The South/Southeast Asia Research Initiative (SARI)

Update and Meeting Objectives

Krishna Prasad Vadrevu
NASA Marshall Space Flight Center

Land-Cover / Land-Use Change Program

NIES JAPAN

UNIVERSITY OF MARYLAND

GOFC-GOLD
GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

NASA

Presentation topics

- Background to the SARI initiative
- Regional Science Issues
- Meeting Objectives

How it started - strong interest in a SARI from local scientists

Jan-10-13th, 2013-Regional Science Meeting, Coimbatore

Total participants =120

US – 18 researchers

Nepal-3; Srilanka-2; Myanmar-1; Afghanistan, Myanmar, Bangladesh-1 each

Pakistan, China invited but could not attend – Visa issues

India – University Researchers, Government, Non-Government, NGO's

Meeting Summary-Need for SARI
NASA The Earth Observer

Summary of the 2013 NASA Land Cover/Land Use Change Regional Science Meeting, South India

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Chris Justice, University of Maryland, College Park, justice@hermes.geog.umd.edu
Prasad Thenkabail, United States Geological Survey, pthenkabail@usgs.gov
Garik Gutman, NASA Headquarters, ggutman@nasa.gov

Introduction

The 2013 NASA Land Cover/Land Use Change (LCLUC) Regional Science Meeting was held in South India and had three components:

- a focused workshop on water resources at the Centre for Water Resources Development and Management (CWRDM), held in Kozhikode, Kerala in India, from January 7-8, and a Land Use (LU) Transect Study from Kozhikode, Kerala, to Coimbatore, Tamil Nadu, in India[1], on January 9;
- a NASA international regional meeting, held January 10-13, at Karunya University in Coimbatore, Tamil Nadu; and
- a training workshop titled *Remote Sensing and Geospatial Technologies for Land Cover and Land Use Change Studies and Applications*, held January 14 at Karunya University.

The goal of the meeting was to discuss land cover/land use change (LCLUC) issues and impacts in the South Asia region. The meeting was organized around eight technical sessions:

1. Agricultural land-use change;
2. LCLUC-related Earth observations (missions, data, and products);
3. Atmosphere/land-use interactions (aerosols, greenhouse gases);
4. LCLUC and the carbon cycle;
5. Forests and LCLUC in mountainous areas;
6. Coastal zones and water resources;
7. Urban LCLUC; and
8. Working towards a Regional Global Observation for Forest and Land Cover Dynamics (GOFC–GOLD) South Asia Regional Information Network (SARIN) (including prospects, opportunities, and challenges).

[1] Kerala and Tamil Nadu are two of the 28 states in India.

The meeting was a joint effort of the NASA LCLUC Program; GOFC–GOLD Program; International System for Analysis Research and Training (START) Program; Monsoon Asia Integrated Regional Studies Program (MAIRS); University of Maryland College Park (UMD); Centre for Water Resources Development and Management (CWRDM) in Kozhikode, Kerala; and Karunya University, in Coimbatore, Tamil Nadu.

NASA LCLUC Workshop on Water Resources and Land Use Transect

Thirty top-level delegates from different institutes and universities in India attended the meeting in addition to twelve researchers from the U.S. **Narasimha Prasad** [CWRDM], welcomed the participants and highlighted the CWRDM water research activities.

After the welcome, **Garik Gutman** [NASA Headquarters] addressed the workshop's participants, presenting an overview of LCLUC issues in South Asia, with focus on agricultural land-cover conversion,

Water resource-focused workshop participants. **Images Credit:** All photos in this article were taken by author or other members of the LCLUC team.

Rhizophora mangle, known as the "red mangrove," near Kadalundi bird sanctuary in Kerala.

forest-cover loss, increasing urbanization, and air pollution. **Chris Justice** [UMD] stressed that much needs to be done in terms of the underpinning science of LCLUC and the linkages with global climate change in South Asia.

Some highlights from the workshop are summarized here:

- The most important LCLUC issue impacting agriculture in south India is *paddy fields* (wetlands) being converted to urban areas and/or left abandoned, with the attendant deficit in rice production.
- This *paddy conversion* is complex, and crosses economic, ecological, sociocultural, structural, and class dimensions.
- Economic return from paddy cultivation does not tend to encourage conservation—due to labor costs.
- At present, land is seen only as real estate needed for residence status, and is the safest and best investment to maximize profits.
- Coconut farming is shrinking due to the unavailability of skilled labor.
- Pollution and sedimentation from *anthropogenic* activities seriously affects aquatic systems/wetlands in South India. This requires more-stringent regulations and greater wetland protection.
- The roles of coastal vegetation and mangroves in protecting lives and property require more research to address contamination—possibly due to saline water intrusion, likely from inadequate drainage systems and poor maintenance of the well surroundings.

The CWRDM arranged several field visits to highlight local LCLUC issues and responses, including urban green park and wetlands conservation, mangrove conservation, and coastal and riparian land use management.

On January 9, participants departed for a Land Use Transect Study from Kozhikode, Kerala, to Coimbatore, Tamil Nadu, involving local scientists. The processes of urban expansion and forest degradation were quite evident during the transect study. During the transect, the participants observed forest fires in the mountains, 50 km (~31 mi) away from Coimbatore.

Coconut, arecanut, banana, and yam plantations, Kozhikode, Kerala.

Smoke from forest fires, Palakkad, Western Ghats, Kerala.

March/April 2013

http://eospso.gsfc.nasa.gov/eos_homepage/for_scientists/earth_observer.php

SARI - Goal

To develop an innovative research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich LCLUC science in South/Southeast Asia.

NASA ROSES Ongoing SARI Projects - 2016-Current

- Assessing the Impacts of Dams on the Dynamic Interactions Among Distant Wetlands, Land Use, and Rural Communities in the Lower Mekong River Basin
- Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos
- Land-Cover/Land-Use Change in Southern Vietnam Through the Lenses of Conflict, Religion, and Politics, 1980s to Present
- A Cobra in the Forest? Quantifying the Impact of Perverse Incentives from Indonesia's Deforestation Moratorium, 2011 to 2016
- The Agrarian Transition in Mainland Southeast Asia: Changes in Rice Farming - 1995 to 2018
- Agricultural Land Use Change in Central and Northeast Thailand: Effects on Biomass Emissions, Soil Quality, and Rural Livelihoods
- Spatiotemporal Drivers of Fine-Scale Forest Plantation Establishment in Village-Based Economies of Andhra Pradesh
- Consequences of Changing Mangrove Forests in South Asia on the Provision of Global Ecosystem Goods and Services
- Landscapes In Flux: The Influence of Demographic Change and Institutional Mechanisms on Land Cover Change, Climate Adaptability and Food Security in Rural India
- Urban Growth, Land-Use Change, and Growing Vulnerability in the Greater Himalaya Mountain Range Across India, Nepal, and Bhutan
- Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar
- Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in Myanmar
- The Future of Food Security in India: Can Farmers Adapt to Environmental Change?
- Impacts of Afforestation on Sustainable Livelihoods in Rural Communities in India
- Understanding Changes in Agricultural Land Use and Land Cover in the Breadbasket Area of the Ganges Basin 2000-2015: A Socioeconomic-Ecological Analysis
- Tropical Deciduous Forests of South Asia: Monitoring Degradation and Assessing Impacts of Urbanization
- The Global Land Rush: A Socio-Environmental Synthesis

More projects to add in the coming months.

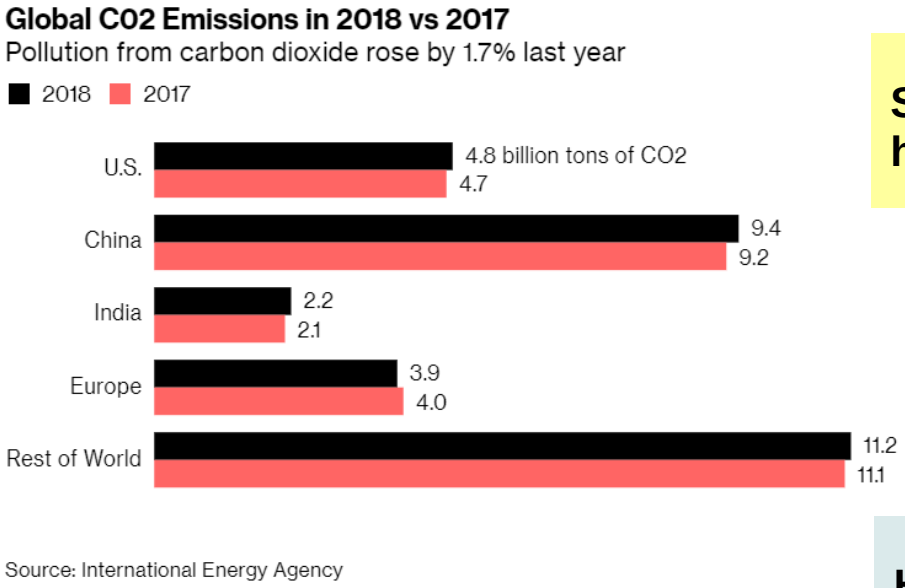
- Background to LCLUC and Emissions in the Region

Background to the LCLUC

- In S/SEA countries, there is an increasing concern that Land Cover/Land Use Changes (LC/LUC) have been increasing due to population growth, and rapid economic development.
- Net GHG Emissions show increasing trend.
- Significant increase in plantations such as Tea, Coffee, Rubber, Teak, Hemp, Coconut, Palm Oil, Casuriana, Eucalyptus, Acacia, etc.
- Recent LCLUC suggests significant decrease in Agricultural lands raising questions on Food Security.
- Agricultural LCLUC are closely tied to Water and Energy related issues including Greenhouse gas (GHG) emissions.
- Increasing Urbanization in different S/SEA countries with increasing energy demands.

