The System of Rice Intensification (SRI)

An Available Response to Rice Price Hikes, Water Shortages, Climate Change, Rising Fuel Costs

Ministry of Agriculture, Jakarta
June 13, 2008

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Cornell University, USA

21st century conditions differ significantly from 20th century

- Arable land for agriculture declining
  - Land per capita in 2050 = 1/3 of 1950 level
- Water will be less and less reliable
- Climate change affects agriculture
  - Extreme events are increasing – more droughts, more storms, extreme temperatures
- Energy costs are higher and rising
  - Modern agriculture was developed with petroleum price of $10-20 per barrel

21st century conditions differ significantly from 20th century

- Environmental constraints are greater than before
  - Concern for quality of water, soil and air
  - Concern for greenhouse gas emissions
- Poverty alleviation is continuing concern – need accessible technology which has beneficial income effects
- Food quality and nutrition concerns
  - Challenge is to produce healthy people

Rice sector needs in 21st century
listed by IRRI for Intl. Year of Rice 2004:

- **Land productivity** must be increased
- **Water productivity** - more crop per drop
- **Technology accessible to the poor**
- **Environmental friendliness**
- **Pest and disease resistance**
- **Tolerance of abiotic stresses** (climate)
- **Better grain quality** -- for consumers
- **Greater profitability** -- for farmers

SRI practices meet all these needs:

- **Higher *yields*** -- usually 50-100% higher
- ***Water reductions*** -- 25-50% less water
- ***Capital expenditures*** -- not necessary
- ***Agrochemical inputs*** – also not needed
- ***Pest and disease resistance*** evident
- ***Resistance to drought and lodging***
- **Better *grain quality*** – more nutritious?
- **Lower *costs of production*** -- by10-20%

Additional benefits of SRI practice:

- ***Time to maturity*** reduced by 1-2 weeks
- ***Milling outturn*** -- higher by about 15%
- ***Other crops' performance*** are being improved by SRI concepts and practices, *e.g., sugar cane, millet, wheat, other crops?*
- ***Human resource development*** for farmers through participatory approach
- ***Diversification and modernization*** of smallholder agriculture

SRI was developed in Madagascar in the1980s -- after 20 years of work

Fr. Henri de Laulanié making field visit, shortly before his death in 1995

First validations outside Madagascar in:

-- **China (1999)**: Nanjing Agricultural University, followed by China National Rice Research Institute (CNRRI), China Hybrid Rice Center, Sichuan Academy of Agric. Sciences, etc., then

-- **Indonesia (1999-2000)**: MOA's Agency for Agricultural Research and Development (AARD), then National IPM Program, etc., then

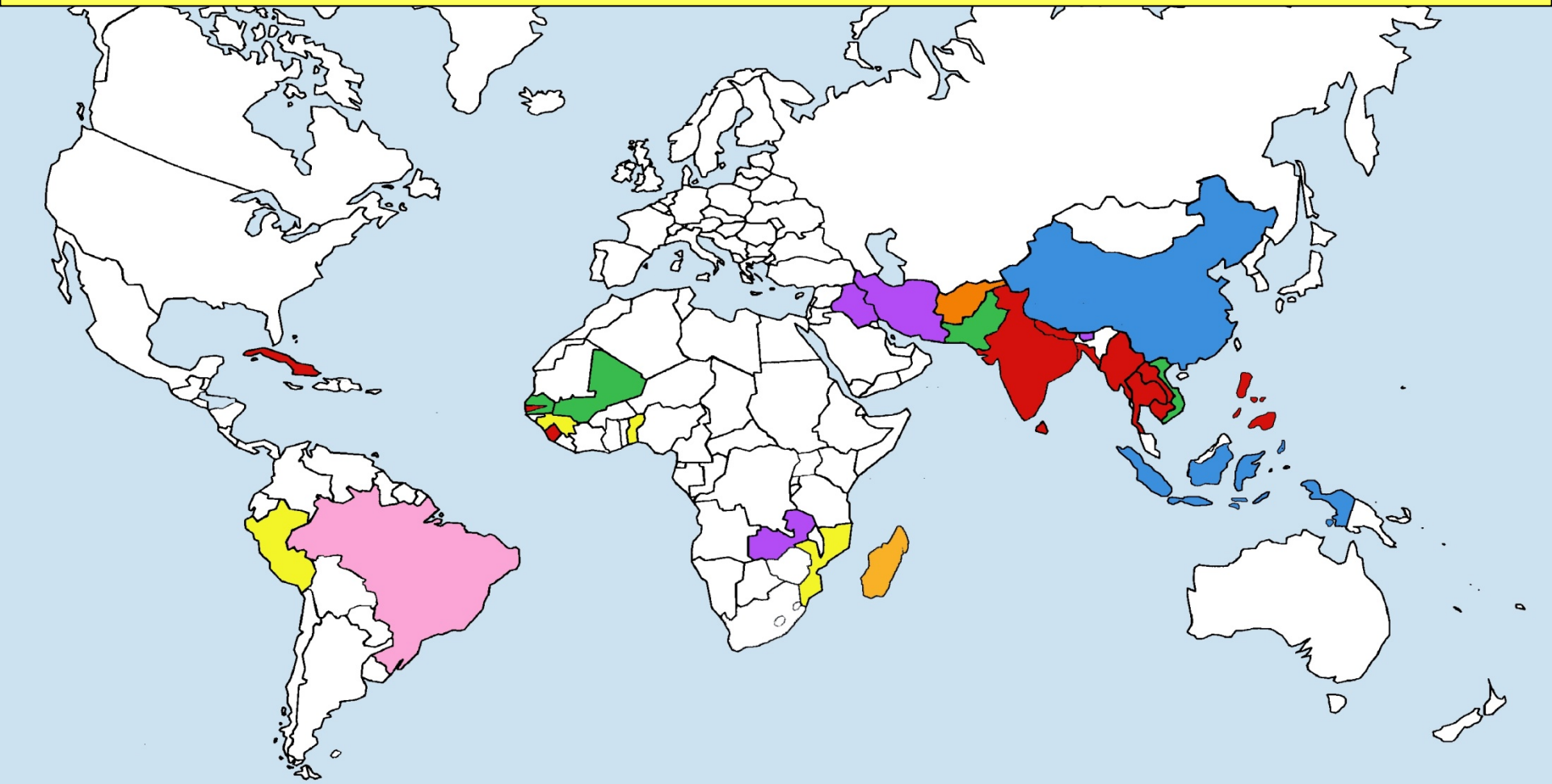
-- Many other countries followed: Bangladesh, Cambodia, Philippines, Sri Lanka, Cuba, etc.

