

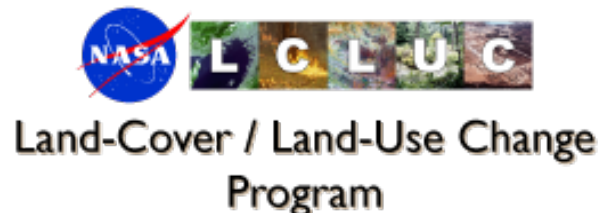
# The LCLUC South/Southeast Asian Research Initiative: Accomplishment and Next Steps

Krishna Prasad Vadrevu

SARI Lead

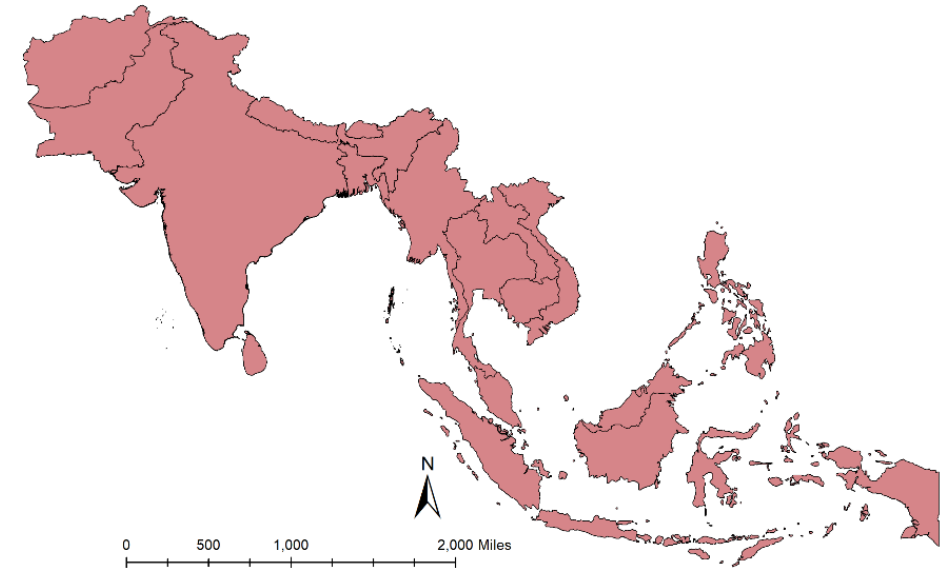
NASA Marshall Space Flight Center

Huntsville, Alabama



# Outline

- Background to the South/Southeast Asia Research Initiative(SARI)
- Goal
- Accomplishments
  - LCLUC science
  - Novel projects and Algorithms
  - Products and Datasets
  - Capacity building
  - Collaborations
  - Publications
- Next Steps



# How SARI started-Strong interest from regional scientists



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

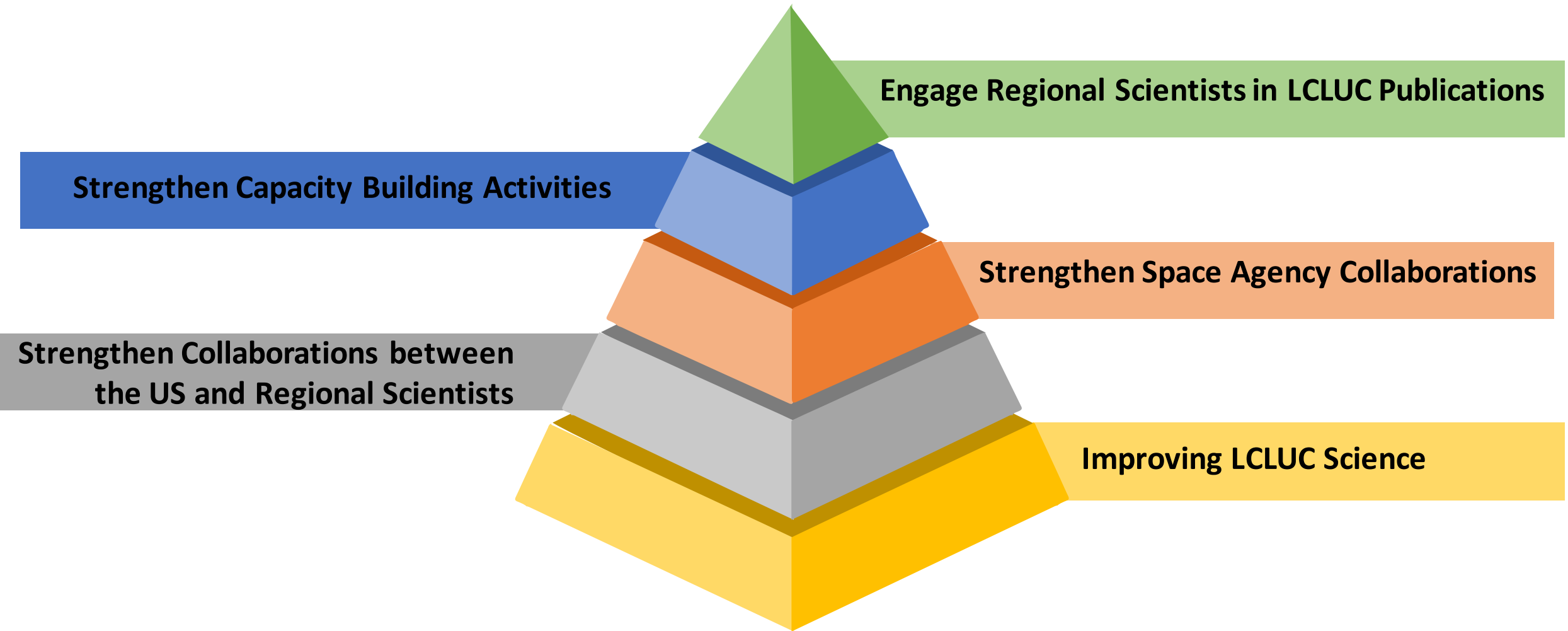
Total participants =120

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



# Needs and Priorities Identified



# Meeting Summary- SARI Research Needs and Priorities - The Earth Observer

24

meeting/workshop summaries

The Earth Observer

March - April 2013

Volume 25, Issue 2

## 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](mailto:krishna@hermes.geog.umd.edu)  
 Chris Justice, University of Maryland, College Park, [justice@hermes.geog.umd.edu](mailto:justice@hermes.geog.umd.edu)  
 Prasad Thirubakhal, United States Geological Survey, [pthirubakhal@usgs.gov](mailto:pthirubakhal@usgs.gov)  
 Garik Gutman, NASA Headquarters, [ggutman@nasa.gov](mailto: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<sup>1</sup>, 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);

<sup>1</sup> Kerala and Tamil Nadu are two of the 28 states in India.



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

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 (GOF-C-GOLD) South Asia Regional Information Network (SARIN) (including prospects, opportunities, and challenges).

The meeting was a joint effort of the NASA LCLUC Program, GOF-C-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.

The Earth Observer

March - April 2013

Volume 25, Issue 2



*Rhizophora mangle*, known as the "red mangrove," near Kadalandi 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.



Coconuts, banana, and jackfruit plantations, Kozhikode, Kerala.



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

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.

