FECT
Foundation for Environment Climate and Technology

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ABOUT FECT: We started research and development in climate and environmental analysis, computation, monitoring and prediction technologies in Sri Lanka with projects from 2000. Our work is oriented towards developing useable scientific and technological information for risk management in water resources, disasters, agriculture, energy, environment and public health. We collaborate with government institutions, research institutes and universities. Our charter mandates us to develop local capabilities.

Preface

This catalogue describes the work of the Foundation for Environment, Climate and Technology (FECT) and its partners. We report on the approaches taken to develop climate assessment, prediction and adaptation in Sri Lanka.

Our officers have engaged in projects for 12 years and have made significant contributions in climate and environmental diagnostic work, climate adaptation projects, science and technology development, and dissemination. Our projects are trans-disciplinary and collaborative with local and international institutions.

This catalogue is organized in six sections as follows:
1. Introduction
2. Climate Impact Analysis and Adaptation Projects
3. Climate Diagnosis, Modelling, Prediction
4. On the ground
5. Climate, Society and Adaptation
6. Profile of the Foundation for Environment, Climate and Technology (FECT)

The impact adaptation analysis and projects are in water resources, agriculture, environment, public health and natural disasters. The climate section deals with data management, assessment of climatology, diagnostics, modelling and prediction.

Our climate-related project work has led to the development of data resources, library resources, trained staff and capability in information technology, publishing and engineering. These capabilities enabled us to create two Internet Resource Centers for bringing scientific information to the relief, rehabilitation and reconstruction efforts after the Tsunami of 2004. FECT.

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Acknowledgements

1. Executive Summary

Overview

Outline: We have been involved in collaborative projects in the *Mahaweli* River basin in Sri Lanka since January 2000. This document 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, tea 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.

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

Information Technology: We have undertaken IT infrastructure development, website development, interactive map servers, and software development for scientific computation. We are pursuing high-performance pc-based computing and internet server development.

Publishing: We have published in newspapers, scientific journals, magazines, Internet, posters, newsletters and as books. We continue to upgrade our capabilities.

Engineering: Our climate work has been oriented towards engineering applications in multi-disciplinary fields. We have established capability in all branches of engineering practice.

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.

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

Partners: We collaborate with government agencies, universities and research institutes in Sri Lanka. Internationally, we have partnered with The Earth Institute at Columbia University, University of North Carolina and the National Aeronautical and Space Agency (NASA), Indian Institute of Tropical Meteorology and Indian Institute of Science and Frontier Research System for Global Change in Japan.

Funding: Our 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). We hope to sustain our work through new partnerships and projects.

Vision: Our vision is to sustain FECT as a center 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.

FECT Background

Our work started in 2000 and we registered ourselves as a non-profit company in 2003. Our work builds on substantial experience and projects of the officers. In Sri Lanka, our work started with Climate Assessment, Prediction and Adaptation Group (CAPAG). CAPAG had been working at the Natural Resources Management Services of the Mahaweli Authority since 2000. We relocated to FECT's own office at the Head works Division of the Mahaweli Authority in Digana, Sri Lanka in August 2005. FECT is organized into programs in Climate, Information Technology, Publishing and Engineering.

Our work is oriented towards developing useable scientific and technological information that can be applied in diverse sectors. We work actively with other Sri Lankan partners in government institutions, research institutes and universities. Our charter limits us from turning private profit and requires us to develop the science and technology field broadly.

Officers
Zeenas Yahiya - Sociology, Media, Documentation
Upamala Tennakoon - GIS, Cartography
Siraj Razick - IT, System Administration, Web designer
Janaki Chandimala - Water Resources, Climate
Manjula Siriwardena - Climate Change, Energy
Yoosuf Ashraj - Data Management

Advisors
Lareef Zubair - Climate, Adaptation and Technology
Vidhura Ralapanawe - Information Technology, Presentation

Collaborators
Ruvini Perera - Water and Environmental Engineering
Neil Devadasan - Information Technology, Databases, GIS
Sarith Mahanama, Hydrometeorology, Modelling
Sabry Razick, Statistical Analysis

Ongoing Projects
- Mahaweli River Basin Management (2000-2004)
- Malaria and Dengue and Predictive Risk Mapping and Early Warning Systems (2003 – 2006)

Completed Projects
- Climate Change and Variability and Tea and Coconut Plantations (2002 – 2005)
- Climate Variability and Rice Production (2000)
- Climate and Human-Elephant Conflict (2001 – 2002)
- Climate and Natural Disaster Risk (2002 – 2004)

Some Current Proposals (under development)
Disaster Risk Identification for Sri Lanka
- Disaster Information Dissemination
- Climate and Rural Energy
- Climate Atlas for Sri Lanka
- Climate Atlas for Renewable Energy

Summary of Projects

River Basin management in the Mahaweli Basin

We collaborate 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 have studied climatic teleconnections with rainfall and stream flow, investigated drought and flood indices, and the applicability of climate information for agricultural, water resources, environmental and disaster management at basin level.

