The System of Rice Intensification -- Implications for Indian Policy: A Global Perspective and Some Specific Suggestions

Norman Uphoff, SRI-Rice, Cornell University

Policy Workshop on System of Rice Intensification
National Agricultural Sciences Complex
Pusa, New Delhi, June 21, 2014

Green Revolution technology from the 1960s has contributed to meeting food needs in the 20th century -- but it is becoming less and less relevant to the conditions of this 21st century

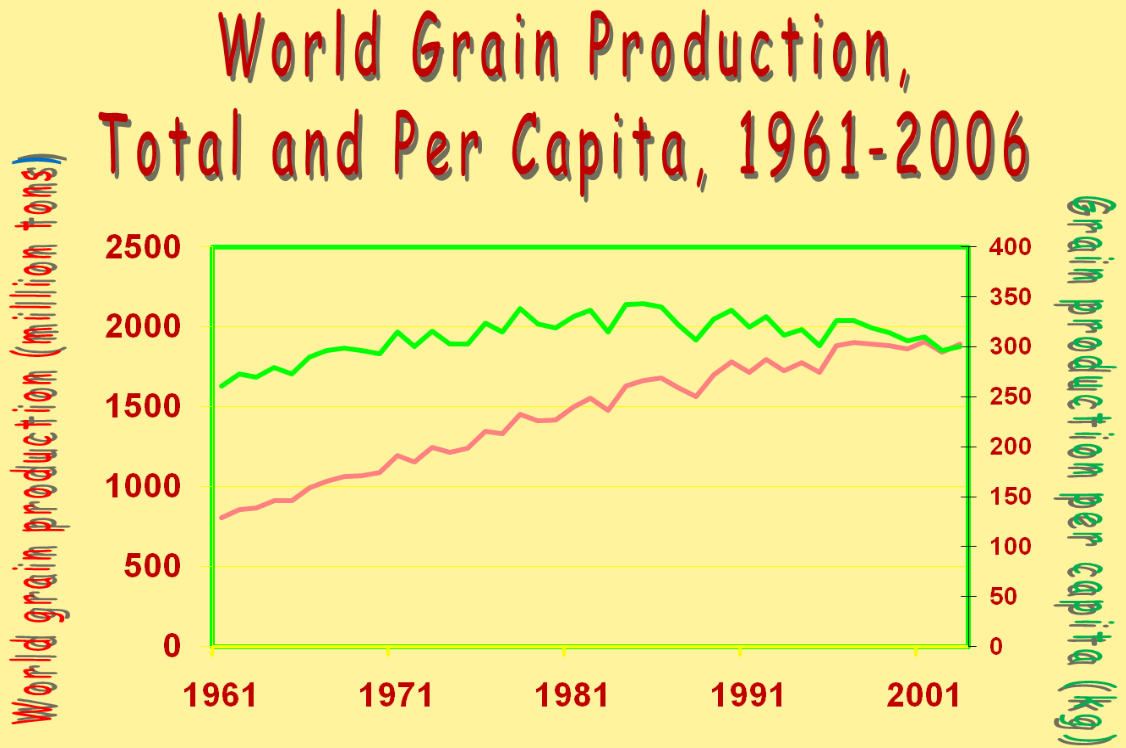
The key elements of GR technology have been:

- ***Development and use of NEW VARIETIES***
- ***Use of EXTERNAL (PURCHASED) INPUTS***
- ***Provision of more and more reliable WATER***
- ***Agrochemical means of CROP PROTECTION***

But this paradigm has begun encountering decelerating gains in productivity in recent years plus negative environmental externalities that reduce soil health and water quality

<u>Green Revolution strategy</u> has been considered as the <u>*necessary*</u> (or even as the <u>best</u> or <u>only</u>) way to achieve <u>higher crop yields</u> + <u>more productivity</u>

However, this <u>*seeds + fertilizer + water strategy*</u> has been experiencing <u>diminishing returns</u>



SRI represents a paradigm shift for agriculture (relevant to more than just rice, also SCI) with major policy implications and opportunities

It points India in different directions from current Green Revolution technologies, investments, policies

- **REDUCED INPUT-DEPENDENCE** – which has important agronomic, economic, environmental, social, budgetary, and political implications
- **LESS GENOCENTRICITY** (fixation on varieties) -- more concern with gene expression studies in the burgeoning field of epigenetics, and valuing the contributions of the **plant-soil microbiome**

Organizations and agencies in most countries have been slow to respond to SRI opportunities

But knowledge and experience are accumulating for more rapid, more economical, more eco-friendly, and more equitable agricultural development

India, through several of its states and with central government support, has been one of most responsive and innovative countries regarding SRI opportunities

Current estimate for China: 3 m farmers, 1 m ha

India: at least 3.5 million farmers, and 1.7 m ha

India is now a world leader on SRI, and also SCI; but national & state policies not capitalizing fully

Increases in CROP YIELD and higher FACTOR PRODUCTIVITY are *not the only reasons* to extend SRI use (maybe not the most important?)