25

meeting/workshop summaries

March/April 2013

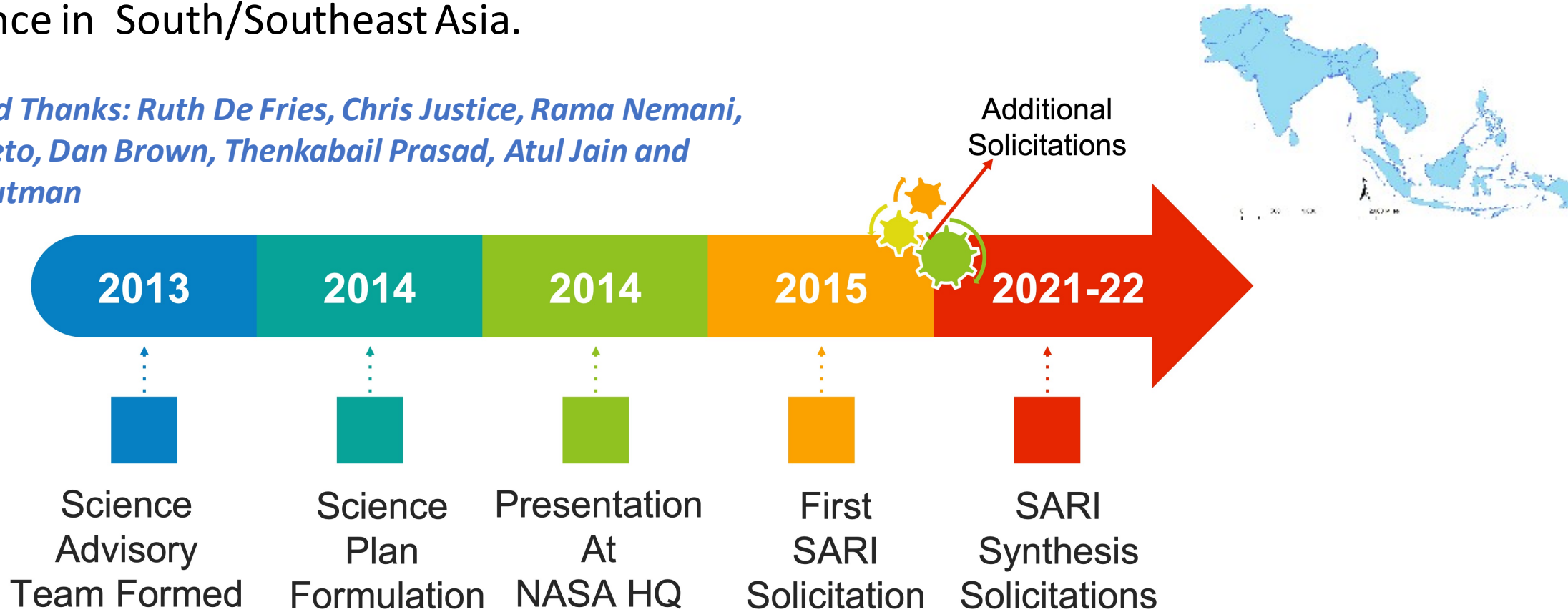
[http://eosps0.gsfc.nasa.gov/eos\\_homepage/for\\_scientists/earth\\_observer.php](http://eosps0.gsfc.nasa.gov/eos_homepage/for_scientists/earth_observer.php)



# NASA Land Cover/Land Use Change (LCLUC) Program South/Southeast Asia Research Initiative (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.

*Profound Thanks: Ruth De Fries, Chris Justice, Rama Nemani, Karen Seto, Dan Brown, Thenkabail Prasad, Atul Jain and Garik Gutman*



**-Balancing Act**

**-Research + outreach activities should be blended to achieve successful science outputs**

# SARI Projects - ROSES-2015 Selections

S.No	2015	Region	PI	Theme
1	Tropical Deciduous Forests of South Asia: Monitoring Degradation and Assessing Impacts of Urbanization	South Asia	Ruth De Fries, Columbia University	Forest degradation and urbanization
2	Understanding Changes in Agricultural Land Use and Land Cover in the Breadbasket Area of the Ganges Basin 2000-2015: A Socioeconomic-Ecological Analysis	South Asia	Li Ping Di	Agricultural land use
3	Impacts of Afforestation on Sustainable Livelihoods in Rural Communities in India	South Asia	Forrest Fleischman/Texas A&M University	Afforestation and sustainable livelihoods
4	The Future of Food Security in India: Can Farmers Adapt to Environmental Change?	South Asia	Meha Jain, University of Michigan	Food security and adaptation
5	Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in	South Asia	Peter Leimgruber/Smithsonian Institution	Deforestation, armed conflicts and policy
6	Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar	South Asia	Tatiana Loboda/University of Maryland	Malaria
7	Urban Growth, Land-Use Change, and Growing Vulnerability in the Greater Himalaya Mountain Range Across India, Nepal, and Bhutan	South Asia	Karen Seto/Yale University	Urbanization and vulnerability
8	Landscapes In Flux: The Influence of Demographic Change and Institutional Mechanisms on Land Cover Change, Climate Adaptability and Food Security in Rural India	South Asia	Philip Townsend/University of Wisconsin-Madison	Food security and adaptation
9	Consequences of Changing Mangrove Forests in South Asia on the Provision of Global Ecosystem Goods and Services	South Asia	Jeffrey Vincent/Duke University	Mangroves and Ecosystem services
10	Spatiotemporal Drivers of Fine-Scale Forest Plantation Establishment in Village-Based Economies of Andhra Pradesh	South Asia	Randolph Wynne/Virginia Polytechnic Institute and State University	Plantations and agricultural transitions

(10 projects over South Asia)



# SARI Projects - ROSES-2016 and 2018 Selections

S.No	2016	Region	PI	Theme
11	Agricultural Land Use Change in Central and Northeast Thailand: Effects on Biomass Emissions, Soil Quality, and Rural Livelihoods	Southeast Asia	Varaprasad Bandaru/University of Maryland, College Park	Emissions, soil quality
12	The Agrarian Transition in Mainland Southeast Asia: Changes in Rice Farming - 1995 to 2018	Southeast Asia	Jefferson Fox/East West Center	Rice Farming
13	A Cobra in the Forest? Quantifying the Impact of Perverse Incentives from Indonesia's Deforestation Moratorium, 2011 to 2016	Southeast Asia	Matt Hansen, Umd	Deforestation, moratorium policies
14	Land-Cover/Land-Use Change in Southern Vietnam Through the Lenses of Conflict, Religion, and Politics, 1980s to Present	Southeast Asia	Jessica McCarty, Miami University	Land use change, religion conflicts and policies
15	Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos	Southeast Asia	Son Nghiem/Jet Propulsion Laboratory	Land use change
16	Assessing the Impacts of Dams on the Dynamic Interactions Among Distant Wetlands, Land Use, and Rural Communities in the Lower Mekong River Basin	Southeast Asia	Qi, Michigan State University	Water resources

S.No	2018	Region	PI	Theme
17	Land-Use Transitions in Indonesian Peatlands	Southeast Asia	Mark Cochrane/University of Maryland, Cambridge	Peatlands and land use
18	Divergent Local Responses to Globalization: Urbanization, Land Transition, and Environmental Changes in Southeast Asia	Southeast Asia	Peilei Fan, Michigan State University	Urbanization, land use and pollution
19	Sowtime: Climate Adaptive Agriculture in the Eastern Gangetic Plains	South Asia	Josh Gray, North Carolina State University	Agriculture and climate
20	Shifting Cultivation at a Crossroad: Drivers and Outcomes of Recent Land-Use Changes in Laos PDR	Southeast Asia	Peter Potapov, University of Maryland, College Park	Shifting cultivation, land use drivers
21	New Transitions in Smallholder Agricultural Systems that Promote Increased Tree Cover Outside of Forests	South Asia	David Skole, Michigan State University	Small holder agriculture and Trees outside forests
22	Forced and Truncated Agrarian Transitions in Asia Through the Lens of Field Size Change	Southeast Asia	Lin Yan, South Dakota State University	Agriculture and field size change

(6 projects on Southeast in 2016; 4 on Southeast and 2 on South Asia in 2018; 3 more in 2019)





S.No	2020	PI	Theme
23	Where are the Missing Burned Areas? Global Hotspots of Burned Area - A Multiresolution Analysis	David Roy, Michigan State U	Burned area mapping
24	Global Hotspots of Change in Mangrove Forests	Marc Simard, JPL	Mangrove mapping
25	Multi-Resolution Quantification and Driver Assessment of Hot Spots of Global Forest Disturbance	Alexandra Tyukavina, UMD	Forest disturbance mapping