Global Carbon Emissions Hit Record High During 2018

Growing disconnect between the climate agreements and emissions

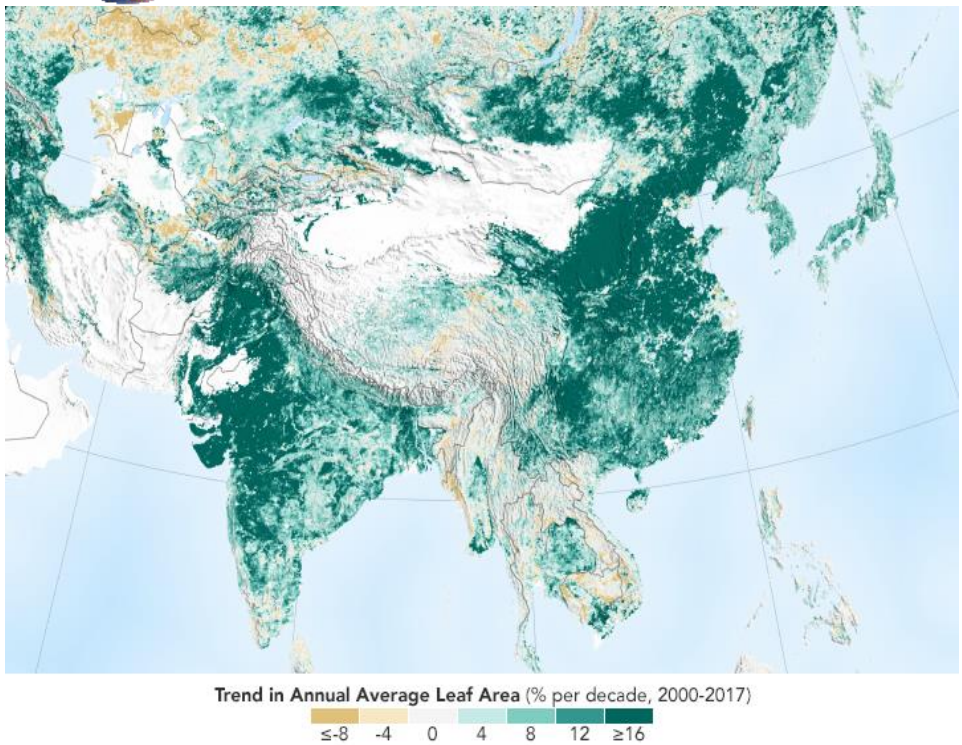


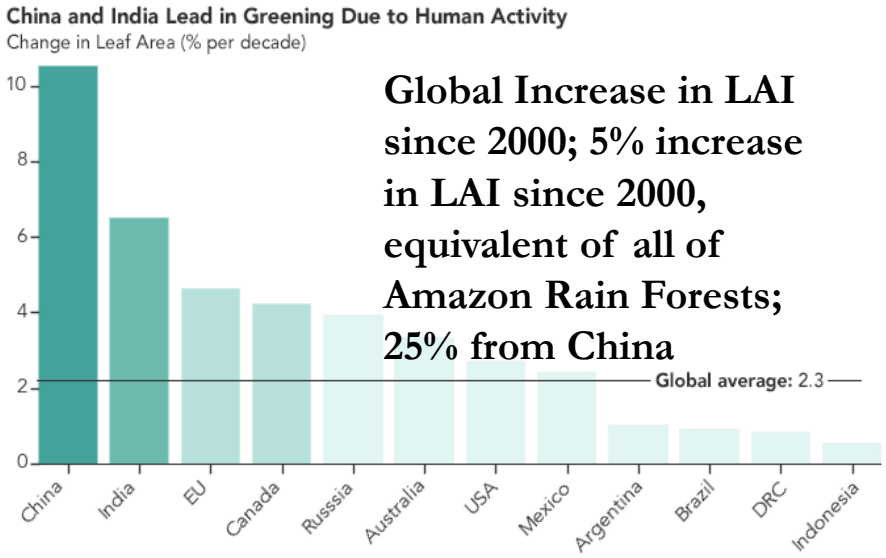
Since Paris agreement (Dec-2015), emissions have risen in each of the first two full years !.

High Energy Demand ! – High Oil Consumption in the US and more Coal Burning in China and India.

Energy demand grew 2.3 percent last year, the most in a decade (IEA). It showed a record 33 gigatons of carbon emissions from energy, up 1.7 percent from the previous year. Global electricity demand rose 4 percent and was responsible for half the growth in overall energy demand.

China and India Lead in Greening (Myneni et al., 2019)





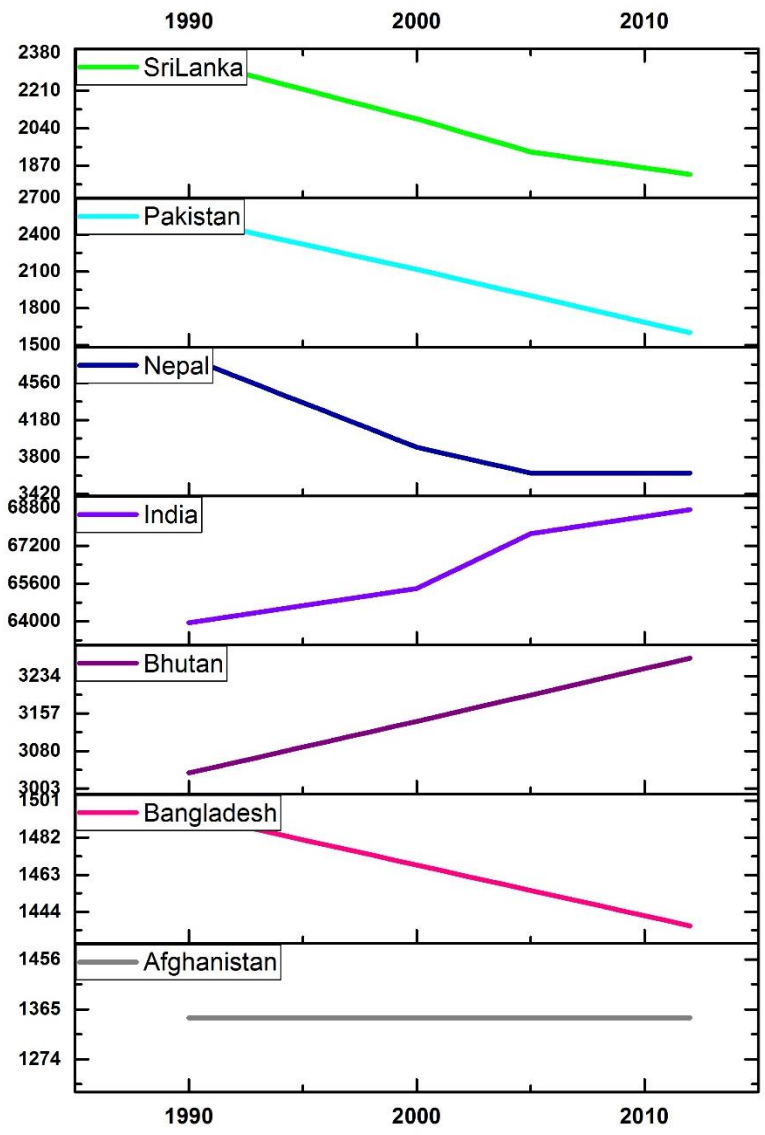
Global Increase in LAI since 2000; 5% increase in LAI since 2000, equivalent of all of Amazon Rain Forests; 25% from China

