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Nowcasting from space: Impact of tropical cyclones on Fiji's agriculture

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ONLINE APPENDIX

ADB Economics Working Paper No. 676

**NOWCASTING FROM SPACE:
IMPACT OF TROPICAL CYCLONES ON FIJI'S AGRICULTURE**

Ilan Noy, Elodie Blanc, Madhavi Pundit, and Tomas Uher

January 2023

APPENDIX: VARIABLES AND RESULTS

Table 1. Correlation Analysis at the Regional Level, EM-DAT

Variable	Sentinel		MODIS	
	EVlch	EVldiff	EVlch	EVldiff
Disaster magnitude value	0.132	0.346	-0.209	-0.272
Total deaths	0.138	0.340	-0.199	-0.261
Number of injured people	0.142	0.331	-0.188	-0.248
Number of affected people	0.131	0.346	-0.210	-0.273
Total number of affected people	0.131	0.346	-0.210	-0.273
Economic damages	0.139	0.337	-0.195	-0.256

EM-DAT = Emergency Events Database, EVlch = relative enhanced vegetation index change, EVldiff = absolute enhanced vegetation index change, MODIS = Moderate Resolution Imaging Spectroradiometer.

Source: Authors.

Table 2. Correlation Analysis at the Regional Level, Desinventar

Variable	Sentinel		MODIS	
	EVlch	EVldiff	EVlch	EVldiff
Total deaths	0.043	0.136	-0.156	-0.190
Number of injuries	0.059	0.135	-0.155	-0.195
Number of missing people	-0.051	0.094	-0.110	-0.104
Destroyed houses	0.061	0.135	-0.155	-0.195
Damaged houses	-0.110	0.012	-0.021	0.016
Directly affected people	-0.113	0.007	-0.015	0.025
Evacuated people	-0.010	0.122	-0.140	-0.152
Total losses	0.062	0.134	-0.155	-0.195
Local losses	0.062	0.134	-0.155	-0.195
Hospitals	0.062	0.134	-0.155	-0.195

EVlch = relative enhanced vegetation index change, EVldiff = absolute enhanced vegetation index change, MODIS = Moderate Resolution Imaging Spectroradiometer.

Source: Authors.

Table 3. Independent Variables

Variable	Description	Source
>10 years of education	Ratio of farmers with at least 11 years of education	FAC
>8 years of education	Ratio of farmers with at least 9 years of education	FAC
Agricultural education	Ratio of farmers who attended agricultural education	FAC
Agricultural income	Household agricultural income	HIES
Agricultural use <10 years	Ratio of land which has been in agricultural use for less than 10 years	FAC
Banana	Ratio of agricultural land used for growing bananas	FAC
Breadfruit	Ratio of agricultural land used for growing breadfruit	FAC
Business income	Household business income	HIES
Cassava	Ratio of agricultural land used for growing cassava	FAC
Dalo	Ratio of agricultural land used for growing dalo	FAC
Distance	Distance from the cyclone path (1 = less than 50 km, 2 = 50–100 km, 3 = 100–200 km, 4 = more than 200 km)	IBTrACS; TC Winston
Farmers with difficulties	Ratio of farmers with functional difficulties (such as seeing, hearing, or movement difficulties)	FAC
Female farmers	Ratio of female farmers	FAC
Household crop income	Household crop income	FAC
Household size	Agricultural household size	FAC
Irrigated farm area	Ratio of irrigated agricultural land	FAC
Kumala	Ratio of agricultural land used for growing kumala	FAC
Land under freehold	Ratio of agricultural land under freehold land tenure	FAC
Land under lease from state	Ratio of agricultural land under lease from state land tenure	FAC
Married	Ratio of married farmers	FAC
Mobile phone ownership	Ratio of farmers who own a mobile phone	FAC
No savings account (money)	Ratio of farmers who do not own a savings account due to lack of money	FAC
No savings account (money/access)	Ratio of farmers who do not own a savings account due to lack of money or access	FAC
Other income	Household other income	HIES
Permanent crop area	Ratio of agricultural land used to grow permanent crops	FAC
Rice	Ratio of agricultural land used for growing rice	FAC

Variable	Description	Source
Savings account ownership	Ratio of farmers who own a savings account	FAC
Self-employed	Ratio of self-employed farmers	FAC
Tertiary education	Ratio of farmers with tertiary education	FAC
Total income	Total household income	HIES
Total transfer	Total household transfer (remittances and transfers from the government)	HIES
Traditionally owned land	Ratio of agricultural land traditionally owned	FAC
Yaqona	Ratio of agricultural land used for growing yaqona	FAC

FAC = Fiji Agriculture Census, HIES = Household Income and Expenditure Survey, IBTrACS = International Best Track Archive for Climate Stewardship, km = kilometer, TC = tropical cyclone.

