



System of Rice Intensification Research: a Review

1993-2013

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Presentation at the International Rice Congress, Bangkok, Thailand,
Oct 31, 2014

Conceptual Framework

Methodology



Principles



SRI Practices

*Indicative
and to adapt*

System of Rice Intensification



A. Early and healthy plant establishment



B. Minimize competition between plants



C. Build fertile soils rich in organic matter and soil biota



D. Manage water carefully, avoid flooding & water

- Soil preparation
- Seed treatment/ pre-germination
- Raised bed nursery
- *Transplanting:*
 - At 2 leave stage, 8-12 days old
 - or -
- *Direct seeding:*
 - Precision seeding (at 1 or 2 plants/ hill)

Reduce plant density

- 1 plant/hill
- and -
- Increase spacing between plants (25cm x 25cm or more), planted in a grid
- Mechanical weeding

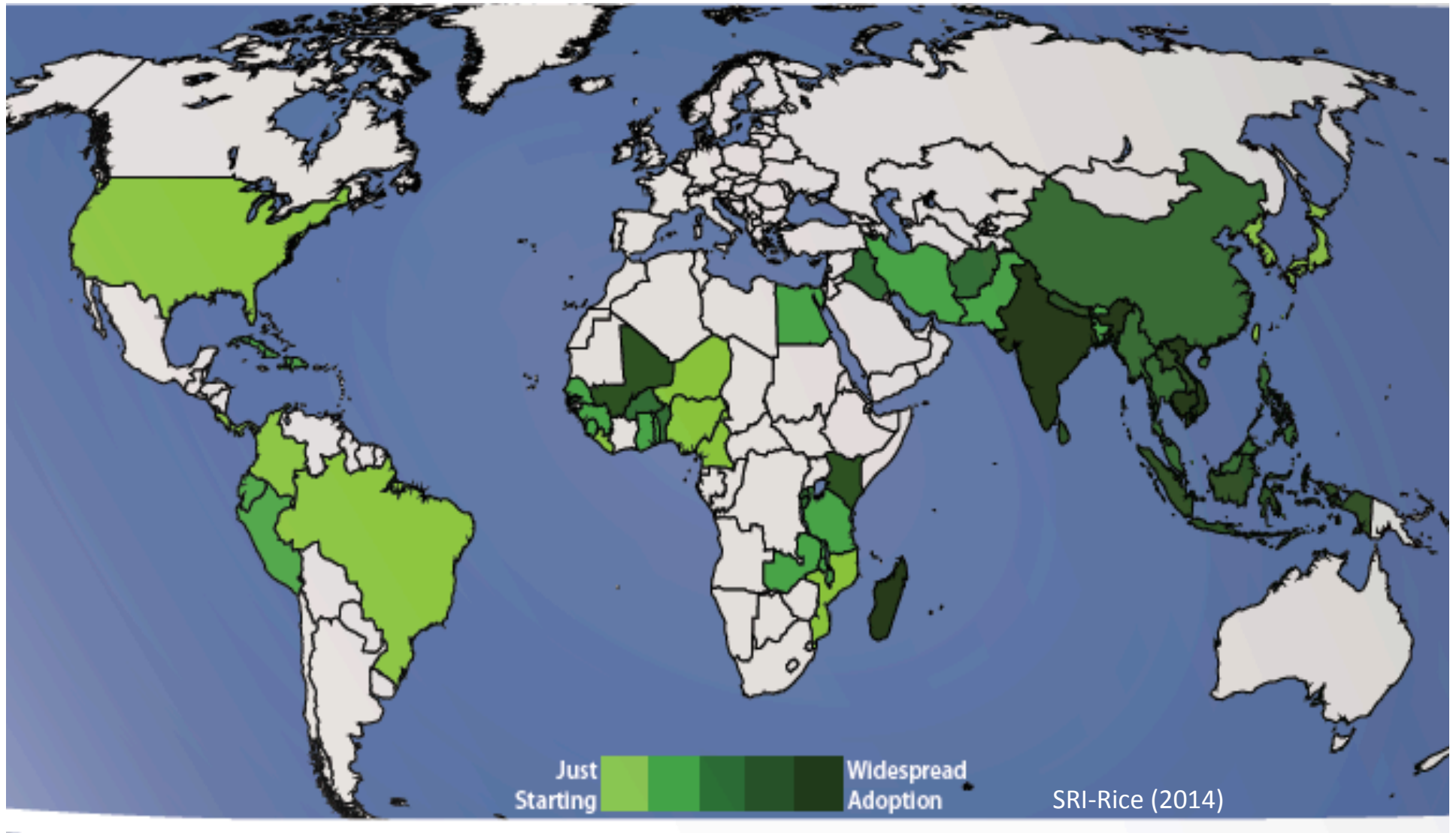
- Fertilize with organic matter and add chemical fertilizer if needed:
 - Manure/compost
 - Cover crop / green manure
 - Crop residues
- Incorporate OM or combine SRI with Conservation Agriculture

- Land preparation: Leveling, bunding, application or organic matter
- Non flooded conditions during the vegetative period
- Alternate wetting and drying (AWD) – or -
- Bunding, additional irrigation or drainage

(Styger and Jenkins, 2014)

Spread and Adoption of SRI

More than 10 million farmers benefit from SRI methods in 54 countries (end of 2013)



SRI Research Review

- How SRI research has evolved
- What has been researched
- Who has carried out the research
- What were the findings

