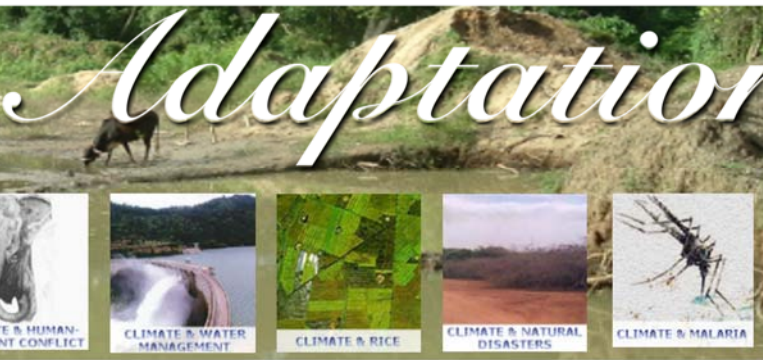


# IRI's Sri Lanka Projects

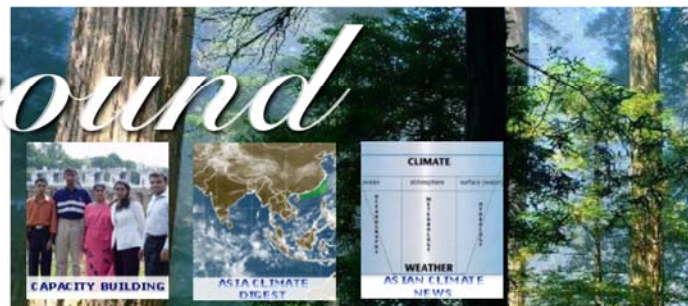
## Climate



## Adaptation Projects



## On the Ground



# IRI's Sri Lanka Projects

Contact: Lareef Zubair,  
International Research Institute for Climate and Society  
The Earth Institute at Columbia University  
P.O. Box 1000, 130 Monell Building, 61 Rt 9W  
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<http://iri.columbia.edu/~mahaweli/> ,  
<http://www.climate.lk/>

**ABOUT IRI:** The mission of the IRI is to enhance society's capability to understand, anticipate and manage the impacts of seasonal climate fluctuations, in order to improve human welfare and the environment, especially in developing countries through strategic and applied research, education and capacity building, and provision of forecast and information products, with an emphasis on practical and verifiable utility and partnerships. Africa, Asia and Pacific, and Latin America and Caribbean are major domains of the world where the IRI anticipates working for the foreseeable future. IRI researchers work with colleagues beyond the IRI and support and leverage resources for undertaking complex problem and identifying practical outcomes of use to policy and decision-makers at many levels.

# Preface

This catalogue describes the work of The International Research Institute for Climate and Society, its officers and its partners. It is intended to provide a sampling of the work we have undertaken. In particular, we report on the approaches taken to develop climate assessment, prediction and adaptation in multiple sectors.

We have engaged in projects and have made significant contributions in climate and environmental diagnostic work, climate risk management projects, science and technology knowledge management and dissemination. Our projects are trans-disciplinary and team members have partnered with local and international institutions at many levels. They have published locally and internationally.

In this catalogue, an overview is followed by sections on climate adaptation and risk management projects, climate assessment and prediction, partnerships and networking and broader issues of society and technology. The risk management projects are in water resources, agriculture, environment, public health and natural disasters. The climate section deals particularly with data management, assessment of climatology, diagnostics, modeling and prediction. The partnerships, capacity building and communication that went along with our projects are described next. This is followed by an interrogation of issues in climate, society and technology.

Our climate-related project work has led to infrastructure, trained staff and capability in information technology, publishing and engineering for science and sustainable development.

## Outline

1. Introduction
2. Climate Adaptation and Impact Analysis Projects
3. Climate Diagnosis, Modelling, Prediction
4. Partnerships, Capacity Building and Outreach
5. Climate, Society and Adaptation

# 1. Introduction

## 1.1. Summary

## 1.2. IRI

- International Research Institute for Climate and Society
- Earth Institute at Columbia University

## 1.3. Summary of Projects

## 1.4. Summary of Climate Work

- Climate work for sectoral projects

## 1.5. Summary of Partnerships, Capacity Building and Outreach

## 1.6. Summary of Climate, Society and Technology work

## 1.7. Sri Lanka at a Glance

## 1.8. Climate of Sri Lanka

# Summary

**Outline:** This summary describes our projects, research, contributions to training and education, partners and collaborators.

**Project Work:** We have demonstrated the use of the hydro-climatic expertise with projects for water resources management, human-elephant conflict, coconut and rice agriculture, malaria and dengue risk assessment and disaster risk management. We plan to continue our work in these sectors and undertake further work in renewable energy and coastal issues.

