POLICY BRIEF

AUGUMENTING FARMER INCOME WITH ON-FARM CARBON AND WATER TRADE-OFFS

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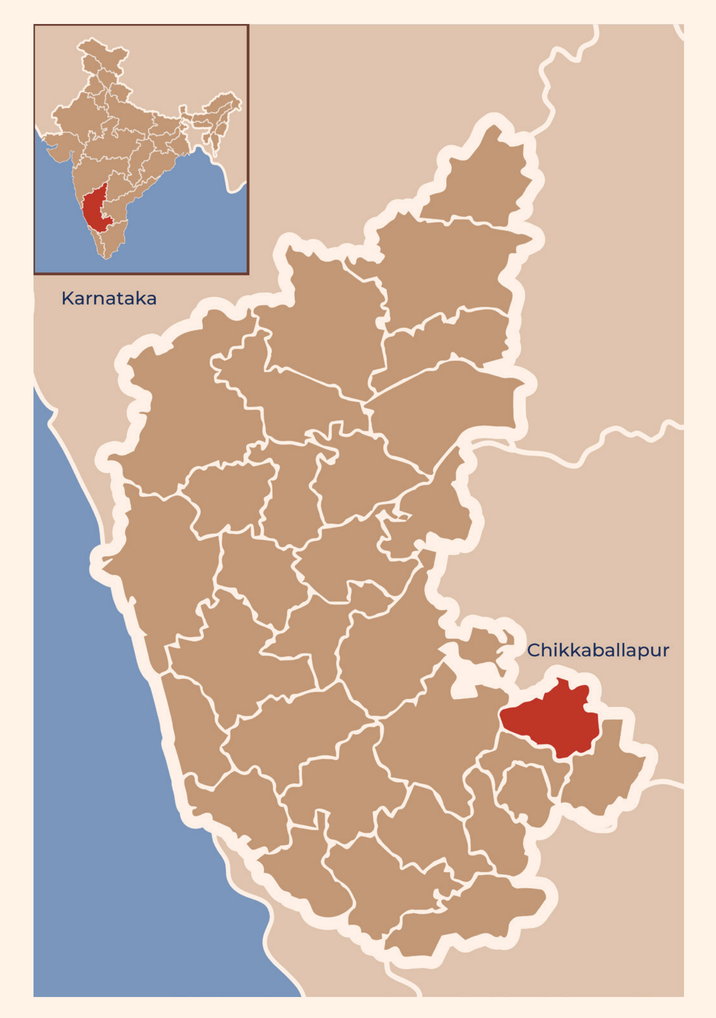


Janapara Foundation facilitated the study at Chintamani, Chikkaballapur district.

