



Minimum soil disturbance and increased crop residue retention improve N, P, K and S budgets for rice-based cropping systems

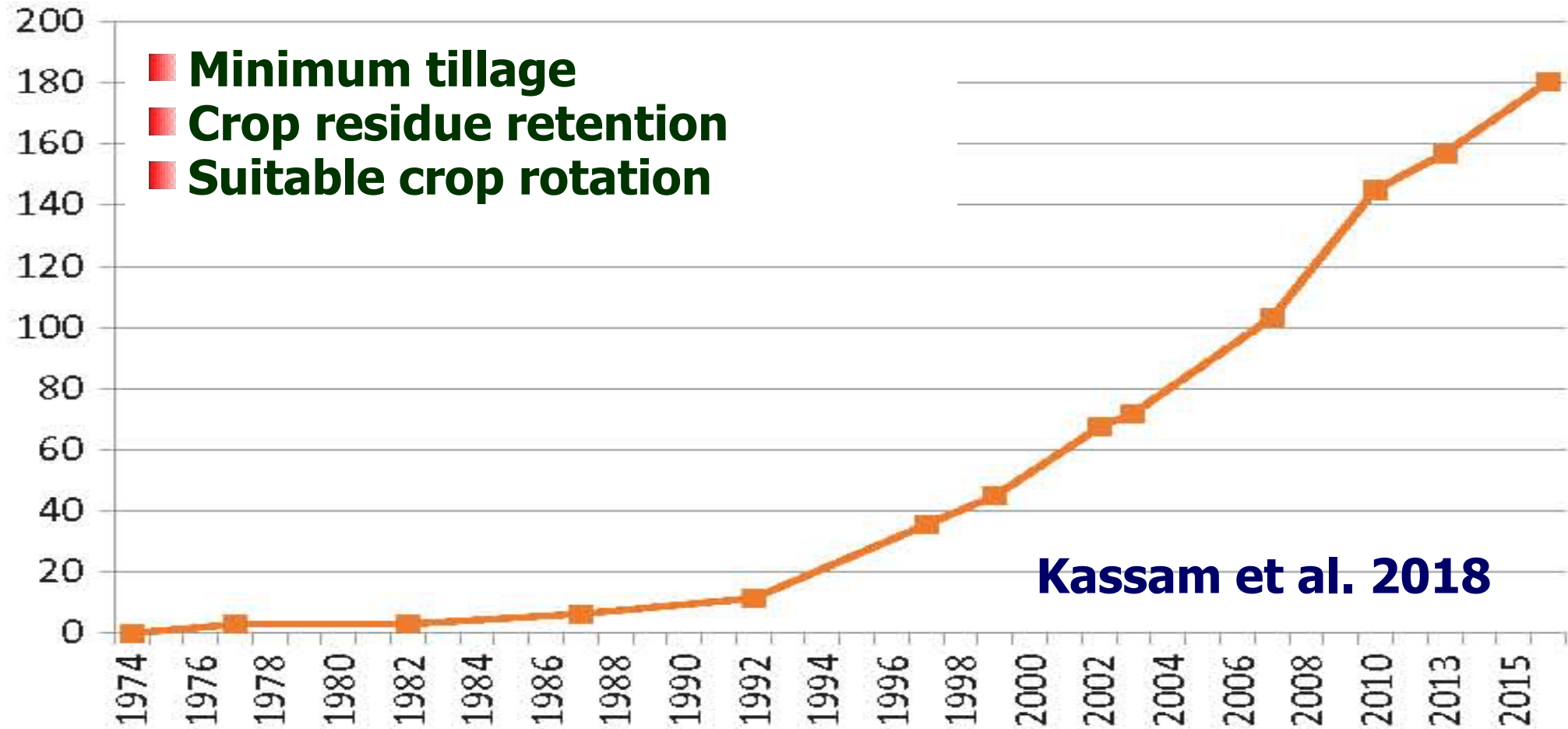
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Global Symposium on Soils for Nutrition | 26-29 July 2022



Conservation Agriculture (CA)