**Climate Work:** We have undertaken climatic diagnostics, climate prediction hydro-climatic analysis, modeling and prediction. We continue to build a state of the art hydro-meteorological monitoring and prediction system.

**Training:** Ten persons have been employed under these projects. Two of them have obtained post-graduate degrees and one an undergraduate degree. A similar number are currently pursuing higher education. Others have been able to obtain training in institutes such as the International Research Institute for Climate and Society, International Centre for Theoretical Physics, Post-Graduate Institute of Agriculture and the School of Computing Sciences at the University of Colombo. We have conducted workshops for the Mahaweli Authority, Central Engineering Consultancy Bureau and the Department of Meteorology. We have supported IT infrastructure development, website development, GIS including an interactive map server, and software development for scientific computation in Sri Lanka.

**Post-Graduate Education:** We have provided lectures and supported thesis research at the Post-Graduate Institute of Sciences, University of Moratuwa, University of Peradeniya and University of Colombo in water resources management, meteorology, oceanography, environmental science, geographic information systems and disaster management.

**Partners:** We collaborate with relevant agencies, universities and research institutes locally and Internationally.

**Funding:** The work has been funded through grants from International Research Institute for Climate and Society, The Earth Institute at Columbia University, System for Analysis, Research and Training (START), Global Environmental Facility (GEF) and the Office of Global Programs at US National Oceanic and Atmospheric Agency (NOAA).

**Vision:** Our vision is to sustain the work in Sri Lanka as a demonstration of excellence in climate, environmental and information technologies where state of the art research is pursued and advanced technological capability is maintained and where all of this used to execute socially valued projects.

# Summary of Projects

## **River Basin management in the Mahaweli Basin**

We collaborate with the Mahaweli Authority of Sri Lanka (MASL) to explore the use of climate information for river basin management. We have studied climatic teleconnections to the river basin rainfall and stream flow, investigated drought and flood indices, and the applicability of climate information for agricultural, water resources, environmental and disaster management in the basin.

## **Climate Variability and Rice Production in Sri Lanka**

Our research has indicated a significant relationship between rice production in Sri Lanka and ENSO. These findings are useful to underpin the use of seasonal climate predictions for agricultural management and policy-making in Sri Lanka and the Mahaweli River basin.

## **Climate Change and Variability and Tea and Coconut Plantations**

This project was a three-year collaborative undertaking between IRI and five Sri Lankan organizations, funded by the global change system for Training, Analysis and Research (START). We engaged in climatic analysis, impact assessment, development of adaptation strategies and capacity building. We have developed climate change assessments and contributed to a prediction scheme for Coconut production.

## **Climate and Human-Elephant Conflict**

This project was in collaboration with the Center for Environmental Research and Conservation, Environment and Forest Conservation Division of the MASL and the Department of Wildlife Conservation in Sri Lanka. We established precipitation and NDVI climatologies, undertook downscaling of climate predictions and identified a link between drought in the first half of the year and elephant deaths.

## **Climate and Natural Disaster Hotspots**

We identified disaster hazard risk spatially and seasonally for Sri Lanka at fine scales along with the impacts of combination of these risks. We also studied the vulnerability to disaster. This work resulted in a proposal for disaster risk management. This work was funded by The Earth Institute at Columbia University with a grant from the World Bank.

## **Climate Variability and Malaria and Dengue**

We are studying the interaction of dengue and malaria and climate in Sri Lanka in collaboration with the International Water Management Institute, the Anti-Malaria Campaign and the Foundation for Environment, Climate and Technology in Kandy, Sri Lanka in a project funded by the Climate Variability and Human Health program of the Office of Global Programs of NOAA.

# Summary of Climate Work

We have undertaken hydro-climate data management, climatic diagnostics, hydro-climatic analysis, climate modeling and climate prediction. Our work has been oriented towards the needs of our climate applications projects. We have also published these in international and national journals as well as in newspaper and magazine articles and communicated this work with two dozen presentations, through post-graduate education and workshops.

*Data Management:* We have acquired and organized data and carried out careful quality assessment of key data.

*Climate assessment and research:* We worked towards understanding the climatologies, inter-annual variation, decadal variations, long-term trends and the causes of these. We developed a climate calendar which is a succinct and novel representation of the seasonality of climate.

*Climate Diagnosis:* We diagnosed seasonal, inter-annual, decadal, multi-decadal and long-term trends. In particular, we investigated the impact of two of the principal modes of regional inter-annual variability, the El Niño-Southern Oscillation and the Indian Ocean Dipole. In addition, we provided detailed assessments of climate change.