Source: Authors.

Table 4. All Absolute Enhanced Vegetation Index Change Values—Selected Independent Variables

Independent Variable	EVI _{diff}			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0458 ^a 0.0058	0.0899 ^a 0.0212	0.0433 ^a 0.0102	0.0422 ^a 0.0068
Female farmers	0.1895 ^b 0.0971	0.3233 ^b 0.1740		0.3166 ^a 0.1153
Banana	-0.2957 ^a 0.0882	-0.6218 ^a 0.1586		-0.5103 ^a 0.1103
Cassava	0.1111 ^a 0.0327	0.4136 ^a 0.0877		0.2439 ^a 0.0535
Dalo	-0.1332 ^a 0.0490			
Total income (HIES) (in F\$'000)	0.0027 ^b 0.0016	0.0092 ^a 0.0029		0.0066 ^a 0.0021
Total transfer (HIES) (in F\$'000)	-0.0103 ^b 0.0055	-0.0190 ^b 0.0111	-0.0126 ^c 0.0052	-0.0221 ^a 0.0073
Other income (HIES) (in F\$'000)	-0.0501 ^c 0.0230	-0.0813 ^b 0.0418		-0.0693 ^c 0.0299
>8 years of education		-1.0667 ^a 0.2346		-0.4451 ^a 0.1571

Independent Variable	EVIDiff			Winston + Josie/Keni
	All TCs	Winston	Josie/Keni	
No savings account (money/access)		-0.2168 ^c 0.1074	-0.1586 ^c 0.0717	
Permanent crop area		0.2058 ^c 0.0862		0.1388 ^c 0.0538
Land under freehold		-0.1779 ^c 0.0808		
Yaqona		0.1743 ^c 0.0697		0.1189 ^c 0.0494
Household size			0.0513 ^c 0.0211	
>10 years of education			-0.5711 ^a 0.1525	
Self-employed			0.0942 ^b 0.0481	
Irrigated farm area			-0.1272 ^c 0.0495	
Rice			-0.2410 ^c 0.0962	
Agricultural income (HIES) (in F\$'000)				
Farmers with difficulties				0.4341 ^b 0.2282
Mobile phone ownership				0.1398 ^b 0.0829
N	183	60	62	122
Adjusted R-square	0.349	0.591	0.508	0.446

EVIDiff = absolute enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.10

^c p < 0.05

Source: Authors.

Table 5. All Absolute Enhanced Vegetation Index Change Values—All Independent Variables

Independent Variable	EVIDiff			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0445 ^a 0.0063	0.0787 ^a 0.0269	0.0345 ^b 0.0175	0.0421 ^a 0.0070
Household size	0.0098 0.0283	0.0070 0.0505	0.0158 0.0353	0.0066 0.0331
>8 years of education	-0.2041 0.2640	-0.9757 ^c 0.4752	-0.1612 0.3355	-0.5573 ^b 0.3101
>10 years of education	-0.0066 0.2466	0.2298 0.4811	-0.1416 0.3061	0.1131 0.2886
Self-employed	0.0135 0.0479	0.0089 0.0835	0.0888 0.0604	0.0498 0.0562
Farmers with difficulties	0.1991 0.2185	0.4991 0.4091	0.1556 0.2715	0.4289 ^b 0.2564
Mobile phone ownership	0.0307 0.0828	0.1157 0.1557	0.0767 0.1024	0.1034 0.0978
No savings account (money/access)	-0.0264 0.0712	-0.1456 0.1428	-0.1707 0.1066	-0.0871 0.0838
Female farmers	0.2006 ^b 0.1202	0.3837 ^b 0.2120	0.2244 0.1508	0.2998 ^c 0.1413
Irrigated farm area	-0.0312 0.0511	-0.0725 0.0880	-0.0980 0.0636	-0.0714 0.0586
Permanent crop area	0.0581 0.0789	0.1805 0.1435	0.0261 0.1029	0.0743 0.0932
Land under freehold	-0.0357 0.0424	-0.1882 ^b 0.1005	0.0523 0.0509	-0.0576 0.0522
Yaqona	0.0185 0.0789	0.1617 0.1395	-0.0438 0.0988	0.0412 0.0927
Rice	-0.0664 0.1058	0.0927 0.1929	-0.3073 ^c 0.1366	-0.0959 0.1249
Banana	-0.3202 ^a 0.1202	-0.6722 ^a 0.2303	-0.1801 0.1501	-0.4819 ^a 0.1412

