FINAL REPORT
TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION (APN PROJECT 2000 – 03)

Prepared by: Eileen L. Shea, East-West Center (Principal Investigator)

FEBRUARY 5-23, 2001
EAST-WEST CENTER
HONOLULU, HAWAII, USA

Sponsored by:

East-West Center
Asia-Pacific Network for Global Change Research (APN)
International START Secretariat
Office of Global Programs of the U.S. National Oceanic and Atmospheric Administration
International Pacific Research Center (IPRC), University of Hawaii

With Contributions from:

International Research Institute for Climate Prediction, Columbia University (USA)
International Global Change Institute (IGCI) of the University of Waikato (New Zealand)
Agricultural Production Systems Research Unit (APRSU), Queensland Department of Primary Industries (Australia)

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Background

The concept of Training Institute on Climate and Society in the Asia-Pacific Region **was developed in direct response to APN's call for proposals in the area of climate change and variability.** The original proposal recognized that communities, businesses, resource managers and government officials in the Asia-Pacific region face significant challenges and opportunities associated with effectively anticipating and responding to the regional consequences of climate variability and change, including, for example:

- changes in temperature, rainfall, and tropical storms associated with the El Niño-Southern Oscillation (ENSO) cycle;
- variations in the timing, duration and intensity of monsoon-related rainfall;
- the implications of variations in sea level for communities, businesses and unique ecosystems in low-lying coastal areas;
- anticipating and responding to the consequences of future climate change associated with human activities.

Understanding, anticipating and effectively responding to the consequences of climate variability can significantly enhance the capacity of the Asia-Pacific community to address critical near-term issues as well as broader national and regional challenges related to: enhancing the quality of life; promoting economic development and growth; and ensuring effective environmental stewardship in a region characterized by large (and, in some cases, growing) populations, emerging economies and unique and vulnerable ecosystems. A focused education and training program is a critical component of any such regional capacity-building effort.

In this context, the Training Institute on Climate and Society in the Asia-Pacific Region was designed to achieve the following **objectives**:

- increase understanding of the impacts of climate variability and change on communities, private enterprise and natural resources in the Asia-Pacific Region;

- review climate prediction and assessment capabilities and explore the applications of those tools and techniques to support decision making in the Asia-Pacific Region;

- explore regionally relevant and appropriate options for adaptation, mitigation and capacity building related to climate variability and change;

- enhance the currently-limited cadre of individuals in the Asia-Pacific region knowledgeable about emerging climate predictive capabilities and applications tools which, potentially, could yield substantial economic and societal benefits in a variety of sectors such as agriculture, water resource management health and coastal resource management; and

- enhance the dialogue between the scientific community, opinion leaders and decision makers concerned with responding to the societal challenges of climate variability and change in the Asia-Pacific region.

The **proposal to APN requesting support for the Training Institute is included with this final report as Appendix 1.**

The Institute was organized and directed by Eileen Shea, Climate Project Coordinator at the East-West Center. Ms Shea was supported by a small Steering Committee comprised of representatives of the scientific community and decision makers in affected sectors in the region and from sponsoring and collaborating institutions. Steering Committee membership included: Dr. Reid Basher (International Research Institute for climate prediction, Columbia University, USA); Professor Sulochana Gadgil (Center for Atmospheric and Oceanic Sciences, Indian Institute of Science, INDIA); Professor John Hay (International Global Change Institute, University of Waikato, NEW ZEALAND); Dr. Michael Manton (Bureau of Meteorology Research Center, AUSTRALIA); Professor Julian (Jay) McCreary (International Pacific Research Center, University of Hawaii USA); Professor Akamasi Sumi (Center for Climate System Research, University of Tokyo, JAPAN) and Dr. Hassan Virji (International START Secretariat, USA). In addition to providing guidance on the overall structure and organization of the Institute, the Steering Committee served as the selection committee for Institute participants.

Training Institute Summary

The three-week **Training Institute on Climate and Society in the Asia-Pacific Region** was held at the East-West Center facilities in Honolulu, Hawaii, USA from February 5-23, 2001. Funding for the Training Institute was provided by APN (APN Project 2000-03), the International START Secretariat, the Office of Global Programs of the U.S. National Oceanic and Atmospheric Administration, the International Pacific Research Center at the University of Hawaii, and the East-West Center. Other Training Institute partners, including the International Research Institute for climate prediction (IRI), the International Global Change Institute at the University of Waikato in New Zealand and the Agricultural Production Systems Research Unit (APSRU) of the Queensland Department of Primary Industries in Australia, provided vital contributions in the form of lecturer support, background materials and climate forecasting, application and assessment tools.

Twenty participants were selected through a competitive process from universities, research and educational institutions, non-governmental organizations, government agencies, and private-sector enterprises throughout the Asia-Pacific region. In addition to scientific and educational qualifications, selection criteria included the likelihood of participants directly applying new skills in their work (e.g., climate researchers, forecasters and resource managers) and leveraging opportunities for wider dissemination of Institute information products (e.g., university educators and non-governmental organizations). Participants in the February 2001 Training Institute on Climate and Society represent the following countries: Australia, Bangladesh, China, Cook Islands, Fiji, India, Indonesia, Pakistan, the Phillipines, Papua New Guinea, Sri Lanka, Thailand, and Vietnam. In addition, the participation of an individual from Ethiopia provides an opportunity to link with scientists engaged in similar work in another region. **A Participant List (including contact information) is provided as Appendix 3** to this report and **Appendix 4 provides brief background statements on each of the participants.**

The Training Institute was organized as an intensive, three-week program of lectures, small working group sessions and hands-on research projects emphasizing the use of data and insights drawn from participants' experiences. **The detailed Syllabus for the Training Institute is attached as Appendix 2** to this final report. The first week of the Training Institute provided an overview of key climate system processes in the Asia-Pacific Region (e.g., El Niño-Southern Oscillation, the Austral-Asian monsoon, and the Pacific Decadal Oscillation) and their societal consequences with a specific focus on recent experience and emerging opportunities related to the use of seasonal forecasts to support decision making in the region. First week activities were led by scientists from the East-West Center, the University of Hawaii (including the International Pacific Research Center, the School of Ocean and Earth Science and Technology, and the College of Social Sciences), and the International Research Institute for climate prediction of Columbia University. Early in the second week, a team of scientists from the University of Waikato's International Global Change Institute will led formal presentations and learning-by-doing exercises that exposed Training Institute participants to integrated assessment issues, methods and tools. The third week of the Training Institute built on the results of the evolving Climate and Agriculture (CLIMAG) effort being supported by START and APN. A team of CLIMAG project scientists led by Holger Meinke of the Queensland Department of Primary Industries shared the results of CLIMAG project and related activities designed to promote the use of seasonal forecasts to support agricultural decision-making. This portion of

the Training Institute provided an opportunity for CLIMAG project scientists and Training Institute participants to discuss development of a collaborative regional research project, involving national case studies and a common protocol, dealing with climate forecasts, their transmission and use in the context of different farming systems and cultural settings. The **complete list of Training Institute lecturers (with contact information) is provided as Appendix 5** to this final report. The **Institute Director's opening lecture is included as Appendix 6** to this final report. **Appendix 8 includes a brief description of the learning-by-doing exercises** conducted during the Training Institute.

Institute Products

At registration, participants were provided with a notebook of background material that included:

- the detailed Training Institute Syllabus;
- a summary of the Training Institute background, objectives and organization;
- a listing of the Training Institute Steering Committee membership and sponsors;
- a Participant List (including contact information) and brief Participant Background Summary;
- a list of Institute lecturers; and
- selected background readings compiled by the Institute Director with guidance from invited lecturers and the Training Institute Steering Committee (including user manuals for the tailored software programs used as part of the Training Institute).

The **complete list of Background Readings included in the participants' background notebooks is included as Appendix 10** to this final report. **Appendix 11 provides a listing of suggested supplemental readings and source materials** that were made available for participants during the Training Institute. Throughout the Institute, participants had access to individual personal computers equipped with standard Windows-based software along with selected software programs used during the Training Institute. This tailored software included: CLIMLAB from the International Research Institute for climate prediction; VANDACLIM and FIJICLIM integrated assessment model software provided by the International Global Change Institute of the University of Waikato; and some tailored exercises developed using the climate and agriculture techniques being used as part of the CLIMAG South Asia project. Upon departure, Training Institute participants were provided with a CD containing copies of CLIMLAB and VANDACLIM (along with electronic versions of the Institute syllabus, participant information and contact information on Training Institute lecturers). A second CD containing the CLIMAG exercise background software and copies of most of the lectures presented during the three-week Training Institute was compiled and forwarded to the participants after their return home. Paper copies of lecturer presentations were made available throughout the Training Institute.

Insights from Participants

Participant discussions throughout the three-week Training Institute provided some valuable insights on a number of issues related to Training Institute itself and the development and use of climate information to support decision-making in the Asia-Pacific Region. **Appendix 9 contains bulleted summaries of those discussions in three important areas**, including:

- comments shared during a brainstorming session on the question "*Why did I come to the Training Institute*";
- key issues raised during lectures and learning-by-doing exercises on the topic of *climate vulnerability and adaptation*; and
- a summary of *critical research needs and information gaps* that should be addressed to enhance the development and application of useful and usable climate information to support decision making in the Asia-Pacific Region.

On February 22, the Institute participants were asked to share some of their perspectives on the Training Institute along with some ideas on how they might apply the lessons learned during the Institute to support their own efforts upon returning home. The **Institute Director's closing thoughts (included in Appendix 7)** provided a summary of some of the common themes and recommendations that emerged from these presentations and discussions during the Training Institute. This summary along with the formal evaluations completed by the participants can be used to help guide similar training activities in the future and broader efforts to enhance the development and application of useful and usable climate information to support decision-making in the Asia-Pacific Region.

Asia-Pacific Climate Information Network

In this context, one of the most exciting products to emerge from the Training Institute was a commitment among participants and lecturers to continue to share knowledge and experiences and help create a network of scientists, forecasters, agencies and research and educational institutions throughout the Asia-Pacific region skilled in the use of information on the consequences of climate variability and change to support practical decision-making in such critical sectors as agriculture, water resource management, community planning and resource management. Working with the participants and Training Institute lecturers, the East-West Center has agreed to help **facilitate the emergence of this "Asia-Pacific Climate Information Network"** through the establishment of an electronic bulletin board to support information exchange and dialogue among the participants and lecturers. In addition to applying lessons learned in Honolulu to their own efforts, participants and lecturers agreed to identify and engage other potential Network partners (individuals and institutions) and look for future opportunities for collaborative, multi-disciplinary research projects in climate prediction, assessment and applications within individual countries and among regional and sub-regional groups addressing shared problems. In pursuing the establishment of an Asia-Pacific Climate Information Network, the Institute Director will build on related, ongoing activities including, but not limited to:

- East-West Center programs, including, most notably, efforts with the South Pacific Regional Environment Programme (and other regional organizations) to establish a Pacific Islands Climate Information System;
- Climate assessment and applications programs of the South Pacific Regional Environment Programme;
- the work of the Pacific ENSO Applications Center;
- the Extreme Climate Events project (and related activities) of the Asian Disaster Preparedness Center;
- the efforts of the International Research Institute for climate prediction to establish a regional network of partners in climate forecast applications research;
- related programs of Training Institute sponsors (especially APN and START) and contributing partners (International Global Change Institute of the University of Waikato; the University of Hawaii, including the International Pacific Research Center; Australia's CSIRO and the CLIMAG South Asia project team); and
- current and planned climate forecasting, applications and assessment programs of individual nations throughout the Asia-Pacific region (including operational weather and climate.

All the participants committed to sharing the information learned during the Training Institute with others in their own countries and, thus, expand the Training Institute's regional "reach" beyond the twenty participants in this initial Training Institute.

Thoughts for the Future

The participants in the February 2001 Training Institute on Climate and Society unanimously voiced their support for of continuing this type of training activity. **Participant evaluations gave the February 2001 Training Institute on Climate and Society in the Asia-Pacific Region** an overall rating of Excellent to Very Good.

Completed evaluations are available upon request but the following selected quotes from participant evaluation forms are offered by way of example:

- "The designing of the Syllabus is excellent. The selection of the participants has been very good. The resource speakers gave wonderful input on a wide range of issues. The methodologies for linking climate forecasts to decision making excellent."
- "The Training Institute has now set a standard for organizing such training workshops and this (standard) will be hard to match."
- What I liked best was the "overall training institute design and structure and specifically the quality and capability of the lecturers and program coordinator."
- "It really expanded my perspectives on climate change. I met some very qualified, knowledgeable people whom I learned a lot from. It was fantastic! I've attended trainings before but this one had something special about it."
- "The coordinator and her staff did a very nice job. The facilities are excellent; computers are available any time. Topics presented, as well as resource persons, are excellent."
- "The training Institute is very useful in developing countries by establishing a brainstorming group; problem-solving discussions and a communications forum. The continuity of the training institute should be maintained."

The participant evaluations and related discussions also provided a number of specific suggestions for future programs, including:

- expanding the scope of sectors addressed during lectures and learning-by-doing exercises (with an emphasis on water resource management, extreme events such as typhoons/tropical cyclones/hurricanes, tourism, health, fisheries, coastal resources and biodiversity as initial priorities);
- more opportunities for participants to *formally* share their own experiences and insights throughout the Training Institute (i.e., more opportunities to engage individual participants as "lecturers" throughout the Training Institute);
- consider follow-up workshops or "mini-training" programs within individual countries or at a sub-regional level;
- more "role-playing" exercises to explore the communication challenges associated with the development and use of climate information, including greater exploration of the challenges and opportunities associated with interactions with the media and press as well as dialogue with decision makers; and
- enhanced opportunities for individual lecture teams to coordinate their efforts and adjust their lectures and planned activities based on this interaction in advance of the Training Institute; one specific suggestion in this regard related to integrating more discussion of socio-economic consequences into the opening week lectures on key climate processes in the Asia-Pacific Region.

With these recommendations and related discussions throughout the three-week Training Institute, the individuals and institutions that served as partners in and sponsors of the February 2001 Training Institute are committed to exploring opportunities to continue similar "climate and society" training programs in the Asia-Pacific Region. In a more general sense, the participants also emphasized **the need to establish and sustain an effective, interactive dialogue between the providers of climate forecast (and assessment) information in the scientific community and the intended users of that information** in the public and private sectors. Participants and lecturers alike recognized the need to secure the human resources and funding to support this dialogue on an ongoing basis. In addition, many of the participants encouraged APN and the other Training Institute sponsors to provide **support for multi-disciplinary, collaborative research projects that emerge as a result of the new partnerships established during the February 2001 Training Institute** (and subsequent programs).

FINAL REPORT ON THE

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

February 5-23, 2001
East-West Center
Honolulu, HI USA

LIST OF APPENDICES

APPENDIX 1

Project Title: TRAINING INSTITUTE ON CLIMATE VARIABILITY AND SOCIETY IN THE ASIA-PACIFIC REGION (APN2000-03)

Amount Requested From APN: $ 78, 720 (US)

Detailed Proposal

This proposal **responds directly to APN's call for proposals in the area of climate change and variability**. It recognizes that communities, businesses, resource managers and government officials in the Asia-Pacific region face significant challenges and opportunities associated with effectively anticipating and responding to the regional consequences of climate variability and change, including, for example:

- changes in temperature, rainfall, and tropical storms associated with the El Niño-Southern Oscillation (ENSO) cycle;
- variations in the timing, duration and intensity of monsoon-related rainfall;
- the implications of variations in sea level for communities, businesses and unique ecosystems in low-lying coastal areas;
- anticipating and responding to the consequences of future climate change associated with human activities.

Understanding, anticipating and effectively responding to the consequences of climate variability can significantly enhance the capacity of the Asia-Pacific community to address critical near-term issues as well as broader national and regional challenges related to: enhancing the quality of life; promoting economic development and growth; and ensuring effective environmental stewardship in a region characterized by large (and, in some cases, growing) populations, emerging economies and unique and vulnerable ecosystems. A focused education and training program is a critical component of any such regional capacity-building effort.

The East-West Center and the International START Secretariat propose to organize a three-week **Training Institute on Climate Variability and Society in the Asia-Pacific Region** to be held at the East-West Center facilities in Honolulu, HI in the late fall/winter 2000/2001. Participants will be drawn from universities, research and educational institutions, non-governmental organizations, government agencies, and private-sector enterprises throughout the Asia-Pacific region through a competitive process. The Institute will help create a regional network of scientists, opinion leaders, decision makers and institutions throughout the region skilled in the use of information on the consequences of climate variability to support practical decision making in such critical sectors as agriculture, water resource management and coastal community planning and resource management.

