The South/Southeast Asia Research Initiative (SARI) Update and Meeting Objectives

Krishna Prasad Vadrevu, NASA Marshall Space Flight Center, Alabama

Abstract

Land Use/Cover Change (LU/CC) is one of the most important types of environmental change in South and Southeast Asian countries. Several studies suggest that LU/CC in these countries is in large part driven by population growth and economic development. In the region, changes that are most common include urban expansion, agricultural land loss, land abandonment, deforestation, logging, reforestation, etc. To address the research needs and priorities in the region, a regional initiative entitled South Southeast Asia Regional Initiative (SARI) has been developed involving US and regional scientists. The initiative is funded by NASA Land Cover, Land Use Change program. The goal of SARI is to integrate state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich LU/CC science in South Southeast Asian countries. In the presentation, LU/CC change research in SARI countries will be highlighted including the drivers of change. For example, in South Asia, forest cover has been increasing in countries like India, Nepal and Bhutan due to sustainable afforestation measures; whereas, large-scale deforestation in Southeast Asian countries is still continuing, due to oil palm plantation expansion driven by the international market demand in Malaysia and Indonesia. With respect to urbanization, South and Southeast Asian countries contain 23 megacities, each with more than 10 million people. Rapid urbanization is driving agricultural land loss and agricultural intensification has been increasing due to less availability of land for growing food crops such as in India, Vietnam, and Thailand. The drivers of LUCC vary widely in the region and include such factors as land tenure, local economic development, government policies, inappropriate land management, land speculation, improved road networks, etc. In addition, variability in the weather, climate, and socioeconomic factors also drive LU/CC resulting in disruptions of biogeochemical cycles, radiation and the surface energy balance of the atmosphere. The presentation will also highlight SARI collaborative activities with space agencies, universities and non-government organizations including data sharing mechanisms in the region.

The South/Southeast Asia Research Initiative (SARI) Update and Meeting Objectives

Krishna Prasad Vadrevu
NASA Marshall Space Flight Center

Presentation topics

- **Background to the SARI initiative**

- **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

Krishna Prasad Vadrevu, University of Maryland, College Park, krishna@hermes.geog.umd.edu
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

SARI is NASA LCLUC Program funded regional initiative

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.

SARI Priority

- Involving National Researchers and Practitioners – Universities, Institutes and Operational Agencies;
- Strong emphasis on Applied Research with regional / national societal applications and benefits.
- Facilitate strengthening regional/national projects through co-design and collaborations;

SARI Regional Needs Meetings funded by NIES, Japan and several international/regional partners

Collaborations are the Key !

SARI Agriculture Meeting – New Delhi

-Total Meeting Participants = 94

-Total Presentations – 42;

-Meeting Outputs – IJRS Special Issue

International Journal of Remote Sensing

Submit your papers to this special issue on Remote Sensing of Agriculture in South/Southeast Asia

Deadline: 31 December 2017

Print Email Tweet Share

South/Southeast Asian countries are growing rapidly in terms of population, industrialization and urbanization. One of the key challenges in the region is food security. Although total food production and productivity has increased in the region because of additional land area converted to agricultural land use during 1960's to 2000 and improved varieties and crop management, growth rate of food production in recent times has slowed down, mostly due to loss of agricultural lands related to increasing urbanization and industrialization and less optimal use of available technology. Further, the weather and climate systems in the region, driven primarily by monsoon variability are characterized by extreme weather events, resulting in droughts or flooding which can impact agricultural production. In this region, monitoring the agricultural crop production in a timely manner is essential to predict and prepare for disruptions in the food supply. Further, improved and up-to-date information on agricultural land cover and associated land use practices can help in understanding the role and response of the agricultural sector to environmental change and for improved land management and planning.

Despite the progress in remote sensing and geospatial technologies, little emphasis has been placed on developing robust methods for operational mapping/monitoring of cropped areas and forecasting crop production. In most countries of South/Southeast Asia, the mapping efforts have focused on the classification of land cover types and generalize cropland areas into a single or limited number of thematic classes. Crop-specific LULC information is currently limited to very few countries in

Explore International Journal of Remote Sensing

An official journal of the Remote Sensing and Photogrammetry Society

Published by Taylor & Francis
24 online issues, 12 print issues per year

Stay up-to-date with the latest research

Subscribe to the journal's RSS feed. Find out more on Taylor & Francis Online:

- Journal home page
- Editorial board
- Aims & scope
- Instructions for authors

http://explore.tandfonline.com/cfp/est/tres-remote-sensing-in-asia-cfp

Eds: Krishna Vadrevu, Vinay Dadhwal, Garik Gutman and Chris Justice

NASA ROSES – 2015-2018 LCLUC South Asia Projects

Agriculture and Food security

- **Landscapes In Flux: The Influence of Demographic Change and Institutional Mechanisms on Land Cover Change, Climate Adaptability and Food Security in Rural India**

- **The Future of Food Security in India: Can Farmers Adapt to Environmental Change?**

- **Understanding Changes in Agricultural Land Use and Land Cover in the Breadbasket Area of the Ganges Basin 2000-2015: A Socioeconomic-Ecological Analysis**

Urban

- **Urban Growth, Land-Use Change, and Growing Vulnerability in the Greater Himalaya Mountain Range Across India, Nepal, and Bhutan**

Human Health

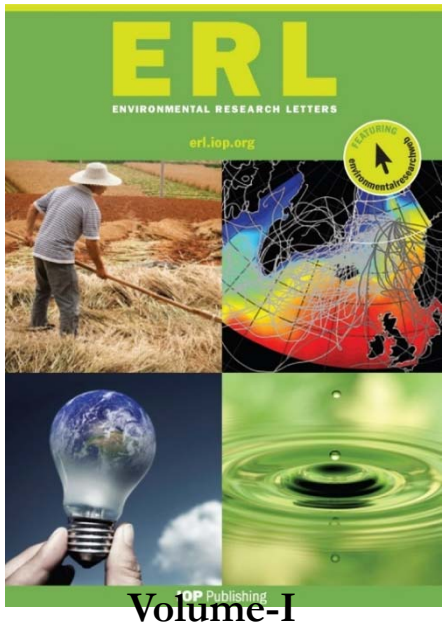
- **Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar**

