NASA South/Southeast Asia Research Initiative (SARI)

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NASA Marshall Space Flight Center
Huntsville, Alabama
Outline

- Background to the South/Southeast Asia Research Initiative (SARI)
- SARI Projects and Updates
- SARI outputs to date
- SARI Synthesis
Despite some hurdles
- December holidays
- COVID delays
- TET holidays

Huge Thanks to VNSC and VNUET for their commitment, hardwork and efficiency for pulling this meeting.
Workshop on Land Cover Land Use Change, Southeast Asia, Hanoi, Vietnam – November 5-11th, 2011

Mapping and estimating rice residue burning and associated emissions scenarios in the greater-Hanoi region of Vietnam.

5-publications from Ph.D
-3 greater than 80 citations
-2 greater than 100 citations

Currently, Deputy Branch Manager Geospatial Engineer Research and Development Center, US Army, Virginia
International Meeting on Land Use and Emissions in South/Southeast Asia, Ho Chi Minh City, Vietnam – October 17-19th, 2016

Vietnam National University-Ho Chi Minh City, Ho Chi Minh City
University of Technology, VNSC, Vietnam

https://sari.umd.edu/meetings/international-meeting-land-use-and-emissions-southsoutheast-asia
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
Meeting Summary- SARI Research Needs and Priorities - The Earth Observer

- Focus LCLUC thematic areas
- Need for products
- Strengthen Research ties
- Training opportunities
- Student opportunities
- How to strengthen ISRO – NASA collaborations?
- Data access (how to access ISRO satellite data)
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.

Dr. Krishna Vadrevu, SARI Lead, NASA MSFC

- Science Advisory Team Formed (2013)
- Science Plan Formulation (mid-2014)
- Presentation at NASA HQ by Science Team (end-2014)
- First SARI ROSES Solicitation (2015)
- SARI Synthesis Solicitation (2021)

