land and adopt a higher stocking rate than is prudent, thus exaggerating the financial problems during drought periods[7].

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6   Relationships between farmland prices, government policies, returns and the general inflation rate are complex, and form the basis of a Masters thesis in progress at Lincoln College by Peter Seed.

7   The issue of concessional interest rates to young farmers from Rural Bank Settlement Loans raises a property rights issue should those same farmers find themselves in financial difficulty for any reason. Does the state make a commitment to maintaining these same settlers on the land? One school of thought would say no - the loan concession is a one-off distribution. However, a political lobby exists which pursues the line of thought that a moral committment has been made, and these settlers were placed in a serious position by changes in government policy. Therefore, by implication, the state must meet its obligations to these settlers.

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