The proposed Institute is a collaborative venture between the International START Secretariat and the East-West Center in partnership with APN and the Office of Global Programs of the U.S. National Oceanic and Atmospheric Administration (NOAA/OGP) as principal sponsors. The Institute organizers intend to complement APN and NOAA/OGP resources with financial or in-kind support from a number of other national, regional and international organizations and institutions active in the study of climate variability and change in the Asia-Pacific region (see Appendix 3 for a more complete list of anticipated collaborators). APN resources are being sought to: (1) ensure a broad representation from scientific, educational, non-governmental and enterprise programs and institutions and government agencies throughout the region; (2) provide the participants with the latest information and insights from recent and ongoing studies of climate variability for the Asia-Pacific region; and (3) familiarize participants with state-of-the-art climate forecasting and assessment tools to support decision making. An additional benefit would be creation of a network of researchers who can undertake future regional research and case studies within a broader collaborative framework (such as APN).

The proposed training Institute would be **designed to achieve the following objectives**:

- increase understanding of the impacts of climate variability and change on communities, private enterprise and natural resources in the Asia-Pacific Region;
- review climate prediction and assessment capabilities and explore the applications of those tools and techniques to support decision making in the Asia-Pacific Region;
- explore regionally-relevant and appropriate options for adaptation, mitigation and capacity-building related to climate variability and change;
- enhance the currently-limited cadre of individuals in the Asia-Pacific region knowledgeable about emerging climate predictive capabilities and applications tools which, potentially, could yield substantial economic and societal benefits in a variety of sectors such as agriculture, water resource management health and coastal resource management; and
- enhance the dialogue between the scientific community, opinion leaders and decision makers concerned with responding to the societal challenges of climate variability and change in the Asia-Pacific region.

Institute products will include: copies of invited presentations and summaries of selected topical working group discussions; highlights of hands-on research projects begun or completed during the Institute; and, most importantly, the creation of a network of individuals actively engaged in the development and use of climate information to support practical decision making. Maximum use of electronic media such as the World Wide Web (WWW) will be made to support broad dissemination of Institute proceedings throughout the region and Institute organizers will investigate the use of the PEACESAT satellite system to broadcast selected Institute proceedings (such as invited lectures and formal presentations) to a wider regional audience.

The Institute will be organized as an intensive, three-week program of lectures, small working group sessions and hands-on research projects for a group of 20-25 participants selected through a competitive process from the Asia-Pacific region. Selection criteria will include the likelihood of participants directly applying new skills in their work (e.g., climate researchers, forecasters and resource managers) and leveraging opportunities for wider dissemination of Institute information products (e.g., university educators and non-governmental organizations). Formal presentations and group discussions will be complemented with hands-on research projects emphasizing the use of data and insights drawn from participants' experiences. The Institute will be conducted at the state-of-the-art conference facilities at the East-West Center in Honolulu, HI and will take advantage of the East-West Center's significant experience and expertise in hosting international meetings and study sessions focused on critical issues in the Asia-Pacific region. This venue allows the Institute organizers to take advantage of the expertise in climate processes and consequences resident at the University of Hawaii (UH), including scientists working in the School of Ocean and Earth Sciences and Technology (SOEST), the Social Science Research Institute (SSRI), the Pacific ENSO Applications Center (PEAC) and the U.S.-Japan International Pacific Research Center (IPRC).

During the final week of the Institute, participants will engage a focused exploration of the use of seasonal-to-interannual climate forecasting to support agriculture in the Asia-Pacific Region. This second phase of the Institute will build on the results of the evolving Climate and Agriculture (CLIMAG) effort being developed for joint support by START and APN and will provide an opportunity to develop a collaborative regional research project, involving national case studies and a common protocol, dealing with climate forecasts, their transmission and use in the context of different farming systems and cultural settings. Institute organizers envisage development of a multi-national comparative study focused on improving the utility of climate forecasts for users in the agricultural sector, utilizing a common research methodology and including a basic survey instrument, that could explore: (1) individual and organizational responses to climate forecasts; (2) user information needs related to forecast timing and content (e.g., spatial and temporal resolution, format) and issues related to forecast accuracy and uncertainty; (3) the effectiveness of forecast communication channels; and (4) scientific, technical or institutional barriers that currently limit the use of climate forecasts to support agricultural decision making in the region. Such a multi-national comparative study could then be conducted following the Institute with researchers gathering for a follow-up workshop one year later to report on results and provide the basis for a multi-authored publication (funding for the follow-up workshop and report to be pursued separately). In this context, Drs. Graeme Hammer and Holger Meinke of the Agricultural Production Systems Research Unit (APSRU) of the Queensland Department of Primary Industries in Australia (and their colleagues) have agreed to help organize the final week of the Institute. Their participation will provide an important opportunity for them to make the climate assessment and decision support tools they have developed available to a larger network of colleagues in the Asia-Pacific region. Their participation, also, will provide an opportunity to share some initial results of their APN/START-supported CLIMAG regional demonstration project in South Asia and explore the applications of their methodologies to other countries in the Asia-Pacific region as part of an APN-wide activity.

The Institute will be organized and coordinated by Eileen Shea at the East-West Center who will serve as the Institute Director. The Institute Director will be supported by a small Steering Committee comprised of representatives of the scientific community and decision makers in affected sectors in the region and from sponsoring and collaborating institutions (see Appendix 4 for list of Steering Committee members). In addition to providing guidance on the overall structure and organization of the Institute, the Steering Committee will also serve as the selection committee for Institute participants.

Initial Steering Committee discussions of Institute timing, organization and technical issues will take place in spring 2000. Initial contact with invited guest lecturers and hands-on project leaders began in early 2000. An initial Institute announcement with a call for applications will be issued in spring (May/June). Competitive selection of participants will be completed during the summer of 2000 and logistical arrangements for transportation and accommodations will begin. A detailed agenda and description of Institute research projects will be disseminated in late summer/early fall 2000 along with special guidance for participants relating to data and other information requirements associated with the Institute's research projects (and will be made available on APN and START websites). The Institute is expected to be scheduled during in the winter of 2000/2001 (most likely between the months of January and March 2001) with exact dates to be determined in consultation with the Institute Steering Committee, collaborating institutions and key invited lecturers and will be based, in part, on the availability of adequate East-West Center meeting and dormitory facilities.

Relationship to APN Research Framework and Priorities

The Institute will be organized around the following themes that represent some of the most critical, climate-related challenges in the region and are consistent with APN priorities:

- **Agriculture**, including issues related to subsistence as well as commercial agriculture. This component of the Training Institute will be organized to provide an APN contribution to the START-CLIMAG project;
- **Water Resources**, including water resource management, drought management and health-related issues;
- **Coastal Communities and Resources**, including challenges associated with the consequences of climate variability for coastal infrastructure and human settlements as well as critical coastal and marine resources such as fisheries and coral reefs; and
- **Vulnerability, Impact and Adaptation Assessment** tools and techniques.

The third week of the Institute will provide an opportunity for participants to design and initiate a focused study of the potential application of new and emerging climate forecasting and applications tools to support agriculture in the Asia-Pacific region. A preliminary description of topics for discussion at the proposed Training Institute is included as Appendix 5.

Regional Collaboration, Capacity Building and Links to Policy

As described in more detail in Appendices 1, 4 and 5, the proposed Training Institute will draw on the assets and special expertise of a number of institutions and programs addressing climate and global change issues in the Asia-Pacific region. The Institute will include participation by scientists, educators, opinion leaders and decision makers (public and private) in practical, hands-on explorations of how information on climate variability can be applied to high-priority problems facing decision makers in the region today – like water resource management, emergency preparedness, agricultural planning and coastal community planning and resource management. As described previously, the third week of the Institute will focus on improving the utility of climate forecasts to support agricultural decision making in the Asia-Pacific region.

Relationship to Global Change Research Programmes and Related Research

The proposed Training Institute on Climate Variability and Society in the Asia-Pacific Region builds on a strong foundation of research into the nature and consequences of climate variability and change including: the World Climate Research Program's Tropical Ocean-Global Atmosphere (TOGA) Program and the ongoing WCRP Climate Variability (CLIVAR) program; investigations of the societal implications of climate variability and change through the International Human Dimensions of Global Change (IHDP) Programme and the START CLIMAG project; and assessments of the regional and national consequences of climate variability and change being conducted in the context of the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC). In this latter context, the proposed Institute will be closely integrated with ongoing climate assessment programs of the South Pacific Regional Environment Programme (SPREP) and an emerging Pacific islands regional assessment of the consequences of climate variability and change being coordinated by the East-West Center. Insights gained from an early 2000 workshop on climate and island coastal communities being organized as part of the Pacific islands regional assessment, for example, will be used to help design discussions and a hands-on project related to the Institute's coastal theme. Similarly, the Institute will benefit from an October 1999 Workshop on the implications of the 1997-1998 ENSO event for water resources in the Pacific islands that is being organized by the South Pacific Geosciences Commission and the University of Hawaii. The 1997-1998 case study information and forecasting scenario exercises that will be used during the October Workshop will provide valuable background information and insights. The Training Institute will also take advantage of the integrated climate vulnerability and adaptation assessment model and training tools developed by the International Global Change Institute (University of Waikato, New Zealand). Experience and insights into climate forecasting, analyses and applications will be drawn from the ongoing programs of the national meteorological and hydrological services and specialized meteorological centers in the region and World Meteorological Organization programs such as the WMO Climate Prediction and Information Services (CLIPS) program. The Institute also will incorporate experience and insights in tailoring forecasts of climate variability for regional users and supporting the needs of decision makers through the active involvement of regional pilot projects like the Pacific ENSO Applications Center (PEAC) as well as the climate forecasting and applications programs of the International Research Institute for climate prediction (IRI). The proposed Training Institute will constitute a contribution to the START project on climate and agriculture (CLIMAG) and will be organized as a follow-up to the APN Workshop on CLIMAG in Asia being held in Kobe, Japan in October 1999. The proposed Training Institute will complement the work of APN's sister network in the Americas (specifically the July 1999 IAI Summer Institute on "Interactions between Seasonal-to-Interannual Climate Variability and Human Systems") with an exploration of similar issues in the Asia-Pacific region and, thereby, enhance the collective capabilities of the collective APN/IAI/ENRICH global change research network.

APPENDIX 2

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

FEBRUARY 5-23, 2001

INSTITUTE SYLLABUS[1]

WEEKEND OF FEBRUARY 3 AND 4

- Participants arrive in Honolulu

SUNDAY, FEBRUARY 4

5:00-7:00 p.m. **Early Registration and Light Dinner**
East-West Center Gallery, First Floor John A. Burns Hall

MONDAY, FEBRUARY 5

8:00 a.m. **Continental Breakfast**
Registration – John A. Burns Hall, Second Floor Lobby

9:00 a.m. **OPENING CEREMONIES**

Oli Aloha

Welcome by Institute Director

Opening Remarks

Charles Morrison, President East-West Center
Jefferson Fox, Director of Studies, East-West Center
Statements from other sponsors and partners

Group Photo

10:15 a.m. MORNING TEA

10:30 a.m. **INTRODUCTIONS AND STATEMENTS OF INTEREST**

Institute Director moderates a session during which each participant provides a brief introduction to himself/herself and why they wanted to participate in the Training Institute (i.e., an opportunity to expand on the written Statement of Interests). Approximately 5-10 minutes each.

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[1] Unless otherwise indicated, all lecture sessions are in Room 2115/2111A, John A. Burns Hall, East-West Center (1601 East-West Road, Honolulu, HI 96848). Computer resources for Training Institute participants will be available in Room 2063/2064 John A. Burns Hall; this room will be used for some sessions.

MONDAY, FEBRUARY 5 (continued)

12:00 noon LUNCH

1:30 p.m. **OVERVIEW OF THE INSTITUTE**

Institute Director provides an overview of the Institute including goal, objectives, curriculum topics and schedule. Institute sponsors available to offer additional thoughts and/or respond to questions. Session concludes with a detailed overview of topics and activities for the first week

2:30 p.m. **U.S. VISA Orientation** (Valerie Wong, East-West Center)

3:00 p.m. AFTERNOON TEA

3:30 p.m. **Overview of Computer and Information Resources for Participants** (EWC Staff)

5:30 –7:30 **OPENING RECEPTION – Garden Level, EWC Imin International Conference Facility (Jefferson Hall)**
(hosted by International Pacific Research Center, University of Hawaii jointly with International Pacific CLIVAR meeting)

TUESDAY, FEBRUARY 6

8:30 a.m. **Climate System Dynamics in the Asia-Pacific Region: An Historical Perspective** – Tom Schroeder (University of Hawaii)

10:00 a.m. MORNING TEA

10:15 a.m. **The Austral-Asian Monsoon System** – H.Annamalai (International Pacific Research Center, University of Hawaii)

11:30 a.m. **Emerging Insights into Monsoon Predictability** – Johannes Loschnigg (International Pacific Research Center)

12:00 noon LUNCH

1:30 p.m. **The ENSO Cycle** – Axel Timmermann (International Pacific Research Center, University of Hawaii)

3:00 p.m. **Decadal Variability** – Shang-Ping Xie (International Pacific Research Center, University of Hawaii)

4:30 p.m. **Satellite Remote Sensing – A Tool for Prediction and Applications**— Tony Busalacchi (ESSIC, University of Maryland)

6:00 p.m. ADJOURN FOR THE DAY

WEDNESDAY, FEBRUARY 7

8:30 a.m. **CLIMATE SCIENCE FOR SOCIETY—CREATING INNOVATIVE PARTNERSHIPS IN ASSESSMENT AND APPLICATIONS** – Eileen Shea (East-West Center)

10:00 a.m. MORNING TEA

10:20 a.m. **Climate Change Issues for the Asia-Pacific Region** -- Jack Katzfey (Atmospheric Research, CSIRO, Australia)

12:00 noon LUNCH

1:00-2:00 p.m. **Individual ID Card Photos** – EWC Imin International Conference Center

2:00 p.m. **OPPORTUNITIES FOR INFORMAL DISCUSSIONS WITH GUEST LECTURERS FROM FIRST WEEK** – Speakers available for questions/discussions in individual or small-group settings

6:00 p.m. **ADJOURN FOR THE DAY**

THURSDAY, FEBRUARY 8

8:30 a.m. **KEYNOTE ADDRESS ON LINKING THE SCIENCE OF SEASONAL PREDICTION TO SOCIETY: THE IRI AND ITS MISSION** – Shardul Agrawala (IRI)

10:00 a.m. MORNING TEA

10:15 am. **KEYNOTE ADDRESS: SEASONAL CLIMATE FORECASTING: THE SCIENCE AND THE PRACTICE** – Simon Mason (IRI)

12:00 noon LUNCH

1:30 p.m. **REGIONAL EXPERIENCE WITH THE USE OF ENSO FORECASTS—SELECTED CASE STUDIES** (approximately 30 minute presentations plus time for Q&A)

Pacific ENSO Applications Center: The 1997-1998 Experience -- Michael Hamnett (University of Hawaii)

3:00 p.m. AFTERNOON TEA

3:15 p.m. **Climate and Health: Emerging Insights** – Nancy Lewis (University of Hawaii)

THURSDAY, FEBRUARY 8 (continued)

4:00 p.m. **Extreme Climate Events Project** – Kamal Kishore (Asian Disaster Preparedness Center)

6:00 p.m. ADJOURN FOR THE DAY

FRIDAY, FEBRUARY 9

8:30 a.m. **CHALLENGES AND OPPORTUNITIES IN SEASONAL FORECASTING** – Shardul Agrawala and Simon Mason (IRI)

During the February 9 and February 10 sessions, Shardul Agrawala and Simon Mason will address issues related to:

Presenting Probability Forecasts to Users (the IRI net assessments)

Analyzing and Communicating Forecast Quality

Introduction to IRI products, Climate Data Library, and ClimLab software

Sessions will include both formal presentations and hands-on exercises relevant to sectoral needs and applications.

