

# **Nutrient best management practices in rice**

**Roland J. Buresh**

**International Rice Research Institute (IRRI),  
Philippines**

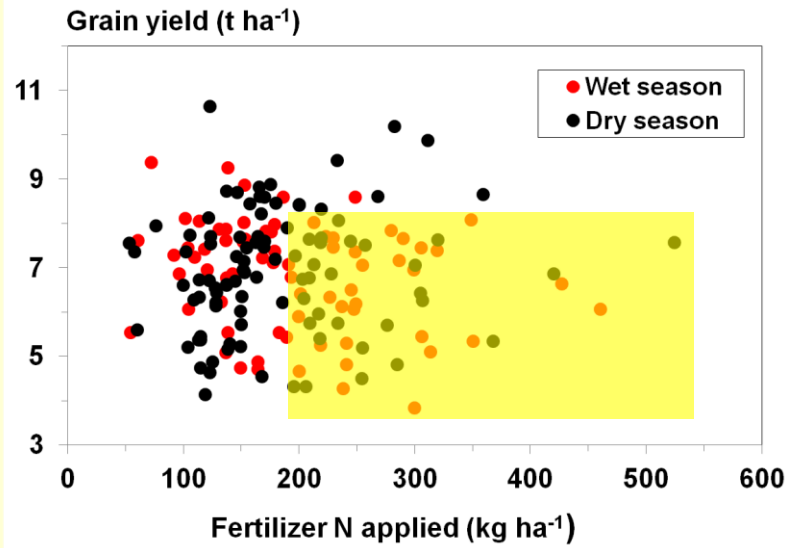
**IFA Indonesia seminar  
Jakarta  
23 April 2014**

- **Fertilizer is vital for rice production**
- **Nearly all rice farmers use fertilizer**
- **But most farmers do not use nutrient best management practices in rice production**

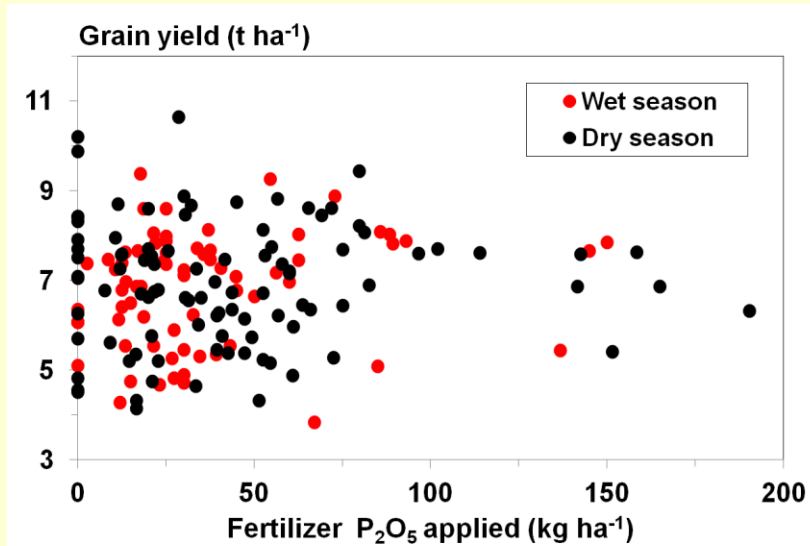


### N fertilizer rates in Java vary greatly among farmers

High N rates do not ensure high yield

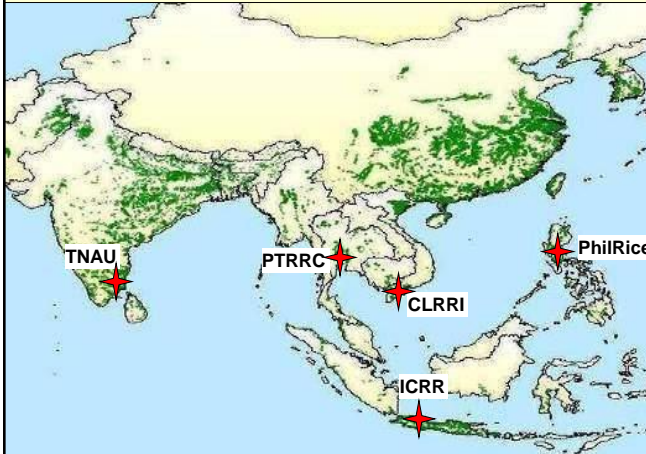


### P<sub>2</sub>O<sub>5</sub> fertilizer rates in Java also vary among farmers and are not strongly related to yield





**Collaborative research between IRRI and IAARD starting from 1995 led to site-specific nutrient management (SSNM) for rice**