Prof. Yuan Long-ping, director, China National Hybrid Rice Research and Development Center, with SRI plot in 2001

SICA field in Cuba, 2003 – 12 t/ha (Los Palacios 9 cv)

First SRI farmer in Brazil, Señor Juarez -- double yield, Rio Grande do Sul state, 2007

SRI has been spreading among countries in Asia, Africa, and Latin America – now up to 30



Before 1999: Only Madagascar – Now: China, Indonesia, Cambodia, Vietnam, Philippines, Laos, Myanmar, Thailand; India, Nepal, Bangladesh, Sri Lanka, Pakistan, Bhutan; Afghanistan, Iran, Iraq, Gambia, Guinea, Senegal, Mali, Sierra Leone, Benin, Mozambique, Zambia; Cuba, Peru, Brazil

SRI Spreading within Countries, e.g., China

- 2005: about **20,000 ha** of SRI in Sichuan and Zhejiang Provinces each, and perhaps **10,000 ha** elsewhere; total = 50,000 ha
- 2007: **120,000 ha** in Sichuan Province and **110,000 ha** in Zhejiang Province, due to Sichuan Academy of Agric. Sciences and China National Rice Research Institute working with Provincial Depts. of Agriculture
- Extension service reports SRI spreading most rapid among larger farmers, because of **savings of seed, water, cost** and **labor**

Bu Tou village, Tian Tai county, Zhejiang Province, China
Demonstration area for China National Rice Research Institute

INDIA – started slowly, but now expanding rapidly

- GOI National Food Security Mission has allocated $40 million for SRI extension to 5 million hectares
- 2008: SRI demonstrations in 136 districts across 14 states
- Support for SRI methods from Directorate of Rice Research, Indian Council for Agric. Research

Tamil Nadu State of India

THE HINDU
Online edition of India's National Newspaper
Tuesday, Jan 01, 2008

Tamil Nadu

4.3 lakh hectares brought under SRI plan

Special Correspondent

It is 20 per cent of State's total paddy coverage area

Photo: E. Lakshmi Narayanan

Healthy trend: **Agriculture Minister Veerapandi S. Arumugam inspecting the paddy crop cultivated under System Rice Intensification method in Chandirapillai Valasu, near Salem, on Monday. —**

SALEM: A healthy 20 per cent of the State's total paddy coverage area of 21.5 lakh hectares has been brought under the System Rice Intensification (SRI) programme, said Agricultural Minister Veerapandi S. Arumugam.

After eliciting farmers' views on the advantages of the SRI scheme being introduced in the remote Thumbal village falling under the Upper Vellaru River Water and Land Development Programme of Tamil Nadu Agricultural University in Salem district, on Monday, the Minister while talking to reporters said the coverage under the SRI during 2006-07, the first year of experimentation was a mere 4,638 hectares. Next year it was increased to 11,320 hectares.

"And today we have brought a staggering 4.3 lakh hectares under the scheme in the total paddy coverage area of 21.5 lakh hectares.

2007-08 main season: SRI used on **430,000 ha,** according to the TN Minister of Agriculture (20% of area) (*The Hindu*, 1/1/08)

2008-09 target set for **750,000 ha**

-- SRI area was 4,638 ha in 2005-06 and 11,320 ha in 2006-07 --

WHY THE EXPANSION?

