
Mannava V. K. Sivakumar · James Hansen (Eds.)

Climate Prediction and Agriculture

Advances and Challenges

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With 102 Figures and 55 Tables



World Meteorological Organization



Global Change System for Analysis,
Research and Training



The International Research Institute
for Climate and Society



Springer

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Foreword

It is estimated that hunger is currently affecting one out of every seven people on planet Earth. Projections show that unless the world community is prepared to undertake intensive and sustained remedial action over a long-term, there could still be almost 700 million people chronically undernourished by the year 2010, with over 300 million in sub-Saharan Africa alone. Agriculture and its associated industries are primary sources of food and a major employment sector in most developing countries.

Climate change, and increasing climate variability, as well as other global environmental issues such as land degradation, loss of biological diversity and stratospheric ozone depletion, threaten our ability to meet the basic human needs in adequate food, water and energy, safe shelter and a healthy environment. To address these challenges, it is important to integrate the issues of climate variability and climate change into resource use and development decisions. Decreasing the vulnerability of agriculture to natural climate variability through a more informed choice of policies, practices and technologies will, in many cases, reduce its long-term vulnerability to climate change. For example, the introduction of seasonal climate forecasts into management decisions can reduce the vulnerability of agriculture to floods and droughts caused by the El Niño-Southern Oscillation (ENSO) phenomena.

In order to address the challenges facing sustainable agricultural development, the World Meteorological Organization (WMO) gives priority to the timely and effective implementation of some of the activities of its World Climate Programme, in particular the Agricultural Meteorology Programme and the Climate Information and Prediction Services (CLIPS) project, to ensure that progress made in the seasonal to interannual climate prediction is translated into field applications to ensure food security. In this regard, the Commission for Agricultural Meteorology (CAGM) of WMO has recommended that weather and climate forecasts should be increasingly tailored towards the requirements of agriculture in order that farmers can make their decisions with greater confidence.

The Climate Prediction and Agriculture (CLIMAG) interdisciplinary project was established in 1998 with the goal to demonstrate the practical utility of climate forecasts in agricultural decision-making. CLIMAG builds on the advances made in several areas especially in the science of climate forecasting, downscaling large area climate

forecasts to local applications, integration of climate forecasts in operational crop models to develop alternative scenarios for operational decision making, and capacity building at the local level in all these areas. Needless to say, there are numerous challenges in all these areas.

The use of climate information and prediction products in planning agricultural activities has become very useful in some parts of the globe especially developing countries, as was demonstrated by the CLIMAG pilot projects carried out in South Asia and West Africa over the past four years.

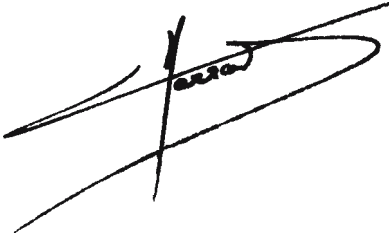
Furthermore, the Global Change System for Analysis, Research and Training (START) initiated the Advanced Training Institute on Climatic Variability and Food Security in July 2002 to equip young professionals from developing country with expertise in agriculture and food security to apply advances in climate prediction to their home institutions' ongoing efforts to address climate-sensitive aspects of agricultural production, food insecurity and rural poverty. Following this training institute, seed grants were provided with funding from the Lucille-Packard Foundation for follow-up project work on aspects of climate and food security in 14 countries.

It is with this background that, WMO, START and the International Research Institute for Climate and Society (IRI) organized an "International Workshop on Climate Prediction and Agriculture – Advances and Challenges" from 11 to 13 May 2005 at WMO in Geneva, Switzerland. The main objective of this workshop was to review advances in the application of seasonal climate prediction in agriculture over the past 5 years, and identify challenges to be addressed in the next 5–10 years to further enhance operational use of climate prediction in agriculture in developing countries.

Prior to the International Workshop, participants in the David and Lucille Packard Foundation-funded project on climate variability and food security were convened at a "Synthesis Workshop of the Advanced Institute on Climatic Variability and Food Security" from 9 to 10 May 2005 at WMO in Geneva to present their results, share their experiences, and synthesize lessons learned. The workshop was made possible through generous support from the Packard Foundation, the Asian Pacific Network (APN), the Inter-American Institute for Global Change Research (IAI), the National Oceanic and Atmospheric Administration/Office of Global Programs (NOAA/OGP), the Netherlands Ministry of Foreign Affairs (DGIS), the International START Secretariat (START), the World Meteorological Organization (WMO), and the International Research Institute for Climate and Society (IRI).