10:00 a.m. MORNING TEA PROVIDED

12:00 noon LUNCH

3:00 p.m. AFTERNOON TEA PROVIDED

5:30 p.m. ADJOURN FOR THE DAY

SATURDAY, FEBRUARY 10

8:30 a.m. **CONTINUE PRESENTATIONS AND HANDS-ON TRAINING RELATED TO THE CHALLENGES AND OPPORTUNITIES IN SEASONAL FORECASTING** – Shardul Agrawala and Simon Mason (IRI)

SUNDAY, FEBRUARY 11

INDIVIDUAL STUDY; PREPARE FOR PRESENTATIONS
INSTITUTE DIRECTOR MEETS WITH WEEK 2 LECTURERS

MONDAY, FEBRUARY 12

8:30 a.m.	**INTEGRATED ASSESSMENT OF CLIMATE CHANGE: ISSUES, METHODS AND TOOLS** **Overview of Climate Change Science and Societal Implications** – John Hay (International Global Change Institute, University of Waikato)
9:30am	**Overview of Models used in National-scale, Integrated Assessments of Impacts and Adaptation Relating to Climate Change** – Gavin Kenny (International Global Change Institute, University of Waikato)
10:00 a.m.	MORNING TEA
11:00 a.m.	**Demonstration of an Integrated Assessment Tool** – Neil de Wet (International Global Change Institute, University of Waikato)
11:15 a.m.	**Introduction of Training Exercise 1 – Integrated Assessment of Climate Change Induced Pressures** – Neil de Wet (International Global Change Institute, University of Waikato)
11:30 a.m.	**Group Work on Exercise 1**
12:00 noon	LUNCH
1:00 p.m.	**Group Work on Exercise 1 (cont.)**
3:00 p.m.	AFTERNOON TEA
3:15 p.m.	**Reporting Back and Discussion** – Training Groups and IGCI Training Team
3:45 p.m.	**Overview of Agricultural Production Systems – The Role of Environmental Factors**– Gavin Kenny (International Global Change Institute, University of Waikato)
4:15 p.m.	**Demonstration of an Integrated Assessment Tool for the Agriculture Sector** – Gavin Kenny (International Global Change Institute, University of Waikato)
4:30 p.m.	**Introduction of Training Exercise 2 – Integrated Assessment of the Impacts of Climate Change on Agriculture** – Gavin Kenny (International Global Change Institute, University of Waikato)
4:45 p.m.	**Group Work on Exercise 2**
6:00 p.m.	ADJOURN FOR THE DAY

TUESDAY, FEBRUARY 13

8:30 a.m.	**Group Work on Exercise 2 (cont.)**
10:00 a.m.	MORNING TEA
10.30 a.m.	**Reporting Back and Discussion** – Training Groups and IGCI Training Team
11:00 a.m.	**Overview of Potential Adaptive Responses for Agricultural Production Systems** – Neil de Wet and Gavin Kenny (International Global Change Institute, University of Waikato)
11:30 a.m.	**Introduction of Training Exercise 3 – Integrated Assessment of Adaptive Responses to Climate Change in the Agriculture Sector** – Neil de Wet and Gavin Kenny (International Global Change Institute, University of Waikato)
12:00 p.m.	LUNCH
1:00 p.m.	**Group Work on Exercise 3**
2:45 p.m.	AFTERNOON TEA
3:45 p.m.	**Reporting Back and Discussion** – Training Groups and IGCI Training Team
~ 4:45 p.m.	**Overview of Cross-sectoral Integration – Linkages Between Agriculture and other Sectors** - John Hay (International Global Change Institute, University of Waikato)
	Demonstration of Cross-sectoral Linkages using an Integrated Assessment Tool – John Hay (International Global Change Institute, University of Waikato)
	Discussion – Institute Participants and Training Team
6:00 p.m.	ADJOURN FOR THE DAY

WEDNESDAY, FEBRUARY 14

ORGANIZED GROUP FIELD TRIP; DEPART BURNS HALL AT 8:30 A.M.

THURSDAY, FEBRUARY 15

8:30 a.m. **Overview of Methods and Tools for Integrated Assessment** - John Hay (International Global Change Institute, University of Waikato)

9.00 a.m. **National Activities in Integrated Assessment: Experiences, Needs and Responses** – Regional Working Groups

10:00 a.m. MORNING TEA

10:30 a.m. **Reporting Back and Discussion** – Institute Participants and Training Team

11:30 a.m. **Recommendations** – Institute Participants

11:55 a.m. **Conclusion of Integrated Assessment Module** – John Hay (International Global Change Institute, University of Waikato)

12:00 noon LUNCH

1:30 p.m. **INDIVIDUAL STUDY AND SMALL-GROUP DISCUSSIONS**

3:00 p.m. AFTERNOON TEA

3:30 p.m. **KEYNOTE ADDRESS ON THE SOCIETAL APPLICATIONS OF CLIMATE FORECASTS**-- Mickey Glantz (Environmental and Societal Impacts Group, NCAR) -- **Asia Room, EWC Imin International Conference Center**

6:00 p.m. ADJOURN FOR THE DAY

FRIDAY, FEBRUARY 16

8:30 a.m. **Realizing the Potential Benefits of Climate Prediction: Issues and Approaches** – James Hansen (IRI)

9:45 a.m. MORNING TEA

10:15 a.m. **FROM FORECASTING TO APPLICATIONS—DECISION-SUPPORT TOOLS**

Application of ENSO Forecasts for Agriculture in Northern Australia – Graeme Hammer (Queensland Department of Primary Industries, APSRU)

Introduction to APN-CLIMAG Project on Management Responses to Seasonal Climate Forecasts in Mixed Cropping Systems of South Asia's Semi-Arid Tropics – Holger Meinke (Queensland Department of Primary Industries, APSRU)

FRIDAY, FEBRUARY 16 (continued)

12:30 noon LUNCH

1:30 p.m. **BEGIN SMALL-GROUP ROLE-PLAYING EXERCISE IN THE POSSIBLE USE OF ENSO FORECASTS FOR AGRICULTURE**
[Use a designed scenario to focus on the "communication" aspects of the development, dissemination, use and evaluation of seasonal climate forecasts to support agricultural decision making with participants playing the roles of four key groups of players: national meteorological service forecasters; farmers; the press/media; and agricultural experts (e.g., extension agents)]

SATURDAY, FEBRUARY 17

8:30 a.m. **INDIVIDUAL STUDY/SMALL GROUP DISCUSSIONS**

SUNDAY, FEBRUARY 18

INDIVIDUAL STUDY/PRESENTATION PREPARATION

MONDAY, FEBRUARY 19

9:00 a.m. **Simulating Agricultural Systems: Why and How (or 'Hard data for soft systems'); continuation of the CLIMAG discussions from Friday**--Holger Meinke

10:30 a.m. MORNING TEA

10:45 a.m. **Economic Valuation of Climate Forecasts** —James Hansen (IRI)

12.00 noon LUNCH

1.30 p.m. **Seasonal forecasting in India: ENSO and the Indian Monsoon**—Krishna Kumar

3:00 p.m. AFTERNOON TEA

3:15 p.m. **BEGIN SMALL-GROUP EXERCISES WITH APSIM**

Participants will be given APSIM output and asked to analyze the results to answer 'what if' questions. Participants will be divided into 5 groups for this task. **APSIM exercises continue through Wednesday morning with three specific learning-by-doing exercises.**

5:30 p.m. ADJOURN FOR THE DAY

TUESDAY, FEBRUARY 20

8:30 a.m.	**CONTINUE WORK ON INITIAL APSIM EXERCISE**
9:30 a.m.	**Working Groups Report on Initial APSIM exercise**
10:00	MORNING TEA
10:30 a.m.	**Decision analysis and cropping options based on seasonal forecasts in India** (Results from the Toowoomba workshop)—R. Selvaraju
12:00 noon	LUNCH
1:30 p.m.	**Decision analysis and cropping options based on seasonal forecasts in Pakistan** (Results from the Toowoomba workshop)— M. Aslam
3:00 p.m.	AFTERNOON TEA PROVIDED
3:30 p.m.	**BEGIN WORK ON SECOND APSIM EXERCISE**
5:30 p.m.	ADJOURN FOR THE DAY

WEDNESDAY, FEBRUARY 21

9:00 a.m.	**CONTINUE SMALL-GROUP EXERCISES WITH APSIM**
10:00 a.m.	MORNING TEA
12:00 noon	LUNCH
1.30 p.m.	**CONTINUE SMALL-GROUP EXERCISES WITH APSIM**
3:00 p.m.	AFTERNOON TEA
3.30 p.m.	**PRESENTATIONS OF RESULTS OF FINAL APSIM EXERCISE**
4:30 p.m.	**Panel discussion: CLIMAG – The Next Steps** – CLIMAG Project Team
5:30 p.m.	ADJOURN FOR THE DAY

THURSDAY, FEBRUARY 22

8:30 a.m. **PARTICIPANT PRESENTIONS ON INDIVIDUAL EXPERIENCES WITH/PLANS FOR THE USE OF CLIMATE FORECASTS AND OTHER CLIMATE INFORMATION TO SUPPORT DECISION MAKING IN THEIR OWN COUNTRIES** (approximately 15 minutes each).

10:00 a.m. MORNING TEA

10:30 a.m. **PARTICIPANT PRESENTATIONS CONTINUE**

12:00 noon LUNCH

1:30 p.m. **PARTICIPANT PRESENTATIONS CONTINUE**

3:00 p.m. AFTERNOON TEA

3:15 p.m. **COMPLETE PARTICIPANT PRESENTATIONS**

5:00 p.m. ADJOURN FOR THE DAY

7:00 p.m. **CLOSING BANQUET – Address by Institute Director**
(Duc's Restaurant; bus departs front of Imin Conference Center at 6:30)

FRIDAY, FEBRUARY 23

9:30 a.m. **INSTITUTE REVIEW AND A LOOK TO THE FUTURE**
(Institute Director)

9:45 a.m. **CLOSING REMARKS FROM INSTITUTE ORGANIZERS AND SPONSORS**

10:00 a.m. **INTRODUCTION TO EWC ALUMNI ASSOCIATION**

10:15 a.m. **PRESENTATION OF CERTIFICATES & CLOSING CEREMONIES**

10:45 a.m. **TRAINING INSTITUTE CONCLUDES**

AFTERNOON

OPPORTUNITIES FOR INFORMAL DISCUSSIONS WITH GUEST LECTURERS FROM WEEK THREE – Speakers available for questions/discussions in individual or small-group settings.

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APPENDIX 3

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

FEBRUARY 5-23, 2001
EAST-WEST CENTER
HONOLULU, HAWAII, USA

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APPENDIX 4

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

FEBRUARY 5-23, 2001
EAST-WEST CENTER
HONOLULU, HAWAII, USA

BRIEF PARTICIPANT BACKGROUND STATEMENTS

Santiago R. Baconguis has an M.S. in Civil Engineering (Water Resources, 1980) from the University of the Philippines, and is a Ph.D. candidate in Agricultural Sciences (Soil) at the Gregorio Araneta University Foundation (GAUF). He is currently Chief Science Research Specialist of the Coastal Zone and Freshwater Ecosystems Research Division, Ecosystems Research and Development Bureau, College, Laguna. In addition to his research activities, he is also involved in training researchers, technicians, students and farmers in the area of soil and water conservation.

Kithisiri Bandara has a M.S. degree in Meteorology (1983) from the University of Reading, UK and is pursuing his Ph.D. at the University of Colombo, Sri Lanka. Currently, he is Deputy Director of the Department of Meteorology, Sri Lanka, in charge of the National Meteorological Center. He is presently engaged in a research project on thunderstorms and tornadoes funded by the National Science Foundation of Sri Lanka.

Rizaldi Boer has received a Ph.D. in Agriculture (1994) from the University of Sydney, Australia, and is currently a Lecturer and Researcher at the Department of Geophysics and Meteorology, Faculty of Mathematics and Natural Sciences, Bogor Agricultural University. He has been involved in many research activities related to the field of agroclimatology and climate change. A recent activity was a multi-disciplinary activity to develop an Information System for Rice in Indonesia.

Pasha Carruthers has a B.A. in Archaeology and Biology (1997) from Simon Fraser University, Vancouver, Canada, and a Post Graduate Certificate in Climate Change Vulnerability And Adaptation Assessment (1999) from the University of the South Pacific, Fiji. She is a Researcher and Technical Officer (V&A) /Acting PICCAP Coordinator with Pacific Island Climate Change Assistance Program, Cook Islands. Her responsibilities include conducting island specific sectoral V&A assessments.

Nathaniel Cruz obtained a Master of Science Degree in meteorology from the University of the Philippines and is presently pursuing a Ph.D. at the same institution. As a professional meteorologist, he now works as a Senior Weather Specialist in the Climatology and Agrometeorology Branch (CAB) of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). As part of his professional duties, Mr. Cruz is currently involved in several ongoing ENSO and climate change related studies.

Diriba K. Dadi holds a Bachelor of Science degree in Statistics (1989) from Addis Ababa University and advanced diploma in General Meteorology (1993) from India Meteorological Department. He is currently Team Leader of Weather Forecast and Early Warning Team, National Meteorological Services Agency of Ethiopia. He is engaged in research activities and is responsible for preparing and issuing short, medium and long-range weather predictions, including seasonal weather outlook for the country.

Paul Della-Marta has a B.Sc. in Physics (1997) from the Curtin University of Technology, Perth, Australia, and is working toward a BApp.Sc. in Statistics at Murdoch University in Perth. He is currently a Climate Scientist with the Bureau of Meteorology, National Climate Centre in Melbourne, Australia. Activities include research into Australia's long-term climate variability.

Susan Espinueva has a B.Sc. in Chemical Engineering (1981), from Mapua Institute of Technology, a M.Sc. in Meteorology (1996) from the University of the Philippines, and is working toward her Ph.D. in Meteorology, also at the University of the Philippines. Her thesis concerns Rainfall Forecasting for Hydrological Forecasting in a river basin. As well as a Ph.D. student, she is a Flood Forecaster/Researcher at the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA).

Jimmy Gomoga has a B.Sc. in Physics and Mathematics (1994), from the University of Papua New Guinea. He is currently a Research Meteorologist and Forecaster with the Papua New Guinea National Weather Service. Recently appointed as a Chief Climatologist, his professional activities range from Consultancy for daily, monthly and seasonal weather forecasts to Analysis of Climate Data for variability and trends in climate change affecting Papua New Guinea and the communication of these findings.

Yanjun Guo has a B.S. in Meteorology (1994) and a M.S. in Atmosphere-Ocean Interaction (1997) from Nanjing University, Atmospheric Sciences Department. She is a climatologist with Climate Diagnostic Lab./NCC/CMA. Currently, she is working on "Study on ENSO Monitoring and Prediction System", a project under China Ninth Five-year Key Project "Study on Short-term Climate Prediction System in China.

Hoang Minh Hien has a Ph.D. in Physic of Atmosphere (1985), from the Bulgaria Academia of Science, Bulgaria. He is Head of Satellite Meteorology Group, National Center for Hydro-Meteorological Forecasting, Hydro-Meteorological Service of Vietnam. His research activities include applications of meteorological satellite data.

Fareeha Iqbal has a B.A. in Economics, Statistics and Mathematics (1994), from Punjab University, Pakistan, and a B.Sc. (Hons.) in Environmental Science and Film and Media Studies (1999), from the University of Stirling, UK. She is currently a Consultant on Climate Change at the Sustainable Development Policy Institute (SDPI), Islamabad, Pakistan.

Akhouri Pramod Krishna has a B.Sc. (Honours) in Geology, Physics and Chemistry (1981) from St. Xavier's College in Ranchi India, and an M.Tech in Applied Geology with specialization in Earth Resources Technology (1984) from University of Roorkee, Department of Earth Sciences, Roorkee, India. He is Researcher with G.B Pant Institute of Himalayan Environment and Development. He has been working to find scientific solutions for sustainable development in the Himalayan region, and carrying out quite a few projects on these issues.

Jian-hua Lu has a Doctorate in Climatology (1999) from the Institute of Atmospheric Physics, Chinese Academy of Sciences. His thesis was a simulation study of regional atmosphere-vegetation interaction on inter-annual and decadal scales. He is currently a Researcher at the Institute of Atmospheric Physics, Chinese Academy of Sciences where he collaborates with scientists in other disciplines in developing an integrated assessment model for the impacts of climate change in north China.

Simon Motilal has a B.Sc. in Geography and Earth Science (1998), and a Post Graduate Diploma in Geography (1999). He is currently Climate Application Officer with the Fiji Meteorological Service, performing climate analysis and response to user inquiries. He also carries out climatological research and development work. Also responsible for the introduction of GIS and remote sensing to the Fiji Met. Service.

Atreyi Paul has a B.Sc. in Environmental Science (1996) from the University of Delhi, Maitreyi College, New Delhi, and a Post Graduate Diploma in Environmental Management (1998) from the Indian Institute of Social Welfare and Business Management in Calcutta. She is currently a Researcher at the Centre for Atmospheric Science, Indian Institute of Technology, New Delhi, where she is involved in a study of the inter-annual and intra-seasonal variability of the Indian Monsoons.

Endang Titi Purwani Pradhana has a Master's in Plant Protection (1980) from Bogor Institute of Agriculture. She is currently a Technical Officer/Forecaster with the Directorate of Food Crop Protection, Directorate General of Food Crop Production, Ministry of Agriculture, Republic of Indonesia. Her main activity is conducting agricultural development programs. She is also involved in writing scientific publications, guidebooks and papers on plant protection (IPM).