SRI yields are averaging 50% higher -- with less seed, less water, and less manual labor

Two Districts in Tamil Nadu

- **Tiruchi District** (*The Hindu*, 4/26/08):
- 2007-08: **17,000 ha**
- 2008-09: target of **30,000 ha** assigned
- 2008-09: district proposed target of **61,000 ha (100%)**
- SRI yield in 2007-08 averaged **8.4 t/ha**, some up to **13 t/ha**

- **Erode District** (*The Hindu*, 5/23/08)
- 2006-07: **500 ha**
- 2007-08: **13,570 ha**
- 2008-09: **40,000 ha**
- **10.7 t/ha** average SRI yield in 2007-08 vs. yield using regular methods of **8.4 t/ha**
- Increase of **3.3 t/ha** -- with reduced inputs

SRI is Not a Technology = 6 Core Ideas

1. Use young seedlings to preserve growth potential [however -- DIRECT SEEDING is becoming an option]
2. Avoid trauma to the roots -- transplant quickly, shallow, no inversion of root tips that will slow growth
3. Give plants wider spacing – *one plant per hill* and in *square pattern* to achieve 'edge effect'
4. Keep paddy soil moist but unflooded – mostly aerobic -- not continuously saturated, then
5. Actively aerate the soil -- as often as possible
6. Enhance soil organic matter as much as possible

Practices 1-3 stimulate *plant growth*; while practices 4-6 enhance the *growth and health of roots and soil biota*

Two Paradigms for Agriculture:

- **GREEN REVOLUTION strategy was to:**

  (a) Change the genetic potential of plants, and

  (b) Increase the provision of external inputs -- more water, more fertilizer and insecticides, etc.

- **SRI / AGROECOLOGY instead changes the management of plants, soil, water & nutrients to:**

  (a) Promote the growth of root systems, and

  (b) Increase the abundance and diversity of soil organisms to better enlist their benefits

Get better PHENOTYPES from all genotypes

Cambodia,
Takeo Province:
rice plant grown
from single seed,
with SRI methods
and trad. variety

Nepal, Morang District: Single rice plant grown with SRI methods

India, AP: Single SRI plant – Swarna, normally ‘shy-tillering’

India, Maruteru Research Station, AP:
roots of a single rice plant (MTU 1071)


Cuba: Two plants, same variety
(VN 2084) and same age (52 DAP)

SRI plant roots growing profusely in soil in Cuba


Sister plants,
both 80 days
same variety

Vietnam: FFS farmer in Dông Trù village, Hanoi Province – after typhoon

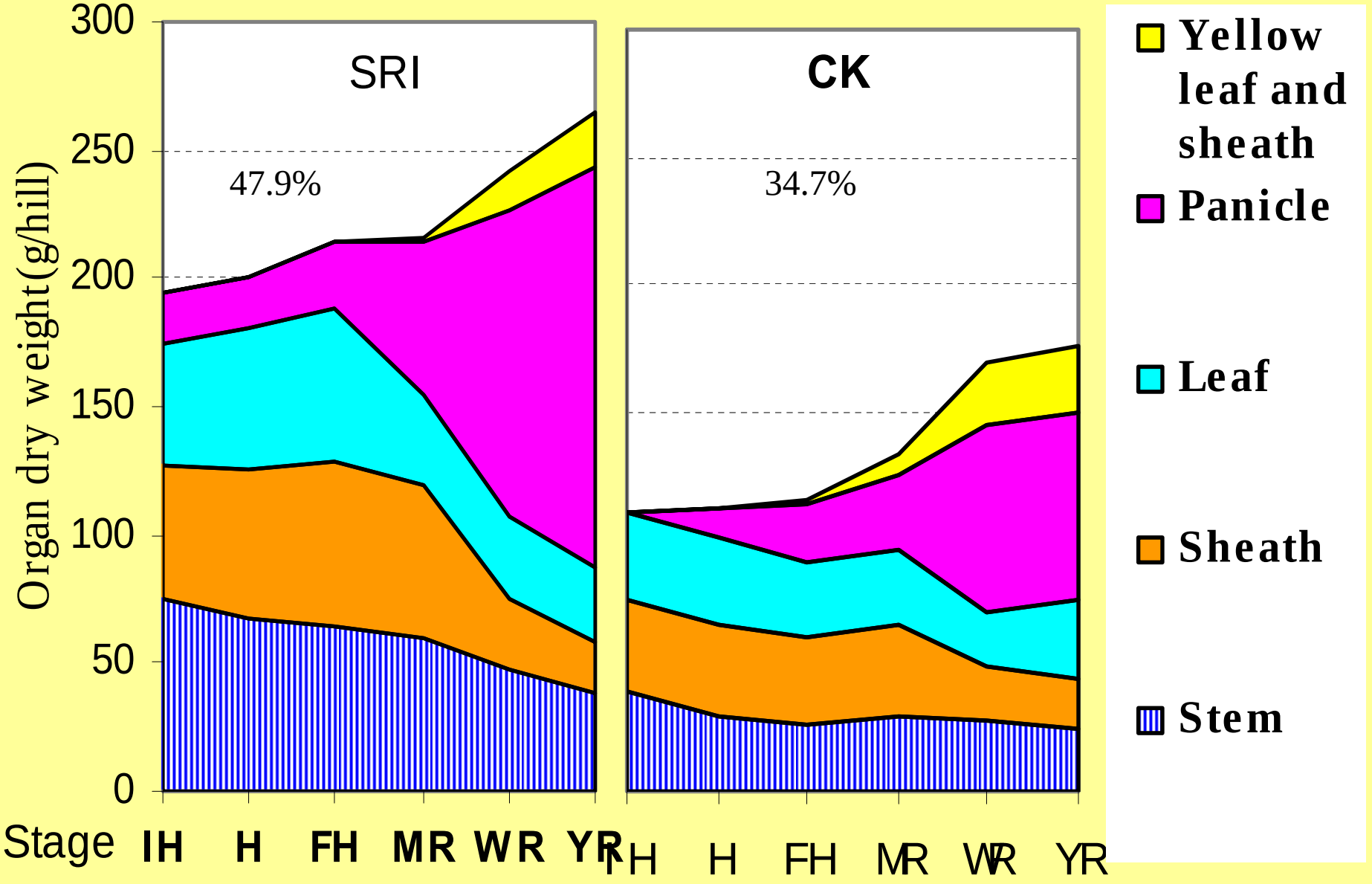
Indonesia, Lombok Province: Rice plants of same variety and same age