Independent Variable	EVIDiff			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Cassava	0.1165 0.0834	0.3767 ^c 0.1471	-0.0063 0.1033	0.1655 ^b 0.0976
Dalo	-0.0781 0.1005	-0.0335 0.1810	-0.1468 0.1251	-0.0935 0.1186
Total income (HIES) (in F\$'000)	0.0043 ^c 0.0020	0.0107 ^a 0.0038	0.0014 0.0026	0.0065 ^a 0.0024
Agricultural income (HIES) (in F\$'000)	0.0011 0.0050	0.0071 0.0088	0.0021 0.0062	0.0034 0.0058
Total transfer (HIES) (in F\$'000)	-0.0137 ^c 0.0065	-0.0242 ^b 0.0142	-0.0161 ^c 0.0079	-0.0221 ^a 0.0079
Other income (HIES) (in F\$'000)	-0.0576 ^c 0.0291	-0.0848 0.0524	-0.0242 0.0363	-0.0629 ^b 0.0341
N	183	60	62	122
Adjusted R-square	0.323	0.541	0.452	0.425

EVIDiff = absolute enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.10

^c p < 0.05

Source: Authors.

Table 6. Negative Absolute Enhanced Vegetation Index Change Values—Selected Independent Variables

Independent Variable	EVI _{diff}			Winston + Josie/Keni
	All TCs	Winston	Josie/Keni	
Distance	0.0413 ^a 0.0052	0.0985 ^a 0.0192		0.0379 ^a 0.0063
Household size	0.0283 ^b 0.0141		0.0437 ^a 0.0139	
Banana	-0.1670 ^b 0.0793			-0.3338 ^a 0.0941
Cassava	0.1167 ^a 0.0298	-0.3088 ^b 0.1286	0.0712 ^b 0.0339	0.1569 ^a 0.0438
Dalo	-0.1226 ^a 0.0413	-0.4305 ^a 0.1107	-0.0912 ^b 0.0377	
Household crop income (in F\$'000)	0.0014 ^b 0.0007	0.0025 ^c 0.0014		
>8 years of education		-0.7859 ^a 0.2728		-0.3879 ^b 0.1665
Tertiary education		1.5789 ^a 0.4970		0.5166 ^c 0.2840
Mobile phone ownership		-0.4719 ^b 0.1777		
Savings account ownership		0.5290 ^a 0.1384	-0.1066 ^c 0.0576	
Female farmers		0.7470 ^a 0.2336	0.2102 ^b 0.0842	0.1910 ^c 0.1022
Irrigated farm area		-0.1798 ^b 0.0713	-0.0633 ^b 0.0293	
Traditionally owned land		-0.2291 ^a 0.0663		-0.0825 ^b 0.0393
Land under freehold		-0.4953 ^a 0.1120	0.1081 ^a 0.0293	-0.0973 ^c 0.0541
Land under lease from state		-0.5753 ^b 0.2540		-0.3076 ^b 0.1337

Independent Variable	EVI _{diff}			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Yaqona		-0.1381 ^c 0.0668		
Rice		-0.3561 ^b 0.1526	-0.1897 ^b 0.0845	
Total income (HIES) (in F\$'000)		0.0101 ^b 0.0039		0.0043* 0.0024
Total transfer (HIES) (in F\$'000)		-0.0232 ^c 0.0119		-0.0122 ^c 0.0068
>10 years of education			-0.3993 ^a 0.1069	
Agricultural education			0.9081 ^a 0.1970	
Self-employed			0.0935 ^b 0.0351	
No savings account (money/access)			-0.2891 ^a 0.0492	
No savings account (money)			0.2570 ^a 0.0864	
Other income (HIES) (in F\$'000)			-0.0260 ^c 0.0133	-0.0570 ^b 0.0250
Farmers with difficulties				0.4255 ^b 0.2027
N	127	39	50	91
Adjusted R-square	0.463	0.731	0.749	0.499

EVI_{diff} = absolute enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.05

^c p < 0.10

Source: Authors.

