The welfare effects of switching to sustainable farming

Results strictly following PAP

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Abstract

The intervention provides information and two rounds of training on organic farming practices. The intervention is implemented as a randomized controlled trial (RCT). Whereas a first study has focused on the short term effects with respect to knowledge, perceptions, awareness and experimentation (Grimm & Luck, 2023), this study will take a longer horizon and focus on the adoption of organic farming practices, conversion from conventional to organic farming and the effects on farmers' welfare conditional on adoption. Welfare will be measured through agricultural profits and revenue, nutritional security, subjective wellbeing and health. This study can rely on a four-wave panel data set (baseline, two midline and endline survey) and substantial qualitative field research.

Kommentiert [NL1]: Copied from AEA portal

Summary Results (PAP)

We estimate intent-to-treat (ITT) effects of organic farming training on Indonesian smallholders' welfare indicators. The training showed no impact on farm-level outcomes, including farming revenues, household labor allocation, total expenditures, or disaggregated spending on chemical inputs, organic inputs, and hired labor. Some evidence suggests the training reduced self-reported health issues in the treatment group. However, this effect is expected to arise from reduced chemical use and exposure during handling, yet no correlation between chemical input expenditures and health outcomes was found. These results should therefore be interpreted cautiously. Training exposure did not affect satisfaction with job, income, or free time, nor did it produce consistent effects on perceptions of farming. Respondents rated their agreement with statements such as "farming is worthwhile for youth," "farming preserves nature," and "farming is an opportunity to become wealthy." A small positive effect emerged for the perception that farming is worthwhile for the youth.

More details, including the analysis of adoption dynamics will be published in a separate paper. This document refers purely to the outcomes outlined in the PAP.

Key outcomes and empirical estimation

Primary Outcomes

Agricultural yields, revenue, profits, labor

- Agricultural revenue (per ha) during the last season measured at the respondent level & separately for rice
- Agricultural profits (per ha) during the last season measured at the respondent level & separately for rice (considering revenues, input costs, land rent costs and labor cost)
- Rice yields (per ha) during the last season at the respondent level (for those respondents that grow rice)
- Average respondent and family labor during the last season per ha (we will pay particular attention to rice plots because around 85% of respondents in previous waves cultivated at least 1 rice plot. Looking at the same commodity across respondents will increase comparability)

Secondary Outcomes

Income and wealth

- Satisfaction with household income: measured on a scale from 1 (not satisfied at all) to 10 (very satisfied)
- Asset ownership index (motorcycle, car, fridge, washing machine, Laptop, TV)
- Electricity expenditures per HH member (in 000 IDR)
- Financial distress: Binary variable =1 if respondent answers that HH was in financial distress anytime during the last 6 months (financial distress: unable to fulfil usual daily expenditures)
- Nutritional insecurity: Binary variable =1 if respondent answers that HH faced with a situation when there has not been enough food to feed the HH during the last 6 months

Health

- Health perception: Respondents perception of own current health on a scale from 1 to 10. 1 means the worst health the respondent can imagine and 10 means the best health the respondent can imagine.
- Perceived health complaints: skin irritation (itchy), skin irritation (hurt), sore throat, cough, dizziness, diarrhea during the last 2 months. Binary variables=1 if respondent reports yes for the respective complaint. We will also measure this as an index variable ranging from 0 (no complaints) to 6 (suffered from all 6 complaints)

Perception & satisfaction

- Perceptions farming:
    - Perspective future generations: For the youth it is worth to engage in farming (binary=1) if respondent agrees /agrees very much

- Perspective business person: A successful farmer is regarded like a successful business person (binary=1) if respondent agrees /agrees very much
- Perspective income opportunities: Farming is a good opportunity to become wealthy (binary=1) if respondent agrees /agrees very much

- Satisfaction:
  - Satisfaction being a farmer: measured on a scale from 1 (not satisfied at all) to 10 (very satisfied)
  - Satisfaction with amount and quality of free time: measured on a scale from 1 (not satisfied at all) to 10 (very satisfied)

Empirical Strategy for Intent-to-Treat Effects

To measure the impact of the repeated training on our key outcomes of interest, we will run regressions of the following form:

