

The challenge of making climate adaptation profitable for farmers: evidence from Sri Lanka's rice sector

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ONLINE APPENDIX

Table A1. Descriptive household level statistics for selected variables

HH-Level Means	Mean	Standard Errors	Diff. 5 th -1 st quintiles of income
Gender of HH head (1=female)	0.036	0.006	-0.040
Age of HH head	53.825	0.413	-5.380
Highest education of HH head	10.138	0.120	1.320
HH size	3.943	0.051	1.248
Field area (acres)	6.391	0.162	4.405
Normalized ag asset wealth index (0-1)	0.146	0.006	0.140
HH has raised or owned livestock (1=yes)	0.192	0.015	-0.019
HH has sole ownership of its largest field (1=yes)	0.752	0.016	0.110
HH head's primary employment is off farm (1=yes)	0.135	0.012	0.130
HH received subsidy for fertilizers or other input	0.677	0.017	0.190
HH sold other crop on the market	0.816	0.017	0.209
HH received food aid (1=yes)	0.416	0.018	-0.222
HH received a loan for ag. activity	0.453	0.018	0.050
HH participated in crop insurance scheme (1=yes)	0.436	0.018	0.115
HH received info on improved seeds (1=yes)	0.121	0.012	0.097
HH received info on new ag. technologies(1=yes)	0.121	0.012	0.069
Total field area with agro-wells (acres)	0.685	0.058	0.842
HH rented a tractor	0.671	0.017	0.010
HH bought input from commercial sources	0.821	0.014	0.191
Distance (km) to agrarian services center	6.301	0.192	0.293
Distance (km) to established marketplace	13.170	0.576	5.601
Distance (km) to fertilizers retailer	4.205	0.179	0.057
Share of land that is irrigated	0.663	0.010	0.082
Off-farm income share (of gross income)	0.443	0.013	0.176
Income share from transfers (of gross income)	0.074	0.006	-0.252
Agricultural income share (of gross income)	0.480	0.013	0.089
Off-farm income (rupees)	343300.2	16278.1	635856.8
Value of transfer (rupees)	20958.5	1696.2	-16775.7
Total value of harvest production	433240.5	24595.9	922042.4
Gross income (rupees)	832270.1	40448.1	1910546.9
Observations		1,100	

Notes: The table also includes the inter-quintile difference between variable means calculated at highest and the lowest quintile of the gross income distribution. With the only exception of the "distance from fertilizer retailers", all the inter-quintile differences are statistically different from zero at 1% significance level.

Table A1. Descriptive field level statistics for selected variables

Variables	Maha season		Yala season	
	Lowland	Upland	Lowland	Upland
Characteristics of the fields and production				
Rice yield (kg/acre)	1712.49	66.28	1667.39	12.61
Field harvested less than planted due to wilting (1=yes)	0.244	0.414	0.107	0.144
Field area (acres)	2.189	2.533	1.944	2.469
Field applied with inorganic fertilizer (1=yes)	0.993	0.890	0.993	0.593
Quantity of inorganic fertilizer used (kg) on field	276.189	371.764	219.957	159.087
Quantity of inorganic fertilizer used (kg/acre) on field	133.845	165.583	139.040	100.825
Field applied with organic fertilizer (1=yes)	0.043	0.035	0.029	0.058
Quantity of organic fertilizer used (kg) on field	17.743	30.155	10.765	19.684
Quantity of organic fertilizer used (kg/acre) on field	14.064	22.726	8.291	23.713
Field sprayed with herbicide (1=yes)	0.936	0.579	0.851	0.130
Times herbicide was sprayed on field	1.162	0.652	1.208	0.170
Quantity of herbicide used (kg/acre) on uplands	0.881	0.428	0.933	0.115
Field preventatively weeded(1=yes)	0.032	0.046	0.066	0.061
Field acquired via <i>bethma</i> (1=yes)	0.028	-	0.108	-
Gini-Simpson index (land area) of crop cultivated	0.021	0.078	0.097	0.127
Adjusted Gini-Simpson index (land area) of crop cultivated	0.013	0.041	0.044	0.055
Conventional practices				
Field mechanically ploughed (1=yes)	0.994	0.931	0.984	0.914
Field levelled with mechanized methods (1=yes)	0.125	0.045	0.081	0.030
Field sown with manual direct seeding methods(1=yes)	0.030	0.630	0.139	0.343
Retained crop residue on field (1=yes)	0.971	0.714	0.952	0.690
Adaptation practices				
Field sown with short duration rice seeds(1=yes)	0.364	0.036	0.264	0.0014
HH grew maize on field (1=yes)	0.0018	0.534	0.049	0.026
HH grew other crops(1=yes) on the field	0.048	0.864	0.209	0.995
Field with improved water management practices (1=yes)	0.0019	0.0018	0.013	0.014
Retained trees on field (1=yes)	0.085	0.234	0.103	0.221
Soil erosion barriers on field (1=yes)	0.014	0.151	0.013	0.155
Retained crop residue for 5 yrs and added water/urea (1=yes)	0.118	0.0014	0.125	0.0017
Observations	1,013	629	508	336

Table A3. Summary table of the main results from the impact assessment of the adoption of single practices

List of Variables	Sensitivity	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	
		Total gross value of harvest			Total net value of harvest			Gross total income			
MAHA LOW	Short duration rice seeds	-0.017	0.006	0.038	0.043	0.048	0.016	0.064	-0.017	0.014	-0.002
	Residue retention[+5yrs&wat/urea]	-0.148***	0.286*	0.249	0.535***	0.169*	0.105	0.274***	-0.090	0.177*	0.087
	Other crops in the field	-0.187***	-0.005	0.236**	0.231	-0.206	0.147**	-0.059	0.063	0.018	0.080
MAHA UP	Cultivating maize	0.164***	0.028	-0.308***	-0.280	-0.136	-0.164***	-0.300**	0.114	-0.103***	0.010
	Retaining trees	0.027	-0.144	-0.037	-0.181	-0.364***	-0.013	-0.378***	0.031	-0.016	0.015
	Soil erosion barriers	0.020	-0.120	-0.041	-0.161	0.255**	-0.013	0.242*	0.102	-0.010	0.092
	Short duration rice seeds	-0.053**	0.061	0.240	0.301***	-0.272	0.407	0.135	0.135	0.017	0.152
YALA LOW	Other crops in the field	-0.093***	0.061	-0.277	-0.216	-1.016	1.006	-0.011	0.143	-0.109	0.035
	Retaining trees	-0.020	-0.075	0.141	0.065	-0.331	0.240	-0.092	-0.008	-0.121	-0.129
	Residue retention[+5yrs&wat/urea]	0.038	0.481***	-0.052	0.429***	0.504***	-0.109	0.395***	0.195**	-0.014	0.181*
YALA UP	Retaining trees	-0.027	-0.165	0.044	-0.121*	-0.246	0.037	-0.209	-0.053	0.034	-0.019
	Soil erosion barriers	-0.057	0.194	0.104	0.298**	0.164	0.126	0.290**	-0.012	0.074	0.062

Notes: Levels of significance are * p<0.10; ** p<0.05; *** p<0.01.

