Towards Disentangling Environmental Costs of India's Agricultural Trade Network

Shekhar Sharan Goyal[1,2], Raviraj Dave[2] ,Udit Bhatia[2] and Rohini Kumar[1]

[1]Helmholtz Center for Environmental Research, UFZ, Leipzig, Germany
[2]Indian Institute of Technology Gandhinagar, Palaj, Gandhinagar, Gujarat -382355, India

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1. Introduction

- Nitrogen (N) is essential for agricultural productivity, yet its surplus poses significant environmental risks.
- Currently, more than half of the nitrogen applied to croplands is lost, resulting in resource wastage, contributing towards increased greenhouse gas emissions and biodiversity loss.
- To properly understand current environmental risks, it is essential to quantify the amount of surplus nitrogen applied in the past, which remains limited in the Indian context.

2. Objective

- Understanding nutrient pollution in interstate agricultural trade system
- Restructuring Indian agricultural trade system towards lower environmental nutrient footprint

3. Conceptual Understanding

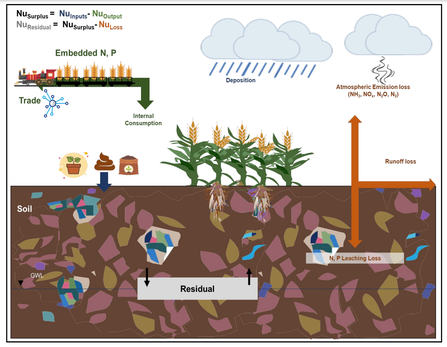

Fig1: Nitrogen Surplus in Crop Production: Nitrogen cycle in agricultural systems.

4. Trade Data

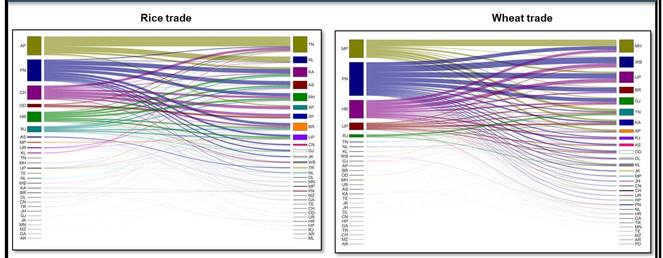

Fig2: Average interstate Railroad (a) Rice and (b) Wheat trade (kg) in India from 2009-20.

5. Results

Indian interstate trade exacerbates nutrient pollution in food production hubs

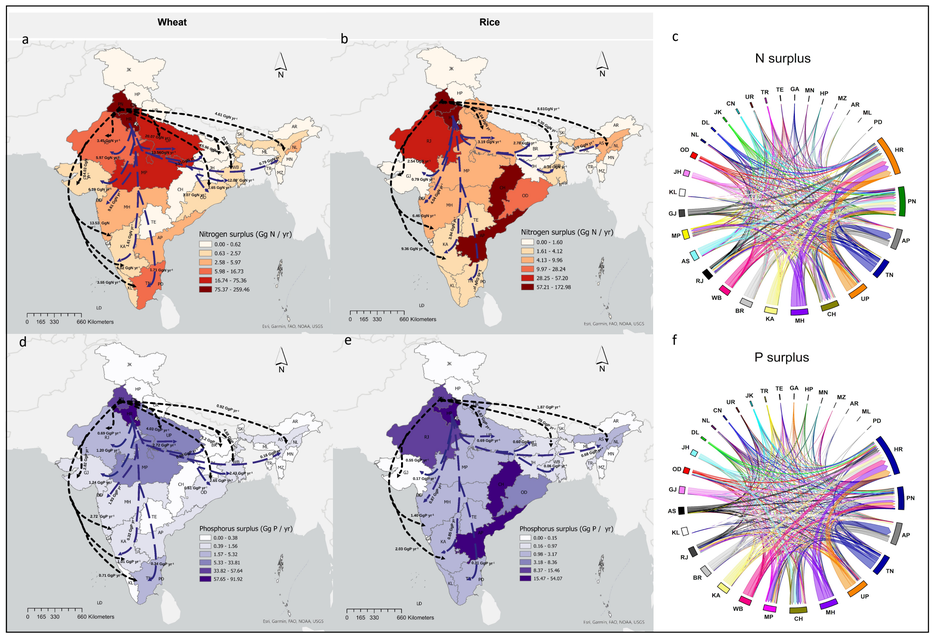

Fig3: The spatial variation of nitrogen (N) and phosphorus (P) surplus in the interstate rice and wheat trade.

