Supplementary Material

Farming Without a Livelihood: Structural Differentiation and Household Income Among Paddy Farmers in West Java, Indonesia. This file contains Supplementary Table S1 (regression models), Supplementary Note S2 (the modelled dry season and the sensitivity of expenditure coverage), and Supplementary Note S3 (notes on method, robustness and known limits).

Supplementary Table S1. Ordinary least squares models, HC3 robust standard errors

Term	R/C ratio	Expenditure coverage (%)	Yield (kg/ha)
log farm size	0.372 (<0.001)	32.5 (<0.001)	230 (<0.001)
water secure (combined measure)	-0.158 (0.109)	22.8 (0.345)	222 (0.218)
simple irrigation	-0.340 (0.112)	35.0 (0.282)	-105 (0.756)
semi-technical irrigation	0.046 (0.812)	28.3 (0.260)	-528 (0.063)
technical irrigation	-0.522 (0.006)	13.2 (0.549)	214 (0.464)
rainfed	-0.411 (0.030)	10.9 (0.713)	-238 (0.433)
Purwakarta	0.467 (<0.001)	-25.4 (0.339)	-177 (0.371)
Subang	0.195 (0.010)	-81.1 (<0.001)	153 (0.273)
Tasikmalaya	0.116 (0.240)	-63.7 (0.008)	-802 (<0.001)
Irrigation type, joint test p	<0.001	0.447	<0.001
Regency, joint test p	0.001	<0.001	<0.001
n	1037	1037	1037
R-squared	0.231	0.082	0.247

Note. Coefficients with p-values in parentheses. Reference categories are lift irrigation and Indramayu. Cell entries are on the scale of the outcome. Farm size is associated with all three outcomes. Irrigation type is jointly associated with yield and with the revenue-to-cost ratio but not with expenditure coverage. Regency is jointly associated with all three outcomes. The combined water-access measure adds no further explanation once irrigation type and regency are in the model. These models describe association, not causal effects.

Supplementary Note S1. The modelled dry season (MT2) and sensitivity of expenditure coverage

The wet season (MT1) is observed; the dry season is modelled per household. Land preparation, machinery and land tax are held constant across seasons. Fertiliser, pesticide and the labour tied

to them scale with an input ratio; seed is held constant because the nursery is carried out in full; harvest labour and output scale with a yield ratio; and expected output is multiplied by one minus a crop failure rate. Base parameters are assigned by water reliability, 0.8, 1.0 and 0 for water-secure households and 0.6, 0.25 and 0.5 for the rest, for the yield ratio, input ratio and crop failure rate respectively. The base model is verified against the dataset: the ratio of modelled dry-season revenue to observed wet-season revenue equals 0.80 for every water-secure household and 0.30 for every household without secure water, exactly as the parameters imply.

Scenario (aggregate expenditure coverage, %)	Small (<0.5 ha)	Medium (0.5-1 ha)	Large (>1 ha)
Main model	79	109	153
No second season at all	77	97	115
Lower bound: family labour charged, not returned	61	84	153
Upper bound: all labour payments returned	81	135	249

Eleven parameter settings were tested, covering yield ratios from 0.5 to 0.7, input ratios from 0.25 to 0.5 and crop failure rates from 0.4 to 0.6, in addition to the no-second-season scenario above. Across these settings, coverage on small farms ranges from 70% to 82% and never reaches full coverage, on medium farms from 79% to 116%, and on large farms from 74% to 170%. The crop failure rate, not the yield ratio, is the parameter to which the result is most sensitive. The base model and the four scenarios in the table above are computed directly from the dataset; the range figures summarise the full set of sensitivity runs.

Supplementary Note S2. Notes on method, robustness and known limits

1. Aggregation. Per-hectare figures in Tables 3, 4 and 5 are class totals divided by class total area. Averaging household-level per-hectare ratios instead gives higher figures for the small class, because a household holding 0.1 hectares carries the same weight as one holding 2 hectares. Both are defensible; the aggregate is reported because it describes the class as a production system. Median household ratios are given alongside so the reader can see the difference.

