

People, Technology, and Science

Lessons learned and un-learned from co-production of innovations
in Sub-Saharan Africa

Lisbon, 27 June 2025, Paul C. Struik



Overview of talk

- The complexity of co-producing innovations - examples
 - Soil and nutrient management
 - Pest management
 - Disease management
- Learning with farmers in Convergence of Sciences and
CoS-Strengthening Innovation Systems
- Unlearning in the Malmon programme



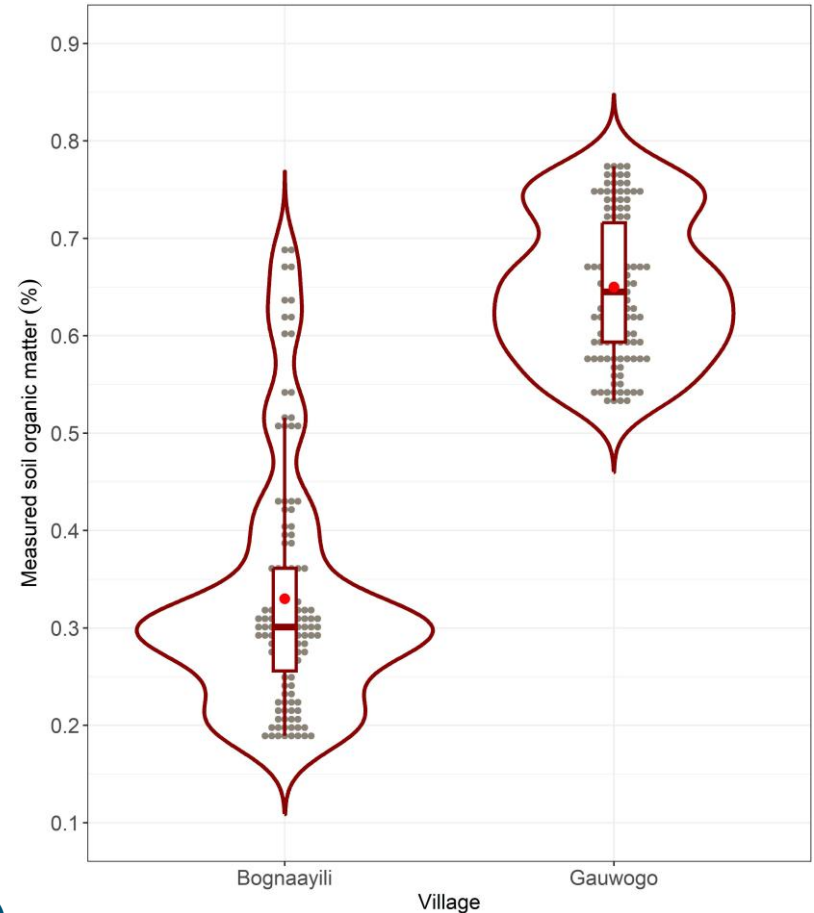
Soil and nutrient management in Sub-Saharan Africa

- Low intrinsic soil fertility
- Poor access to and low affordability of fertilizer
- Low fertilizer use efficiency
- Poor availability of animal and green manure
- Low soil organic matter content
- Large variation in soil organic matter at small scale
- Oftentimes, land tenure systems enhance nutrient mining