Table 7. Negative Absolute Enhanced Vegetation Index Change Values—All Independent Variables

Independent Variable	EVIDiff			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0384 ^a 0.0057	0.1196 ^b 0.0394	0.0024 0.0143	0.0380 ^a 0.0069
Household size	0.0332 0.0292	-0.0162 0.0776	0.0389 0.0247	0.0156 0.0347
>8 years of education	-0.0194 0.2662	-0.8159 0.5059	-0.0458 0.2699	-0.3713 0.3311
>10 years of education	0.1582 0.3056	0.7243 0.6503	-0.3028 0.2783	0.2737 0.3694
Tertiary education	0.2330 0.3936	1.2150 0.8376	-0.0847 0.3676	0.3493 0.4842
Agricultural education	-0.2650 0.3148	-1.0799 0.6671	0.8260 ^b 0.2958	-0.1899 0.3934
Self-employed	0.0008 0.0519	0.0414 0.1314	0.0869 ^c 0.0502	0.0120 0.0625
Farmers with difficulties	0.4139 ^c 0.2297	0.3575 0.5668	0.1495 0.2042	0.6643 ^b 0.2746
Mobile phone ownership	-0.1198 0.1189	-0.6163 0.4061	0.0179 0.1244	-0.0455 0.1535
Savings account ownership	-0.0153 0.1183	0.4491 0.2611	-0.0999 0.1237	-0.0768 0.1506
No savings account (money/access)	-0.0022 0.0822	-0.1990 0.2301	-0.2721 ^a 0.0835	-0.0475 0.1019
No savings account (money)	0.0013 0.1280	0.0431 0.3779	0.2143 ^c 0.1220	-0.0112 0.1535
Female farmers	0.0571 0.1407	0.7060 ^b 0.2754	0.1885 0.1206	0.2537 0.1709
Irrigated farm area	-0.0283 0.0461	-0.2251 ^c 0.1089	-0.0693 ^c 0.0404	-0.0716 0.0555
Traditionally owned land	-0.0898 ^b 0.0428	-0.2513 ^b 0.1037	-0.0475 0.0374	-0.1037 ^c 0.0524

Independent Variable	EVIDiff			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Land under freehold	-0.0989 ^c 0.0566	-0.4585 ^a 0.1379	0.0608 0.0548	-0.1091 0.0690
Land under lease from state	-0.1995 0.1264	-0.6153 0.3691	-0.0943 0.1270	-0.3153 ^c 0.1817
Yaqona	-0.0509 0.0513	-0.2189 0.1864	-0.0029 0.0511	-0.0490 0.0685
Rice	-0.0116 0.1083	-0.3177 0.2149	-0.2555 ^c 0.1279	-0.0664 0.1276
Banana	-0.2011 ^c 0.1099	-0.0839 0.2650	-0.0407 0.1099	-0.3101 ^b 0.1411
Cassava	0.1049 0.0654	-0.2452 0.2255	0.0745 0.0701	0.1205 0.0935
Dalo	-0.1457 ^c 0.0802	-0.5942 ^a 0.1772	-0.0609 0.0842	-0.1260 0.0997
Household crop income (in F\$'000)	0.0016 ^c 0.0009	0.0033 ^c 0.0017	-0.0004 0.0010	0.0006 0.0012
Total income (HIES) (in F\$'000)	0.0021 0.0027	0.0087 0.0060	0.0001 0.0026	0.0058 ^c 0.0034
Total transfer (HIES) (in F\$'000)	-0.0123 ^c 0.0070	-0.0264 0.0156	-0.0033 0.0061	-0.0168 ^c 0.0084
Other income (HIES) (in F\$'000)	-0.0250 0.0278	3.54e-08 0.0761	-0.0246 0.0276	-0.0499 0.0357
N	117	39	50	89
Adjusted R-square	0.467	0.695	0.662	0.462

EVIDiff = absolute enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.05

^c p < 0.10

Source: Authors.

