SUPPLEMENTARY MATERIAL

Profitability of Boundary Poplar and Eucalyptus Plantations for Farmers in Western Uttar Pradesh

Terms used in this file: "adopters" are the tree growers of the main text, and "never-adopters" are the non-growers who had never grown trees. The 21 non-growers who had grown trees earlier are excluded from the comparisons unless stated.

Table S1. Annualised gap between block plantation with wheat intercrop and open rice–wheat cropping (INR/ha/year, 10% discount rate, 2025 prices)

Scenario	Poplar (500 trees/ha)	Eucalyptus (1,665 trees/ha)
Intercrop full rotation, full price	−49,711	90,188
Intercrop full rotation, price −25%	−80,777	24,904
Intercrop full rotation, price −50%	−111,844	−40,380
Intercrop 3 years, full price	−79,614	63,963
Intercrop 3 years, price −25%	−110,681	−1,321
Intercrop 2 years, full price	−89,048	53,418
Intercrop 2 years, price −25%	−120,115	−11,866

Poplar at 5 × 4 m and eucalyptus at 3 × 2 m. Open rice–wheat net return: INR 207,113/ha/year (median). Wheat intercrop net return: INR 61,129/ha/year. Price discounts refer to wood from dense blocks relative to boundary trees. Positive values mean that the block plantation earns more than open rice–wheat cropping; negative values mean that it earns less.

Table S2. Effect of adoption on adopters, all estimators (ATT, log points; % effect in brackets)

Outcome	Weighted OLS	AIPW	Entropy balancing	AIPW, common support	EB, common support	AIPW, with current characteristics
Household income	0.241*** (0.062) [27.3]	0.269*** (0.060) [30.9]	0.020 (0.088) [2.0]†	0.221** (0.080) [24.7]	0.153* (0.072) [16.5]	0.103 (0.065) [10.8]
Per capita income	0.245*** (0.058) [27.8]	0.270*** (0.055) [31.0]	0.020 (0.080) [2.0]†	0.219** (0.072) [24.5]	0.151** (0.064) [16.3]	0.116* (0.063) [12.3]
Farm income per ha	0.064 (0.039) [6.6]	0.029 (0.040) [2.9]	−0.017 (0.061) [−1.7]†	0.051 (0.044) [5.2]	0.037 (0.046) [3.8]	0.172*** (0.033) [18.8]
Crop income per ha	−0.132*** (0.019) [−12.4]	−0.130*** (0.015) [−12.2]	−0.129*** (0.024) [−12.1]†	−0.129*** (0.020) [−12.1]	−0.126*** (0.020) [−11.8]	−0.143*** (0.013) [−13.3]
Household income, stock-based tree income	0.159** (0.056) [17.2]	0.202*** (0.055) [22.4]	−0.047 (0.081) [−4.6]†	0.148* (0.079) [16.0]	0.080 (0.068) [8.3]	
Farm income per ha, stock-based tree income	−0.071* (0.040) [−6.9]	−0.080* (0.039) [−7.7]	−0.126 (0.059) [−11.8]†	−0.071 (0.053) [−6.9]		

ATT = average effect of adoption on adopters; OLS = ordinary least squares; AIPW = augmented inverse probability weighting; EB = entropy balancing. n=219 (120 adopters, 99 never-adopters; common support 100 and 92). All estimates condition on predetermined characteristics (age, schooling, family size, caste, owned land, distances to timber market and road) and block fixed effects and use sampling weights; the last column adds current characteristics (operated area, leased share, parcels, tractor, livestock, organisation membership, extension contacts, credit card, off-farm employment, distance to nursery). Village-clustered standard errors in parentheses (influence-function based for AIPW). $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.10$, using wild cluster bootstrap p-values for OLS and EB and $t(11)$ for AIPW. † Effective comparison group of 17 households.

Table S3. Pathways: effect of adoption on characteristics excluded from the main models

Outcome	Weighted OLS	AIPW	Weighted means: adopters/never-adopters
Operated area (ln ha)	0.110** (0.054)	0.144** (0.055)	1.58/0.98 ha
Leased-in share of operated area	0.064** (0.030)	0.081** (0.031)	0.09/0.11
Total crop income (ln)	−0.022 (0.059)	0.014 (0.053)	INR 246,000/170,000
Livestock income (ln 1+)	−0.131 (0.076)	−0.204** (0.066)	INR 81,000/85,000
Off-farm income (ln 1+)	0.754 (0.799)	0.860 (0.822)	INR 157,000/135,000
Asset score (0 to 11)	0.385* (0.191)	0.439** (0.176)	5.8/5.0

Table S4. Sensitivity to unobserved selection (Oster, 2019; weighted)

	Household income	Per capita income	Farm income per ha	Crop income per ha	Household income, stock-based
Uncontrolled coefficient	0.333	0.306	−0.051	−0.110	0.266
Controlled coefficient	0.241	0.245	0.064	−0.132	0.159
R^2 uncontrolled/controlled	0.08/0.29	0.06/0.38	0.00/0.47	0.17/0.22	0.05/0.29
Bias-adjusted coefficient (δ=1)	0.203	0.223	0.099	−0.162	0.120
δ for coefficient=0	6.3	11.4	<0	<0	4.1

Weighted least squares with predetermined covariates and block fixed effects. $R_{max}=1.3 \times$ controlled R^2. A negative δ indicates that the coefficient moves away from zero as selection on unobservables increases.