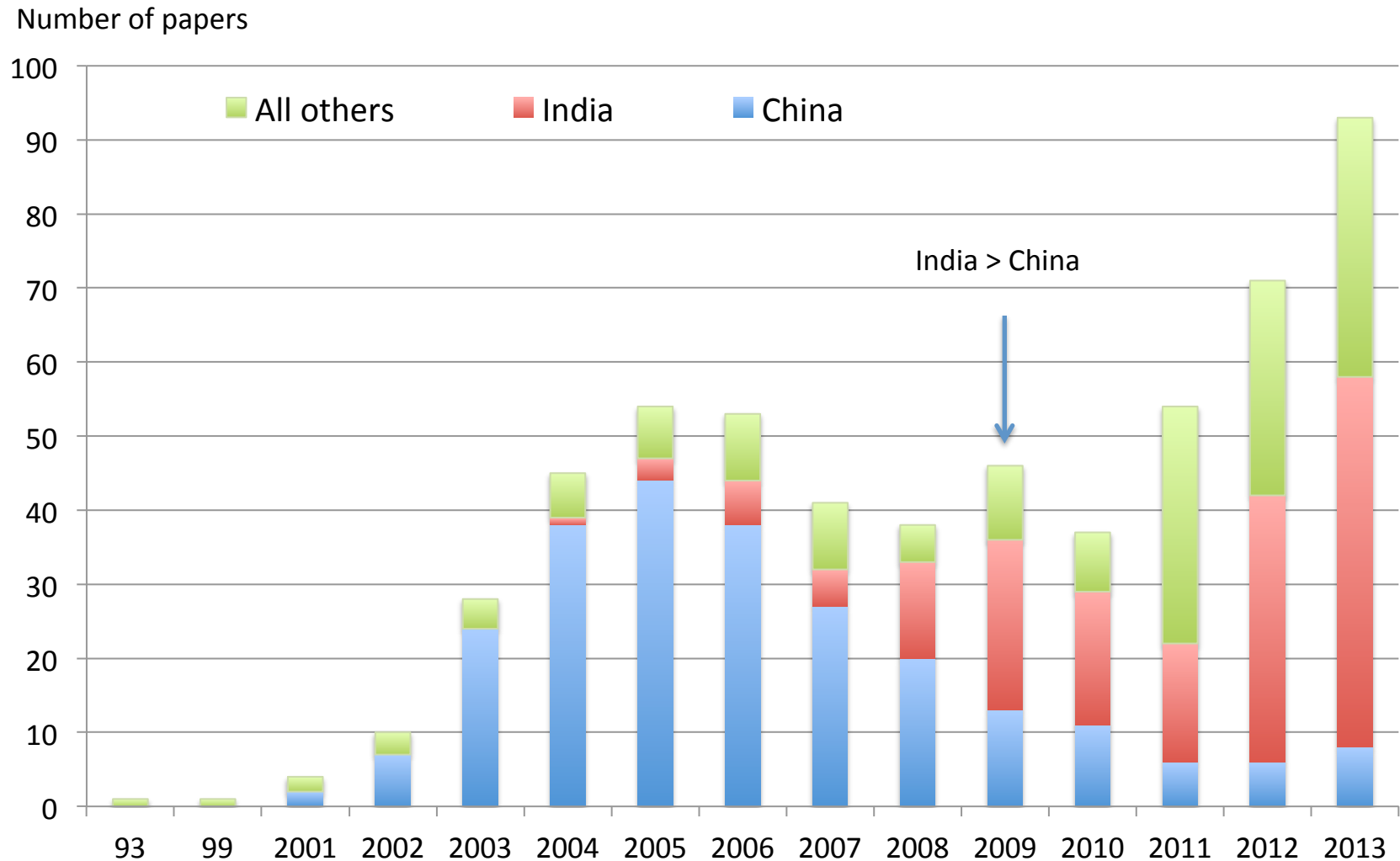
Methodology



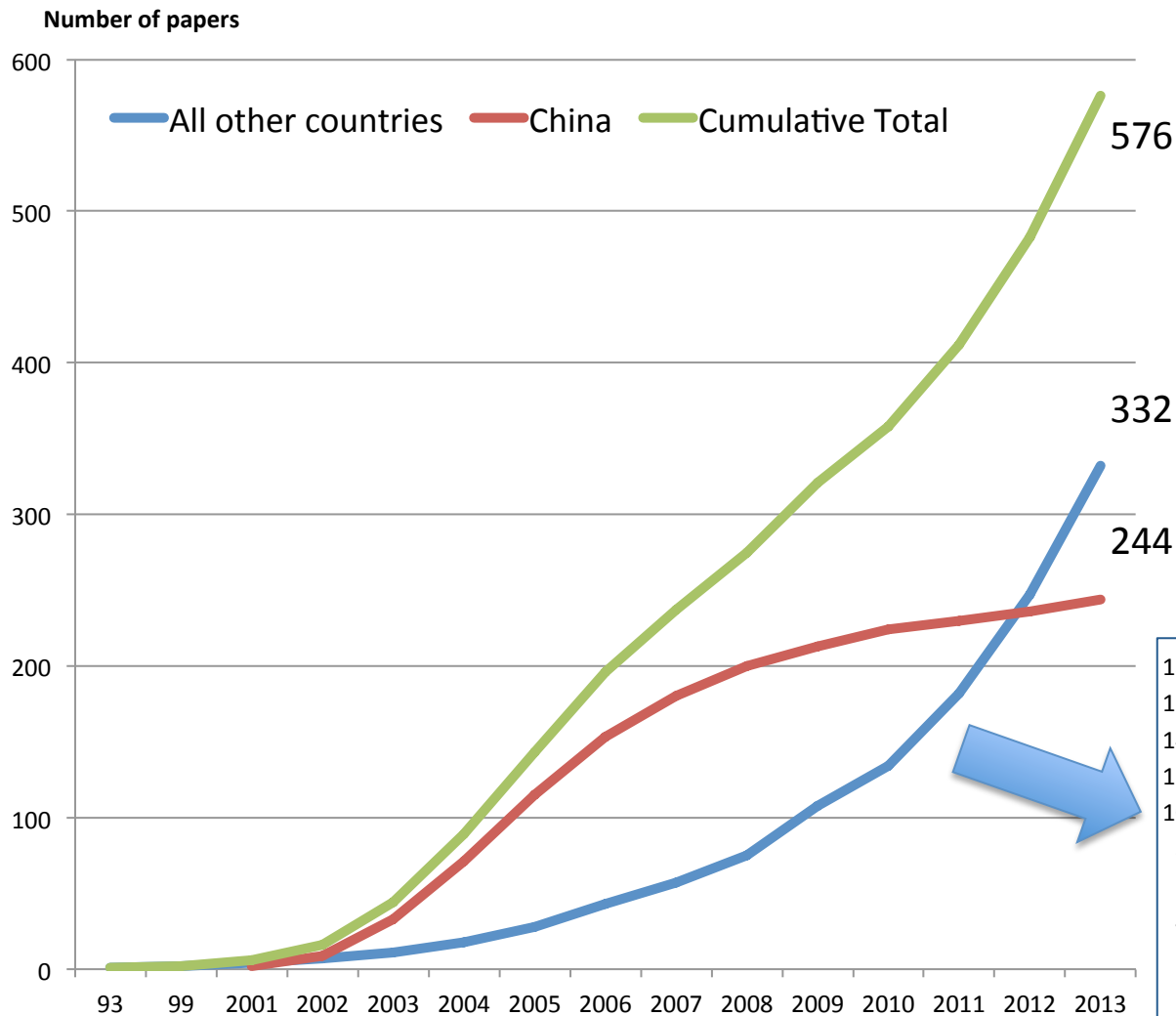
624 Journal Articles

- All articles key-worded (32 kw)
- All references available at <http://sri.cals.cornell.edu/> (Refworks, Mendeley)

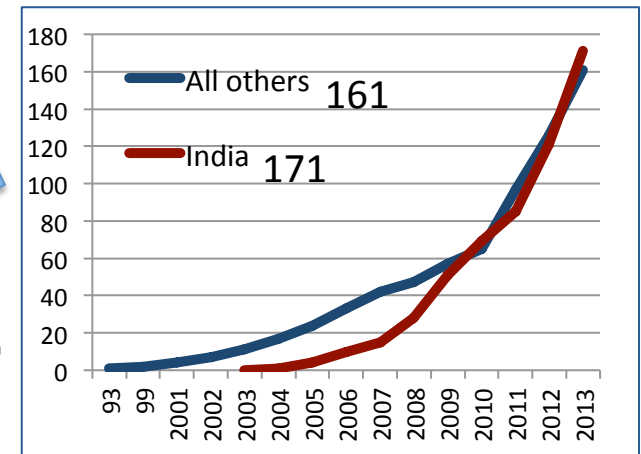
Number of articles by year and by country group