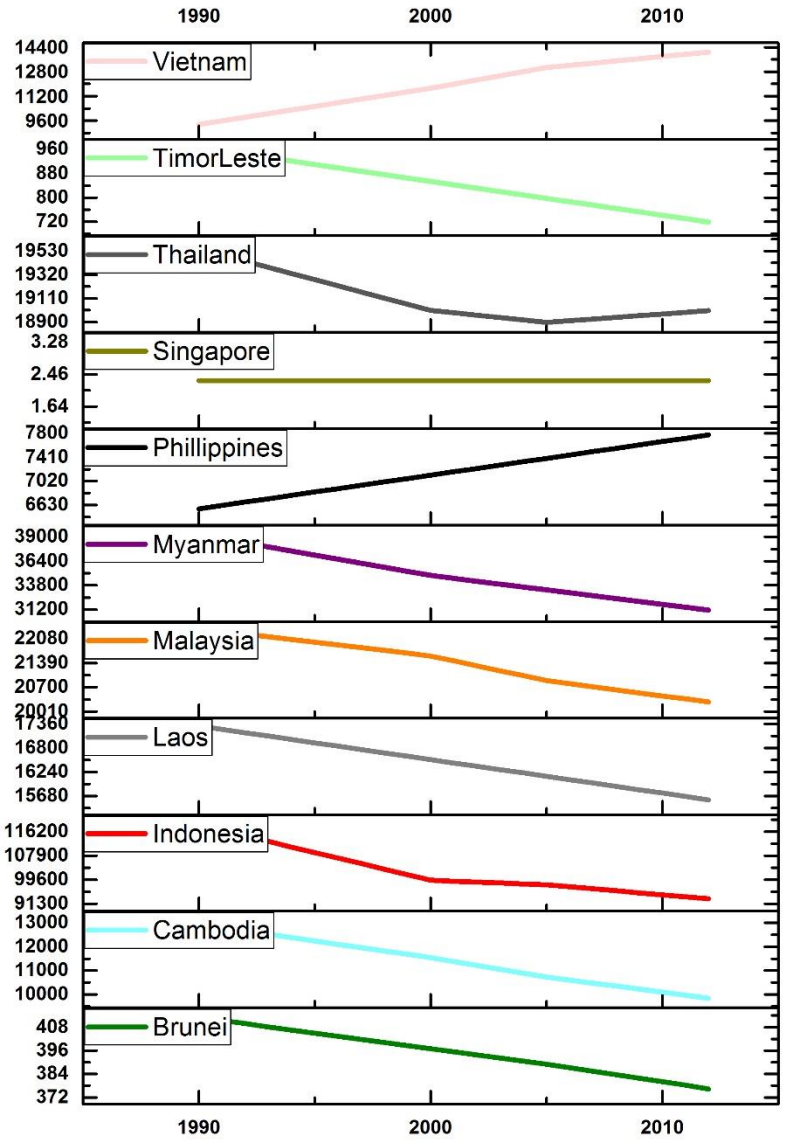
Global green leaf area has increased by 5 percent since the early 2000s, an area equivalent to all of the Amazon rainforests. At least 25 percent of that gain came in China.

China and India—the world's most populous countries—are leading the increase in greening on land. The effect comes mostly from ambitious tree-planting programs in China and *intensive agriculture in both countries.*

Key point: The crop land area in China and India has not changed much since the early 2000s; yet both countries have greatly increased both their annual total green leaf area and their food production through multiple cropping practices (Myneni et al., 2019; Nature) !

Forest Area in South/SE Asia

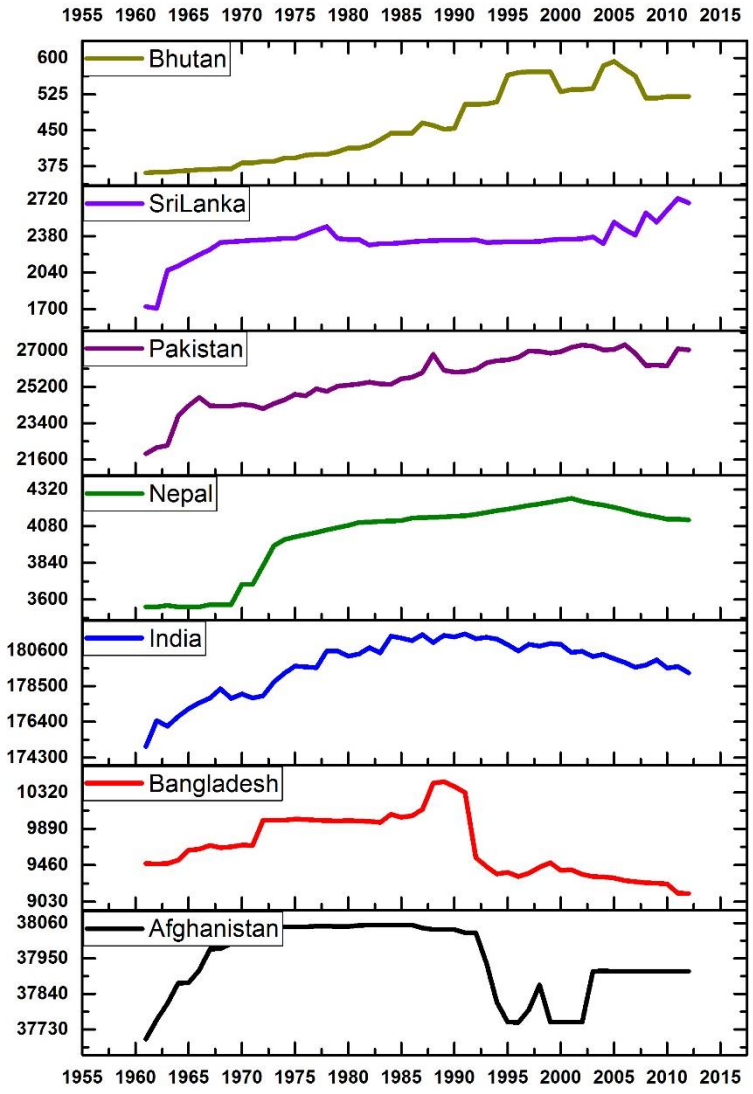


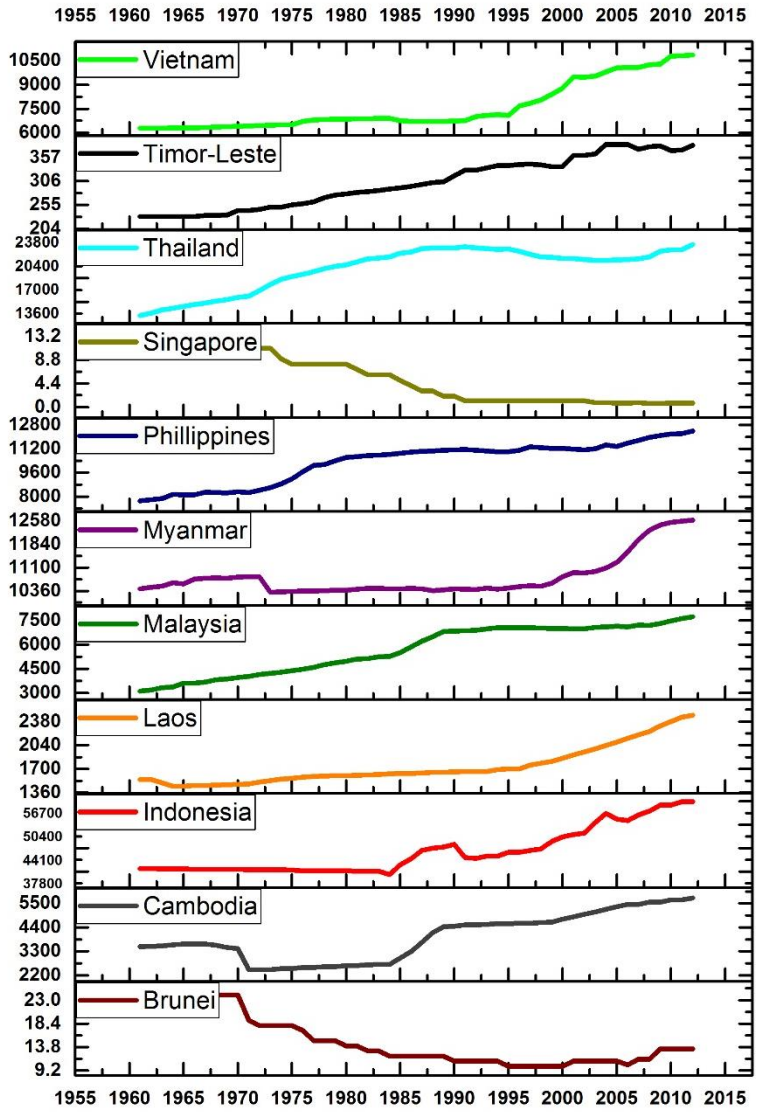


Significant decrease in Forest Area (x 1000ha) in Several South and Southeast Asian Countries

Drivers and impacts poorly understood ! Vadrevu et al., ERL, (12)120201 Data Source: FAO, 2015

