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Agriculture & Food

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Does Sustainable Intensification Pay? Evidence from Sub-Saharan Africa

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Problem statement and findings

Sustainable agricultural intensification (SI)	• Widespread soil degradation & more erratic and changing weather
Good for jobs?	• Little known about the labor requirements and the returns to family labor
Opportunity	• new data from 7 African countries w/ info on SI practices & ag labor
Finding	• Only cereal-legume intercropping consistently showing pos returns to labor
Take away	• More empirical evidence needed, as well as supportive policies in the interim

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Analyzed SI practices

Cereal-legume intercropping	• Defined as the joint cultivation of cereals and legumes on the same plot, either as mixed stands or intercropped.
Organic fertilizer	• If the farmer applied any quantity of organic fertilizer on the plot.
Soil and water conservation measures.	• Captured if any intervention—including bunding, terracing, ridging, vegetative strips, or hedgerows —is present on the plot.
Agroforestry	• Defined as the joint cultivation of trees (both fruit- and non-fruitbearing and non-tree crops on the same plot.

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Data

					Type of analysis		
Country	**Survey name**	**Source**	**Year**	**Practices**	**HH**	**Plot**	**Panel**
Burkina Faso	Enquête Harmonisée sur le Conditions de Vie des Ménages, Panel Survey	EHCVM	2021-22	3	X		
Ethiopia	Socioeconomic Survey (ESS)	LSMS-ISA	2018-19	4	X	X	X
Ethiopia[a]	Socioeconomic Panel Survey (ESS)	LSMS-ISA	2020-2021	4			X
Malawi	Integrated Household Panel Survey (IHPS)	LSMS-ISA	2016-2017	4			X
Malawi	Integrated Panel Household Survey (IHPS)	LSMS-ISA	2019-20	4	X	X	X
Mali	Enquête Harmonisée sur le Conditions de Vie des Ménages	EHCVM	2021-22	3	X		
Nigeria	Nigeria General Household Survey (GHS)	LSMS-ISA	2018-19	4	X	X	
Tanzania	Tanzania National Panel Survey (TZNPS)	LSMS-ISA	2021-22	4	X	X	
Togo	Enquête Harmonisée sur le Conditions de Vie des Ménages	EHCVM	2021-22	3	X		

Note: 3 practices correspond to cereal-legume intercropping, use of organic fertilizers and agroforestry, while 4 practices include also soil and water conservation measures.
[a] We did not use the latest wave of Ethiopia for the main analysis, as information on cellphone ownership was missing, which belongs to the standard set of control variables in our main analyses.

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Each practice adopted by 22-42 % of the farmers; SI most widely practiced in ETH and MWI

Households adopting (%):	All	ETH	MWI	NGA	TZA	BFA	MLI	TGO
Intercropping	23	9	16	32	31	27	13	16
Organic fertilizer	42	73	34	31	23	55	51	8
Soil and water conservation	33	80	53	4	13	NA	NA	NA
Agroforestry	22	30	50	8	33	2	1	20