2015-2016 LCLUC South Asia Projects

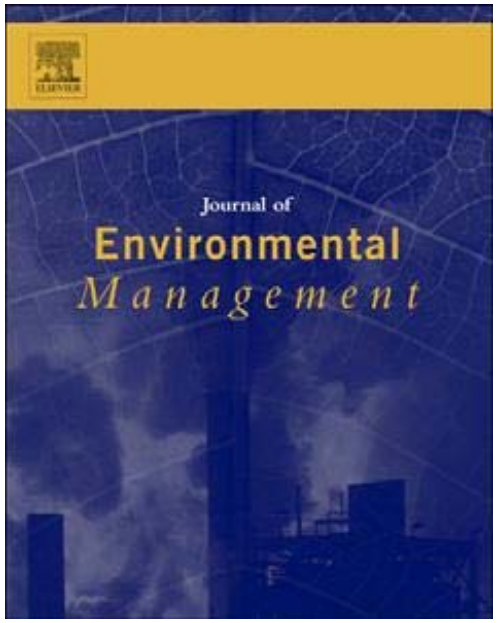
Forests

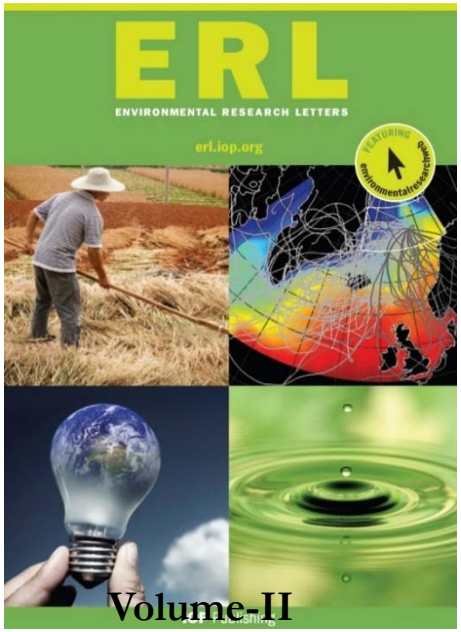
- Spatiotemporal Drivers of Fine-Scale Forest Plantation Establishment in Village-Based Economies of Andhra Pradesh
- Consequences of Changing Mangrove Forests in South Asia on the Provision of Global Ecosystem Goods and Services
- Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in Myanmar
- Impacts of Afforestation on Sustainable Livelihoods in Rural Communities in India
- Tropical Deciduous Forests of South Asia: Monitoring Degradation and Assessing Impacts of Urbanization

SARI - Peer Reviewed Publications

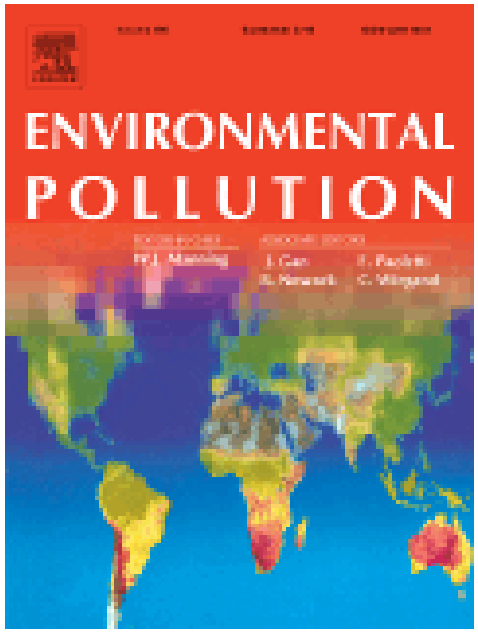


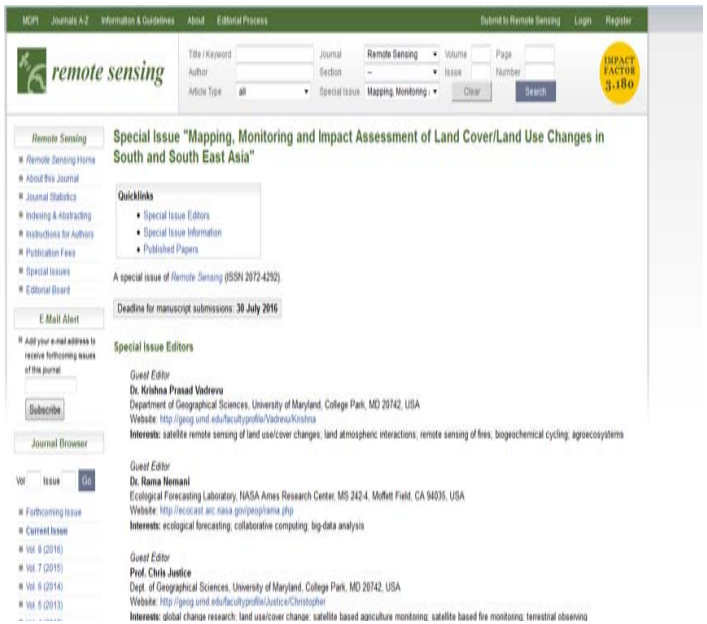
Volume-I





Volume-II



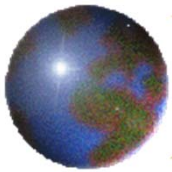


SARI forthcoming meetings (2017-2018)

- 2018 - SARI LCLUC regional meeting in Phillippines
  - Meeting: March 17-18-19
  - Training: March 20-21-22