Table 8. All Relative Enhanced Vegetation Index Change Values—Selected Independent Variables

Independent Variable	EVIch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0761 ^a 0.0101	0.1440 ^a 0.0301	0.0915 ^a 0.0157	0.0735 ^a 0.0119
Permanent crop area	0.1043 ^b 0.0500			
Banana	-0.4865 ^a 0.1534	-0.8138 ^a 0.2714		-0.6357 ^a 0.1816
Cassava	0.2364 ^a 0.0514	0.6036 ^a 0.1156		0.2738 ^a 0.0651
Total transfer (HIES) (in F\$'000)	-0.0235 ^a 0.0078		-0.0261 ^b 0.0098	-0.0277 ^b 0.0118
>8 years of education		-1.6837 ^a 0.3935		-0.7441 ^a 0.2643
Female farmers		0.4936 ^c 0.2688		
Yaqona		0.1813 ^b 0.0810		
Total income (HIES) (in F\$'000)		0.0120 ^b 0.0048		0.0072 ^b 0.0035
Other income (HIES) (in F\$'000)		-0.1970 ^a 0.0700		-0.0910 ^c 0.0487
Mobile phone ownership			0.2723 ^b 0.1166	
Agricultural use <10 years			-0.1960 ^b 0.0907	
Irrigated farm area			-0.2143 ^b 0.0910	
Rice			-0.4032 ^b 0.1720	

Independent Variable	EVIch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
N	183	60	62	122
Adjusted R-square	0.305	0.526	0.453	0.380

EVIch = relative enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.05

^c p < 0.10

Source: Authors.

Table 9. All Relative Enhanced Vegetation Index Change Values—All Independent Variables

Independent Variable	EVIch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0750 ^a 0.0106	0.1553 ^a 0.0348	0.0944 ^a 0.0213	0.0735 ^a 0.0121
>8 years of education	-0.2257 0.3140	-1.2493 ^b 0.5643	-0.2603 0.4000	-0.6629 ^c 0.3716
Self-employed	-0.0280 0.0724	-0.0681 0.1290	0.0237 0.1024	0.0028 0.0870
Mobile phone ownership	0.1032 0.1320	0.1327 0.2393	0.3176 ^c 0.1692	0.2548 0.1573
Female farmers	0.2491 0.1792	0.6499 ^b 0.3150	0.3067 0.2416	0.4333 ^b 0.2097
Agricultural use <10 years	-0.0832 0.0959	0.0042 0.1745	-0.2107 ^c 0.1237	-0.1141 0.1152
Irrigated farm area	-0.0256 0.0887	-0.0027 0.1513	-0.1855 0.1124	-0.0678 0.1029
Permanent crop area	0.1651 ^c 0.0880	0.2621 0.1577	0.0655 0.1161	0.1513 0.1044
Yaqona	0.1237 0.0803	0.3324 ^b 0.1419	0.0664 0.1048	0.1723 ^c 0.0949
Rice	-0.0481 0.1531	0.1942 0.2646	-0.4736 ^b 0.2026	-0.1059 0.1810
Banana	-0.5319 ^a 0.1723	-0.8800 ^a 0.3018	-0.3853 ^c 0.2184	-0.7200 ^a 0.2010
Cassava	0.2852 ^a 0.0901	0.7331 ^a 0.1617	0.1058 0.1157	0.3560 ^a 0.1060
Total income (HIES) (in F\$'000)	0.0070 ^b 0.0031	0.0143 ^b 0.0055	0.0053 0.0041	0.0096 ^b 0.0037
Agricultural income (HIES) (in F\$'000)	0.0019 0.0082	0.0092 0.0145	0.0041 0.0105	0.0056 0.0096
Total transfer (HIES) (in F\$'000)	-0.0234 ^b 0.0104	-0.0241 0.0202	-0.0309 ^b 0.0133	-0.0313 ^b 0.0126

Independent Variable	EVlch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Other income (HIES) (in F\$'000)	-0.1010 ^b 0.0486	-0.1330 0.0842	-0.0622 0.0628	-0.1050 ^c 0.0575
N	183	60	62	122
Adjusted R-square	0.305	0.507	0.426	0.381

EVlch = relative enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.05

^c p < 0.10

Source: Authors.