2. One large outlier excluded. The survey recorded one holding of 35 hectares in Subang, an order of magnitude above the next largest and 7.9% of the total area of the large class on its own. It is excluded from all tables, so the analytical sample is 1,037 of 1,038 households and the large class has 190 rather than 191. Excluding it moves the large-class aggregate R/C from 1.89 to 1.93 and cost per hectare from Rp 16,902,615 to Rp 16,400,914, so no conclusion turns on the decision.

3. Land opportunity cost is deliberately excluded. 769 of 1012 households with recorded tenure (76%) cultivate land they own. The analytical question is the livelihood adequacy of existing smallholders, not the investment return available to a new entrant, for whom land would be a purchased input. The magnitude is reported here so that readers can apply their own judgement.

30 households have a verified land rent payment after name-based links were cleaned, with a median of Rp 21,164,286 per hectare per year, that is Rp 10,582,143 per hectare per season, or 65% of the current production cost per hectare. Charging it to every household would move the aggregate R/C ratio from 1.85 to 1.12, and the small class specifically from 1.65 to 0.99, that is to below break-even. 71 sharecropping households imply a comparable figure. These observations are concentrated in Subang and no rent data were collected in Indramayu, so they are reported as an order of magnitude rather than as a basis for costing. A substantial part of the measured surplus is therefore a return to owning land rather than to farming it, and households with little land capture little of that return.

4. Machinery cost. Machinery is charged as a seasonal rental-equivalent cost per hectare, not as a purchase price. Where a household owned rather than rented equipment, the rental rate prevailing in its own regency was applied. 554 of 1037 households have a machinery entry from the field record; the remaining 483 were reconstructed from enumerator recall and are flagged in the dataset.

5. Dry season (MT2) is modelled, not observed. Land preparation, machinery and tax follow the wet season unchanged. Fertiliser, pesticide and the labour tied to them scale with a fixed input ratio; harvest labour and output scale with the yield ratio; and the whole expected output is multiplied by (1 minus the crop failure rate), set at 0.5 on the basis of the qualitative interviews. The model was replicated independently in Python and matches the spreadsheet to Rp 0 across all 1037 households. Eleven parameter settings were tested, covering yield ratios from 0.5 to 0.7, input ratios from 0.25 to 0.5, crop failure rates from 0.4 to 0.6, and a scenario removing the second season entirely; that scenario leaves aggregate coverage at 77%, 97% and 115% for the three classes. Coverage on small farms ranges from 70% to 82% and never approaches full coverage, on medium farms from 79% to 116%, and on large farms from 74% to 170%. The conclusion is robust for small farms and sensitive to the parameters chosen for the other two classes. The crop failure rate, not the yield ratio, is the parameter the result is most sensitive to.

6. Negative returns. 108 households record a negative wet-season net return and 187 a negative annual farm net return. These are not errors. They are households whose family labour, valued at the market wage, exceeds what the crop earns, which is the situation the paper is describing.

7. Prices. 863 households reported their own farm-gate price and it was used as given. For the remaining 174, the median price of the village, then the sub-district, then the regency was applied in that order. The source of the price used is recorded per household in the dataset.

8. Sample. Enumeration covered approximately 1,100 households across the four regencies, of which 1,038 have complete cost, output and expenditure records. The single 35-hectare outlier described in note 2 is set aside, giving an analytical sample of 1,037. At 95 percent confidence with p = 0.5, the margin of error is 3.0 percentage points for the pooled sample; by regency it is 4.7 points in Subang, 6.3 in Tasikmalaya, 6.5 in Indramayu and 8.7 in Purwakarta. The smallest regency-by-size cell, the 13 large-farm households of Tasikmalaya, carries a margin of 27 points, so proportions for that cell are indicative only.

9. Water as a private cost in Indramayu. Machinery cost per hectare is Rp 2.85 million in Indramayu against Rp 1.70 million in Subang and Rp 0.87 million in Tasikmalaya. Within Indramayu, the 183 pump-owning households spend Rp 3.18 million per hectare on machinery against Rp 1.46 million for the 47 households without a pump, while neither yield nor the revenue-to-cost ratio differs significantly between the two groups (Mann-Whitney $p = 0.363$ and $p = 0.658$). The machinery item includes pump rental, so households without a pump of their own are not necessarily without pumped water.