Supplementary Materials: Climate and socioeconomic factors drive irrigated agriculture dynamics in the lower Colorado River Basin

Cynthia L. Norton [1], Matthew P. Dannenberg [2], Dong Yan[1], Cynthia Wallace[3], Jesus Rodriguez[3], Seth M. Munson[4], Willem J.D. van Leeuwen[5], William K. Smith [1,*]

	Warm Season	Cool Season
INDVI (Growing Season-DOY)	97-273	1-97 and 273-365
Precipitation (Month)	4-9	1-5 and 10-12
Average Temperature (Month)	4-9	1-5 and 10-12
VPD (Month)	4-9	1-5 and 10-12
Aridity (PPT/PET) (Month)	4-9	1-5 and 10-12

Table S1. Seasonal division of climate variables.

LCRP	Active Validation	Fallow Validation	Total
Active Classified	5531	108	5639
Fallow Classified	1546	7672	9218
Total	7077	7780	14857
Kappa Coefficient			0.5
Overall Accuracy			0.89
Commission Error	0.22	0.01	
Producer Accuracy	0.78	0.98	
Omission Error	0.02	0.17	
User Accuracy	0.98	0.83	

Table S2. LCRP validation matrix.

PPAMA	Active Validation	Fallow Validation	Total
Active Classified	3543	378	3921
Fallow Classified	351	1418	1769
Total	3894	1796	5690
Kappa Coefficient			0.5
Overall Accuracy			0.87
Commission Error	0.09	0.21	
Producer Accuracy	0.91	0.79	
Omission Error	0.09	0.19	
User Accuracy	0.90	0.80	

Table S3. PPAMA validation matrix.

LCRP_EXTENT	R	p.value	slope
cool_vpd	-0.522	0.019	-0.008
cool_temp	-0.468	0.033	-0.013
warm_vpd	-0.459	0.036	-0.008
warm_pet	0.441	0.044	0.003
warm_temp	-0.182	0.233	-0.012
cool_pet	-0.123	0.284	-0.003
warm_ai	0.198	0.538	0.117
warm_ppt	-0.209	0.576	-0.012
cool_ppt	0.247	0.787	3E-05
cool_ai	0.253	0.863	0.011

Table S4. Lower Colorado River planning extent (LCRP_extent) correlations with warm and cool seasonal climate variables such as vapor pressure deficit (vpd), temperature (temp), precipitation (ppt), potential evapotranspiration (pet) and an aridity index (ai = ppt/pet) . Statistics highlighted orange were used in the main paper.

PPAMA_EXTENT	R	p.value	slope
cool_ai	0.459	0.036	0.118
cool_ppt	0.293	0.134	0.0002
cool_pet	-0.155	0.257	-0.005
warm_temp	0.089	0.306	0.018
cool_vpd	-0.2	0.545	-0.005
cool_temp	0.2	0.562	0.007
warm_pet	0.22	0.636	0.001
warm_ai	-0.25	0.716	-0.055
warm_vpd	0.25	0.810	0.001
warm_ppt	0.25	0.863	0.018

Table S5. Pinal and Phoenix active management area extent (PPAMA_extent) correlations with warm and cool seasonal climate variables such as vapor pressure deficit (vpd), temperature (temp), precipitation (ppt), potential evapotranspiration (pet) and an aridity index (ai = ppt/pet). Statistics highlighted orange were used in the main paper.

LCRP_iNDVI	R	p.value	slope
warm_pet	-0.727	0.001	-0.006
cool_vpd	0.721	0.001	0.015
cool_temp	0.675	0.002	0.024
cool_pet	0.531	0.016	0.008
warm_vpd	0.383	0.071	0.009
warm_ppt	0.344	0.097	0.004
warm_ai	0.134	0.273	0.275
warm_temp	0.243	0.754	0.004
cool_ai	-0.245	0.771	-0.025
cool_ppt	-0.249	0.809	-4E-05

Table S6. Lower Colorado River planning iNDVI (LCRP_iNDVI) correlations with warm and cool seasonal climate variables such as vapor pressure deficit (vpd), temperature (temp), precipitation (ppt), potential evapotranspiration (pet) and an aridity index (ai = ppt/pet) . Statistics highlighted orange were used in the main paper.

PPAMA_iNDVI	R	p.value	slope
warm_pet	-0.646	0.003	-0.007
warm_vpd	-0.588	0.008	-0.016
warm_ai	0.415	0.055	0.353
warm_ppt	-0.415	0.084	-0.022
warm_temp	-0.02	0.332	-0.022
cool_vpd	-0.10	0.359	-0.009
cool_ppt	0.17	0.505	0.0001
cool_pet	-0.20	0.563	-0.003
cool_temp	0.27	0.884	0.002
cool_ai	0.27	0.91	0.009

Table S7. Pinal and Phoenix active management area iNDVI (PPAMA_iNDVI) correlations with warm and cool seasonal climate variables such as vapor pressure deficit (vpd), temperature (temp), precipitation (ppt), potential evapotranspiration (pet) and an aridity index (ai = ppt/pet). Statistics highlighted orange were used in the main paper.