Global uptake of CA in M ha of cropland

BANGLADESH



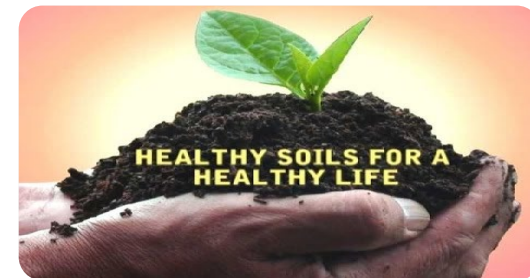
Conservation agriculture

Conventional agriculture

**Both with recommended fertiliser rates
BAU farm after 15 crops (5 years)**

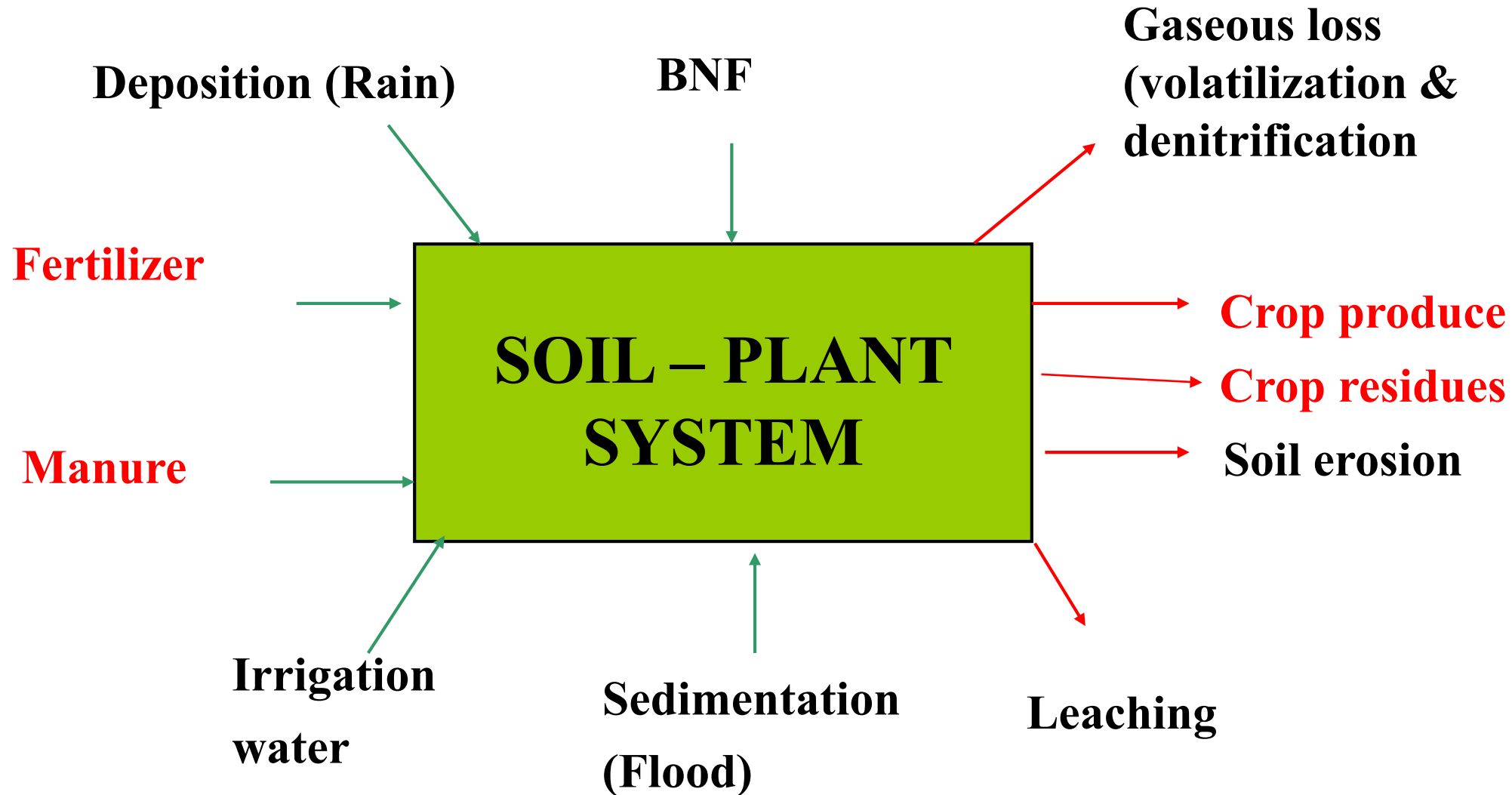
Nutrient budget: Research question?