**Practical Guide**



**Leaf color chart**



Indonesia was one of five initial partners from 1995

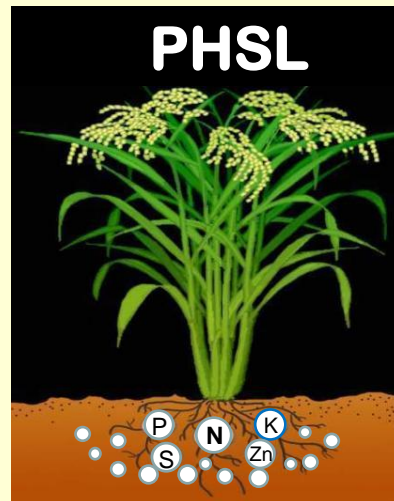


**A computer-based decision tool was developed to help extension and farmers**

**Pemupukan Hara Spesifik Lokasi (PHSL) Padi Sawah**

**Nutrient Manager for Rice**

- Uses site-specific nutrient management (SSNM) developed through research
- Provides farmers with nutrient best management matching conditions in farmer's fields
- Focuses on increasing income of farmers by US\$ 100 per hectare per crop





**PHSL Padi Sawah was launched in Indonesia by the Minister of Agriculture in January 2011**

**PHSL - Pemupukan Hara Spesifik Lokasi Padi Sawah v1.11**



Available at: <http://webapps.irri.org/nm/id>

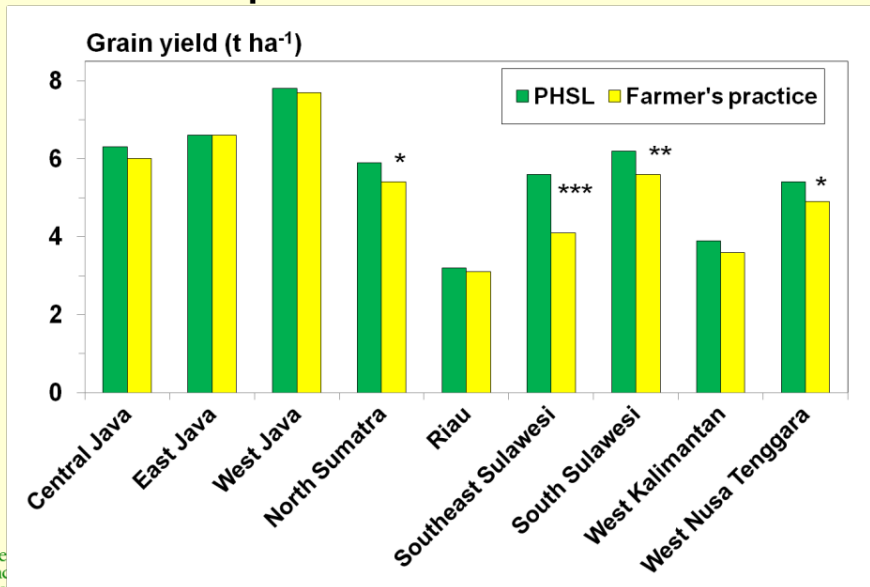
**PHSL has been evaluated in farmers' fields across Indonesia**

**PHSL recommendation**

**Farmers' fertilizer practice**

**A field plot using the PHSL recommendation was compared to an adjacent field plot with the farmer's practice for fertilizer use**

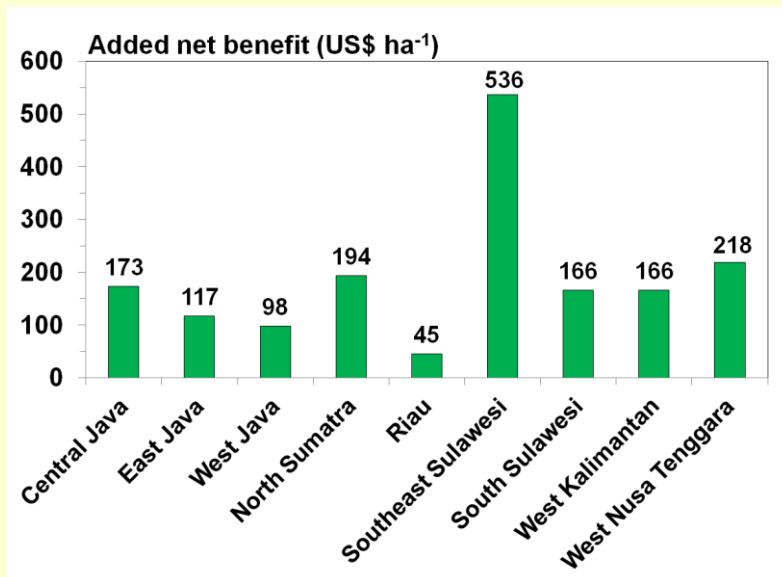
### PHSL v. 1.0 matched or exceeded yield for farmer's practice in 2011-2012 wet season



