CONCLUSIONS FOR AGRICULTURAL PRACTICE, POLICY AND DEVELOPMENT

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Seasonal forecasts are new and particular

Climate scientists are understandably proud and excited by their emerging knowledge about the El Niño and other climatic phenomena and about the potential of this knowledge to give advance warning of the unwelcome impacts of climate on human society and the environment. It is astonishing to think that when many of us were children the current idea of the El Niño and its global climatic significance was simply not known.

The climate – through storms, floods, and drought are the driving force behind most natural disasters worldwide, and the costs of these events in human and dollar terms have been steadily rising over recent decades. The predictions of changes to the climate arising from enhanced concentrations of greenhouse gases adds to the urgency of finding ways to better adapt to climatic impacts. And one doesn't need to tell an audience such as this that the vagaries of climate are a preoccupation in the agricultural community, from small farmers and rural commerce to major traders, policymakers and aid agencies. One study showed that the three most significant indicators of Australian GDP were the US and Japanese GDPs – and an El Niño-related climate indicator!

So does seasonal forecasting represent a climatic golden egg about to be laid? A few more scientific studies and then we will get the problems under control? Not really. This is a topic of both promise and complexity, where there is still much to learn, in both science and practice. We must be patient, careful and discerning, and we must avoid the easy roads of either overconfidence or disillusionment.

The presentations in this session *Seasonal Climate Forecasts in Agriculture* have outlined a number of particular characteristics of climate forecasts which need to keep in mind. Key points are as follows.

- There is a sound scientific foundation for modern seasonal forecasting. The predictability mainly arises from slowly changing patterns of heat in the tropical oceans (the previous speakers Drs. Antonio Moura and Stephen Zebiak have been pioneers in developing this field.)

- Climate forecasts are <u>not</u> universally available – unlike weather forecasts. Predictability, and forecast skill, tends to be present only in some regions, mainly in the tropics, and in some seasons.

- A large fraction of the climate's variability arises from random weather processes which cannot be predicted months ahead. Scientific forecasts of these variations are simply impossible.

- Forecasts can be made only in terms of shifts in the odds – of the changed probability of certain conditions. A strong forecast, say of higher chances of dryer than usual conditions, still leaves some chance of wetter conditions.

- The utility of such probability forecasts can only be assessed by tests over a run of years – this can be done by simulation of decision strategies, as described earlier by Dr James Hansen.

Only when equipped with a knowledge of these particular characteristics of seasonal climate forecasts can a user make effective use of forecasts in their decisions.

Real users have real problems

In agriculture, the application of climate forecasts is as much about the human dimension as about the climate and agro-ecology. If a selection of farmers were asked whether they thought climate forecasts were useful, the answers would most likely range from misplaced optimism "They are great – last year I saved heaps by planting cotton rather than corn", to cautious no-regrets approaches "I cleaned out the ditches in spring – it needed to be done anyway", and finally through to pessimism or disbelief "Hell, how can you use that stuff – it's so vague and they don't seem to get right too often – at least not on my farm".

At an aggregate or policy level, similar stories might be heard, albeit on a larger scale. These might concern the setting of commodity contract prices, the allocation of excess or scarce irrigation water, the positioning of national fire-fighting equipment and human resources, or the management of grain aid stocks by international relief agencies. In each case, beyond the specifics, there is a similar set of general considerations, some reflected in the farmers' answers above.

- Decisions are particular, to specific matters, places, and times. Climate forecasts need to be tailored to the specific situation to be most useful. However, most forecasts are still broad brush in space and time.

- To use climate forecasts requires a rich context of knowledge about the role played by climate in the problem at hand, about what has happened in past years, and what is happening around the decision time in the region of interest.

- Decision options and sequences can be complex. Conditions and needs change over time. Rain may fall during a drought. Prices may rise or fall. Some decisions can be deferred. Some decisions made now will expand or contract options later. Climate is only one of the factors in the decision. There may be many decision points along the way.

- A range of generic decision strategies are available - including no action, no-regrets type steps, avoidance through diversification or insurance, quantitative strategies based on simulations, and high consequence bet-the-farm decisions.

- There are opportunity costs to obtaining forecasts and other climate information and to learning enough to effectively use it. Opportunity cost can be a major barrier to uptake by small operators.

- Decisions often will be influenced by the media, opinion makers, and the stance of early adopters in the community. The available information may be good, but then again it can be exaggerated, misleading or plain wrong.

- Use of forecasts means probabilistic management of risk. Probability forecasts are hard to communicate and understand. Human capacity to assess and to tolerate risk depends on personal

traits as well as the identifiable economic consequences. Strategies have to accommodate the chance of negative outcomes in some years.

- A forecast decision strategy can be optimised for yield, risk minimization, or environmental or social advantage.

