Open Habitats under Threat in Mountainous, Mediterranean Landscapes: Land Abandonment Consequences in the Vegetation Cover of the Thessalian Part of Mt Agrafa (Central Greece)

Supplementary material

Figure S1. Human population from 1940 to 2011 in each municipal district of the study area. Municipal districts 1-9 are mainly around Lake Plastiras, while municipal districts 10-13 are areas mainly away from Lake Plastiras. Data from Hellenic Statistical Authority (ELSTAT).

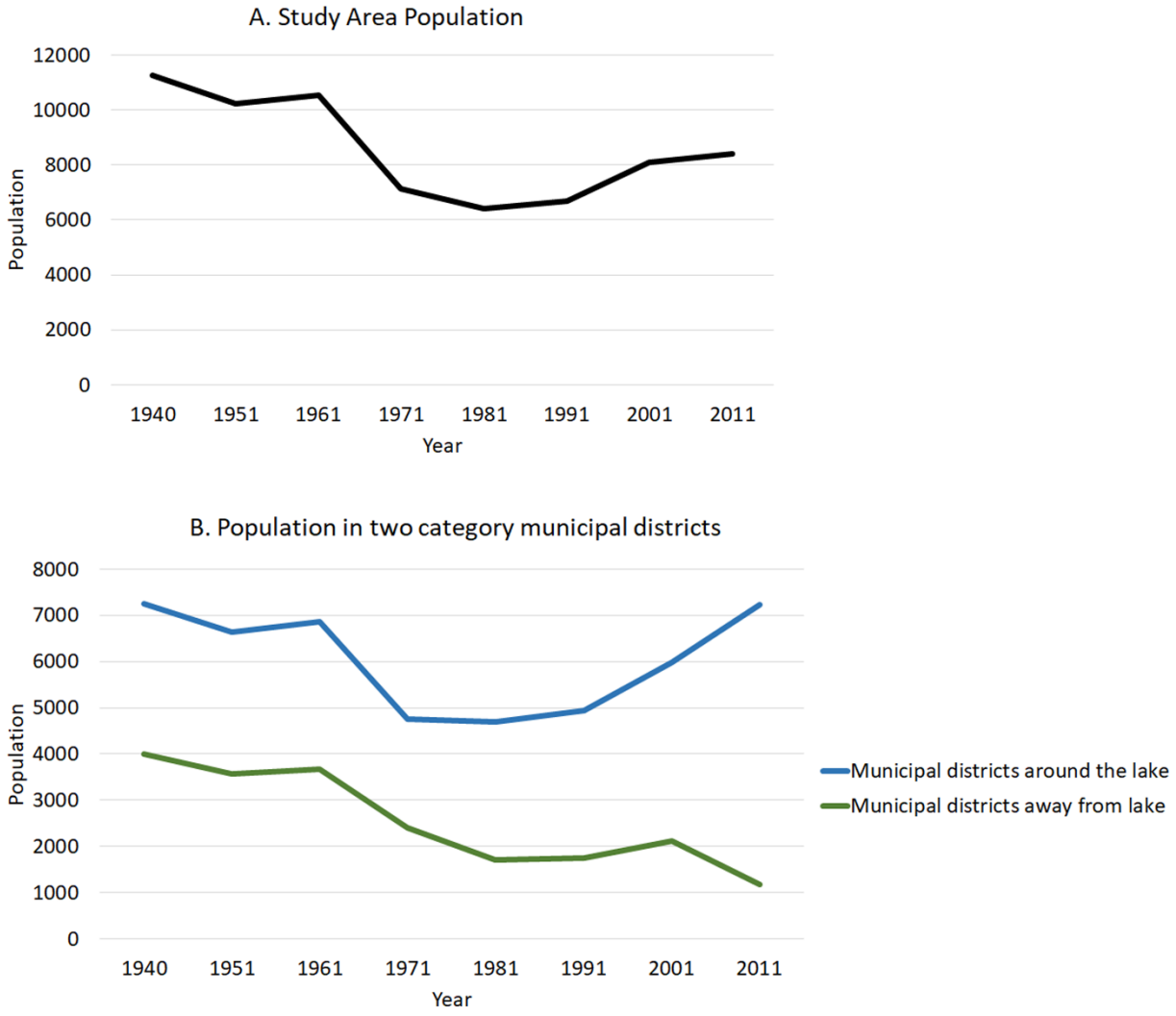

Figure S2. Human population from 1940 to 2011 in the study area (A) and in the two types of municipal districts (around the lake and away from the lake) (B). Data from Hellenic Statistical Authority (ELSTAT).