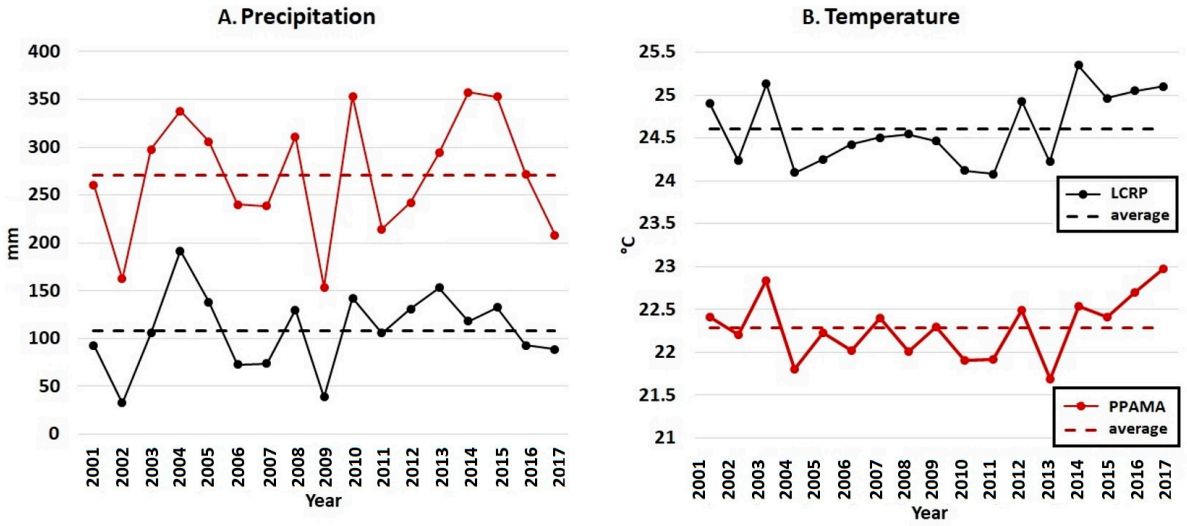

Figure S1. Mean annual precipitation (A) and temperature (B) for both LCRP and PPAMA areas.