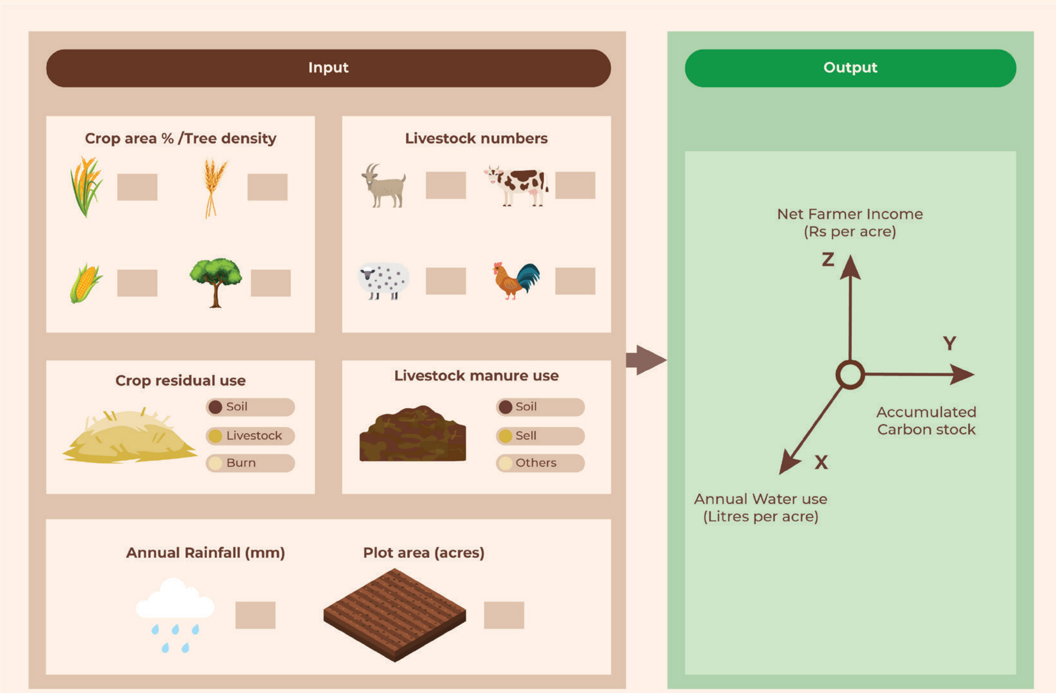
EXECUTIVE SUMMARY

Agroecological practices such as crop diversification (intercropping, crop rotation, agroforestry, etc.) and livestock integration offer ecological benefits such as carbon and water sequestration. In the long term, such practices often improve on-farm soil health and water use efficiency on-farm. However, civil society organisations (CSOs) that promote these practices encounter many social, economic, and institutional challenges in persuading farmers, including unclear short-term trade-offs associated with agroecological transitions. Evidence-based economic forecasting is crucial to ensuring that farmers' incomes are supported during transitions for improved agroecological outcomes.

In this brief, we pilot a farm-scale tool to estimate the trade-offs between farmer income, carbon storage, and water requirement across different types of farms in a semi-arid region, and suggest the following measures to better plan farm interventions:

- Provide farmers with information on farm design options
- Tailor agroecological interventions to local land use, needs, and priorities
- Develop and implement joint landscape management for ecosystem services