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.

Climate Change and Variability and Tea and Coconut Plantations

This project was a three-year collaborative undertaking between five Sri Lankan organizations and IRI, 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 IRI, Center for Environmental Research and Conservation (CERC), 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 vulnerability to disaster. This work resulted in a proposal for disaster risk management. This work was published by 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 in a project funded by the Climate Variability and Human Health program of the Office of Global Programs of NOAA. We also undertake analysis of dengue and climate.

FECT staff members outside and inside the office at Digana Village, Kandy, Sri Lanka, January 4, 2006.

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 driven by the needs of our climate applications projects. We have published in international and national journals as well as in newspaper and magazine articles. This work was communicated through two dozen presentations, through post-graduate education and workshops.

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

Climate Assessment and Research: We worked towards understanding the climatological patterns. We developed a climate calendar which is a 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 Modelling: 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. 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 Modelling: We have developed a water resources system simulation model for the *Walawe*. We have calibrated a land surface model for small catchments and collaborated to produce an island-wide land surface model that mimics hydrological features at high resolution.

Hydro-climatic Monitoring: We are working towards a near real-time hydro-meteorological monitoring system in collaboration with the Mahaweli Authority which combines surface and satellite-based observations.

CLIMATE WORK FOR SECTORAL PROJECTS

Climate and Water Resources Management: We explored the usability of climate information and predictions for river basin management. We developed seasonal rainfall predictions.

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 assessment, undertook impact studies and vulnerability studies.
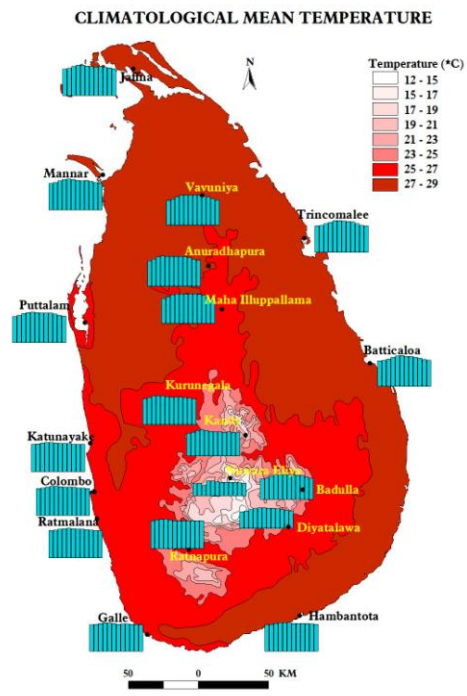
Climate and Environment: We developed geospatial hydro-climate and environmental databases and elephant ecology databases, assessed relationships between climate variability and elephant deaths. We also characterized NDVI data sets and its links to climate.

Climate and Health: We are undertaking climate impact analysis on dengue and malaria in Sri Lanka and hope to develop early warning systems. A physically based hydrology model was implemented.

Climate and Disaster Risk Management: We developed methodologies to use weather and climate information for flood, drought, landslide and cyclone hazard identification.
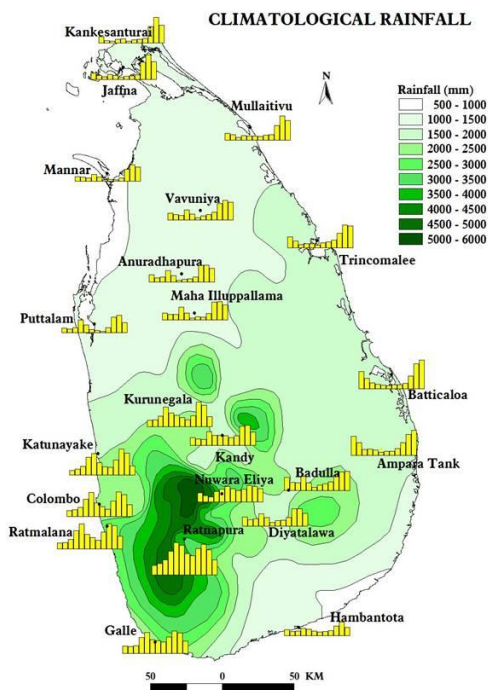
Mean Annual Rainfall   Mean Annual Temperature

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). 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 conducted 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 were 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 IRI and the International Center for Theoretical Physics (ICTP).