Interstate Trade Effects on Graywater generation and Nutrient Savings

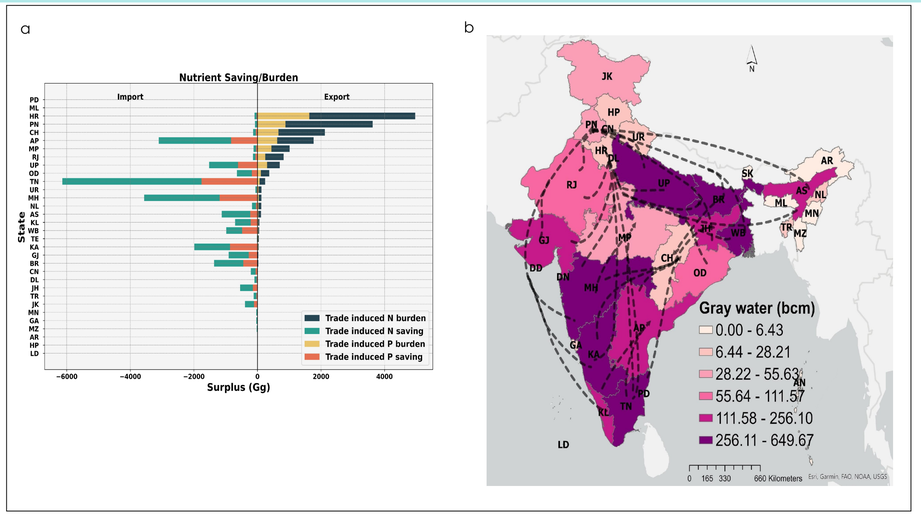

Fig4: Interstate rice & wheat trade redistributes environmental costs importers save graywater while exporters bear N & P burdens.

Quantifying environmental co-benefits of nitrogen based crop restructuring and its implication on trade network system

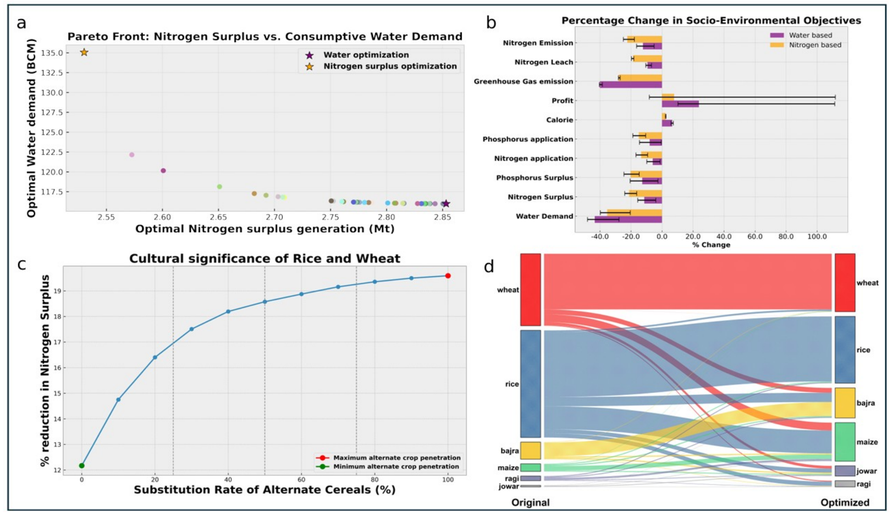

Fig5: Evaluation of agricultural restructuring strategies in India.

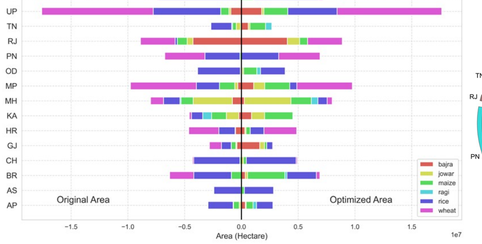

Fig6: Nitrogen surplus minimization based cropland restructuring

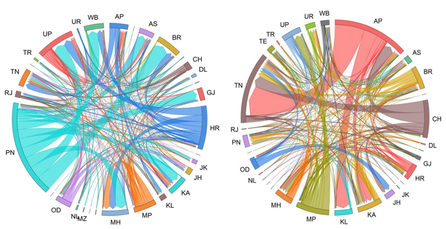

Fig7: Restructured trade network based on minimum N surplus optimized cropland

6. Conclusion

- Trade-related burdens in these regions would demand over 350 billion cubic meters of (gray)water annually to maintain groundwater-related nutrient levels within safe limits.
- Nitrogen-focused crop restructuring strategy could offering significant socio-environmental benefits by reducing nitrogen surplus by 16–24%, water use by 20–40%, and greenhouse gas emissions by 28% (113 Mt CO_2 eq), while enhancing farmer incomes and calorie production.

7. References

- Goyal, S.S., Dave, R., Kumar, R. and Bhatia, U., 2024. Indian interstate trade exacerbates nutrient pollution in food production hubs. Communications Earth & Environment, 5(1), p.9.
- Goyal, S.S., Kumar, R. and Bhatia, U., 2024. Quantifying environmental co-benefits of nitrogen-based crop restructuring and its implication on trade network system. (under review)

8. Acknowledgment

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shekhar-sharan.goyal@ufz.de | https://orcid.org/0009-0000-6979-3975 | https://www.linkedin.com/in/shekhar-goyal-2b0676131