*Climate Modeling:* We developed a model for capturing topographically induced rainfall. We also developed a high-resolution wind climate model ignoring the rainfall mechanisms. We partnered to develop a high-resolution regional climate model.

*Climate Prediction:* We have investigated the skill of seasonal predictions from global climate models over Sri Lanka. We have collaborated to implement a statistical methodology to correct the biases for predictions of global models for rainfall over Sri Lanka and to make it available at high resolution.

*Hydro-climatic Diagnosis:* We have published studies on the ENSO and Indian Ocean influences on the *Kelani* and *Mahaweli* streamflow.

*Hydro-climatic Modeling:* We have developed a water resources system simulation model for the *Walawe*. We have calibrated the land surface model for small catchments in the *Mahaweli* headstream and collaborated to produce an island-wide land surface model that mimics hydrological features at high resolution and which is driven by global climate data.

*Hydro-climatic Monitoring:* We are working towards a state of the art hydro-meteorological monitoring and prediction system in collaboration with the Mahaweli Authority which combines surface and satellite-based observations.



## CLIMATE WORK FOR SECTORAL PROJECTS

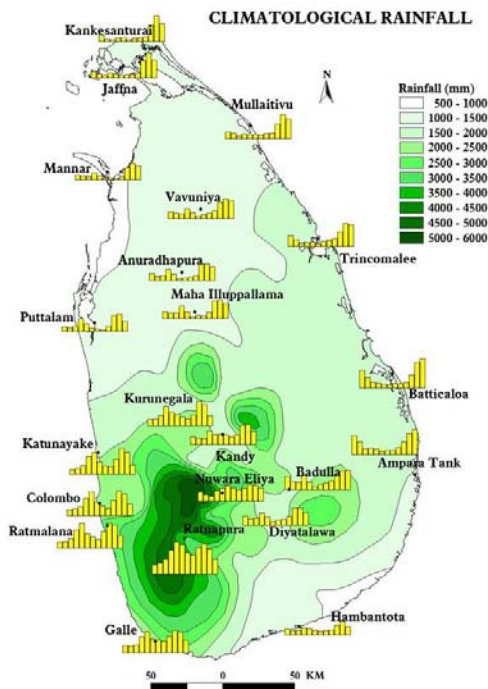
*Climate and Water Resources Management:* Our work has involved exploring the usability of climate information and predictions for water resource and river basin management. We have provided climate information and forecasts and supported the formation of a National Steering Committee on Seasonal Climate Predictions and Applications (NASCOM), government agencies and relevant scientists and engineers.

*Climate and Agriculture:* We have reported on the climate impacts on rice and coconut production and the prediction of crop production. We developed climate change analysis, undertaken impact studies and vulnerability studies.

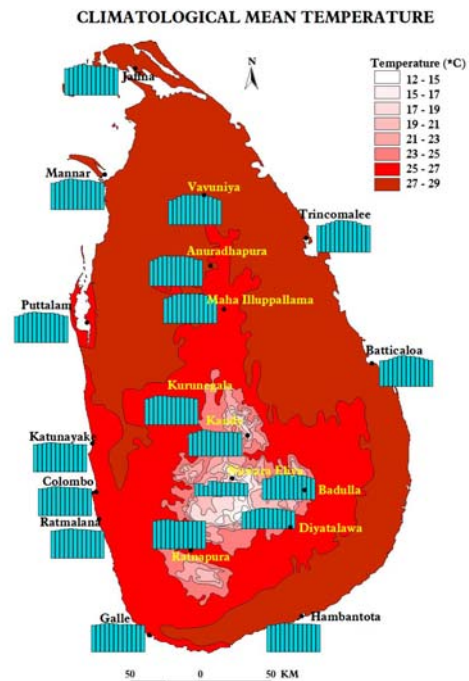
*Climate and Environment:* We have evaluated the Climate and Habitat Interactions Affecting the Conservation and Management of elephants in Southeast Sri Lanka. We developed geospatial databases and assess long-term scenarios of the responses of habitat and elephant ecology to seasonal climate forecasts. We also characterized NDVI data sets and their links to climate.

*Climate and Health:* We are undertaking climate impact analysis on dengue and malaria in Sri Lanka with a view to develop early warning systems. A physically based hydrology model was implemented to establish relations between climate and malaria

*Climate and Disaster Risk Management:* We developed methodologies to use weather and climate information in hazard identification for Sri Lanka for floods, droughts, landslides and cyclone.



Mean Annual Rainfall



Mean Annual Temperature

# Summary of Partnerships, Capacity Building and Outreach

Our partners in projects alone are listed below:

*River Basin management in the Mahaweli Basin:* We collaborated with the Mahaweli Authority of Sri Lanka (MASL) and the International Research Institute for climate and society (IRI) to explore the use of climate information for river basin management. We also worked with the Irrigation Department, the Ministry of Water Resources and the Interim National Water Resources Authority and the NASA Global Modeling and Assimilation Office.