Cumulative number of SRI articles from 1993-2013 by year and by country groups

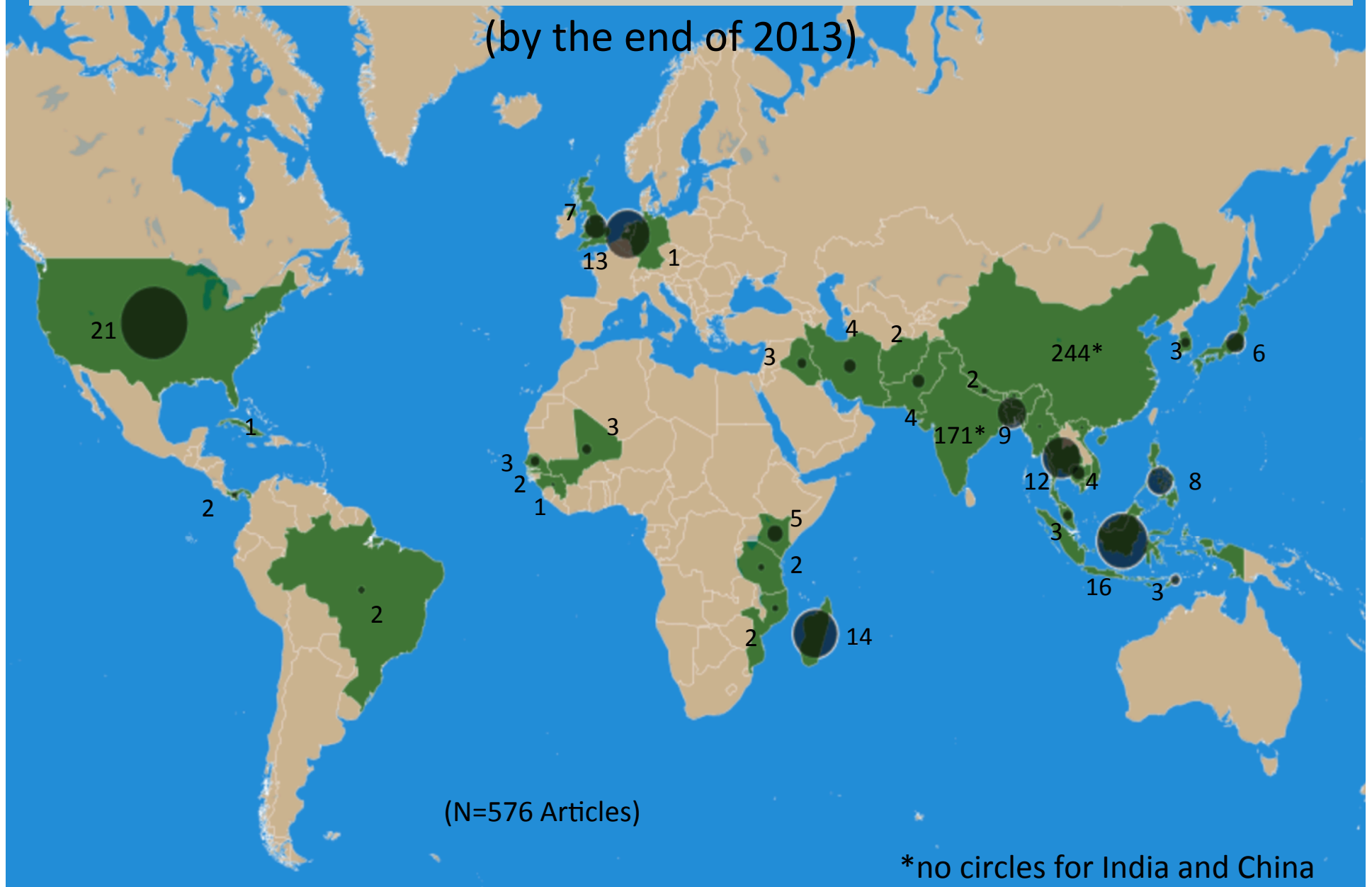


273 journals,
with 72 Chinese
journals (26%)