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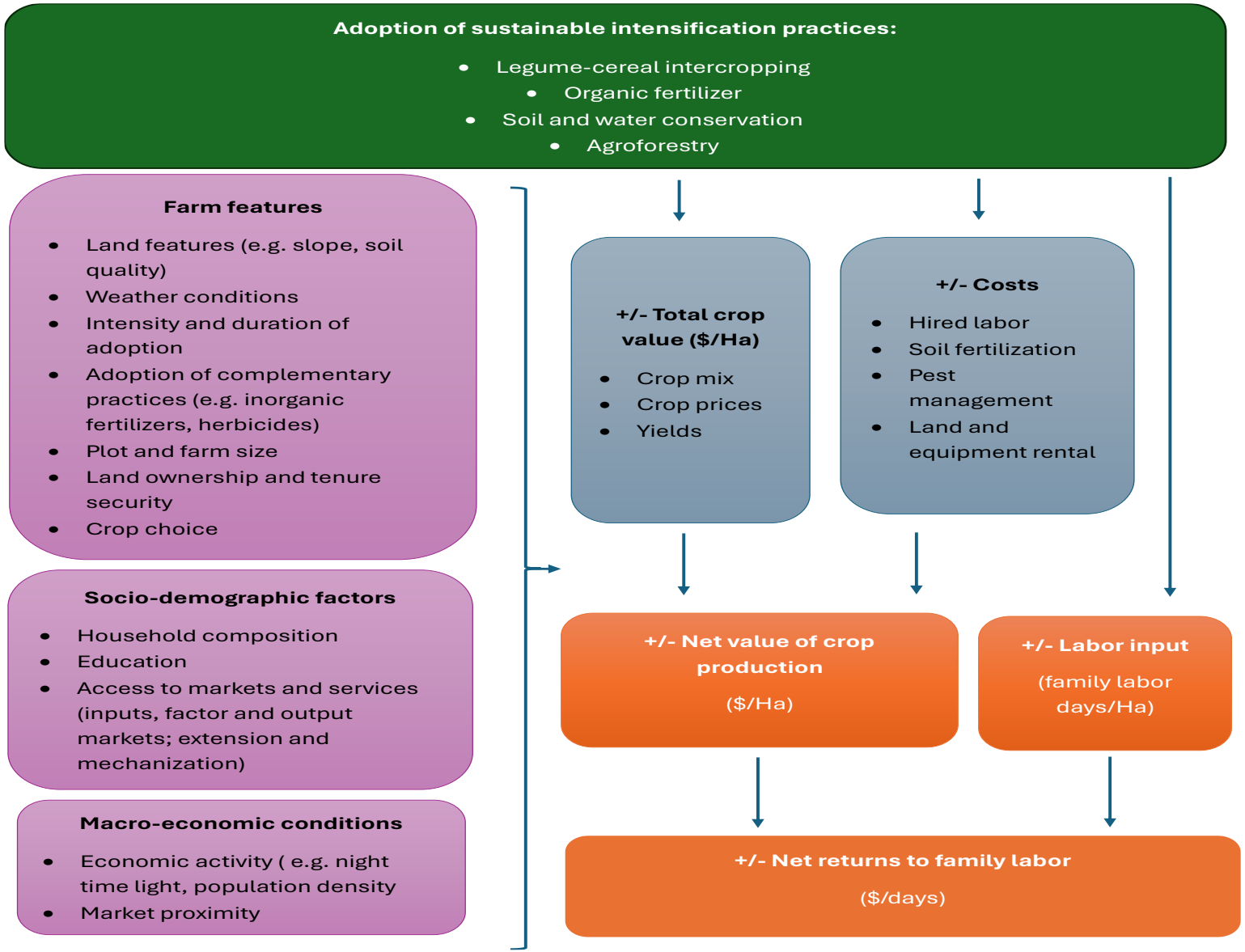
Conceptual framework



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Addressing potential source of bias

- Endogeneity due to omitted variable bias and reverse causality
  - Adoption of SI practices may be influenced by omitted observable and unobservable factors, which may also be affect the outcome variables.

➢ Explored Endogenous Switching Regression (ESR) & Instrumental variable (IV) approach
  - No suitable instrument due to multiple practices and the diversity of contexts

➢ Inclusion of an extensive set of control variables that account for key household, farm, and spatial characteristics

➢ Inclusion of country fixed effects to absorb time-invariant heterogeneity across national contexts and measurement

➢ Robustness checks
  - Plot-level model with household fixed effects
  - Household fixed effects panel model (only for Ethiopia and Malawi)