AN ILLUSTRATION OF THE TRANSFARM TOOL INTERFACE

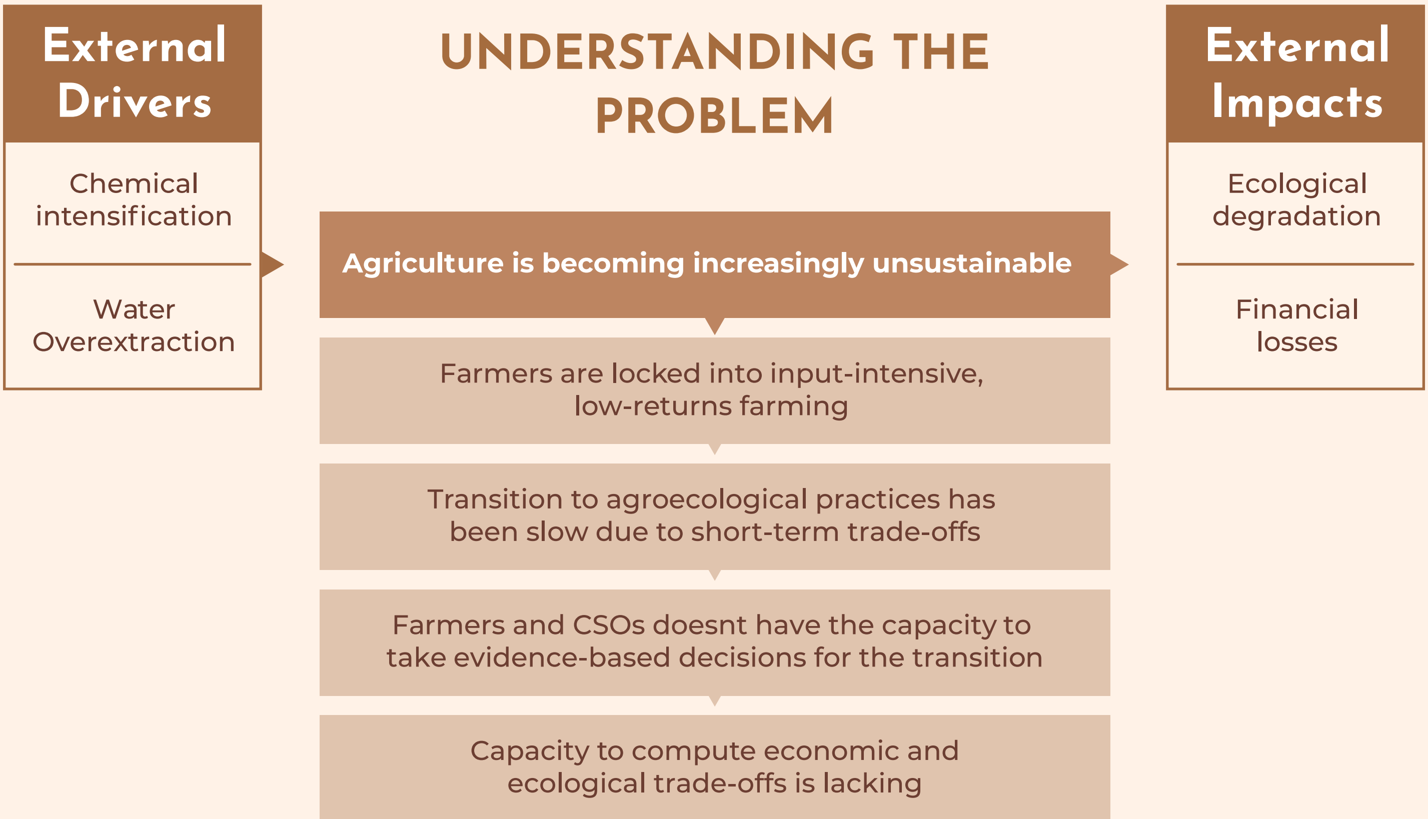


WHAT IS THE PROBLEM?

Farms around the world are faced with an increasing shortage of water and arable land.Intensive farming with unsustainable agricultural practices such as over-irrigation, overuse of fertilisers and pesticides, and large-scale monocropping, has led to land degradation.In India, this threat is especially dire as almost a third of arable land is now degraded, and the pressure on groundwater reserves has multiplied manifold over the last five decades. About 70% of Indian farmers operate on very small farms (<0.05 ha), and the income from these farms is heavily dependent on government subsidies for inputs, and minimum support price procurement schemes. The uptake of government roadmaps and guidelines to promote agroecological practices remains low because farmers are locked into ecologically and financially unsustainable farming systems.

To break these unsustainable lock-ins, smallholder farmers must be able to estimate the economic implications of changing their farming regime. Short-term trade-offs could include up-front investment in materials such as seedlings or livestock, or delayed income due to slower crop cycles. Long-term trade-offs could include reduced costs of irrigation and manure, or increased income from payments for ecosystem services. Data for market and labour prices are often not accessible, verified, or up to date. Even with data availability, evidence-based trade-off assessment requires dynamic computations, which would be challenging for implementation organisations and farmers. There is a need for a consolidated tool where farmers can account for these variables when planning to transition to a different agroecological regime. Recommendations from this policy brief can be applied across geographies.

Fig. 1: Evidence is needed to facilitate sustainable agroecology transitions.