-Balancing Act
- Research + outreach activities should be blended to achieve successful science outputs
<table>
<thead>
<tr>
<th>S.No</th>
<th>2015</th>
<th>Region</th>
<th>PI</th>
<th>Theme</th>
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<tbody>
<tr>
<td>1</td>
<td>Tropical Deciduous Forests of South Asia: Monitoring Degradation and Assessing Impacts of Urbanization</td>
<td>South Asia</td>
<td>Ruth De Fries, Columbia University</td>
<td>Forest degradation and urbanization</td>
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<td>3</td>
<td>Impacts of Afforestation on Sustainable Livelihoods in Rural Communities in India</td>
<td>South Asia</td>
<td>Forrest Fleishman/Texas A&amp;M University</td>
<td>Afforestation and sustainable livelihoods</td>
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<td>4</td>
<td>The Future of Food Security in India: Can Farmers Adapt to Environmental Change?</td>
<td>South Asia</td>
<td>Meha Jain, University of Michigan</td>
<td>Food security and adaptation</td>
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<td>5</td>
<td>Complex Forest Landscapes and Sociopolitical Drivers of Deforestation - The Interplay of Land-use Policies, Armed Conflict, and Human Displacement in</td>
<td>South Asia</td>
<td>Peter Leimgruber/Smithsonian Institution</td>
<td>Deforestation, armed conflicts and policy</td>
</tr>
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<td>6</td>
<td>Understanding the Role of Land Cover/Land Use Nexus in Malaria Transmission Under Changing Socio-Economic Climate in Myanmar</td>
<td>South Asia</td>
<td>Tatiana Loboda/University of Maryland</td>
<td>Malaria</td>
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<td>7</td>
<td>Urban Growth, Land-Use Change, and Growing Vulnerability in the Greater Himalaya Mountain Range Across India, Nepal, and Bhutan</td>
<td>South Asia</td>
<td>Karen Seto/Yale University</td>
<td>Urbanization and vulnerability</td>
</tr>
<tr>
<td>8</td>
<td>Landscapes In Flux: The Influence of Demographic Change and Institutional Mechanisms on Land Cover Change, Climate Adaptability and Food Security in Rural India</td>
<td>South Asia</td>
<td>Philip Townsend/University of Wisconsin-Madison</td>
<td>Food security and adaptation</td>
</tr>
<tr>
<td>9</td>
<td>Consequences of Changing Mangrove Forests in South Asia on the Provision of Global Ecosystem Goods and Services</td>
<td>South Asia</td>
<td>Jeffrey Vincent/Duke University</td>
<td>Mangroves and Ecosystem services</td>
</tr>
<tr>
<td>10</td>
<td>Spatiotemporal Drivers of Fine-Scale Forest Plantation Establishment in Village-Based Economies of Andhra Pradesh</td>
<td>South Asia</td>
<td>Randolph Wynne/Virginia Polytechnic Institute and State University</td>
<td>Plantations and agricultural transitions</td>
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(10 projects over South Asia)
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<tbody>
<tr>
<td>11</td>
<td></td>
<td>Agricultural Land Use Change in Central and Northeast Thailand: Effects on Biomass Emissions, Soil Quality, and Rural Livelihoods</td>
<td>Varaprasad Bandaru/University of Maryland, College Park</td>
<td>Emissions, soil quality</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>The Agrarian Transition in Mainland Southeast Asia: Changes in Rice Farming - 1995 to 2018</td>
<td>Jefferson Fox/East West Center</td>
<td>Rice Farming</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>A Cobra in the Forest? Quantifying the Impact of Perverse Incentives from Indonesia's Deforestation Moratorium, 2011 to 2016</td>
<td>Matt Hansen, Umd</td>
<td>Deforestation, moratorium policies</td>
</tr>
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<td>14</td>
<td></td>
<td>Land-Cover/Land-Use Change in Southern Vietnam Through the Lenses of Conflict, Religion, and Politics, 1990s to Present</td>
<td>Jessica McCarty, Miami University</td>
<td>Land use change, religion conflicts and policies</td>
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<tr>
<td>15</td>
<td></td>
<td>Land Use Status, Change and Impacts in Vietnam, Cambodia and Laos</td>
<td>Son Nghiem/Jet Propulsion Laboratory</td>
<td>Land use change</td>
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<td>16</td>
<td></td>
<td>Assessing the Impacts of Dams on the Dynamic Interactions Among Distant Wetlands, Land Use, and Rural Communities in the Lower Mekong River Basin</td>
<td>Qi, Michigan State University</td>
<td>Water resources</td>
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<td>SARI Projects - ROSES-2016 and 2018 Selections</td>
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<td>(6 projects on Southeast in 2016; 4 on Southeast and 2 on South Asia in 2018; 3 more in 2019)</td>
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<tr>
<td>S.No</td>
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<td>23</td>
<td>Where are the Missing Burned Areas? Global Hotspots of Burned Area - A Multiresolution Analysis</td>
<td>David Roy, Michigan State U</td>
<td>Burned area mapping</td>
<td></td>
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<tr>
<td>24</td>
<td>Global Hotspots of Change in Mangrove Forests</td>
<td>Marc Simard, JPL</td>
<td>Mangrove mapping</td>
<td></td>
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<tr>
<td>25</td>
<td>Multi-Resolution Quantification and Driver Assessment of Hot Spots of Global Forest Disturbance</td>
<td>Alexandra Tyukavina, UMD</td>
<td>Forest disturbance mapping</td>
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**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)

- **Southeast Asia Synthesis** – being selected.
• Some on-going LCLUC and Pollution issues in South/Southeast Asia
How Air Quality Compares in Asia

Levels of average PM2.5 air pollution in Asian countries/regional economies in 2020 (in μg/m³)

Good (0.0-12.0)  Moderate (12.1-35.4)  Unhealthy (sens. groups) (35.5-55.4)  Unhealthy (55.5+)

Worst air
- Bangladesh: 77.1
- Pakistan: 59.0
- India: 51.9
- Mongolia: 46.6
- Afghanistan: 46.5

Best air
- Japan: 9.8
- Singapore: 11.8
- Philippines: 12.8
- Taiwan: 15.0
- Hong Kong: 15.4

Out of 28 Asian countries were sufficient data exists
Source: IQAir World Air Quality Index
Agriculture, Forests and Other Land Use still is a significant source of net CO2 Emissions in Asia
South Asia – LCLUC Drivers Identified by SARI PI’s

- **Afforestation**
  - Drivers: Policy changes, participatory forestry not dominant

- **Urbanization and LCLUC**
  - Drivers: Migration, rural livelihoods and non-farm income