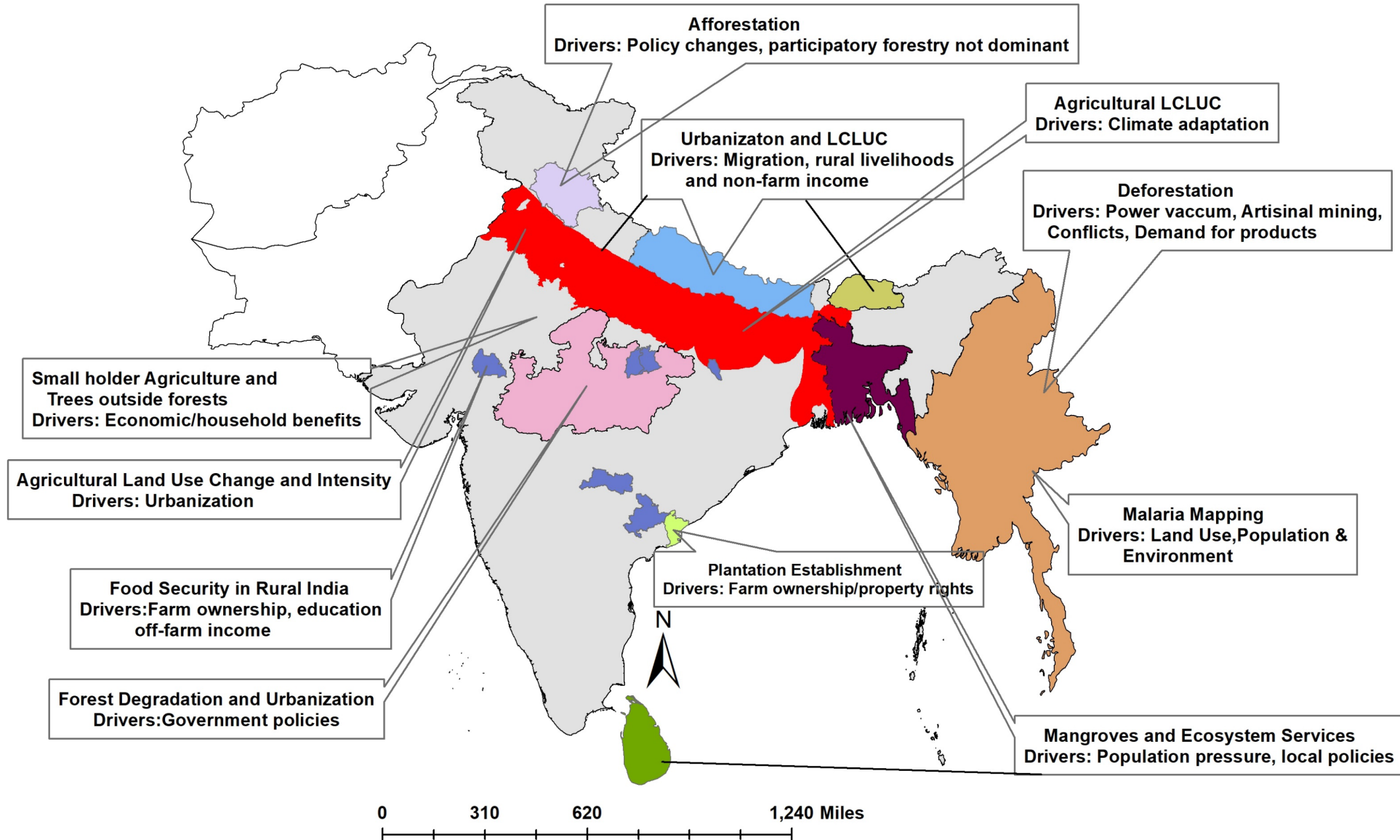
## Synthesis Project – South Asian Countries-2022-2026

- **South Asian smallholder forests and other tree-based systems: synthesizing LCLUC data and approaches to foster a natural climate solution that improves livelihoods – David Skole (MSU) - Selected**
- **Southeast Asia Synthesis – not selected yet – Addendum Solicitation Just Announced – See ROSES-22 Amendment 61: New Opportunity in ROSES-22: A.55 Land-Cover/Land-Use Change Southeast Asia Research Initiative**

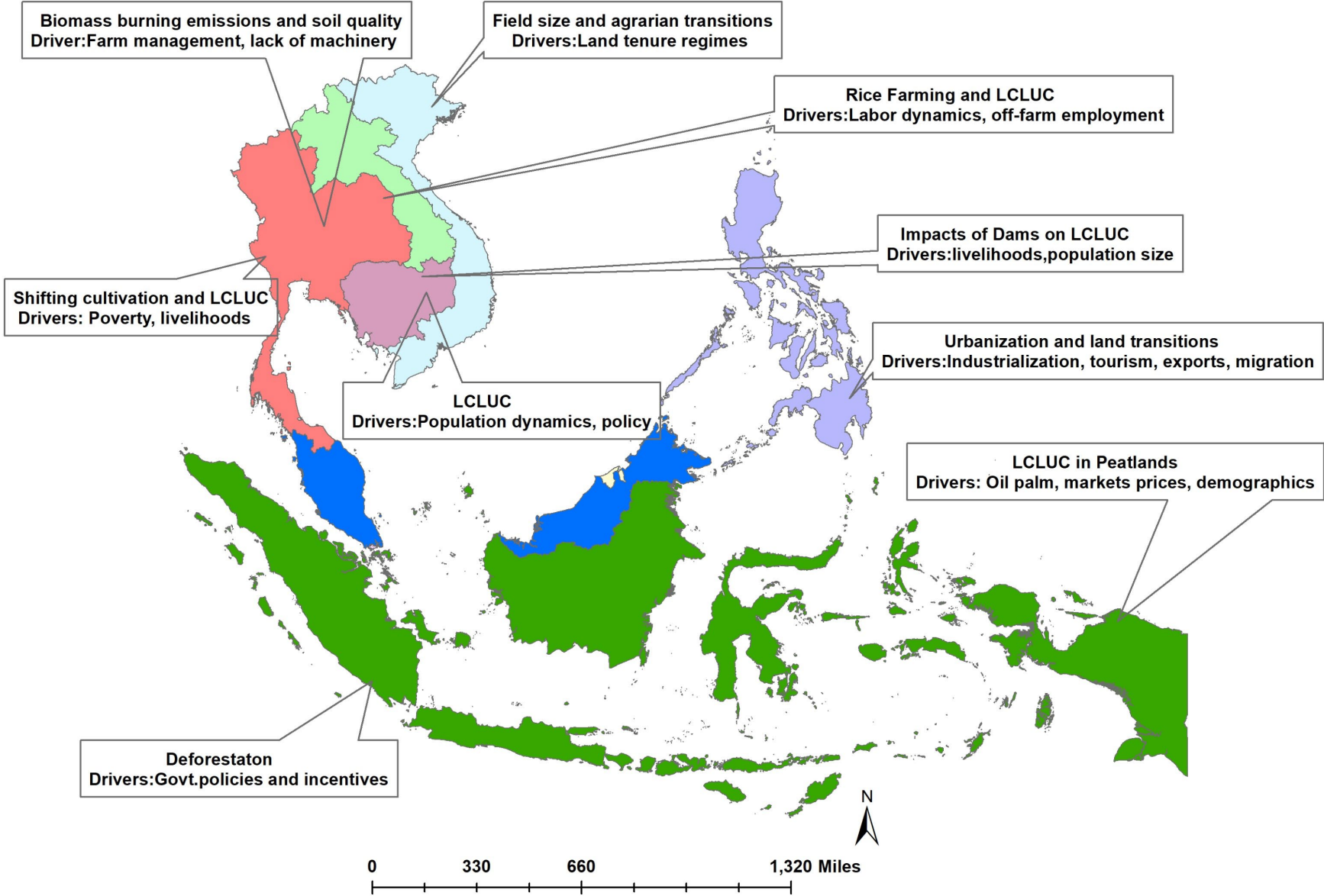
- LCLUC Drivers, Novel Algorithms, Socioeconomic Questions and Policy Relevance, Metadata efforts



# South Asia – LCLUC Drivers Identified by SARI PI's



# Southeast Asia – LCLUC Drivers Identified by SARI PI's



## Agriculture

Agricultural field size mapping – VHR data and modified Geographic Object Based Image Analysis (GEOBIA) approach

## Plantations

Smallholder – Plantations mapping - VHR + MuSLI in combination with Deep Learning

## Urbanization

Urbanization in the Himalayas – Landsat and VHR - Timeseries analysis methods

## Deforestation

Deforestation in Indonesia – Landsat and Machine Learning Methods

## Built-Up Volume

Urban built-up Volume in Southeast Asia – QuikSAT Scatterometer Dense Sampling studies

## Slash and Burn

Slash and burn agriculture in Laos – Landsat, Sentinel and VHR data, decision trees and stratified sampling approach



SARI

# Socioeconomic Questions and Policy Relevance

## Trees Outside Forests

*Farmer-promoted capture of ecosystem services value increases carbon sequestration and improves livelihoods.*

## Migration

*Forest degradation maps together with household surveys can aid in policy measures.*

## Tree Plantation

*Plantation programs in rural areas should be through participatory management; otherwise they can harm local livelihoods (pastoralists in Himalayas)*