*Climate Variability and Rice Production:* We collaborated with colleagues at the Institute of Fundamental Studies and Department of Agriculture.

*Climate Change and Variability and Tea and Coconut Plantations:* This undertaking was funded, by the global change system for Training, Analysis and Research (START) and was in collaboration with the Department of Meteorology (DoM), Tea Research Institute (TRI), Coconut Research Institute (CRI) and University of Peradeniya.

*Climate and Human-Elephant Conflict:* This project was in collaboration with the IRI, Center for International Earth Science Information Networks (CIESIN), Center for Environmental Research and Conservation (CERC), Environment and Forest Conservation Division of the MASL and the Department of Wildlife Conservation.

*Climate and Natural Disaster Hotspots:* Our partners are the Center for Hazards and Risk Research (CHRR), Center for International Earth Science Information Network (CIESIN), and The Earth Institute at Columbia University. This project was funded by The Earth Institute at Columbia University with a grant from the World Bank.

*Regional Climate Modeling:* We collaborated on Regional Climate Modelling focused on Sri Lanka, with the help of the IRI and the International Center for Theoretical Physics.

*Climate Variability and Malaria and Dengue:* We collaborated with the International Water Management Institute (IWMI), the Anti-Malaria Campaign (AMC), NASA/GSFC land surface group, University of Kelaniya, and the IRI. The project was funded by NOAA/NSF/EPRI Climate Variability and Human Health program. Scientists attached to the University of North Carolina and University of Toronto collaborate with us on research on climate impacts on Dengue Fever.

## Capacity Building

We have supported, lectured and provided resources for research, for students in post-graduate courses in meteorology, oceanography, water resources and disaster management at the University of Peradeniya, Moratuwa and Colombo. We have provided on-the-job training, training through collaborative research and conducted workshops both formally and informally. We supported the National Steering Committee on Seasonal Climate Predictions. We are training Mahaweli Engineers in Climate analysis and predictions for water management. We provided a series of 4 lectures at the Department of Meteorology and training for meteorologists.

## Outreach

We created websites, distributed newsletters and provided many feature articles. We have produced the the South Asian Climate News, a quarterly newsletter reaching 1500 scientists and policy makers by email and postal mail. We also supported the distribution of the Asian Climate Digest in Sri Lanka. One thousand five hundred citations on climate related topics were organized into a Reference Guide in an effort supported by the National Science Foundation, Sri Lanka and IRI.



After a project collaboration meeting at the Tea Research Institute, Ratnapura, June 2002. Partners from the Coconut Research Institute, Department of Meteorology, Tea Research Institute, University of Peradeniya are present here.



Neil Ward and Lareef Zubair of the IRI along with Dr. Jayantha Obeysekera of the South Florida Water District having discussions with Acting Director (G.H.P. Dharmaratna), Deputy Directors (K.R. Abeysinghe, G. Samarasinghe), Senior Meteorologist Lalith Chandrapala of the Sri Lanka Department of Meteorology, Colombo

# Summary of Climate, Society and Technology Work

Our contribution needs to be sensitive to the environmental, technological, historical and socio-economic setting. We are preparing manuscripts on environmental hazards and policy, on science and technology history, on energy conservation and renewable energy and on climate and climate adaptation in Sri Lanka. Here, we report on some aspects of these works.

**Traditional Agriculture and Sustainability:** We have argued in a paper that appeared in *Science, Technology and Society*, that the indigenous irrigation systems in Sri Lanka offer a useful counterpoint of an irrigation system that has many favourable attributes.

**Environment Impact Analysis in Sri Lanka:** Our work on EIA has led to an understanding of environmental history, law and protection. A summary was reported in the *Journal of the Institution of Engineers* in Sri Lanka and in *Environmental Impact Analysis*.

**Technology and Communication:** There are often failures of communication between metropolitan climate forecasts centers and peripheral users. We have analyzed the reasons for miscommunication during the El Niño of 1997 and the successful communication during the El Niño of 2002 in Sri Lanka.