Table A4. Average labour by adaptive strategy (person days)

	HH labour	Hired labour	Total labour
Short duration rice seeds (<i>low-maha</i>)	14.377	13.734	28.111
Short duration rice seeds (<i>low-yala</i>)	19.257	20.954	40.211
Other crops in the field (<i>up/maha</i>)	44.931	12.320	57.251
Other crops in the field (<i>low/yala</i>)	68.609	21.564	90.173
Cultivating maize (<i>up/maha</i>)	77.010	11.633	88.643
Retaining trees (<i>up- maha</i>)	24.300	12.443	36.743
Retaining trees (<i>low- yala</i>)	30.876	20.654	51.530
Retaining trees (<i>up- yala</i>)	24.215	21.345	45.561
Soil erosion barriers (<i>up-maha</i>)	30.697	15.577	46.274
Soil erosion barriers (<i>up-yala</i>)	34.108	24.596	58.704
Residue retention [+5yrs&wat/urea] (<i>low-maha</i>)	33.994	15.243	51.197
Residue retention [+5yrs&wat/urea] (<i>low-yala</i>)	30.563	17.531	51.009

Table A2. Adoption determinants of selected practices affecting sensitivity to water-stress at HH level

List of Variables	<i>Short duration rice seeds on lowlands yala</i>	<i>Other crops in the field on lowlands yala</i>	<i>Improved Residue retention lowlands maha</i>	<i>Other crops in the field on uplands maha</i>	<i>Cultivating maize uplands maha</i>
Gender of HH head (1=female)	0.01	-0.08	0.04	-0.04*	-0.13
Age of HH head	-0.00	-0.00**	-0.00	-0.00*	-0.00
Highest education of HH head	-0.00	0.00	-0.00	0.00*	0.01
HH family size	0.03**	0.03*	-0.01	0.00	0.01
Field area	0.01	-0.01	-0.00	0.01***	0.01
Normalized ag asset wealth index (0-1)	-0.25	0.36**	-0.08	-0.08**	-0.05
HH raised or owned livestock	0.03	-0.05	-0.03	0.01	-0.01
Sole ownership of largest field	-0.09**	0.03	-0.07***	0.02	0.05
Total field area under agro-wells (acres)	-0.01	-0.00	0.01*	-0.00	-0.05***
Off-farm head's primary employment	-0.05	-0.05	0.04	0.01	0.13
Subsidy for fertilizers or other input	0.02	-0.19***	0.01	-0.05***	0.05
HH received food aid	-0.08*	0.04	-0.01	0.02*	0.11
HH received a loan for ag. activity	-0.07*	0.04	-0.05**	0.01	0.04
Crop insurance scheme	0.07*	-0.08*	-0.05**	-0.00	0.02
Input from commercial sources	-0.04	0.05	0.05	0.02	0.78***
Log. distance (km) to ASC	0.03	-0.01	-0.03*	0.01	0.03
Log. distance (km) to marketplace	0.02	0.02	-0.01	0.01	0.01
Log. distance (km) to fertilizers retailer	-0.05**	0.02	0.03*	-0.00	0.01
Share of land that is irrigated	0.29***	-0.09	-0.00	0.02	-0.11
Irrigation: Major	1.99***	-0.09	-0.08	-0.01	-0.07
Irrigation: Minor	2.11***	-0.19	-0.08	0.02	-0.01
Irrigation: Mahaweli	2.13***	-0.14	-0.02	-	0.19
HH received info on improved seeds (1=yes)	0.02	-0.08*	0.02	0.02	0.15**
HH received info on new cultivation technologies (1=yes)	0.08	0.08	-0.02	-0.00	-0.01
FO leave-out mean of adoption	0.31***	0.46***	-0.33**	0.06**	1.08***
Observations	427	427	707	498	513

Notes: Levels of significance are * p<0.10; ** p<0.05; ***p<0.01.

Appendix A

Table A6. Sample design

Cluster (DS)	Number of farm family				Total	Sample of farmer organization			
	Major	Minor	Rain-fed	Mahaweli		Major	Minor	Rain-fed	Mahaweli
Padaviya	2,392	2,649	30	0	5,071	5	5	0	0
Medawachchiya	0	9,067	0	0	9,067	0	10	0	0
Nuwargam Palatha Central	76	4,997	0	0	5,073	1	9	0	0
Kahatagasdigiliya	0	10,209	0	0	10,209	0	10	0	0
Galenbidunuwewa	2,993	8,308	0	0	11,301	3	7	0	0
Nuwargam Palatha eastern	417	1,029	301	0	17,47.0	2	6	2	0
Nochchiyagama	0	5,467	0	6,125	11,592	0	5	0	5
Thabuththegama	0	0	0	4,150	4,150	0	0	0	10
Thirappane	312	2,728	161	0	3,201	1	8	1	0
Palugaswewa	0	3,170	0	0	0	0	10	0	0
Galnewa	110	5,336	0	1,994	7,440	0	7	0	3
Total						12	77	3	18

Note: DS: Divisional Secretariat.

Source: HARTI elaboration from District Statistical Branch, Anurādhapura, Department of Census and Statistics.