- ➔ Quantification of nutrient gains through different pathways?
- ➔ Quantification of nutrient losses through different pathways?
- ➔ Quantification of nutrient budget under CA and fertilizer management?



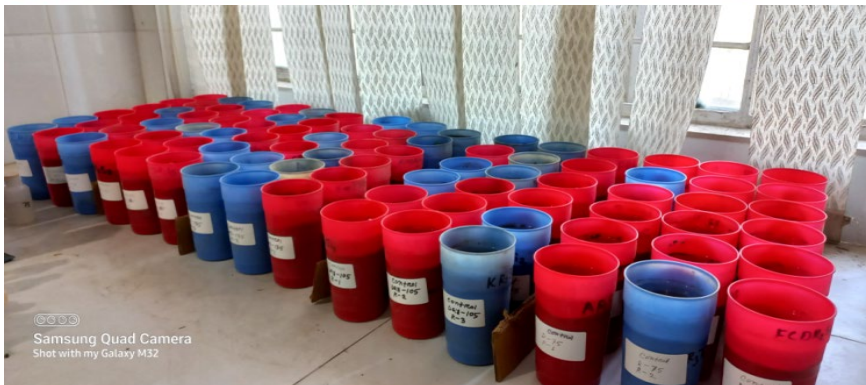
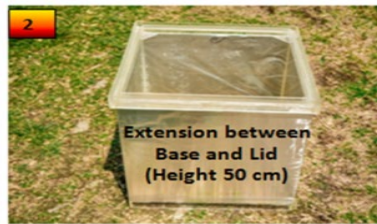
NUTRIENT BUDGET: Concept

NUTRIENT INPUT - OUTPUT PATHWAYS



System based approach to quantify input- output flows for N, P, K & S

Example: $N \text{ Budget} = (N_{\text{org}} + N_{\text{fert}} + N_{\text{dep}} + N_{\text{bnf}} + N_{\text{iri}}) - (N_{\text{cro}} + N_{\text{vol}} + N_{\text{den}} + N_{\text{lea}} + N_{\text{ero}})$



Nutrient Budget (NB) study under CA

Nutrient	Cropping pattern	Location	AEZ	Starting year
N	Wheat-M.bean-T. Aman	BAU farm	9	2012*
	Boro-T. Aus-T. Aman	BAU farm		2018
P	Mustard-M.bean-T. Aman	RARS, Ishurdi	11	2015**
	Wheat-M. bean-T. Aman	ARS, Pabna		2018
K	Lentil-T. Aus-T. Aman	Durgapur	11	2010 ‡
	Potato-Maize-T. Aman	Durgapur		2018
S	Wheat-T. Aus-T. Aman	Godagari	26	2010 ‡
	Mustard-M. bean-T. Aman	RARS, Ishurdi		2010 **

Long-term expt.; * BAU, ** BARI, ‡ Murdoch Univ.