## Mekong Delta and Rice Farming

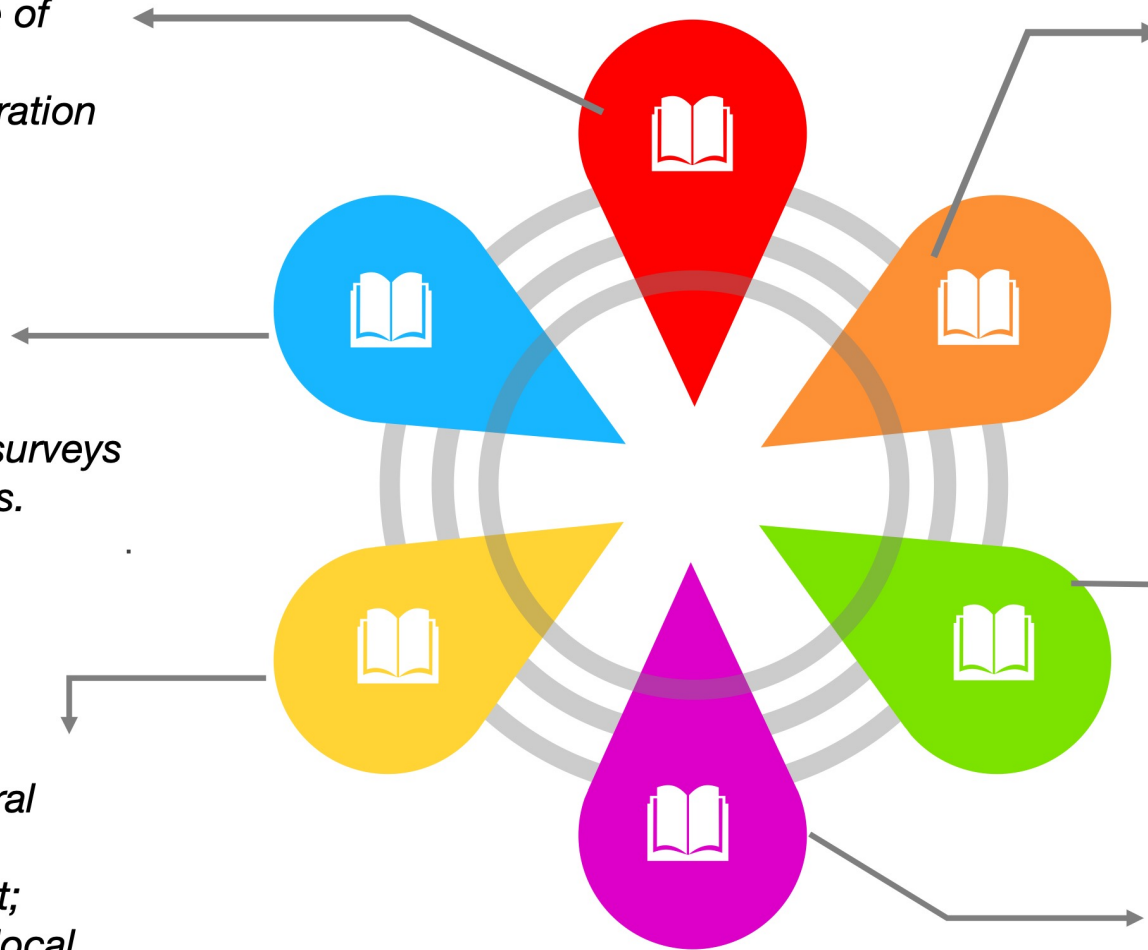
*Smallholder farmers are modernizing rapidly; Policy makers need to be aware of these changes and assist them to become more economically productive.*

## Forests and Peatland Loss in Indonesia

*Understanding socioeconomic and ecological drivers of smallholder oil palm expansion is critical for slowing deforestation on Indonesia's peatlands.*

## Ag.Residue Burning, Thailand

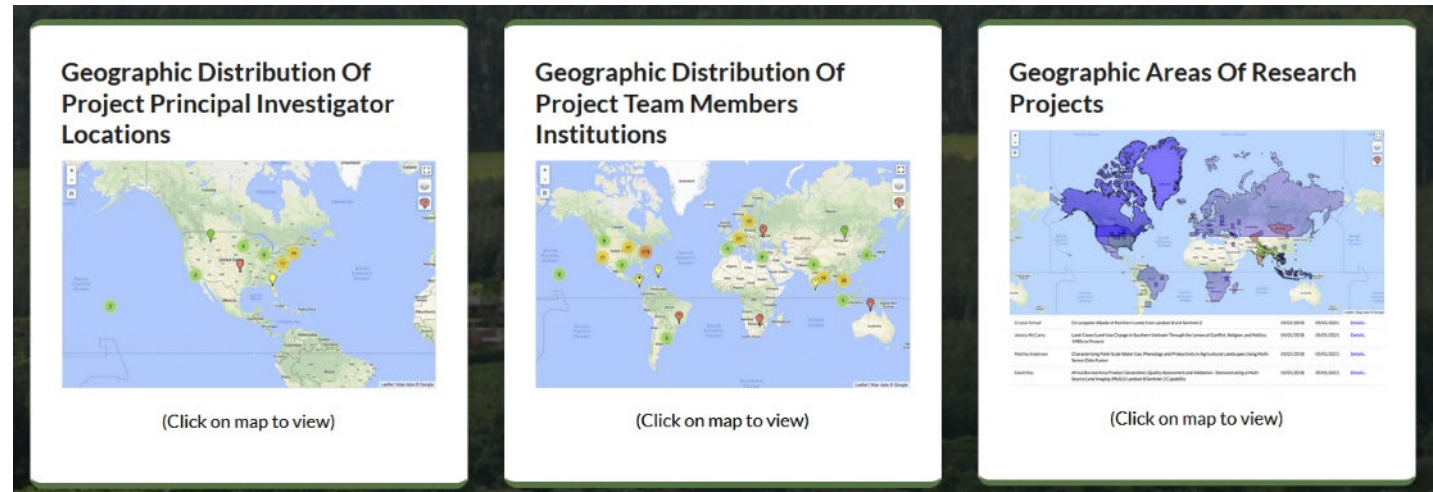
*Electricity generation from biomass can be a source of income and employment. Policies promoting the same should be considered.*



# LCLUC Products and Metadata Efforts

- All data/products are shared through the LCLUC website
- Data includes both remote sensing/non-remote sensing
- Metadata being created for each product with citation
- If already distributed through DAAC's, only weblinks to be provided
- Product sharing being made mandatory through NASA grants (grant award letter)
- 18-different PI's already responded and shared their data/products

## LCLUC Website



# SARI Meetings



Inventory, Modeling and Climate Impact of Greenhouse Gas Emissions from Economic Activities in the Asian Region

June 24th-26th, 2014



Logos for NIES JAPAN, GOF-C-GOLD (Ghana Education Trust for Global Education), UNIVERSITY OF MARYLAND, and START (Small Area Studies in the Tropics). Below the logos, it says "Local Host: VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY".





# Collaborations are the Key – SARI Meetings Facilitated by Regional and International partners



# Documenting Regional Research Needs and Priorities - Meeting Summaries

## Summary of the 2019 South/Southeast Asia Research Initiative Land Cover Land Use Change Regional Science Meeting

Krishna Prasad Vadrevu, NASA Marshall Space Flight Center, [k.vadrevu@nasa.gov](mailto:k.vadrevu@nasa.gov)  
 Kustari Karamiah, University of Technology, Malaysia, [kustari@utm.my](mailto:kustari@utm.my)  
 Tsuneo Matsunaga, National Institute for Environmental Studies, Japan, [matsunaga@nies.go.jp](mailto:matsunaga@nies.go.jp)  
 Chris Justice, University of Maryland, College Park, [cjustice@umd.edu](mailto:cjustice@umd.edu)  
 Garik Gutzman, NASA Headquarters, [gutzman@nasa.gov](mailto:gutzman@nasa.gov)

### Introduction

As a result of growth in South and Southeast Asia (S/SEA), land use/cover change (LUCC) is occurring at a rapid rate, moving from forest to agriculture and from agricultural areas to residential and urban use, with concomitant disruption of water and forest resources, biodiversity, regional climate, biogeochemical cycles, and the atmosphere. To address these issues, NASA's Land Cover/Land Use Change (LCLUC) Program—South/Southeast Asia Research Initiative (SARI, [www.sari.usm.edu](http://www.sari.usm.edu)) in collaboration with other partners organized a meeting, titled *Land-Use/Cover Changes, Environment and Emissions in South/Southeast Asia*, held July 22–24, 2019, at the Hilton Hotel in Johor Bahru, Malaysia. The University of Technology, Malaysia (UTM) hosted the meeting. Collaborators included the National Institute for Environmental Studies (NIES), Japan; the international Global Observations of Forest and Land-Use Dynamics (GOFC-GOLD) program; START<sup>1</sup>, U.S.; and the international Group on Earth Observations Global Agricultural Monitoring (GEOGLAM) initiative, in addition to fourteen other national and international partners. The meeting aimed to review the availability, potential, and limitations of different satellite data sources and methodologies for monitoring LUCC, and its impact on the environment. Another objective was to strengthen GOFC-GOLD/SSEA regional networks on the latest LUCC science.