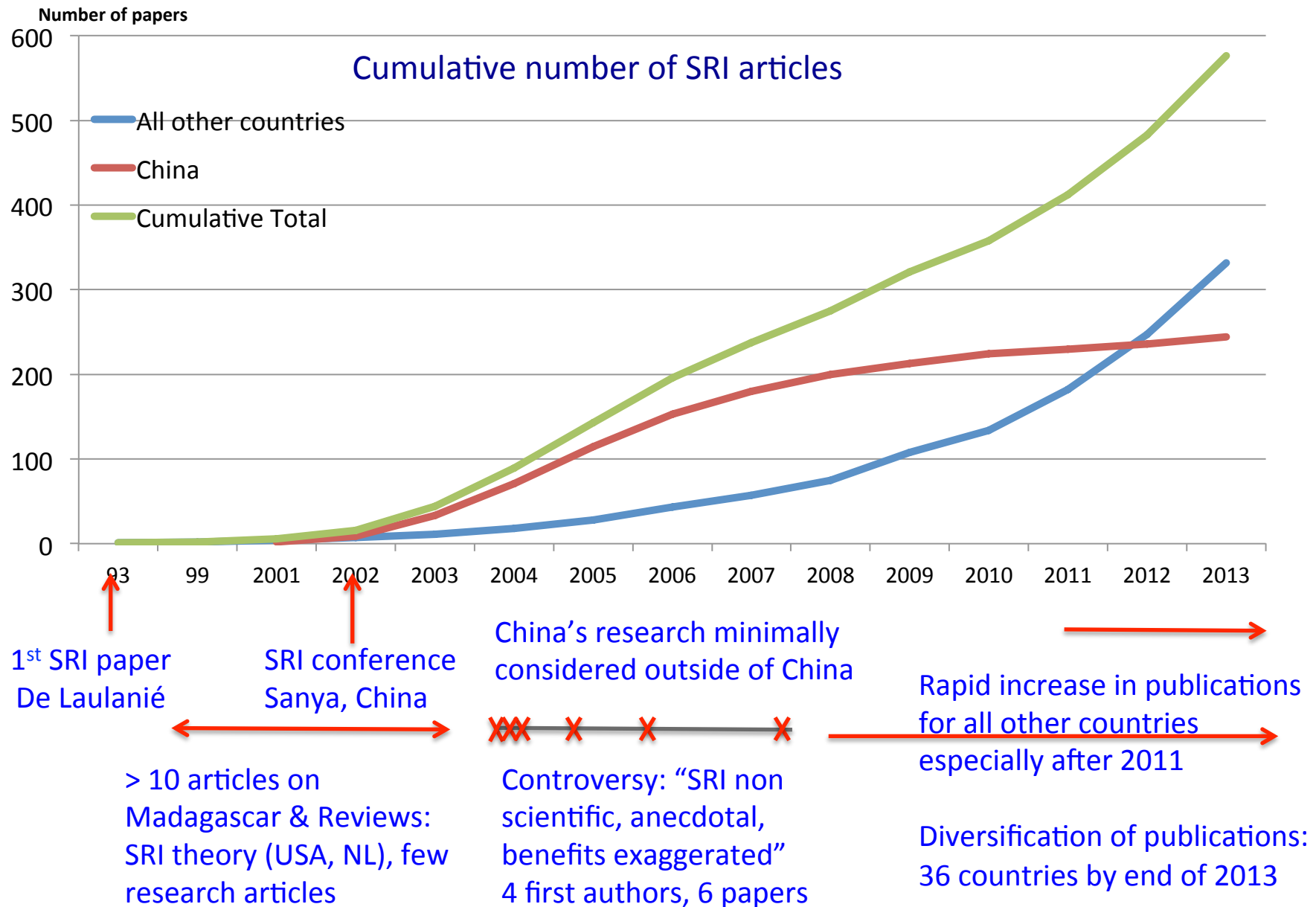


Number of SRI journal articles published per country

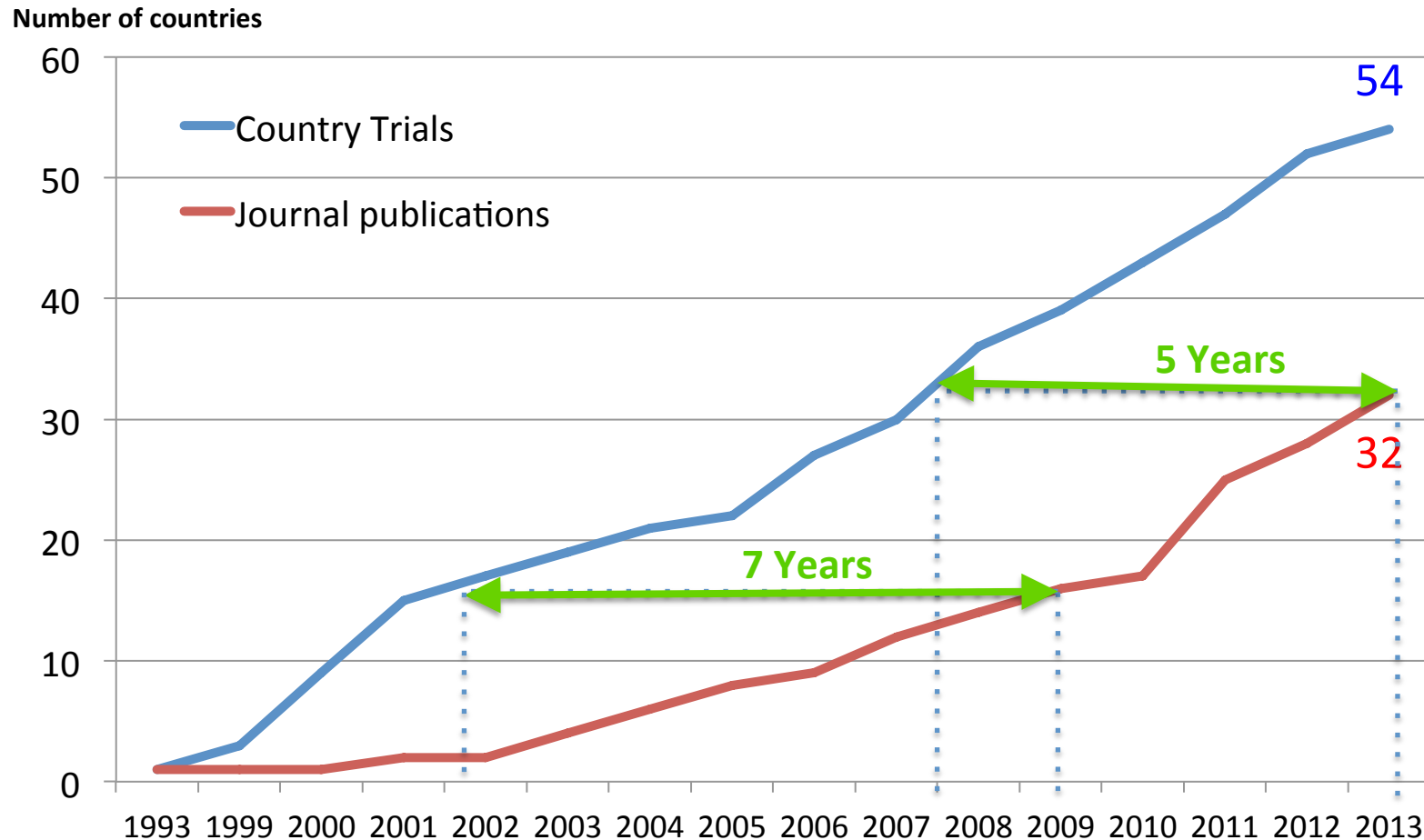
(by the end of 2013)