- **WATER SAVINGS** – meta-analysis shows average reduction in total water requirements of 22%, and in irrigation water requirements of 35% (TWUE 52% higher; IWUE 78% higher)
- **FISCAL SAVINGS** – reductions in expenditure for electricity and diesel subsidies? large reductions in fertilizer subsidies without any loss of yield?
- **CLIMATE-RESILIENCE** – greater tolerance for biotic and abiotic stresses -- pests and diseases; and drought, storm, temperature extremes, etc.

Quick review of policy issues and opportunities that are raised by SRI/SCI

In the RESEARCH domain – reduce the social and other **distances** between 'lab' and 'land' and support **two-way communication**, with more farmer participation in framing research questions and in conducting and evaluating in-field research.

Experiment-station research may not always be giving the most appropriate results, particularly because the contributions of the **soil biota** (which are always location-specific) are usually ignored in most current agronomic research.

Quick review of policy issues and opportunities that are raised by SRI/SCI

In the <u>EXTENSION domain</u> – reorient tasks and responsibilities of extension personnel from mostly promoting **<u>inputs</u>** and promoting their sale → to communicating, refining and applying **<u>ideas and knowledge</u>** -- a very *different orientation* if acting as **facilitators** more than as advertisers or promoters.

More support for **<u>farmer-to-farmer extension activities</u>** for **horizontal diffusion of innovations** rather than emphasize top-down promotion which lacks precise local applications and credibility.

Quick review of policy issues and opportunities that are raised by SRI/SCI

In the realm of <u>SUBSIDIES</u> -- <u>level the playing field</u>! so that **agroecological innovations** like SRI are ***<u>not discriminated against</u>*** by artificially low prices of **fertilizers** and promotion of **hybrid seeds**, plus the subsidization of **electricity and water** – all of which create ***large fiscal burdens for government***.

Might give subsidies to get SRI/SCI methods tried out -- but **productivity gains** from these alternative methods can make such inducements unnecessary.

Subsidies are costly for government <u>and environment</u>.

Quick review of policy issues and opportunities that are raised by SRI/SCI

In the realm of LABOUR – labourers become both more skilled and more productive with SRI → they should be remunerated appropriately, receiving a ***fair share*** of the greater value-added that they create by their skilled labour.

Training should be given to agricultural labourers, with appropriate arrangements for **surplus-sharing**, or **premium** added to labourers' standard daily wage.

Whether SRI is labour-intensive or labour-saving depends on prior degree of intensity; can save labour

Quick review of policy issues and opportunities that are raised by SRI/SCI

Regarding **<u>LABOUR</u>** – often labour shortages in rural areas, so **<u>mechanization</u>** should be invested in.

Need to have ***<u>better implements and tools</u>*** for SRI/SCI → to (1) enhance labour productivity, (2) reduce drudgery, and (3) reduce labor requirements.

Develop tools with ***farmer participation*** -- less costly and more effective to have open **<u>design competition</u>**, rather than to rely on **design contracts**.

Motorized **weeders** and **mechanical transplanters** can significantly reduce the labour requirements; also do **direct-seeding** or **broadcasting/thinning** > TP.

Quick review of policy issues and opportunities that are raised by SRI/SCI

Regarding <u>INFRASTRUCTURE</u> -- because there is social as well as economic value from SRI water saving, should invest in improving **<u>land leveling</u>** and **<u>water harvesting structures</u>** so that farmers can grow more food with less water – 21st century economics.

Also **<u>fertile soil</u>** should be regarded as agricultural infrastructure; build up ***soil organic matter*** as a national priority – productive use of unskilled labour; also can ***sequester carbon*** to buffer climate change.

Also **<u>farm-to-market roads</u>** and **<u>storage facilities</u>** can and should be improved, for marketable surpluses.

Quick review of policy issues and opportunities that are raised by SRI/SCI

Along with <u>hardware of MARKETING</u> (facilities), should develop <u>market software</u> (organization).

SRI methods can produce **<u>superior quality rice</u>** (organic); this needs its own marketing channels so that both farmers and consumers benefit.