Number of farms = 289

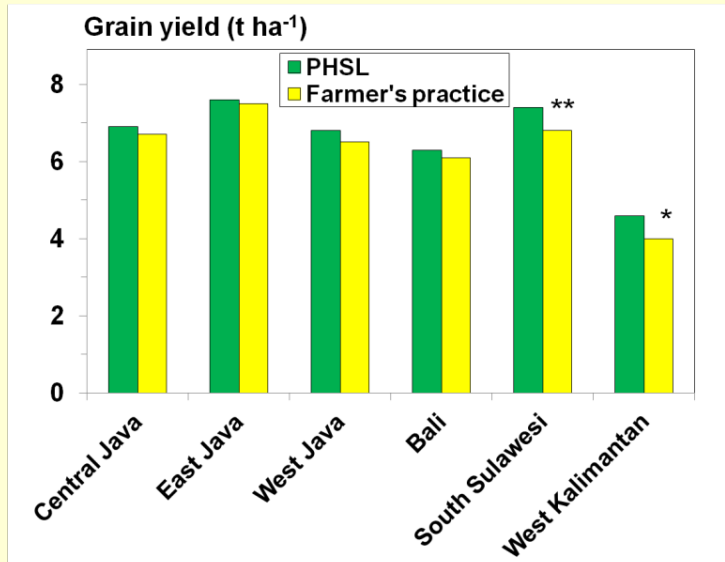
### PHSL v. 1.0 increased income of farmers in 2011-2012 wet season

