

Bundling Solar-based Irrigation and Vermicompost: Using a Living Lab Approach in Ethiopia: Impacts on Crop Yield, Soil Moisture, and Rural Livelihoods

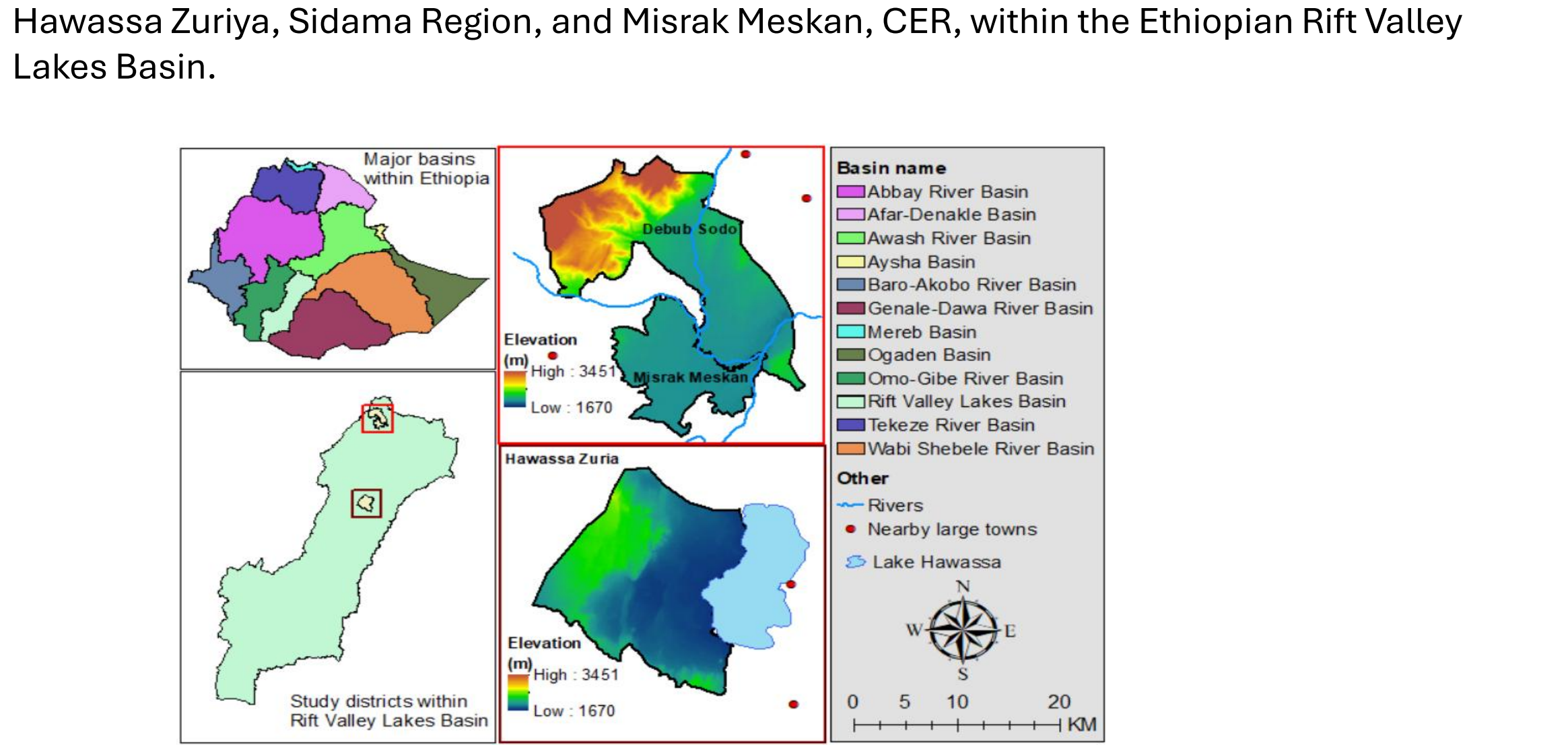
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Background and Objectives

- Solar-powered irrigation ensures reliable water access at lower energy and labor costs, enabling crop diversification.
- However, irrigation alone cannot resolve declining soil fertility, nutrient depletion, and organic matter loss.
- This study tested whether bundling solar irrigation with soil fertility management (vermicompost) improves crop yield, soil moisture, and farmer livelihoods.