Table 10. Negative Relative Enhanced Vegetation Index Change Values—Selected Independent Variables

Independent Variable	EVlch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0687 ^a 0.0081	0.1378 ^a 0.0288		0.0640 ^a 0.0095
Household size	0.0405 ^b 0.0219		0.0561 ^c 0.0218	0.0581 ^c 0.0272
Banana	-0.2317 ^b 0.1235			-0.4118 ^a 0.1533
Cassava	0.1611 ^a 0.0464	-0.3400 ^b 0.1719		0.1729 ^a 0.0602
Dalo	-0.1890 ^a 0.0643	-0.7470 ^a 0.1804	-0.2352 ^a 0.0727	-0.2007 ^a 0.0743
Household crop income (in F\$'000)	0.0021 ^c 0.0010	0.0042 ^b 0.0021		
>8 years of education		-0.8894 ^b 0.4386		
>10 years of education		1.4935 ^a 0.4639	-0.5094 ^c 0.1902	

Independent Variable	EVIch			Winston + Josie/Keni
	All TCs	Winston	Josie/Keni	
Agricultural education		-1.7946 ^c 0.7817	1.4420 ^a 0.3060	
Mobile phone ownership		-0.8078 ^a 0.2593		
Savings account ownership		0.6853 ^a 0.1826	-0.1793 ^b 0.1035	
Traditionally owned land		-0.1943 ^c 0.0784		
Land under freehold		-0.3897 ^c 0.1706	0.1776 ^a 0.0463	
Yaqona		-0.3698 ^a 0.1146	-0.1034 ^b 0.0536	
Self-employed			0.1293 ^c 0.0549	
No savings account (money/access)			-0.4516 ^a 0.0761	
No savings account (money)			0.3813 ^a 0.1358	
Female farmers			0.3644 ^a 0.1308	0.3316 ^b 0.1683
Irrigated farm area			-0.1419 ^a 0.0457	
Permanent crop area			-0.1051 ^c 0.0516	
Rice			-0.3953 ^a 0.1202	
Other income (HIES) (in F\$'000)			-0.0474 ^c 0.0209	
Farmers with difficulties				0.5515 ^c 0.2682

Independent Variable	EVIch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Total transfer (HIES) (in F\$'000)				-0.0134 ^b 0.0075
N	127	43	50	91
Adjusted R-square	0.468	0.595	0.755	0.512

EVIch = relative enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.10

^c p < 0.05

Source: Authors.

Table 11. Negative Relative Enhanced Vegetation Index Change Values—All Independent Variables

Independent Variable	EVIch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Distance	0.0649 ^a 0.0090	0.2035 ^b 0.0769	0.0097 0.0197	0.0626 ^a 0.0107
Household size	0.0457 0.0437	0.0086 0.1216	0.0561 0.0336	0.0398 0.0520
>8 years of education	0.0665 0.3538	-0.4654 0.7750	0.0613 0.3381	-0.0167 0.4370
>10 years of education	0.3457 0.4176	1.6002 1.3931	-0.6392 ^c 0.3474	0.4220 0.5041
Agricultural education	-0.4070 0.5060	-2.3084 ^c 1.1079	1.3298 ^a 0.4463	-0.3740 0.6149
Self-employed	-0.0021 0.0786	0.0780 0.2095	0.1097 0.0732	0.0168 0.0945
Farmers with difficulties	0.4155 0.3294	0.2836 0.9259	0.0852 0.3000	0.6089 0.4007
Mobile phone ownership	-0.2605 0.1768	-1.1931 ^c 0.6320	0.0056 0.1644	-0.3050 0.2306