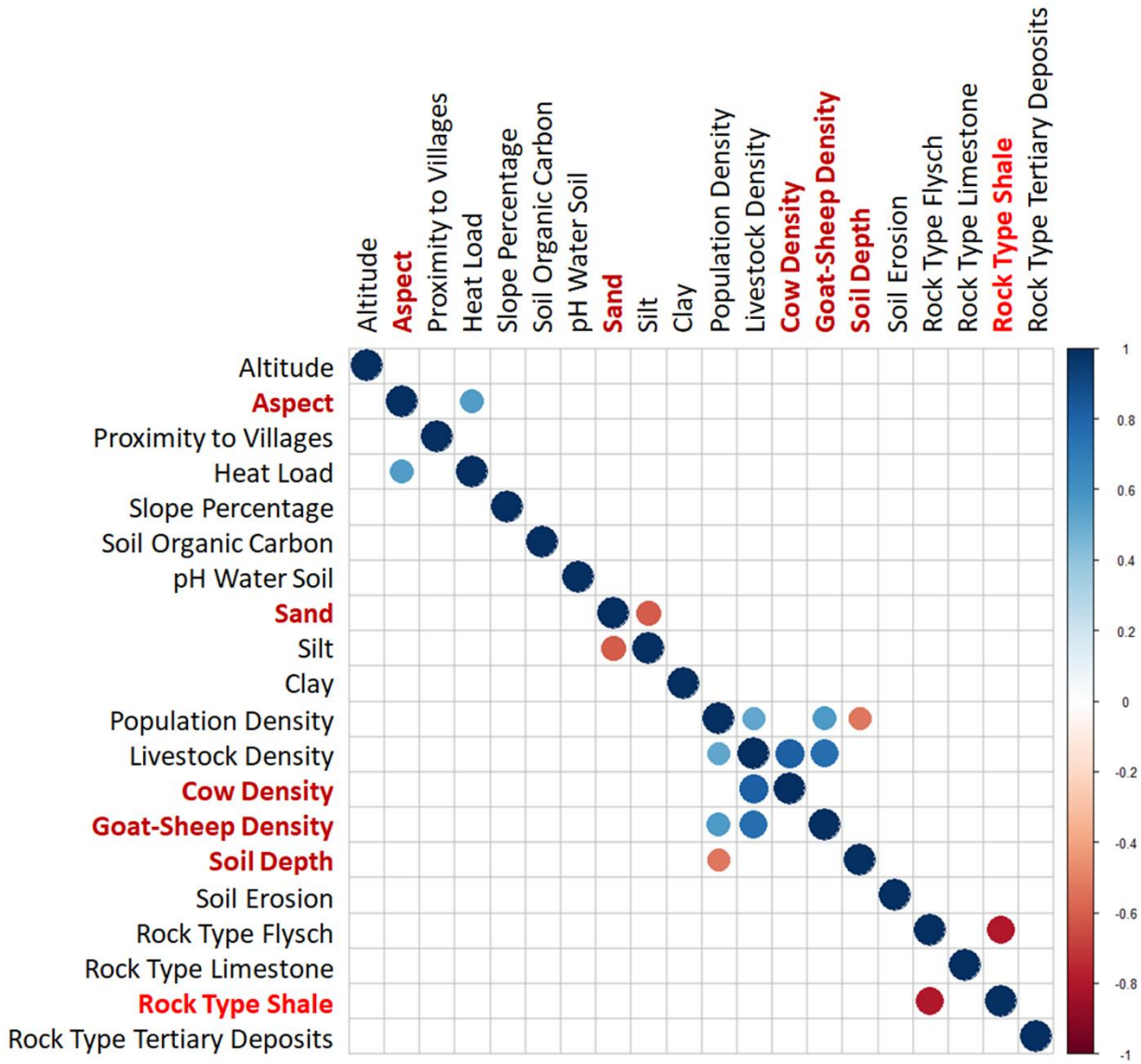

Figure S3. Spearman correlation coefficient values higher than |0.5| between predictors tested to be used for modelling land type occurrence. The six variables in red font were chosen to be excluded from the model because their correlation coefficient with other variables was exceeding |0.5|. Population Density and Livestock Density variables were both retained despite having correlation coefficient higher than |0.5|, so as to be able to explore their impact on LULC classes occurrence.

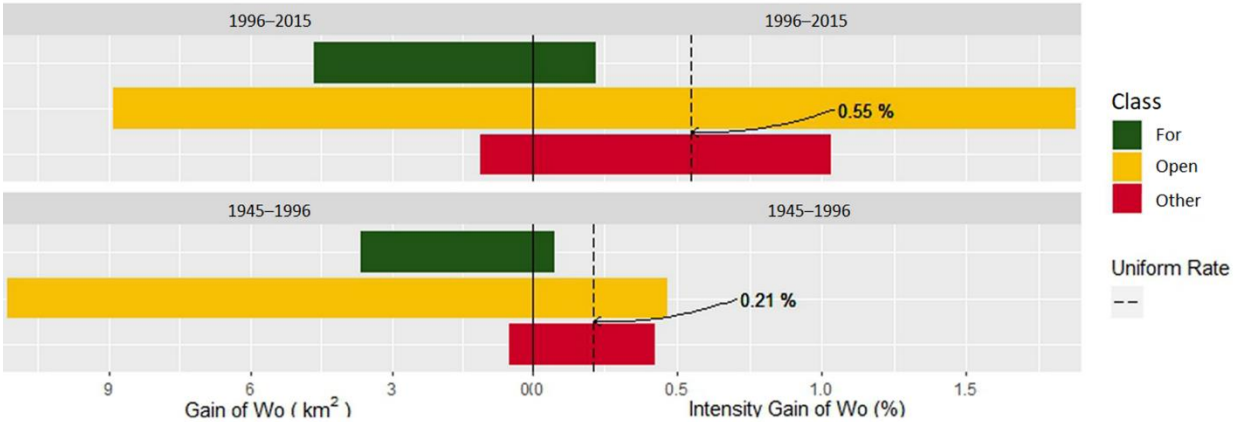

Figure S4. Transition level intensity analysis for woodlands gain in the study area for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show woodland gross surface gain from each other LULC class for each period. Bars that extend to the right of zero axis show intensity of transitions to woodland from each other class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the LULC classes available for transition. Classes with bars extending beyond this line are considered as targeted, while those with bars before that line are considered as avoided. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

