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Seasonal Climate Forecasts and Adoption by Agriculture: A Review and Recommendations

J. D. Garbrecht, H. Meinke, M. V. K. Sivakumar, R. P. Motha, and M. J. Salinger.

Recent advances in atmospheric and ocean sciences and a better understanding of the global climate have led to skillful climate forecasts at seasonal to interannual time scales, even in mid-latitudes. These scientific advances and forecasting capabilities have opened the door to practical applications that benefit society. Benefits include reduction of weather/climate related risks and vulnerability, increased economic opportunities, enhanced food security, mitigation of adverse climate impacts, protection of environmental quality, and so forth.

Agriculture in particular can benefit substantially from accurate long-lead seasonal climate forecasts. Indeed, agricultural production very much depends on weather, climate and water availability, and unexpected departures from anticipated climate conditions can thwart the best laid management plans. Timely climate forecasts offer means to reduce losses in drought years, increase profitability in good years, deal more effectively with climate variability, and choose from targeted risk management strategies. In addition to benefiting farmers, forecasts can also help marketing systems and downstream users prepare for anticipated production outcomes and associated consequences.

Despite the tantalizing benefits that seasonal climate forecasts offer, there is little evidence of widespread applications of seasonal climate forecasts in agriculture. Application constraints that are often cited include limited forecast skill, unrealistic expectations of benefits, inappropriate forecast variables, difficulties integrating forecasts into decision processes, gaps between science products and decision needs, inadequate communication of forecast information, and so forth.

However, once climate is considered within the broader context of all other variables that impact an agricultural enterprise, constraints can be addressed and climate forecasts can produce valuable decision information. This requires a change from a very analytical view of climate towards a more issue-focused, holistic perspective: rather than producing a ‘forecast’, we must create ‘actionable climate knowledge’. For example, climate knowledge has contributed to better farm management for a producer of grain/cotton in NE Australia, an environment that is characterized by one of the largest rainfall variability in the world. When questioned, the producer pointed out that since he started following and using seasonal climate information for management decisions, his whole thinking about crop and cropping systems management has changed, and the speed and thoroughness of implementation of water conservation strategies was greatly influenced by forecasts. This was a direct result of scientists and farmer collaboration that helped to overcome prevailing forecast adoption constraints.

Forecast Adoption Issues

Many forecast adoption issues were discussed at a workshop in Brisbane, Australia, from 15 to 18 February 2005. The World Meteorological Organization (WMO), together with the Queensland Department of Primary Industries and Fisheries (DPI&F), organized and hosted the Workshop of the WMO Expert Team (ET) on "Climate Change/Variability and Medium- to Long-Range Predictions for Agriculture." This ET met under the auspices of the Commission for Agricultural Meteorology (CAgM) of WMO. The specific objectives of the ET were:

1) To appraise and report on current capabilities in the analyses of climate change/variability and long-range prediction studies, specifically as they relate to and affect agriculture, rangelands, forestry, and fisheries at the national and regional levels;

2) To produce a review on the current status of methodologies for the presentation of seasonal-to-interannual prediction products and applications to the agricultural end user;

3) To review the availability and suitability of software packages for the calculation of appropriate seasonal climate variability indices for agricultural applications; and,

4) To make recommendations on research and development activities needed to improve the technology for the benefit of agriculture, rangelands, forestry, and fisheries.

The ET comprised 10 international experts from the broad disciplines of agriculture and climatology, and from various parts of the world. A group of 17 Australian and New Zealand scientists working on climate forecasting and agricultural applications also participated in the workshop. The workshop was held under the leadership of Dr Holger Meinke, Principal Scientist, Emerging Technologies, DPI&F, Australia. Also in attendance were Dr M. V. K. Sivakumar, Chief of the Agricultural Meteorology Division of the WMO, Dr R. P. Motha, President of the CAgM of WMO, and Dr Jim Salinger, Chair of CAgM Open Program Area Group on Climate Change/Variability and Natural Disasters in Agriculture.