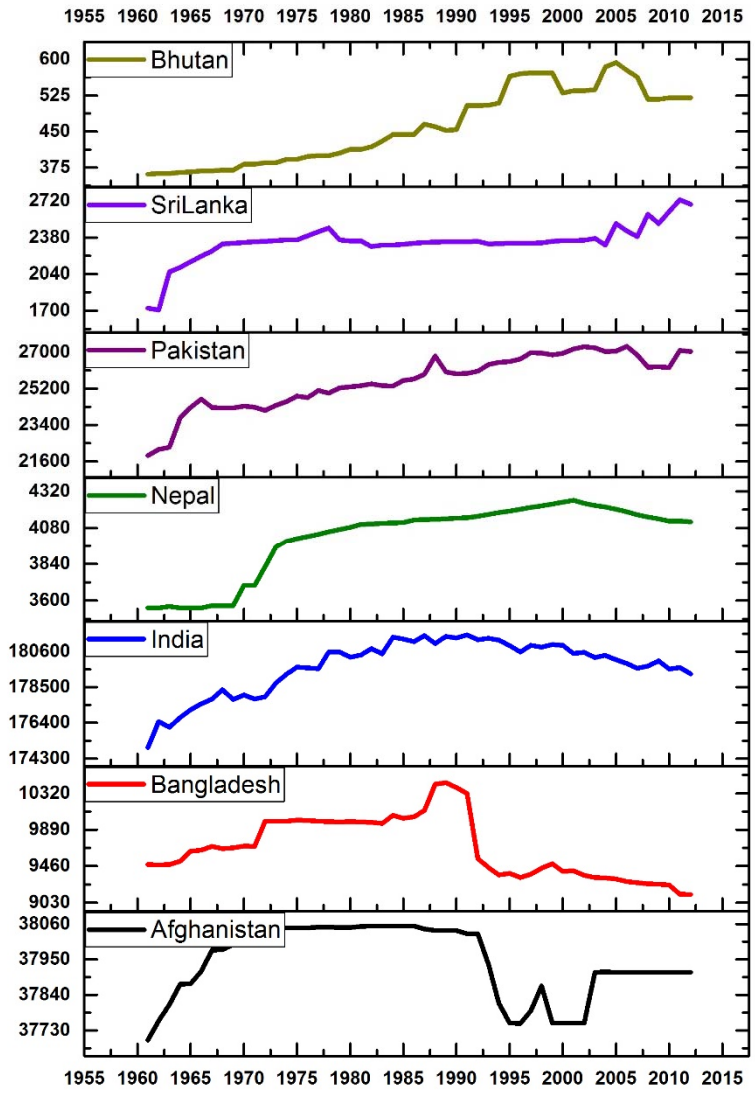
- 2018 - LCLUC and Emissions Meeting in Laos
  - Dates: TBD
  - Training

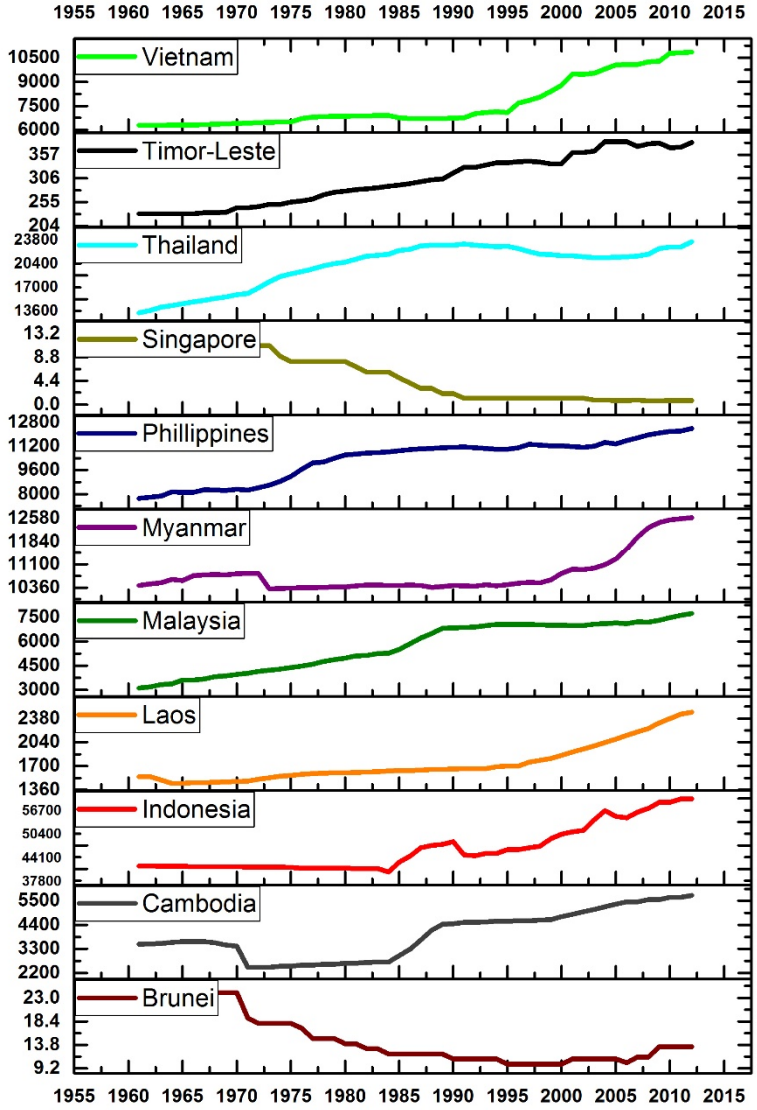
- 2018 - LCLUC in Mountain Environments, Bhutan
  - Dates: TBD
  - Training



LCLUC in SARI Countries and Meeting Objectives

Agricultural land use in South/SE Asia





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

Vadrevu et al., 2017, ERL (in press)