INDONESIA: Dried rice plants in Nippon Koei office, Jakarta

INDONESIA: Results of 9 seasons of on-farm comparative evaluations of SRI in E. Indonesia, by Nippon Koei, 2002-06

- No. of trials: **12,133**
- Total area: **9,429.1 hectares**
- Ave. increase in yield: **3.3 t/ha -- 78%**
- Reduction in **water requirements**: **40%**
- Reduction in **fertilizer use**: **50%**
- Reduction in **costs of production**: **20%**

*Bali, DS 2006: 24 farmers on 42 hectares: **13.3 t/ha** with SRI + Longping hybrids; standard = **8.4 t/ha***



"Non-Flooding Rice Farming Technology in Irrigated Paddy Field"
Dr. Tao Longxing, China National Rice Research Institute, 2004

CNRRI factorial trials, 2004 and 2005, using two super-rice hybrid varieties, seeking to break the plateauing of S-R yields

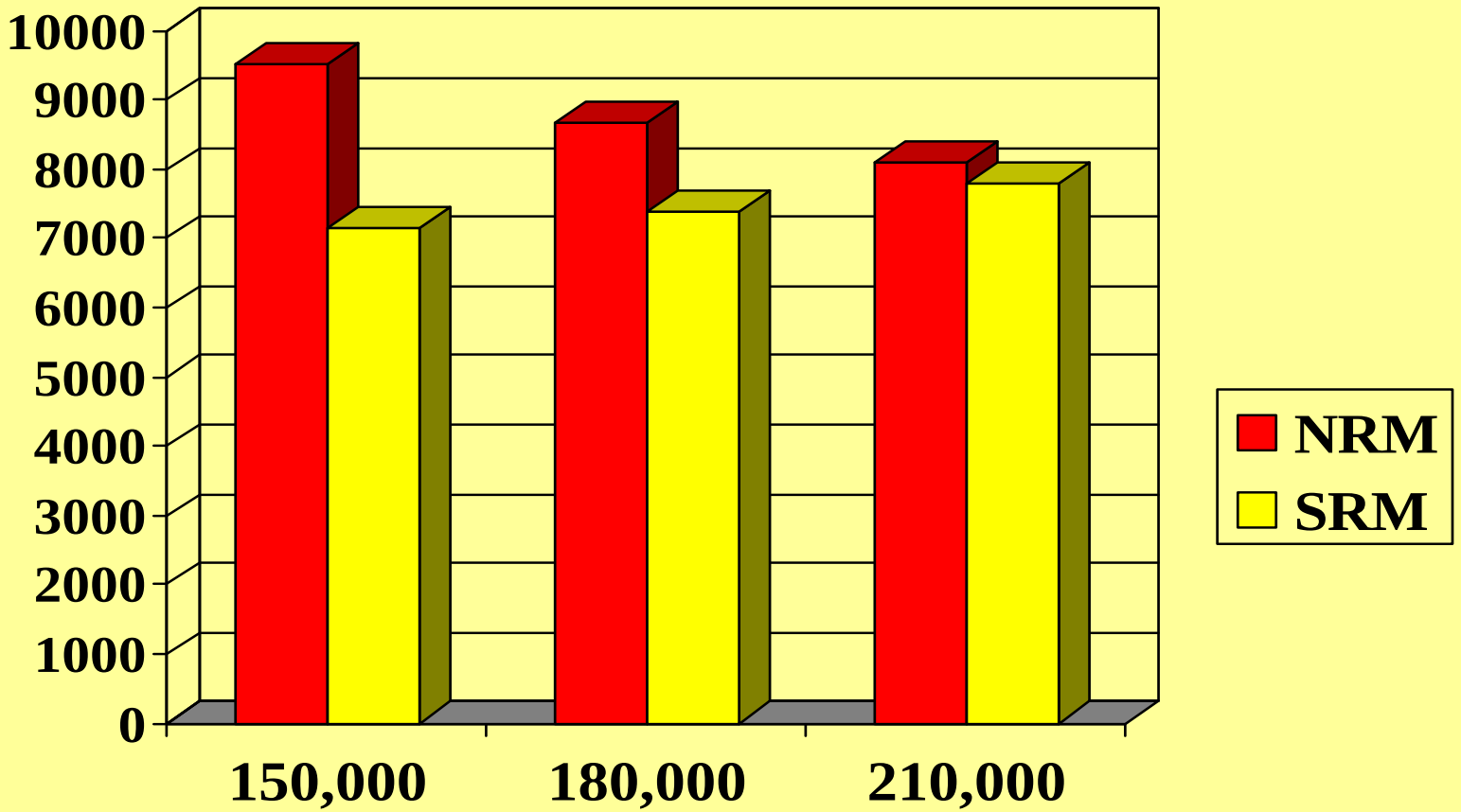
Standard Rice Mgmt

- 30-day seedlings
- 20x20 cm spacing
- Continuous flooding
- Fertilization:
  - 100% chemical