3-Factor experiment (Split-split-plot design)

Factor A: Crop establishment methods

Conventional practice

Strip planting

Factor B: Crop residue retention

Low residue (15 or 20% plant ht)

High residue (30 or 40% plant ht)

Factor C: Nutrient rate

Low (50 or 75%)

Medium (Recom. 100%)

High (125 or 150%)

Wheat



Mungbean



Rice



An Example

Nutrient balance calculation (kg/ha/yr)

Potato- Maize-T. Aman

Nutrient input

K dose	Fertilizer	Crop residue	Irrigation	Rainwater	Total
LD	159	87.2	8.2	10.6	265
RD	255	93.0	8.2	10.6	367
HD	351	99.1	8.2	10.6	469

Nutrient output

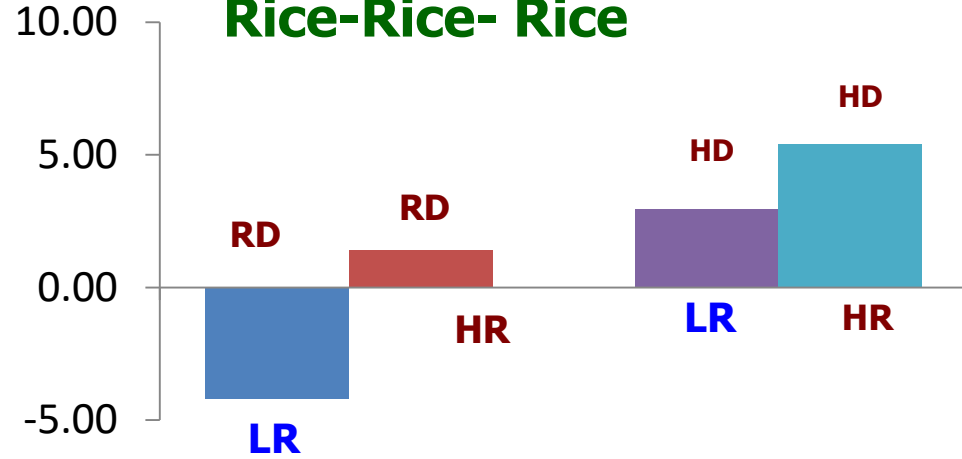
K dose	Potato	Grain	Stover	Grain	Straw	Leaching	Total
LD	121	27.4	112	16.3	83.5	33.7	394
RD	142	32.4	124	18.1	91.5	33.7	442
HD	165	37.5	136	20.2	101	33.7	493

K dose	K input	K output	K balance
LD	265	394	- 129
RD	367	442	- 75
HR	469	493	-24

LD = Low dose, 50%
RD = Recom dose, 100%
HD = High dose, 150%

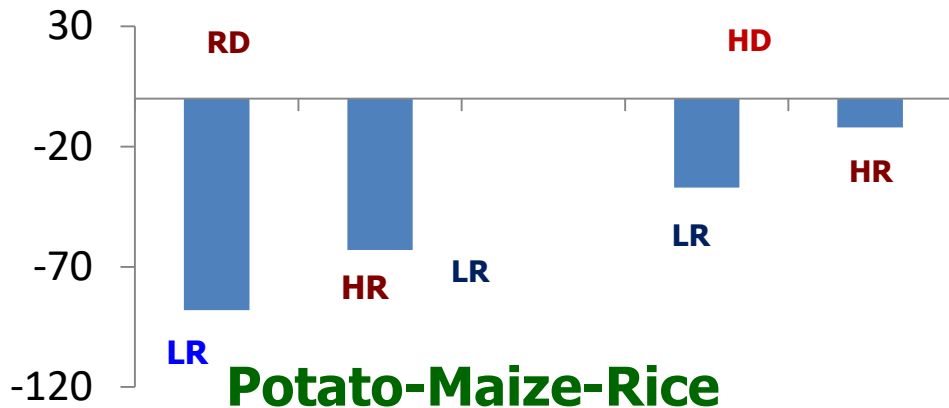
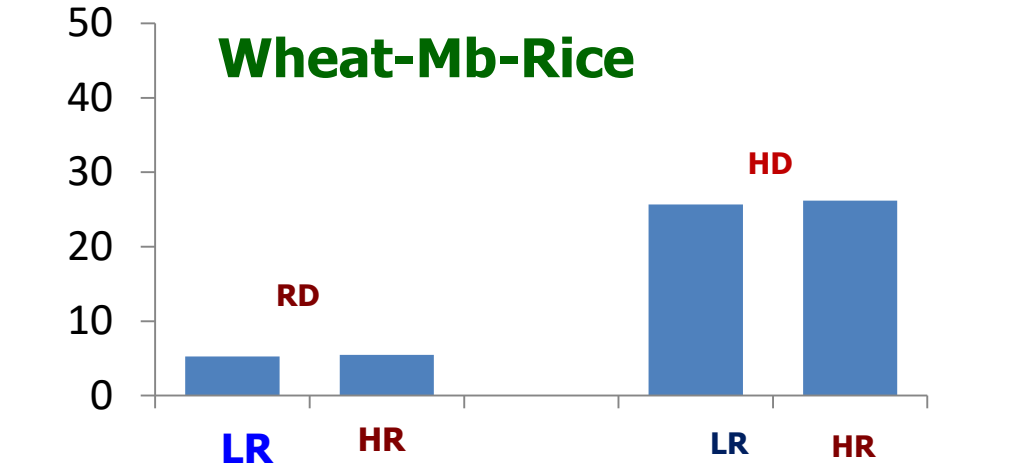
N balance (kg/ha)