Data Source: FAO, 2015

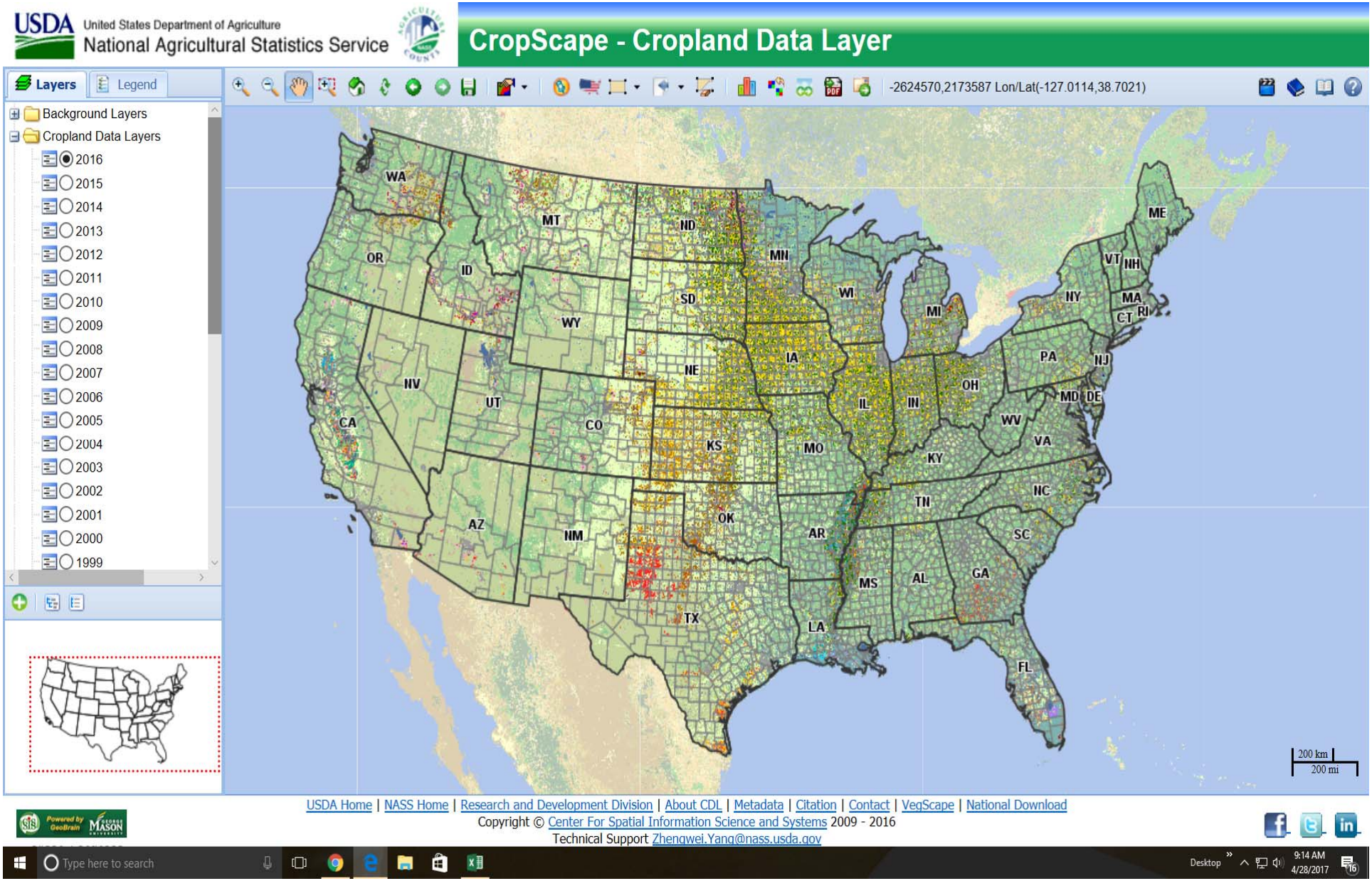
Agriculture

- Long- term Food Security is a major concern for the region;

- Agricultural production and land use is changing
  - Crop water requirements;
  - Extreme events (flooding and drought (almost every year!)
  - Adaptation options needs to be explored to address food security questions

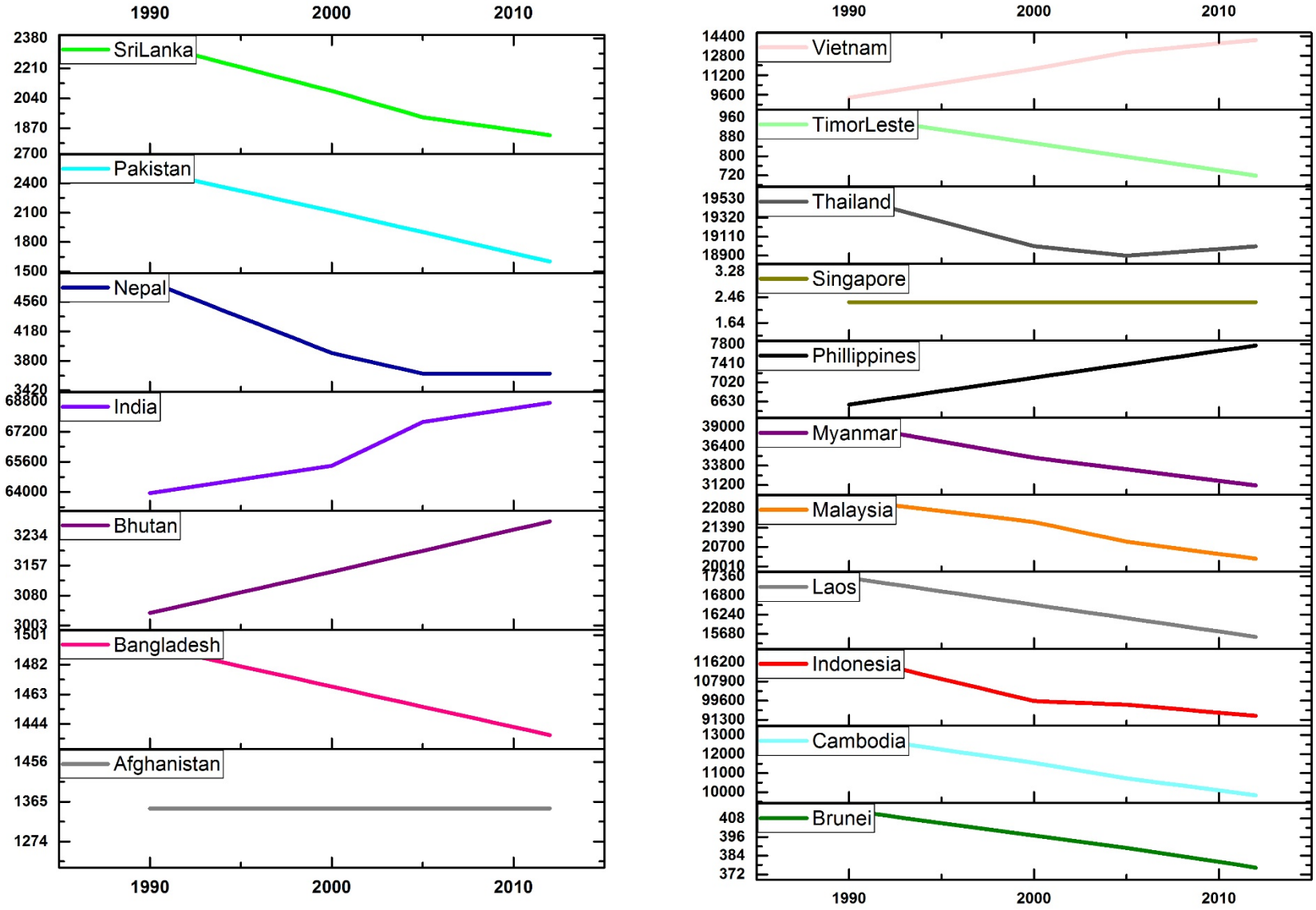
- RS data needed to monitor agriculture (within season) and forecast crop production (integrating Landsat+ Sentinel + other high resolution data);

- Transitioning from research to operational products
  - 3-year research projects (eg: 6-different teams working on Rice mapping in Mekong; coordination required and transitioning from research to operations;
    - Crop type and area statistics
    - Production estimates
    - Yield forecasting
      - GEOGLAM working on some of the above activities.