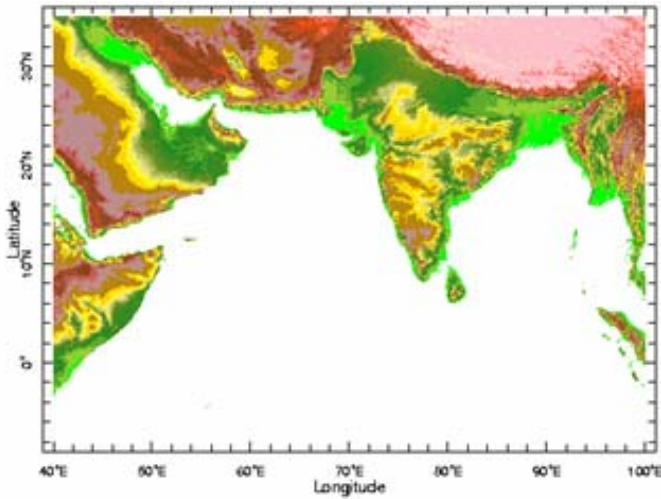


Earthen bund and the *Bisokotuwa* or valve pit at the *Kantalai* Tank that was built in the 5th Century and later expanded in the 12th Century. The diagram has been reproduced from a wood-cut in John Davy's "Travels in Ceylon" produced in 1821.



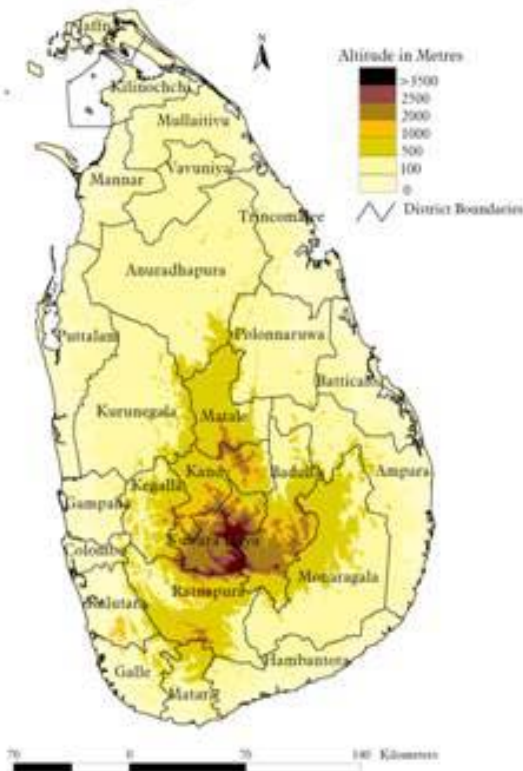
In response to the IRI work, the Minister of Water Resources and Irrigation instructed the formation of a national steering committee to carry out a systematic evaluation of seasonal climate forecasts and undertake its appropriate dissemination to all users in January 2003. The IRI is now supporting the national steering committee on climate prediction by providing climate information directly this committee.

# Sri Lanka - At a Glance

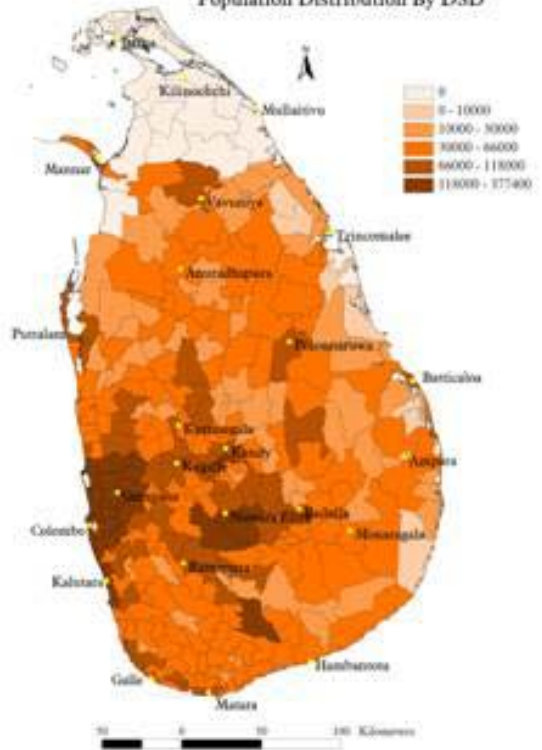


Sri Lanka is located at the southern tip of Asia in the Indian Ocean. The Indian Ocean surrounds it. The Tibetan Plateau and Himalayan mountain range to the North, the African and Maritime continents to the West and East, all play their part in Sri Lanka's climate.

Topography and District Boundaries



Population Distribution By DSD



The island is 65,000 square kilometers in extent and the principal topographic feature is an anchor shaped mountain massif in the South-Central part of the island. There are 25 administrative districts (shown) and 9 provinces which are made up of 2-5 districts each (not shown).

55% of the population is concentrated in 20% of the land area. 30% of the population are in urban areas. The least populated districts have 10% of the population in 40% of the land. (Data for the Northern DSD Divisions were unavailable.)