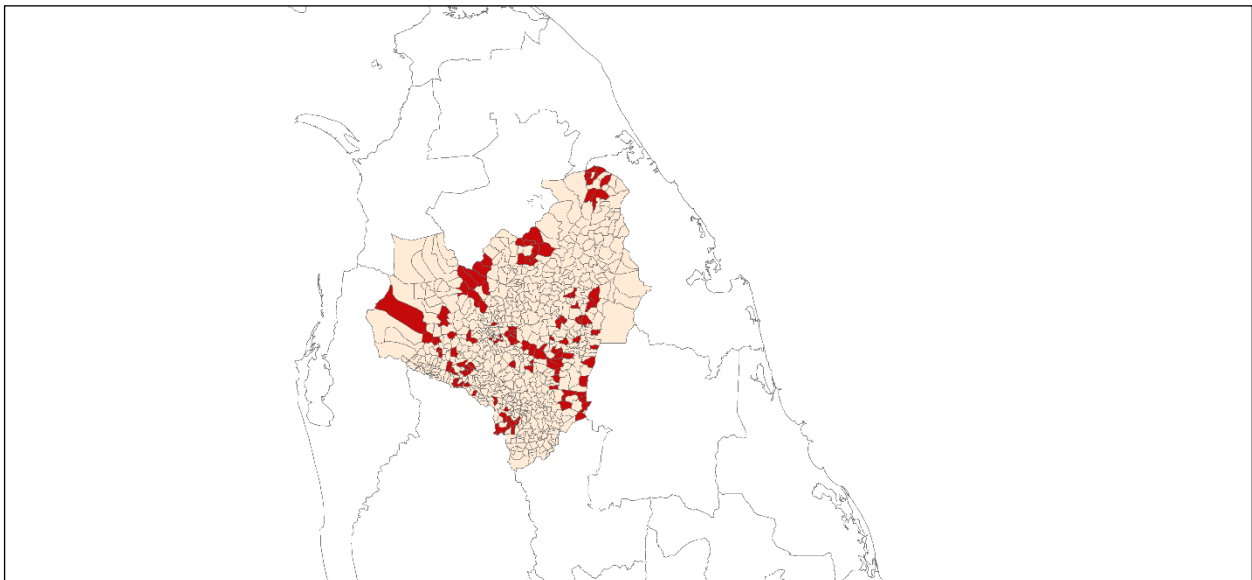


Figure A1. Geographic location of households sampled within the Anurādhapura district at Grama Niladari (GND) levels (red polygons).

Source: Authors' elaboration on sampled households.

Appendix B

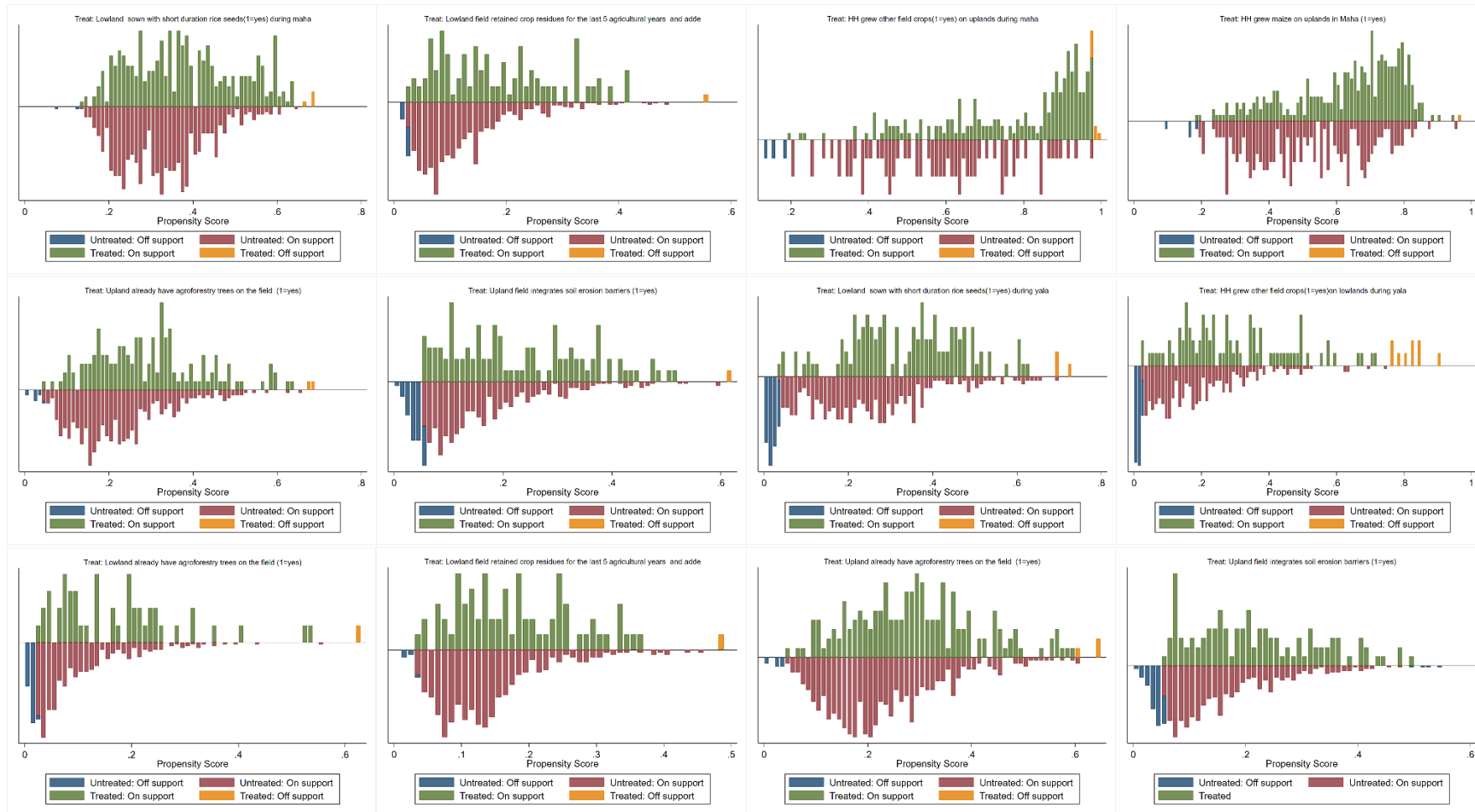


Figure A2. Propensity Score probability distribution by treatment variable.