1997-2016 – possible because of strong validation data at a plot scale from Farm service bureau; such data may not be available in S/Seast Asia

Forest Area in South/SE Asia



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

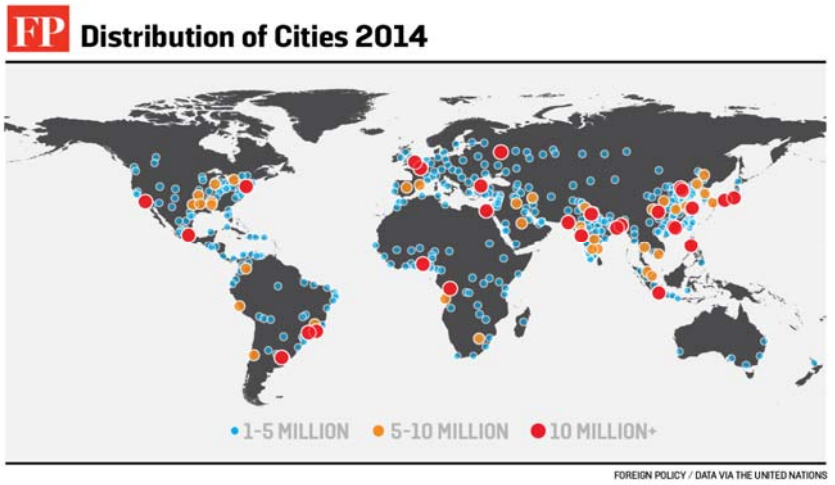
Vadrevu et al., 2015, ERL (in review)

Data Source: FAO, 2015

Urbanization and LCLUC

- Urbanization is occurring rapidly at the cost of agriculture and forest lands.

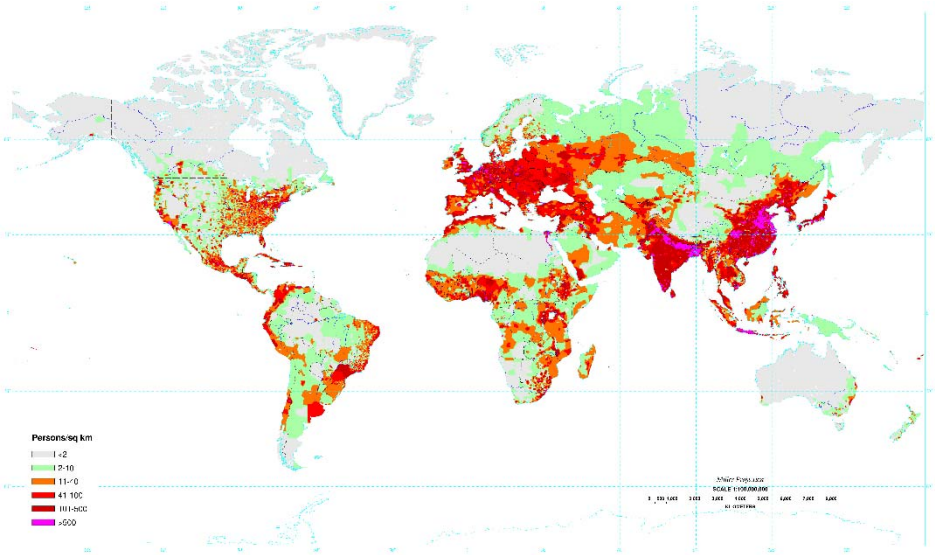
- Currently, 28.33% of South/Southeast Asian population lives in urban areas and it is estimated that by 2030, more than 55% of the population will be urban.

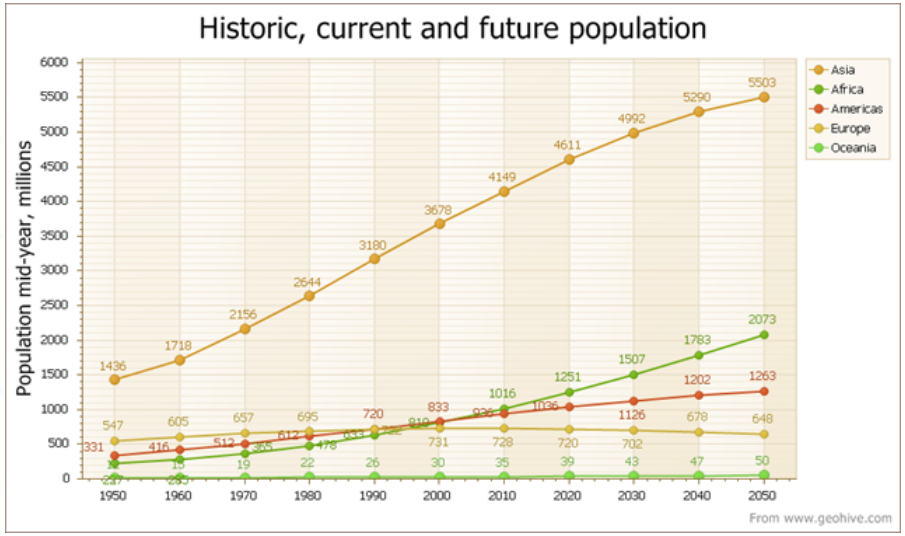


- Urban sprawl has been increasing in different cities at the cost of agricultural lands, ecologically sensitive and natural areas.
- Increasing Urbanization is resulting in air, water and solid waste pollution problems in most cities.