New Rice Mgmt (SRI)

- 20-day seedlings
- 30x30 cm spacing
- Alternate wetting and drying (AWD)
- Fertilization:
  - 50% chemical,
  - 50% organic

Average super-rice YIELDS (kg ha^{-1}) with new rice management (SRI) vs. standard rice management at different plant densities ha^{-1}



Rapid Spread with Higher Yield

	Area under paddy (ha)	Paddy produc-tion (mt)	Ave. yield (mt/ha)	Area under SRI (ha)	SRI produc-tion (mt)	Ave. SRI yield (mt/ha)	No. of fami-lies
2005-06	15,613	49,976	3.009	24.5	170.08	6.942	122
2006-07	15,632	50,976	3.261 (2.65)	2,300	15,669.9	6.813	5,335

INDIA: data from Department of Agriculture, Rajnagar Subdistrict Office, State of Tripura

Reduced Water Use

- Application of minimum of water to meet the plants' needs – either by:
  - Small daily applications to maintain soil moisture, according to soil type, with some periods of soil drying, or
  - Alternate wetting and drying – may give lower yield but saves on labor
- *Higher yield with less water* means greater water productivity achieved, toward goal of 'more crop per drop'

Trend in Decreasing Water Table Level in Punjab State of India

Year	Affected area	Depth of water level (in feet)
1973-74	3%	30
2005-06	30%	70
2023	Whole of Punjab?	160

Statistics of DOA Punjab

SRI Saving of Irrigation Water in Punjab

Method of cultivation	No. of irrigations per acre	Time to irrigate one acre (4" delivery pipe)	Saving of water under SRI
Conven-tional methods	25	4 hours	50-55 %
SRI	13	2 hours	

- If we apply SRI method of cultivation on 26 lakh hectares of rice area in Punjab, then it is estimated that 50% of water can be saved.

Dr. Amrik Singh, MANAGE, Gurdaspur

India: Punjabi farmer showing difference in rice phenotypes

Punjab Chief Minister Requests Assistance for Introducing SRI

FINANCIAL EXPRESS, May 17, 2008

BADAL asks Centre to include State in food security mission

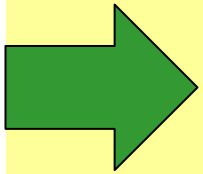
http://www.financialexpress.com/news/Badal-asks-Centre-to-include-state-in-food-security-mission/310836/

Chandigarh, May 16 The Punjab government has asked the Centre to include the entire state in the National Food Security Mission (NFSM)-Rice to ensure better contribution to the Central Pool of food-grains on one hand and the long-term National Food Security due to improved ecological sustainability of agriculture production pattern in the state, on the other.

In a letter to the minister for agriculture Sharad Pawar, Punjab chief minister, Parkash Singh Badal mentioned that none of the districts had been included in the programme for implementation in Kharif-2008. Badal pointed out that the NFSM-Wheat was being implemented in 10 districts of the state for increasing the productivity and production of wheat.

The state had implemented this programme in right earnest, which had shown tangible results in NFSM districts and the same interventions have been made in other districts of the state as well though from its own resources.

Badal also referred to System of Rice Intensification (SRI) that had already been introduced in some districts of the state and the results were also very encouraging in terms of saving 30-35% of irrigation water and higher yield potential than the traditional method of planting paddy.