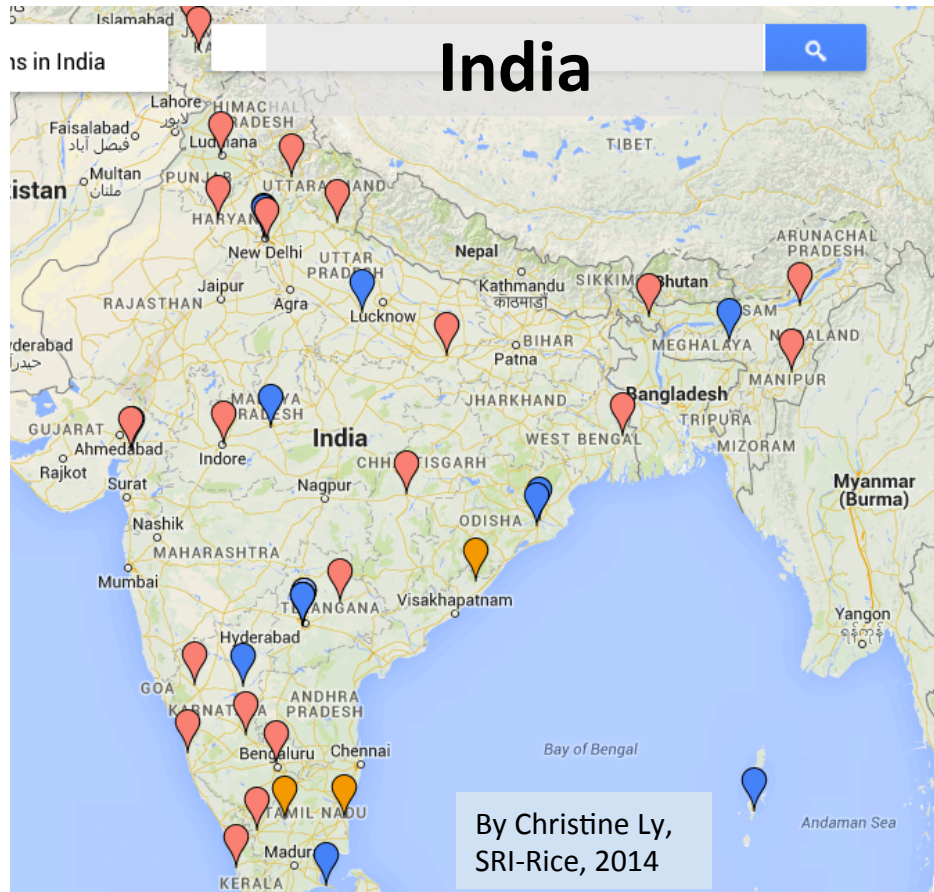
Evolution of SRI Research



Number of countries with reported SRI trials and published journal articles (from 1993-2013)



Institutions where SRI research was undertaken and published



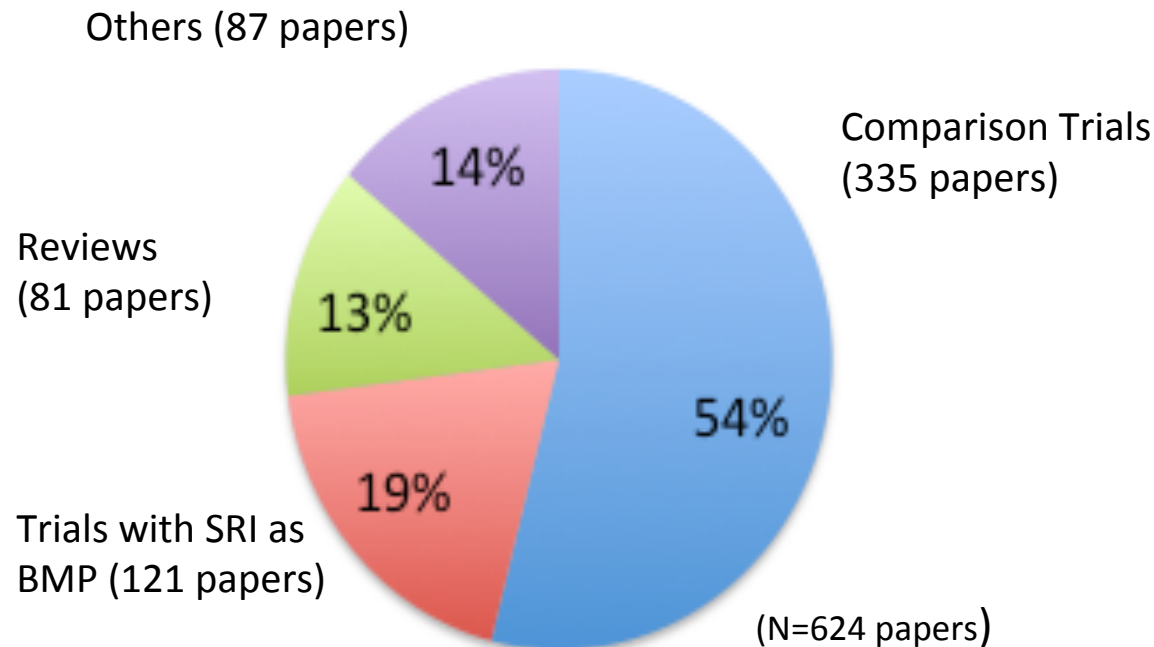
BLUE: Research Centers
RED: Universities

Maps available at sririce.org



BLUE: Universities and research institutes
RED: Local agricultural extension
YELLOW: Government departments of agriculture
GREEN: Companies