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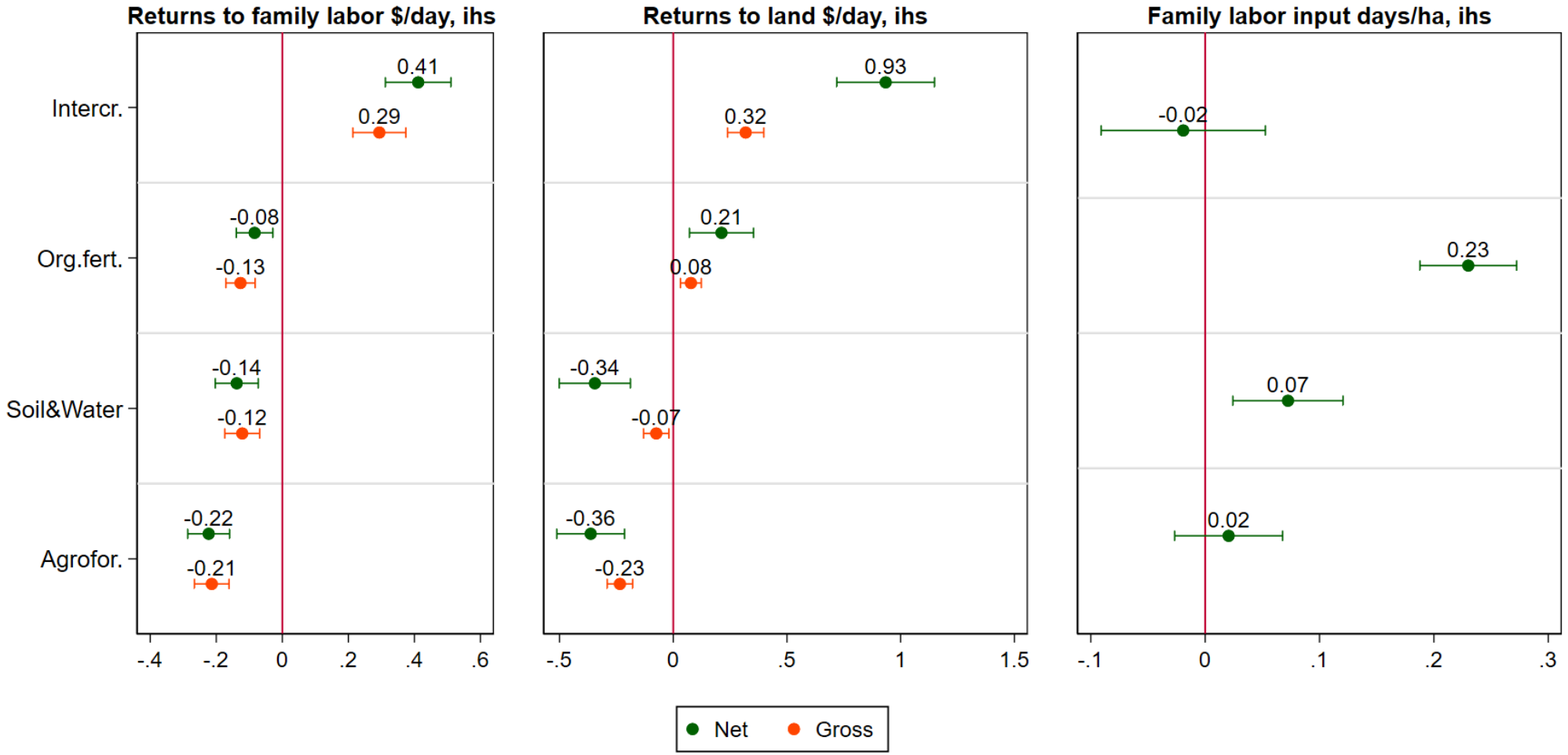
Positive returns to family labor from intercropping, but negative returns for the other practices

Plot level
4 countries



Note: Authors' own elaboration. Data from LSMS surveys from Ethiopia, Malawi, Nigeria and Tanzania (N=24,369). All models use OLS regression with household, farm and spatial covariates, as well as country fixed effects. All outcomes are inverse hyperbolic sine transformed. SE are clustered at the HH level. 95% confidence intervals. SI practices defined as dummy variables if applied at the plot.