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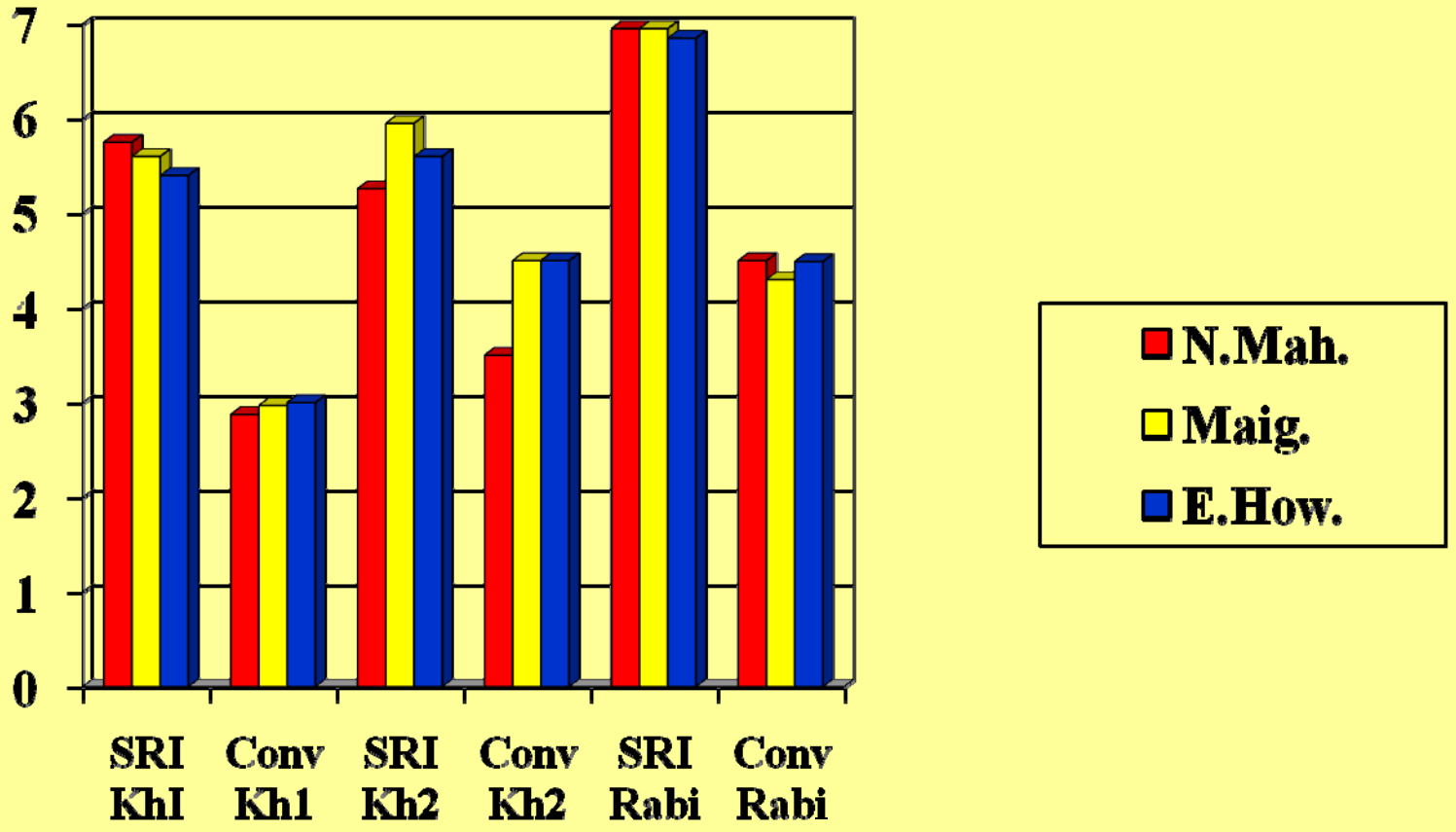
Accessibility for Poor Households

- SRI requires no purchase of external inputs, although these can be used
  - All varieties respond to SRI practices – so *no need to purchase new seeds*, although highest yields with HYVs/hybrids
  - Decomposed biomass is sufficient for soil nutrition – so *no need to buy fertilizers;* fertilizer gives good results but not best
  - No/little need for agrochemical protection
- Since credit is not necessary – there is no need for households to go into debt

Dimatali – tribal village in Rajnagar Subdivision, South Tripura District – in 2006-07, 21/78 farmers were using SRI and getting **6.5 t/ha** yield vs. **2.5 t/ha** conventional

-- **Two years earlier were *not even doing row planting***

Paddy Yield in Three Socially-Marginal Villages of Teliamura Agricultural Sub-Division, Tripura State, India, by season, 2006-07



CAMBODIA: SRI introduced by LDS Charities in 2006-07

to 146 households whose previous average yield was **1.06 t/ha:**
when using SRI methods, they averaged **4.02 t/ha**

Hang Hein's sons (left) transplanted his whole SRI field in **1 day** (0.9 ha)
-- Hein's neighbors (right) using traditional methods of transplanting
not only required **more labor per hectare** but also got **lower yields**
Hang Hein's previous yield = **1.2 t/ha** -- with SRI methods = **5.0 t/ha**

Environmental Benefits

- Lower water requirement reduces pressure on natural ecosystems
- Reduced N fertilizer applications preserve water quality (less NO_3)
- Reduced use of agrochemicals benefits both soil and water quality
- Not flooding reduces methane (CH_4) (GHG), *although need to assess* N_2O

Pest and Disease Resistance

- SRI rice plants are more resistant to pests and diseases
  - Little/no need for agrochemical protection – not worth expense
- IPM crop management activities are always recommended, however
- Some agrochemical protection may be used on an as-needed basis

Vietnam National IPM Program: average of data from trials in 8 provinces, 2005-06:

	Spring season			Summer season		
	SRI Plots	Farmer Plots	Differ-ence	SRI Plots	Farmer Plots	Differ-ence
Sheath blight	6.7%	18.1%	63.0%	5.2%	19.8%	73.7%
Leaf blight	--	--	--	8.6%	36.3%	76.5%
Small leaf folder	63.4*	107.7*	41.1%	61.8*	122.3*	49.5%
Brown plant hopper	542*	1,440*	62.4%	545*	3,214*	83.0%
AVERAGE			55.5%			70.7%

* Insects/m^2

Pest incidence in nursery (TNAU)