- *LCLUC interactions in urban environments are poorly understood and need immediate attention.*

Population and Pollution



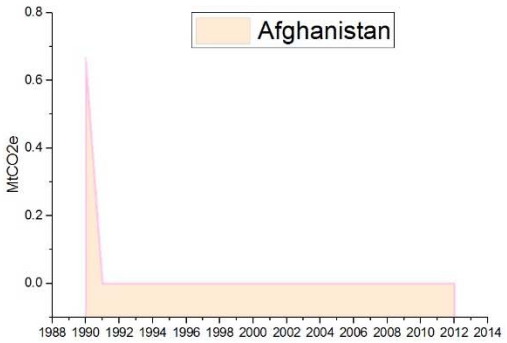


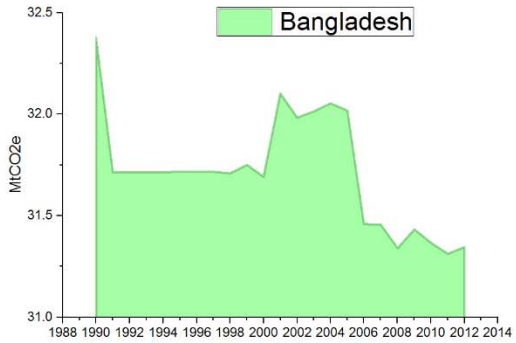
Nearly 60% of worlds population is in Asia (4.5 billion people)

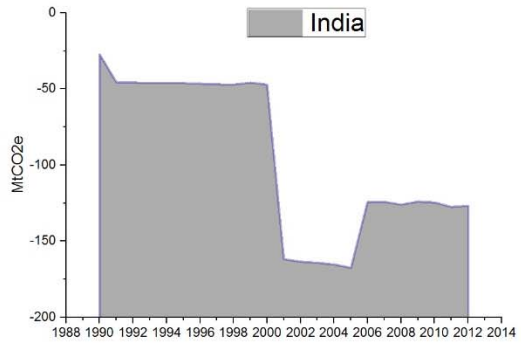
Nearly 2/3rd of world population growth is in Asia

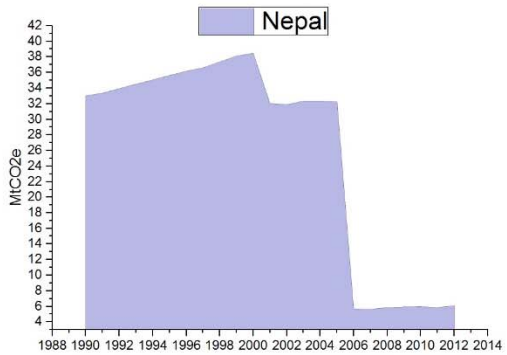
Nearly 50 million people are being added every year!