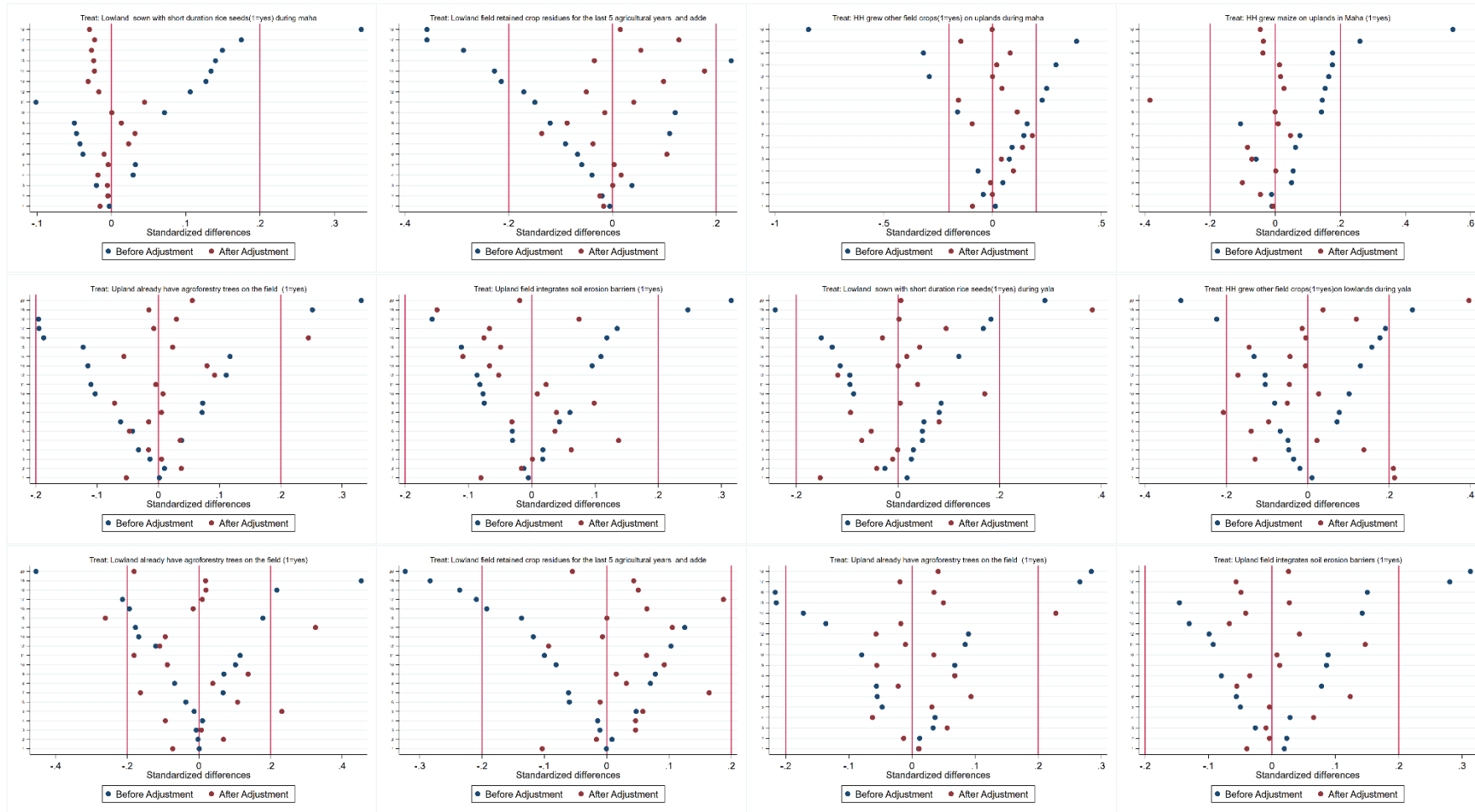


Figure A3. Balancing test of covariates distribution before and after the propensity model.