Northern Ghana

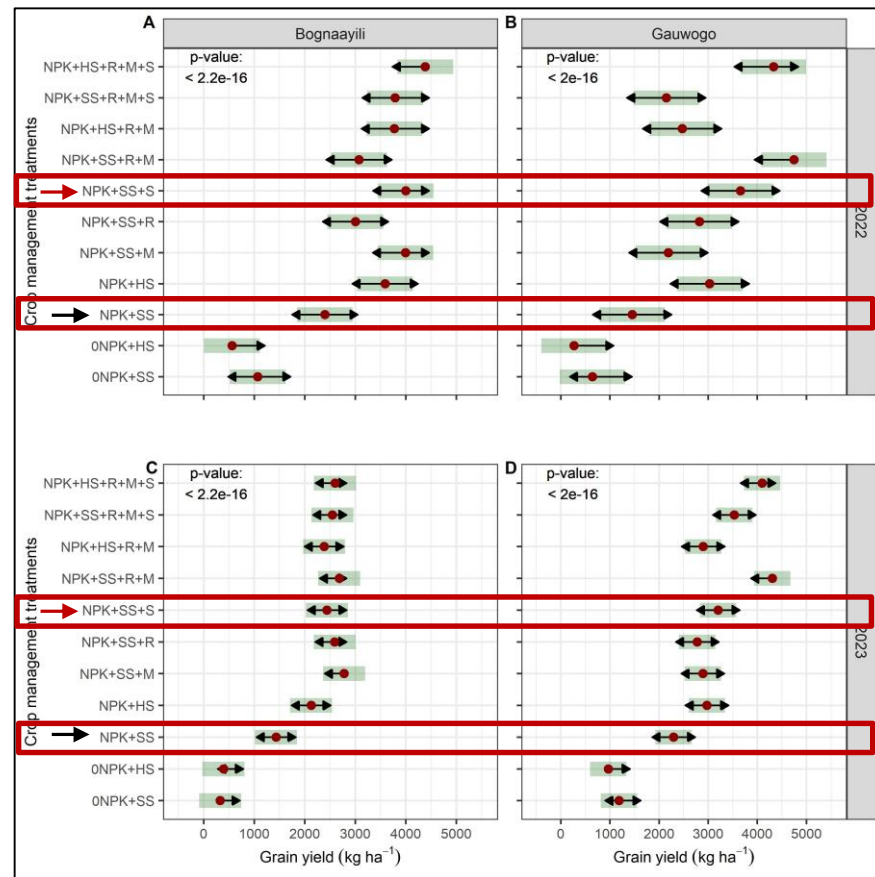
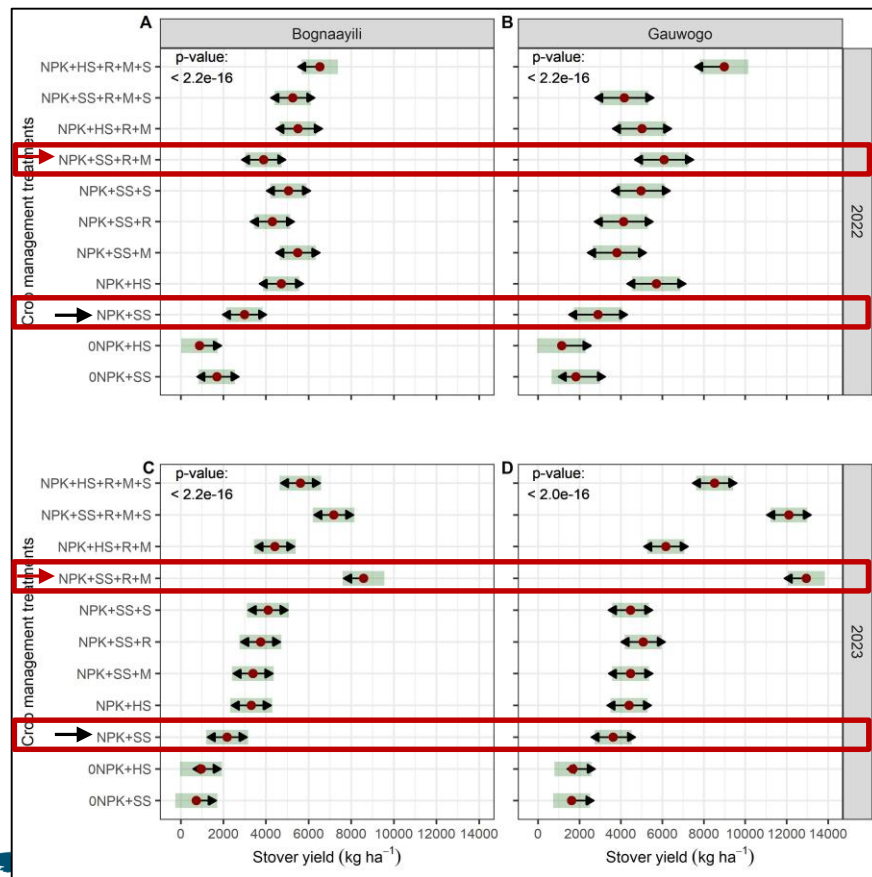
- Variation in fertility requires specific and detailed knowledge from farmer and researcher
- Variation can sometimes be made visible by drone flights recording (specific) weed populations
- We could have learned more together