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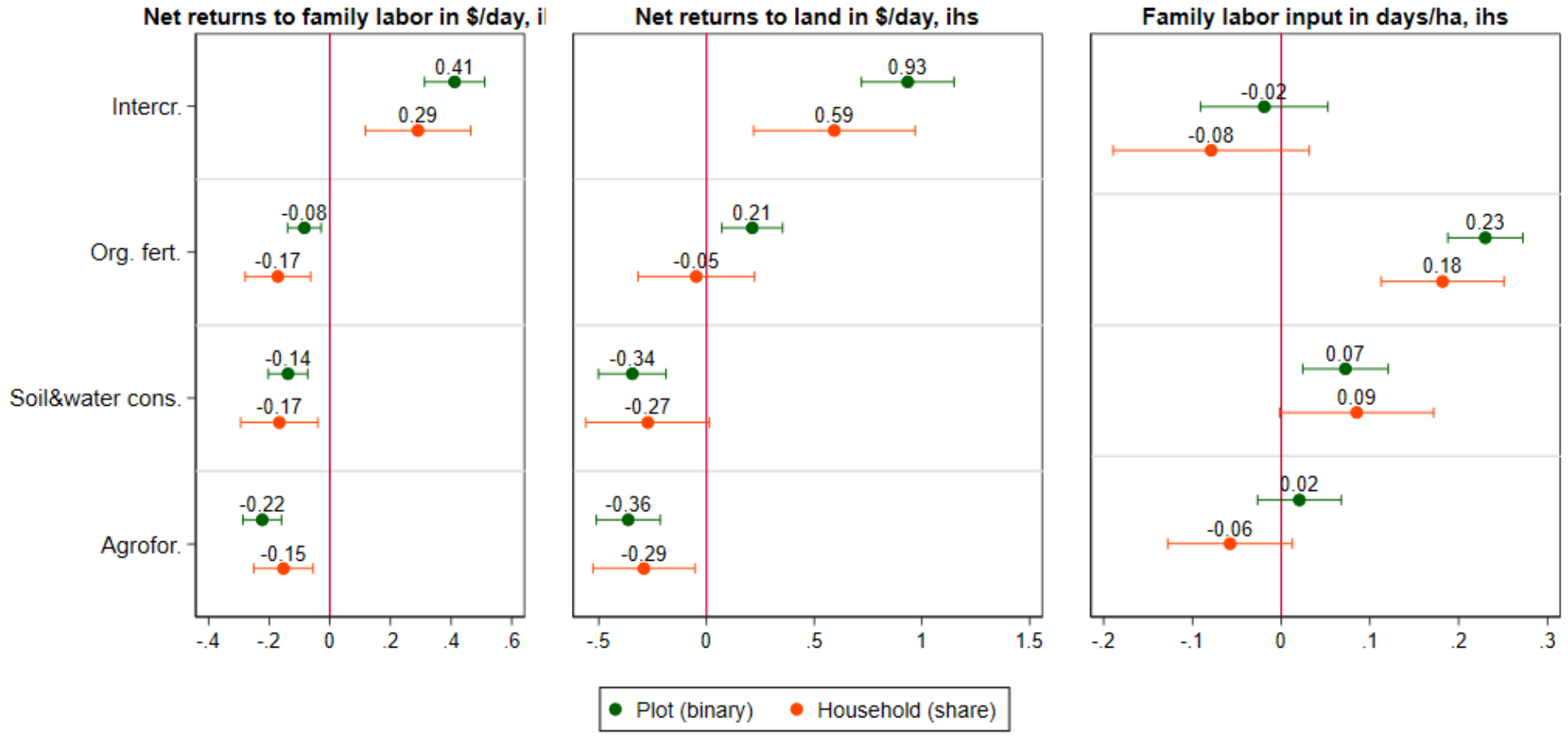
Results persist at the household level

Household & plot level
4 countries



Note: Authors' own elaboration. Data from LSMS surveys from Ethiopia, Malawi, Nigeria and Tanzania, (household sample = 8,920; plot sample = 24,369). All models use OLS regression with household, farm and spatial covariates, as well as country fixed effects. SE is clustered at the PSU level. All outcomes are inverse hyperbolic sine -transformed- 95% confidence intervals. SI practices defined as the % of land upon which the practice is applied in the HH level analysis, dummies for application in the plot level analysis.