- Forecast use is not necessarily even-handed; a favorable forecast strategy for one group may disadvantage another group (e.g. traders versus small farmers.)

The main conclusion for the farmer is that this is not a simple technology that can be plucked from the shelf and applied without too much effort. The science and agricultural practices involved are still in an early stage of development. However, a modest investment in learning about the climate and climate forecasting and its potential for the farmer's district and production system will allow more informed decisions, especially in times of stress. Among other things, it will help avoid poor and possibly costly decisions, such as overreacting to media reports or failing to take simple low cost options early enough when good forecasts have been made.

Farmers should take an opportunistic approach to seek out specific uses for their particular operation. They should be wary of generalities that may not apply to them. In the same way that forecasts have skill in certain seasons and places, so too the potential payoff in their use will most likely be confined to particular places, times and decision situations. The thinking has to shift toward niche opportunities and away from universal solutions.

For larger operators and public agencies the advice is much the same, except that the economies of scale provide the potential for large payoffs and hence for systematic studies to examine specific opportunities and strategies for forecast use. A study that Session Moderator Dr Jim Jones was associated with estimated that the benefits of effective forecast use across the south east of the United States could amount to hundreds of millions of dollars per annum. The need to search for the niche applications nevertheless remains.

The experience of the IRI and other researchers is that the required systematic studies should involve retrospective simulation and evaluation of the proposed forecast strategy over as many years as possible, and should integrate the climatic, farm system and human dimensions of the situation. Involving the actual decision-makers in the design and conduct of the study is highly desirable. Building a knowledge of climate and climate forecasting among the study participants and intended users is essential to the subsequent effective use of forecasts.

The role of the policymaker

We will assume that the policymaker has a mandate and a wish to promote the wise development of climate forecasting and its application. The basic economic rationale for public investment, beyond the obvious significance of climate to agriculture, is that field fails the usual tests for private investment. Among other things, it requires long term development of the knowledge base and large scale specialist research capabilities, and the benefits of the investment are relatively uncertain and would be impossible to fully capture by a private investor. The large scale national gains, in respect to reduction of losses, industry efficiency and gains to consumers, require public initiative and investment.

An additional justification is that the effective use of forecasts provides a necessary return on past and ongoing public investments in climatic and related environmental monitoring and research. The founders

of the International Research Institute for Climate Prediction saw the institute as a means to capitalize on the previous two decades of research into the El Niño and its prediction. Conversely, to develop the potential of climate forecasts requires a strong commitment to maintaining the underpinning infrastructure of ocean and atmospheric monitoring, together with the research programs and expert interpretive services needed to insure a reliable flow of authoritative information to users and the public. The National Oceanic and Atmospheric Administration (NOAA) is responsible for these functions in the United States and has been a leading advocate and supporter of the necessary international programs and coordination.

It is useful to introduce here the concept of "climatic security". This encompasses policymaker actions to secure the public against the threats of the climate, by means of monitoring, warnings, the development of policy mechanisms to identify and reduce vulnerability to climatic hazards and to facilitate the sharing of risk, the provision of authoritative public information, and the support of high quality research. Unfortunately, public funds are usually applied much more freely to visible responses to crises than to the less visible mitigation activities listed here. Research and development on the policy and human dimensions of the problem have lagged the physical research and need greater emphasis in future.

The policymaker thus has a very critical role in stimulating and supporting the development of climate forecasts and their beneficial applications. There is much to be done, but the scope of the tasks are relatively well understood. There is a growing consensus among researchers, service providers and users about the priorities for action. In the United States, there many opportunities for the Department of Agriculture to stimulate and support research and the dissemination of authoritative information to the agricultural community.

Developing country perspective

The application of climate forecasts to developing countries is of particular importance and is a prime focus of attention for the International Research Institute for Climate Prediction. Partly this for scientific reasons, in that the variability and predictability of the climate is greatest in the tropics, where most countries are less developed.

But it is also motivated by the recognition that these countries, with their rural populations, reliance on agriculture and other land based industries, and weak infrastructures, are very vulnerable to the impacts of climate fluctuations. Climatic disasters such as the recent floods in Mozambique and droughts in the Greater Horn are a serious brake on the economic and social development of poor countries. The proactive goal is to develop a *resilience* culture, to prepare for, respond to, and of course reduce the inevitable impacts of climate fluctuations, both now and under any future changed climate.

The needs of the developing countries in respect to seasonal climate forecast are similar in general terms to those already outlined above – such as research on the impacts of climate, the development of forecast products and forecast use strategies tailored to regional and local needs, and the provision of reliable forecasts and background information. But there is also a strong additional need to develop local human capacities and infrastructure so that the countries can themselves establish the necessary durable capabilities in operations, research and policy formation.