<sup>1</sup>START (not an acronym) is a core international partner of the U.S. Global Change Research Program that seeks to realize a sustainable future through science (<https://start.org>).



Photo 1. SARI LCLUC regional science meeting participants in Johor Bahru, Malaysia. Photo credit: University of Technology Malaysia (UTM) team

The three-day meeting was attended by 170 participants from 16 countries—see Photo 1 below.

After several opening presentations, the bulk of the meeting was organized into five sessions, including:

- Updates on Regional Programs and Space Agency Activities;
- Agricultural LUCC;
- Land–Atmosphere Interactions and Emissions;
- Forest LUCC; and
- Urban LUCC.

In addition, on the final day of the meeting there were three discussion sessions that focused on regional research and priorities for agriculture, atmosphere, and LUCC capacity-building themes.

The remainder of this article is organized by day and presents highlights from each of the sessions and the discussions. It also includes a brief description of a press conference held on the afternoon of the first day, to introduce the local media to the practical applications of LUCC science, and a three-day, hands-on training event that took place immediately after the SARI LCLUC meeting, which focused on the use of remote sensing and geographic information systems for LUCC applications. The reader is directed to <https://go.nasa.gov/3a4NtUK> to find more information about the meeting, including the full presentations.

meeting summaries

meeting/workshop summaries

### Summary of the 2019 NASA Land Cover/Land Use Change Regional Science Meeting, SARI Initiative

**Introduction**  
 The 2019 NASA Land Cover/Land Use Change Regional Science Meeting, SARI Initiative, was held in Johor Bahru, Malaysia, from July 22–24, 2019. The meeting was organized by the University of Technology Malaysia (UTM) and the National Institute for Environmental Studies (NIES), Japan. The meeting was attended by 170 participants from 16 countries. The meeting was organized into five sessions, including: Updates on Regional Programs and Space Agency Activities; Agricultural LUCC; Land–Atmosphere Interactions and Emissions; Forest LUCC; and Urban LUCC. In addition, on the final day of the meeting there were three discussion sessions that focused on regional research and priorities for agriculture, atmosphere, and LUCC capacity-building themes. The remainder of this article is organized by day and presents highlights from each of the sessions and the discussions. It also includes a brief description of a press conference held on the afternoon of the first day, to introduce the local media to the practical applications of LUCC science, and a three-day, hands-on training event that took place immediately after the SARI LCLUC meeting, which focused on the use of remote sensing and geographic information systems for LUCC applications. The reader is directed to <https://go.nasa.gov/3a4NtUK> to find more information about the meeting, including the full presentations.



Photo 1. SARI LCLUC regional science meeting participants in Johor Bahru, Malaysia. Photo credit: University of Technology Malaysia (UTM) team

### SARI International



The SARI International meeting was held in Johor Bahru, Malaysia, from July 22–24, 2019. The meeting was organized by the University of Technology Malaysia (UTM) and the National Institute for Environmental Studies (NIES), Japan. The meeting was attended by 170 participants from 16 countries. The meeting was organized into five sessions, including: Updates on Regional Programs and Space Agency Activities; Agricultural LUCC; Land–Atmosphere Interactions and Emissions; Forest LUCC; and Urban LUCC. In addition, on the final day of the meeting there were three discussion sessions that focused on regional research and priorities for agriculture, atmosphere, and LUCC capacity-building themes. The remainder of this article is organized by day and presents highlights from each of the sessions and the discussions. It also includes a brief description of a press conference held on the afternoon of the first day, to introduce the local media to the practical applications of LUCC science, and a three-day, hands-on training event that took place immediately after the SARI LCLUC meeting, which focused on the use of remote sensing and geographic information systems for LUCC applications. The reader is directed to <https://go.nasa.gov/3a4NtUK> to find more information about the meeting, including the full presentations.

- Updates on Regional Programs and Space Agency Activities;
- Agricultural LUCC;
- Land–Atmosphere Interactions and Emissions;
- Forest LUCC; and
- Urban LUCC.

meeting summaries

### Land-Use Change

The Land-Use Change session was held in Johor Bahru, Malaysia, from July 22–24, 2019. The session was organized by the University of Technology Malaysia (UTM) and the National Institute for Environmental Studies (NIES), Japan. The session was attended by 170 participants from 16 countries. The session was organized into five sessions, including: Updates on Regional Programs and Space Agency Activities; Agricultural LUCC; Land–Atmosphere Interactions and Emissions; Forest LUCC; and Urban LUCC. In addition, on the final day of the meeting there were three discussion sessions that focused on regional research and priorities for agriculture, atmosphere, and LUCC capacity-building themes. The remainder of this article is organized by day and presents highlights from each of the sessions and the discussions. It also includes a brief description of a press conference held on the afternoon of the first day, to introduce the local media to the practical applications of LUCC science, and a three-day, hands-on training event that took place immediately after the SARI LCLUC meeting, which focused on the use of remote sensing and geographic information systems for LUCC applications. The reader is directed to <https://go.nasa.gov/3a4NtUK> to find more information about the meeting, including the full presentations.



Photo 1. SARI LCLUC regional science meeting participants in Johor Bahru, Malaysia. Photo credit: University of Technology Malaysia (UTM) team