Agricultural land use in South/SE Asia

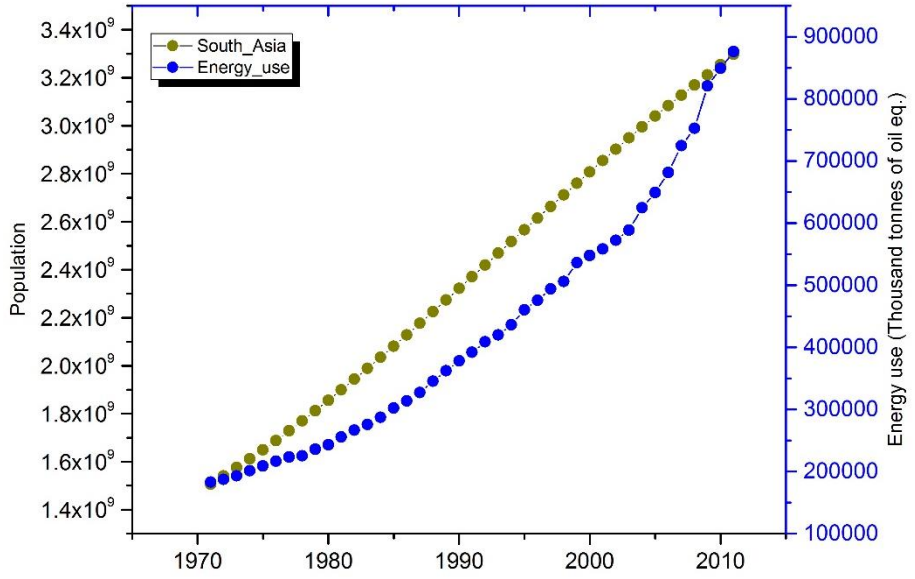


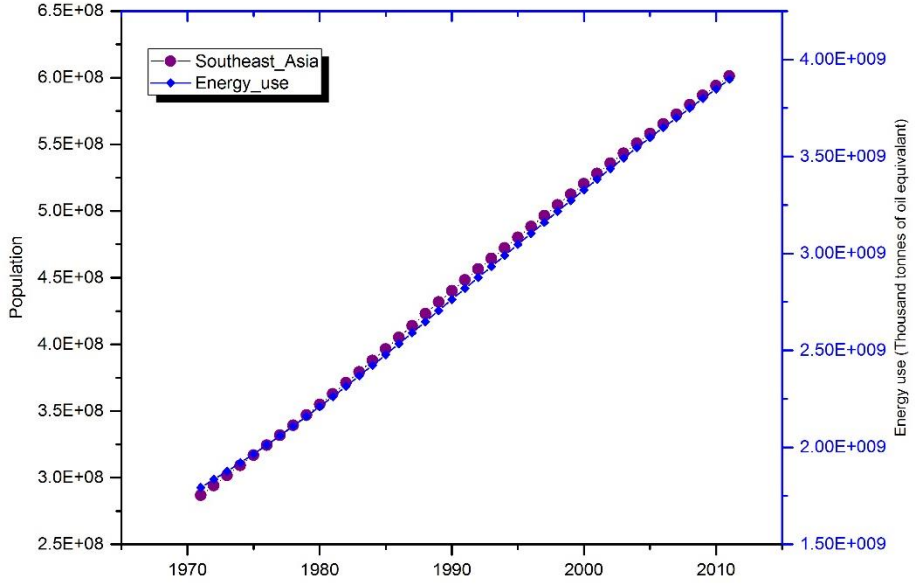


Significant increase in Agricultural Land Area (x 1000ha) in Several South and Southeast Asian Countries

Drivers and impacts poorly understood ! Vadrevu et al., ERL, (12)120201 Data Source: FAO, 2015

Population and Energy Use



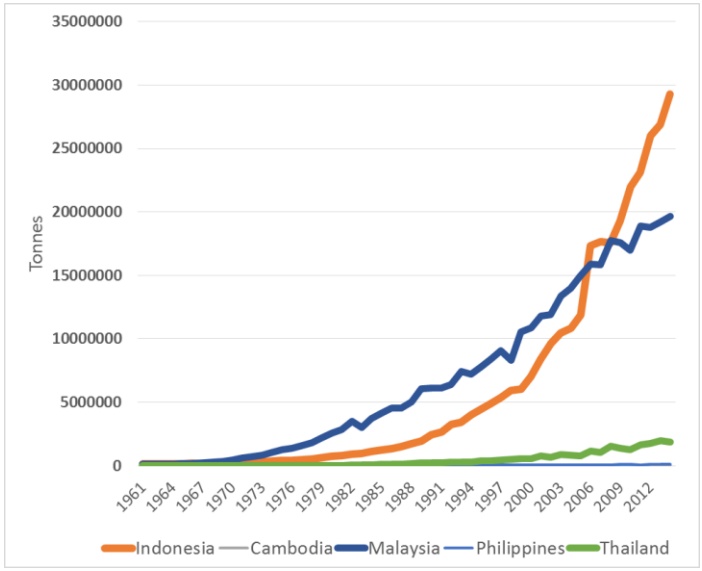


Data source: FAO.org (public domain)

Land use conversions to Palm Oil Plantations

-Forest and Peat lands converted to palm plantations

-Ecological, environmental, social implications

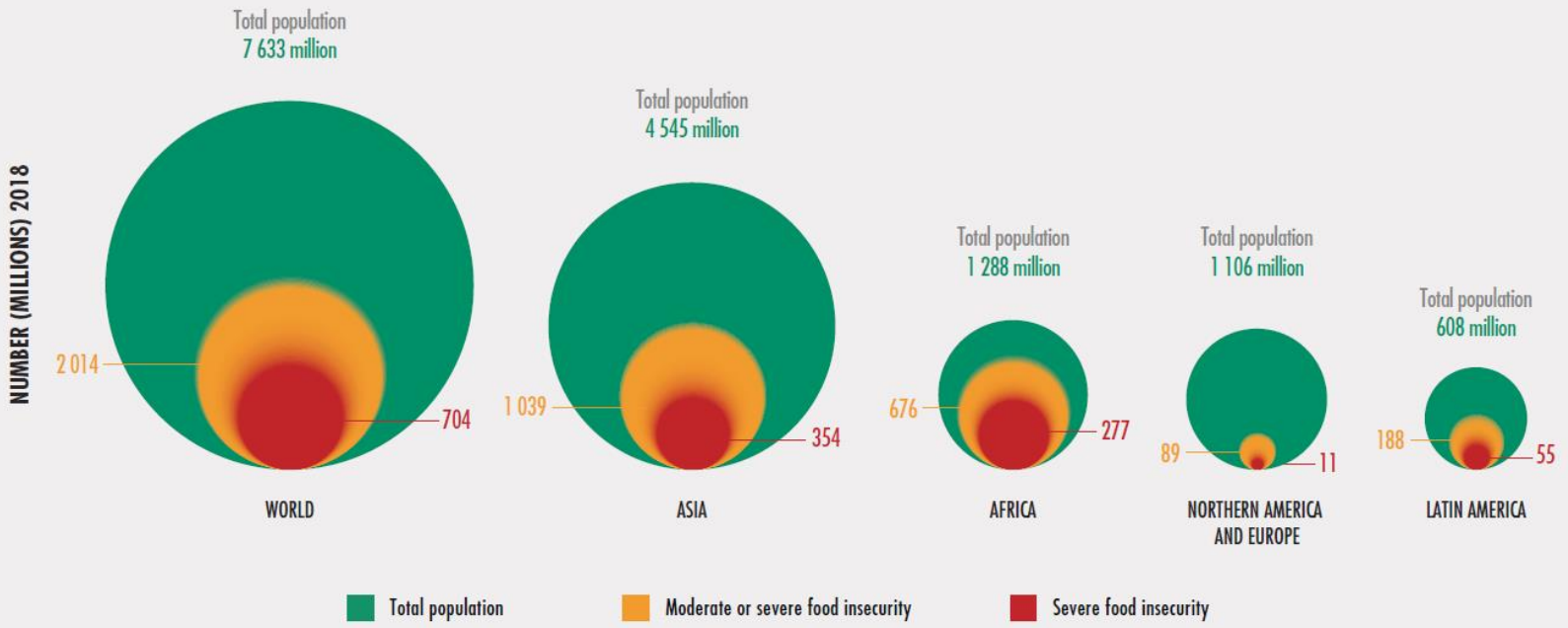


Factor increase of 200 from 1961-2012

Extraordinary growth rate in Palm oil share: The share of palm oil in the global supply of major vegetable oils has increased from about 21% in 1990 to 40% in 2017. ***Most of the expansion in supply of palm oil occurred in Malaysia and Indonesia (FAO, 2019)***

Concentration and Distribution of Food Insecurity by Severity

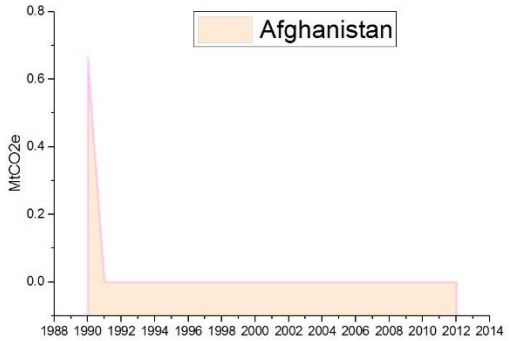
FIGURE 11
THE CONCENTRATION AND DISTRIBUTION OF FOOD INSECURITY BY SEVERITY DIFFERS GREATLY ACROSS THE REGIONS OF THE WORLD

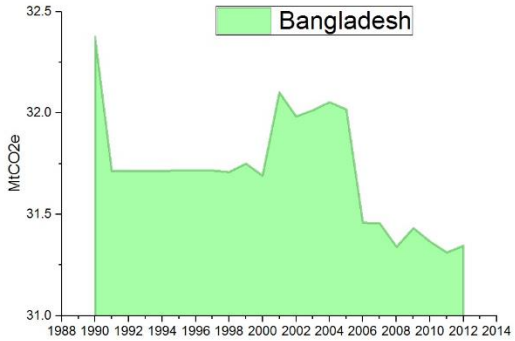


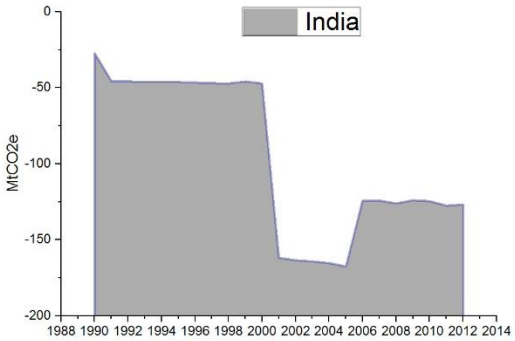
SOURCE: FAO.