Objectives: Evaluate how bundling solar irrigation with vermicompost affects crop yields, soil moisture, and farmer-perceived livelihood/environmental benefits in Ethiopia's Rift Valley.



Methodology: Living Lab Approach

- Co-Design:** Farmers, researchers, and extension agents jointly set trial designs, selected crop varieties, and determined vermicompost rates.
- Shared Execution:** Solar-irrigation farmers and local experts actively led trial setup, management, and joint monitoring.
- Iterative Learning:** Regular field visits and stakeholder dialogues enabled real-time feedback and adaptive management.

Experimental Design

- Field trial: 2025 growing season | RCB with 3 to 4 replications | Plot: 100 m² (25 m × 4 m) | 1 m buffer between plots

Treatments

- T1: Solar-based irrigation + current farmer practice
- T2: T1 + vermicompost at 4 t ha⁻¹
- T3: T1 + vermicompost at 8 t ha⁻¹

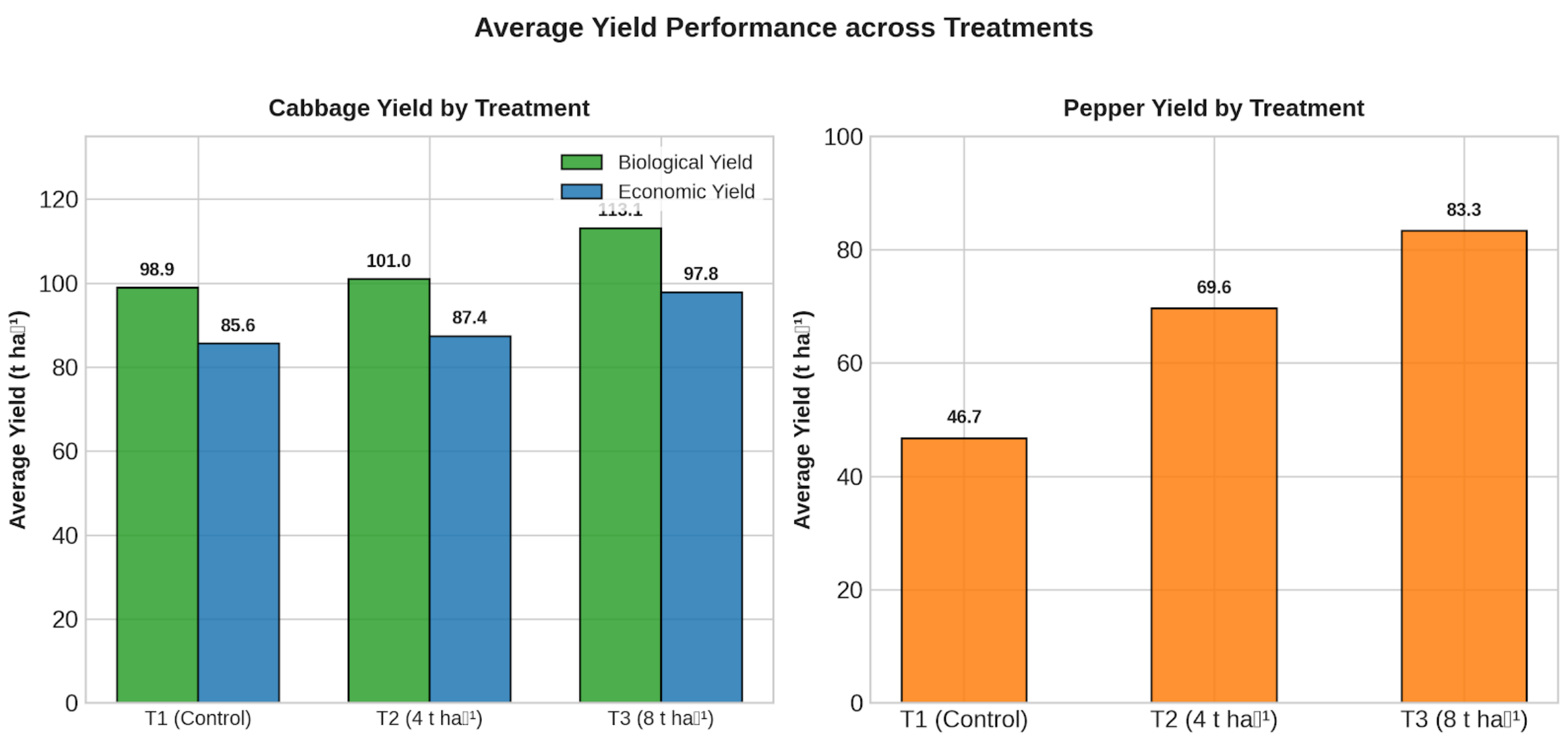
Data Collection

- Biophysical: soil moisture dynamics at six depths to 1 m and crop yields.
- Socio-economic: 24 farmer recall key informant interviews and direct field observations.

Results and Discussion

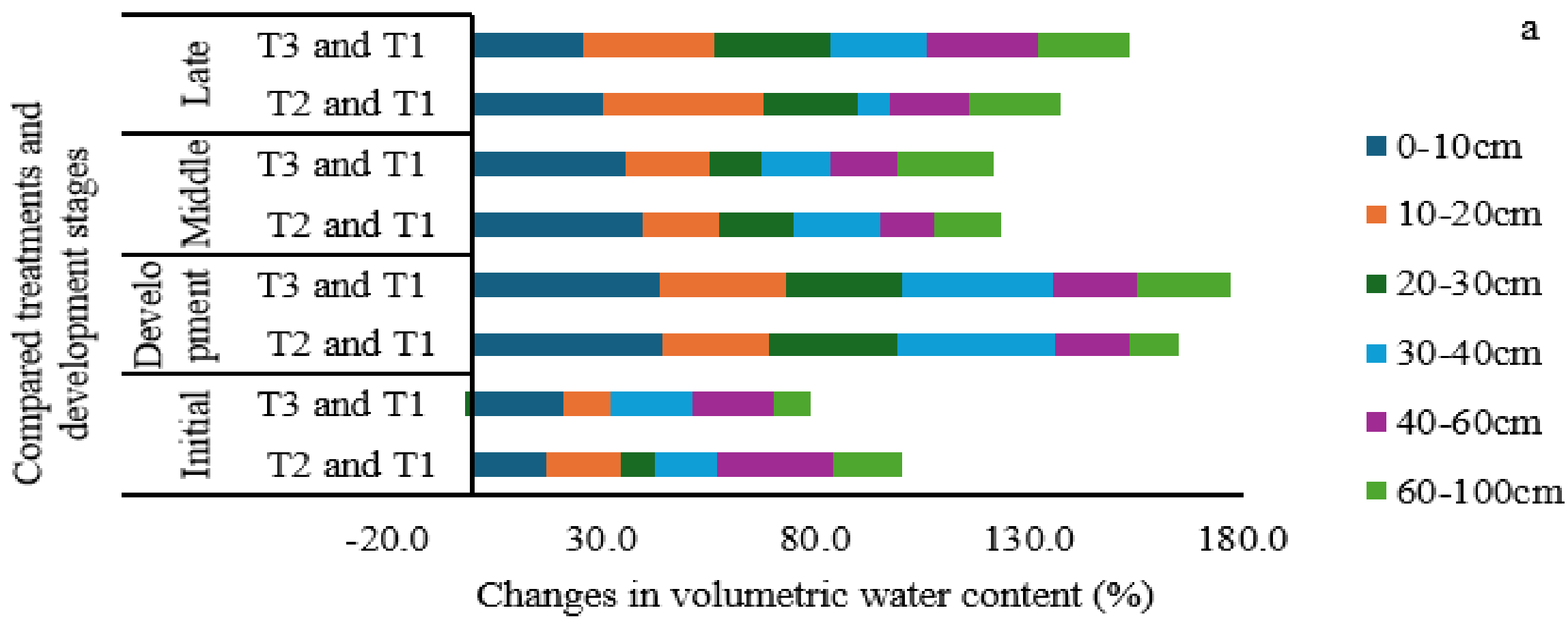
Yield of Tested Crops

- Bundling helps to increase production.
- T2 – increased cabbage (13%); chili pepper (44%).
- Soil fertility
- Nutrient uptake
- Water-use efficiency