(1) $$Y_{iv} = \beta_{0\,iv} + \beta_1 T_v + \beta_2 X_{ij}^0 + \beta_3 Y_{iv}^0 + \beta_4 S_v + \varepsilon_{ij}$$

where Y_{iv} is the outcome of interest for a given respondent *i* in village *v* measured at the time of the fourth survey wave in 2023. T_v is a binary variable indicating whether the respondent lives in a village that was assigned to the training intervention. β_1 captures the treatment effect. While the treatment was randomized, we use additional covariates to increase the precision of the estimates. X_{ij}^0 denotes a vector of control variables, measured at baseline. Y_{iv}^0 denotes the outcome variable at baseline. We will include this variable as a control whenever available. Because this variable is not available for all outcomes and because for some outcomes, the baseline and endline measurements are not completely identical, we choose this ANCOVA treatment effect model. S_v captures the randomization strata and ε_{ij} denotes the individual level error term, that is clustered at the village level.

Descriptives and Balance

Table 1
Baseline summary statistics (2018)

	Sample mean	sd	Control group mean	Treatment group mean	C-T
Individual and household characteristics					
Male (=1)	0.83	0.38	0.79	0.87	-0.08***
Age (in yrs.)	53.75	11.78	54.40	53.09	1.31
Muslim (=1)	0.96	0.18	0.95	0.97	-0.02
Completed junior high school (=1)	0.47	0.50	0.46	0.48	-0.02
Refrigerator (=1)	0.37	0.48	0.34	0.40	-0.05
Washing machine (=1)	0.14	0.35	0.13	0.15	-0.03
Financial difficulty last 12 months (=1)	0.55	0.50	0.55	0.56	-0.01
Farming is main activity (=1)	0.78	0.41	0.79	0.78	0.00
Farmers' decisions matter (perception) (=1)	0.57	0.49	0.58	0.56	0.02
Agr. environmental pollution is a problem (perception) (=1)	0.46	0.50	0.46	0.45	0.01
Agricultural characteristics					
Cultivated land (in ha)	0.35	0.44	0.30	0.41	-0.11***
Land ownership share	0.61	0.43	0.62	0.61	0.01
Rice (=1 if respondent planted rice)	0.93	0.26	0.94	0.91	0.03*
p-value for joint orthogonality test			0.03		
p-value for joint orthogonality test (13 land outliers (>2ha) dropped)			0.17		

Note: Total N= 1,200 respondents at baseline, from a total of 60 villages with 20 respondents per village. The treatment group comprises 600 farmers and the control group comprises 600 farmers. C-T denotes the difference in means, significant differences are denoted as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 1 reports baseline summary statistics by treatment status. We employ a joint orthogonality F-test to assess baseline balance between the control and treatment groups. Despite randomization, we obtain a p-value below 10% (p = 0.03). This appears to be driven by differences in gender composition and cultivated land sizes. Re-estimating the joint orthogonality F-test but excluding outliers with cultivated land sizes greater than 2 hectares increases the p-value substantially to 0.17. Apart from these two variables, baseline characteristics are well-balanced between the groups. Additionally, there are no substantial differences between the treatment and control group with respect to any other structural variables not shown in Table 1.

At baseline, data were collected from the full sample of 1,200 respondents. The sample size decreased to 1,148 in the first follow-up, 1,017 in the second, and 942 in the third follow-up survey, reflecting an attrition rate of 22% from baseline to 2023. Attrition was primarily due to respondents passing away, health issues preventing interviews, discontinuation of farming activities (mainly due to age), or migration.

Results

ITT effects on primary outcomes "Agricultural yields, revenue, profits, labor"

Table 2
Treatment effects (ITT): Farm outcomes (all plots)

	(1) Revenue IDR 1,000/ha	(2) HH labor (h/week)	(3) Expenditures all IDR 1,000/ha	(4) Profits IDR 1,000/ha	(5) Profits IDR 1,000/ha
Treatment	-1,001.915	-0.020	-395.946	-602.298	-601.075
	(0.495)	(0.992)	(0.612)	(0.483)	(0.475)
Control mean (2023)	5194.24	24.037	8012.952	-7145.519	-8587.788
Assumption wage in IDR 1,000				15	20
N		942	942	942	942
R-squared adj.		0.109	0.086	0.085	0.092

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. Expenditures and revenue are top codded at 99%. For profits, the value HH labor had to be estimated in IDR. Cols. 4 and 5 present profit estimations based on the lower and upper bound of common agricultural worker wages in the region.