Independent Variable	EVlch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
Savings account ownership	0.0794 0.1682	0.8583 ^c 0.4320	-0.1406 0.1575	0.1567 0.2062
No savings account (money/access)	0.0362 0.1244	-0.2118 0.4369	-0.4127 ^a 0.1291	0.0584 0.1543
No savings account (money)	0.0345 0.1989	0.2177 0.6438	0.3364 ^c 0.1727	0.0602 0.2355
Female farmers	0.0108 0.2220	0.6641 0.4558	0.2829 0.1719	0.2017 0.2549
Irrigated farm area	-0.0031 0.0692	-0.2384 0.1620	-0.1243 ^b 0.0591	-0.0625 0.0836
Permanent crop area	-0.0283 0.1228	0.0198 0.3224	-0.0518 0.1206	-0.1030 0.1649
Traditionally owned land	-0.0816 0.0592	-0.2437 ^c 0.1322	-0.0339 0.0506	-0.0742 0.0706
Land under freehold	-0.0960 0.0922	-0.4436 ^c 0.2428	0.1180 0.0828	-0.0743 0.1123
Yaqona	-0.1262 0.1287	-0.4355 0.4334	-0.0414 0.1196	-0.2076 0.1770
Rice	0.0014 0.1759	-0.2880 0.3508	-0.4375 ^b 0.1887	-0.0869 0.2071
Banana	-0.2750 0.1693	-0.2049 0.4416	-0.0382 0.1539	-0.3390 0.2194
Cassava	0.0694 0.1353	-0.3705 0.4509	0.0403 0.1289	-0.0317 0.1914
Dalo	-0.2798 0.1766	-1.0747 ^b 0.4132	-0.1172 0.1630	-0.3633 0.2337
Household crop income (in F\$'000)	0.0022 0.0014	0.0044 0.0029	-0.0013 0.0013	0.0009 0.0017
Total transfer (HIES) (in F\$'000)	-0.0141 0.0101	-0.0350 0.0247	-0.0066 0.0081	-0.0185 0.0121
Other income (HIES) (in F\$'000)	-0.0268 0.0333	0.0753 0.1120	-0.0378 0.0297	-0.0107 0.0433

Independent Variable	EVlch			
	All TCs	Winston	Josie/Keni	Winston + Josie/Keni
N	117	39	50	89
Adjusted R-square	0.463	0.573	0.688	0.444

EVlch = relative enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations, TC = tropical cyclone.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.05

^c p < 0.10

Source: Authors.

Table 12. Tropical Cyclone Harold Regression Output—Absolute and Relative Enhanced Vegetation Index Change Values

Independent Variable	EVldiff		EVlch	
	Selected Variables	All Variables	Selected Variables	All Variables
Self-employed	-0.1167 ^a 0.0436	-0.1352 ^b 0.0747	-0.1982 ^c 0.0847	-0.2479 ^c 0.1215
Agricultural income (HIES) (in F\$'000)	-0.0126 ^c 0.0048	-0.0099 0.0080	-0.0235 ^c 0.0094	-0.0159 0.0138
Other income (HIES) (in F\$'000)	-0.1010 ^a 0.0241	-0.0623 0.0439	-0.1940 ^a 0.0468	-0.1180 0.0781
Distance		-0.0013 0.0209		0.0151 0.0275
Household size		-0.0032 0.0436		
>8 years of education		0.2010 0.4130		0.6680 0.5041
>10 years of education		0.1071 0.3871		
Farmers with difficulties		-0.1251 0.3348		
Mobile phone ownership		-0.0673 0.1242		-0.0855 0.2115
No savings account (money/access)		-0.0595 0.1314		

Independent Variable	EVldiff		EVlch	
	Selected Variables	All Variables	Selected Variables	All Variables
Female farmers		0.0144 0.1810		0.0175 0.2993
Irrigated farm area		0.0607 0.0830		0.1216 0.1488
Permanent crop area		0.1360 0.1235		0.2442 ^b 0.1431
Land under freehold		0.0102 0.0601		
Yaqona		0.0427 0.1198		0.1055 0.1300
Rice		0.1387 0.1623		0.2383 0.2492
Banana		-0.0264 0.1838		-0.1156 0.2852
Cassava		0.0613 0.1267		0.1320 0.1454
Dalo		-0.0061 0.1498		
Total income (HIES) (in F\$'000)		-0.0012 0.0031		-0.0009 0.0050
Total transfer (HIES) (in F\$'000)		0.0012 0.0093		-0.0033 0.0163
Agricultural use <10 years				-0.0120 0.1491
N	61	61	61	61
Adjusted R-square	0.259	0.056	0.241	0.127

EVlch = relative enhanced vegetation index change, EVldiff = absolute enhanced vegetation index change, F\$ = Fiji dollar, HIES = Household Income and Expenditure Survey, N = Number of observations.