Rice-Rice- Rice



P balance (kg/ha)

Wheat-Mb-Rice



Potato-Maize-Rice

K balance (kg/ha)



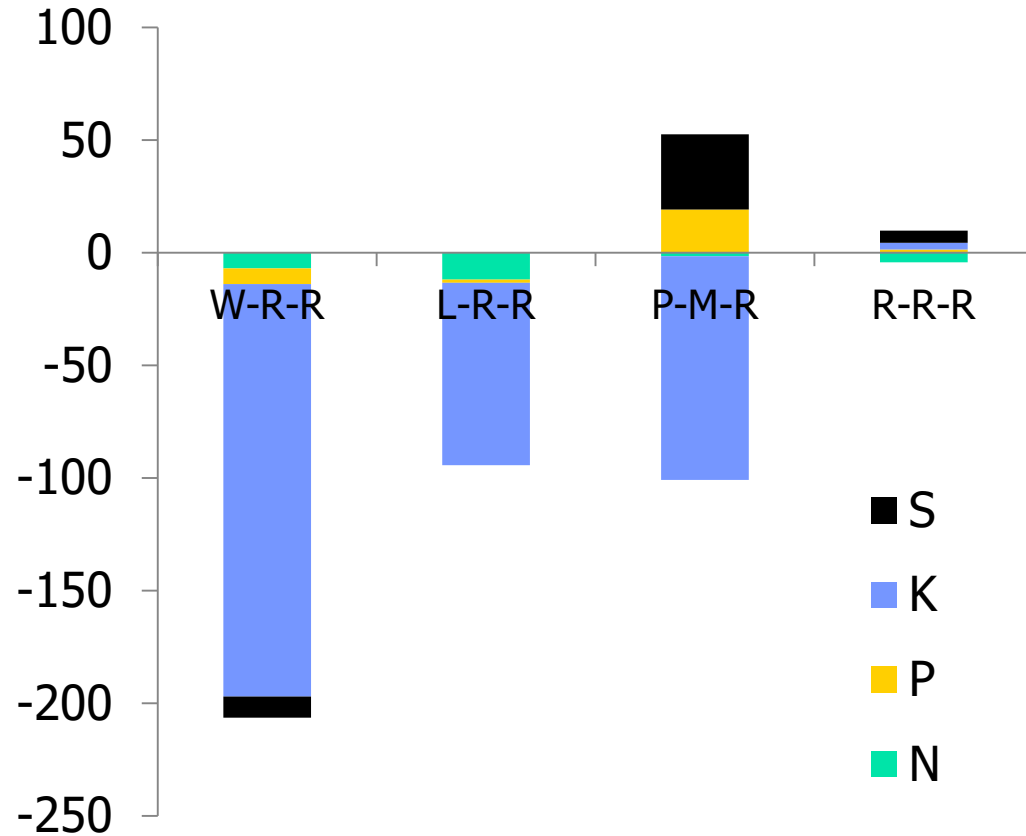
Wheat-Rice-Rice

S balance (kg/ha)