Insects (their damage or population)	SRI cultivation (mean ± SE)	Conventional cultivation (mean ± SE)	*t* value (difference) (SRI reduction)
Cut worm (% damaged leaves per seedling)	0.0 ± 0.0 (0.0)	20.4 ± 4.8 (19.1)	16.1** (∞)
Thrips (per seedling)	0.5 ± 0.2 (0.9)	6.1 ± 0.5 (2.5)	19.3** (92%)
Green leaf hopper (per seedling)	0.1 ± 0.0 (0.8)	0.4 ± 0.1 (0.9)	14.8** (75%)
BPH (per seedling)	0.0 ± 0.0 (0.0)	0.2 ± 0.0 (0.8)	11.5** (∞)
Whorl maggot (% damaged leaves per seedling)	0.8 ± 0.2 (0.9)	9.3 ± 2.6 (9.1)	12.5** (91%)

Figures in parentheses are transformed values ** Significant difference (P<0.001)

Pest incidence in main field (TNAU)

Insects (their damage or population)	SRI cultivation (mean ± SE)	Conventional cultivation (mean ± SE)	*t* value (difference) (SRI reduction)
Whorl maggot (% damaged leaves per hill)	17.9 ± 1.9 (18.0)	23.2 ± 2.0 (19.1)	6.6** (23%)
Thrips (per hill)	6.6 ± 0.1 (2.2)	20.2 ± 2.0 (4.1)	12.2** (67%)
Green leaf hopper (per hill)	0.6 ± 0.1 (1.0)	1.1 ± 0.2 (1.2)	10.7** (45%)
BPH (per hill)	1.1 ± 0.2 (1.2)	2.7 ± 0.2 (1.8)	14.4** (60%)
Whorl maggot (% truncated leaves per hill)	5.6 ± 1.8 (5.9)	8.8 ± 1.4 (9.1)	4.5** (36%)
Figures in parentheses are transformed values ** significant difference (P<0.001)			

Resistance to Abiotic Stresses

- DROUGHT resistance
- Little or no LODGING
- Less effect of extreme temperatures

WHY? Larger, stronger root systems and possibly because more uptake of silicon when paddy soils are not kept saturated

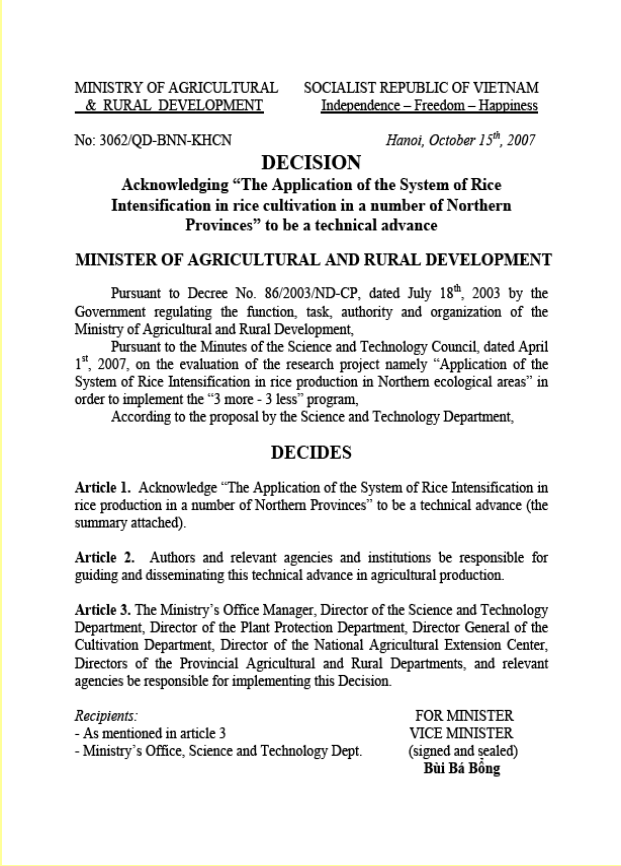
Need climate-proofing for climate change

Sri Lanka: rice fields of same variety, same irrigation system, and *same drought* -- left, conventional methods; right, SRI

Rice fields Dong Tru, Hanoi Province, Vietnam after typhoon: 'normal' rice field on right; SRI practices in middle and on left

VIETNAM

SRI declared ‘technical advance’ by Ministry of Agriculture and Rural Development, Oct. 15, 2007



MINISTRY OF AGRICULTURAL & RURAL DEVELOPMENT

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness

No: 3062/QD-BNN-KHCN

Hanoi, October 15th, 2007

DECISION

Acknowledging “The Application of the System of Rice Intensification in rice cultivation in a number of Northern Provinces” to be a technical advance

MINISTER OF AGRICULTURAL AND RURAL DEVELOPMENT

Pursuant to Decree No. 86/2003/ND-CP, dated July 18th, 2003 by the Government regulating the function, task, authority and organization of the Ministry of Agricultural and Rural Development,

Pursuant to the Minutes of the Science and Technology Council, dated April 1st, 2007, on the evaluation of the research project namely “Application of the System of Rice Intensification in rice production in Northern ecological areas” in order to implement the “3 more - 3 less” program,

According to the proposal by the Science and Technology Department,

DECIDES

Article 1. Acknowledge “The Application of the System of Rice Intensification in rice production in a number of Northern Provinces” to be a technical advance (the summary attached).