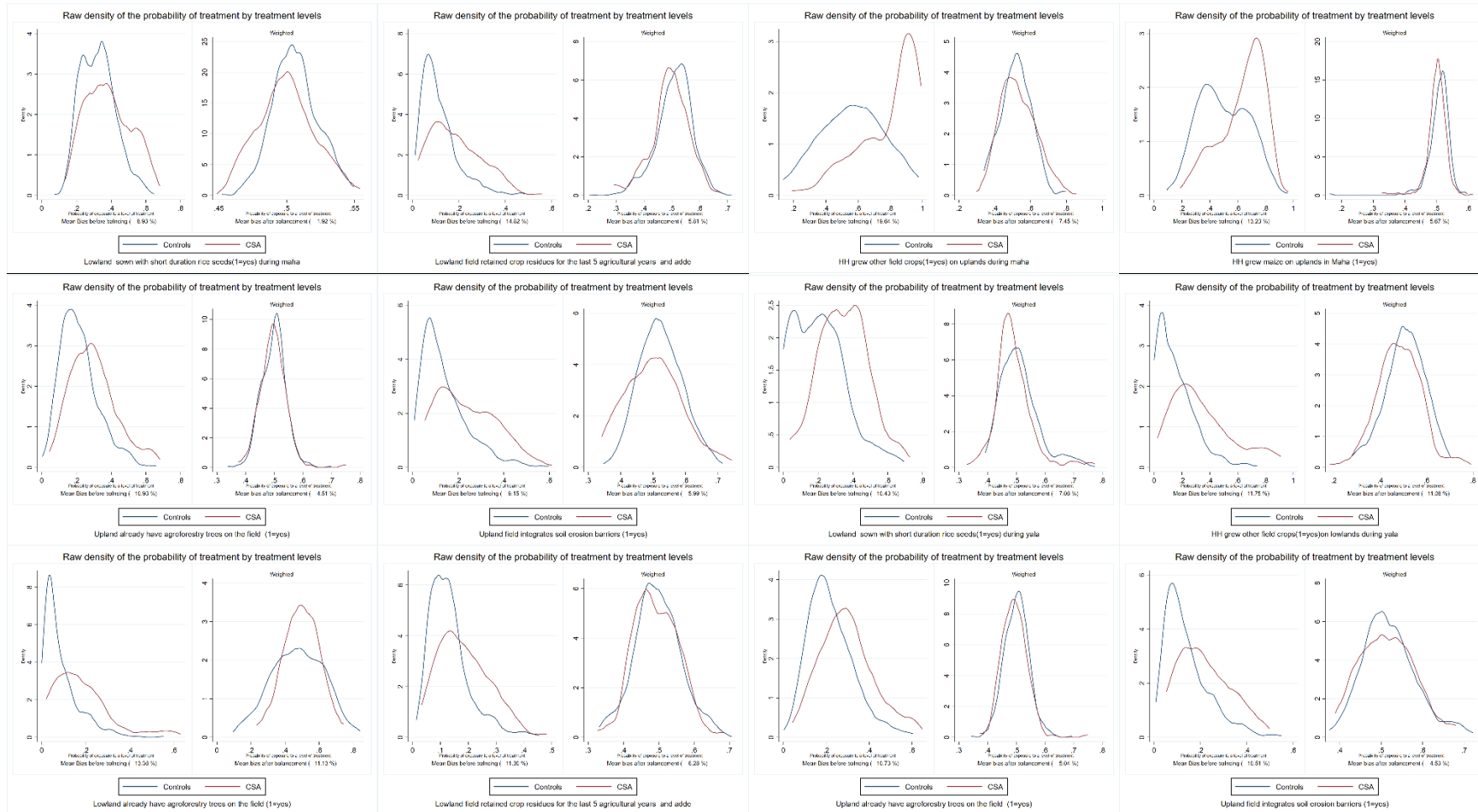


Figure A4. Density function of treatment probability before and after the propensity model.

Appendix C

Table A7. Adoption determinants of selected practices by type of land during the *maha* season

List of Variables	1	2	3	4	5	6
	Lowlands		Uplands			
Gender of HH head (1=female)	-0.16	0.04	-0.04*	-0.13	0.01	-0.15
Age of HH head	-0.00	-0.00	-0.00*	-0.00	0.00	-0.00
Highest education of HH head	-0.01	-0.00	0.00*	0.01	0.01	0.01*
HH family size	0.00	-0.01	0.00	0.01	-0.01	0.02
Field area	-0.00	-0.00	0.01***	0.01	-0.01*	-0.00
Normalized ag asset wealth index (0-1)	0.05	-0.08	-0.08**	-0.05	0.10	-0.12
HH raised or owned livestock	0.04	-0.03	0.01	-0.01	-0.00	0.03
Sole ownership of largest field	-0.04	-0.07***	0.02	0.05	0.05	-0.01
Total field area under agro-wells (acres)	-0.00	0.01*	-0.00	-0.05***	0.01	0.01
Off-farm head's primary employment	-0.02	0.04	0.01	0.13	-0.02	-0.16***
Subsidy for fertilizers or other input	-0.08	0.01	-0.05***	0.05	0.03	0.01
HH received food aid	-0.04	-0.01	0.02*	0.11	0.03	-0.02
HH received a loan for ag. activity	0.08**	-0.05**	0.01	0.04	0.04	0.03
Crop insurance scheme	0.03	-0.05**	-0.00	0.02	-0.08*	-0.09***
Input from commercial sources	0.05	0.05	0.02	0.78***	-0.15*	0.01
Log. distance (km) to ASC	0.04	-0.03*	0.01	0.03	0.00	-0.04*
Log. Distance (km) to marketplace	-0.01	-0.01	0.01	0.01	-0.01	-0.02
Log. Distance (km) to fertilizers retailer	-0.04*	0.03*	-0.00	0.01	-0.05**	0.02
Share of land that is irrigated	0.07	-0.00	0.02	-0.11	0.10	0.12*
Irrigation: Major	0.07	-0.08	-0.01	-0.07	-0.08	-0.04
Irrigation: Minor	0.11	-0.08	0.02	-0.01	-0.00	-0.07
Irrigation: Mahaweli	0.04	-0.02		0.19	-0.25	-0.22
HH received info on improved seeds (1=yes)	0.02	0.02	0.02	0.15**	-0.13**	0.03
HH received info on new cultivation technologies(1=yes)	0.09	-0.02	-0.00	-0.01	0.11*	0.04
FO leave-out mean of adoption	0.44***	-0.33**	0.06**	1.08***	-0.36***	-0.16***
Observations	707	707	498	513	513	513

Notes: Levels of significance are * p<0.10; ** p<0.05; ***p<0.01. The dependent variables according to the specification number are (1) Short duration rice seeds; (2) Improved Residue retention; (3) Other crops in the field; (4) Cultivating maize; (5) Retaining trees; (6) Soil erosion barriers.

Table A8. Adoption determinants of selected practices by type of land during the *yala* season

List of Variables	1	2	3	4	5	6
	Lowlands				Uplands	
Gender of HH head (1=female)	0.01	-0.08	0.06	0.03	-0.19	-
Age of HH head	-0.00	-0.00**	0.00	-0.00*	0.00	0.00
Highest education of HH head	-0.00	0.00	0.01	-0.01***	0.01	0.01
HH family size	0.03**	0.03*	0.01	-0.00	0.01	0.01
Field area	0.01	-0.01	-0.00	-0.00	-0.01**	-0.00
Normalized ag asset wealth index (0-1)	-0.25	0.36**	0.11	-0.14	0.15	-0.26
HH raised or owned livestock	0.03	-0.05	0.02	-0.00	0.04	0.07
Sole ownership of largest field	-0.09**	0.03	-0.02	-0.04	-0.03	0.04
Total field area under agro-wells (acres)	-0.01	-0.00	-0.01	0.01	0.00	0.02
Off-farm head's primary employment	-0.05	-0.05	-0.06	0.02	-0.02	-0.21**
Subsidy for fertilizers or other input	0.02	-0.19***	0.06	0.03	0.01	-0.01
HH received food aid	-0.08*	0.04	-0.03	-0.03	0.03	-0.04
HH received a loan for ag. activity	-0.07*	0.04	0.03	-0.08**	0.06	-0.04
Crop insurance scheme	0.07*	-0.08*	-0.03	-0.03	-0.13***	-0.05
Input from commercial sources	-0.04	0.05	0.00	0.09	-0.23**	0.08
Log. distance (km) to ASC	0.03	-0.01	0.05***	0.00	-0.11***	-0.03
Log. Distance (km) to marketplace	0.02	0.02	0.00	-0.03	-0.01	-0.06**
Log. Distance (km) to fertilizers retailer	-0.05**	0.02	-0.03*	0.05**	-0.02	-0.02
Share of land that is irrigated	0.29***	-0.09	0.07	0.03	0.18	0.05
Irrigation: Major	1.99***	-0.09	-0.27***	0.10	0.10	-0.15
Irrigation: Minor	2.11***	-0.19	-0.25***	0.02	0.15	-0.00
Irrigation: Mahaweli	2.13***	-0.14	-0.22**	0.06	-	-
HH received info on improved seeds (1=yes)	0.02	-0.08*	-0.08**	0.03	-0.11	0.07
HH received info on new cultivation technologies(1=yes)	0.08	0.08	0.05	-0.04	0.06	-0.02
FO leave-out mean of adoption	0.31***	0.46***	0.05	-0.36***	-0.38**	0.16
Observations	427	426	427	427	301	293

Notes: : Levels of significance are * p<0.10; ** p<0.05; ***p<0.01. The dependent variables according to the specification number are: (1) Short duration rice seeds; (2) Other crops in the field; (3) Retaining trees; (4) Improved residue retention; (5) Retaining trees; (6) Soil erosion barriers.