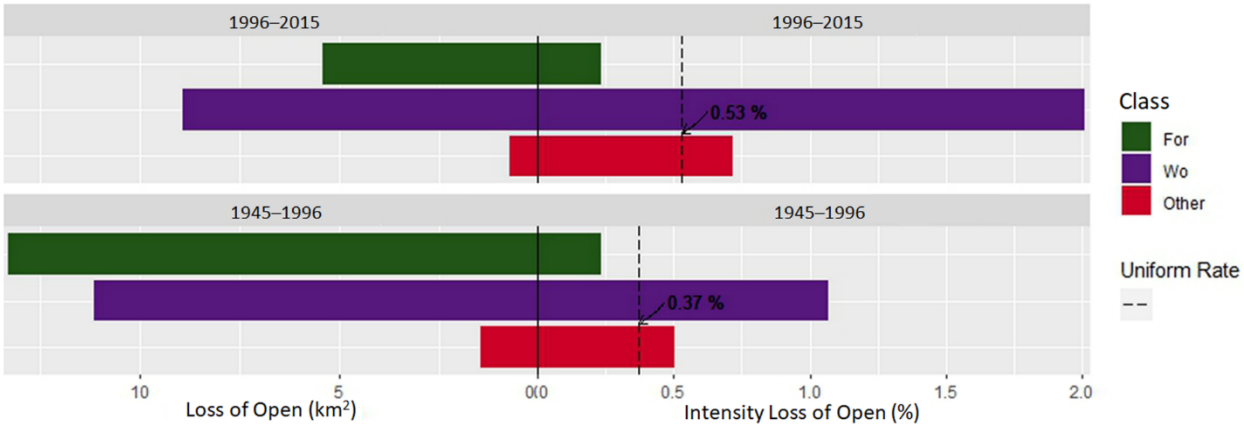

Figure S5. Transition level intensity analysis for open habitats loss in the study area for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show open habitat gross surface loss to each other LULC class for each period. Bars that extend to the right of zero axis show intensity of transitions from open habitat to each other class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the LULC classes available for transition. Classes with bars extending beyond this line are considered as targeted, while those with bars before that line are considered as avoided. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

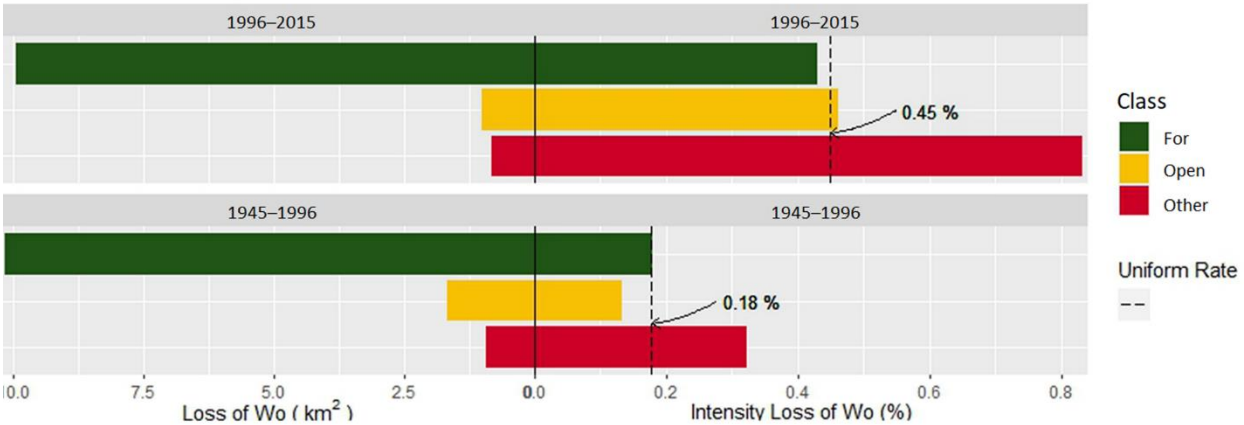

Figure S6. Transition level intensity analysis for woodlands loss in the study area for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show woodland gross surface loss to each other LULC class for each period. Bars that extend to the right of zero axis show intensity of transitions from woodland to each other class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the LULC classes available for transition. Classes with bars extending beyond this line are considered as targeted, while those with bars before that line are considered as avoided. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