Ahmed Salahuddin has a B.Sc. (Honours) in Geography (1987) and a M.S. in Geography (1994) from Katholieke Universiteit Leuven, Leuven, Belgium. He is currently a Research Fellow, Bangladesh Unnayan Parishad (BUP) with the Centre for Research and Action on Environment and Development, Dhaka, Bangladesh. He is involved in different aspects of core research pertaining to environment, climate change impacts and social issues in Bangladesh.

Ramasamy Selvaraju has a Ph.D. in Agronomy and Agricultural Meteorology (1994) from Tamil Nadu Agricultural University, Coimbatore, India. He is currently an assistant Professor at Tamil Nadu Agricultural University. He is involved in ongoing ACIAR and APN research projects that have a strong base in translating the ENSO climate language to appropriate action to optimize the input use through crop modeling in agricultural production systems. He has been involved in many research activities related to agroclimatology and natural resource management.

Arjuna Subbiah has a M.S. in Zoology with Agriculture Entomology (1974) from Madurai University, Madurai, India. He is currently on deputation to ADPC, Bangkok as a Technical Advisor; ADPC Extreme Climate Events Program with the Asian Disaster Preparedness Center. His responsibilities include providing technical support to the country partners in Indonesia, the Philippines and Vietnam to apply long-range Pacific SST based climate forecast information for decision-making purposes. His research efforts include climate variability, associated impacts and response mechanisms.

APPENDIX 5

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

FEBRUARY 5-23, 2001
EAST-WEST CENTER
HONOLULU, HAWAII, USA

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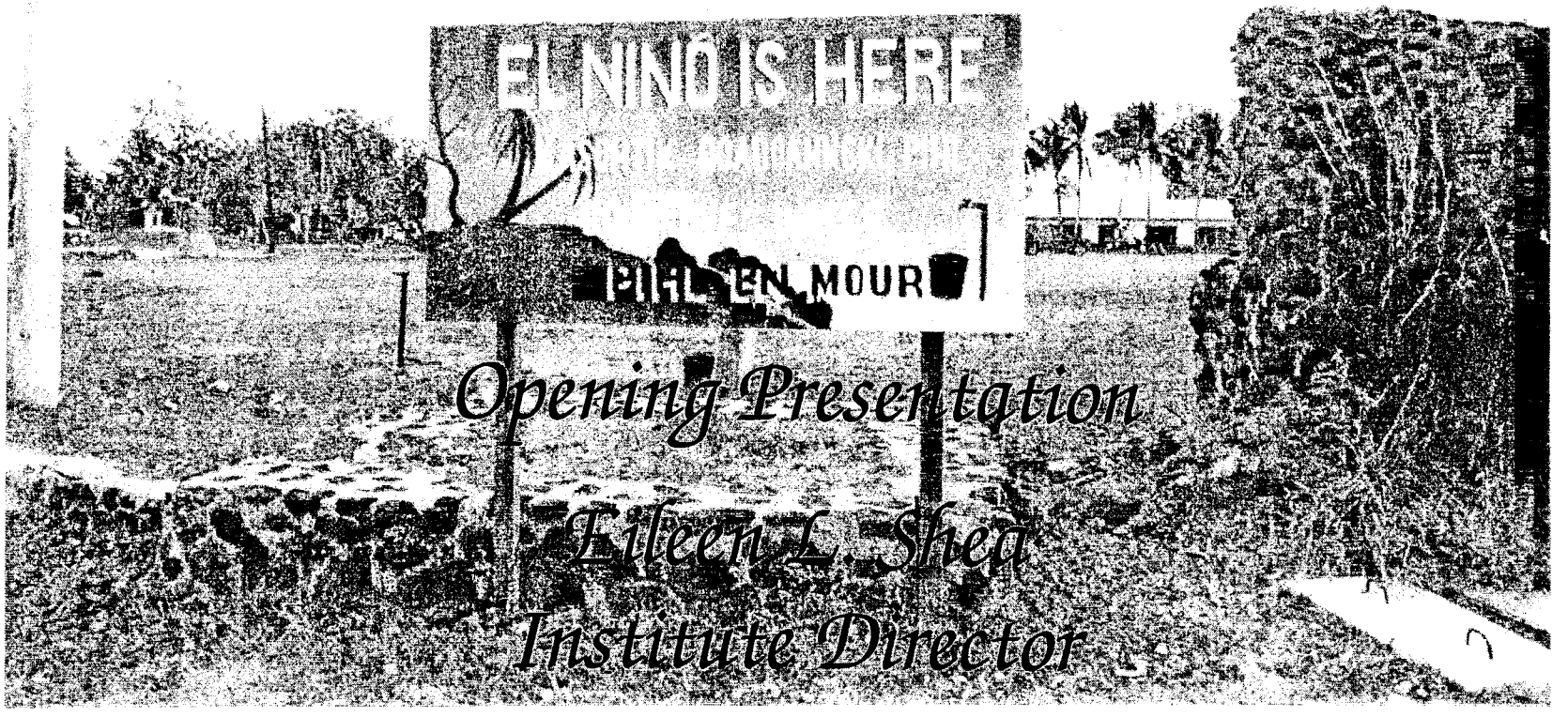
APPENDIX 6

Training Institute on Climate and Society in the Asia Pacific Region



Opening Presentation

Eileen L. Shea
Institute Director

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

INSTITUTE OBJECTIVES

- **Increase understanding of key processes and climate-related vulnerability**
- **Review emerging prediction and assessment capabilities in a regional context**
- **Explore opportunities to improve the use of climate information to support decision making**
- **Consider opportunities for regional research and collaboration**

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

INSTITUTE OBJECTIVES

- Enhance the regional network of individuals skilled in the use of climate information to support practical decision making

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

REGIONAL REPRESENTATION

Australia, Bangladesh, China, Cook Islands, Ethiopia, Fiji, India, Indonesia, Pakistan, Philippines, Papua New Guinea, Sri Lanka, Thailand, Viet Nam

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

INSTITUTE SPONSORS

- EAST-WEST CENTER
- ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH (APN)
- INTERNATIONAL START SECRETARIAT
- NOAA OFFICE OF GLOBAL PROGRAMS
- INTERNATIONAL PACIFIC RESEARCH CENTER, UNIVERSITY OF HAWAII

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

INSTITUTE PARTNERS

- INTERNATIONAL RESEARCH INSTITUTE FOR CLIMATE PREDICTION (IRI), COLUMBIA UNIVERSITY (USA)
- INTERNATIONAL GLOBAL CHANGE INSTITUTE (IGCI), UNIVERSITY OF WAIKATO (NEW ZEALAND)
- AGRICULTURAL PRODUCTION SYSTEMS RESEARCH UNIT (APSRU), CSIRO/QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES (AUSTRALIA)

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

INSTITUTE ORGANIZATION

- INVITED LECTURES & GROUP DISCUSSION
- HANDS-ON, "LEARN-BY-DOING" EXERCISES
- GROUP DISCUSSIONS & PARTICIPANT PRESENTATIONS
- OPPORTUNITIES FOR INFORMAL DISCUSSIONS WITH LECTURERS, INSTITUTE SPONSORS AND PARTNERS AND PARTICIPANTS

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

WEEK ONE

- OVERVIEW OF CLIMATE SYSTEM DYNAMICS, PATTERNS AND TRENDS IN THE REGION
- OVERVIEW OF SOCIETAL CONSEQUENCES AND REGIONAL EXPERIENCE WITH THE USE OF CLIMATE FORECASTS
- THE IRI SEASONAL FORECASTING SYSTEM

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

WEEK TWO

- INTEGRATED ASSESSMENT ISSUES, METHODS AND TOOLS
- FIELD TRIP – CLIMATE AND LIFE IN HAWAII
- CHALLENGES & OPPORTUNITIES IN THE USE OF CLIMATE INFORMATION TO SUPPORT DECISION MAKING

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

WEEK THREE

- THE USE OF CLIMATE FORECAST INFORMATION TO SUPPORT AGRICULTURE:
  - CLIMAG PROJECT EXPERIENCE TO DATE
  - NEW OPPORTUNITIES FOR IN-COUNTRY APPLICATIONS AND REGIONAL RESEARCH

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

WEEK THREE

- PARTICIPANTS SHARE NEW IDEAS REGARDING THE USE OF CLIMATE INFORMATION TO SUPPORT DECISION MAKING IN YOUR OWN SETTINGS—HOW WILL YOU USE THE KNOWLEDGE GAINED DURING THE INSTITUTE?

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

CLOSING CEREMONIES

- BANQUET (THURSDAY, FEBRUARY 23)
- PRESENTATION OF CERTIFICATES
- THOUGHTS ON FUTURE OPPORTUNITIES
- CLOSING REMARKS BY SPONSORS, PARTNERS AND ORGANIZERS

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

East-West Center Support

- **Eileen Shea**, Institute Director, Room 2062 Burns Hall; ext. 7253
- **Glenn Yamashita**, Program Officer, Room 3025 Burns Hall; ext. 7762
- **Anna Tanaka**, Secretary, ext. 7607
- **Arlene Hamasaki**, Secretary, ext. 7639

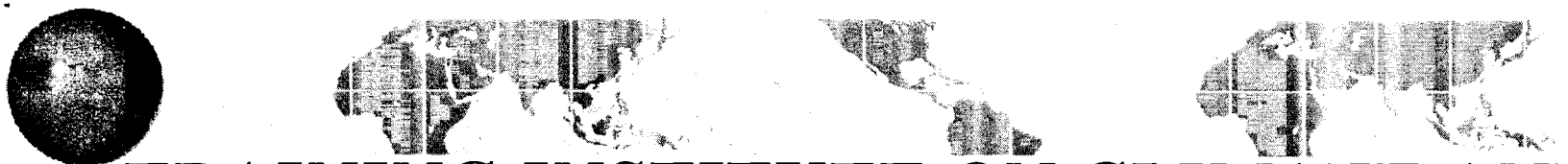
APPENDIX 7

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

EILEEN L. SHEA

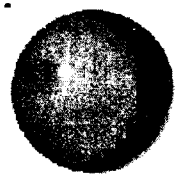
INSTITUTE DIRECTOR

FEBRUARY 23, 2001



TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

- CLIMATE AND SOCIETY AS ONE SYSTEM
- ENCOURAGE A PROCESS OF SHARED LEARNING AND JOINT PROBLEM-SOLVING
- INFORM THE DECISION MAKING PROCESS ("INFORM THE POLICY PROCESS NOT THE POLICY MAKER")
- CLIMATE VARIABILITY & CHANGE CONTINUUM



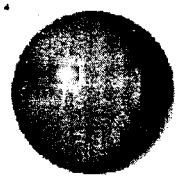
TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

"IT'S THE PROCESS, STUPID"

- CONTINUOUS DIALOGUE & INTERACTION
- ITERATIVE AND EVOLUTIONARY
- ONGOING EVALUATION AND ADJUSTMENT
- USEFUL AND USABLE INFORMATION

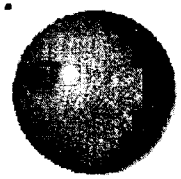
TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

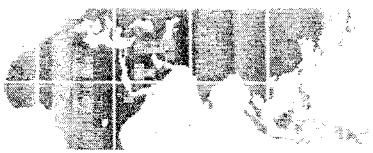
- LEARN TO SPEAK A COMMON LANGUAGE
- UNDERSTAND/PRESENT THE RANGE OF POSSIBLE OUTCOMES AND CONSIDER A SUITE OF OPTIONS
- "INFORMATION BROKERS" PLAY IMPORTANT ROLES – SOMETIMES WE ARE THEY!
- INTEGRATION – AS A GOAL AND AN APPROACH



TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

- PAST AS PROLOGUE
- ADDRESS TODAY'S PROBLEMS TODAY AS WE PLAN FOR THE FUTURE
- VULNERABILITY AND ADAPTATION:
  - FOCUS ON ACTION – EMPOWER THE PLAYERS
  - BUILD RESILIENCE/ADAPTIVE CAPACITY
  - PURSUE "WIN-WIN" MEASURES
  - LEARN-BY-DOING





TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

PURSUE INNOVATIVE PARTNERSHIPS

- MULTI-DISCIPLINARY TEAMS
- REGIONAL APPROACHES
- SCIENCE, GOVERNMENT, BUSINESS, NGO'S PRESS/MEDIA AND COMMUNITIES
- SCIENTISTS AND DECISION MAKERS

CLIMATE AND SOCIETY

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION: SOME CLOSING THOUGHTS

- WE ARE "OHANA" – THE EMERGENCE OF AN ASIA-PACIFIC CLIMATE INFORMATION NETWORK
- COMMIT TO CONTINUED DIALOGUE AND EXCHANGE
- LOOK FOR OPPORTUNITIES FOR JOINT RESEARCH
- SHARE OUR KNOWLEDGE WITH OTHERS

APPENDIX 8

Exercise 1: Scenarios

International Global Change Institute (IGCI)
University of Waikato
Hamilton, New Zealand

12 February 2001

Introduction

Congratulations! You have been selected to be a member of a team of international experts drawn together in order to undertake a climate change V&A assessment for Fiji. Your brief is to assess the effects of climate change on agriculture in Viti Levu. To aid your assessment you have at your disposal a state-of-the-art integrated assessment tool – FIJICLIM. The team has decided that the first priority is to master the climate change scenario generator in FIJICLIM.

FIJICLIM Scenario Generator

The FIJICLIM scenario generator allows the user to examine baseline climatology for Fiji as well as to generate two types of climate change scenario: **synthetic** and **model-based**.

The synthetic scenario generator enables users to make incremental adjustments to temperature and rainfall. These adjustments are applied uniformly to the baseline climate data.

The model-based generator involves the **linked-model** approach. There are two components to this approach. Library files of output from MAGICC describing global temperature and sea-level changes are used as input to the scenario generator. The global temperature changes are used to ***scale*** temperature and rainfall changes for Viti Levu, which have been extracted from the patterns of change for the Pacific region as projected by complex global climate models (GCMs). These changes are applied to the present climate (1990 baseline) to create climate scenarios for the year of interest (e.g. 2100).

When using the scenario generator in FIJICLIM, it is important to have an appreciation of the three key uncertainties in projecting climate changes for Fiji, namely: the climate sensitivity; future greenhouse gas emissions; and regional patterns of change.

- **Greenhouse gas emission rates**: These uncertainties arise as a consequence of uncertainties about future demographic, technological, social and developmental trends and changes. Thus, a large range of emission scenarios are contained within FIJICLIM. Recent IPCC emission scenarios are the SRES set: A1, A2 (high), B1 (low) and B2.

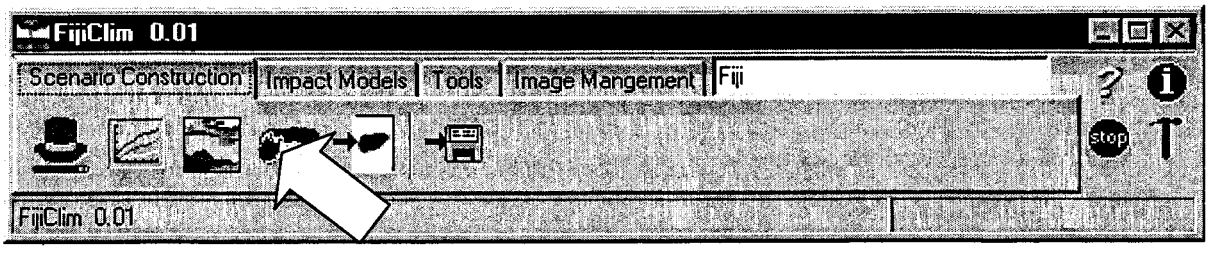
- **Climate Sensitivity**: refers to the *equilibrium* change in global-mean temperature for a *doubling* of carbon dioxide. There is considerable scientific uncertainty regarding the value of the climate sensitivity because of feedbacks in the climate system. High, Best-estimate and Low choices produce corresponding high, middle and low projections of global warming for a given greenhouse gas emissions scenario.

- **Climate Change Patterns**: Regional patterns of climate change can only be provided by very complex, 3-dimensional models of the world's climate system, called general circulation models, or GCMs. However, at the scale of regions or countries, different GCMs often show very different results, particularly for precipitation changes. Thus, a range of GCM outputs are available in FIJICLIM for examining uncertainties.

Objective 1. Examine the Current Baseline Climate (25 min)

Your first step in the V&A process is to examine the current climate and in particular to gain an understanding of the climate conditions in Fiji that are relevant to agriculture. Follow the steps described below to produce a baseline climatology (1990 baseline climate) for Viti Levu:

1. Open FIJICLIM. The main menu is displayed.



2. On the scenario construction toolbar click on the icon which is labelled "Generate a country scenario" (ARROW).
3. Select mean temperature as the climate variable of interest and click on OK.
4. On the scenario construction window which is displayed select the linked model approach (default setting) and set the year to 1990 (the baseline climate). Click OK.
5. On the month selector window select all the months of the year. Click OK.
6. You may repeat this process selecting precipitation as the climate variable of interest. Load the precipitation palette to improve the final image.