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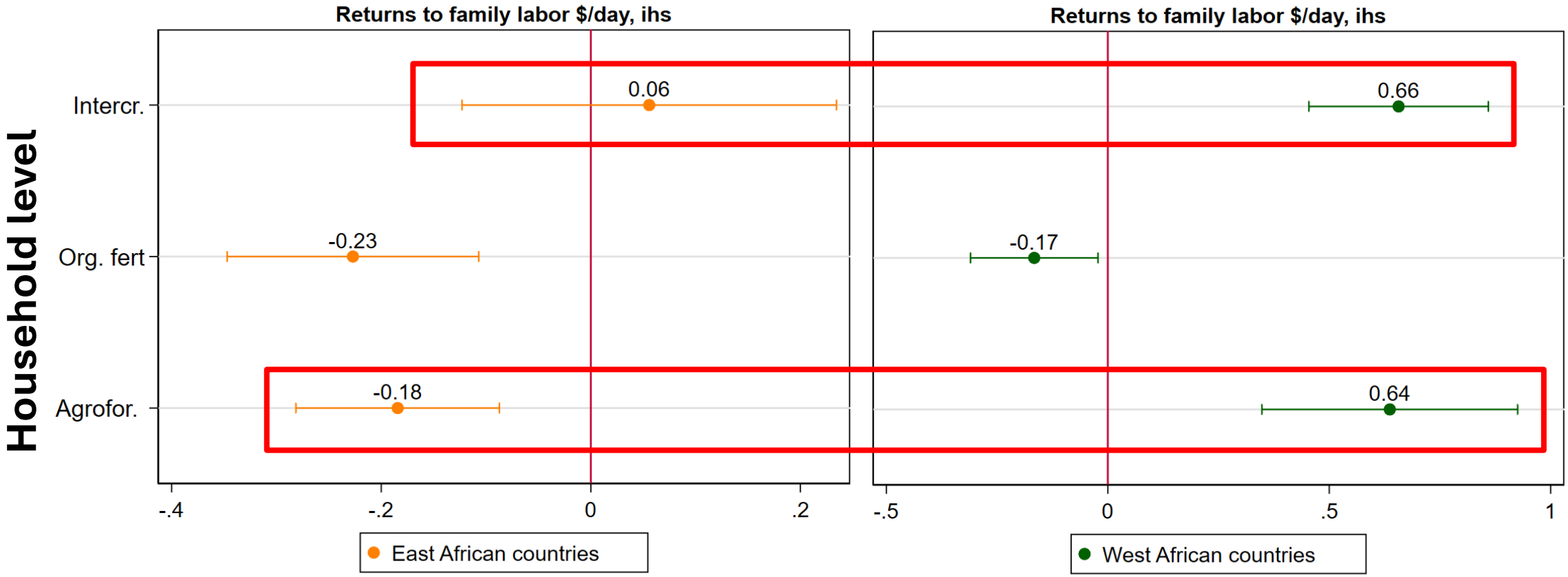
Context matters: returns to family labor are much larger for intercropping in W-Africa and positive for agroforestry



Note: Authors' own elaboration. Data from LSMS surveys for Ethiopia, Malawi, Nigeria, Tanzania, N=8,868) and EHCVM surveys (Burkina Faso, Mali, and Togo, N=7,227). West African countries are all EHCVM countries plus Nigeria. All models use OLS regression with household, farm and spatial covariates, as well as country fixed effects. All outcomes are ihs-transformed. SE is clustered at the PSU level. 95% confidence intervals. SI practices defined as the % of land upon which the practice is applied.