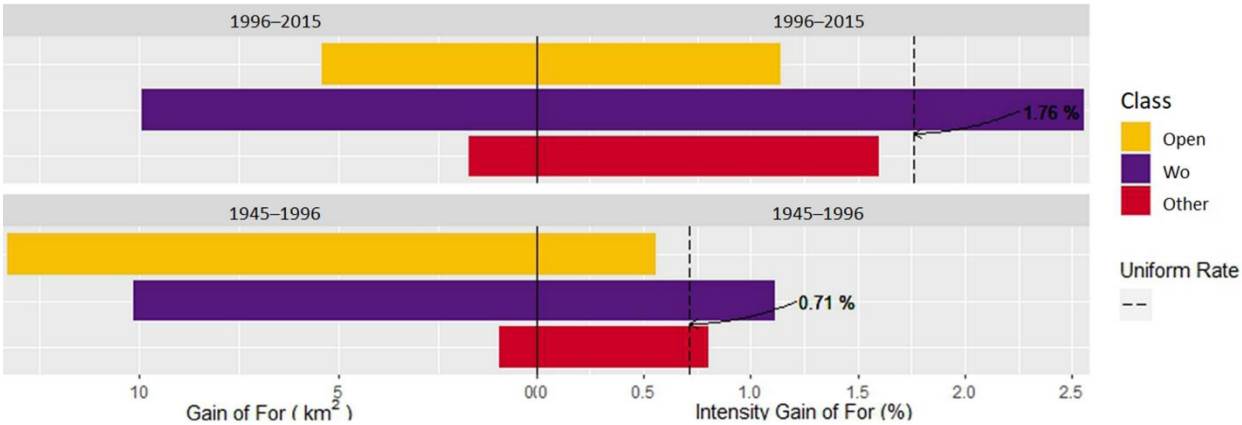

Figure S7. Transition level intensity analysis for forests gain in the study area for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show forest gross surface gain from each other LULC class for each period. Bars that extend to the right of zero axis show intensity of transitions to forest from each other class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the LULC classes available for transition. Classes with bars extending beyond this line are considered as targeted, while those with bars before that line are considered as avoided. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

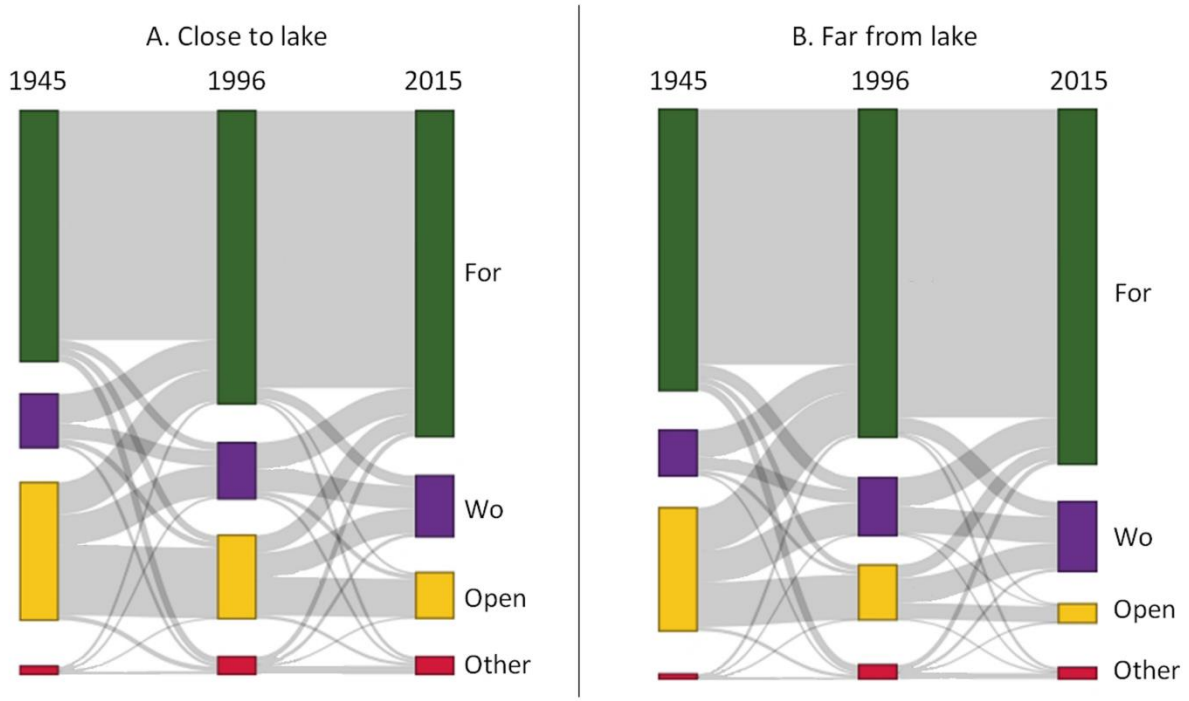

Figure S8. Sankey diagrams of LULC changes between the studied years for the two types of municipal districts (A: close to lake, B: far from lake). For: Forest, Wo: Woodland, Open: Open habitat, Other: urban, water and rock land cover classes.