Can intensification (sulfur, increased plant density, ridging, and mulching) help increase NPK use efficiency?



Maize yield response



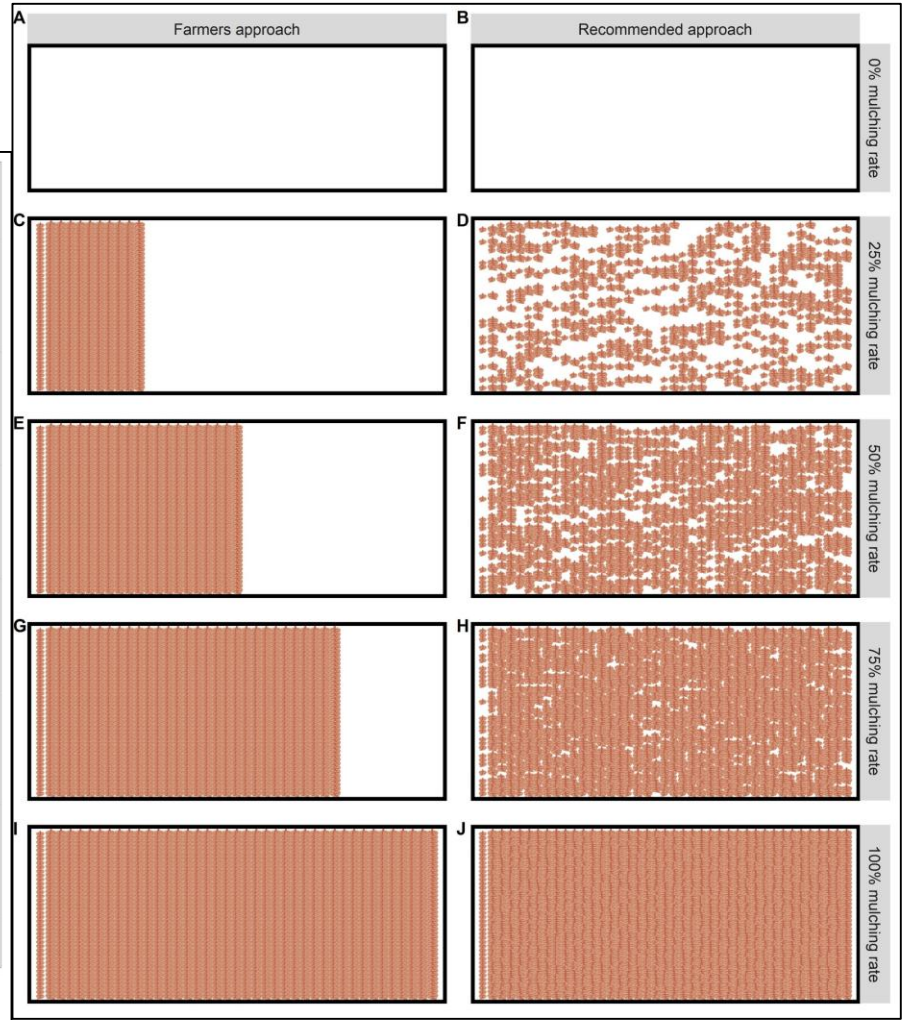
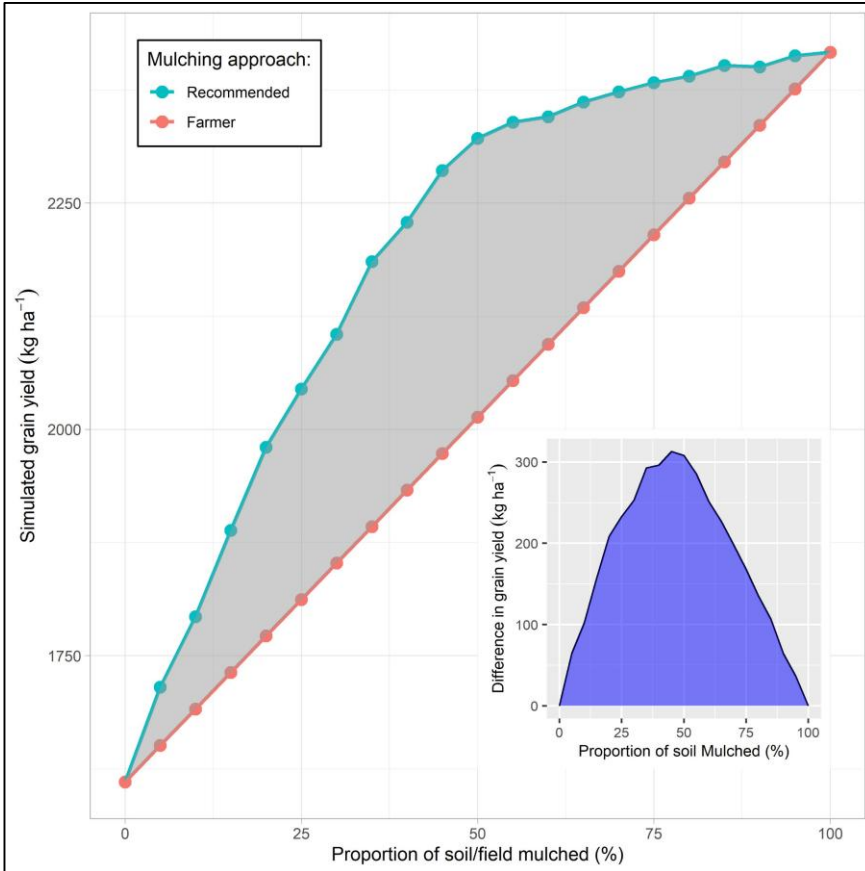
Maize yield response