Table S5. Correlates of adoption including current characteristics (weighted logit, 240 households)

Variable	Coefficient	Clustered SE	Odds ratio	AME	p (clustered)	p (WCR)
Age (years)	0.026	0.024	1.03	0.004	0.287	0.372
Schooling (years)	0.136	0.037	1.15	0.019	0.004	0.002
Family size	0.091	0.088	1.10	0.013	0.322	0.314
Member in non-farm work	0.625	0.368	1.87	0.088	0.118	0.145
Operated area (ln ha)	1.131	0.316	3.10	0.156	0.004	0.006
Leased-in share	−0.710	0.569	0.49	−0.098	0.238	0.164
Number of parcels	0.070	0.201	1.07	0.010	0.734	0.776
Owns tractor	0.669	0.454	1.95	0.099	0.168	0.042

Variable	Coefficient	Clustered SE	Odds ratio	AME	p (clustered)	p (WCR)
Livestock (tropical livestock units)	−0.411	0.176	0.66	−0.057	0.040	0.033
General caste category	1.143	0.195	3.14	0.177	<0.001	0.001
Member of a farmer organisation	0.480	0.425	1.62	0.066	0.282	0.250
Extension contacts (per year)	0.472	0.156	1.60	0.065	0.011	0.028
Kisan Credit Card	0.191	0.413	1.21	0.026	0.653	0.763
Distance to timber market (km)	−0.193	0.043	0.82	−0.027	0.001	0.001
Distance to nursery (km)	−0.055	0.041	0.95	−0.008	0.205	0.208
Block fixed effects	Yes					

SE = standard error; AME = average marginal effect; WCR = restricted wild cluster bootstrap. Non-adopters include 21 past growers. McFadden pseudo-R^2=0.26; area under the receiver operating characteristic curve=0.80. Several covariates (operated area, tractor, livestock, organisation membership, extension contacts, credit) may be consequences of adoption, so the coefficients describe how adopters differ today rather than why they adopted.

Table S6. Sensitivity of the gain of boundary trees over crops to a crop loss that grows with tree age and to the price conversion rate (INR per ha per year, 2025 prices, median values)

Scenario	Poplar 8%	Poplar 10%	Poplar 12%	Eucalyptus 8%	Eucalyptus 10%	Eucalyptus 12%
Constant crop loss (as in Table 2 of the main text)	33,808	28,631	23,712	9,391	6,839	4,395
Crop loss 50% higher from the fifth year	28,800	23,800	19,100	5,500	3,100	800
Crop loss twice as high from the fifth year	23,800	19,100	14,500	1,600	−600	−2,800
Past costs and sales converted at 4% instead of 6% a year	28,200	23,500	19,100	6,000	3,700	1,500
Rise in crop loss over the whole rotation at which trees stop paying (%)	123	104	86	34	25	16

Gain over crops = yearly income from trees at the median of 287 trees per ha minus the crop loss in the wheat and paddy seasons (median INR 27,416 per ha per year), at interest rates of 8, 10 and 12%. Poplar is harvested at 7 years and eucalyptus at 6 years; in the rows for a growing loss, the loss is raised from the fifth year to the end of the rotation and converted to an equal yearly amount. The conversion at 4% applies to sales up to five years before the survey and gives the largest possible fall in tree values (9%); planting costs, which would also fall, are left unchanged, so the figures are conservative. These are deterministic calculations at median values and differ from the simulated averages in Table 2 of the main text.

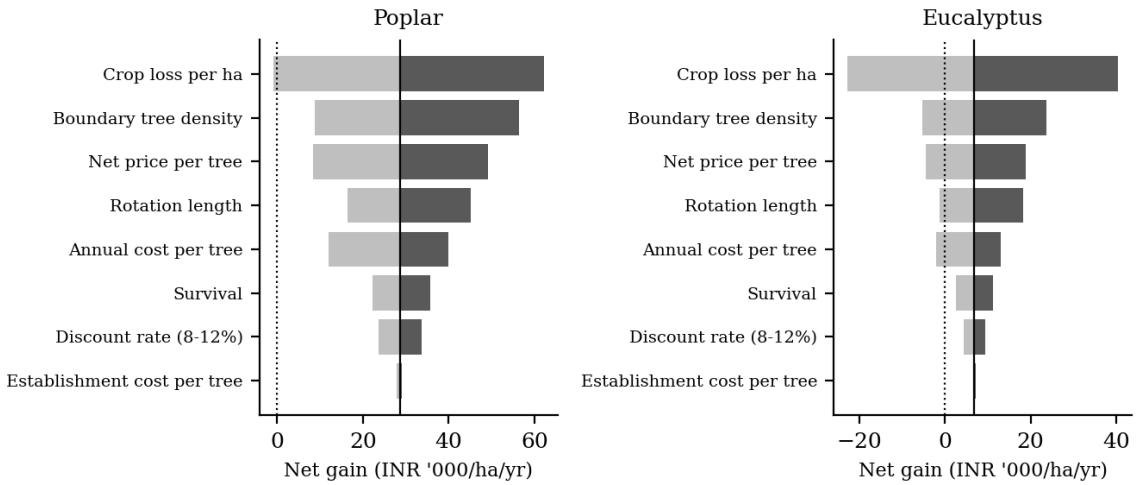

Figure S1. One-way sensitivity of the net annual gain per hectare of boundary field

Bars show the effect of moving each input from its 10th to its 90th percentile (dark: favourable end; light: unfavourable end), with other inputs at central values. The solid line marks the base case and the dotted line zero.