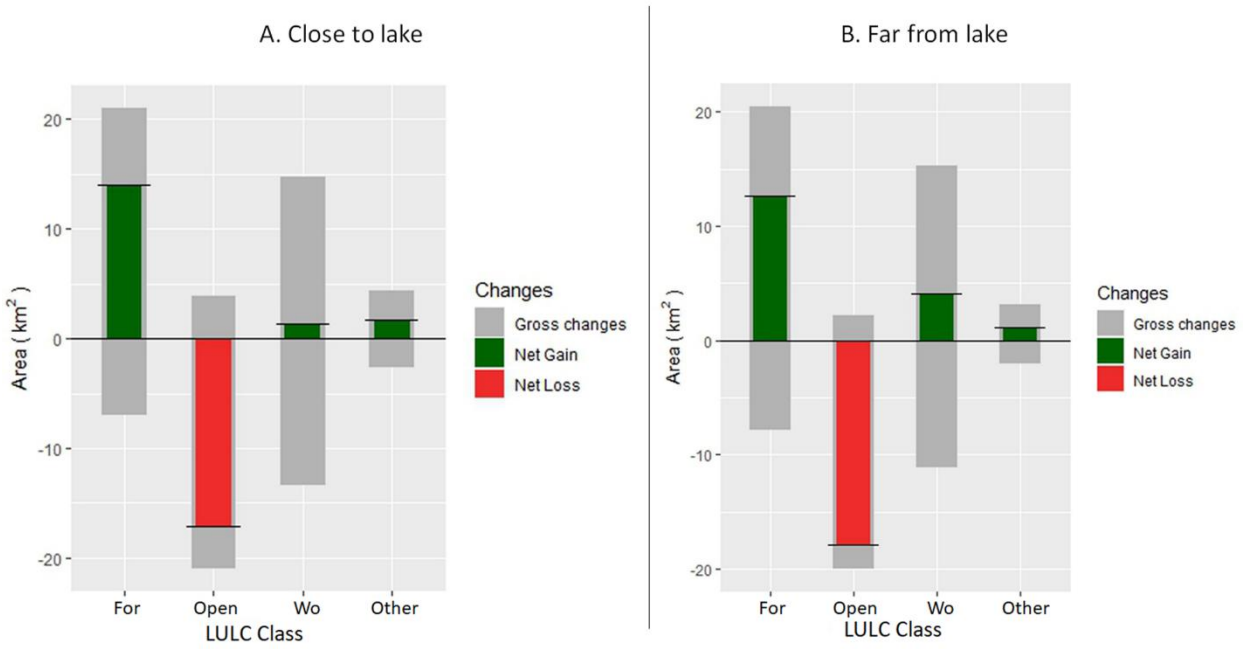

Figure S9. Net and gross LULC changes in km² for the study period for the two types of municipal districts (A: close to lake, B: far from lake). For: Forest, Wo: Woodland, Open: Open habitat, Other: urban, water and rock land cover classes.