Increase in yield  
More effective use of fertilizer



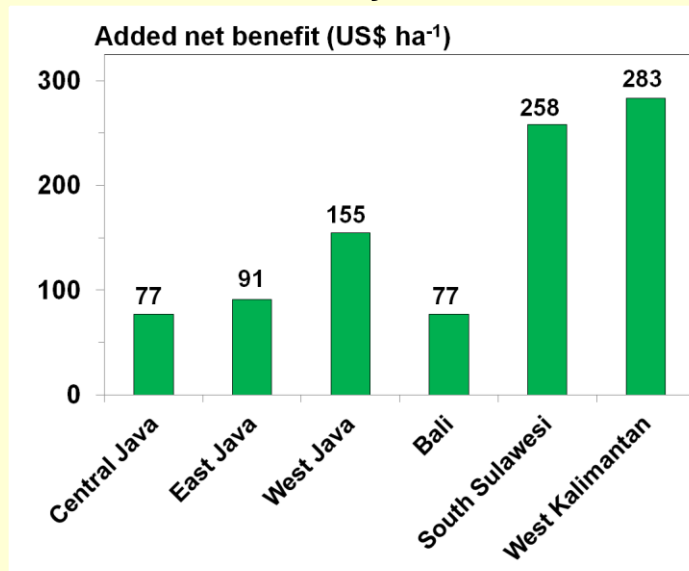
Number of farms = 289

### Upgraded PHSL v. 1.11 slightly exceeded yield for farmer's practice in 2012 dry season



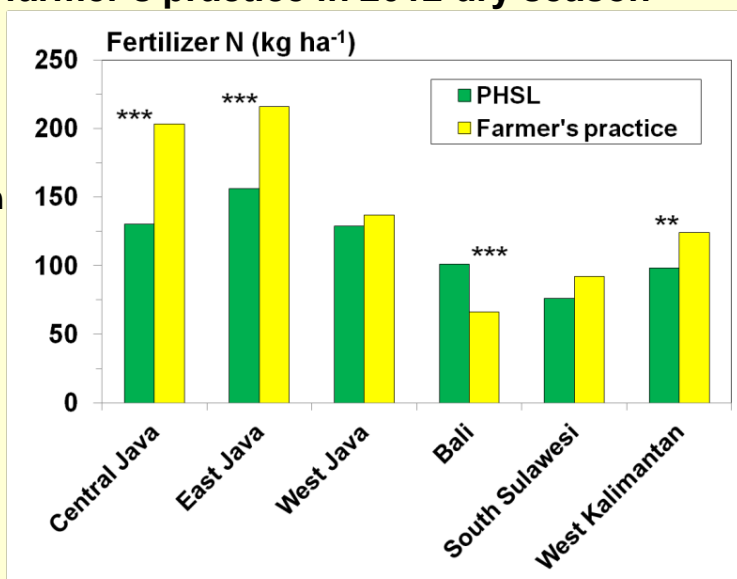
### PHSL v. 1.11 increased income of farmers in 2012 dry season

Slight increase in yield  
Adjustment in fertilizer use



## PHSL often reduced N fertilizer compared to farmer's practice in 2012 dry season

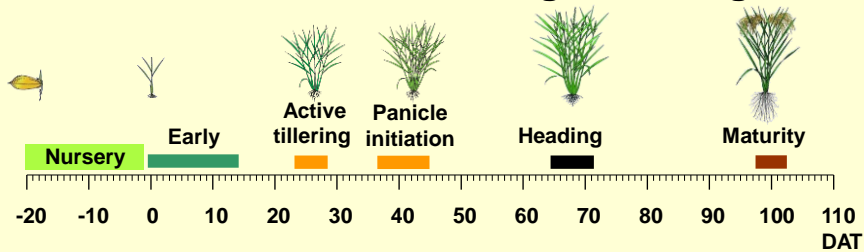
N fertilizer did not decrease in all cases with PHSL



## How can rice yield be increased with a reduction in N fertilizer use?

1. Reduce disease and insect pests associated with luxuriant crop uptake of N.
2. Adjust timing of N fertilizer to better match the needs of the rice crop.

## PHSL recommends application of N fertilizer at critical rice growth stages



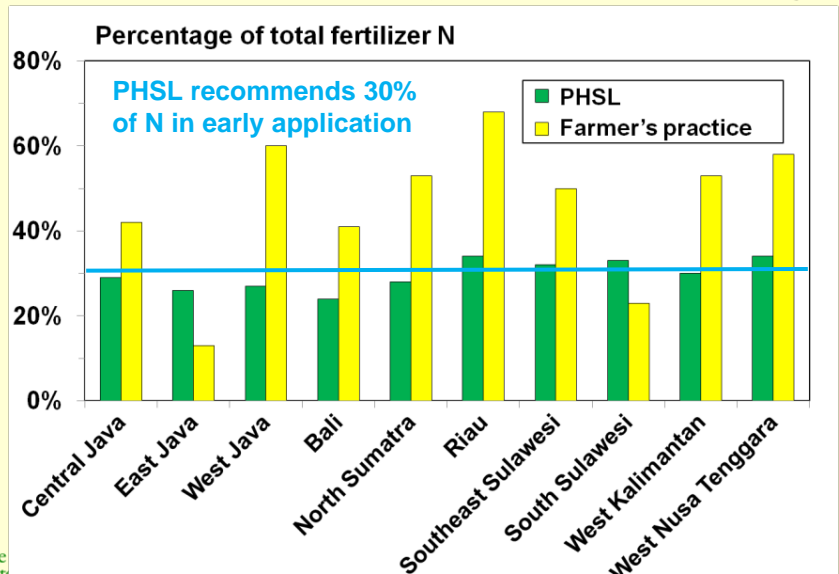
### Early

- Apply only moderate amount of N
- Usually apply about 30% of total fertilizer N