In summary;

- ❖ Rainfall deficit had stronger effect on yield in Bognaayili, likely due to low SOM,
- ❖ Sulfur alone had important effect on maize response to NPK,
- ❖ Sulfur and increased planting density had no additional impact on yield under NPK plus mulching and ridging.



Mulching by farmers

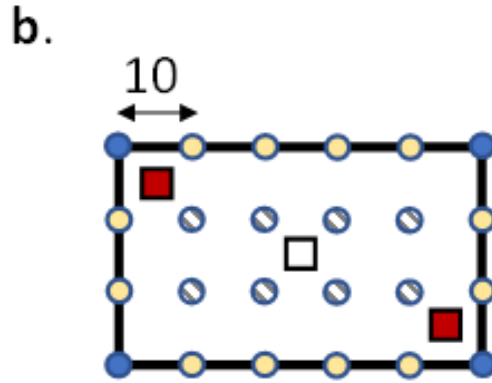
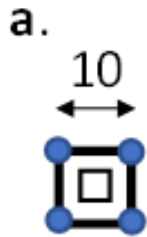


Pest management (fruit and stem borer in eggplant cultivation in Bangladesh)

- High pest pressure and high density of eggplant crops, turning this pest into a public bad
- Inefficient spraying regimes (resistance)
- Spraying at least weekly
- Lack of knowledge on population dynamics of the pest
- Trapping in a single field attracts more male moths than are killed and more than if neighboring fields also contain traps
- Lack of trust (catching male adults to reduce caterpillars)?
- Optimum trap density?
- Do we need a community-based strategy?
- Can we teach farmers to trust the IPM approach?