Appendix D

Robustness Check I

In order to take into account the possibility of adopting multiple practices on the same field, we have implemented a robustness check to test the existence of complementarities among different practices. It is worth noting that with few relevant exceptions, in the Sri Lanka rice sector there is little evidence of the adoption of multiple practices on the same field during the same season (see table A9).

Table A9. Incidence of mutual exclusive package of practices by season/field type

Season/Land type	Adaptive strategy	% of field
MAHA LOW	No Practices	55.74
	Residue retention	7.84
	Short duration rice seed	32.49
	Short duration rice seed + Residue retention	3.92
	<i>Total</i>	<i>100.00</i>
MAHA UP	No Practices	7.95
	Soil erosion barriers	1.91
	Retaining trees	3.29
	Soil erosion barriers + Retaining trees	0.42
	Other crops in the field	59.74
	Other crops in the field + Soil erosion barriers	6.97
	Other crops in the field + Retaining trees	13.92
	Other crops in the field + Retaining trees + Soil erosion barriers	5.79
<i>Total</i>	<i>100.00</i>	
YALA LOW	No Practices	42.77
	Residue retention	6.50
	Retaining trees	4.22
	Residue retention + Retaining trees	0.28
	Other crops in the field	14.66
	Other crops in the field + Residue retention	1.51
	Other crops in the field + Retaining trees	2.95
	Other crops in the field + Residue retention + Retaining trees	0.79
	Short duration rice seed	20.15
	Short duration rice seed + Residue retention	3.23
	Short duration rice seed + Retaining trees	1.73
	Short duration rice seed + Retaining trees + Residue retention	0.20
	Short duration rice seed + Other crops in the field	0.84
	Short duration rice seed + Other crops in the field + Retaining trees + Residue retention	0.18
<i>Total</i>	<i>100.00</i>	
YALA UP	No Practices	66.40
	Soil erosion barriers	8.86
	Retaining trees	18.37
	Soil erosion barriers + Retaining trees	6.36
<i>Total</i>	<i>100.00</i>	

In this framework, we have created a set of variables (one for each season–land typology dyad) to categorize the mutually exclusive adoption of a specific combination (package) of practices. As the mutually exclusive categories are not equally populated, we have selected for the empirical estimation only those packages for which the number of fields allows an empirical estimation. Depending on the

number of plots available in each season-typology, the thresholds to include a category vary between 3-5 per cent of the sample.

In particular, the probability of the mutually exclusive adoption of a specific package, j , of practices has been modelled using a multinomial logit function in the spirit of Di Falco and Veronesi (2013), on a categorical variable encompassing all the mutually exclusive combinations of practices:

$$P(T_j = t|W^1) = (W^1 \beta_j) = \frac{\exp(\beta_{0j} + W^1 \beta_{1j})}{1 + \sum_{j=1}^{M-1} \exp(\beta_{0j} + W^1 \beta_{1j})} \text{ with } j = 1, \dots, (M - 1), \quad (A1)$$

where W^1 is a vector of household and field characteristics corresponding to the vector W used for the main analysis but excluding the dummies for all the practices adopted in the same season/land type as they are directly modeled in the multinomial categories.

The balancing properties of the weighted sample have been tested using pairwise comparisons of the variables across the levels of factor variables using the Bonferroni method (the results are available upon request). The kernel densities of the unbalanced and balanced sample are reported in figure A5.