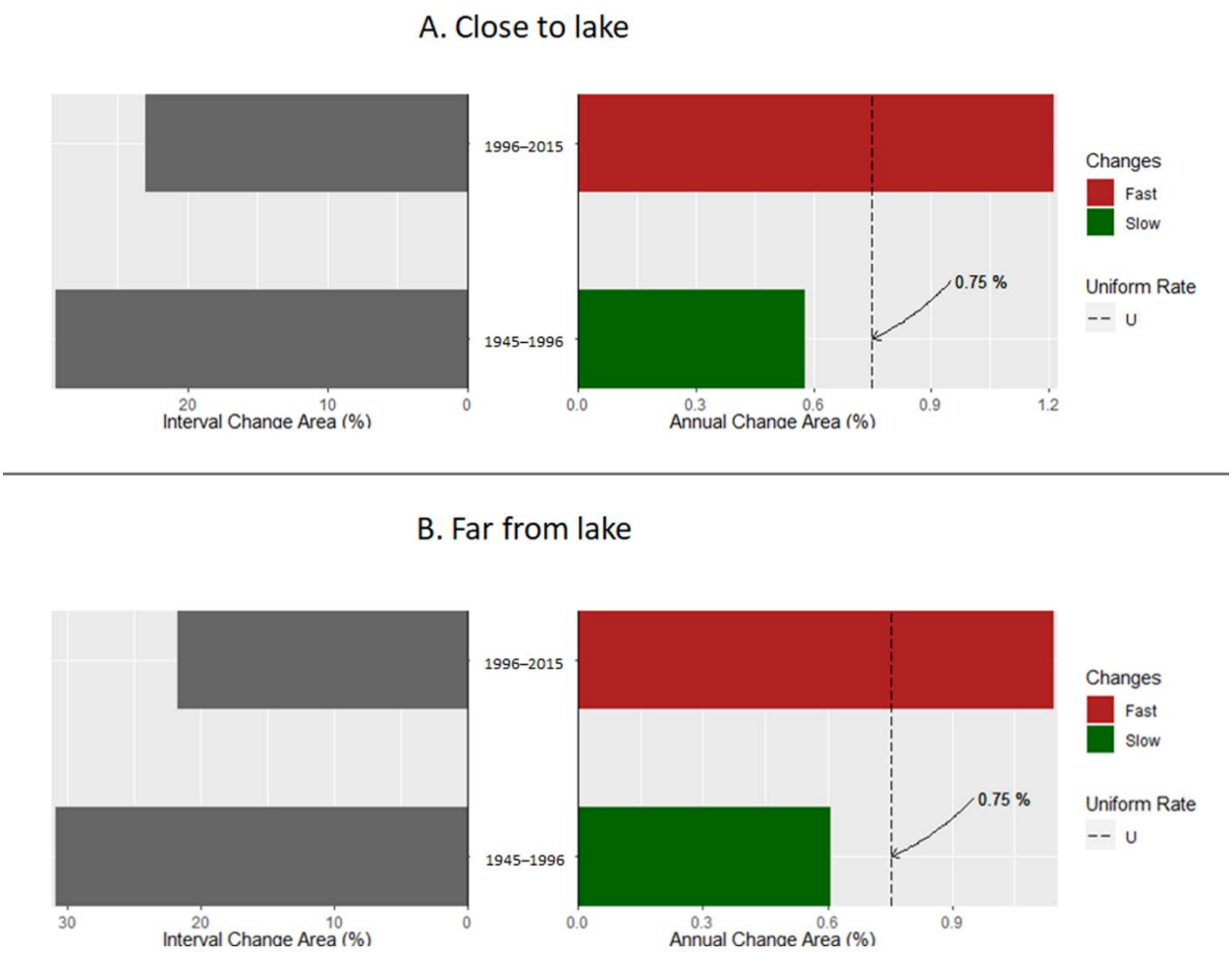

Figure S10. Interval level intensity analysis for the two types of municipal districts (A: close to lake, B: far from lake), for the periods 1945-1996 and 1996-2015, for the total change area in each period (left plot) and the rate of change for each period (right plot). The vertical, dashed line at the right plot represents the hypothesized uniform intensity for the total period (1945-2015) and the periods having a bar extending beyond this line are considered as changing fast (red color), while those having a bar before that line are considered as changing slow (green color).