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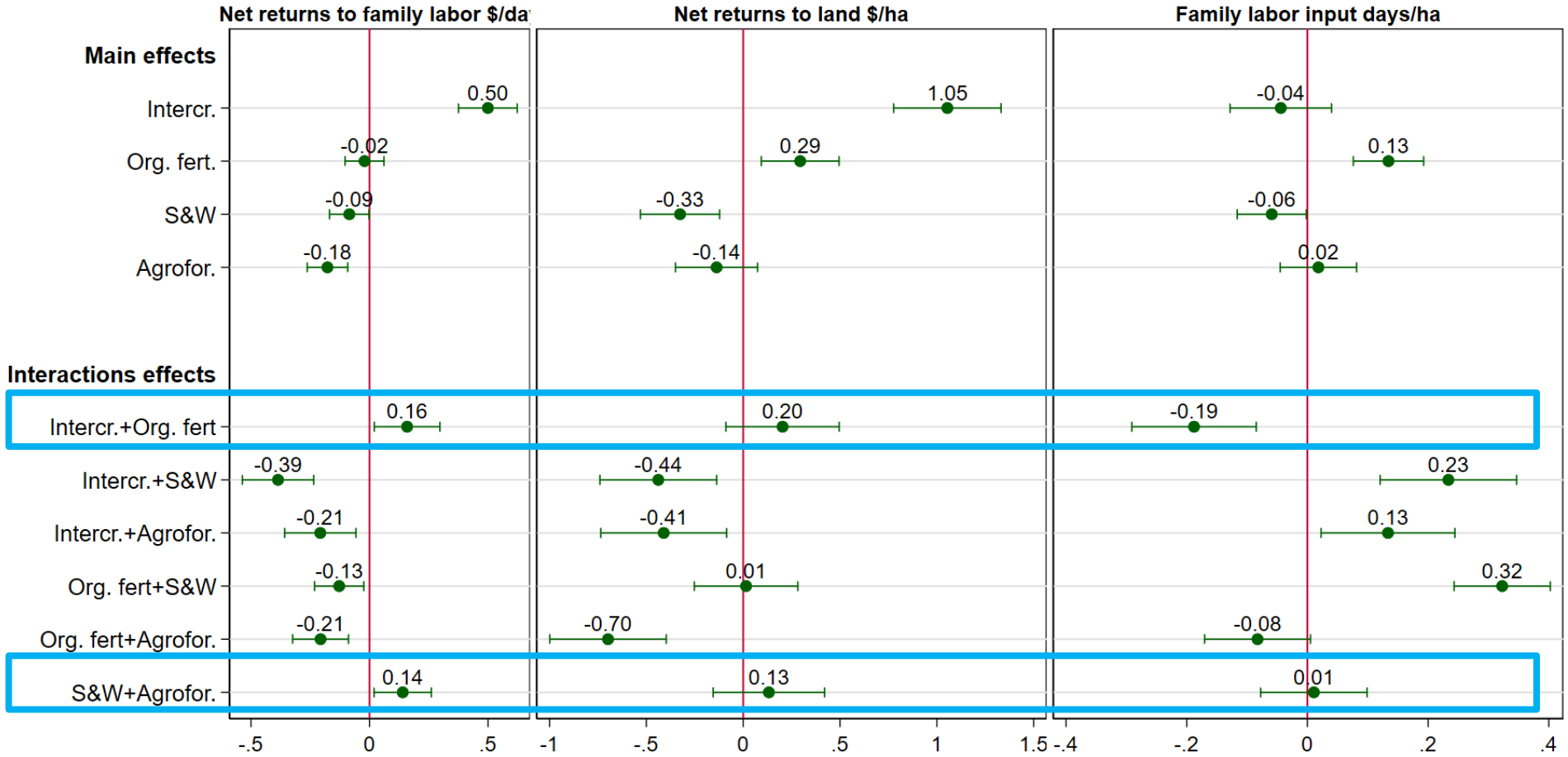
Synergies from joint SI practices on return to labor limited to two combinations; effects mostly negative

Plot level
4 countries



Note: Plot level, 4 countries. Authors' own elaboration. Data from LSMS surveys from Ethiopia, Malawi, Nigeria and Tanzania (N=24,369). All models use OLS regression with household, farm and spatial covariates, as well as country fixed effects. SE is clustered at the HH level. 95% confidence intervals. SI practices defined binary variables indicating adoption at the plot level.