Bottom-Up Approach  
 Inputs to NASA ROSES LCLUC calls



# SARI 7 YEARS OF SCIENCE

-25 projects and more being added

>300 scientists

>200 institutions

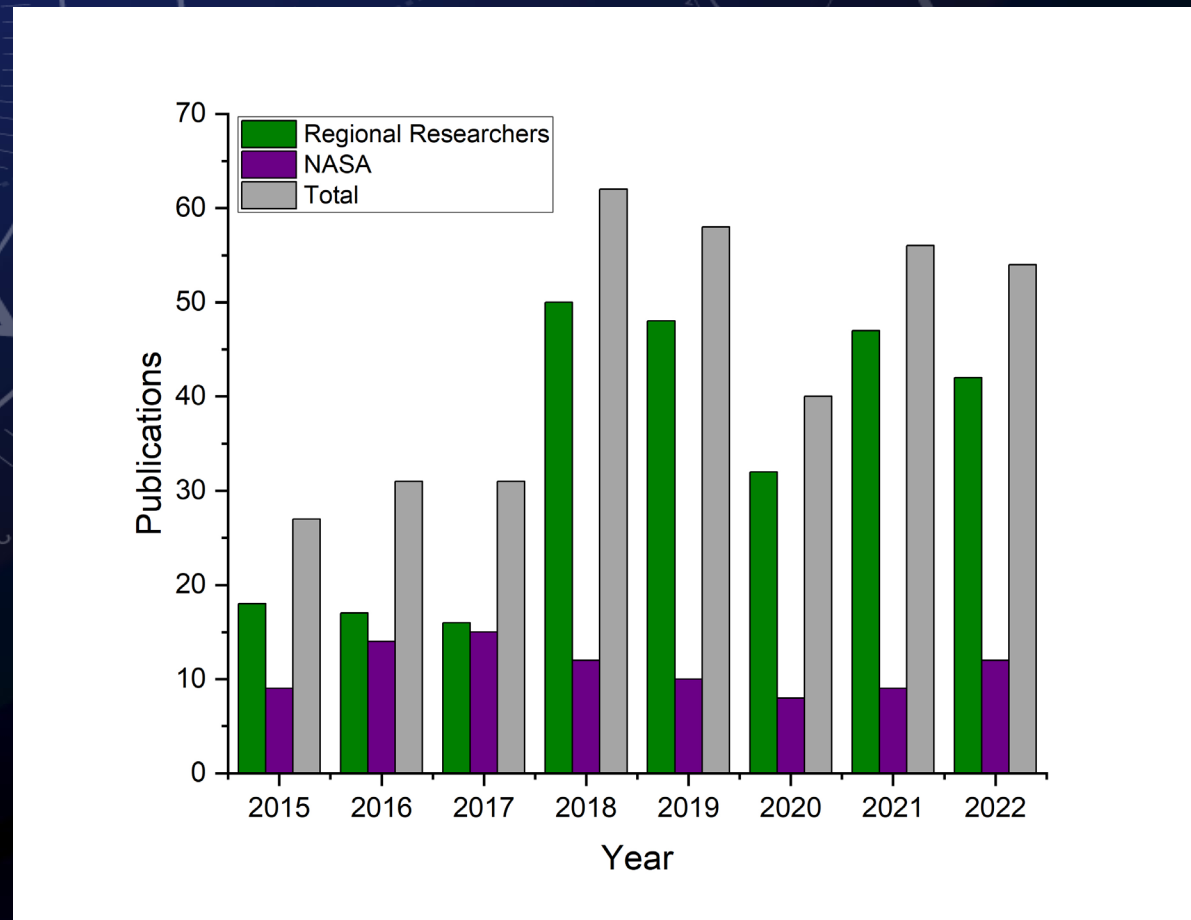
14-different

Special

Issues in

Journals

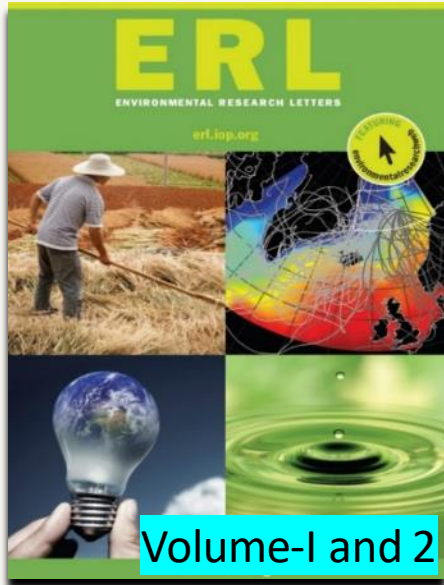
Nearly 350 publications in peer reviewed journals and books



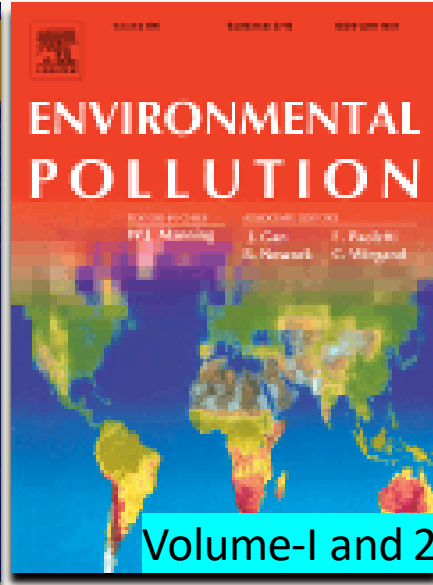
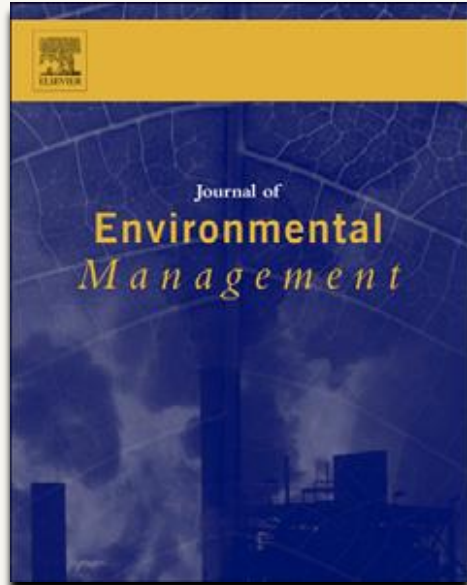
## South-Southeast Asia

*Oct-2013 – India Meeting – SARI idea proposed*  
*2015-SARI First SARI Solicitation*

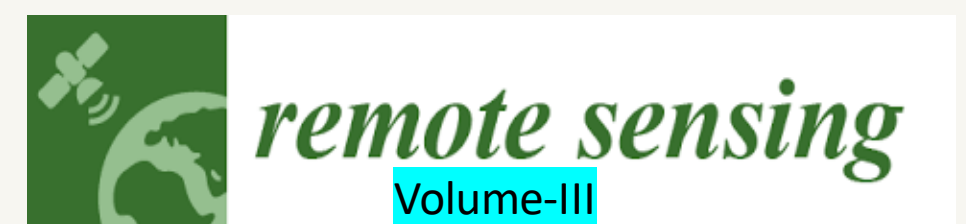
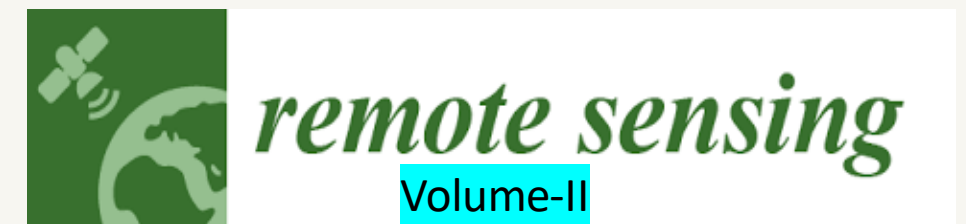
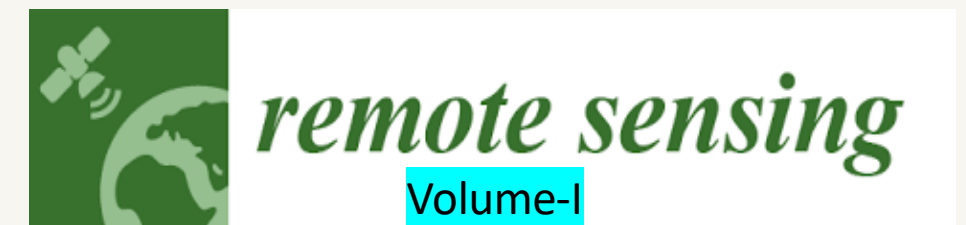
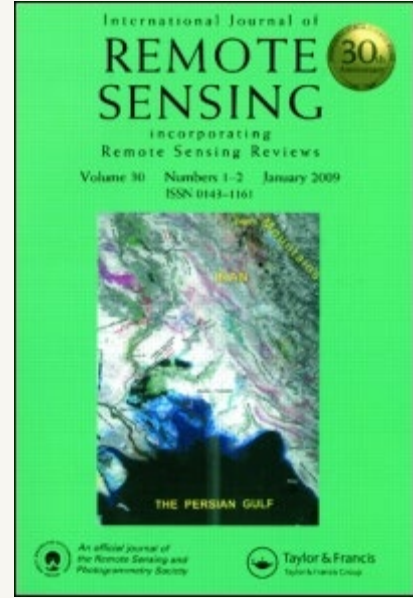
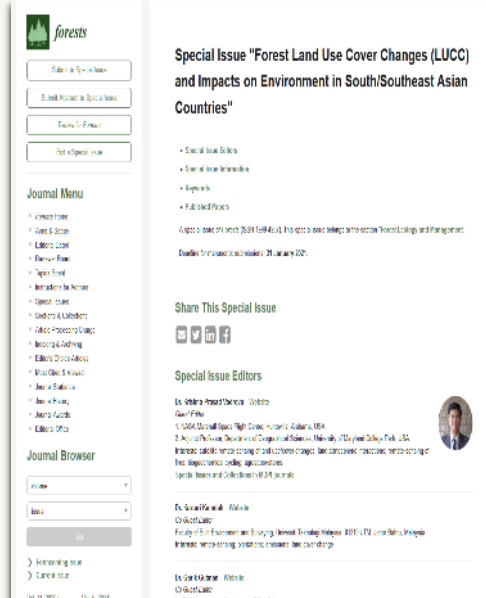
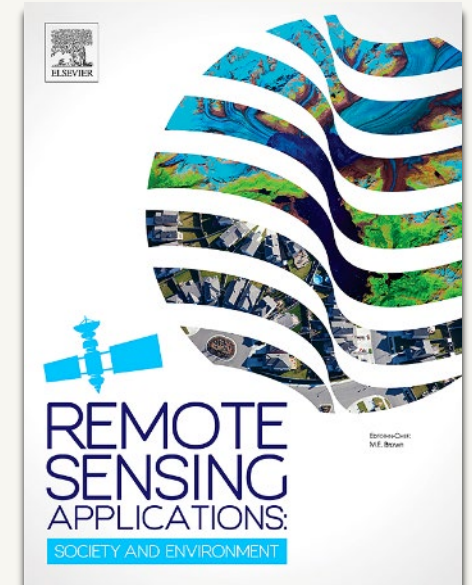
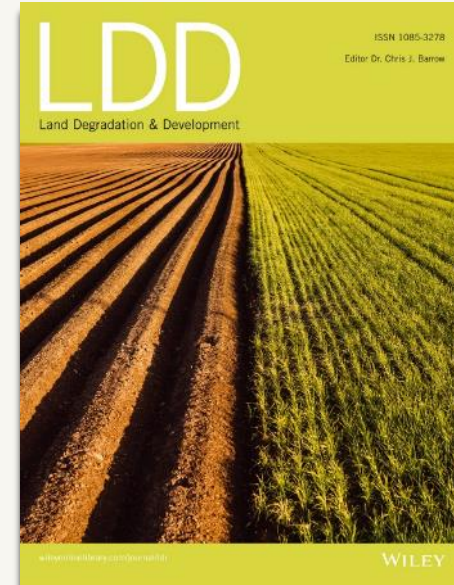
# SARI Special Issues Published in Multiple Journals