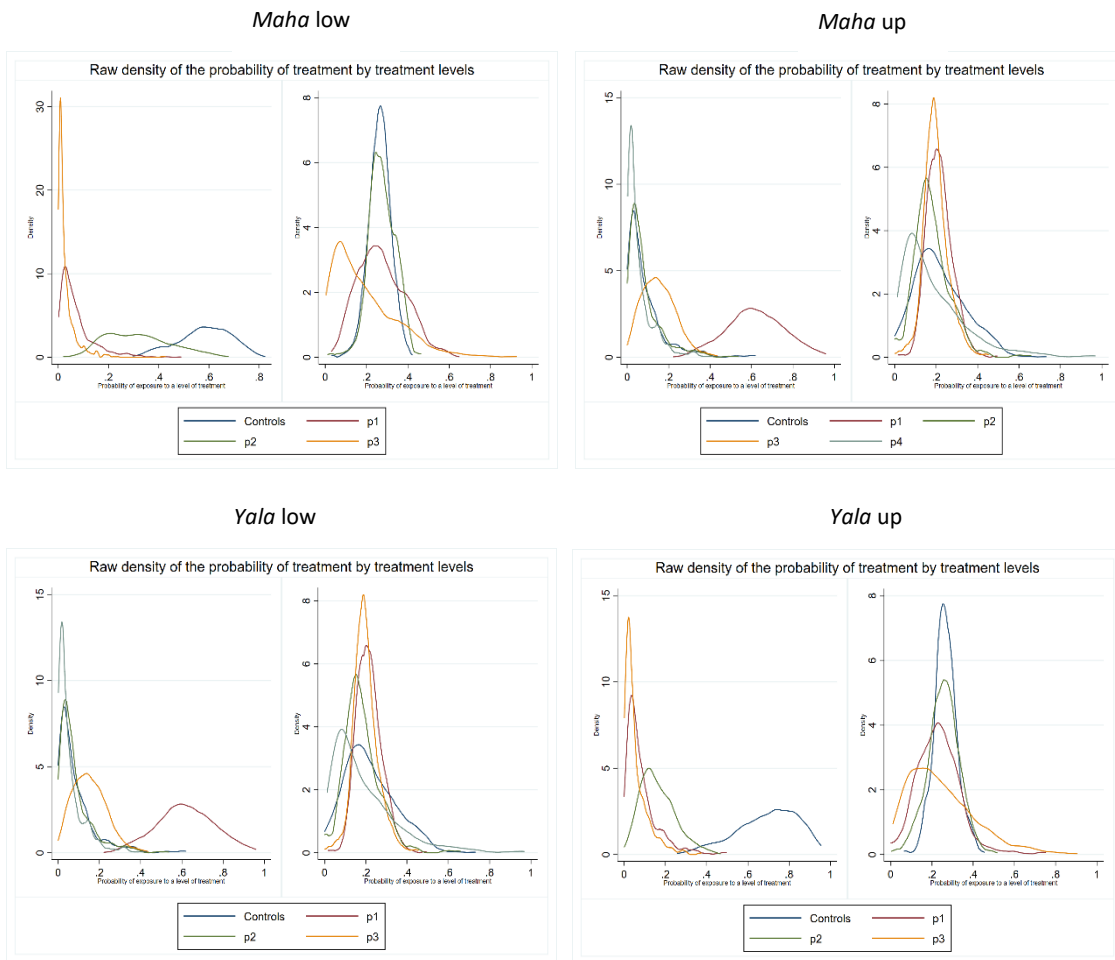


Figure A5. Density function of treatment probability before and after the multinomial propensity model.

The weights from the multinomial logit model have been subsequently used to estimate an Inverse Probability Weighting (IPW) model for each dyad season/land type. The results do not highlight strong complementarities, but it is worth noting that the coefficients related to certain packages have been estimated on a very small number of observations. The main results have been summarized in table A10 (complete results are available upon request).

Table A10. Summary table of the main results from the impact assessment of mutually exclusive practices

	List of Variables	Sensitivity	Direct welfare	Indirect welfare	Net welfare	Direct welfare	Indirect welfare	Net welfare	Direct welfare	Indirect welfare	Net welfare
			Total gross value of harvest			Total net value of harvest			Gross total income		
MAHA LOW	Residue retention	-0.085*	0.295	0.144	0.439	-0.053	0.092	0.039	0.095	0.088	0.183**
	Short duration rice seeds	-0.003	0.101	0.004	0.105	0.038	0.003	0.040	0.043	0.002	0.045
	Short duration rice seeds +	-0.268***	0.471	0.455	0.925	0.401**	0.290**	0.690***	-0.176	0.281**	0.105
	Residue retention										
	Other crops in the field	-0.120	-0.052	0.222	0.170	0.058	0.100	0.158	0.132	-0.062	0.070
MAHA UP	Other crops in the field +	-0.085	-0.647	0.158	-0.488	0.412	0.071	0.483	0.200	-0.046	0.154
	Soil erosion barriers										
	Other crops in the field +	-0.078	-0.073	0.145	0.072	-0.444*	0.065	-0.379	0.198	-0.043	0.155
	Retaining trees										
	Other crops in the field +										
YALA LOW	Retaining trees +	-0.036	0.446	0.066	0.512	0.237	0.030	0.267	0.877**	-0.020	0.857**
	Soil erosion barriers										
	Residue retention	0.042	0.594**	0.004	0.598***	0.922	-0.566	0.356**	0.191	0.096	0.287*
	Other crops in the field	-0.124***	-0.508	-0.011	-0.519	-1.900***	1.614**	-0.286	0.329	-0.293	0.036
	Short duration rice seeds	-0.090***	0.121	-0.008	0.113	-1.299**	1.180**	-0.118	0.292	-0.208	0.085
YALA UP	Soil erosion barriers	-0.063	0.173	0.137	0.309	0.233	0.156	0.389*	0.084	0.075	0.158
	Retaining trees	0.027	-0.217	-0.059	-0.276	-0.115	-0.107	-0.221	-0.190	-0.037	-0.228
	Soil erosion barriers +	-0.063	-0.054	0.135	0.081	-0.090	0.150	0.060	-0.178	0.073	-0.105
	Retaining trees										

Notes: Levels of significance are * p<0.10; ** p<0.05; ***p<0.

Robustness Check II

Since the use of IPW has the unfortunate property of giving a very high weight to very unlikely observations, with the weight going to infinity as the probability goes to zero, this robustness check tests the same models included in the main text by excluding the treated households with low conditional probability (<5th percentile) of adoption and control household with high probability of adoption from the sample (>95th percentile). Table A11 summarizes the main results (complete results are available upon request).

Table A11. Summary table of the main results obtained excluding extreme weights

List of Variables	Sensitivity	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect
		Total gross value of harvest			Total net value of harvest			Gross total income		
<i>MAHA</i> Short duration rice seeds	-0.005	0.030	0.011	0.041	0.055	0.004	0.060	0.007	0.002	0.009
<i>LOW</i> Residue retention[+5yrs&wat/urea]	-0.151***	0.256	0.318*	0.574***	0.139	0.110	0.249**	-0.134	0.191*	0.057
Other crops in the field	-0.267***	-0.137	0.361***	0.224	-0.275	0.164**	-0.111	0.228	0.039	0.266
<i>MAHA</i> Cultivating maize	0.158***	0.073	-0.315***	-0.242	-0.106	-0.172***	-0.279**	0.084	0.118***	-0.034
<i>UP</i> Retaining trees	0.047	-0.259	-0.066	-0.325*	-0.421***	-0.025	-0.446***	0.021	-0.027	-0.006
Soil erosion barriers	0.023	-0.114	-0.047	-0.161	0.269**	-0.015	0.255*	0.103	-0.010	0.094
Short duration rice seeds	-0.055**	0.064	0.255	0.319***	-0.317	0.472	0.155	0.085	0.037	0.122
Other crops in the field	-0.092***	0.056	-0.282	-0.226	-1.024	1.018	-0.006	0.277	-0.229	0.047
<i>YALA</i> Retaining trees	-0.016	-0.114	0.184	0.069	0.256	-0.341	-0.085	0.006	-0.153	-0.147
<i>LOW</i> Residue retention[+5yrs&wat/urea]	0.056	0.546***	-0.079	0.467***	0.506***	-0.103	0.402***	0.189*	-0.025	0.165*
<i>YALA</i> Retaining trees	-0.035	-0.209	0.053	-0.155	-0.310**	0.048	-0.262*	-0.076	0.043	-0.033
<i>UP</i> Soil erosion barriers	-0.060	0.187	0.106	0.293**	0.146	0.130	0.276**	-0.048	0.077	0.029

Notes: Levels of significance are * p<0.10; ** p<0.05; ***p<0.01.