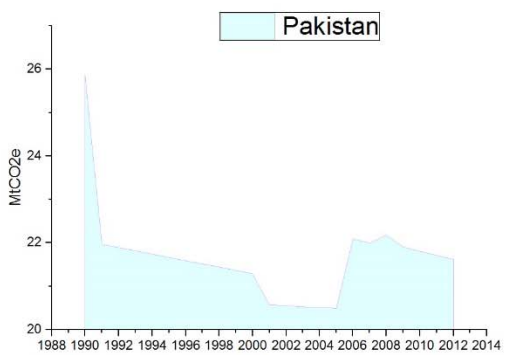
GHG emissions from LUCF in South Asia

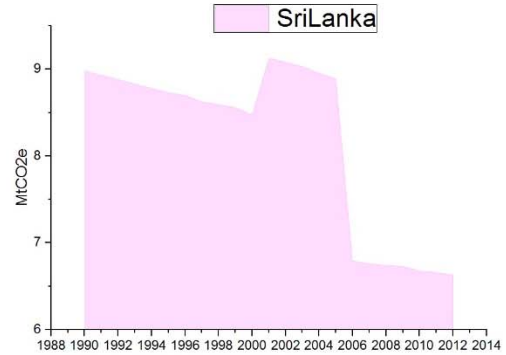


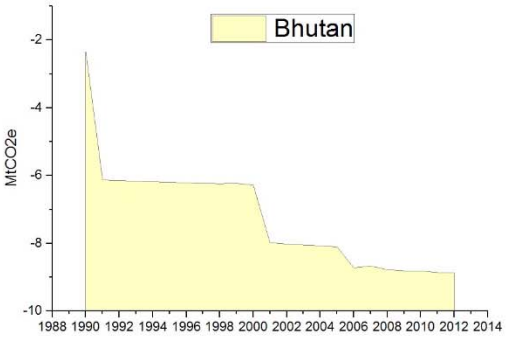








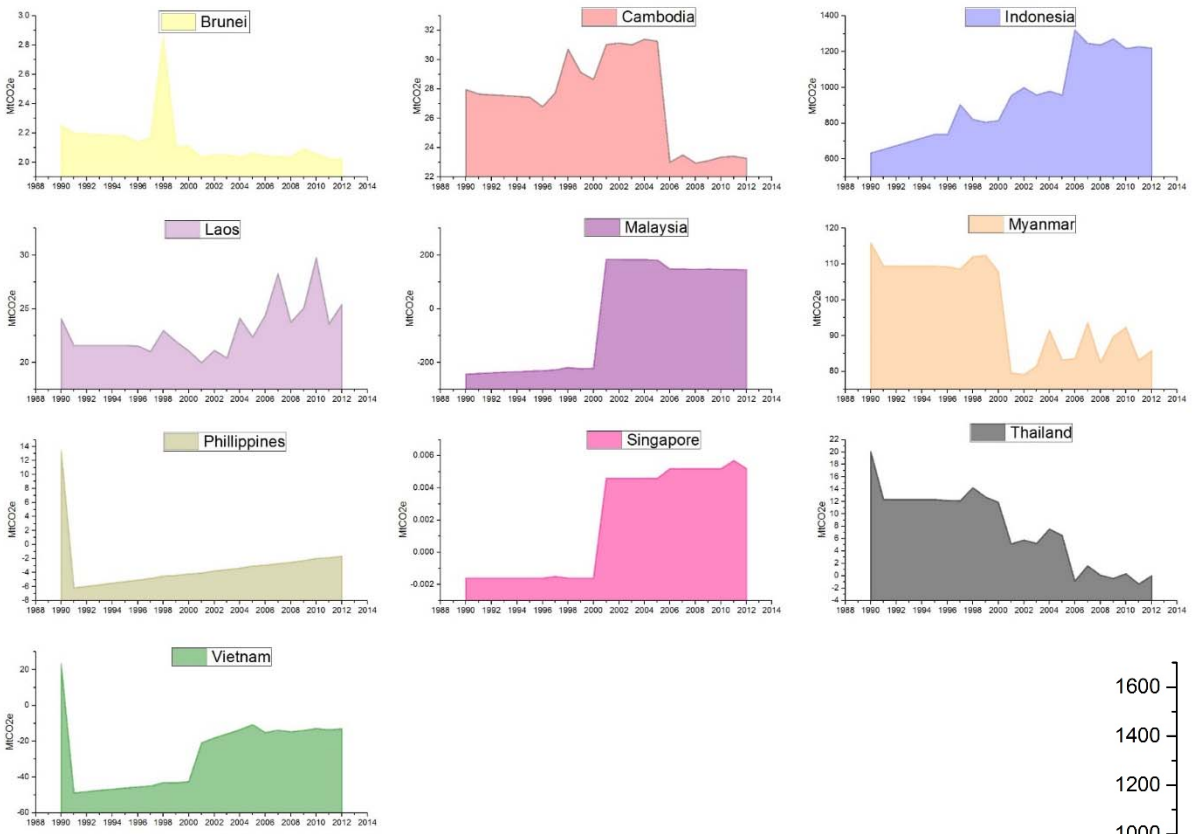




GHG emissions from LUCF sector seems decreasing significantly in South Asia

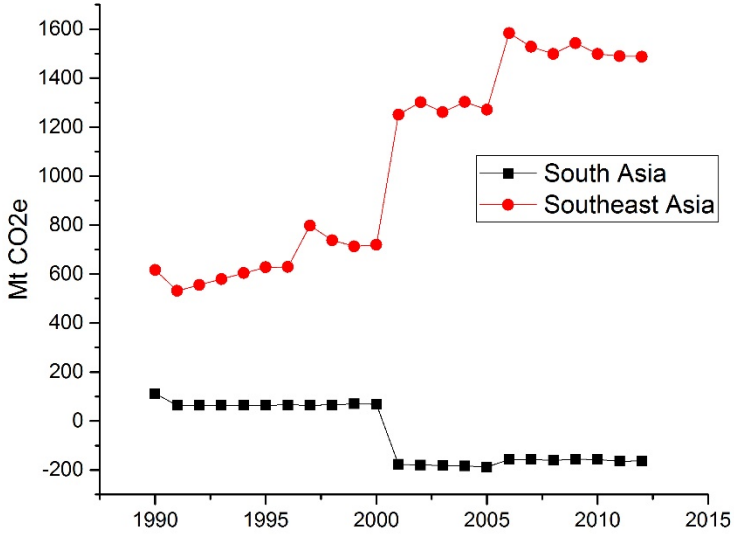
Vadrevu et al., 2015, ERL (in review)

GHG emissions from LUCF in Southeast Asia



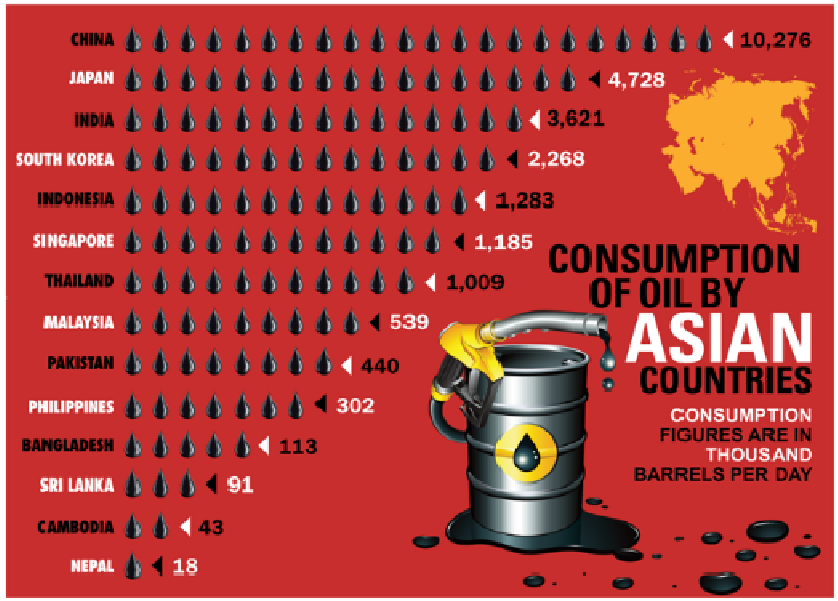
GHG emissions from LUCF sector seems decreasing in Southeast Asia too,