THE RESEARCH

Introduction

Agroecology has the potential to mitigate the adverse effects of unsustainable monoculture practices. However, it encounters barriers to widespread adoption, largely due to perceived short-term sacrifices against long-term benefits. The intricate interplay between economic viability and environmental sustainability in smallholder farming is evident in India, where nearly a third of the land is degraded. This degradation, exacerbated by chemical-intensive monocropping, results in significant losses in agricultural productivity and environmental degradation. Amid these challenges, agroecology emerges as a promising solution, integrating ecological and social principles for sustainable food production. However, promoting its adoption necessitates transparent communication of benefits and understanding the nuanced trade-offs between economic and ecological parameters. This study demonstrates such trade-off calculations for three agroecology transitions, namely, crop diversification, livestock integration, and agroforestry involving carbon finance.

Methods

The methodology proposes a farm-scale trade-off assessment tool to evaluate transition scenarios in agriculture. Users input plot details and the tool estimates net income, water demand, fodder, soil organic matter, and carbon sequestration based on secondary data. Users can adjust inputs to create different farm scenarios until desired trade-offs are met. The tool interface is Excel-based. A trade-off matrix comprising income, water, and carbon guides analysis. Primary data from Chintamani taluka in Karnataka validates tool estimates. Snowball sampling identifies farmers, and parameters are measured through household surveys. The study categorises crop configurations and assesses income, water use, and carbon stock. Statistical tests validate findings.

Findings

The research demonstrates the potential of the proposed tool to guide farmers towards win-win scenarios, balancing income and ecosystem health. Through trade-off analysis and validation with primary data, the research highlights the significance of design parameters in shaping farm outcomes including farmer income, water use, and carbon sequestration. Results, validated with primary data, indicate significant influences from landholding size, plot size, crop diversity, livestock holdings, tree density, and crop residue use on farm configurations and outcomes.

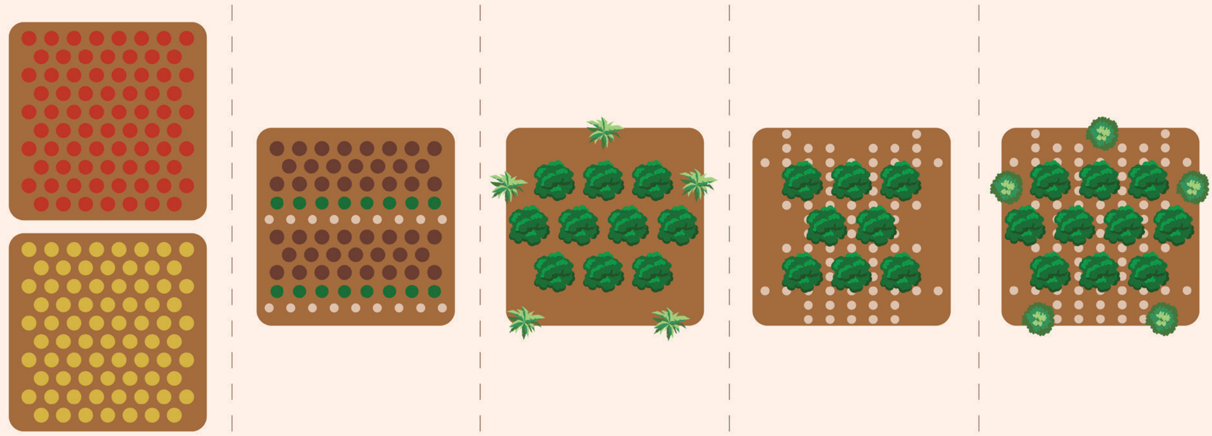
The study examines five categories of farm configurations — monoculture (A), intercropping (B), fruit forests (C), fruit trees with field crops (D), and timber trees with other crops (E) — based on data from 100 plots. Findings reveal an average plot size of 1.95 acres, with significant variations in crop diversity, livestock holdings, and tree density. Analysis shows significant variations in income, water demand, and biomass carbon across the five categories, with correlations indicating the importance of design parameters like plot size, crop area percentage, tree density, livestock type and herd size, etc. as design parameters.