This volume, which brings together the papers presented at the International Workshop and the Synthesis Workshop, presents a good synthesis of the advances made so far in seasonal climate predictions and their applications for management and decision-making in agriculture, and identifies the challenges to be addressed in the next 5 to 10 years to further enhance operational applications of climate predictions in agriculture, especially in the developing countries.


We hope that this volume will serve as a major source of information to all services, agencies and organizations at national, regional and global level involved in promoting operational applications of climate predictions in agriculture.

A stylized, handwritten signature in black ink, consisting of several sweeping, interconnected strokes.

(M. Jarraud)
Secretary-General
World Meteorological Organization

A handwritten signature in black ink, featuring a prominent, flowing 'R' followed by several connected loops.

(Roland Fuchs)
Director
International START Secretariat

A handwritten signature in black ink, with a large, elegant 'S' at the beginning and a series of connected loops.

(Steve Zebiak)
Director General
The International Research Institute for Climate and Society

Preface

The Climate Prediction and Agriculture (CLIMAG) project started ten years ago under the auspices of the Global Change System for Analysis, Research and Training (START), the World Climate Research Programme (WCRP), the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimensions Programme of Global Environmental Change (IHDP) was based on the increasing capacity to model crop growth and yield coupled with the improving ability of meteorologists to provide short- and medium-term weather forecasts. The CLIMAG Task Force, appointed by the START Scientific Steering Committee, developed a dynamic strategic plan which formed the basis for the First International Workshop on CLIMAG which was held from 27 to 29 September 1999 at WMO in Geneva.

The First International Workshop on CLIMAG considered a number of important issues relating to climate prediction applications in agriculture including capabilities in long-term weather forecasting for agricultural production, down-scaling, scaling-up crop models for climate prediction applications, use of weather generators in crop modeling, economic impacts of shifts in ENSO event frequency and strengths and economic value of climate forecasts for agricultural systems.

Much work has been done on various issues related to CLIMAG since September 1999 when the First International Workshop on CLIMAG was held. The International Research Institute on Climate Prediction (IRI) was engaged in many of the activities envisaged under the original CLIMAG work plan. Regional CLIMAG demonstration projects in South Asia and West Africa made considerable progress. A number of research projects were organized under the David and Lucille Packard Foundation-funded project on climate variability and food security. The AIACC project of START is supporting a number of regional projects dealing with assessment of adaptations to climate change impacts on the agriculture sector. NOAA-OGP has supported a number of other individual research projects.

The goal of the START, WMO and the International Research Institute for Climate and Society (IRI) sponsored "International Workshop on Climate Prediction and Agriculture – Advances and Challenges" held at WMO, Geneva from 11 to 13 May 2005 was to review the advances made so far in seasonal climate predictions and their applications for management and decision-making in agriculture and identify the challenges to be addressed in the next 5 to 10 years to further enhance operational

applications of climate predictions in agriculture, especially in the developing countries. Specific objectives of the workshop were:

- to summarize/synthesize the current status of seasonal climate predictions and their applications to small holder agriculture in different parts of the world (with emphasis on advances since the 1999 CLIMAG workshop);
- to identify the ways and means to promote the more active use of seasonal to inter-annual climate forecasts in agricultural planning and operations for the benefit of smallholder agriculture and rural livelihoods in developing countries;
- to develop an effective strategy for the communication and coordination of climate applications to a broader network of users at all levels i.e. agricultural education and research, agricultural extension and farming community (with some emphasis on the Consultative Group on International Agricultural Research (CGIAR));
- to discuss the ways of promoting regional agrometeorological research in order to provide an improved understanding of the interactions between climate processes and their complex linkages with agricultural production and food security.

Altogether there were 15 sessions (including the opening and closing session) in the workshop during which 18 invited papers were presented addressing the different specific objectives of the workshop. All the participants in the workshop were engaged in discussions on these papers and developed several useful recommendations for all organizations involved in promoting climate prediction and applications in agriculture, in particular in the developing countries.

Nine of the invited papers are appearing in a special supplement of *Climate Research* journal and a summary of all these papers is given in the first chapter of this volume. This volume includes eight other invited papers presented at the workshop as well as 18 papers presented by the participants in the David and Lucille Packard Foundation-funded project on climate variability and food security at the “Synthesis Workshop of the Advanced Institute on Climatic Variability and Food Security” held prior to the International Workshop describing the national case studies on CLIMAG.

As editors of this volume, we would like to thank all the authors for their efforts and for their cooperation in bringing out this volume in time. We are most grateful to Mr. M. Jarraud, the Secretary-General of WMO, Dr. Roland Fuchs, Director of the International START Secretariat and Dr. Steve Zebiak, Director General of The International Research Institute for Climate and Society for their continuous support and encouragement.

Mannava V. K. Sivakumar
James Hansen
Editors

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