Table 2 presents the ITT effects of the training on farm outcomes per hectare, including revenue, household labor (hours per week), expenditures, and profits. A reduction in yields and high labor demands are a commonly voiced concern regarding organic farming. The results show no statistically significant impact of the training on any of these outcomes. To estimate profits, household labor hours are valued using the local agricultural worker wage at two bounds: a lower and an upper estimate (columns 4 and 5). Notably, nearly 50% of farmers did not sell any harvest, and 70% sold no rice harvest. Instead, much of the production was for self-consumption or partly given to landowners under share-cropping arrangements. The organic farming training could plausibly affect revenues and profits either by increasing/decreasing farm output or by enabling farmers to obtain higher prices for semi-organic or fully organic products. However, because a large share of farmers did not participate in sales, the price channel is largely inactive for this sample, which likely contributes to the lack of observed effects in the data.

Table 3
Treatment effects (ITT): Farm outcomes (all plots)

			Expenditures details		
	(1) HH labor (h/week)	(2) Expenditures all IDR 1,000/ha	(3) Chemicals inputs IDR 1,000/ha	(4) Organic inputs IDR 1,000/ha	(5) Hired labor IDR 1,000/ha
Treatment	-0.020	-395.946	-47.334	124.052	-519.558
	(0.992)	(0.612)	(0.857)	(0.234)	(0.275)
Control mean (2023)	24.037	8012.952	2262.41	237.424	5188.341
N	942	942	942	942	942
R-squared adj.	0.109	0.086	0.085	0.092	0.082

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. Expenditure variables are top codded at 99%.

Table 3 reports the ITT effects of the training on detailed expenditure categories per hectare, including household labor hours, total expenditures, chemical inputs, organic inputs, and hired labor costs. Table 4 reports the ITT effects only for rice plot outcomes. The results show no statistically significant impact of the training on any of these outcomes.

Table 4
Treatment effects (ITT): Farm outcomes rice plots

	(1) HH labor (h/week)	(2) Hired labor IDR 1,000/ha	(3) Chemicals inputs IDR 1,000/ha	(4) Rice harvest ton /ha	(5) Revenue IDR 1,000/ha
Treatment	0.407	-165.047	-279.645	0.021	-892.713
	(0.565)	(0.627)	(0.255)	(0.924)	(0.383)
Control mean (2023)	4.63	4824.044	2594.318	4.549	8294.524
N	873	873	873	854	238
R-squared adj.	0.075	0.072	0.118	0.079	0.105

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. Expenditure variables and revenue are top codded at 99%. The sample for harvest (Col. 4) is smaller because 20 respondents did not harvest anything by themselves and instead sold the "right to harvest" to someone else. The sample in Col. (5) is smaller because only few respondents sold their rice harvest.

ITT effects on secondary outcomes "Income and wealth"

Table 5 reports the ITT effects of the training on farmers' satisfaction with their income, an asset index, electricity expenses per household member and nutritional insecurity. The results show no statistically significant impact of the training on any of these outcomes.

Table 5
Treatment effects (ITT): Income, wealth and financial distress

	(1) Satisfaction income (1-10)	(2) Asset index (0-6)	(3) Electricity expenditure IDR 1,000/ HH member	(4) Financial distress (=1)	(5) Nutritional insecurity (=1)
Treatment	0.048	0.051	-1.935	-0.051	-0.027
	(0.752)	(0.636)	(0.402)	(0.242)	(0.311)
Control mean (2023)	6.611	2.731	25.328	0.523	0.145
N	942	942	942	942	942
R-squared adj.	0.036	0.339	0.094	0.086	0.063

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. The asset index (Col. 2) reflects ownership of the following 6 assets: motorcycle, car, fridge, washing machine, Laptop, TV. Financial distress and nutritional insecurity refer to the past 6 months.