Note: These images may be captured by pressing Alt-Print Screen and pasting (Ctrl-V) into a Powerpoint slide.

7. Now use FIJICLIM to generate images for a brief Powerpoint presentation summarising current climate conditions in Fiji. Consider:

- *What are the areas of highest mean temperature in Viti Levu? What are the lowest?*
- *How does rainfall vary across the island? How does it vary seasonally?*
- *How does climate influence current agricultural activities? Consider taro, an important root crop in Fiji which does not thrive in areas where the wet season*

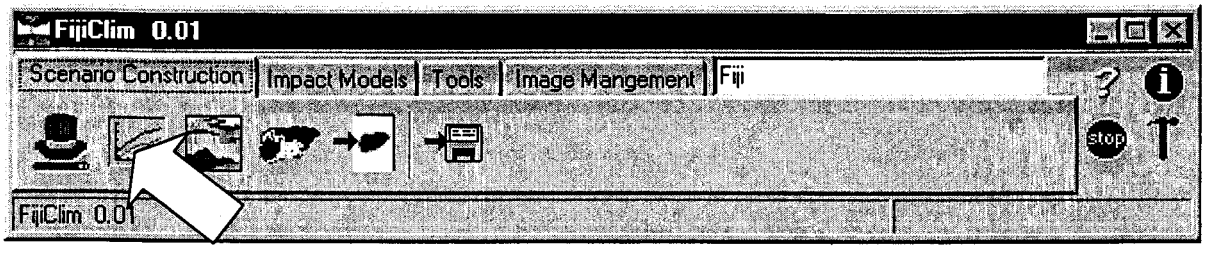
(the 6 months from October to March) rainfall is below 1600mm. (Hint: select the relevant 6 months of the year and on the output image use the **Hammer** icon to define 1600mm as the maximum value shown.)

Objective 2. Explore the range of uncertainty that arises from Greenhouse Gas Emission Scenarios and the value of the Climate Sensitivity (20 min)

At the first team meeting, to discuss climate scenarios which will be used in the study, there is still some confusion about the use of emission scenarios and the climate sensitivity value in the construction of climate scenarios. You have been asked to prepare a 3 min presentation to explain these uncertainties in terms of their effect on global changes.

1. The first task in this section is to develop a set of images which illustrate the significance of the value of the Climate Sensitivity and choice of Emission Scenario in the construction of scenarios of climate change?

   Tips: Click on the **MAGICC Database Tool** on the Scenario Construction tab of the Main Menu.



   Examine the significance of the choice of **SRES emission scenario** and the range of **climate sensitivity** in terms of changes in:

   - global atmospheric carbon dioxide levels;
   - global mean temperature.

   You may wish to click on the graph icon (top of window) to plot the changes over time and to produce the images for your Powerpoint presentation.

2. After some discussion your team has decided that to complete a climate change V&A assessment for Fiji it would be best to use two global change scenarios: a mid-range scenario and a high-range (worst case) scenario. Based on the

experience gained from this exercise, what would be your choices of emission scenario and climate sensitivity to construct these two scenarios of global change?

Note in your Powerpoint file.

Objective 3. Develop scenarios of climate change for Fiji (40 min)

While you have now worked on scenarios of global change, it is clear that the team needs to determine what this may mean in terms of local changes in Fiji.

1. Based on the two sets of global change scenario descriptors identified in the previous task, create a high-estimate and mid-range scenario of climate change for Viti Levu and compare this with the baseline climate (Objective 1).

   Tips: Begin at the **Generate a Scenario** button on the Main Menu. After selecting your Climate Variable, Year and Study Area, select the **CSIRO Climate Change Pattern**, your specified **GHG Emissions Scenario** and your specified **Climate Sensitivity** value (High, Mid, Low). Examine changes in mean **temperature** and **rainfall** for your mid-range and high scenario for the time horizons of interest.

2. Repeat using the **DKRZ GCM pattern** and compare these results to the baseline climatology and to the scenario which used the CSIRO pattern.

   Comment on and record your findings in Powerpoint.

3. Briefly **list** other aspects of future climate that may be important for assessing climate change impacts on agriculture and which are not directly addressed in FIJICLIM generated scenarios. To what degree and how could FIJICLIM be used to address these?

Objective 4. Develop non-climatic scenarios for Fiji (30min)

Now that you feel reasonably confident constructing climate scenarios, the team's attention turns to the task of developing non-climatic scenarios for Fiji that would be useful in terms of a V&A assessment. Remember that a non-climatic scenario is important for the following:

- Assessment (and interpretation) of Impacts;
- Understanding cross-sectoral linkages; and,
- Identification and Assessment of Adaptation options.

Tasks:

1. Use Spectrum to develop demographic scenarios. Record results as a 2D graph and in a table (for the years 2025, 2050, 2100).

   (**Spectrum Tips**: Open **SPECTRUM**. Click on **File** and **Open Projection**. Insert the floppy disc with Fiji demographic data. Open the three Fiji data files from the 'a' drive. Go to **Display / Demography / Population / Total Population**. Chart projections as a **2D graph**. Press OK and capture the image. Press **Configure** to go back and select **Table**. This will give you exact numbers for the approximate year of interest.)

2. Use your own knowledge, experience and expert judgement to identify other areas of change that would be relevant to V&A in the agricultural sector in Fiji. In this exercise consider the population projections together with existing trends in, for example, land use, population shifts, pollution, land degradation, etc, and briefly sketch a plausible scenario.

   (**Note:** This part of the task is highly qualitative and descriptive rather than analytical. Without specific knowledge of Fiji, you may need to generalise from your own knowledge of developing countries / island countries such as Fiji.)

   Briefly (bullet points) describe the areas considered and the trends and changes in your outline scenario. Document on Powerpoint slides.

Exercise 2: Impacts

International Global Change Institute (IGCI)
University of Waikato
Hamilton, New Zealand

February 2001

Problem 1

Evaluating impacts of climate variability and change on sugarcane

Sugarcane production began in Fiji in the latter part of the 19th century. Originally, sugarcane was grown in the vicinity of Suva (the capital of Fiji) in south-eastern Viti Levu. However, the climate in this part of the island was found to be too wet, on average, for high sugar yields and the industry became established in the drier north-western region, centred on the town of Nadi (see Figure 1 below). Indentured labourers were brought from India to work on the sugarcane plantations. Sugarcane rapidly became a mainstay of the Fiji economy, which continues to this day. It presently accounts for approximately 45% of total export earnings.

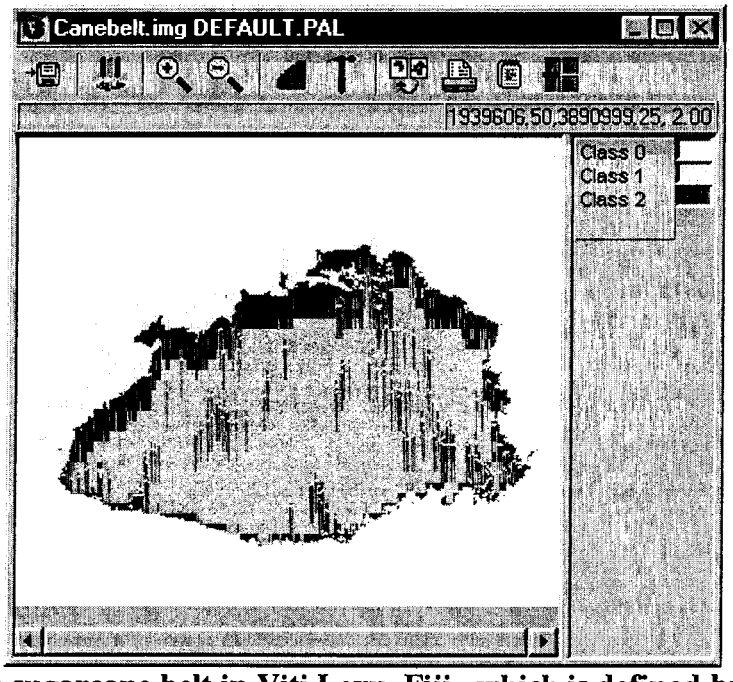


Figure 1: The sugarcane belt in Viti Levu, Fiji , which is defined by the lighter areas.

While the climate of western Viti Levu is well suited for sugarcane production, it is a region that experiences climatic extremes which can have significant effects on production in given years. High rainfall events, often associated with tropical cyclones, can cause significant damage. However, the greatest impact on production is from drought, which is associated in Fiji with El Niño events. The 1997/98 El Niño drought (when temperatures were slightly warmer (+0.5°C) and rainfall was significantly reduced (-50%)) had a particularly severe effect on sugarcane production. The effects of drought, in particular, have been compounded over the last few decades by the expansion of production (in the late 1970s) into more marginal land areas, which are particularly drought prone.

The Minister of Agriculture of Fiji is greatly concerned about this situation, and would particularly like to know if it is likely to worsen as a result of climate change. He has called on a team of international experts, the climate impacts assessment team to address some key questions relating to how sugarcane production might change with climate change.

Note: Use Powerpoint to record your work for presentation

TASKS

(1) Examine changes in sugarcane production in Viti Levu:

- ***What is the present biomass yield in the sugarcane belt in Viti Levu?*** The Fiji MAFF would first like the climate impacts assessment team to estimate present predicted biomass yield (on average) in the sugarcane belt (Hints: find PLANTGRO under the IMPACTS MODELS tab. Select Viti Levu from the site list and select sugarcane from the Plant File. Specify April as the sowing month and check only the YIELD box under OUTPUT IMAGES. For present climate, remember to choose "1990" as the year).

- ***Within the current area of production, what changes in estimated yield will occur with climate change?*** MAFF would like the assessment team to compare sugarcane production under present climate to two future "time-slices", 2025 and 2050, for both warmer, wetter and warmer, drier scenarios of future climate change.

(2) Examine changes in sugarcane production during El Niño events, for the present and future:

- *What was the relative effect of the 1997/98 El Niño event on sugarcane yield?* MAFF would like to quantify the effects of the 1997/98 drought on sugarcane yield. (Hint: use the information provided in the introduction to this exercise, on the average temperature and rainfall changes experienced during the 1997/98 drought, to create a SYNTHETIC scenario).

- *What might be the consequences in the future, with climate change, if the magnitude of change experienced in 1997/98 were to become the norm with El Niño events?* MAFF would like to quantify the possible effects of a future drought under climate change. (Hints: El Niño type GCM results suggest that the climate in Fiji could be 1.0°C warmer and 10% drier **on average by 2050** – adjust the 19978/98 El Niño values by these amounts to develop an El Niño scenario for 2050).

In evaluating your results and preparing your brief for the minister you may want to consider the following:

- The present frequency of low production years (related to El Niño droughts) is 1 year in 4;
- Severe production losses (of 50% or more) presently occur only about 1 year in 8.
- What would be the implications of an increased frequency of severe El Niño events?

Prepare a brief Powerpoint presentation with your key findings.

Problem 2
Evaluating impacts of climate variability and change on root crops

Root crops, such as taro, yam and cassava are an important component of the subsistence agriculture sector in Fiji. The traditional staple crops are taro and yams, which are alternated as wet and dry season crops respectively. Yams have been displaced to a large degree by the hardier, but less nutritious, cassava. Taro is commonly grown as a staple food crop, but in recent years has increased in importance as an export crop, particularly since the presence of taro blight in Samoa. Taro is now Fiji's second major agricultural export earner due to high prices offered from New Zealand and the US. Production in 1997 was 23,350 tonnes, harvested from an area of 2,441 hectares (an average of 9.6 tonnes/ha). Approximately one quarter of the total 1997 production was exported. Cassava and yams are grown predominantly for local consumption. For example, only 0.25% of the total cassava production was exported in 1997, yam exports were even less.

Taro is grown mostly in the wetter areas of Fiji, including eastern Viti Levu, where annual rainfall ranges from 3000 to 4500 mm. In the higher rainfall areas taro is grown all the year around and is usually planted in September to November, before the onset of the rainy season, while the off season crop is grown in March to June. Rainfall has a very strong influence on taro yield, as shown in a sensitivity analysis of the effects of rainfall amount on simulated yield in Koronivia, Viti Levu (Figure 2).

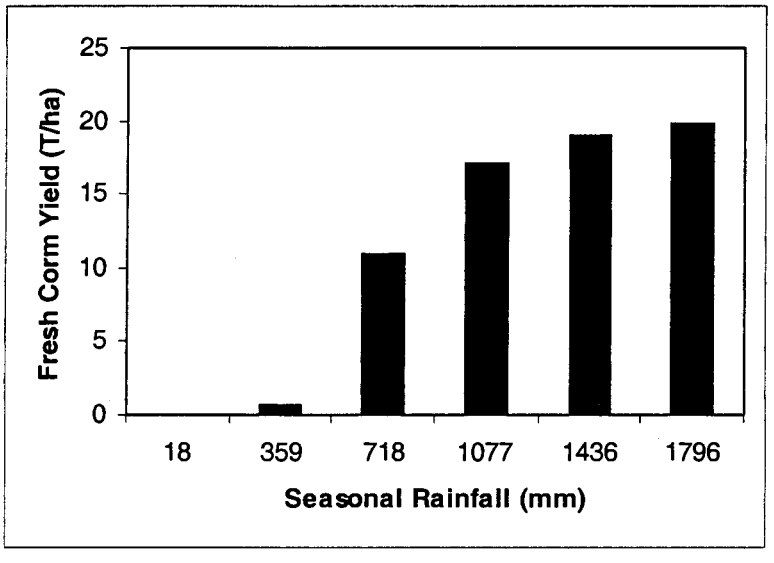


Figure 2: SUBSTOR-Aroid (v2.1) simulation of rainfall effect on fresh taro corm planted in September at Koronivia, Viti Levu, Fiji

Assuming optimal soil and rainfall conditions the expected average yield of taro in Fiji is 15-20 tonnes/ha. Under subsistence conditions, it is more likely to be in the range of 5-15 tonnes/ha, which is the range of national average yield. However, in the more productive higher rainfall areas semi-commercial yields can be as high as 30 tonnes/ha.

Yams are traditionally grown in rotation with taro, generally preferring drier conditions. There are some 60 different cultivars that have been trialled by the MAFF at Nausori, of

which there are different cultivars suitable for different climatic zones. The normal planting time is July to August with expected yields, under optimum conditions, of 20-25 tonnes/ha. National average yields range from 5-10 tonnes/ha.

The 1997/98 drought had a severe impact on taro production, and many people resorted to harvesting wild yams as a food source. The Minister of Agriculture has asked the climate impacts assessment team to evaluate the effects of this drought on taro and to determine the likely effects of such a drought under future climate change conditions. Additionally, he is interested in the possibility of investing in a yam breeding programme to provide greater food security during future droughts and has asked the assessment team to evaluate the potential of this crop, particularly under drought conditions. Traditionally, it is known that yam is a good dry season crop, but the Minister requires some quantitative evidence to satisfy international funding agencies.

TASKS

(1) **Examine changes in taro suitability and yield, relative to the current baseline, under conditions comparable to the 1997/98 El Niño and for an El Niño in the year 2050.** (Hint: choose September as the sowing month for taro and check only the YIELD box under OUTPUT IMAGES)

(2) **Repeat the analysis for yam.** (Hint: choose July as the sowing month for yam and check only the YIELD box under OUTPUT IMAGES)

(3) **Produce a short brief for the Minister of Agriculture, summarising the results of this analysis and providing some advice on future options for taro and yam production, particularly relating to El Niño droughts.**

Exercise 3: Adaptation

International Global Change Institute (IGCI)
University of Waikato
Hamilton, New Zealand

13 February 2001

Introduction

Adaptation to the effects of climate change is a broad field and is currently a mostly theoretical one. It is nevertheless an integral part of V&A analysis as it can be argued that vulnerability only occurs where adaptation is not possible or requires excessive economic, environmental or social cost.

The full process required to identify and evaluate adaptation options would be highly technical, involve methodical analysis and assessment of various options and be ongoing. Your assessment team, however, has been requested by the Minister of Agriculture, at short notice, to prepare a policy brief on adaptation. As a team you have agreed that, given the time constraints, what is needed for this presentation is to scope out the adaptation options and advise the minister accordingly. This initial scoping exercise will be highly qualitative and you will need to rely on your own V&A knowledge, experience and expertise to meet this demand.