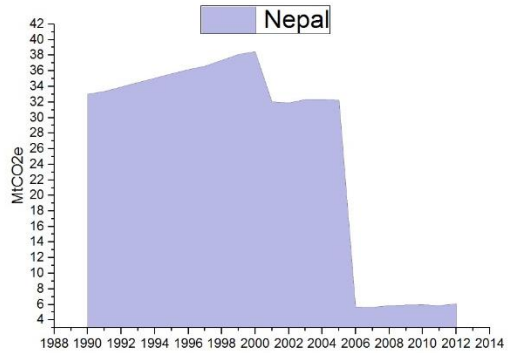
9.2 percent of the world population (or slightly more than 700 million people) were exposed to severe levels of food insecurity in 2018, implying reductions in the quantity of food consumed to the extent that they have possibly experienced hunger (FAO, 2019).

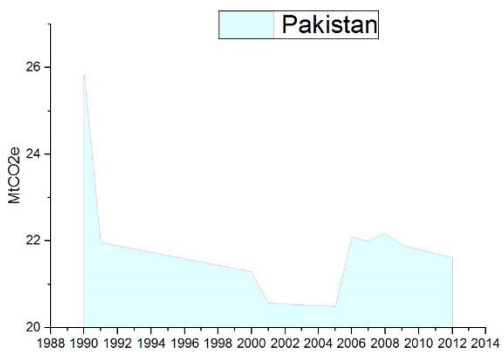
GHG emissions from LUCF in South Asia

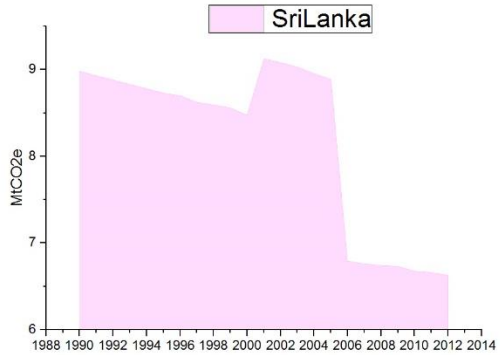


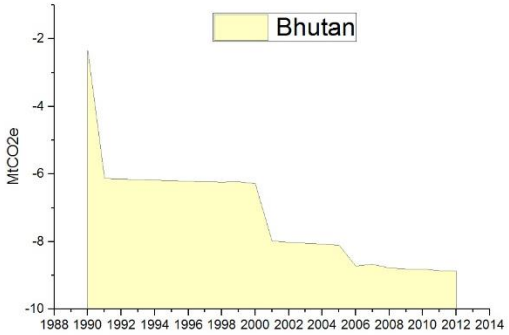








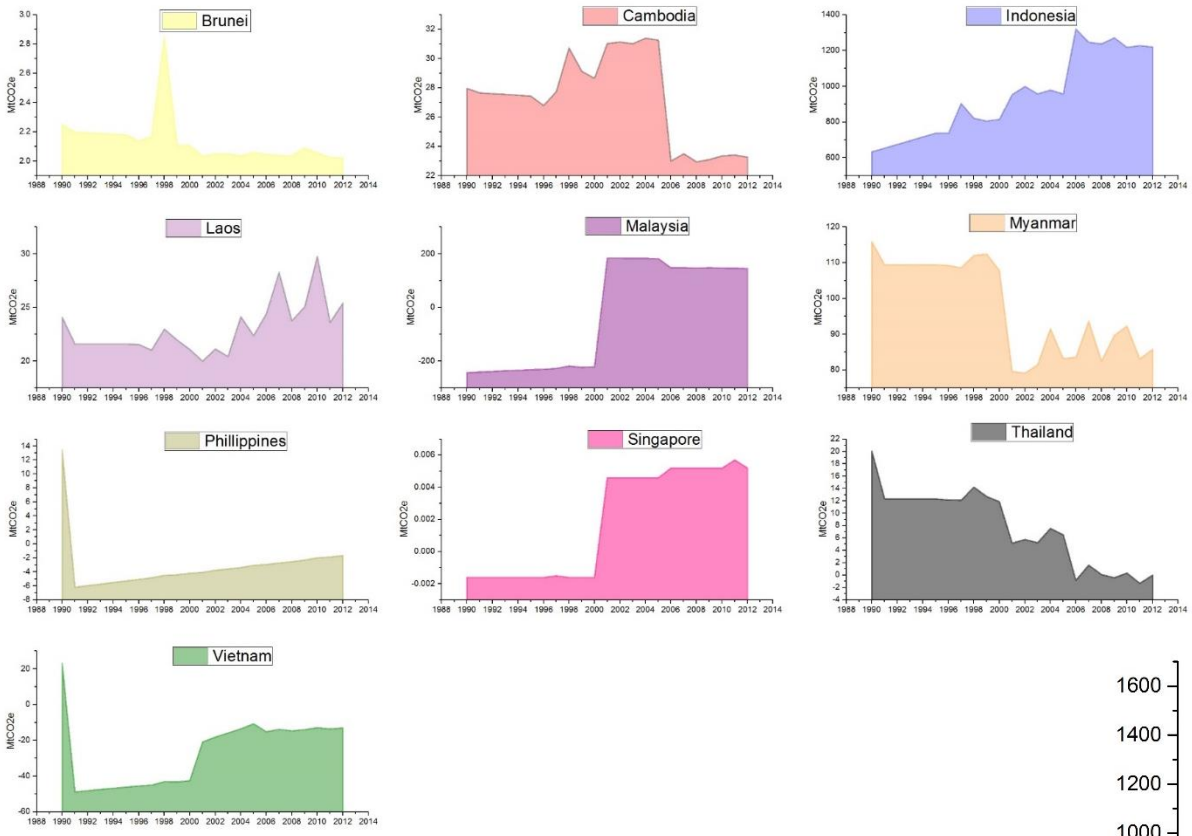




GHG emissions from LUCF sector seems decreasing significantly in South Asia

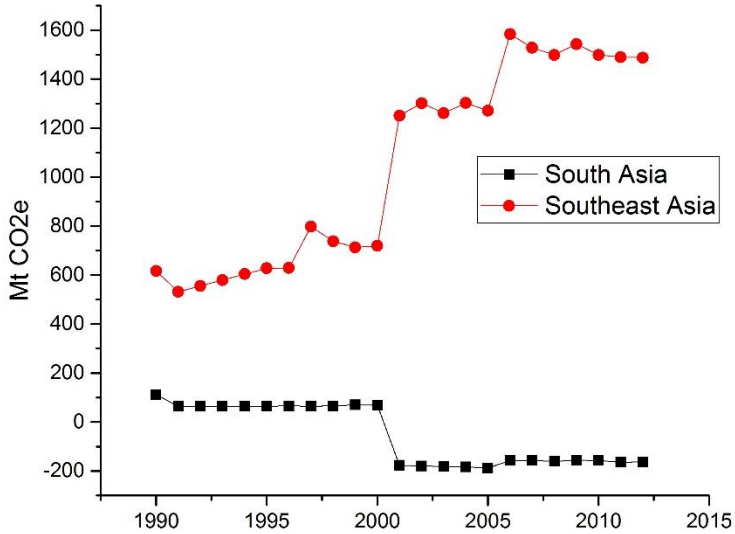
Vadrevu et al., 2017, ERL

GHG emissions from LUCF in Southeast Asia



GHG emissions from LUCF sector seems decreasing in Southeast Asia too,

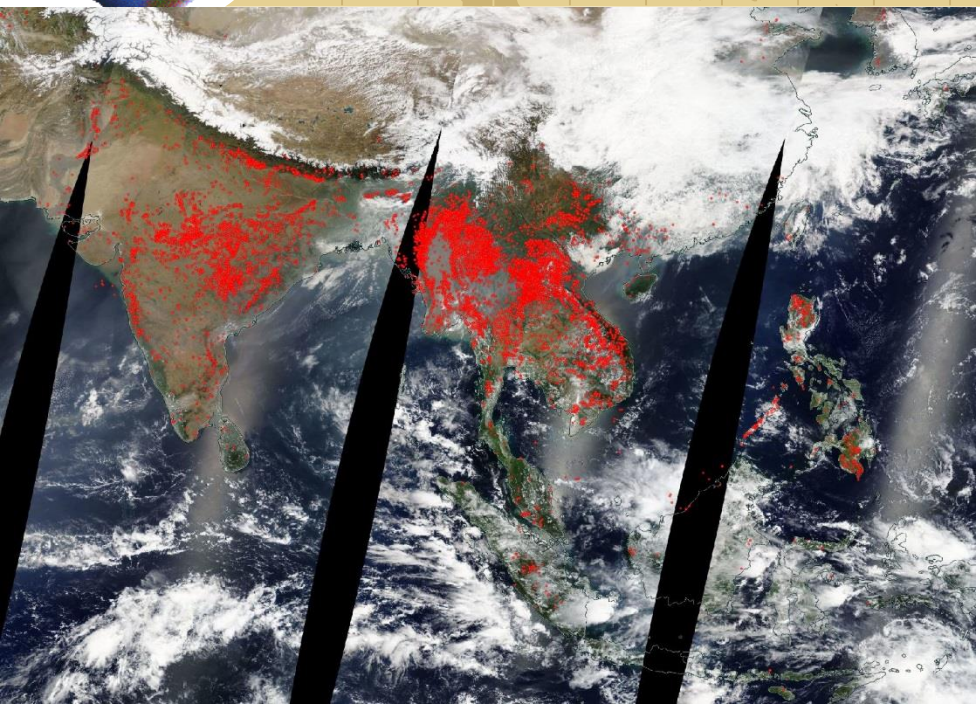
however, not *rapidly as in South Asia*



Some of the drivers to be discussed in the workshop

Vadrevu et al., 2017, ERL

Increasing Agricultural Fires in South/Southeast Asia



- Indonesia: despite govt. claims that fires are under control, 2019 fires in Sumatera suggests a different story.
- Fires occurred mostly in Peatlands.