For example, in the study context, irrigated monocultures and rainfed polycultures delivered lower results on the water use and farmer income metrics respectively (Fig. 2A&B). The position in the win-win quadrant was achieved by iteratively changing the design parameters in the tool, including crop choices, crop area percentage and tree densities. Variations of field crop and tree mixtures performed better in this case. The tool's iterative nature allows for tailored interventions, promoting crop diversification, livestock integration, and carbon monetisation. The tool can enable users to plan sustainable futures for their farms in a way that does not compromise income.

Sustainable agriculture practices like intercropping or agroforestry can result in suboptimal outcomes if the design parameters are not carefully selected considering the economic and ecological trade-offs.

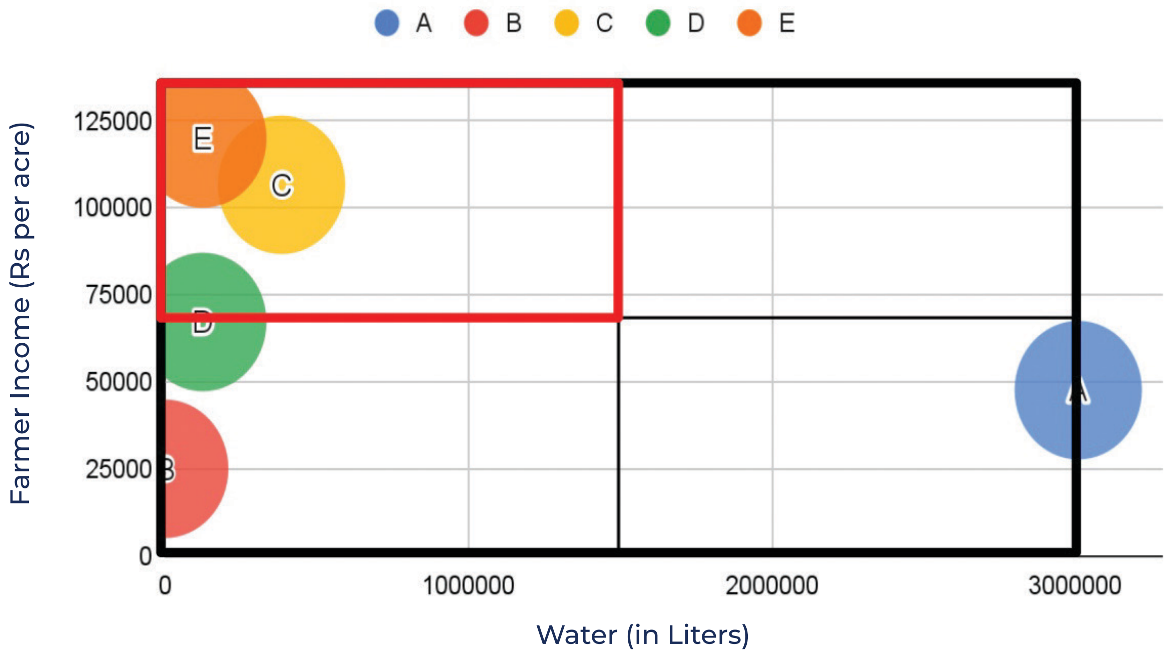
Fig. 2A: Water trade-offs for hypothetical scenarios generated by the tool with the given design parameters.

Plot size: (1.95) acres



	A	B	C	D	E
Crops & area %/ tree density	Tomato (Kharif) - 100% Sweet corn (Rabi) - 100%	Groundnut - 70% Maize - 20% Horsegram - 10%	Mango - 100 trees Coconut - 50 trees	Mango - 80 trees Horsegram - 70%	Mango - 100 trees Silver oak - 50 trees Horsegram - 70%
Source of irrigation	Borewell	Rainfed	Borewell	Borewell	Borewell

Fig. 2B: Water trade-offs for hypothetical scenarios generated by the tool with the given design parameters.



WHAT CAN BE DONE?