The challenge that you now face as a member of the climate change assessment team for Fiji, is developing policy recommendations that will contribute to real and tangible adaptation measures in Fiji. Your focus is on agriculture, but considering the nature of adaptation you will be required to examine other sectors and the wider social, economic and environmental issues which face a developing country such as Fiji.

Note: Objectives 1 and 2 cover your team's preliminary work while objectives 3 and 4 focus on developing the material needed for a Powerpoint presentation for the ministerial brief.

Objective 1. Identify adaptation measures and options (30 min)

Your next team meeting is a brainstorming session to uncover the full range of measures and options that may be considered under the subject of adaptation. To generate ideas you may wish to consider various definitions, types and categories of adaptation. You may also want to reflect on the following material:

1. The impact analysis results (Exercise 2).

2. A broad definition of adaptation:

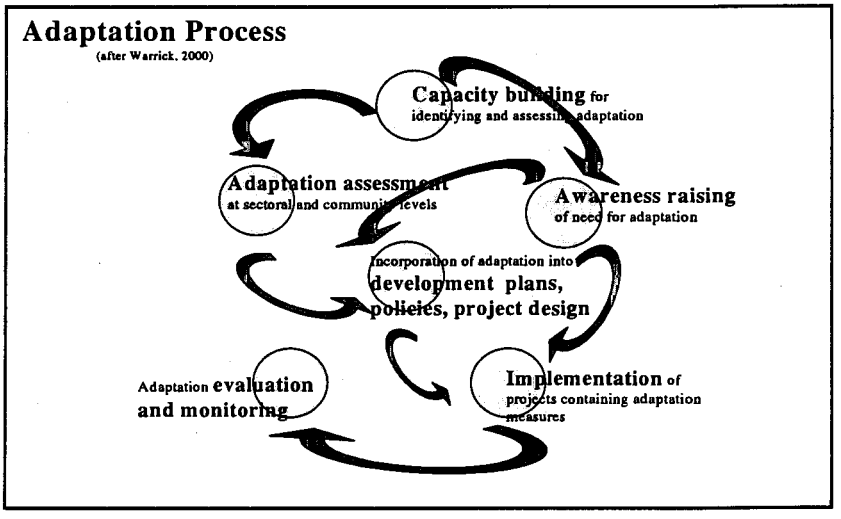
ADAPTATION MEASURES

Measures which increase the ability of:

BIO-PHYSICAL (NATURAL) SYSTEMS
and
COMMUNITIES

to **COPE** with the **EFFECTS** of climate change and accelerated sea level rise.

3. Adaptation as a process:



4. The non-climatic scenarios developed in Exercise 1.

Draft a concise summary list of your ideas. You may want to categorise them in to groups. (Note: There is no need to present this material - it is for your own use.)

Objective 2. Draft a set of evaluation criteria (10 min)

The main task here is to develop an appropriate set of evaluation criteria against which you may assess the value and acceptability of individual adaptation measures. The criteria may include a wide range of economic, social and environmental priorities. It is also recommended however that you include consideration of cross-sectoral linkages, benefits and impacts.

Objective 3. Evaluate adaptation options against adaptation criteria (30 min)

The team has agreed upon a short list of the most important adaptation options. To summarise the work it has been decided that a concise evaluation matrix of adaptation options will be presented to the minister. This would provide a qualitative review of key adaptation options assessed against the selected criteria. It is suggested that the following format for an evaluation matrix is followed:

	Effectiveness	No-regrets merit	etc....			
Option 1	Score or ranking					
Option 2						
etc						

Objective 4. Develop an adaptation scenario for Fiji – for Agriculture and beyond (30min)

From your experience in the V&A assessment so far your team has come to the conclusion that adaptation will need to be a key response to climate change in Fiji. You have become aware of a wide range of measures and initiatives which, if successfully implemented, could make Fiji less vulnerable to the worst effects of climate change.

With your focus on the agricultural sector, but also considering the wider social, economic and environmental issues, your team's opinion is that there may need to be reasonably fundamental and far-reaching changes in policy and practice. It is agreed that the best way in which to present these ideas to the Minister is to prepare an **Adaptation Scenario** which summarises a development trajectory for Agriculture in Fiji which if followed, would make this sector and the wider community less vulnerable to climate change effects.

(Tips: You may want to consider the following:

- cross-sectoral linkages;
- non-climatic pressures;
- demography, institutional needs, capacity building needs, climate impacts etc etc)

Prepare a brief Powerpoint presentation bulleting your key ideas.

Training Institute on Climate and Society
In the Asia-Pacific Region

Friday, February 16

Climate and Agriculture Role-Playing Exercise

On the afternoon of Friday, February 16, Training Institute participants will be engaging in a role-playing exercise to explore the challenges and opportunities associated with the development, communication and use of climate forecasts to support agriculture. In this context, Participants will be asked to take on the roles of four groups representing key players in the climate-agriculture sector in a small Asian country:

- **An association of local farmers** gathered together to discuss their upcoming wet season cropping strategy/plans;

- **A group of agricultural advisors** including technical representatives from the agricultural ministry as well as individuals involved in agricultural extension-type programs who are meeting to put the finishing touches on their plans for the upcoming wet season. They have chosen to meet in the same town (and at the same time) as the farmers Association in order to facilitate discussion with their clients;

- **Reporters from a local newspaper** who are gathered for a meeting with their Editor to discuss potential upcoming news stories. The paper was recently purchased by a new owner and the reporters and Editor are anxious to impress him; and

- **The National Meteorological Service forecasters** who have gathered to consider current conditions and develop the official forecast for the rainy season.

There are three other individuals who play key roles in our drama: **the Director of the National Meteorological Service recently recognized for his groundbreaking research** on ENSO/monsoon interactions and their implications for agriculture; **a charismatic local farmer** who is often interviewed by the media; **and a consulting expert hired by UNEP** to explore the use of climate information to support decision making in this agriculturally-important country.

OPENING SCENE: While each of these groups is meeting (luckily for us in the same town), the local television station decides to acknowledge the recent recognition awarded to the Director of the National Meteorological Service for his research. As a public service, they provide an opportunity for him to provide his perspective on current conditions and their possible implications for the rainy season (1:30 p.m. local time). Joining him on the show will be a charismatic local farmer (a media darling) who will be asked to provide his own perspectives on current conditions. Since both of these individuals are local celebrities, all four groups decide to watch the broadcast in the hotel lounge (our lecture room). Then the four groups go back to

their individual meetings (see attached list of role and room assignments). This is where the fun begins!

With the view of current conditions in mind, each group will continue their deliberations:

- The forecasters will complete development the official forecast which must be released at 2:30 p.m. local time;
- The reporters will discuss whether the scientists' presentation has any news value and their plans for covering the upcoming rainy season;
- The agricultural experts will begin to think about their tasks and what to do – if anything – with the information presented by the scientists; and
- The farmers association will continue their discussion of key factors affecting their rainy season planting decisions and plans.

At 2:30 p.m. local time, the National Weather Service issues the official forecast for the rainy season (provided to the other three groups in whatever manner the forecasters deem appropriate). Each of the other groups can react to the forecast as they see fit and the forecasters prepare to monitor rainy season conditions (for purposes of this exercise, we will assume that they do not adjust their forecast).

At 3:00 p.m. local time, the newspaper publishes a story on the upcoming rainy season and the agricultural experts present their analysis/assessment/guidance to the farmers. Again, each of the groups reacts as appropriate.

By 3:30 p.m., the farmers have decided what they are going to do and the wet season crops have been planted.

SCENE CHANGE: At 3:30 p.m. local time, god has snapped her fingers and the wet season is over. The groups are meeting again, this time to review what happened and discuss some lessons learned. Each group is provided with a summary of what actually happened in terms of rainfall (the only climate variable of interest to be used in this exercise). **At 4:00 p.m. local time, the farmers Association provides the other groups with a description of the impacts of the actual climate conditions on crops.**

From 3:30-5:00, each group summarizes what happened (e.g., given the farmers' planting decisions, how did the crops fare and how would they have reacted to the reality that came to pass. The groups will then discuss lessons learned (e.g., what did they do, what information did they use, what challenges did they face and what might they have done differently. **Each group should prepare no more than three powerpoint slides to summarize what happened and identify some lessons leaned because...**

At 5:00 p.m. local time a spokesperson from each group must appear before the Prime Minister in a special post-season assessment session he has convened. In addition to the four groups, the Prime Minister has asked the UNEP expert to provide his perspectives as well. This meeting will take place in the Prime Minister's conference room (formerly the hotel lounge), Room 2115-2111A.

The primary objective of this exercise is to explore the various challenges and opportunities associated with developing, communicating and using climate forecasts to support agriculture. The primary emphasis will be on the **COMMUNICATION** component of this information and decision support system. Deliberations within groups should take the form of "brainstorming" sessions rather than detailed technical analyses and groups are encouraged to interact with one another as necessary and appropriate throughout the exercise. Groups should define/pursue **REALISTIC modes of interaction** (e.g., designating a spokesperson(s), providing reports or briefings, conducting interviews, etc.). **REMEMBER: THIS IS A ROLE-PLAYING EXERCISE -- participants are asked to step out of their own areas of expertise and "become" the characters they have been asked to play** (a movie director would be asking you "to inhabit" the character). Participants should strive not to be too influenced by their own backgrounds and the actions each group chooses to take should be realistic from the standpoint of that group. Our discussion of lessons learned with the Prime Minister will focus on what each group did and how our individual and collective experiences might be used to improve the mechanisms we use to "inform the process" (as our UNEP expert described it).

THE PLAYERS (Room Assignments to be announced)

The National Meteorological Service forecasters: Cruz, Della-Marta, Guo, Gomoga, Jian-hua Lu, Kumar

The newspaper reporters: Bandara, Iqbal, Moltilal, Salahuddin, Paul, Hammer

The agricultural advisors: Baconguis, Carruthers, Espineuva, Krishna, Selvaraju, Meinke, Rao

The farmers association: Boer, Dadi, Hien, Pradhana, Subbiah, Hansen, Aslam

Director, National Meteorological Service: Krishna Kumar

Famous Local Farmer: M. Aslam

The UNEP Expert: Mickey Glantz

The Almighty: Shea (who may also play other roles)

Common Themes Emerging from Discussions of
The Challenges of Communication in a Climate Information System
(February 16 Climate and Agriculture Role-Playing Exercise)

- Continuing, interactive dialogue among key players (forecasters, farmers, agricultural experts/advisors, press/media) essential.
- Establishing (and sustaining) trust and credibility essential; not always easy to do.
- Effective communication of climate information requires use of language/terminology that is "appropriate" to the users; less use of technical jargon.
- Forecasters and scientists need to be able to communicate forecast limitations (uncertainty) more effectively.
- Using historical analogs/experience can be useful both in characterizing possible outcomes and in understanding/evaluating response options.
- Forecasts should convey a range of possibilities rather than a single number.
- The press/media often focus on "bad news" (at least in this exercise) and this can complicate their engagement as partners in the communication of climate forecasts (and climate information in general).
- Forecast products (and climate information products more generally) can be improved if scientists, forecasters, information brokers and users are all involved in their development, dissemination and evaluation.
- Inform the policy process not, necessarily, a/the single "policy maker"-- i.e., per Mickey Glantz' presentation, target appropriate individuals or institutions involved in the decision making framework rather than assuming there is a single "policy maker" to be addressed.

CLIMATE AND AGRICULTURE

LEARNING-BY-DOING EXERCISES IN SYSTEMS ANALYSIS USING APSIM

HOLGER MEINKE AND GRAEME HAMMER
(AGRICULTURAL PRODUCTION SYSTEMS RESEARCH UNIT)
&
JAMES HANSEN
(INTERNATIONAL RESEARCH INSITUTE FOR CLIMATE PREDICTION)

Conducted at the

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

February 19-21, 2001
East-West Center
Honolulu, HI USA

The Wheat Game

You are a wheat grower in north-eastern Australia. In this semi-arid, subtropical environment farming is tough, particularly when you depend on world market prices. Wheat is grown in winter (May to September), but most of the rain (70%) falls in summer. However, rainfall is extremely variable and growing a successful wheat crop depends strongly on the amount of stored soil moisture that is available at planting and in-season rainfall you might receive.

Nitrogen fertilise is an expensive input, but needed to get the high yields in the good years. Also, you are paid a premium of $5 for each percent protein increase. At planting you need to decide what to do: either apply a low, a medium or a high fertiliser rate to your crop.

ENSO-based seasonal rainfall forecasts at planting are possible and have some skill. Knowing that the odds of getting either above or below median rainfall differ can substantially impact on your decision to apply nitrogen, at least you think so.

You don't want to apply more nitrogen than necessary (ie. if you don't get enough rain, your crop will be water limited and you don't need as much N), but you don't want to limit your potential yield either.

So how does prior knowledge of rainfall probabilities translate into wheat production outcomes? And how do commodity prices and input costs influence the economic decisions you have to make? Finally, how does the stochastic nature of the system affect your income this year and in years to come?

This program is designed to help you in your decision. It demonstrates that rainfall and production distributions are linked, but they are not identical. Even if an above average season is likely and eventuates, it does not necessarily follow that the yields will also be improved. Further, it shows how knowledge about future outcome distributions is necessary to make informed decisions. However, once the decision is made and although your chances of getting a certain outcome are increased, you are only able to grow one wheat crop per year. This single event determines your income and lifestyle for this year and any outcome is possible. Explore the program, look at the various alternatives, evaluate their outcome. Quantify the difference between rainfall probabilities and wheat production. Then answer some specific questions:

1) How do the different soil types and starting soil water conditions influence your nitrogen application decisions when the forecast is favourable (50%, 25%, 25% chance for a good, average and poor season, respectively) or unfavourable (25%, 25%, 50%)?

2) How do wheat prices and the amount of premium payable affect your decision?

3) How sensitive is your decision to changes in input costs for nitrogen fertiliser?

Summarise your findings in a few ppt slides and prepare a group presentation (10-15 min).

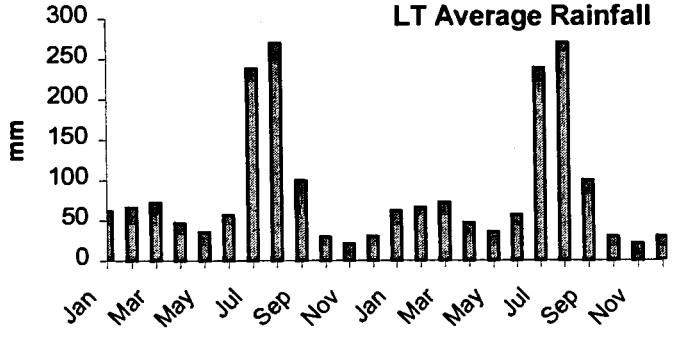
Improving a Wheat – Fallow System (Islamabad)

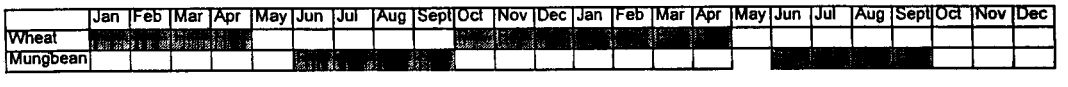
Background

The cropping systems in this region is dominated by a wheat – fallow – wheat rotation. Wheat is a stable food and cropping intensity tends to be relatively low with large areas left fallow for a whole year. Average yields of wheat vary from 0.9 t/ha in the dry zone to 1.4 t/ha in the high rainfall zone.

The introduction of Mungbean in the Wheat-Fallow-Wheat system appears feasible in medium and high rainfall areas. Mungbeans maintain soil fertility and sustain system productivity. Farmers in medium rainfall areas who replaced fallow with Mungbean were able to raise their net system income (Majid et. al 1990). However, the mungbeans, planted in mid summer, can deplete soil water reserves that would otherwise be accessible to the wheat crop. This could lead to reduced wheat yields and possibly even a total failure of the wheat crop.

On-farm experiments in the higher rainfall areas showed that the Mungbean-Wheat system can increase the overall productivity and result in higher farm incomes. It was suggested (Aslam, 1995) that legumes (eg. mungbean, cowpeas) based wheat systems in high rainfall areas will help farmers to sustain system productivity through, moisture conservation, stable economic benefits, improvement in soil nutrition and organic matter over time.





Analysis

To investigate the likely benefits and risks associated with the introduction of a more intensive cropping system, we simulated the traditional fallow-wheat system and the alternative mungbean-wheat rotation. Simulations were conducted for two different soil types varying in their total, plant available water holding capacity (PAWC). In the example given, the higher PAWC soil was analysed and it was concluded that in the absence of any other constraints and with today's cost and prices the mungbean-wheat rotation would perform better than the fallow-wheat rotation in about 90% of years. However, there was a tendency for lower wheat yields (and hence an increased risk to the stable food provision) to occur following a negative or falling SOI phase in May/June. Outcomes were also sensitive to costs and price ratios between the two crops. In addition, a wheat yield of at least 2 t/ha is required to maintain local food supply.