NB (+) : HR > LR; HD > RD

Conventional system

Practice: **CT- LR-RD**

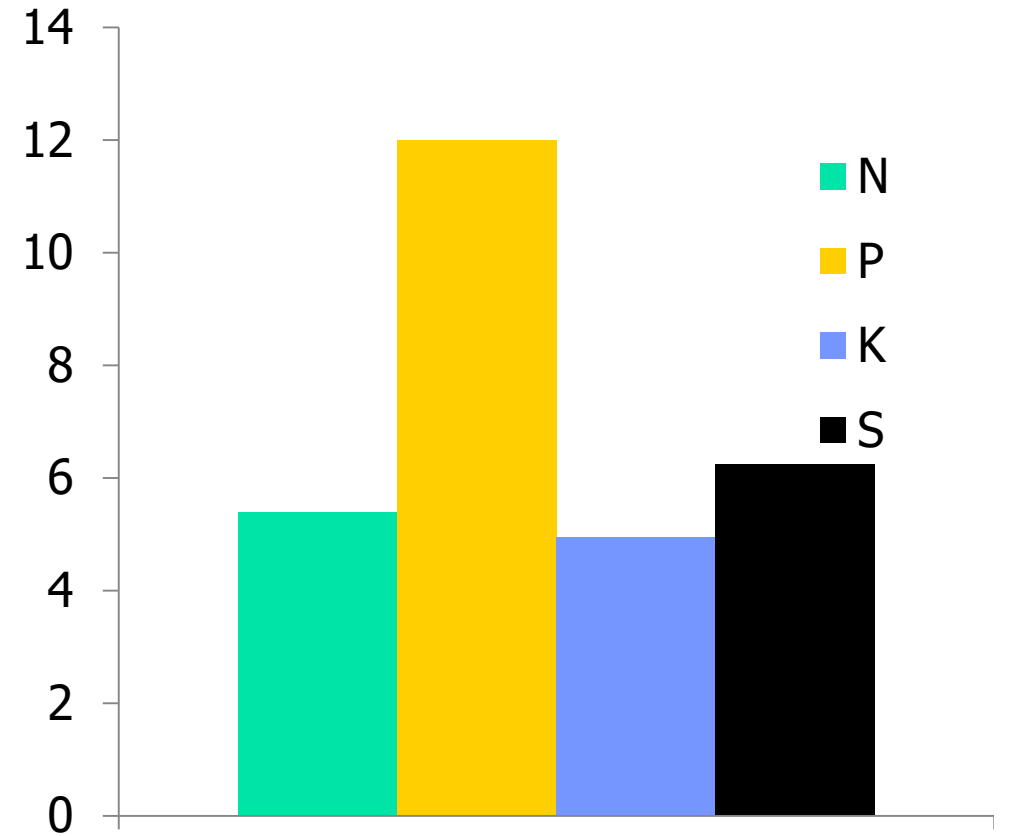


Conventional system

K - Highly negative
N - Slightly negative
P & S – Slightly positive

Improved system (CA)

Practice: **SP- HR-HD**



Improved system (CA)

N, P, K & S – All positive

Minimum nutrient mining in 3-wetland rice systems possibly due to lower decomposition of SOM

NB ± residue and fertilizer management (kg/ha)
Potato-Rice-Rice-Rice pattern at Bogura

Residue	Fert. treatment	Nitrogen	Phosphorus	Potassium	Sulphur
No Residue, NR	Control	-138.2	-37.7	-173.8	-13.5
NR	Farmers' Practice	-40.6	13.8	-82.3	35.9
NR	Recommended Dose RD	-25.6	-7.7	-52.8	5.0
Crop Residue, CR	Control	-98.1	-29.7	-116.0	-8.2
CR	Farmers' Practice	16.0	26.1	-24.7	42.8
CR	Recommended Dose RD	32.5	4.7	25.0	16.8

Crop residue retention (30% plant height) improves nutrient budget

Acknowledgement

- **ACIAR**
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- **PhD students**





Thank you !

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