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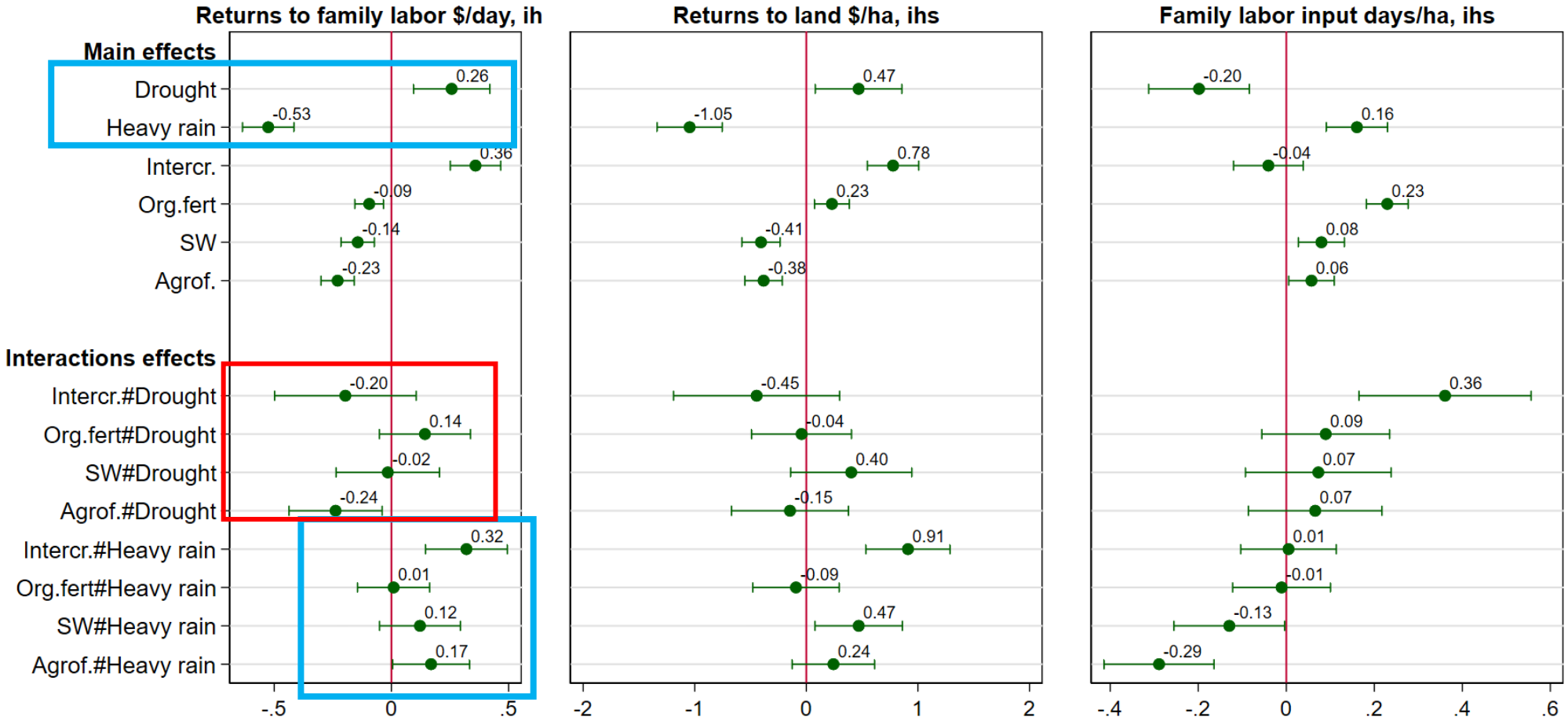
SI and resilience: Drought affects return to labor positively (less labor); flood negatively; SI does not protect against drought (exc org fert) but helps w/flood

Plot level
4 countries



Note: Authors' own elaboration. Data from LSMS surveys from Ethiopia, Malawi, Nigeria and Tanzania (N=24,369). All models use OLS regression with household, farm and spatial covariates, as well as country fixed effects. All outcomes are ihs-transformed SE is clustered at the HH level. 95% confidence intervals SI practices defined binary variables indicating adoption on the plot level.