Robustness Check III

The outcome variables considered for the main analysis are total household values. However, the size of the field cultivated has been included both in the propensity score and in the IPW model as controls. This robustness check estimates the specification in the main text considering the ratio between the total outcome variable and the land size as dependent variables. The main results have been summarized in table A12 (complete results are available upon request).

Table A12. Summary table of the main results obtained considering the ratio of the outcome variable to the land size as dependent variable

List of Variables	Sensitivity	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	
		Total gross value of harvest			Total net value of harvest			Gross total income			
MAHA LOW	Short duration rice seeds	-0.017	0.019	0.047	0.066	0.062	0.032	0.094	-0.010	0.026	0.016
	Residue retention[+5yrs&wat/urea]	-0.148***	0.098	0.323*	0.421***	-0.033	0.199*	0.166*	-0.270**	0.258**	-0.012
	Other crops in the field	-0.186***	-0.026	0.294**	0.268	-0.200	0.203**	0.003	0.045	0.076	0.121
MAHA UP	Cultivating maize	0.165***	-0.161	-0.340***	-0.501**	-0.326***	-0.197***	-0.522***	-0.082	-0.143***	-0.226***
	Retaining trees	0.027	-0.054	-0.042	-0.096	-0.260**	-0.018	-0.278**	0.122	-0.020	0.102
	Soil erosion barriers	0.020	-0.192	-0.043	-0.235	0.174*	-0.015	0.160	0.082	-0.010	0.072
YALA LOW	Short duration rice seeds	-0.051*	-0.112	0.445	0.333***	-0.072	0.257	0.184	0.724	-0.540	0.183*
	Other crops in the field	-0.093***	0.278	-0.540	-0.263	-1.223	1.159	-0.065	0.199	-0.228	-0.029
	Retaining trees	-0.021	-0.115	0.163	0.049	-0.316	0.206	-0.109	-0.077	-0.069	-0.146
	Residue retention[+5yrs&wat/urea]	0.035	0.349**	-0.063	0.286**	0.348**	-0.084	0.264***	0.057	-0.022	0.035
YALA UP	Retaining trees	-0.027	-0.099	0.046	-0.053	-0.185	0.039	-0.147	0.013	0.036	0.049
	Soil erosion barriers	-0.058	0.133	0.122	0.256**	0.103	0.146	0.248**	-0.072	0.092	0.020

Note: Levels of significance are * p<0.10; ** p<0.05; ***p<0.01.

Robustness Check IV

The identification strategy in the main text is based on observable characteristics. However, this strategy does not allow us to rule out the presence of selection bias due to unobservable characteristics as well as the reverse causality between the adoption of a particular practice/technology and the latent sensitivity to water stresses. In order to relax these empirical concerns, this robustness check endogenizes the choice of each practice/technology by including another regression to the structural model. In doing so the model has been identified by means of two further exclusion restrictions: the leave-out mean of the adoption of each specific practice at the farmer organization level and leave-out mean of the cost of labour in each specific season at Grama Niladhari Divisions level (ADM4).

The assumption on which the validity of the strategy relies is that these variables are correlated with the adoption choice at the household level but, conditional on the other covariates, they are not directly linked to the household outcomes. Being the leave-out mean assigned to each household an average calculated at a higher level of aggregation and by excluding its own observed value the specific household considered, this assumption is economically and empirically plausible. It is worth noting that in our empirical framework aimed at estimating the mediating role of the sustainable practices, the three structural equations have been estimated simultaneously by means of a maximum likelihood estimator that is expected to produce consistent results that are more efficient relative to a two-stage procedure. The results from this alternative identification strategy largely support the robustness of those obtained with the doubly robust model used in the main text. The main results have been summarized in table A13 (complete results are available upon request).

Table A13. Summary table of the main results obtained using an IV identification strategy

List of Variables	Sensitivity	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	Direct effect	Indirect effect	Net effect	
		Total gross value of harvest			Total net value of harvest			Gross total income			
MAHA LOW	Short duration rice seeds	-0.056	-0.096	0.073	-0.023	0.001	0.058	0.060	0.011	0.025	0.036
	Residue retention[+5yrs&wat/urea]	-0.232***	0.508	0.312	0.820***	0.492**	0.176	0.668***	0.160	0.114	0.274**
	Other crops in the field	-0.235***	-0.254	0.387***	0.133	-0.285	0.256***	-0.029	0.009	0.148***	0.157
MAHA UP	Cultivating maize	0.122***	-0.061	-0.201**	-0.262	-0.215*	-0.096**	-0.311**	0.056	-0.076**	-0.019
	Retaining trees	0.055	-0.054	-0.091	-0.144	-0.241*	-0.040	-0.281**	0.062	-0.035	0.027
	Soil erosion barriers	0.028	0.126	-0.047	0.080	0.351**	-0.027	0.324**	0.256**	-0.021	0.235**
	Short duration rice seeds	-0.106**	-1.187***	0.157	-1.030***	-1.011***	0.374	-0.638***	-0.029	-0.037	-0.066
	Other crops in the field	-0.178***	-0.902*	0.169	-0.733***	-1.297*	0.959	-0.338**	0.037	-0.071	-0.033
YALA LOW	Retaining trees	-0.041	0.250	0.062	0.312	-0.157	0.066	-0.091	0.097	0.000	0.097
	Residue retention[+5yrs&wat/urea]	0.011	1.564***	-0.017	1.547***	0.762**	-0.023	0.740***	0.326*	-0.001	0.325*
YALA UP	Retaining trees	0.064	0.041	-0.100	-0.059	0.216	-0.081	0.135	0.146	-0.070	0.075
	Soil erosion barriers	-0.049	0.247	0.077	0.325*	0.102	0.063	0.166	0.038	0.039	0.077

Note: Levels of significance are * p<0.10; ** p<0.05; ***p<0.01.

References

Di Falco S and Veronesi M (2013). How can African agriculture adapt to climate change? A counterfactual analysis from Ethiopia. *Land Economics* **89**, 743–766.