Note: Numbers in blue indicate standard errors.

^a p < 0.01

^b p < 0.10

^c p < 0.05

Source: Authors.

Table 13. Summary Statistics

Variable	Obs	Mean	Std	Min	Max
EVldiff	199	-0.04	0.09	-0.33	0.20
EVlch	199	-0.05	0.16	-0.49	0.47
Distance	199	2.58	0.98	1.00	4.00
Female farmers	197	0.13	0.07	0.00	0.32
Banana	197	0.03	0.06	0.00	0.40
Cassava	197	0.20	0.20	0.01	0.85
Dalo	197	0.11	0.13	0.00	0.58
>8 years of education	197	0.86	0.06	0.66	0.96
No savings account (money/access)	197	0.22	0.14	0.03	0.72
Irrigated farm area	197	0.15	0.14	0.00	0.60
Land under freehold	197	0.11	0.16	0.00	0.95
Household size	197	4.21	0.40	2.78	5.24
>10 years of education	197	0.32	0.06	0.11	0.43
Self-employed	197	0.41	0.18	0.08	0.85
Rice	197	0.02	0.08	0.00	0.45
Tertiary education	197	0.07	0.03	0.00	0.13
Mobile phone ownership	197	0.59	0.12	0.19	0.82
Savings account ownership	197	0.45	0.15	0.13	0.69
Traditionally owned land	197	0.68	0.28	0.01	1.00
Land under lease from state	197	0.05	0.09	0.00	0.38
Yaqona	197	0.31	0.28	0.00	0.84
Agricultural education	197	0.05	0.02	0.00	0.11
No savings account (money)	197	0.12	0.05	0.00	0.28
Permanent crop area	197	0.29	0.24	0.01	0.92
Agricultural use <10 years	197	0.39	0.15	0.03	0.74
Married	197	0.73	0.04	0.65	0.84
Farmers with difficulties	197	0.07	0.04	0.01	0.18

Variable	Obs	Mean	Std	Min	Max
Household crop income (F\$)	191	5,282.80	7,790.91	7.01	44,202.96
Total income (F\$)	184	16,314.59	6,151.03	6,382.47	42,989.52
Total transfer (F\$)	184	1,716.48	1,293.41	136.00	6,729.21
Other income (F\$)	184	268.98	340.90	0.00	1,198.31
Business income (F\$)	184	595.54	510.32	0.00	1,978.73
Agricultural income (F\$)	184	3,315.48	1,840.77	350.48	9,301.18

EVlch = relative enhanced vegetation index change, EVldiff = absolute enhanced vegetation index change, F\$ = Fiji dollar, Max = maximum value, Min = minimum value, Obs = number of observations, Std = standard deviation.

Source: Authors.

Table 14. Variables Used in Countrywide Analysis

Variable	Description	Source
Absolute EVI change	Weighted average of district EVldiff values	Satellite imagery (Sentinel, MODIS)
Relative EVI change	Weighted average of district EVlch values	Satellite imagery (Sentinel, MODIS)
Agricultural income change	Relative change (%) of Fiji's agricultural gross value added compared to the previous year	Reserve Bank of Fiji

EVI = enhanced vegetation index, EVlch = relative EVI change, EVldiff = absolute EVI change, MODIS = Moderate Resolution Imaging Spectroradiometer.

Source: Authors.

Table 15. Comparison of Enhanced Vegetation Index with Agricultural Income Change

Year	EVldiff	EVlch	Agricultural Income Change
2016 (TC Winston)	-0.077	-11.79%	-8.72%
2018 (TC Josie/Keni)	-0.035	-5.14%	5.55%
2020 (TC Harold)	0.002	0.44%	2.98%
EVl and agricultural income change correlation	0.79	0.80	

EVI = enhanced vegetation index, EVlch = relative EVI change, EVldiff = absolute EVI change, TC = tropical cyclone.

Source: Authors.