Discussions and Findings

During the first days of the workshop, participants made presentations on a range of topics addressing the above objectives and exchanged experiences on the value of climate forecasts and their application in agriculture. All together, 24 presentations were delivered and discussed. During the last two days of the workshop, the ET synthesized the important points made during the presentations and developed recommendations for all organizations involved in climate forecast applications.

The major issue underlying the lack of successful forecast applications that emerged from this workshop is that climate forecast and impact prediction products offered by the science community often don’t align with practical and application-specific decision needs of the intended user community. The rather narrow focus on ‘producing and using a climate forecast’ rather than taking the more holistic view of ‘creating actionable climate knowledge’ was recognized as a key reason for this lack of alignment. These largely unresolved challenges of problem-oriented, interdisciplinary integration are inhibiting the development of a strong and wide-spread end-user demand for forecasts and prediction products.

The following are specific issues raised during the ET workshop:

- Neither farmers nor policy makers have easy access to relevant decision information, beyond that offered by general climate forecasts, mainly because application-specific impact predictions on user-relevant decision variables are not available or cannot readily be inferred from the climate forecasts.
- Problems posed by climate variations/change and their impacts are multi-dimensional and multi-disciplinary. There is a need for more collaboration, partnerships and participatory approaches to effectively link scientific and end-user organizations.
- There appears to be an inappropriate focus in the science community on developing complex, integrated forecast impact and decision support 'software' intended for end-user operation rather than providing choices, options and recommendations for problems that require solving (technology push rather than demand pull). 'Software' applications and exploratory analyses are often more useful to scientists to generate new insights and develop novel solutions rather than for decision makers themselves. Thus, forecast insights are not necessarily best communicated to users via self-discovery by software applications, though some solutions and option evaluations for targeted applications can be transferred to the agricultural end-user via software products.
- Often, the climate community is not connecting well with the agricultural community, which deals with a much broader, multi-disciplinary decision space in which climate is only one factor. The goal of managing climate variability is to reduce the vulnerability of rural communities to climate risk. Vulnerability depends on both exposure to climate risk, and the inherent capacity of rural communities to cope with it. Climate science provides insights into the exposure of agricultural production systems to climate variability, but provides few insights into the capacity of rural communities to cope with it. More effort is needed to tailor forecast and prediction products to fit into existing decision frameworks.
- On-going assessment and review of forecast application constraints in agricultural is essential to determine research needs and required collaboration.
- Capacity building activities are required in developing countries in terms of institutional structures and communication lines to inform consultants, advisers, extension agents and end users of methodologies and climate forecast interpretation, and to enable agricultural applications. However, the climate community should also consider developing technology and information transfer that are more readily accessible by low-tech end-users.
- Farmer’s actions have consequences that concern the wider community. This partly drives policy formulation that in turn should influence the behaviour of farmers and resource managers in order to achieve better outcomes in terms of improved livelihoods. At least in principle, more efficient and effective policies would result from common approaches and technologies that provide decision makers at all levels and scales with more objective information. Both stakeholder groups can then objectively compare options, evaluate choices and assess policy or management consequences.

Workshop Products

Summaries of presentations have been compiled and are available as unpublished proceedings at http://www.apsru.gov.au/wmoetbne/. A final report to the WMO laid out the major conclusions drawn from the discussion sessions and provided recommendations on the above issues. A book, to be published in 2006 by Springer, will include presentations by workshop participants, as well as the recommendations by the ET. The book will provide more detailed background on the issues and recommendations by the ET and communicate the findings of the ET workshop to a wider audience that include organizations and institutions involved in climate forecast applications and end users in agriculture, rangelands, forestry, and fisheries.

The Climate Change/Variability and Medium- to Long-Range Predictions for Agriculture Workshop was held in Brisbane, Australia, 15-18 February 2005.

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JURGEN GARBRECHT, U.S. Department of Agriculture, Agricultural Research Service; HOLGER MEINKE, Emerging Technologies, DPI&F, Australia; MANNAVA V. K. SIVAKUMAR, Agricultural Meteorology Division of the WMO; RAYMOND P. MOTHA, U.S. Department of Agriculture, Office of Chief Economist; and, MICHAEL J. SALINGER, National Institute of Water and Atmospheric Research, New Zealand.