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/NASA 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 to 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, 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 lectures at the Department of Meteorology and training for meteorologists.

Outreach

We created websites, distributed newsletters and provided feature articles for mass-media. We have produced 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 Director (G.H.P. Dharmaratna), Deputy Directors (K.R. Abeysinghe, G. Samarasinghe) and Senior Meteorologists (Lalith Chandrapala) of the Sri Lanka Department of Meteorology, Colombo

Summary of Climate, Society and Technology Work

Our science and technology 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, Techology 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 lead 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.


Graphic: 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.
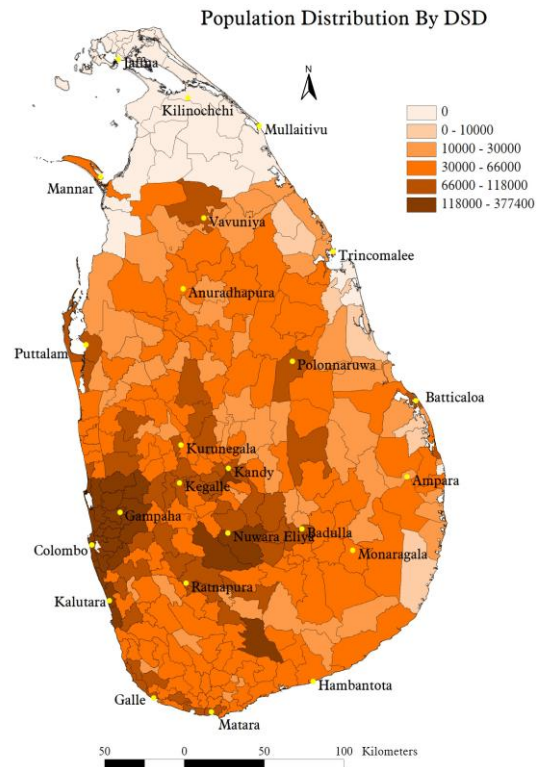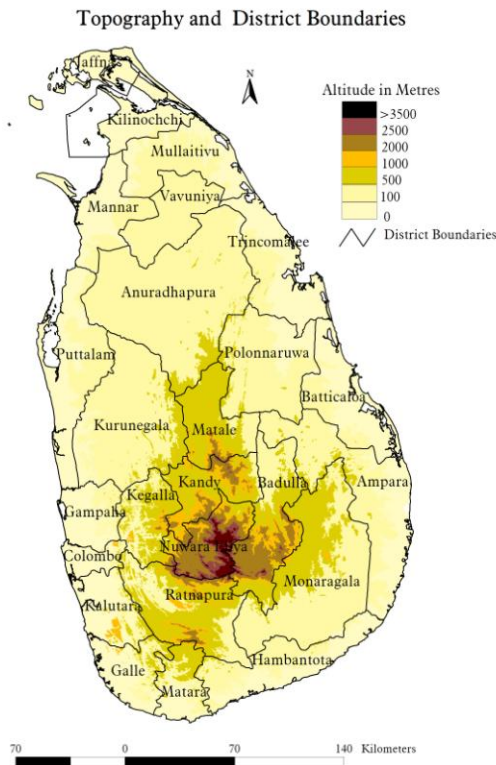

Figure: In response to the IRI work, the Minister of Water Resources and Irrigation instructed the formation of a national steering committee to carry out a systematic evaluation of seasonal climate forecasts and undertake its appropriate dissemination to all users in January 2003. We supported the national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

Sri Lanka - at a glance
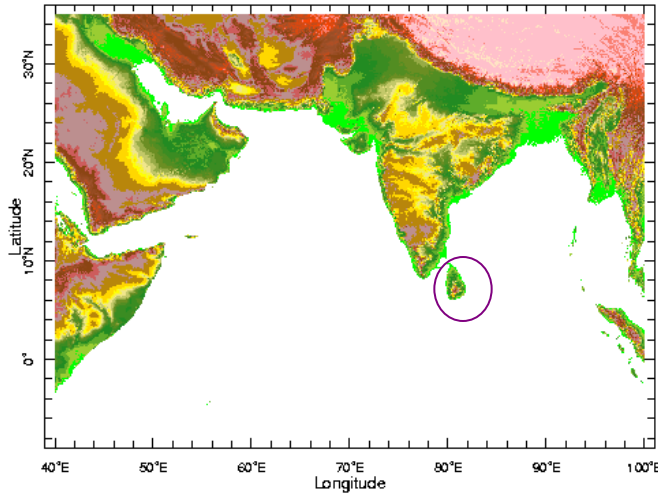
Sri Lanka is located at the southern tip of Asia in the Indian Ocean. The Indian Ocean surrounds it. The Tibetan Plateau and Himalayan mountain range to the north, the African and Maritime continents to the west and east, all play their part in Sri Lanka's climate.