Volume-I and 2

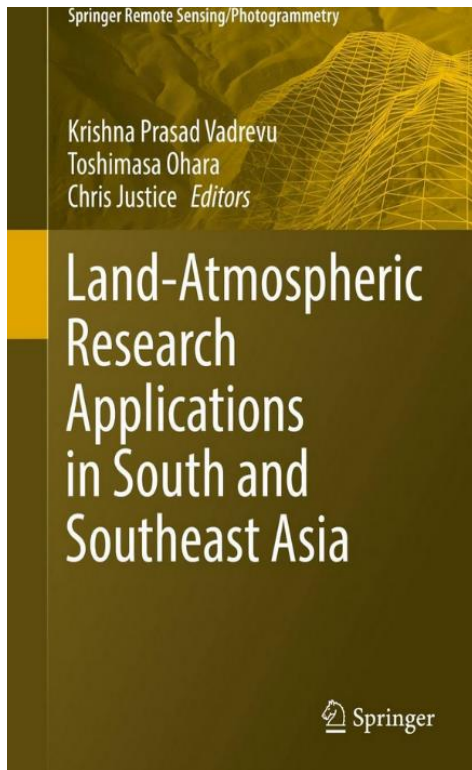


Volume-I and 2

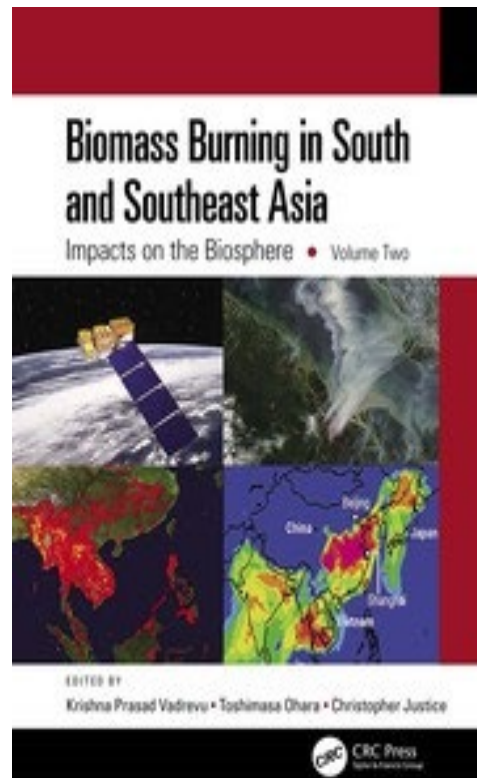


~350 peer reviewed publications in 5-years

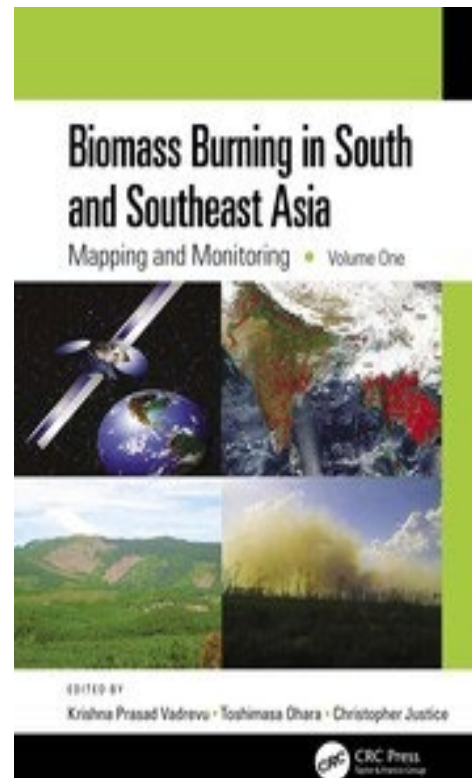
# LCLUC/SARI Books



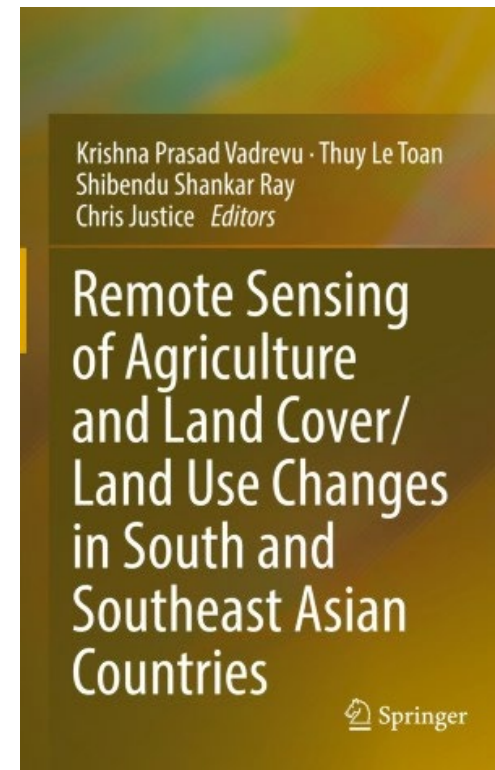
Springer 2018



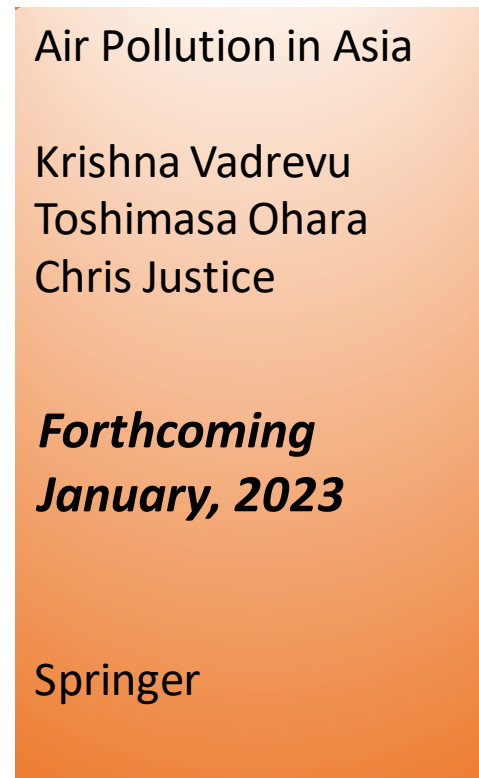
CRC Press, 2021



CRC Press, 2021

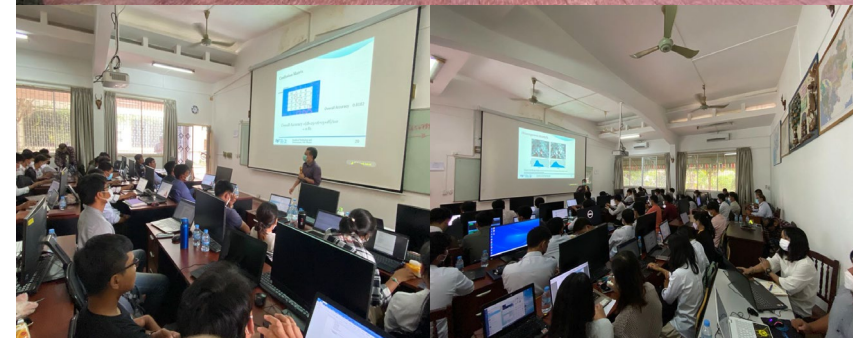
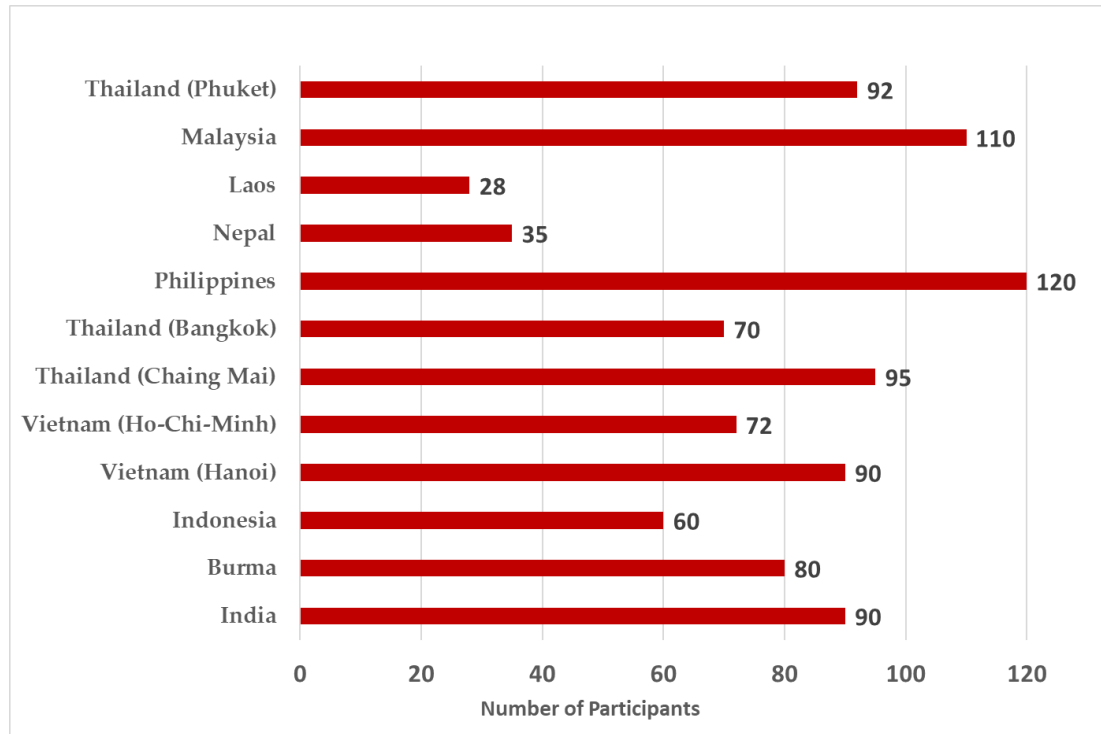


Springer, 2022



Springer, 2023

# SARI – LCLUC Training Events



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



# Example on the Integrated SARI Training Event

Remote Sensing of Land-Use/Cover Change and Climate Impacts In Coastal Zone

17-19th December, 2019, Prince Songkla U, Thailand

## Remote Sensing of Land-Use/Cover Change



- 15-Partners came together to organize a training event in Phuket, Thailand - all under SARI
- Involving SARI, SERVIR, Local Universities, Government, Non-Government, International and Regional Organizations
- We also made it a WGCapD event. It is mandatory to have at least 2 space agency involvement in WGCapD events. Through effective coordination from SARI, we could bring Trainers from 4-different space agencies: NASA + ISRO + GISTDA + JAXA
- **Total Days:** 3 days + 1-day field trip
- **Total Participants:** 92 (university students, govt and participants from non-govt agencies)
- **Logistics:** food provided freely to all
- **Training topic:** advanced remote sensing methodologies for Land use/cover change + cloud computing
- Pre-and post evaluation surveys to get feedback for improving future training events.