Vadrevu et al., 2019.
Nature Scientific Reports

SARI Focus and Priorities

- *SARI Focuses on building research collaborations between the US and regional scientists*

- *Meetings/Workshops help in identifying Needs and Priorities for the region (NASA LCLUC calls)*

- *Training events are integral to SARI*
- *(eg: 3-day training after the meeting)*

SARI Research Needs and Priorities – Meetings/Workshops Funded by International/Regional partners

2018 LCLUC SARI Meeting – Philippines

202 participants – 21 countries representation

3-day meeting + 3-day training

Collaborations are the Key
Chiang Mai Meeting Facilitated by 20-Different Organizations

National Astronomical Research Institute of Thailand

Chiang Mai University

Sponsors and Partners

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GOFC-GOLD
GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

UNIVERSITY OF MARYLAND

NASA

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SARI

GEOGLAM
Global Agricultural Monitoring

Asia-RiCE
Crop Estimation and Monitoring

START
global change SysTem for Analysis, Research & Training

adpc

RESEARCH UNIVERSITY NETWORK THAILAND

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

SESE

RCCES

ASARU
Atmospheric Science and Astronomy Research Unit
Lampang Rajabhat University

Current Meeting – 19 Different Partners

Local Host

UTM UNIVERSITI TEKNOLOGI MALAYSIA — FACULTY OF BUILT ENVIRONMENT & SURVEYING

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GEOGLAM Global Agricultural Monitoring

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HARVEST

START global change SysTem for Analysis, Research & Training

GOFC-GOLD GLOBAL OBSERVATION FOR FOREST AND LAND COVER DYNAMICS

JAXA

CESBIO

VNSC Liftoff your Dream

MICHIGAN STATE UNIVERSITY Founded 1855

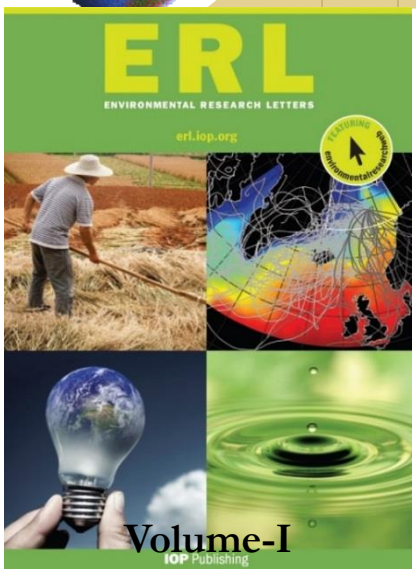
THE CLEAN AIR FORUM SOCIETY OF MALAYSIA

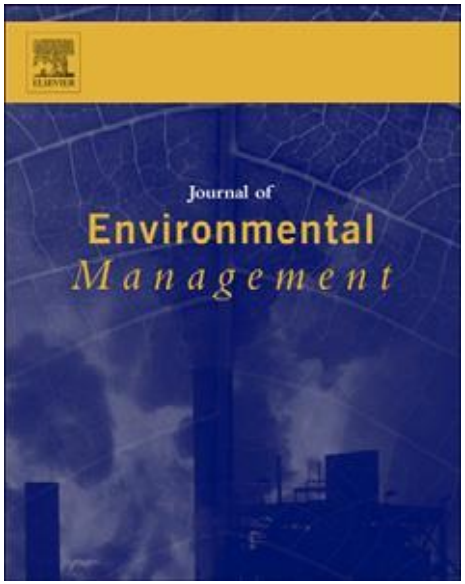
ILLINOIS UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

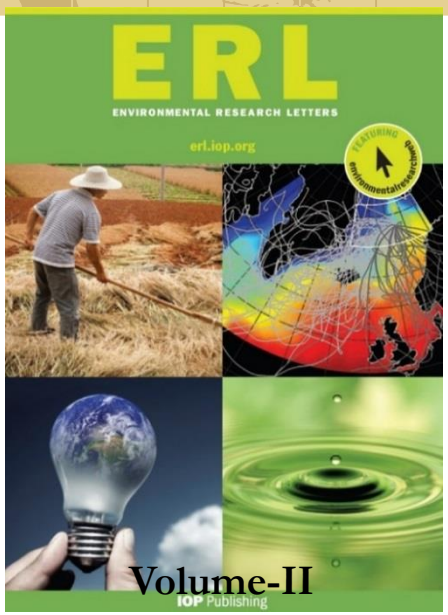
CEOS The Committee on Earth Observation Satellites WGCapD

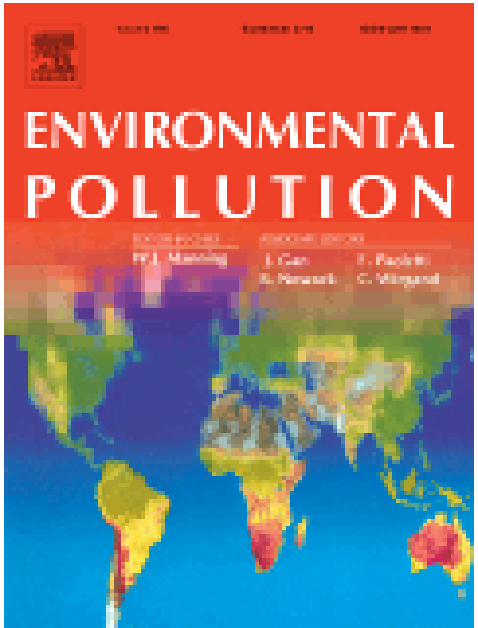
IGRSM INSTITUTION OF GEOSPATIAL AND REMOTE SENSING MALAYSIA

For SARI – Research Outputs are Priority!









Springer

springer.com

Land-Atmospheric Interactions in Asia

Book Series: Springer Remote Sensing/Photogrammetry

Editors: Krishna Prasad Vadrevu, Toshimasa Ohara, Chris Justice

Forthcoming, Summer 2016

- Maximizes reader insights into the quantification of land cover/land use changes (LC:LUC) and greenhouse gas emissions in Asia.
- Focuses on large spatial scales integrating satellite remote sensing and ground based approaches.
- Broadens understanding on integrated approaches combining top down and bottom up methodologies including modeling for characterizing LC:LUC and emissions.
- Explores the causative factors and impacts of LC:LUC and emissions due to population growth, industrial activities and energy demand in Asia.

In Asia, high population growth together with rapid economic development are causing immense pressure to convert land from natural and agricultural areas to residential and urban uses with significant impact on emissions and ecosystem services. This edited volume sheds new light on the causative factors and impacts of LC:LUC on the greenhouse gas (GHG) and aerosols in Asia. The volume will also focus on the use of remote sensing, geospatial technologies, and integrated approaches to characterize LC:LUC and emissions.

Articles are invited from international researchers working on remote sensing of LC:LUC, fires, GHG emission inventories, aerosols, and land-atmospheric interactions in Asia.