Types of research articles

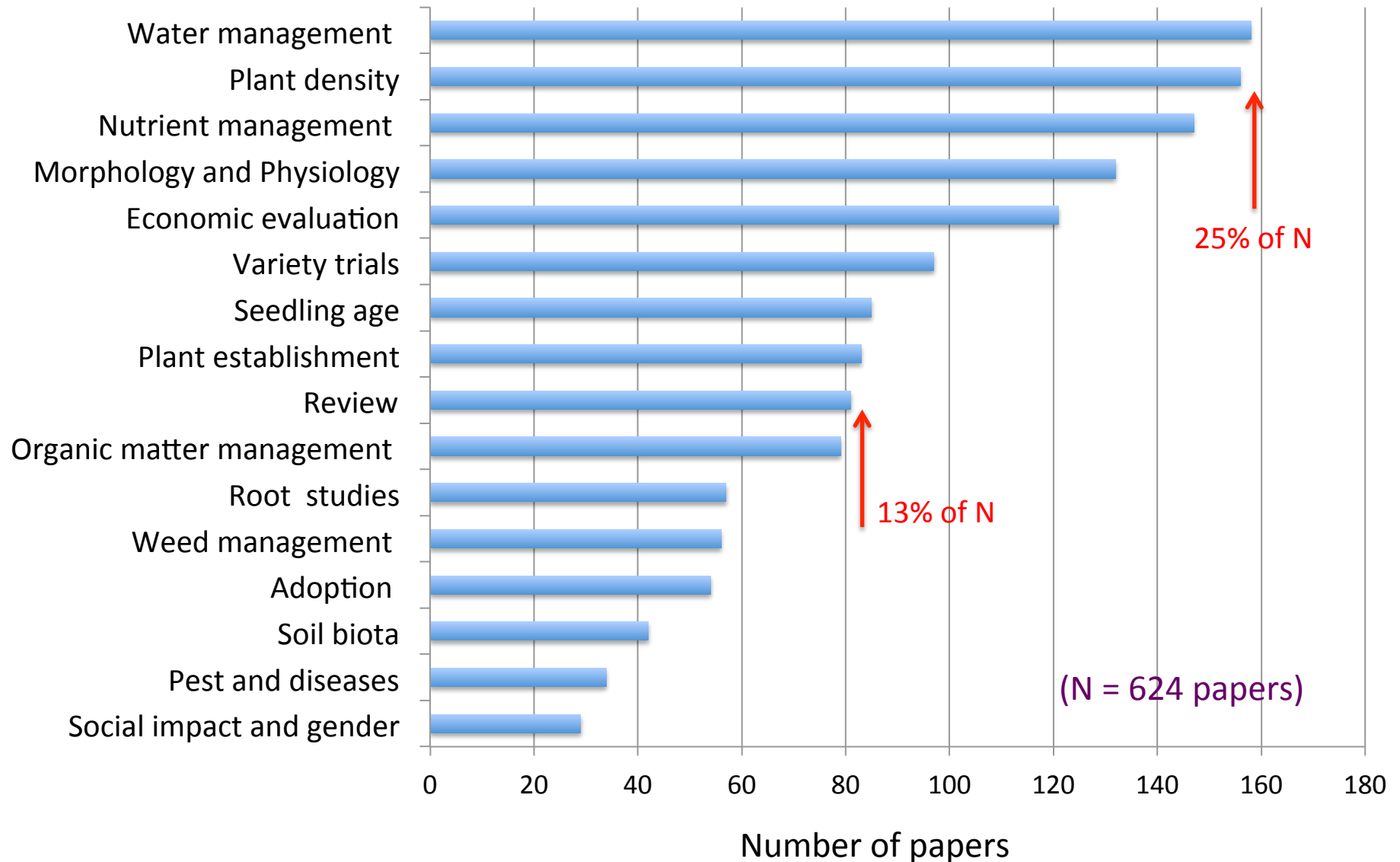


Comparison Trials: most common practices for the 2 Systems

SRI: young, single seedling/hill, wider/adjusted spacing, cono-weeding, AWD, organic matter & chemical fertilization

Conventional : several older seedlings/hill, higher plant density, hand weeding/ herbicides, continuous flooding, chemical fertilization

Main SRI Research Topics



Findings: Tendencies and Trends I

- in relation to SRI:

- Water management - 168 papers
 - Improved water productivity
 - Reduction of irrigation water use (20-50%)
 - In combination with increased yields
- Nutrient management 155 papers
 - Optimum treatments include organic and inorganic fertilization
 - Improved nutrient use efficiency
- Age of seedlings: 88 papers
 - Testing transplanting from 6d to >30d
 - Highest yields with 10-14d old seedlings;
 - Confirms theory to plant before 4th phyllochron

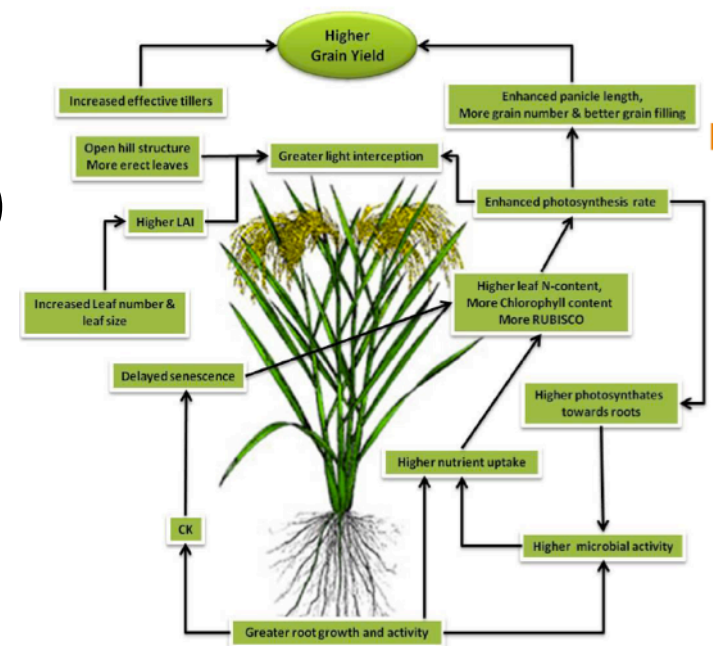
Findings: Tendencies and Trends II

- Economic evaluation 129 papers
 - Production costs and labor: higher/equal/lower
 - Net return and benefit/cost ratio: most often higher
- Adoption Studies 52 papers
 - Quality of training and technical follow up
 - Importance of rice crop and opportunity costs
 - Market access and policy support
 - Social organization of labor and water management