Also, SRI use can raise the yields and profitability of **<u>local/traditional/heirloom varieties</u>** of rice; these should have specialized market channels so that both farmers and consumers can benefit.

Marketing systems should be organized to accept and reward **<u>better-quality, eco-friendly grain</u>**.

Quick review of policy issues and opportunities that are raised by SRI/SCI

Simplest, and cheapest way to accelerate SRI adoption would be to make provisions so that farmers receive <u>10% PREMIUM for SRI paddy</u>

SRI paddy when milled produces **10-20% more polished rice** because of

- **Less chaff** (fewer unfilled grains), and
- **Less breakage of grains** during milling

Have seen this in ***Sri Lanka, China, Cuba, Tripura***

Presently, millers/traders receive <u>windfall profits</u> from farmers' better production; as a matter of **fairness** and as **incentive**, SRI paddy should be better remunerated

Quick review of policy issues and opportunities that are raised by SRI/SCI

Regarding <u>HYBRIDS</u> – with SRI methods, hybrid varieties give the highest yields in terms of **<u>quantity</u>** -- but not necessarily the highest **<u>quality</u>** of grain.

Policy should *not promote hybrids at the expense of* **<u>rice biodiversity</u>**, displacing & losing local varieties.

India's staple food needs can be met with a **<u>mix</u>** of hybrid, improved, and traditional varieties -- let the market and consumer preferences decide the balance.

Policy should be guided by factors like **<u>profitability</u>**, **<u>nutrition</u>**, and the conservation of **<u>rice biodiversity</u>** rather than simply **<u>yield</u>** (and commercial interests).

Quick review of policy issues and opportunities that are raised by SRI/SCI

Finally, India food policies must be made with thought given to the effects of CLIMATE CHANGE

* **Water-saving and drought-tolerance** are becoming more and more important considerations.

* **Pest and disease hazards** are likely to increase, so crops' resistance to these is becoming more urgent.

* **Reductions of greenhouse gas emissions** from agriculture will help to buffer global warming effects

- Currently, irrigated rice is a major source of GHGs
- SRI management can reduce GHG emissions

More productive SRI phenotypes have higher <u>in-plant water-use efficiency</u> as measured by the ratio of **<u>photosynthesis</u>** to **<u>transpiration</u>**

For each 1 millimol of water lost by transpiration:

3.6 millimols of CO_2 are fixed in SRI plants,

1.6 millimols of CO_2 are fixed in RMP plants

This becomes more important with <u>climate change</u>

"An assessment of physiological effects of the System of Rice Intensification (SRI) compared with recommended rice cultivation practices in India," A.K. Thakur, N. Uphoff and E. Antony
<u>Experimental Agriculture</u>, *46(1), 77-98 (2010)*

A Life Cycle Assessment (LCA) of Greenhouse Gas Emissions from SRI and Flooded Rice Production in SE India

Alfred Gathorne-Hardy, with D. Narasimha Reddy, M. Venkatanarayana, and Barbara Harriss-White, Oxford University, UK, and NIRD, Hyderabad

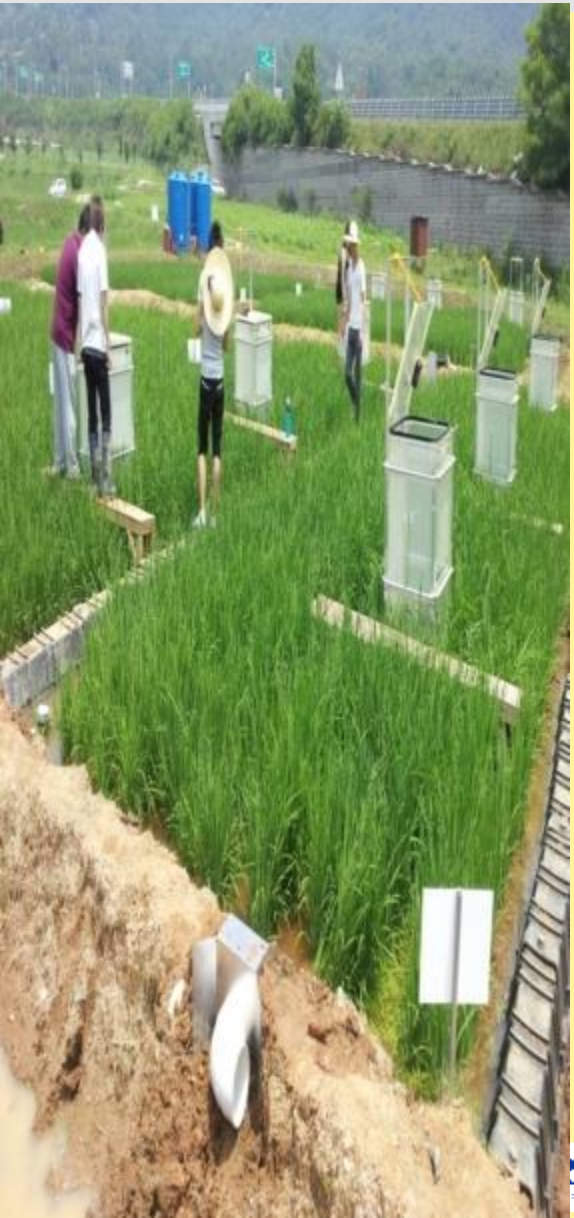
Taiwan Water Conservancy, 61:4 (2013), 100-125.