The Directorate of Economics and Statistics, under the Ministry of Agriculture and Farmers Welfare, documents and disseminates agricultural economic statistics for the benefit of policymakers, farmers, and the public. This includes statistics on cost of cultivation, labour wages, as well as market prices for agricultural commodities. Better coverage of statistics for indigenous grains, vegetables, tree crops, and livestock breeds, will improve the utility of this data in decision-making on smallholder farms. Further, making these statistics accessible on one consolidated and regularly updated platform, such as an internet-based application or tool, will enable farmers, cooperatives, and civil society organisations to better estimate the cost-benefit ratio of agroecological transitions in real time.

Land use planners, civil society organisations, and farmer cooperatives can use the data aggregated at landscape level to plan interventions for improved farmer incomes and ecological outcomes. The tool allows users to nudge existing farm configurations towards improved water use or carbon storage. More ecological parameters that trade off against farmer income may be incorporated in further iterations. Such economic forecasting allows users to estimate upfront investment in farm transition, and the time horizons for returns on the investment. The tool can help spatially and financially prioritise interventions based on their impact and efficiency at the landscape level when combined with qualitative data. More importantly, the tool allows the government to entrust local-level implementers like civil society organisations with decision-making capabilities on crop and livestock choices, and farm designs in promotion and implementation of sustainable agriculture and livestock integration promotion schemes.

Fig. 3
Solving the Problem

Related SDGs

Provide farmers with information on farm design options

Include economic data (e.g. cost of cultivation, market prices, etc.) on indigenous grains, vegetables, tree crops, and livestock breads.

Consolidate up-to-date economic and soil health data on an accessible platform to enable economic forecasting and decision-making at farm scale.

8 DECENT WORK AND ECONOMIC GROWTH

Tailor farm and landscape interventions to local land use, needs, and priorities

Enable farmers to nudge existing farm configurations to improve water use, carbon storage and other ecological parameters.

Estimate costs and benefits of landscape transition options and time horizons to recover returns on investment.

13 CLIMATE ACTION

Develop and implement joint landscape management for ecosystems services

Aggregate landscape-level data to co-develop a management plan based on extant land use.

Retain mosaic farm configurations for improved landscape connectivity and resilience.

15 LIFE ON LAND

HOW?

Improved agronomic data consolidation and accessibility:

The Directorate of Economics and Statistics under the Ministry of Agriculture and Farmers Welfare, together with non-government organisations (NGOs), can make up-to-date agronomic data accessible to farmers, implementers, and NGOs to facilitate better informed agroecology transition decisions.

Tailoring farm design for optimal economic and ecological outcomes:

Government departments such as the State Departments of Horticulture, Forestry, Agriculture, and Animal Husbandry, could integrate the use of the tool with government schemes by entrusting CSOs for locally-appropriate farm-scale interventions along with farmers. For example, decisions regarding provision of tree saplings and livestock need not be universal; region-specific decisions can be facilitated by CSOs using the tool.

Jointly implemented landscape management plans for ecosystem regeneration:

The individual farm choices aggregated at landscape level for planning landscape-scale restoration and water management strategies. CSOs can facilitate the landscape management plans using the tool to nudge the farmers to increase water productivity and soil regeneration. For example, farm choices can be aggregated at irrigation command area scale and that would empower water user associations to negotiate for the fair share of water with the irrigation department. Similarly, the government could also take decisions to incentivise crop choices that would improve water productivity.

Expanding farm income streams to include payments for ecosystem services:

Developing sound policy guidance on carbon, water, biodiversity credits, and other ecological incentive schemes will encourage farmers to adopt agroecological transitions. The tool would help to identify the income trade offs to make sustainable transitions and the initial dip in income could be compensated by innovative financing schemes like payment for ecosystem services if central and state departments of agriculture, forestry, horticulture, and animal husbandry could incentivise for the ecological benefits.

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