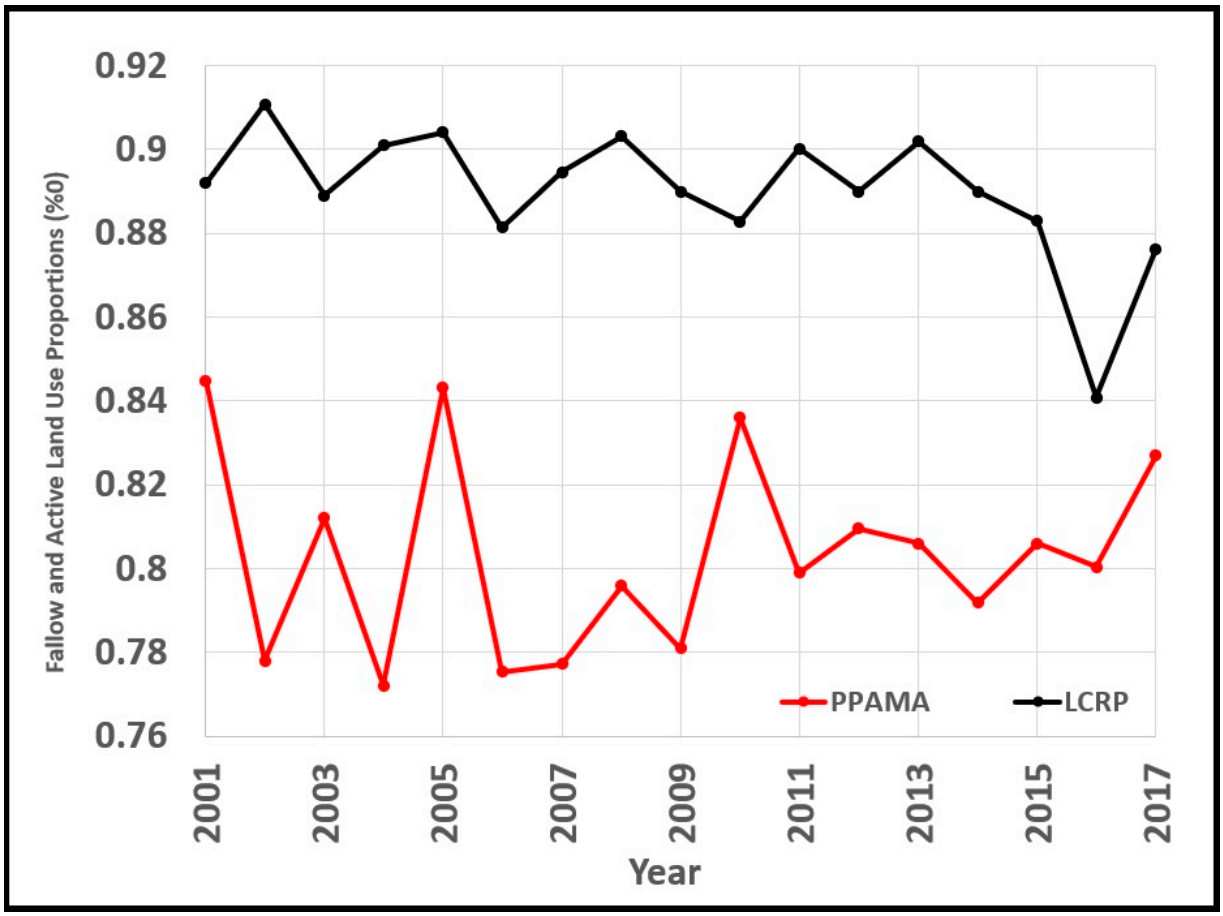

Figure S2. Proportion of active and fallow land for lower Colorado River planning (LCRP) and Pinal and Phoenix active management area (PPAMA) areas. (A) The LCRP shows a higher percentage of active crop during 2001-2017 (A). (B) The PPAMA shows a much lower percentage of active crop from years 2001-2017 and had higher interannual variability (in red).

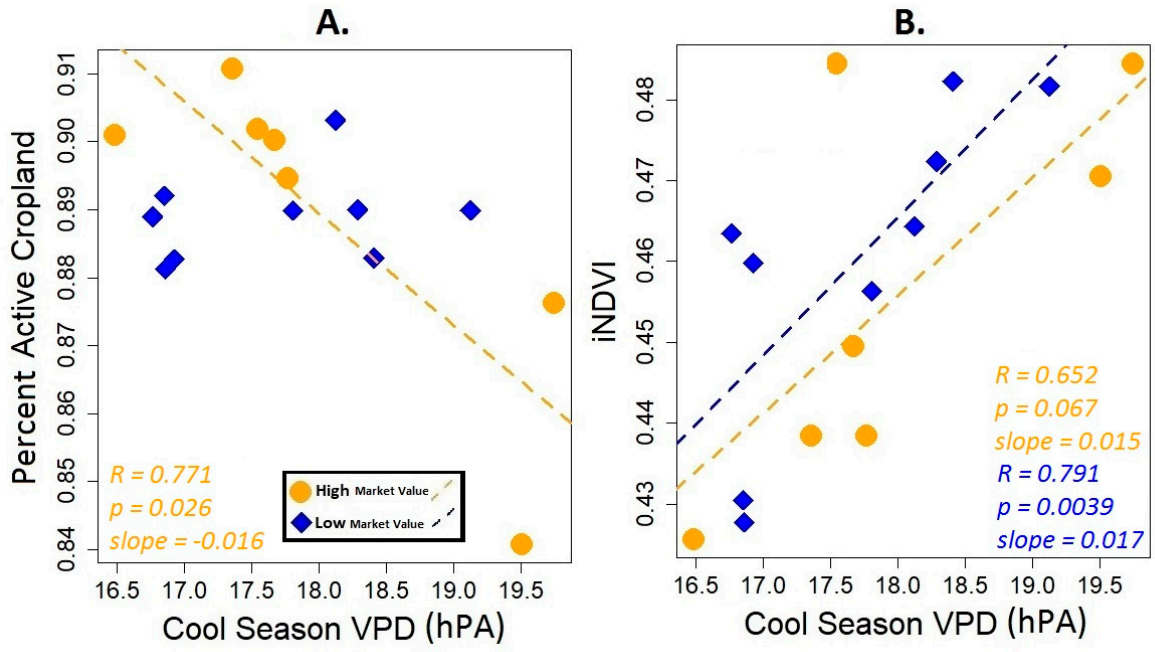

Figure S3. The role of crop market value in the coupling of active cropland extent and active cropland productivity (iNDVI) to climate. (A) LCRP active cropland extent was negatively correlated with cool season vapor pressure deficit during years of high market value (orange circles). (B) LCRP active cropland productivity was most positively correlated with warm season vapor pressure deficit during years of low market value (blue diamonds). Dashed lines show the linear regression fit of the low-market value relationships, which are significant ($p < 0.05$); Correlations and slopes are reported in the plot.