### Active tillering and panicle initiation

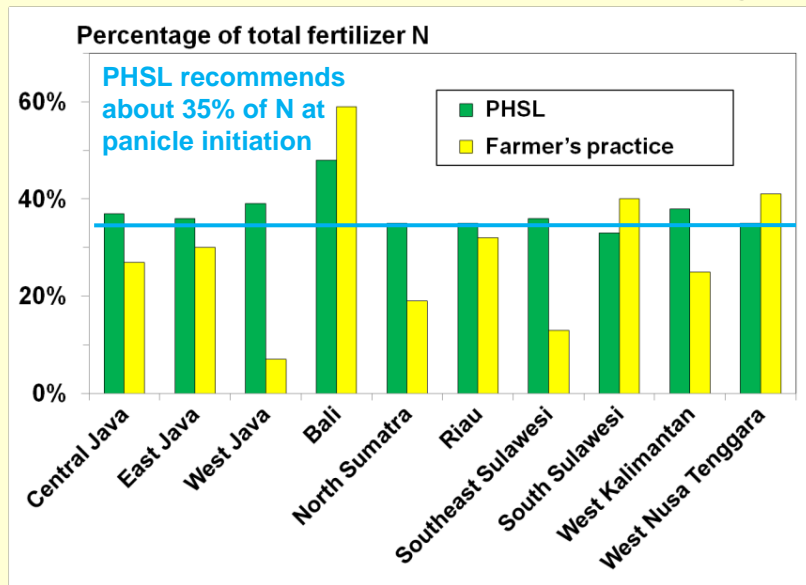
- Apply N at critical growth stages
- Panicle initiation application is about 60 days before harvest
- Adjust N based on crop needs

## Percentage of total fertilizer N applied by farmers before 20 days after transplanting





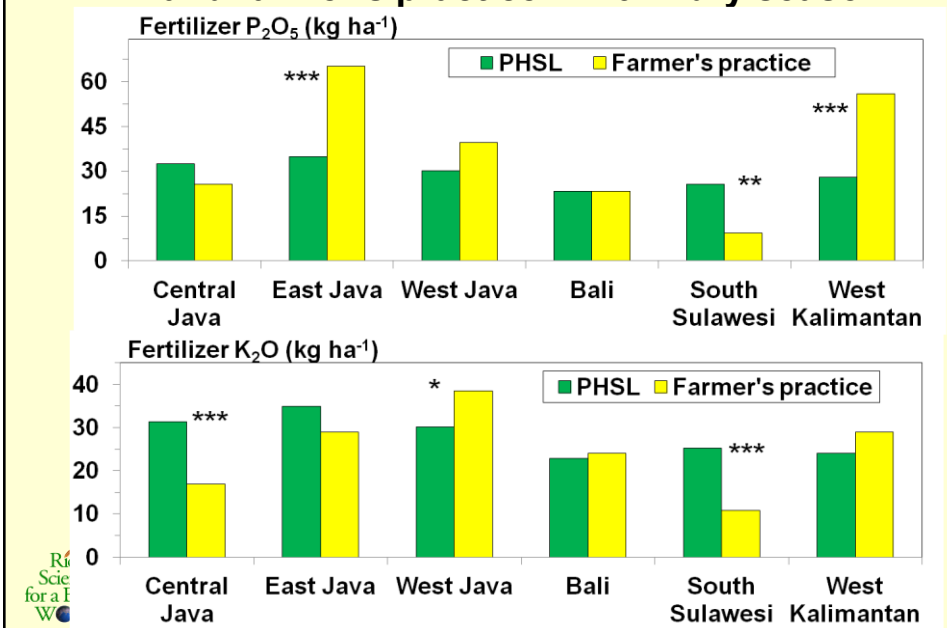
## Percentage of total fertilizer N applied within 34 to 45 days after transplanting



## Observations on N fertilizer management

1. Many rice farmers can use less N fertilizer with no risk of loss in yield.
2. Many rice farmers apply
  - Too much N fertilizer in first 20 days, and
  - Too little N fertilizer at panicle initiation.

## Fertilizer P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O applied with PHSL and farmer's practice in 2012 dry season



## Observations on P and K fertilizer management

1. There is a risk of insufficient application of P and K fertilizer in South Sulawesi
  - One application of pelangi (20:10:10) did not supply sufficient P and K.
2. NPK fertilizers with a high N:P<sub>2</sub>O<sub>5</sub> ratio risk excess application of early N fertilizer.
3. In order to avoid excess early application of N, two applications of pelangi might be necessary
  - One application in first 20 days to supply early N and part of total need for P and K
  - A second application at tillering to supply remaining P and K