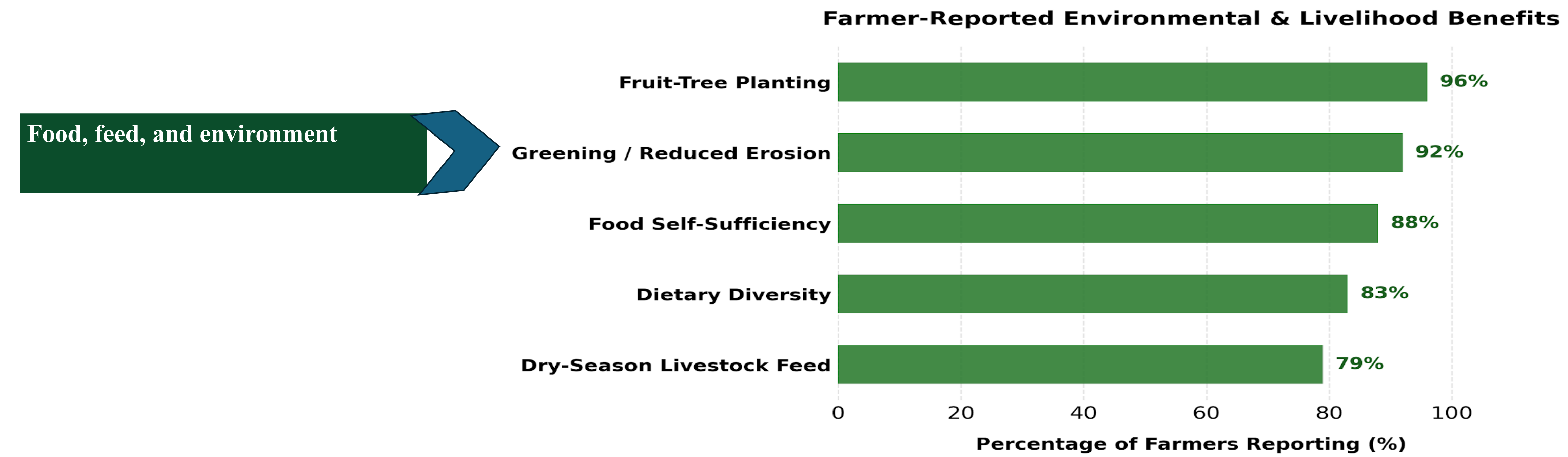
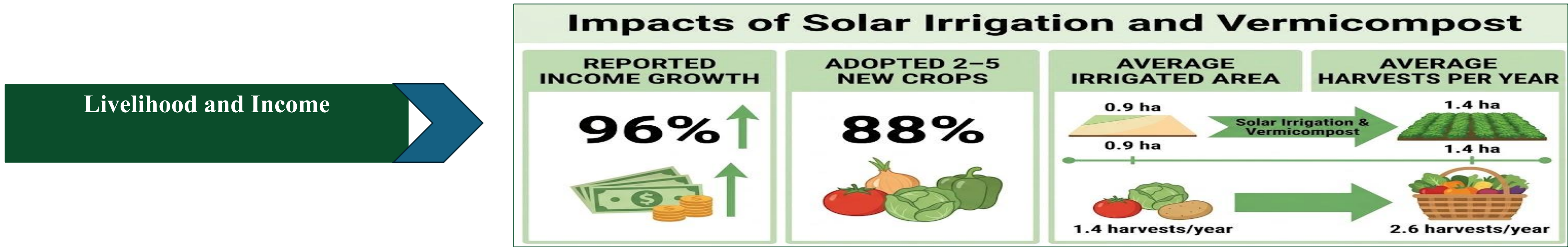
Soil Moisture Availability

Treated plots generally retained more soil moisture volume than the control, with greater differences during later crop stages and within effective rooting depths.



Economic Viability

Findings suggest that bundling solar-based irrigation with vermicompost could be an economically viable option, help increase households' income, and support the adoption and wider use of solar-based irrigation.



Interpretation for Scaling

- Bundle solar pumps with soil fertility management and extension support.
- Strengthen market links, transport, storage, and cooperative marketing.
- Use credit, subsidies, or cooperative finance to reduce upfront costs.
- Promote inclusive access, efficient water management, and groundwater monitoring.

Conclusion: Bundling solar irrigation with vermicompost can improve productivity, soil moisture retention, and livelihood outcomes.