## Agriculture

The primary food crop is rice. Rice cultivation is undertaken as subsistence farming. Coconut and spices too are grown by subsistence farmers. Major plantations grown for export include tea, coconut and rubber.

The agrarian economy is susceptible to disruption through drought, floods and anomalous variability in climate.

## Industry

The major industries are textile & apparel, food & beverage processing, chemical & rubber and mining & minerals. A quarter of the manufactured products are processing of agricultural products (tea, rubber and tobacco). Industry is heavily concentrated in the Western Province. In the last two decades Industrial production has shifted from heavy industries for domestic consumption to textile and other processing for export.

## Infrastructure

Infrastructure development too reflects a pattern of heavy development in the Western Province with subsidiary development in the metropolitan districts of *Kandy* and *Galle*.

**Roads:** Sri Lanka has an extensive road network with a density and coverage better than in most third world countries.

**Electricity Generation and Distribution:** As of 1995, 53% of the households had access to electricity. 65% of the total generation comes from hydropower, putting it at risk during drought periods. Off-grid micro-hydro and solar has been increasingly used to provide power to 28,000 households.

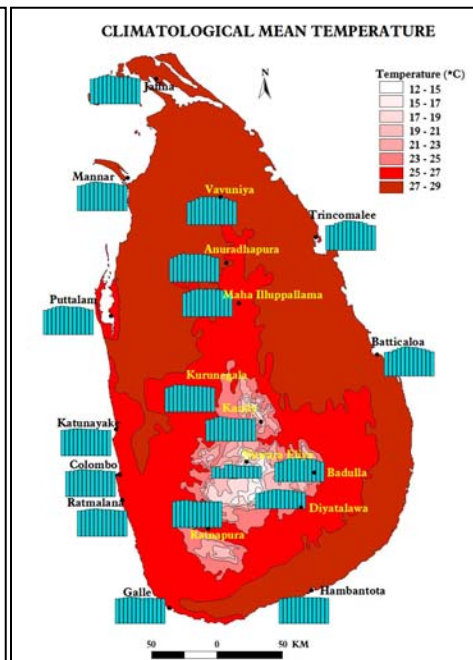
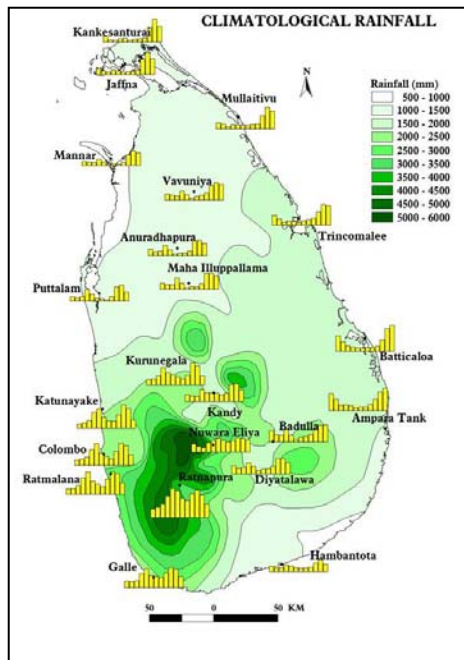
**Telephones:** The density of telephones is low with 41 mainlines and 23 cellular phones per 1000 persons in 2000.

**Irrigation:** The island has a vast network of rivers, reservoirs and canals that are used to manage spatial and seasonal climatic variability.

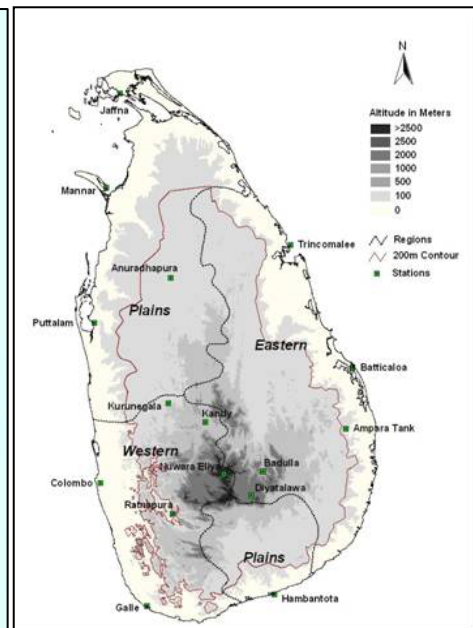
# Climate of Sri Lanka

Sri Lanka receives 1,800 mm of rainfall on average annually distributed unevenly ranging from 500 to 5000 mm/year. The rainfall follows a bimodal climatology with the main rains from September to December and subsidiary rains from May to June. The Eastern and Western Hill Slopes garner orographic rainfall from December to March (NE winds) and May to October (Westerly) respectively. The North-East receives cyclonic rainfall from November to December. Sri Lanka may be divided into four climatically near-homogeneous regions: Northern Plains, Southern Plains, Western Slopes and Eastern Slopes. A radial drainage pattern of 103 rivers largely originating from the central massifs covers 90% of the Island leaving aside the Northern region.