**Conducted field trials to collect information for further improving PHSL**

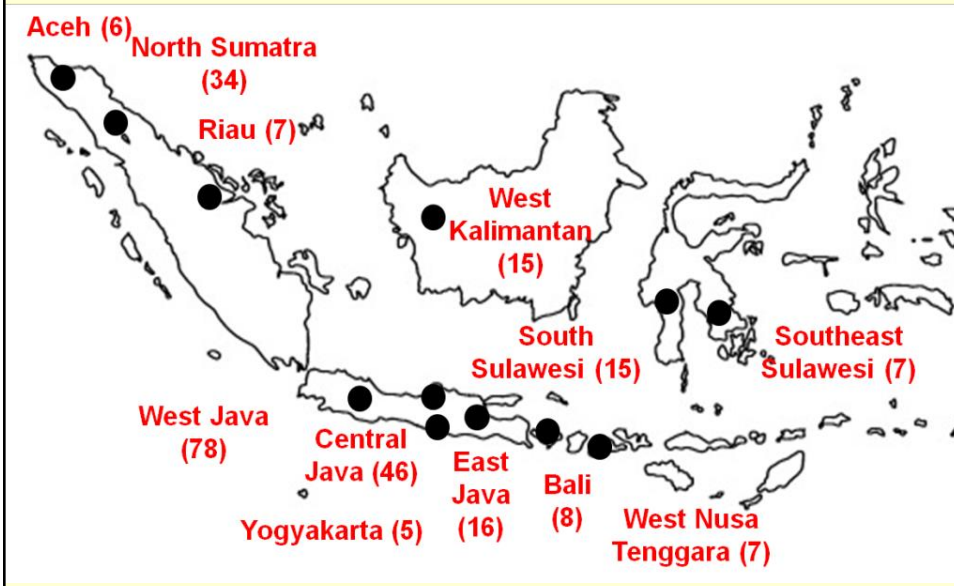
Used nutrient omission plot technique

Full NPK fertilization	No added P	No added K	No added N
+NPK	+NK	+NP	+PK



Photo from Sarlan Abdurachman

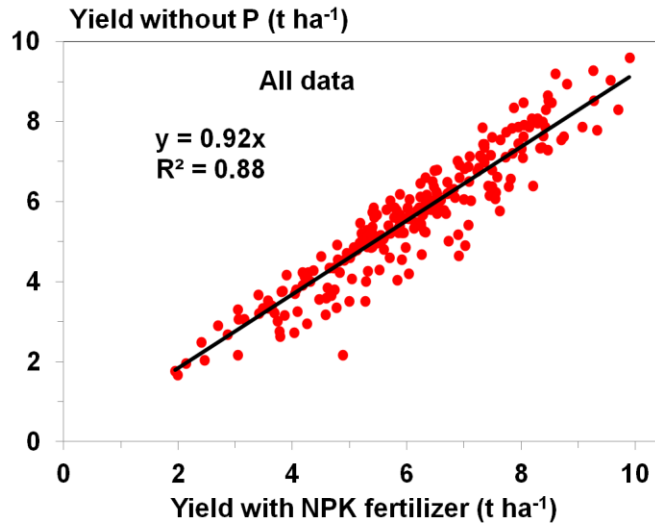
**Location for nutrient omission plot trials conducted with rice in Indonesia**



**Yield without added P vs yield with full NPK fertilization illustrates the need for P**

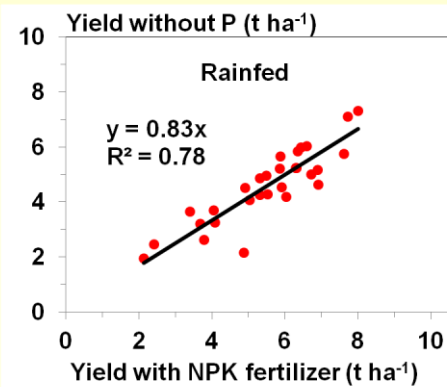
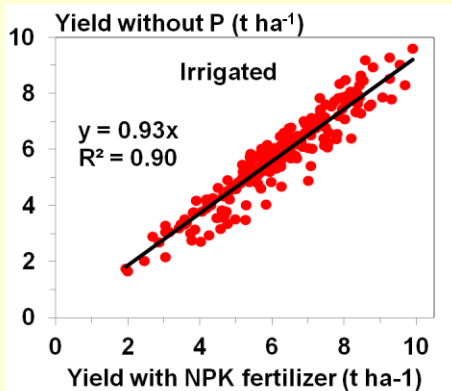
**Yield without P was 92% of yield with full NPK fertilizer**