Findings: Tendencies and Trends III

- Morphology and Physiology: 132 papers; 86 from China (2004-2008); 26 from India (2009-2013)
 - Wider canopy angle and higher leaf area index
 - Higher light interception, chlorophyll content, photosynthesis rate
 - Delayed leaf and root senescence
- Root studies: 57 papers (70% since 2010)
 - Higher root biomass, volume and root length density
 - Higher soil microbial activity

➡ longer grain filling period and higher yields

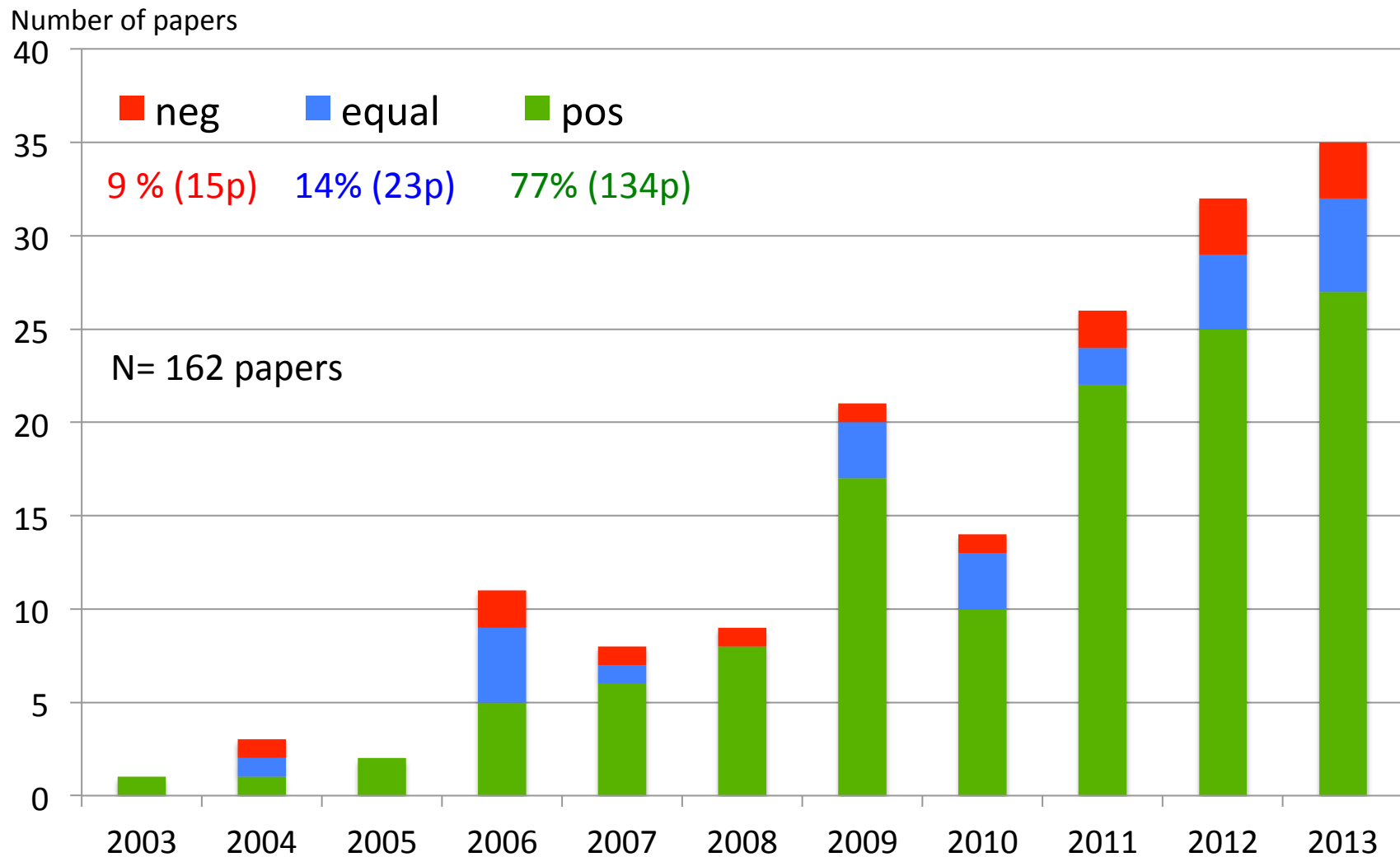


Thakur, et al. 2014

Findings: Tendencies and Trends IV

- Greenhouse gas emissions (10 papers of which 7 papers in 2013 and 2014)
 - Methane reduction (6 papers): all reduced by 10-64%
 - Nitrous oxide (2 papers): increase 22.5%, reduced 12.5%
 - Global warming potential: (4 papers): all reduced by 21-73%

Yield effect for SRI System in Comparison Trials



Conclusions

- > 600 journal articles on SRI largely confirm what can be empirically observed in farmers' fields of >50 countries
 - More efficient phenotype
 - Increased grain productivity
 - Reduced seed, water, agro-chemical use
- In most countries, SRI was first introduced at farmers' level – research publications lag several years behind farmer field results
- Most research undertaken by National Institutions

Recommendations I

Research foci

Deepen topical analysis

- E.g. water, weed, nutrient management
- Optimize physiological processes to produce more effective phenotypes
- Strengthen synergies between plant, soil and soil biota
- Influence genetic expression for reaching plant's genetic potential through management approaches

Recommendations II

Broaden to Farming Systems Level

- Apply a broader farming systems and landscape analysis
- Integrate socio-economic and socio-cultural research with technical research
- Integrate other agro-ecological approaches
Conservation Agriculture, Agroforestry, IPM with SRI

Apply New Research Models

- Include farmers actively in research to identify optimal agronomic practices



Thank You!

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