LESSON LEARNED **Promising changes at the field level are no guarantee for good results at the farm level**

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Promising results at the field level are not necessarily promising at the farm level. Integration of a legume in the usually fallow summer season could have positive effects on the soil, and in addition create additional protein rich yield. However, both whole-farm modelling results and discussions with farmers highlight that the field level benefits have trade-offs with whole-farm objectives like labor and water use.

Important Details

time (or time period)	2015-2018
country & region	India
context & agro-eco landscape type	Rural landscapes, wheat-rice dominated
key actors, stakeholders & beneficiaries	Researchers, policy makers, extension workers
model and/or tools used	On-station field-level research trials, whole-farm exploration

Description & takeaways

The Indo-Gangetic Plains (IGP) are an important agricultural area for cereal production in India. Rice-wheat cropping systems cover a large proportion of the cultivated land and contribute substantially to food consumed. However, the continuous intensive cultivation of these crops has led to soil degradation and over-exploitation of fresh water resources, resulting in challenges to sustain crop productivity whilst also ensuring environmental sustainability.

On-station field-level research trials showed positive effects when the cereal-rotation was supplemented with a legume crop, in the usually fallow summer season. A legume would cover the soil almost all year round (wheat from Nov-April; legume from April-June; rice from June-Oct). This would enhance aggregate stability, modulate soil temperature to favor plant/root growth, sequester carbon and use the residual NO3-N from the surface soil before it is leached to aquifers (and thus avoid groundwater pollution). In addition, it would yield 1-1.5 ton of protein rich food for household consumption or for the market.

A whole-farm exploration was done to test if the cropping sequences wheat –rice – mung bean; wheat – maize – mung bean; and mustard – maize – mung bean would benefit farm performance when looking at the objectives to maximize operating profit and soil organic matter balance and to minimize water use and N losses to the environment.

Despite the benefits at field level, a whole-farm exploration showed that the legume did not always have a positive economic and environmental impact at farm level. We distinguished five farm types with varying

resource endowment and market orientation. For two out of the five types, the 'farm manager' and the 'arable farmer', inclusion of the legume did not benefit the farm. This was mainly because the cropping sequences they already had, were outperforming the new cropping sequence with the legume. For the remaining three farm types, trade-offs were found between the environmental objectives (maximize soil organic matter balance, minimize N losses and water use) and operating profit. There was little scope to improve economic performance and at the same time save water.

When discussing the field trials and model-results in Focus Group Discussions with farmers, they showed reluctance to add a legume in summer. The benefits at field level did in their view not outcompete the extra labor in the hot summer season where temperatures can rise to 40°C. Although the legume does not need excessive amounts of water, the water availability was seen as a serious constraint.

These results stress the necessity to address the impact of field level adaptations on the whole farm, and on the farm household. In addition, the results show differentiated impacts for various farm types, indicating that heterogeneity within the farming community should be taken into consideration.

Key references

Adelhart Toorop, R., Lopez-Ridaura, S., Bijarniya, D., Kalawantawanit, E., Jat, R.K., Prusty, A.K., Jat, M.L., Groot, J.C.J., 2020. Farm-level exploration of economic and environmental impacts of sustainable intensification of rice-wheat cropping systems in the Eastern Indo-Gangetic plains. Eur. J. Agron. 121, 126157. https://doi.org/10.1016/j.eja.2020.126157