**Application of P increased yield by 8% on average**



Number of trials = 244

**Increase in yield with P fertilizer is more for rainfed than irrigated rice**



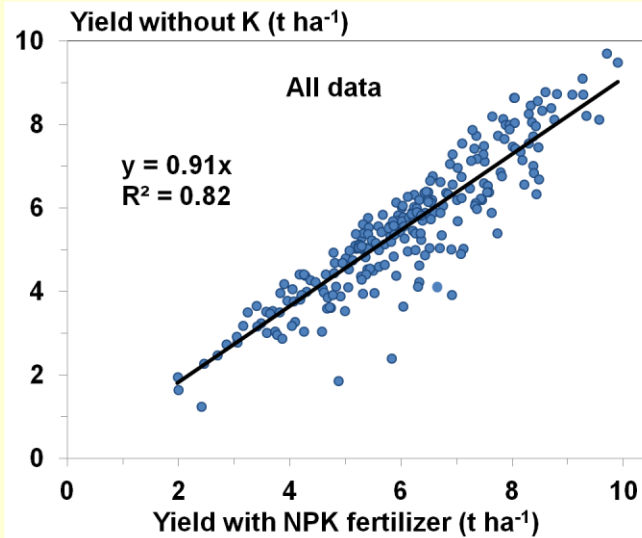
**Application of P increased yield on average by**

- 7% for irrigated rice
- 17% for rainfed rice

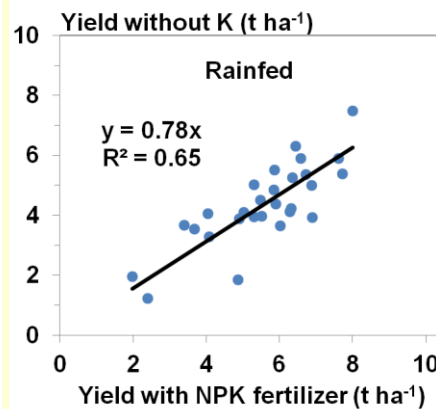
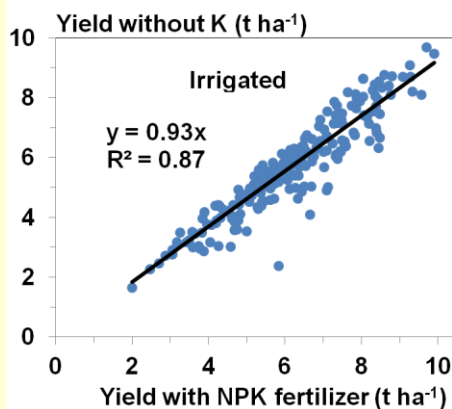
### Yield without added K vs yield with full NPK fertilization illustrates the need for K

Yield without K was 91% of yield with full NPK fertilizer

Application of K increased yield by 9% on average



### Increase in yield with K fertilizer is more for rainfed than irrigated rice



Application of K increased yield on average by

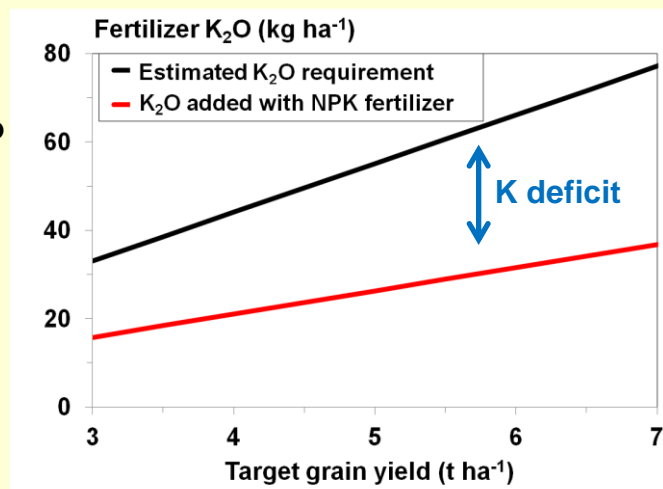
- 7% for irrigated rice
- 22% for rainfed rice

## Observations on P and K fertilizer for irrigated rice

1. **NPK fertilizers with a 1:1 ratio for  $P_2O_5:K_2O$  are generally well suited for irrigated rice.**
2. K inputs through organic materials and irrigation water likely help avoid K deficiencies.
3. Care is needed to ensure that use of NPK fertilizers with a high N:P ratio does not risk excess application of early N fertilizer.