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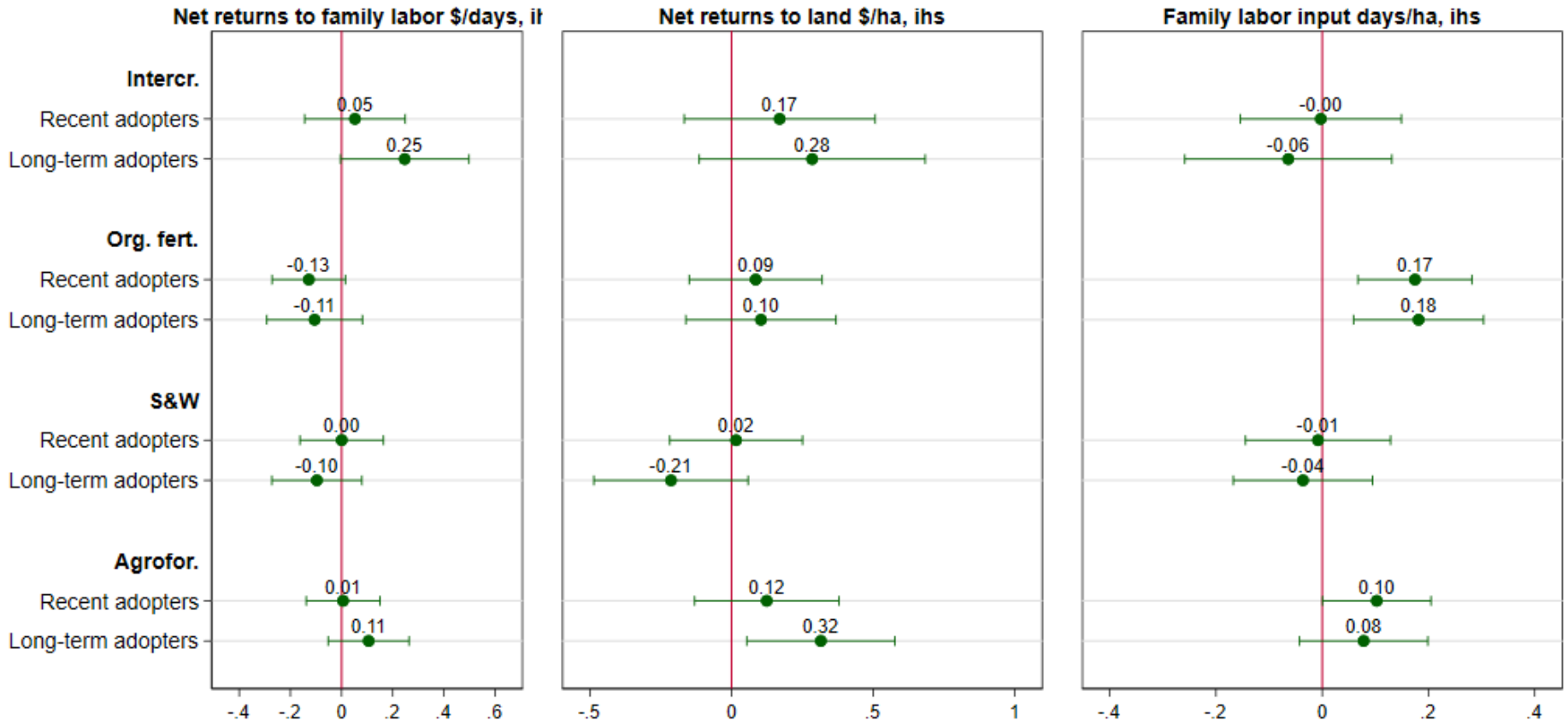
No real discernible improvements in returns to labor from SI over time (3 years), but longer time frames needed

Household level
2 countries



Notes: The analysis is conducted over a three-year timeframe, using two points in time: 2019 and 2016 for **Ethiopia** and 2020 and 2017 for **Malawi**. All models use OLS regression with household, plot and spatial covariates and country fixed effects from first wave. All outcomes are ihs-transformed. SE is clustered at PSU level. 95% confidence intervals. Long-term adopters are compared to short-term adopters, controlling for those who dis-adopted within the past three years and never adopted. Data from LSMS surveys from Ethiopia and Malawi (N = 2,562). Intercropping is defined as the joint cultivation of cereals and legumes on the same plot, as mixed stands or intercropped. Agroforestry is defined as the joint cultivation of trees and non-tree crops on the same plot; trees include fruit-bearing and non-fruit-bearing trees.

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Conclusion

- SI adoption is often associated with **reduced net returns to family labor including b/c increased labor needs not offset by higher returns to land**
- **Only cereal-legume intercropping** consistently shows positive returns. Context also matters (agroforestry positive in West Africa).
- **Joint adoption:** Mostly no gains from joint SI adoption (even the opposite)
- **Context matters:** higher returns to family labor from intercropping and positive returns to agroforestry in West Africa
- **Resilience:** SI partially offsets decline in labor returns under flood
- **Duration:** no real discernible increase in returns to labor over time (3 years).

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Policy implications

- SI is **not a universal "win-win" solution**. It can impose private costs on small-scale farmers while generating public environmental goods.

- Three entry points to address potential income losses:
  - **Mechanization and labor-saving technologies** can help offset the increased labor demand associated with adopting SI practices.
  - **Payments for ecosystem services** (climate finance, carbon markets)
  - **Social protection programs** (e.g. public works, cash transfers)

- **More attention needed** to the labor implications of SI practices (RCTs; long term effects; effectiveness of support)

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