Only community-based IPM works

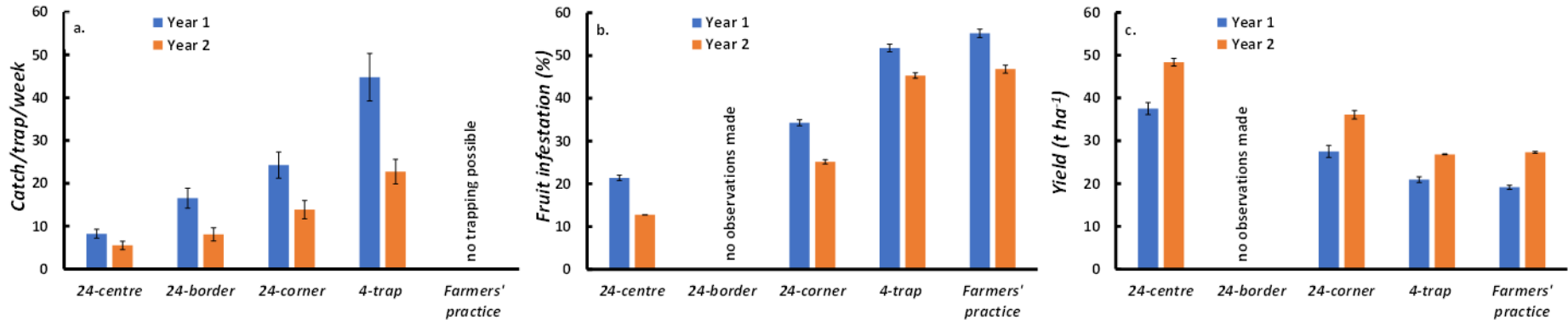


- Corner trap
- Border trap
- Centre trap

- Corner observation plot
- Central observation plot

- a. A 4-trap setting with its central observation plot.
- (b) A 24-trap setting, with two corner observation plots in opposite corners and one central observation plot.
- Size of all observation plots was 4 m × 4 m.

Effects of different trap settings compared with farmers' practice (weekly spraying with insecticide)



In 24-trap plots: fewer catches, fewer fruits infested and more yield than in 4-trap plots
Farmers' practice was similar to 4-trap treatment

Conclusions

- Not spraying is socially and mentally almost no option.
- But farmers learned that the IPM approach could work, was cheap, easy to implement and saved weekly insecticide spraying.
- Mass trapping is inefficient for an individual farmer, under small landholding and high density of eggplant cultivation.
- Trapping is only useful if trap density in the landscape is sufficient.
- Concerted, collective action is needed in sex pheromone trapping.
- But the yield is much better with efficient IPM than with frequent spraying.
- Results are very consistent across years.