Topography and District Boundaries

Altitude in Metres
- >3500
- 2500
- 2000
- 1000
- 500
- 100
- 0

District Boundaries

Population Distribution By DSD

- 0
- 0 - 10000
- 10000 - 30000
- 30000 - 66000
- 66000 - 118000
- 118000 - 377400

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 Divisional Secretariat Divisions (DSD) 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. crops grown for export in plantations are tea, coconut and rubber.

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

Industry

The major industries are textiles and apparel, food and beverage processing, chemical and rubber, and mining and 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 consumer goods for export.

Infrastructure

Infrastructure 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. Off-grid micro-hydro, wind and solar energy 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.
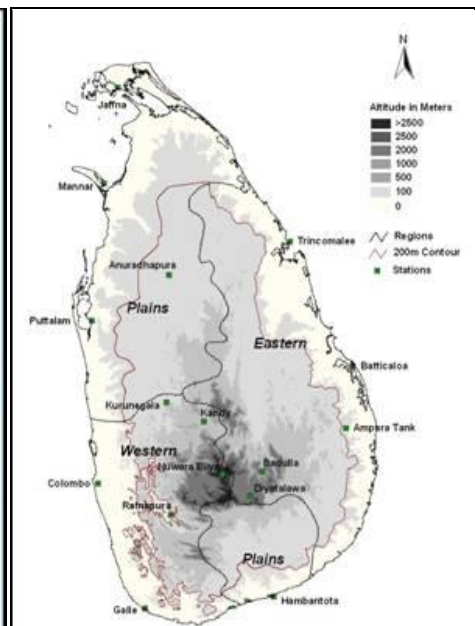
Climate of Sri Lanka

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 April 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. A radial drainage pattern of 103 rivers largely originating from the central massifs covers 90% of the Island leaving aside the Northern region. Sri Lanka may be divided into four climatic regions: Northern Plains, Southern Plains, Western Slopes and Eastern Slopes.