Left to Right:  
Annual Rainfall  
Annual  
- Temperature



Left to Right:  
Major Rivers  
Topography and  
- Regions

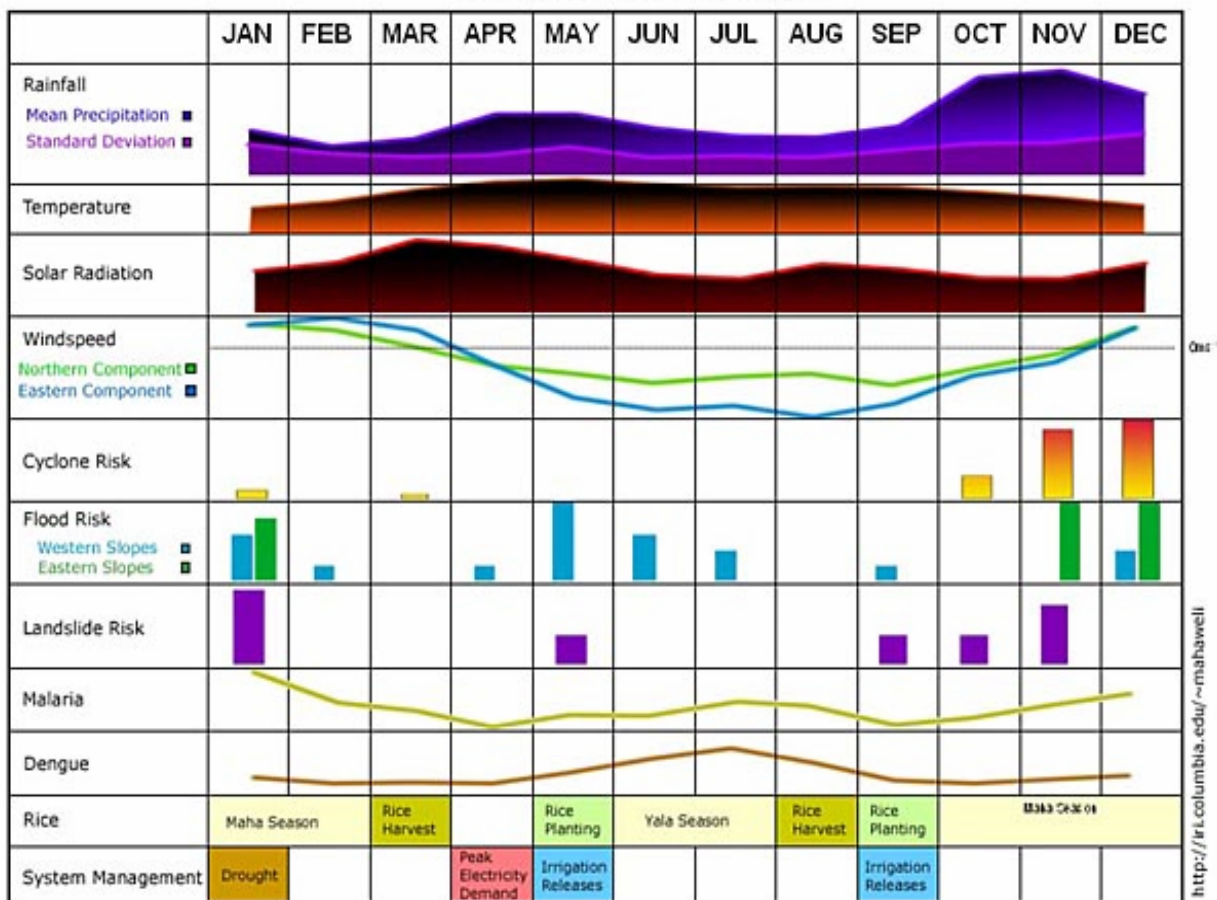


## Climate Calendar

The climate calendar is a succinct and novel representation of the seasonality of climate in Sri Lanka which was developed by Lareef Zubair, Vidhura Ralapanawe inspired by comments from Chet Ropelewski. The panels show from top to bottom by month,

- the mean and standard deviation of rainfall,
- the mean temperature,
- the solar radiation,
- the mean zonal and meridional components of wind speed over Hambantota,
- the cyclone risk,
- the flood risk for eastern and western slopes of the hills,
- the landslide risk,
- the malaria risk,
- the dengue risk,
- the rice cultivation seasons,
- the water resource system operations calendar.