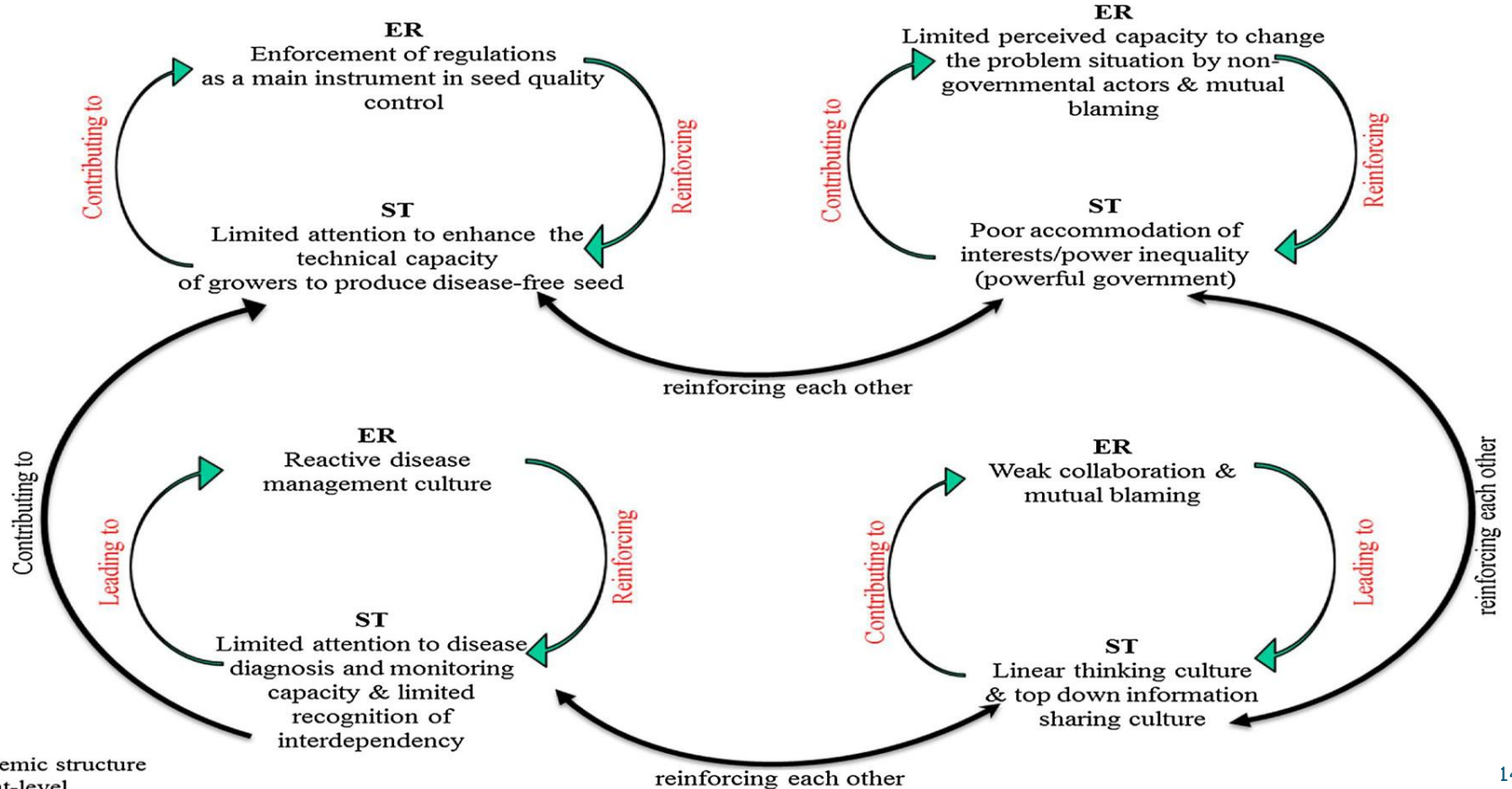
Disease management (other public bads)

Problems:

- Lack of knowledge on symptoms
- Lack of knowledge on mechanisms of spreading
- Poor farm hygiene
- Sometimes control measures are absent or difficult to access
- Public bads travel far (air-borne, seed-borne, water-borne)
- No community level control or management



Systemic structure managing bacterial wilt and late blight in potato in Ethiopia



Combatting bacterial wilt with farmers



Improving coordination among actors in the potato innovation system

Strengthening a monitoring system

Enhancing farmers' capacity through a learning intervention

Fostering integrated disease management through collective action

Enhancing disease diagnosis capacity in smallholder context

Strengthening a national/local level quarantine system



Integrating and scaling up through CoS and CoS-SIS

Two subsequent large-scale research and innovation programmes have tried to co-innovate with farmers through

- Technography
- Joint discovery and analysis of major problems (Diagnostics)
- Co-innovation with farmers
- Institutional change
- Integration of natural and social sciences
and of scientific and farmers' knowledge
- Research on research



Seven lessons learned through CoS and CoS-SIS:

1. Methodological approaches (technography, diagnostics, performance, joint learning, institutional context analysis)
2. Awareness that technology alone cannot expand smallholders' opportunities
3. Mobilisation of smallholders through experimental groups
4. Experimentation with institutional innovations and creation of institutional change
5. Analysis of agrarian systems, institutions and interventions
6. Re-orientation on integration between natural and social sciences
7. Re-orientation on integration of scientific and stakeholder knowledge



To innovate, smallholders need (combinations of) the following

voice: procedures for exerting influence on the decisions that affect them;

services: access to quality planting materials, production inputs, advice and information, machine repairs, credit and veterinary services;

tenure security that allows farmers to invest in land improvement and soil health;

legal frameworks that protect them from corruption, cheating, land-grabbing, unfair competition and profiteering;

integrated value chains that create access to remunerative produce markets and give farmers a fair share in the value added;

transparent and free information on prices, taxes, subsidies and policies; and

infrastructure including roads, irrigation and drainage, laboratories for testing and certification, facilities for seed multiplication, and other supports.