ITT effects on secondary outcomes "Health"

Table 6
Treatment effects (ITT): Health outcomes

			Health complaints					
	(1) Health perceptions (score 1-10)	(2) Health complaints index (0-6)	(3) Skin irritation (itchy) (=1)	(4) Skin irritation (hurt) (=1)	(5) Sore throat (=1)	(6) Cough (=1)	(7) Dizziness (=1)	(8) Diarrhea (=1)
Treatment	0.085	-0.120	0.001	-0.016	-0.044*	-0.067**	0.016	-0.009
	(0.538)	(0.176)	(0.981)	(0.420)	(0.054)	(0.031)	(0.558)	(0.548)
Control mean (2023)	7.823	1.351	0.349	0.145	0.21	0.387	0.187	0.074
N	942	942	942	942	942	942	942	942
R-squared adj.	0.068	0.101	0.042	0.053	0.061	0.044	0.085	0.012

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018.

Table 6 presents the ITT effects of the training on farmers' reported health outcomes. The motivation for analyzing health impacts is that frequent exposure to agricultural chemicals, especially without protective gear, a common situation among Indonesian smallholders, can lead to adverse health effects. Results indicate that farmers in the treatment group report fewer health issues for some categories. To investigate potential mechanisms (not part of the PAP), Table 7 examines the relationship between health complaints and chemical use. Chemical input use is approximated a binary indicator for any pesticide use in the last season, and nitrogen application per hectare from chemical fertilizers (Table 7). Overall, we find no link chemical input measures and health outcomes. We therefore note that these results should be interpreted only cautiously.

Table 7
Correlation chemical inputs use: Health outcomes

			Health complaints					
	(1) Health perceptions (score 1-10)	(2) Health complaints index (0-6)	(3) Skin irritation (itchy) (=1)	(4) Skin irritation (hurt) (=1)	(5) Sore throat (=1)	(6) Cough (=1)	(7) Dizziness (=1)	(8) Diarrhea (=1)
Nitrogen kg/ha	-0.001*	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
	(0.070)	(0.531)	(0.553)	(0.740)	(0.549)	(0.684)	(0.424)	(0.163)
Pesticide used (=1)	-0.123	-0.005	-0.020	-0.037	0.011	0.058	-0.008	-0.008
	(0.346)	(0.960)	(0.612)	(0.122)	(0.698)	(0.115)	(0.784)	(0.638)
Control mean (2023)	7.795	1.41	0.36	0.153	0.221	0.401	0.198	0.077
N	873	873	873	873	873	873	873	873
R-squared adj.	0.076	0.077	0.044	0.050	0.061	0.041	0.087	0.017

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. The sample is restricted to respondents who grew rice in 2023 as information on nitrogen kg/ha is only available for them.

ITT effects on secondary outcomes "Perception & satisfaction"

Table 8 presents the ITT effects of the training on farmers' satisfaction with their job, free time, and their perception of farming. The results show no statistically significant impact of the training on most outcomes, except for the perception of whether farming is worthwhile for youth, where a positive effect is observed.

Table 8
Treatment effects (ITT): Satisfaction and perception of farming

	Satisfaction (score 1 - 10)		Perception of farming (agree=1)		
	(1) Job	(2) Free time	(3) Worthwhile youth	(4) Business person	(5) Wealth opportunity
Treatment	0.171	-0.027	0.042**	0.025	0.021
	(0.227)	(0.824)	(0.027)	(0.369)	(0.292)
Control mean	6.916	7.209	0.893	0.966	0.876
N	942	942	942	942	942
R-squared adj.	0.031	0.080	0.043	0.093	0.061

Note: *** p<0.01, ** p<0.05, * p<0.1. Robust p-values (clustered at the village level) in parentheses. Number of villages=60. All regressions include strata fixed effects and the following controls: gender 2018, age 2018, junior high school 2018, asset ownership 2018, farming main job 2018, land share owned 2018, land size cultivated 2018. Perception is coded as "agree" if respondents reported to strongly agree or agree.