Sri Lanka Climate Calendar





# IRI Background



## IRI's Mission Statement and Approach

The IRI has been involved in collaborative projects on the application of climate information and forecasts in the *Mahaweli* River basin in Sri Lanka since January 2000. This work is in-line with IRI's philosophy of linking climate to societal needs. It is formulated in the "end-to-end" approach of understanding and interaction between producers and the users of climate information.

The mission of the IRI is to enhance society's capability to understand, anticipate and manage the impacts of seasonal climate fluctuations, in order to improve human welfare and the environment, especially in developing countries. This mission is to be conducted through strategic and applied research, education and capacity building, and provision of forecast and information products, with an emphasis on practical and verifiable utility and partnerships.

The IRI favours integrated efforts aimed to address explicit real-world problems involving application of climate information. Achieving results require IRI researchers to advance significant work programs with colleagues beyond the IRI. Together, we build support and leverage resources for undertaking complex problem and identifying practical outcomes of use to policy and decision-makers at many levels.



Neil Ward, Lareef Zubair and Jayantha Obeysekera meet with the Acting Director and Deputy Directors of the Sri Lanka Department of Meteorology, Colombo, Sri Lanka, March 2003.

Prof. Madduma Bandara, Chairman of National Water Resources Authority (Interim) of Sri Lanka and adviser to the Sri Lankan Minister of Irrigation and Water Resources meeting with IRI staff November 2002

# The Earth Institute Background



The Earth Institute aims to be the world's academic pioneer in mobilizing the sciences and public policy in pursuit of a sustainable future, especially for the world's poor. Under the direction of international economist Professor Jeffrey D. Sachs, the Earth Institute supports pioneering projects in the biological, engineering, social, and health sciences, while actively encouraging interdisciplinary projects in pursuit of solutions to real world problems. Some of the Earth Institute Centers are:

- Center for Environmental Research and Conservation (CERC)
- Center for Global Health and Economic Development (CGHED)
- Center for Globalization and Sustainable Development (CGSD)
- Center for International Earth Science Information Network (CIESIN)
- International Research Institute for Climate and Society (IRI)
- Center for Hazards and Risk Research (CHRR)



Nirupam Bajpai (center of CGSD), Lareef Zubair (right), and Irugal Bandara (left) stand in front of a barrage and the Mahaweli River Basin's meteorological stations at the Mahaweli River Basin Authority in Polgolla.



Prof. Jeffrey Sachs with Lareef Zubair at discussion at the Sri Lankan Prime Ministers residence in January 2003.

The Earth Institute has several programs in Sri Lanka. The CGSD has been involved in country advising in 2003. Prof. Jeffrey Sachs was hosted for two visits. We were involved with IRI, CHRR and CIESIN in conducting a case study on disaster risk hotspots. We were involved with IRI, CIESIN and CERC in conducting the project on Human Elephant Conflict. In addition, the CERC, the CGHED and Millennium Challenge Program are involved in Sri Lanka.



The International Research Institute  
for Climate and Society

# Catalogue of Activities

The International Research Institute for Climate and Society,  
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NY 10964-8000, U.S.A

January 2006

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- 1.5. Partnerships, Capacity Building and Outreach
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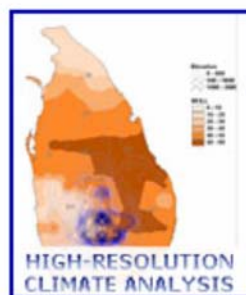
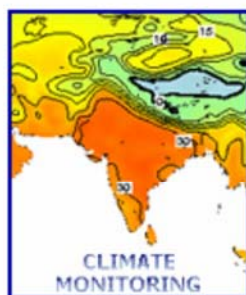
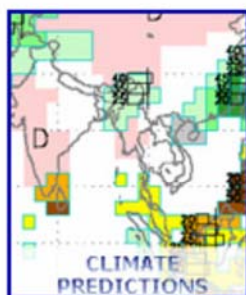
#### 5.2. Environmental Issues in Sri Lanka

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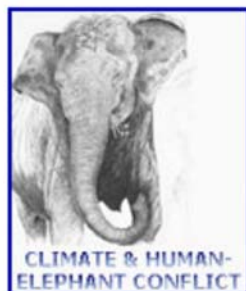
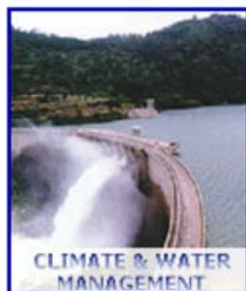
#### 5.3. Technology Transfer and Communication

- (a) ENSO and communication

### **Acknowledgements**



Climate Adaptation



On the Ground