The question remains: Can the same conclusions be drawn if the wheat – mungbean rotations were implemented on a much shallower soil (60 mm PAWC) or with different commodity prices? How often would the minimum threshold NOT achieved using the new rotations? Please use the simulation output provided to answer these questions.

Farm Land Allocation Among Crops, Avinashi, Tamil Nadu, India

Background

The previous exercises focused on management of particular cropping systems in a single field – an enterprise-level analysis. This exercise extends the analysis to a farm-level decision. The dominant cropping systems in the pilot study area near Avinashi (Tamil Nadu, India) are cotton monoculture (i.e., only one crop per field per year), and groundnut followed by sorghum for fodder (Fig. 1). For a representative farm, you will consider whether to allocate available land to cotton, groundnut-sorghum, or some proportion of each.

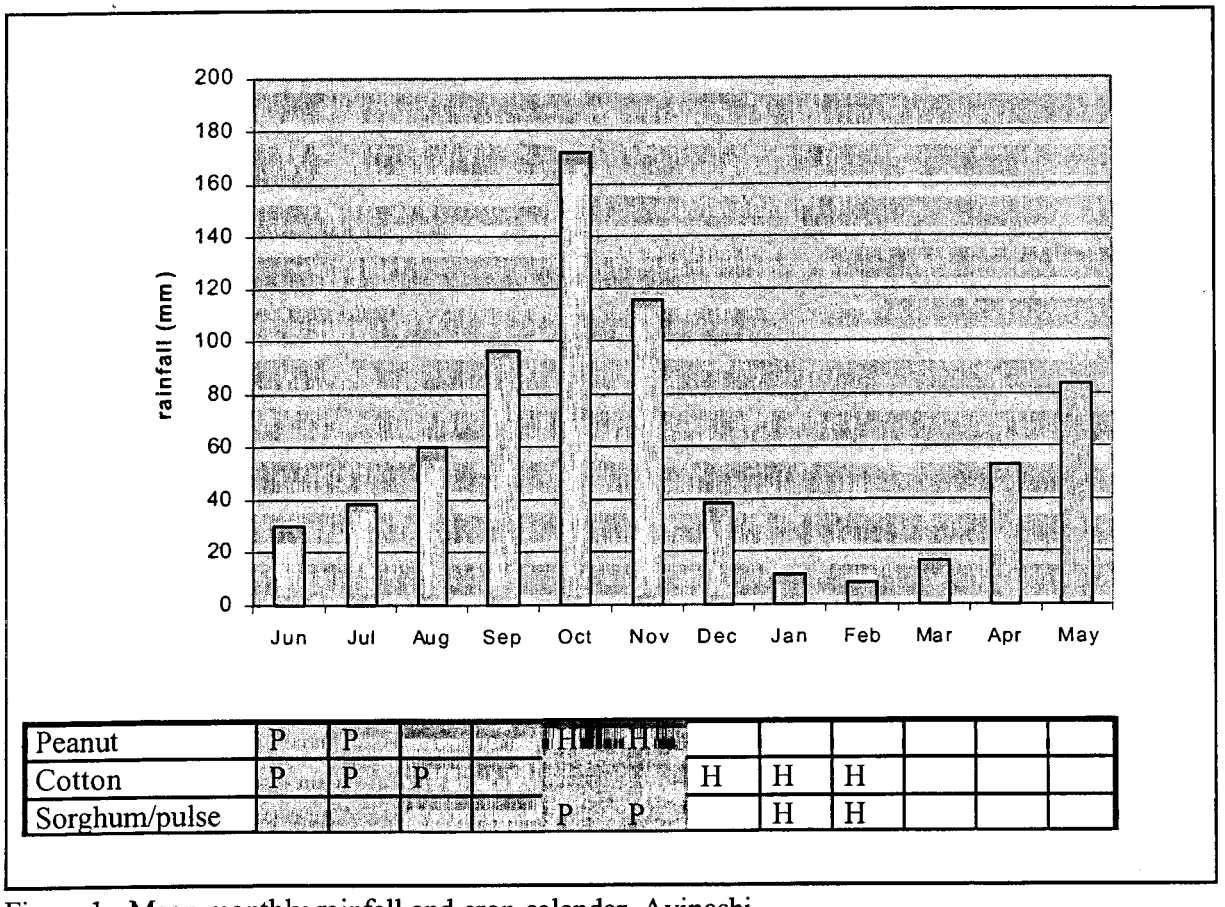


Figure 1. Mean monthly rainfall and crop calendar, Avinashi.

You will allocate land to cropping enterprises in a way that maximizes the certainty-equivalent wealth (equivalent to maximizing expected utility) at the end of a one-year planning period for given expected weather conditions, subject to land availability and non-negativity constraints:

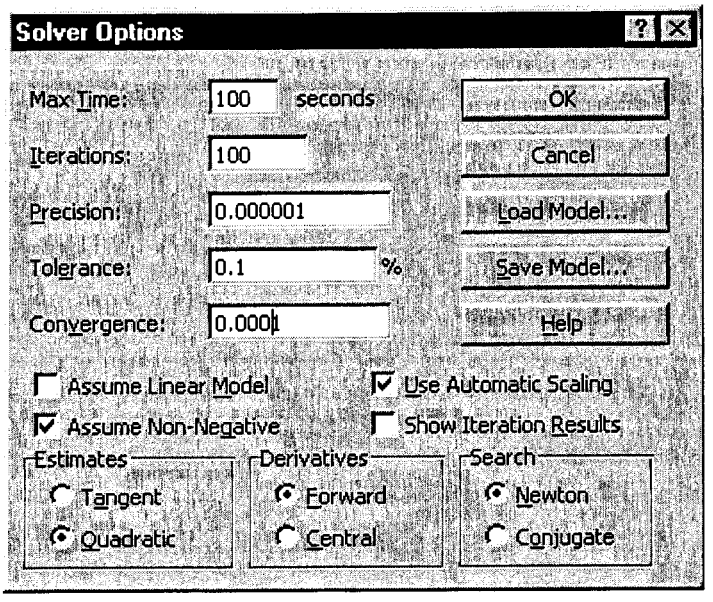


Figure 4.

3. Now explore and record how land allocation, mean income and certainty equivalent change with changing risk aversion. To keep risk aversion in a realistic range, r=0 represents indifference to risk (i.e., mean profit maximization), r=0.5 slight risk aversion, and r=3.0 very strong risk aversion. Remember that mean income and certainty equivalent for all years (i.e., climatology) provide the baseline for estimates of potential forecast information value. Plot and compare cumulative distributions of farm income under risk neutrality and risk aversion.

4. Repeat the same analyses for each SOI phase. You can calculate mean income and certainty equivalent for the forecast system by weighting optimal results for each phase by the number of years in each phase. For each level of risk aversion considered, calculate potential forecast value on a mean income (objective),

$$V_{obj} = \mathrm{E}\{W(\mathbf{x}^* \mid F)\} - \mathrm{E}\{W(\mathbf{x}^* \mid C)\}$$
$$\approx 1/n \sum (W_i(\mathbf{x}^* \mid F_i, \theta_i) - W_i(\mathbf{x}^* \mid C, \theta_i)),$$

and certainty equivalent (subjective) basis,

$$V_{subj} = W_{CE}(\mathbf{x}^* \mid F) - W_{CE}(\mathbf{x}^* \mid C)$$
$$\approx U^{-1}(1/n \sum U(W_i(\mathbf{x}^* \mid F_i, \theta_i))) \; U^{-1}(1/n \sum U(W_i(\mathbf{x}^* \mid C, \theta_i))).$$

Plot and compare cumulative distributions of farm income for the optimal fixed land allocation strategy, and for the optimal flexible strategy (i.e., land allocation optimized for each SOI phase).

5. As you have time, explore the sensitivity of results to (a) prices, (b) costs of production, (c) farm size, or (d) initial wealth. Cotton price (Rs 17-30/kg) varies more than groundnut price (Rs 10-12/kg).

6. As a group, prepare to report briefly on key results and insights.

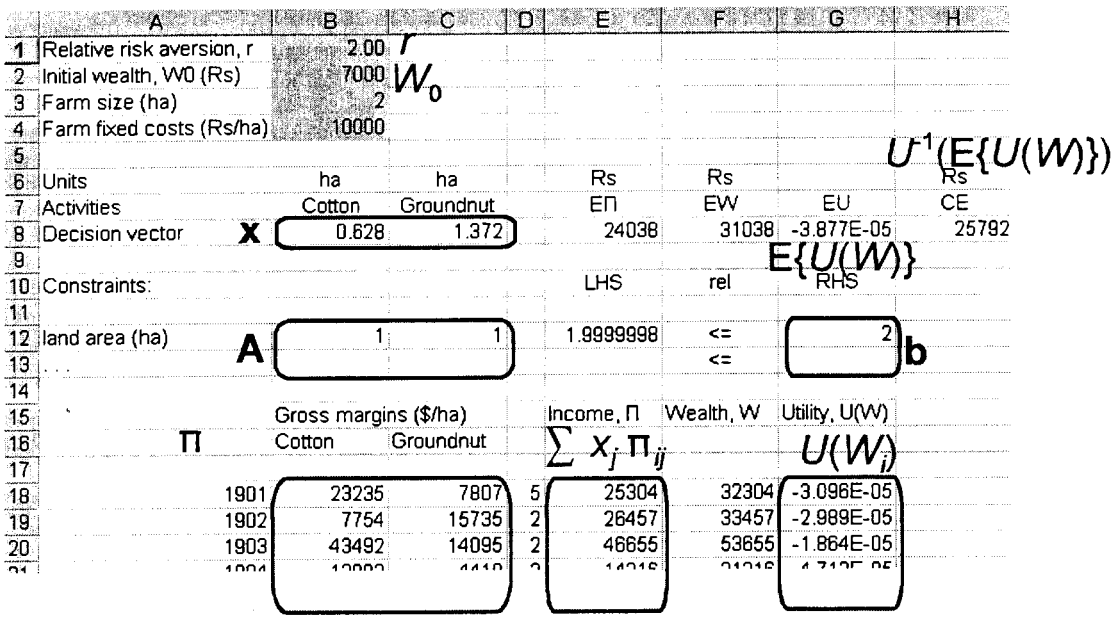


Figure 2. Main components of land allocation model implemented in CropMix.xls.

2. Solving the model requires use of the non-linear optimizer built into the Excel solver. Go to Tools | Solver. Specify the target cell (W_{CE}), decision vector (**x**), and left hand and right hand side constraints as shown in Fig. 3. You also need to set solver options as shown in Fig. 4 to best handle the nonlinear problem. With the default data and assumptions, solve the model and examine the solution (row 8).

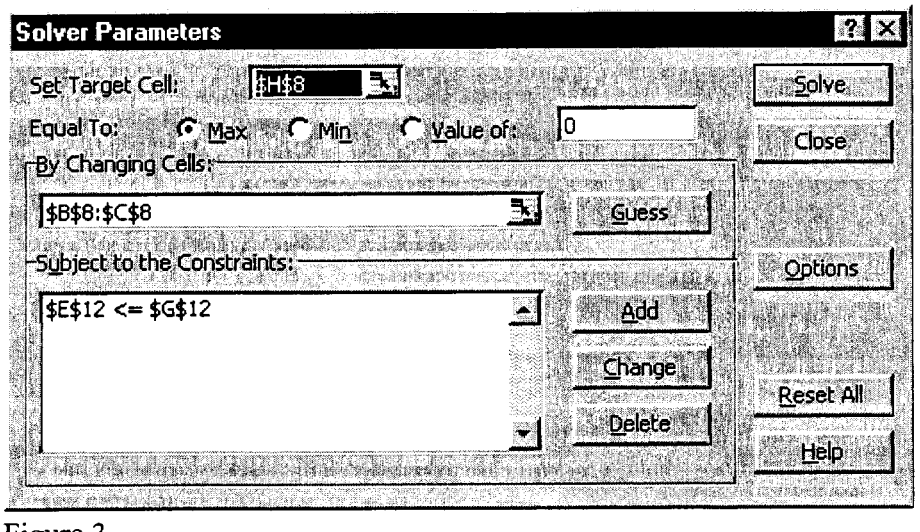


Figure 3.

$$\max_{\mathbf{x}} U^{-1}(\mathrm{E}\{U(W)\}) = U^{-1}(1/n \sum_{i=1}^{n} U(W_0 + \sum_{j=1}^{m} x_j \pi_{ij}))$$

subject to:

$$\mathbf{A}\,\mathbf{x} \leq \mathbf{b},$$

$$\mathbf{x} \geq \mathbf{0}$$

Final wealth W is calculated from initial wealth W_0 and whole-farm income Π obtained from annual per ha net returns π_{ij} and from area x_j allocated to each j of m (2 in our example) crop enterprises. Return π_{ij} to each crop enterprise is calculated from constant production costs and prices, and yields simulated using the ith weather year. Technical coefficient matrix **A** is here a vector [1, 1] that relates land allocated, **x**, to land available, **b** – the only resource constraint considered in our example.

Attitude toward risk is encapsulated in the degree of curvature of a nonlinear utility function. The power function,

$$U(W) = W^{1-r} / (1 - r),$$

used in this study implies constant relative risk aversion, r, and decreasing absolute risk aversion with increasing initial wealth. The inverse of U is,

$$U^{-1} = W = ((1 - r)\,U)^{1/(1-r)}.$$

When r=1, the power function is undefined, and $U(W)$ reduces to $\ln(W)$ and its inverse to $\exp(U)$.

Assignment

1. The model and crop simulation results are in the Excel spreadsheet file, CropMix.xls. The first sheet, **GM** contains a time series of simulated yields for cotton, groundnut and sorghum (grain and stover), and gross margin calculations for each cropping system. What are the mean, standard deviation and cross-correlation of gross margins for the two systems under the given prices? How do you think this information might influence land allocation decisions? Subsequent sheets implement the farm land allocation model described above for all years combined, and for years associated with each SOI phase. Examine the **allyears** sheet. Make sure you understand where and how each component of the model is represented in the spreadsheet (Fig. 2). Assumptions embodied in a few key parameters (blue shaded region) influence the optimal solution.

Risk Analysis and Forecast Value

Risk management entails balancing some tradeoff between the expected value and the variability of outcomes (income or wealth). Farmers employ a range of risk management strategies in an attempt to reduce their vulnerability to fluctuations of climate (Walker and Jodha, 1986; Stern and Easterling, 1999, pp. 40-45). The notion of expected utility makes quantitative exploration of risk-return tradeoffs tractable.

Expected utility

Utility U is a unitless measure of subjective value of, or preference placed on, different returns Π or levels of wealth W (e.g., stored grain, livestock or money), although economists generally focus on wealth, $W = W_0 + \Pi$, on the assumption that initial resource endowment W_0 conditions one's attitude toward a risky decision (Chavas and Holt, 1990). Increasing U with respect to W implies that decision makers prefer more rather than less. The shape of U embodies risk preferences: concave U implies aversion to risk (most people, including smallholder farmers), linear U implies risk neutrality (profit maximizers), and convex U implies risk seeking (gamblers). An economic interpretation attributes risk aversion to decreasing marginal utility of wealth (e.g., stored grain, livestock, money). For example, a person in need of transportation is likely to benefit less from a second or third car than from a single car. Degree of risk aversion is related to the degree of curvature of U. Absolute risk aversion, $R_a(W) = -U''(W) / U'(W)$, is generally thought to decrease with increasing W (Young, 1979; Chavas and Holt, 1990; Pope and Just, 1991). In other words, poorer farmers tend to be more averse to risk than wealthier farmers because low availability of resources increases vulnerability to poor outcomes. The central premise of expected utility theory – the foundation for analysis of decisions under risk (Anderson et al., 1977; Hardaker et al., 1997) – is that, for a given decision, the decision maker seeks to obtain the greatest possible expected subjective benefit (i.e., utility). The premise depends on a few simple assumptions that, while intuitively appealing, empirically do not always hold. Nonetheless, it remains a useful framework for thinking about implications of using skillful but imperfect climate forecasts to improve decision making.