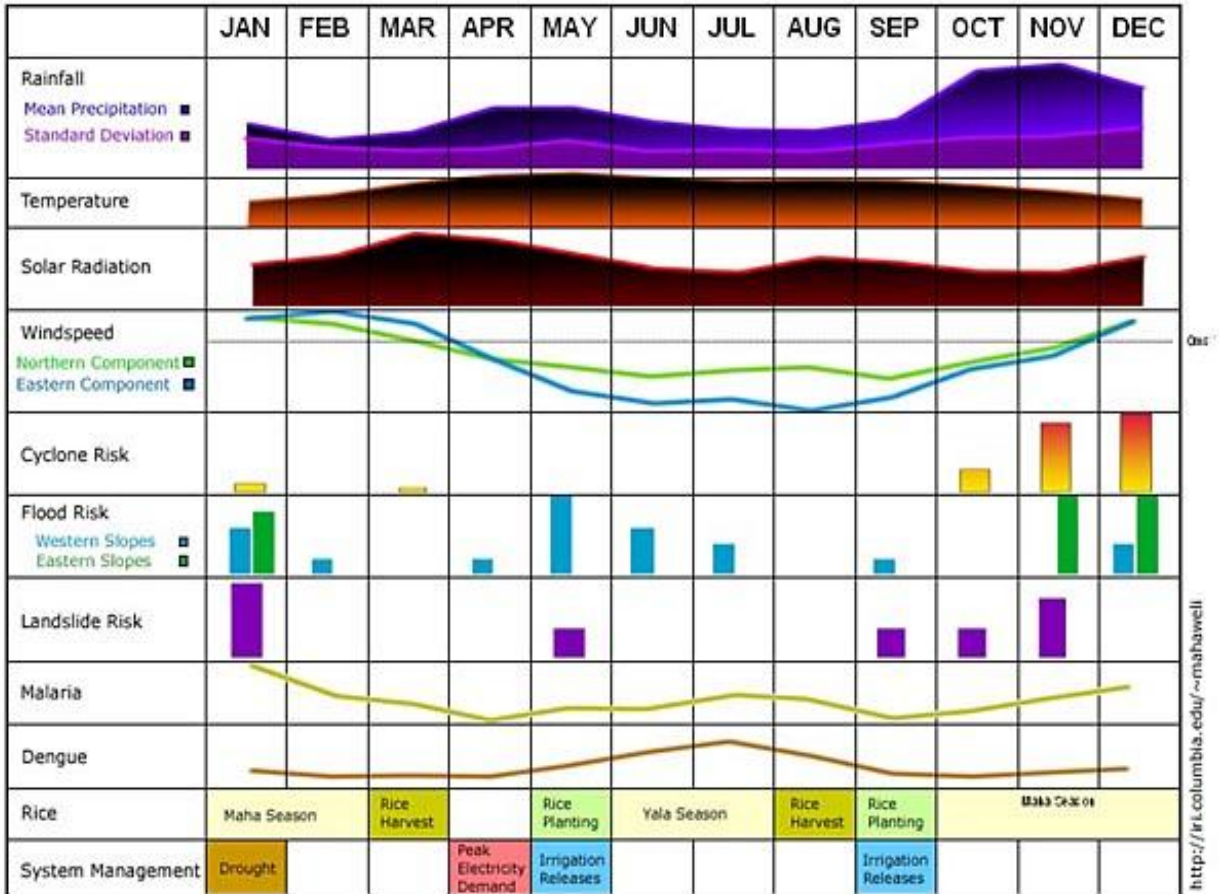Left to Right:
Annual Rainfall
Annual
Temperature
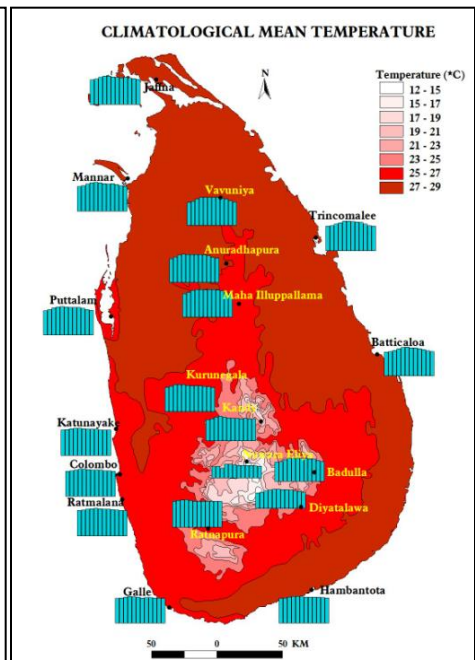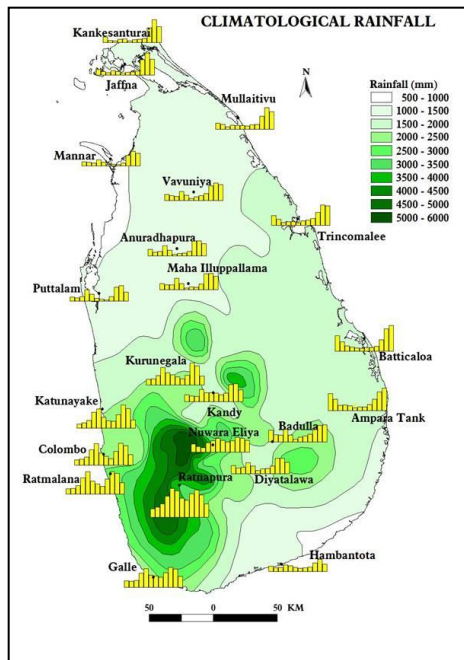
Left to Right:
Major Rivers
Topography and
Regions

Climate Calendar

The climate calendar is a succinct and novel representation of the seasonality of climate.

Sri Lanka Climate Calendar

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Rainfall — Mean Precipitation ■, Standard Deviation ■												
Temperature												
Solar Radiation												
Windspeed — Northern Component ■, Eastern Component ■												
Cyclone Risk												
Flood Risk — Western Slopes ■, Eastern Slopes ■												
Landslide Risk												
Malaria												
Dengue												
Rice	Maha Season		Rice Harvest		Rice Planting	Yala Season		Rice Harvest	Rice Planting		Maha Season	
System Management	Drought			Peak Electricity Demand	Irrigation Releases				Irrigation Releases			

http://iri.columbia.edu/~mahaweli

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 and
• the water resource system operations calendar