Submission Deadline: December 31st, 2015
Email: krkvkp@umd.edu

Dr. Krishna Prasad Vadrevu *(krkvkp@umd.edu), Associate Research Professor, Department of Geographical Sciences, University of Maryland, College Park, USA.*

Dr. Toshimasa Ohara *(tohara@nies.go.jp), Researcher, National Institute of Environmental Studies (NIES), Japan.*

Dr. Chris Justice *(ciustice@umd.edu), Head, Department of Geographical Sciences, University of Maryland, College Park, USA.*

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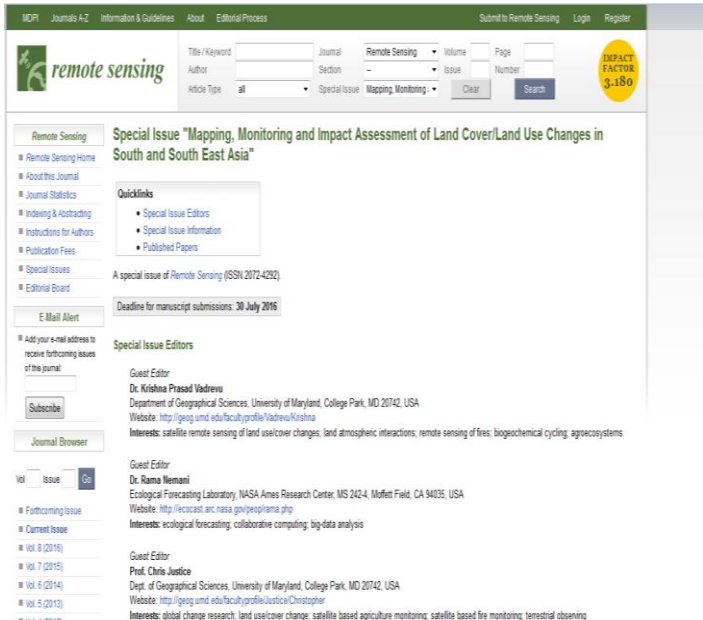
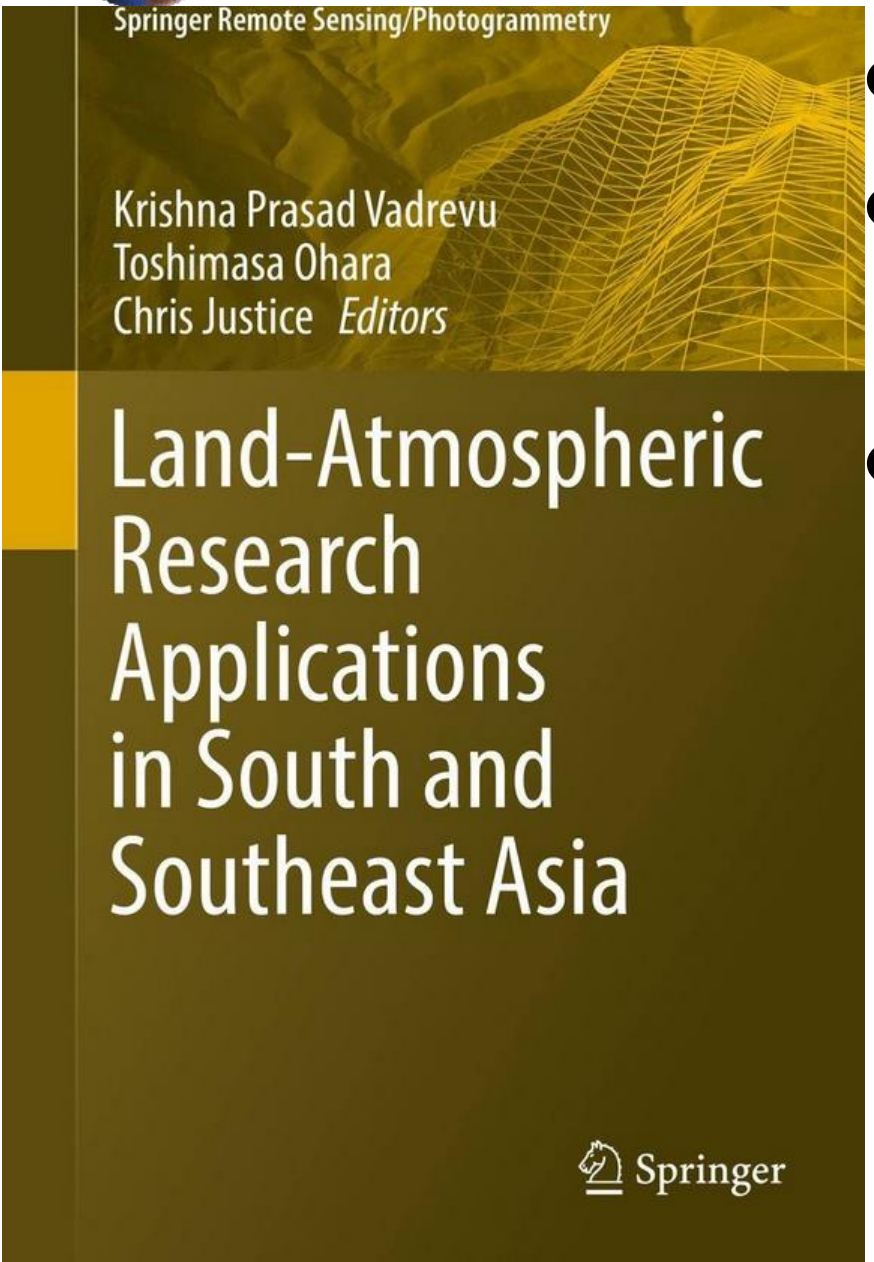


Book Published (2018)



- 30 Chapters
- 101 (authors + co-authors)
- 732 pages

2-other books in progress:

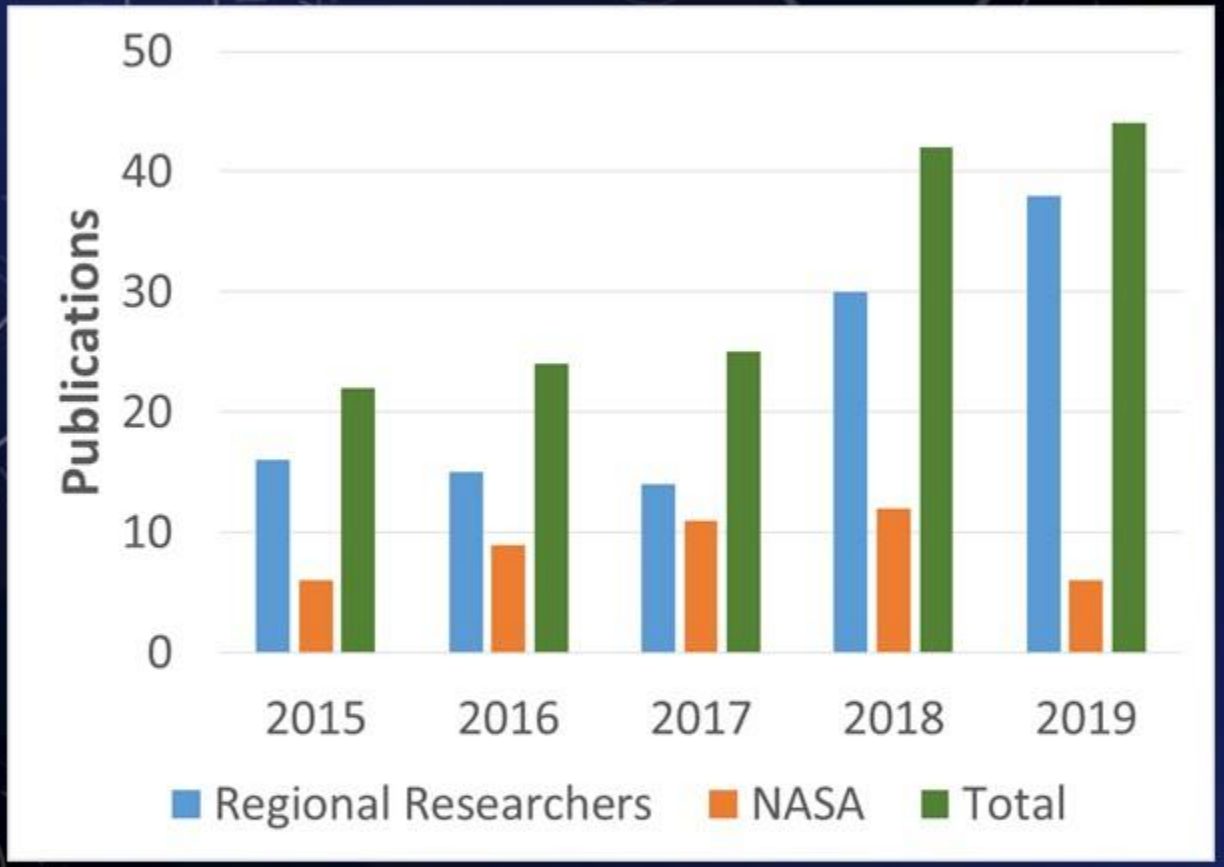
-Biomass burning in Asia (CRC Press – 2 Volumes, 2019)

-Remote sensing of Agriculture in Asia - Springer (2019)