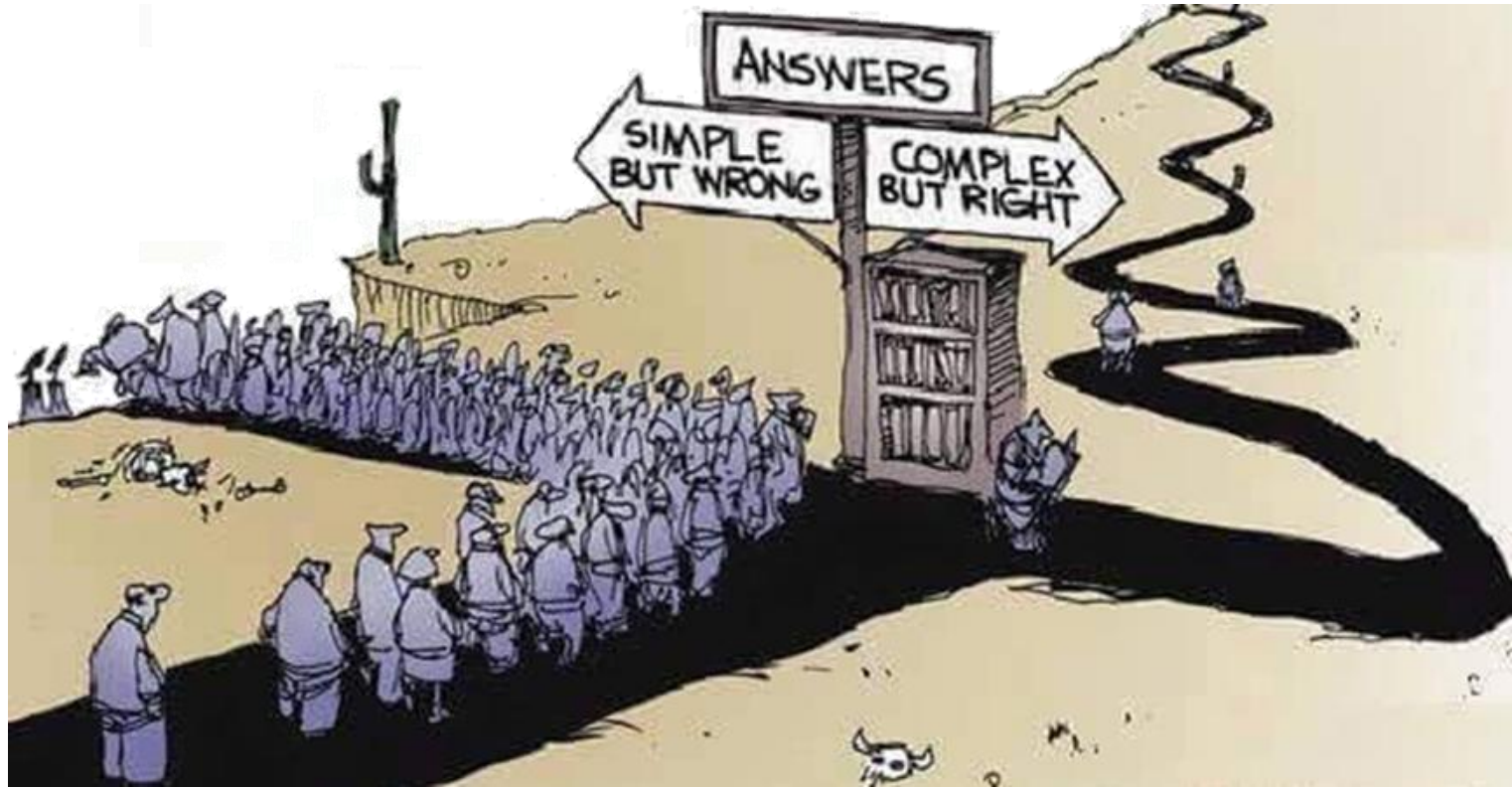
What is left? Four HOWs

Finding practical answers to the following complex questions:

- How can lasting change be catalysed in an agro-ecological setting and an institutional environment that are highly complex?
- How can we use the lessons learned about institutional innovation to make local agro-ecosystems resilient and suitable for sustainable intensification?
- How can sustainable agricultural intensification be orchestrated in such a way that it improves the livelihoods of all the rural poor?
- How can we design and implement agricultural policies that protect smallholder farmers against the threats and uncertainties associated with globalisation of markets?



These HOWs are not simple and require thorough study



We, scientists and farmers alike, even need to unlearn.....

Unlearning (loosely based on Anuraj Soni (2025))

Can be defined as deliberately letting go of mind sets and practices that are no longer fit for purpose

Fosters innovation by challenging old assumptions and embracing new options

Helps to rapidly change technologies

Enables farmers to change to new technologies by disregarding obsolete techniques

Three pillars of unlearning

- Willingness to change
- Breaking with ingrained thought patterns
- Changing habits

Especially in an empirical science such as agronomy and in cultivation practices!

My experience with Malmon was that unlearning was continuous in mangrove rice production



The work by Viriato Cossa (see his presentation later this morning) has demonstrated the power of unlearning for important decision issues:

- Plowing or not plowing?
- Sowing or transplanting or none of the two (volunteer crops)?
- Improved or traditional varieties?
- Twenty or three transplants per hill?

And above all:

- Unlearning to focus on field scale: Farmers make decisions at the landscape/whole farm level, not at the field level, and therefore their decisions might seem suboptimal for a particular field but make sense for their entire set of fields.

Unlearning (1): to plow or not to plow?

- Plowing is considered to be critical, yet often skipped
- Interventions to ease plowing (e.g., tractors) were unsuccessful
- Skipping plowing often provides higher yields than plowing
- Skipping plowing allows earlier sowing, thus reducing labor pressure during peak of transplanting
- Farmers make instant decisions and improvise
- Not plowing is often wise



Unlearning (2): sowing or transplanting or none?

- There are many strategies to establish a crop depending on socio-ecological conditions, but yields are different
- Failure of crop establishment is always a possibility
- Strategies vary per village and per ecology; they are contextual
- Farmers often make ad hoc decisions based on rainfall and availability of labor and land at whole-farm/landscape level



Unlearning (3): improved or traditional varieties?



**Farmers possess many
but use few varieties**



**Farmers prefer robust
late-maturing varieties**



**External pressure to use
early, improved
varieties is
counterproductive**



Unlearning (4):20 or 3 transplants per hill?

- Plant density is very variable, depending on establishment method
- No. of seedlings per hill is often very high,
too high in the eyes of agronomists
- Farmers also tend to underestimate seedling density
at transplanting
- Required no. of surviving seedlings is crucial
- Who needs to unlearn here?



Conclusion and question

- Farmers manage
the river, water, soil, landscape, seed, nurseries, crops, and farm and household in a dynamic way based on opportunities and risks, while improvising to optimize use of available resources, especially land and labor.
- What is the role of maintaining one's network in optimizing one's position in the next year? How do you do that?

[It takes a village to grow a crop.....]

Partly based on PhD research of

Elias Damtew
(Ethiopia)

Eugene Dela
Setsoafia
(Ghana)

Naznin Nahar
(Bangladesh)

Shiferaw
Tafesse
(Ethiopia)

Viriato S.I.
Cossa
(Guinea-Bissau)

Yussif Baba
Kassim
(Ghana)



Finally,

Thank you for your attention
and
the inspiring interactions throughout the programme.

I will never forget how wet and muddy
mangrove rice production is.