## $K_2O$ addition with NPK fertilizer ( $P_2O_5:K_2O = 1:1$ ) might be suboptimal for rainfed rice

**$K_2O$  added with NPK fertilizer to meet  $P_2O_5$  needs does not supply enough  $K_2O$  to meet needs of rice**

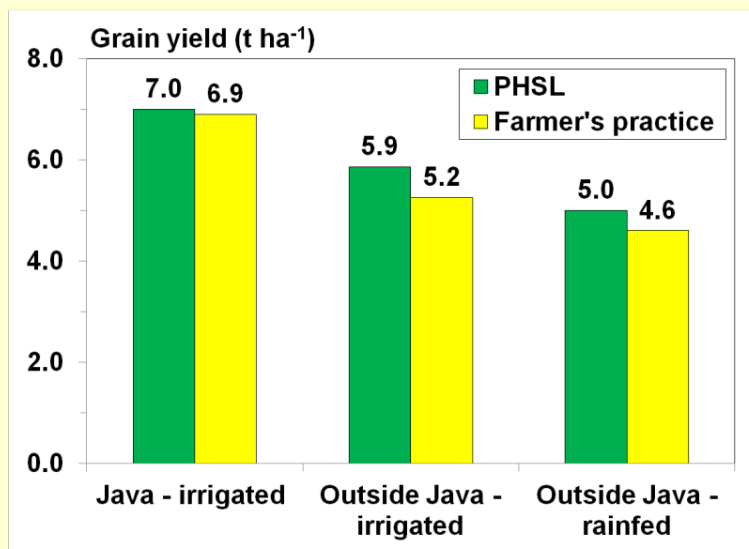


Assume 50% rice straw retained in field

## Observations on P and K fertilizer for rainfed rice

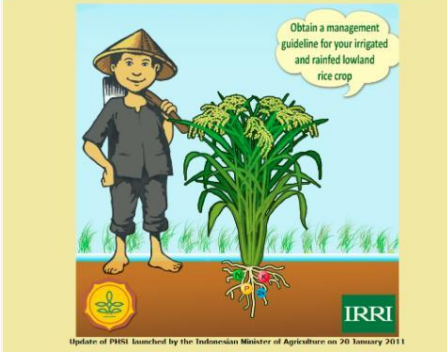
1. **NPK fertilizers with a 1:1 ratio for  $P_2O_5$ : $K_2O$  do not supply sufficient  $K_2O$  when  $P_2O_5$  is optimally supplied.**
2. **Additional K inputs are likely needed through organic materials or additional K fertilizer.**
3. **Soil K supply is low in South and Southeast Sulawesi and in West Kalimantan**

## Use of PHSL recommendations can benefit rice production



## An upgrade of PHSL to an ICT-based *Rice Crop Manager* is planned by IAARD

Rice Crop Manager Indonesia Version 1.0



The upgrade includes:

- Updates in nutrient management identified through research as reported in this presentation
- Best rice management practices of IAARD

*Rice Crop Manager* is already release and promoted nationally in the Philippines and Bangladesh

## What is needed from the fertilizer industry?

1. Support for research to verify optimal fertilizer management, especially for rainfed and tidal rice.
2. Support for wide-scale deployment of ICT-based PHSL recommendations, through fertilizer dealers and kiosks, for the benefit of Indonesian rice farmers.



## Large-scale deployments in the Philippines and Bangladesh provide relevant experiences

- Personal contact with farmers is essential
- Local capacity on use of computers and mobile devices must be built up
- Incentives are merited for local 'agents' reaching farmers



## Acknowledgment

Reported field research was made possible through:

- Participation of staff at Assessment Institutes for Agricultural Technology in East, Central, and West Java; Bali; North Sumatra; Riau; South Sulawesi; Southeast Sulawesi; Kalimantan; and West Nusa Tenggara;
- Technical inputs and support from Made Jana Mejaya, Sarlan Abdulrachman, and staff at the Indonesian Center for Rice Research (ICRR);
- Support from Hasil Sembiring, Director of the Indonesian Center for Food Crops Research and Development (ICFORD);
- Technical inputs from Mahyuddin Syam, Sunendar Kartaatmadja, and Suyamto;
- Technical inputs and assistance from Zulkilfi Zaini and Diah Wurjandari Soegondo at the IRRI Indonesia office; and
- Rowena Castillo, Judith dela Torre, and Marco van den Berg at IRRI.

The development of SSNM and PHS� was made possible through 16 years of support to IRRI from the Swiss Agency for Development and Cooperation (SDC), the International Fertilizer Industry Association (IFA), the International Potash Institute (IPI), and the International Plant Nutrition Institute (IPNI).