- **Agricultural LCLUC**
  - Drivers: Climate adaptation

- **Deforestation**
  - Drivers: Power vacuum, Artisanal mining, Conflicts, Demand for products

- **Small holder Agriculture and Trees outside forests**
  - Drivers: Project just started

- **Agricultural Land Use Change and Intensity**
  - Drivers: Urbanization

- **Food Security in Rural India**
  - Drivers: Farm ownership, education off-farm income

- **Plantation Establishment**
  - Drivers: Farm ownership/property rights

- **Malaria Mapping**
  - Drivers: Land Use, Population & Environment

- **Forest Degradation and Urbanization**
  - Drivers: Driven by policies and less on migration

- **Mangroves and Ecosystem Services**
  - Drivers: Population pressure, local policies
Southeast Asia – LCLUC Drivers Identified by SARI PI’s

Biomass burning emissions and soil quality
Driver: Farm management, lack of machinery

Field size and agrarian transitions
Drivers: Land tenure regimes

Rice Farming and LCLUC
Drivers: Labor dynamics, off-farm employment

Impacts of Dams on LCLUC
Drivers: Livelihoods, population size

Urbanization and land transitions
Drivers: Industrialization, tourism, exports, migration

LCLUC in Peatlands
Drivers: Oil palm, markets prices, demographics

Deforestation
Drivers: Govt. policies and incentives

Shifting cultivation and LCLUC
Drivers: Poverty, livelihoods

LCLUC
Drivers: Population dynamics, policy
Indonesia, Malaysia, and Thailand are home to 80% of the world’s oil palm plantations, which is driven by global demand for oil palm-derived products, such as renewable energy, food-based, and health/beauty product. More than half of net deforestation resulted from agricultural expansion (i.e. oil palm and cropland) with total gross forest losses in 2000 attributed to the conversion to cropland, oil palm, and regrowth – less due to Urbanization.

Land cover classification for Sumatra and Western Malaysia for the years of a) 2000 and b) 2015.

- Forest cover became less fragmented in part due to the rise of large-scale monoculture plantations.
- The mean size of oil palm patches almost doubled from 2000-2015.
- Patches of forests were replaced by oil palm mostly in the eastern part of Sumatra.

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. (Myneni et al., Nature, 2019)
Without entering the political debate on which country is contributing more to global emissions(?) – tackling pollution is important and essential to protecting Life on Land.

Good Pollution mitigation-related governance reduces environmental burdens, saves environment including ill-health impacts.
Satellite Data and Products for Air Pollution Studies

* Hatching = No Data
• SARI Outputs
Collaborations are the Key – SARI Meetings Facilitated by Regional and International partners
- 23 projects and more being added
- > 250 scientists
- > 150 institutions
- 12 different Special Issues in Journals

South-Southeast Asia

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

Nearly 350 publications in Peer reviewed journals and Books
SARI Special Issues Published in Multiple Journals

Volume-I and 2

~200 peer reviewed publications in 5-years
LCLUC/SARI Books

- **Land-Atmospheric Research Applications in South and Southeast Asia**
  - Krishna Prasad Vadrevu
  - Toshimasa Ohara
  - Chris Justice
  - Springer, 2018

- **Biomass Burning in South and Southeast Asia**
  - Krishna Prasad Vadrevu
  - Toshimasa Ohara
  - Chris Justice
  - CRC Press, 2021

- **Biomass Burning in South and Southeast Asia**
  - Krishna Prasad Vadrevu
  - Toshimasa Ohara
  - Chris Justice
  - CRC Press, 2021

- **Remote Sensing of Agriculture and Land Cover/Land Use Changes in South and Southeast Asian Countries**
  - Krishna Prasad Vadrevu
  - Thuy Le Toan
  - Shibendu Shankar Ray
  - Chris Justice
  - Springer, 2022

- **Air Pollution in Asia**
  - Krishna Vadrevu
  - Toshimasa Ohara
  - Chris Justice
  - Forthcoming

  Springer, 2022
Promoting Open Source Tools and Cloud Computing Platforms For LCLUC Research (Ex: GEE)
Vision, support and guidance to build the SARI regional science initiative

Dr. Gutman (NASA HQ) and Prof. Justice (UMd)
Questions?