# COVID Crisis – 2020-2021





# Virtual Meetings and Training Events



## WELCOME TO LCLUC

Welcome to the NASA Land-Cover and Land-Use Change (LCLUC) Program website. LCLUC is an interdisciplinary science program in the Earth Science Division of the Science Mission Directorate. LCLUC is part of the Carbon Cycle and Ecosystems Focus Area with links to some programs in other Focus Areas.

### Search LCLUC Website

Enter terms then hit Search...

### LCLUC Science Team Meeting Schedule

DATE	LOCATION
10/19/2021	Bethesda, MD
10/19/2020	Online
07/22/2019	Johor Bahru, Malaysia
04/09/2019	Rockville, MD

1 of 10 next >

[LCLUC - Related Meetings](#)

[LCLUC - Related Calendar](#)

### NASA LCLUC SARI Webinar Series 2019-2020



[LCLUC E-Newsletter](#)

[LCLUC Webinar Series](#)

### April

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

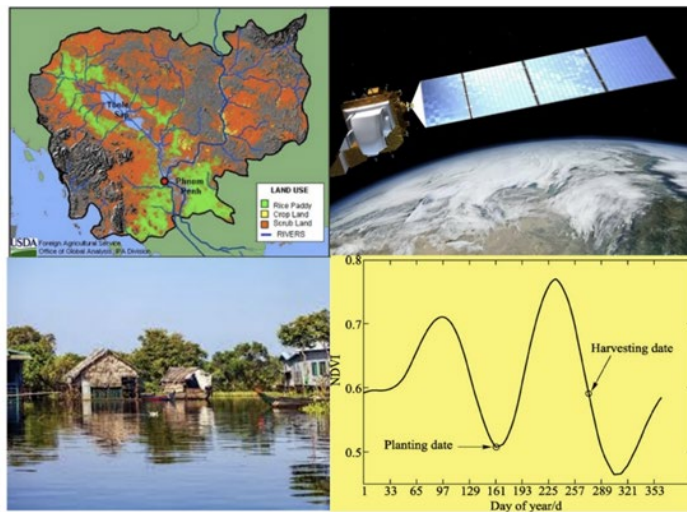
### Featured Project

"Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos"

Principal Investigator: Son Nghiem

The overall science objective of this research is to quantitatively document the current status and rate of change of

# International Workshop On Land Cover/Land Use Changes, Forestry, and Agriculture in South/Southeast Asia, Phnom Penh, Cambodia, August 08-12<sup>th</sup>, 2022



## Workshop Focus

- LCLUC and Forestry (mapping, monitoring, and impacts)
- LCLUC and Agriculture (crop type mapping, crop yields, modeling, and impacts)
- LCLUC and Land Atmospheric Interactions

## Training Focus

- Forest Plantations Mapping and Monitoring
- Agricultural Crop Mapping and Monitoring
- SWAT Analysis and Hydrology
- LCLUC Mapping

*Open Source Software and GEE*

## Outputs

- Special Issue in Remote Sensing Journal
- EO Article being published
- CRC Book on SARI solicited



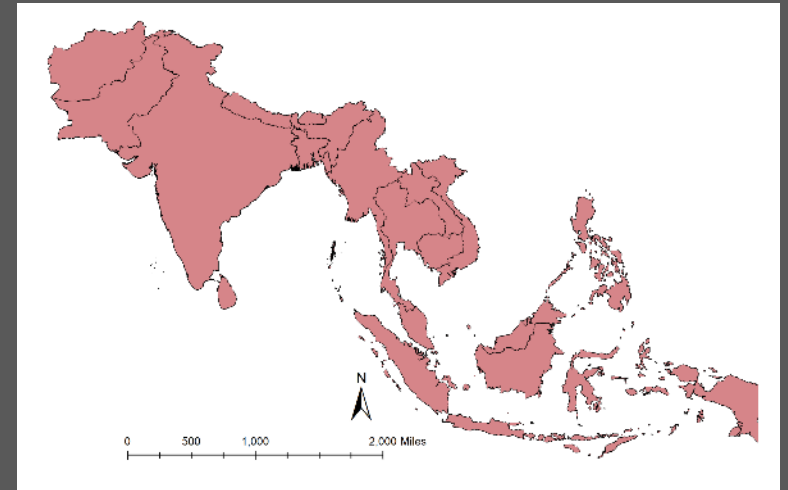
# SARI Next Steps



*Dr. Gutman (NASA HQ) and  
Prof. Justice (UMd)*



*Vision, support and  
guidance to build  
the SARI regional  
science initiative*



Questions?