Article 2. Authors and relevant agencies and institutions be responsible for guiding and disseminating this technical advance in agricultural production.

Article 3. The Ministry’s Office Manager, Director of the Science and Technology Department, Director of the Plant Protection Department, Director General of the Cultivation Department, Director of the National Agricultural Extension Center, Directors of the Provincial Agricultural and Rural Departments, and relevant agencies be responsible for implementing this Decision.

Recipients:
- As mentioned in article 3
- Ministry’s Office, Science and Technology Dept.

FOR MINISTER
VICE MINISTER
(signed and sealed)
Bùi Bá Bổng

Grain Quality

- More milled rice per bushel of SRI paddy
  - Fewer unfilled grains – less chaff
  - Fewer broken grains – less shattering
- Less chalkiness – maybe other quality improvements? Should be studied
- More nutritional value? Not studied yet
  - Possibly more protein due to more N uptake and maybe also higher quality protein
  - Possibly more micronutrients -- given larger deeper root systems and denser grains

Data from China on Grain Quality

Characteristic	Conventional Methods	SRI Methods (3 spacings)	Difference
Chalky kernels (%)	39.89 – 41.07	23.62 – 32.47	↓30.7%
General chalkiness (%)	6.74 – 7.17	1.02 – 4.04	↓65.7%
Milled rice outturn (%)	41.54 – 51.46	53.58 – 54.41	↑16.1%
Head milled rice (%)	38.87 – 39.99	41.81 – 50.84	↑17.5%

Paper by Prof. Ma Jun, Sichuan Agricultural University, presented at 10th conference on Theory and Practice for High-Quality, High-Yielding Rice in China, Haerbin, 8/2004

Higher Profitability

When production is increased with lower costs of production, this means even greater net income for farmers

Average reduction in cost/ha across 10 evaluations in 8 countries = 25%

(N = 4,214: IRRI, IWMI, GTZ, etc.)

Less Time to Maturity

51 SRI farmers in Morang district, Nepal, monsoon season, 2005, who planted popular *Bansdhan* (145-day) variety

Age of seedling	N of farmers	Days to harvest	Reduction (in days)
> 14 d	9	138.5	6.5
10 - 14 d	37	130.6	14.4
8 - 9 d	5	123.6	21.4

With doubling of yield from 3.1 to 6.3 t/ha

Extension to Other Crops

Farmers are taking SRI concepts and practices and are now starting to apply them to other crops:

- **Sugar cane (Andhra Pradesh)**
- **Finger millet (*Elusine coracana*) (Jharkand, Karnataka)**
- **Wheat (Himachal Pradesh, Poland)**

SRI IS NOT A TECHNOLOGY – it is a set of insights and concepts that can benefit the whole agricultural sector


MAY 27 2008
ఆకురెలచిన వి.297 రకం "శ్రీ" చెరకు దుబ్బు
MAY 27 2008
ఆకురెలచని వి.297 రకం "శ్రీ" చెరకు దుబ్బు

Winter wheat in Poland before going into winter dormancy

System of Finger Millet Intensification on left; regular management of improved variety and of traditional variety on right, picture courtesy of PRADAN, Jharkand

SRI crop of G. Moghanraj Yadhav, Nagipattanam district, Tamil Nadu

"Productivity is increased [with SRI], and at the same time the environment is saved. . . . I want to urge everybody, starting with the Minister of Agriculture and everyone else -- let us support this SRI method with our maximum capacity."

-- Indonesian President S. B. Yudhoyono speaking at SRI Harvest Festival, Cianjur, July 30, 2007

What Can Be Done to Support SRI Dissemination?

SRI strategy is have an alliance among:

- **Government agencies**
- **Research institutes and universities**
- **Farmer organizations/cooperatives**
- **Civil society organizations/NGOs**
- **Private sector**
- **Interested individuals**

Measures to Support SRI Dissemination

- Premium price for SRI paddy? – 10%?
  - Justified by higher milling outturn (15-20%)
  - Paid by millers, not by government
- Improved water control to provide reduced but reliable irrigation supplies
  - Value of water saving justifies investment in hardware and 'software' for irrig. mgmt.
- Training and certification of SRI skills
  - 25% higher wage for skilled SRI labor

Measures to Support SRI Dissemination

- Schemes to facilitate access to markers and weeders (hire-purchase)
- Evaluate SRI grain quality which could justify higher price, because of milling out-turn rate, and nutritional value
- Continue agronomic research and evaluation; also economic evaluations
- Support farmer-to-farmer exchanges and farmer innovation

SRI/SICA Dissemination Is Problem-Solving > Extension

- **Need to have 'can-do' agronomists and extensionists – not 'can't-do'**
- **Old Chinese proverb**: ***Those who say that something cannot be done should* stop *interrupting those who are doing it.***
- ***SRI = opportunity > technology***

THANK YOU

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

- Email: ciifad@cornell.edu or ntu1@cornell.edu or
- tefysaina.tnr@simicro.mg


Sri Lanka:
Cono-weeder

Sri Lanka:
Motorized
Weeder

Indonesia:
Marker rake

Indian Punjab:
Marker roller