SARI: RECENT 4 YEARS OF SCIENCE

Over 150 papers and 3 books 4th to be announced

10-different Special Issues in Journals

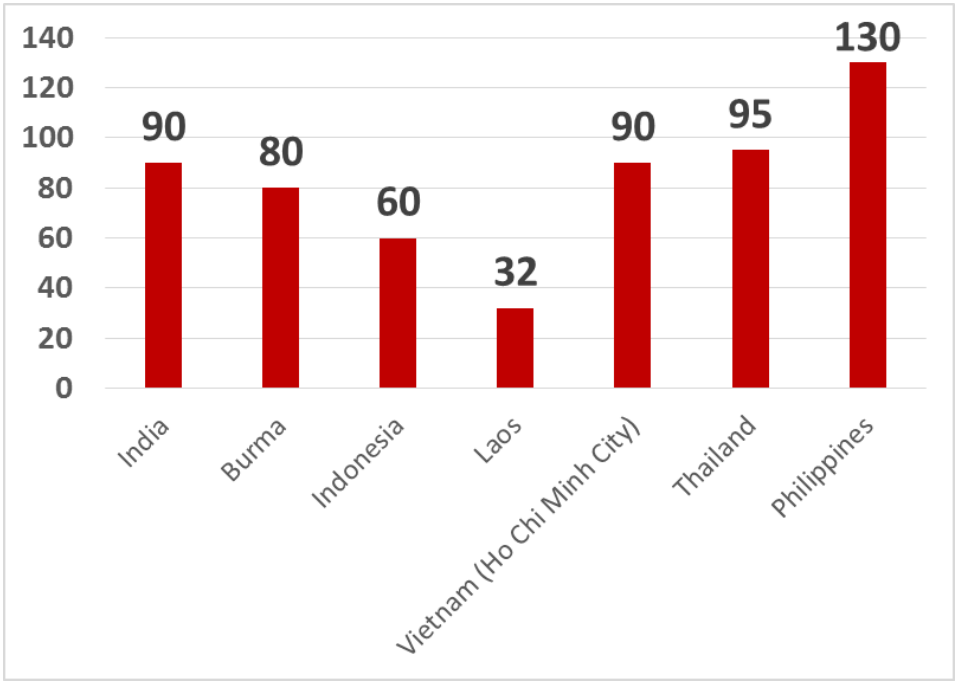


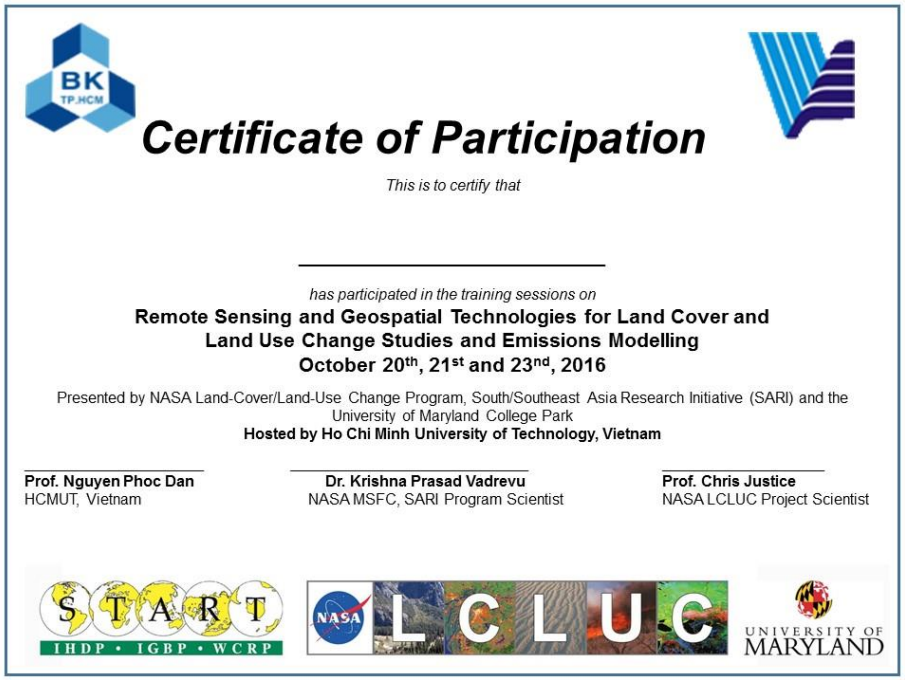
>200 scientists
>100 institutions
>18 projects

South-Southeast Asia

Oct-2013 – India Meeting – SARI idea proposed
2015-SARI formed; 2016- 1st SARI proposals funded;

Training Events –Early Career Researchers





Certificate of Participation

This is to certify that

has participated in the training sessions on

Remote Sensing and Geospatial Technologies for Land Cover and Land Use Change Studies and Emissions Modelling
October 20th, 21st and 23nd, 2016

Presented by NASA Land-Cover/Land-Use Change Program, South/Southeast Asia Research Initiative (SARI) and the University of Maryland College Park
Hosted by Ho Chi Minh University of Technology, Vietnam

Prof. Nguyen Phoc Dan
HCMUT, Vietnam

Dr. Krishna Prasad Vadrevu
NASA MSFC, SARI Program Scientist

Prof. Chris Justice
NASA LCLUC Project Scientist

START IHDP • IGBP • WCRP

NASA LCLUC

UNIVERSITY OF MARYLAND

Promoting Open Source Tools and Cloud Computing Platforms (Ex: GEE)

Training participants for this meeting: 100

Meeting Objectives

- Review space agency related science in South/Southeast Asia (S/SEA);
- Review the causes and impacts of LCLUC specific to agriculture, forests, and urban ecosystems in S/SEA;
- Review latest research specific to GHG inventories, aerosols; biomass burning pollutants and emissions modeling;
- Identify important regional research + capacity building and training needs and priorities in S/SEA.

Meeting Sessions

Plenary Sessions (Day 1 and 3)

- Session-1 – Space Agency Presentations
- Session-2 – Agricultural LCLUC
- Session-3 – Land Atmospheric Remote Sensing and Emissions
- Session-4 – LCLUC and Forestry
- Session-5 – Urban LCLUC

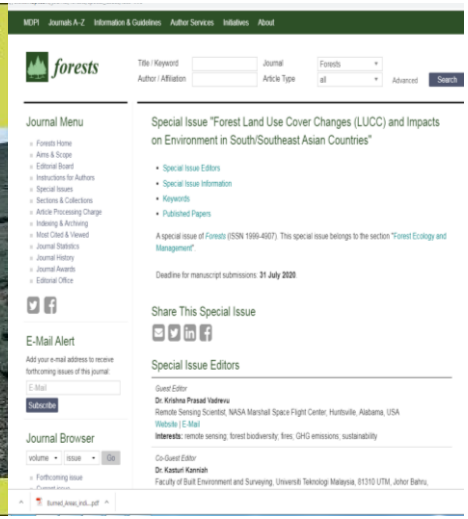
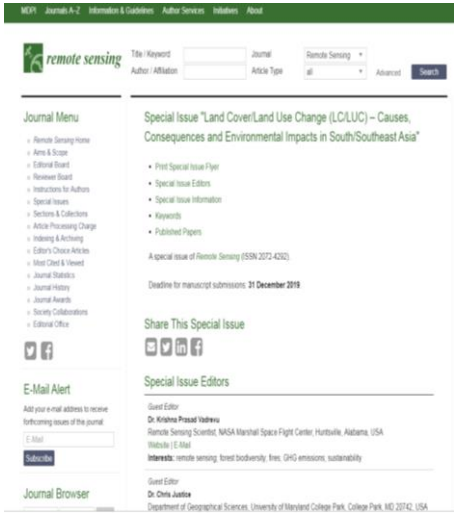
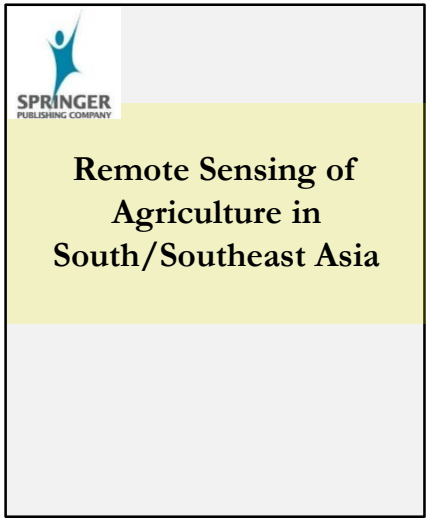
Parallel Sessions (Day-2)

- Session-1 – Atmospheric Science and LCLUC
- Session-2 – Agricultural LCLUC

Discussion Sessions (Day-2 and 3)

- Day-2 : Thematic Research Needs and Priorities;
- Day-3 : Regional Science, User Needs and Priorities.

4-Different Outputs for the Current Meeting

Journal Special Issue	Journal Special Issue	Journal Special Issue	Springer Book
			
Guest Editors Dr. Krishna Vadrevu (NASA) Dr. Garik Gutman (NASA) Dr. Tsuneo Matsunaga (NIES) Prof. Chris Justice (UMd)	**Guest Editors** Dr. Krishna Vadrevu (NASA) Dr. Garik Gutman (NASA) Dr. Tsuneo Matsunaga (NIES) Prof. Chris Justice (UMd)	**Guest Editors** Dr. Krishna Vadrevu (NASA) Dr. Kasturi Kanniah (UTM) Dr. Garik Gutman (NASA) Prof. Chris Justice (UMd)	**Book Editors** Dr. Krishna Vadrevu (NASA) Dr. Thuy Le Toan (CESBIO) Dr. Shibendu Ray (MNCFC) Prof. Chris Justice (UMd)

Strongly encourage everyone to submit.
Please talk to us for publication ideas

SARI forthcoming meetings (2019-2020)

- 2019 – Sustainable Forestry in South Asia – Current Status, Science and Conservation Priorities, India
  - Meeting: November 7-9th, 2019
  - Training: TBD

- 2019 - NASA-GISTDA Advanced Remote Sensing Training
  - Training: December, 2019

- 2020 - WEF-SARI LCLUC Meeting, Cambodia
  - Meeting: February
  - Training: February

LCLUC - Dr. Gutman and Prof. Justice

Vision and support
to build the SARI regional science initiative

Welcome to Johor Bahru