however, not *rapidly as in South Asia*

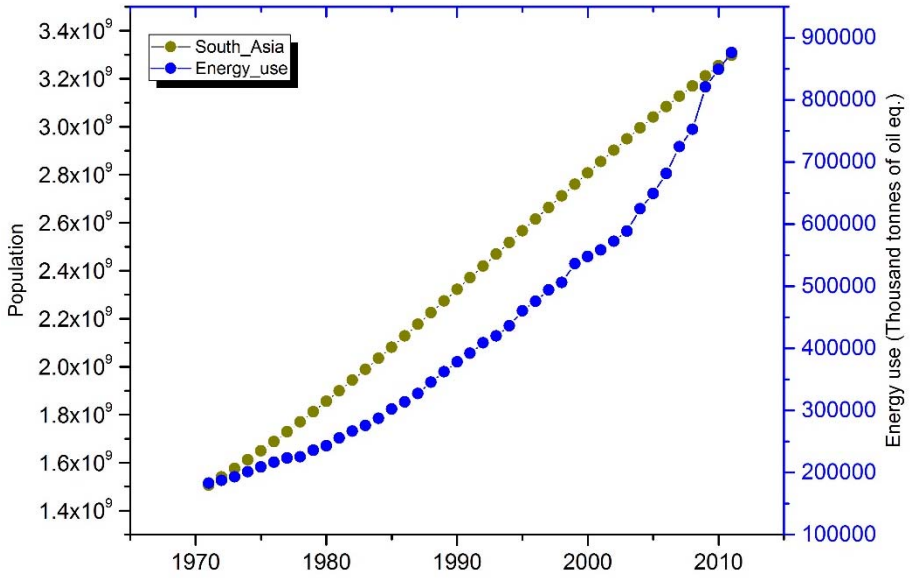


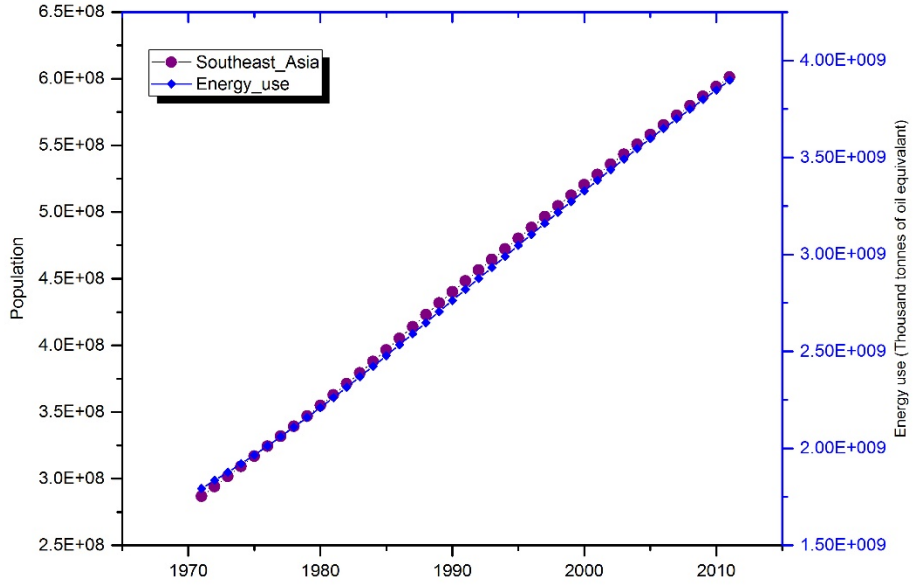
Some of the drivers to be discussed in this meeting

Population and Energy Use



(SOURCE: US ENERGY INFORMATION ADMINISTRATION, 2012)






Fires and smoke in Indonesia (6/19/2016) – Also a Recurring Event

Fires, Riau province, Indonesia, June, 2013, 2016

Meeting Focus

- Review regional and national science initiatives, relating to LCLUC in the region;
- Review the causes and impacts of LCLUC specific to agriculture, forests, urban and coastal ecosystems in the Asian region;
- Review GHG and SLCP emission estimates from different sources in the Asian region;
- Review latest updates on atmospheric correction algorithms;
- Review latest research specific to aerosols; biomass burning and emissions modeling;
- Strengthen the SARI activities in the region.

Meeting Sessions

- **Session-1** – Agricultural Land Use/Cover Changes
- **Session-2** – Land Atmospheric Interactions
- **Session-3** – Urban Land Use/Cover Changes
- **Session-4** - Forest Land use/Cover Changes
- **Dedicated Poster Session**
- **Panel Discussions (Day-2) :** Research needs;
- **Discussion Session (Day-3):** User needs and priorities.

Current Meeting Outputs

Special Issue:

Remote Sensing of Land Use/Cover Changes (LU/CC) in South/Southeast Asia

Editors:

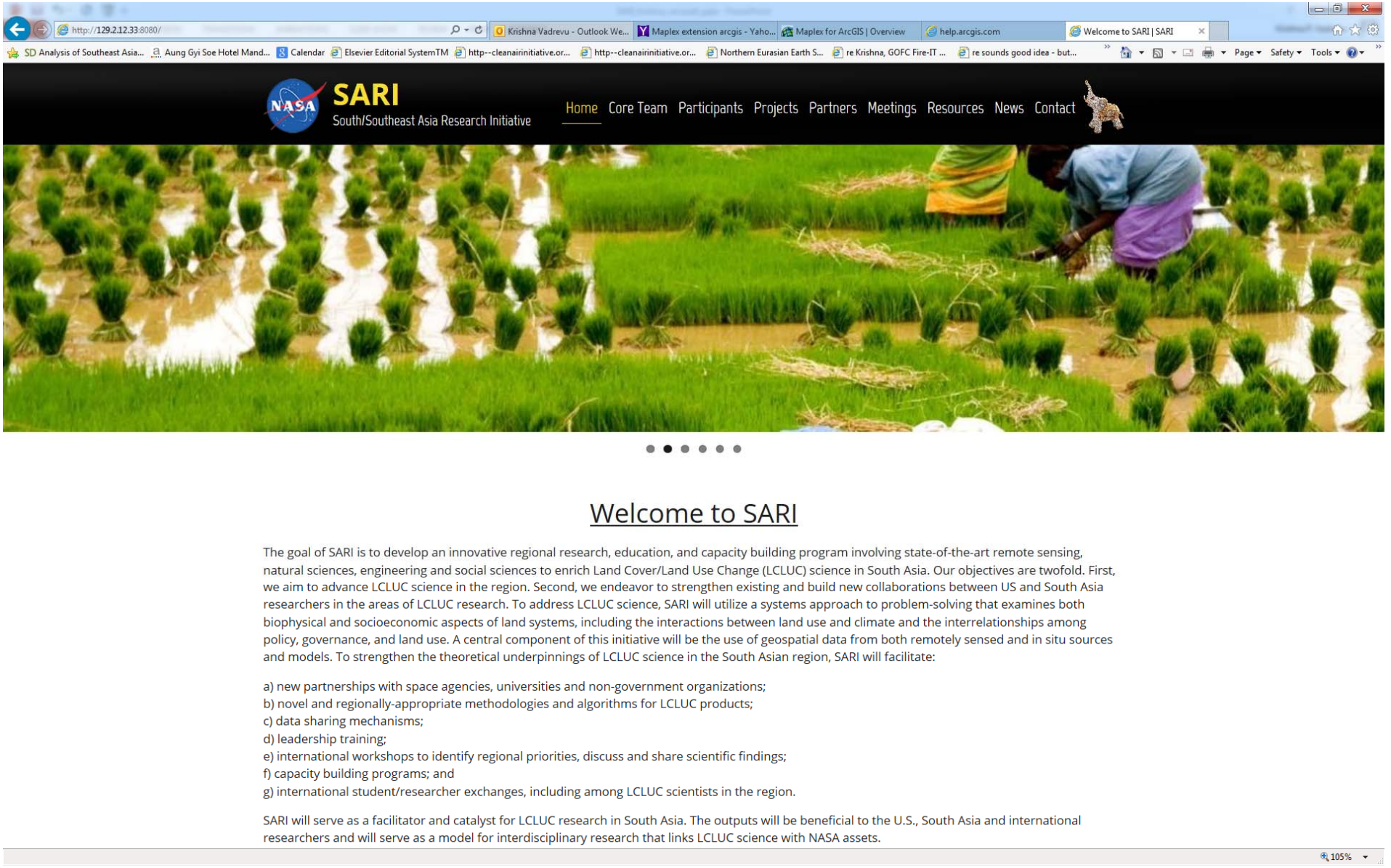
-Krishna Vadrevu, NASA MSFC)

-Andreas Heinimann (Univ. of Bern, Switzerland)

-Chris Justice (Univ. of Maryland, USA)

-Garik Gutman (NASA HQ)

Deadline: March 31st, 2018



SARI website

www.sari.umd.edu