A trivial example illustrates the key concepts of expected utility theory. In this example, a game involving a single toss of a coin creates a risky scenario with two equally-probable wealth outcomes, W_1 and W_2 (Fig. 1). Here the expected outcome $E\{W\}$ is the simple average, $(W_1+W_2)/2$. The vertical axis shows utility associated with each outcome, and with the expected outcome. Notice that the expected value of $U(W)$, denoted by $E\{U(W)\}$, is less than the utility of the expected outcome, $U(E\{W\})$, due to the concavity of U. Because the scale of a utility function is arbitrary and unitless, it is useful to transform expected utility back to units of W. This transformation yields the *certainty equivalent*, $W_{CE} = U^{-1}(E\{U(W)\})$, which can be interpreted as the certain outcome that is equivalent, in terms of decision maker preferences, to the full distribution of outcomes associated with a risky prospect. It is the subjective value, under certainty, of the risky scenario. A *risk premium*, $RP = E\{W\}-W_{CE}$, is the maximum amount that the decision maker would be willing to pay to eliminate the risk associated with the scenario.

Risk management involves selecting among multiple alternatives, each with its own distribution of outcomes. For each risky alternative, $E\{U(W)\}$ and W_{CE} are functions of the distribution of outcomes that characterize the choice, and the shape of the utility function that is assumed to characterize the decision maker. Theory predicts that the decision maker will seek to select the feasible alternative that yields the greatest $E\{U(W)\}$ or, equivalently, W_{CE}.

Optimal use of climate information

Climate variability can be represented by density functions $f(\theta)$ under climatology C and $g(\theta|F_j)$ conditioned on forecast F_j, where θ is a dynamic realization of weather. Let $\mathbf{x}$ represent a strategy consisting of a vector of climate-sensitive decisions, and $\mathbf{x}^*$ an optimal strategy. Return $\Pi_i(\mathbf{x}, \theta_i, \mathbf{e})$ is a function of management strategy $\mathbf{x}$, realized weather θ, and vector $\mathbf{e}$ representing all other environment variables. Expected utility theory implies the decision rule, in the absence of climate forecasts, to adjust $\mathbf{x}$ in a way that maximizes expected utility,

$$\max \; E\{U(W)\} = \int U(W(\mathbf{x}, \theta) f(\theta))\, d\theta, \tag{1a}$$

subject to whatever constraints limit the range of feasible options. In practice, we cannot know the full distribution of climatic or economic outcomes, but can approximate them by looking at the historical climate record over the past n years. Assuming that weather from each past year has equal probability of occurring, the decision problem is approximated by,

$$\max \; E\{U(W)\} \approx 1/n \sum U(w_i(\mathbf{x}, \theta_i)), \tag{1b}$$

again subject to constraints.

Skillful climate forecasts alter the probability distribution of climatic outcomes in a given year. When forecast F_j, is given, the decision rule is modified to reflect the resulting conditional climatology:

$$\max \; E\{U(W|F_j)\} = \int U(W(\mathbf{x}, \theta)\, g(\theta|F_j))\, d\theta$$
$$\approx 1/n_j \sum U(W_i(\mathbf{x}_j, \theta_i \mid F_j)). \quad (2)$$

Any inferences about the forecast system and its value require integration across the range of forecasts considering the probability of each forecast being issued. Application of the decision rule is straightforward for categorical forecasts such as ENSO phases (i.e., El Niño, neutral and La Niña years), where $j = 1..3$.

Value of forecast information

The economic value of information is typically defined as the difference in benefits between optimal use of the new information and optimal use of the information available prior to introduction of the new information. It is useful to differentiate between objective forecast value based on difference in expected returns to optimal use of forecasts vs. climatology,

$$V_{obj} = E\{W(\mathbf{x}^* \mid F)\} - E\{W(\mathbf{x}^* \mid C)\}$$
$$\approx 1/n \sum (W_i(\mathbf{x}^* \mid F_i, \theta_i) - W_i(\mathbf{x}^* \mid C, \theta_i)), \quad (3)$$

and subjective value expressed in certainty-equivalent terms,

$$V_{subj} = W_{CE}(\mathbf{x}^* \mid F) - W_{CE}(\mathbf{x}^* \mid C)$$
$$\approx U^{-1}(1/n \sum U(W_i(\mathbf{x}^*|F_i, \theta_i)))\, U^{-1}(1/n \sum U(W_i(\mathbf{x}^*|C, \theta_i))) \quad (4)$$

(Hilton, 1981; Mjelde et al., 1996). It is also instructive to consider the value of forecasts in particular years,

$$V_i = W(\mathbf{x}^* \mid F_i, \theta_i) - W(\mathbf{x}^* \mid C, \theta_i) \quad (5)$$

which can sometimes be negative.

Equations 3-4 define value associated with optimal use of forecast information relative to climatology for some well-defined decision problem under very specific assumptions. They are therefore appropriately viewed as approximations of potential, or technically-feasible, value rather than expressions of actual value of forecasts.

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CLIMAG SOUTH ASIA PROJECT REVIEW[1]
FEBRUARY 21, 2001
EAST-WEST CENTER
HONOLULU, HI USA

Program Manager/Review Moderator: Eileen Shea

Following their exposure to the background, objectives, methodology and tools used in the CLIMAG South Asia Project, participants are asked to assume the role of a "review panel" for the project. The review panel will be convened on the afternoon of February 21 and will take the form of an open discussion designed to:

- Evaluate the relevance and effectiveness of the approach used in the current South Asia project;
- Evaluate the relevance and feasibility of and provide guidance on the design and implementation of a follow-on project (or projects);
- Consider the relevance and appropriateness of the approach used in the South Asia CLIMAG Project for other sectors and other countries in the Asia-Pacific Region; and
- Provide the program manager and project scientists with some reflections on lessons learned from this initial project in the context of improving the link between climate science/information and societal applications.

Project scientists will be available to answer questions during the review panel deliberations.

Due to time constraints, the program manager encourages the use of a round-table, brainstorming process to identify and document key issues and recommendations.

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[1] Role-playing exercise conducted in the context of the February 5-23, 2001 Training Institute on Climate and Society in the Asia-Pacific Region, conducted at the East-West Center in Honolulu, HI.

Summary of the role-play "Review of the CLIMAG S Asia project"

Issue	Response	Recommendation	Comment
Are SOI phases the most appropriate index for monsoonal environments? Skill maps of the system would be desirable. Is the SOI phase approach feasible in places like Indonesia that have very limited historical data?	- to date still highest degree of forecasting capability from SOI phases, easy connection with systems modelling - lots of climate research in progress, new work needs to connect with systems analysis - approach is not dogmatic but pragmatic - skill does not equal usefulness	SOI phase system is still misunderstood and undervalued. Need to get information kit and phase maps out to participants and other scientists.	This forecast system does not depend on an ENSO forecast and can be used anytime, anywhere. In regions with no ENSO signal it will show simply 'climatology'.
The training was useful and appropriate. However, it would be good to cover other sectors such as environment and water resources. The project provided and excellent example of effective applications in dryland cropping. This needs to be broadened to agriculture in general and then to other sectors such as fisheries, disaster management and relieve, energy and mining, health etc.	The concept of systems approaches is generic and can be expanded into these sectors. It requires systems experts within these sectors to champion it. We can only show them the general framework, which was developed for our sector.	There appears to be a big demand for systems approaches in other sectors. Hence, similar projects with an application focus should be conducted for these other sectors.	The CLIMAG team might be able to help these groups to set up the process, but they can't do the work.
The project has clearly shown the relevance of seasonal climate forecasts and climate variability information. The link to non-climatic factors (eg. economics, social) is very important and these factors need to be seen in perspective.			Issue to be addressed in phase 2.
A follow-on project should focus on S Asian regions and must include rice systems, including paddy rice.			
"feedback mechanism" – how is the user			Issue to be addressed in

feedback being incorporation from the stakeholders to the providers. To what extent is the project providing insights into the process?			phase 2.
Local acceptance of project findings might be difficult if credibility and trust between institutions and individuals has not been established.	Agreed. Need to demonstrate the value of local, participatory systems approaches (ie. the value of dialogue). CLIMAG can demonstrate the value of the approach only, but is limited in what can be implemented (time and resource constraints). Demonstration projects are PROCESS and not PRODUCT oriented approaches.	Implementation of the approach requires longterm funding at local level. However, much remains to be done at the process level → important for phase 2 of the project. A new project should link institutions (eg. CG centres) as well as scientists. Pay attention to institutional capacity building and sustained program evaluation by all players.	Dialogue and interactions are very important. Through this approach new, shared communities are created. There is a desire from others to become part of this community. The process has to be DEMAND rather than SUPPLY driven. It also needs to be resourced.
Emphasis was very much on hard, quantitative systems analysis and not so much on community values and interactions.	The demonstration project - due to time and resource constraints - deliberately restricted itself to this part of the whole picture, because it was achievable. However, links to social sciences and policy were established via partner projects.	A follow-on project must take the socio-economic conditions and policy constraints and implications explicitly into account.	
How did farmers react to simulations and probabilities?	Generally better than anticipated. Often more insights are gained when the model does not agree with farmers experience or expectations. This forms the basis for DISCUSSION support.	This needs to be followed up with a participatory approach in phase 2.	
Is one-year grant funding effective and should it continue?	Useful only for demonstration purposes. Longterm tool development, co-learning and implementation is people intensive and time consuming. The	The project has created a broader, more extensive network. This has also increased the demand for this approach which is now difficult to satisfy. A network has been	Short-term projects can raise expectations of people that cannot be satisfied if funding does

	one-year funding limitation meant less attention to dialogue than to hard systems analysis.	build. Now it needs to be broadened and maintained.	not continue. This can lead to dissatisfaction and frustration.
Research should focus on most vulnerable nations and not only on semi developed countries.	You need to walk before you can run. Funding and time constraints mean that the team has to build on existing infrastructure. You cannot create this from scratch within the available timeframe. Based on project outcomes capacity building in resource poor nations needs to commence in line with physical infrastructure development.	Focus future activities for development work on regions with existing human resources and infrastructure. In parallel commence capacity building activities based on project outcomes in the resource poorer countries.	
A (micro-)watershed approach should be considered in order to address regional issues.	Can be done. Requires $ and people to do it.		

APPENDIX 9

SELECTED INSIGHTS DERIVED FROM TRAINING INSTITUTE DISCUSSIONS

TRAINING INSTITUTE ON CLIMATE AND SOCIETY IN THE ASIA-PACIFIC REGION

FEBRUARY 5-23, 2001

EAST-WEST CENTER
HONOLULU, HI USA

In response to the question "Why did you want to come to the Training Institute?" the participants offered the following:

- Multi-disciplinary challenges and opportunities in understanding and applying climate information
- "End-to-end" character of the problem: monitoring, research, prediction, assessment, and applications
- Involves a continuum of information:
    - Global-to-local (and vice-versa)
    - Climate-to-weather (or weather-to-climate, depending on perspective)
    - User-to-scientist (and back again)
- Focused on/interested in "interfaces" and "interactions"
    - *e.g.*, ENSO, monsoon, land surface, etc.
    - climate and societal impacts
    - science and users
- Challenges and opportunities of engaging and "serving" users
- Enhancing public awareness and understanding
- "Extreme events" of particular interest and importance
- Extended forecasts (and applications): an increasingly important responsibility
- Regional/local character of impacts and users is important
- Common problems/individual experiences: shared learning
- Opportunity to develop new partnerships
- Personal interests and professional goals
- Desire for a joint science-user community; individual roles as "information brokers"
- Implications of climate for community development particularly important
- Recognize diversity of users/audiences
- Take advantage of new/emerging technologies and methodologies
- Need to close the information gap between scientists and policymakers

Common Themes Emerging from Discussions
Of Vulnerability and Adaptation Issues and Tools

- Important to set climate variability and change in the context of other social, economic and environmental issues; integrated assessment modeling provides a valuable tool.

- Adaptation should receive greater attention/emphasis:

    - Already committed to a certain degree of anthropogenic climate change;

    - Learning to adapt to natural variability today can enhance resilience/adaptive capacity and provide valuable insights for the future;

    - Developing and pursuing adaptation options can empower Asia-Pacific communities by focusing on developing and implementing appropriate actions to reduce vulnerability;

    - Addressing "win-win" measures (e.g., improving infrastructure, encouraging energy conservation and efficiency) early will have both near-term and long-term benefits.

- Encourage an anticipatory, pro-active (rather than reactive) approach.

- Assessment should be viewed as a continuing, iterative and interactive process that emphasizes two-way dialogue and enables shared learning and joint problem solving.

- Shared learning and joint problem solving requires the active engagement of all "experts" in both analytical studies and dialogue – scientists, governments, businesses, community leaders, information brokers (e.g., media/press and specialists in key sectors), NGO's, etc.

- "Information Brokers" (e.g., extension agents, sectoral associations, non-governmental organizations, etc.) can play a vital role in sustaining the interactive dialogue at the heart of the assessment process.

- Public education is vital and should be enhanced – formal and informal education.

Research Needs/Information Gaps Emerging From Group Discussions And Individual Presentations

- Enhanced information on the local and regional consequences of climate variability and change for human and natural systems involving both research and dialogue with affected sectors/communities.

- Improved understanding of and capabilities to simulate/model climate variability and change at the regional (and ultimately local) level.

- Improved understanding of and capabilities to anticipate the influence and consequences of climate variability and change on extreme events.

- Improved understanding of and capabilities to simulate the interaction of long-term, anthropogenic climate change with patterns of natural variability (on various timescales).

- Indian Ocean dynamics and consequences, including:

    - Influences/impacts on local and regional climate/weather;
    - Interactions with other regional and global-scale processes (e.g., monsoon and ENSO).

- Improved understanding and ability to simulate/model the influences of changes in local/regional oceanic and land surface conditions (e.g., Eurasian snow cover) on key patterns and consequences of natural variability (e.g., ENSO and monsoon) as well as long-term climate change.

- Patterns of longer-term (inter-decadal) variability and, more specifically, their local and regional climate consequences, including insights into how those patterns can/should be integrated into forecasts and future climate projections.

- Key processes and local/regional consequences of monsoon-ENSO interactions.

- Understanding and predicting both intra-seasonal and inter-decadal variability in the monsoon.

- Development and maintenance of historical databases on climate conditions and their societal consequences (useful and reliable baseline information).

- Implementation and maintenance of climate observations that address regional and local climate information needs as well as the interests of the scientific community.

- Improved understanding of the information needs of user communities and the incorporation of those needs in the design and evaluation of climate information products and the design of climate observation, research, modeling and assessment programs.

- Enhanced capabilities for systems analysis and assessment models that integrate climate information with other relevant social, economic and environmental considerations.

APPENDIX 10

TRAINING INSTITUTE FOR CLIMATE AND SOCIETY
IN THE ASIA PACIFIC REGION
BACKGROUND READINGS

Week One (February 5-10)

Climate System Overview

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Week Two (February 12-17)

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Week Three (February 19-23)

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National Research Council. 1999. "Summary and Chapters 1, 2, 3 and 4," in *Making Climate Forecasts Matter*. Washington, D.C.: National Academy Press.

APPENDIX 11

Supplemental Readings

- *Copies will be made available in Computer Resource Room (2063/2064 John A. Burns Hall).*
- *Reference copies of selected books will be available for use during the institute.*

Thompson, David W.J., and John M. Wallace. 2000. Annular Modes in the Extratropical Circulation. Part 1: Month to Month Variability. *In* Journal of Climate. Vol. 13. pp. 1000-1016. Cambridge: American Meteorological Society.

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- Chapter 4: Changes in the Climate Systems on Decade to Century Timescales.
- Chapter 3: Changes in the Climate System on Seaesonal to Interannual Time Scales. pp. pp.87-126.
- Chapter 7: Human Dimensions of Global Environmental Change. pp. pp.293-375.

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- Chapter 2: Global Change and Social Science. pp. pp.24-43.
- Chapter 4: Human Consequences and Responses. pp. pp.101-166.

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- Executive Summary pp. pp.24-43.
- Chapter 1: Our Common Journey. pp. pp. 21-58.
- Chapter 6: Integrating Knowledge and Action. pp. pp. 275-332.
- Chapter 4: Environmental Threats and Opportunities. pp. pp. 185-232.

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- Chapter 4: Short Term Weather Prediction: An Orchestra in need of a conductor. pp. 61-83..
- Chapter 1: Prediction in the Science of Policy. pp. 11-22.
- Chapter 18: Decision Making and the Future of Nature: Understanding and Using Predictions. pp. 361-387. Washington D.C.: Island Press.

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- Effects of Interannual Climate Variability and Climate Change on Rice Yield in Java, Indonesia. pp. 29-39.
- Vulnerability of Rice and Corn to Climate Change in the Phillipines. pp. 41-51.
- Agricultural Vulnerability and Adaptation to Global Warming in China. pp. 63-73.
- Vulnerability of Sri Lanka Tea Production to Global Climate Change. pp. 87-94.
- Vulnerability Assessment of Angat Water Resevoir to Climate Change. pp. 191-201.

- Copies will be made available in the Computer Resource Room (2063/2064 John A. Burns Hall).
- Reference copies of selected books will be available for use during the institute.

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