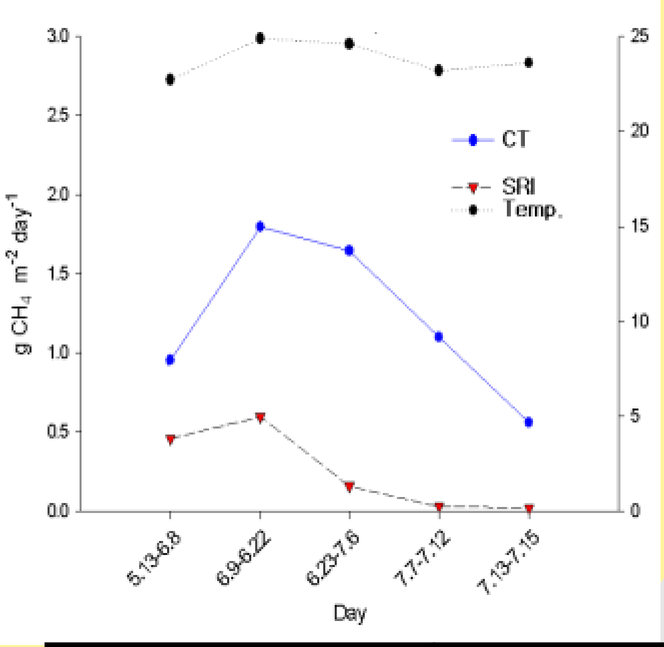
Considering both CH_4 and N_2O from total production cycle, **SRI paddies emitted >25% less GHG** per ha (in CO_2-eq), and **>60% less net GHG emissions per kg of paddy rice** because of the 58% higher yield per hectare with SRI management.

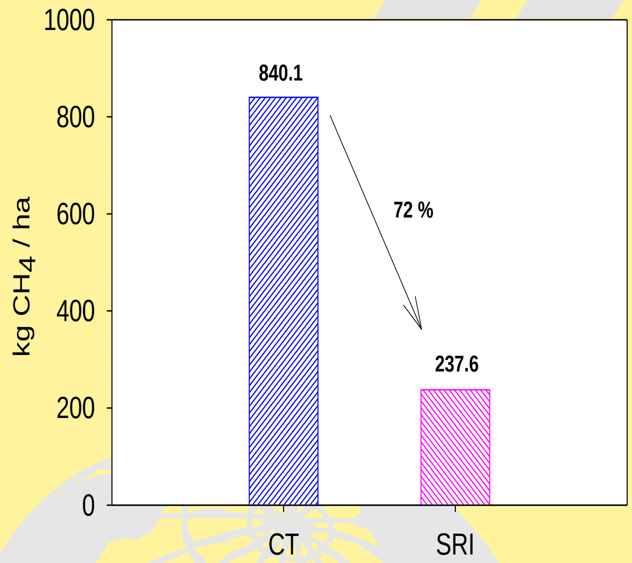
A study in Vietnam found **significant 20% reduction in CH_4**, and a **non-significant reduction of 1.5% in N_2O** (*Promoting the System of Rice Intensification: Lessons Learned from Trà Vinh Province, Vietnam*, GIZ/IFAD, Hanoi, 2013.

A study in Korea found **65-73% reduction in GHG emissions** compared to conventional flooded rice production (J.D. Choi, et al., *Irrigation and Drainage*, 63:263-270 (2014).

Comparison of methane gas emission







Treatment	Emission (kg/ha)		CO_2 ton/ha equivalent
	CH_4	N_2O	
CT	840.1	0	17.6
SRI	237.6	0.074	5.0

THANK YOU

Web page: http://sri.ciifad.cornell.edu/

Email: ntu1@cornell.edu [NTU-one]