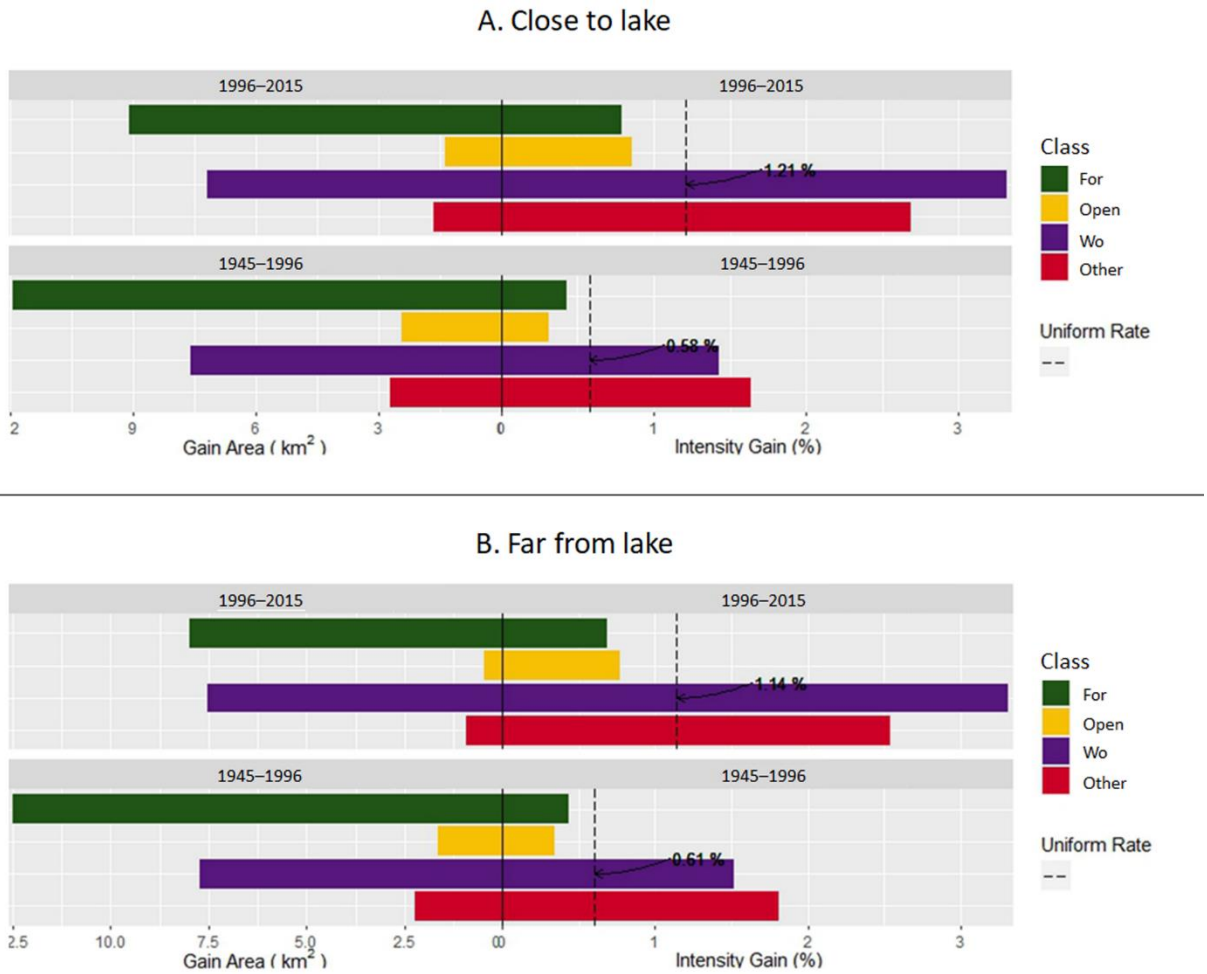

Figure S11. LULC class level intensity analysis for area gain for the two types of municipal districts (A: close to lake, B: far from lake), for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show the gross surface gain for each LULC class. Bars that extend to the left of zero axis show the intensity of gain for each class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the total landscape of the study area. Classes with bars extending beyond this line are considered as having active gains, while those with bars before that line are considered as having dormant gains. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

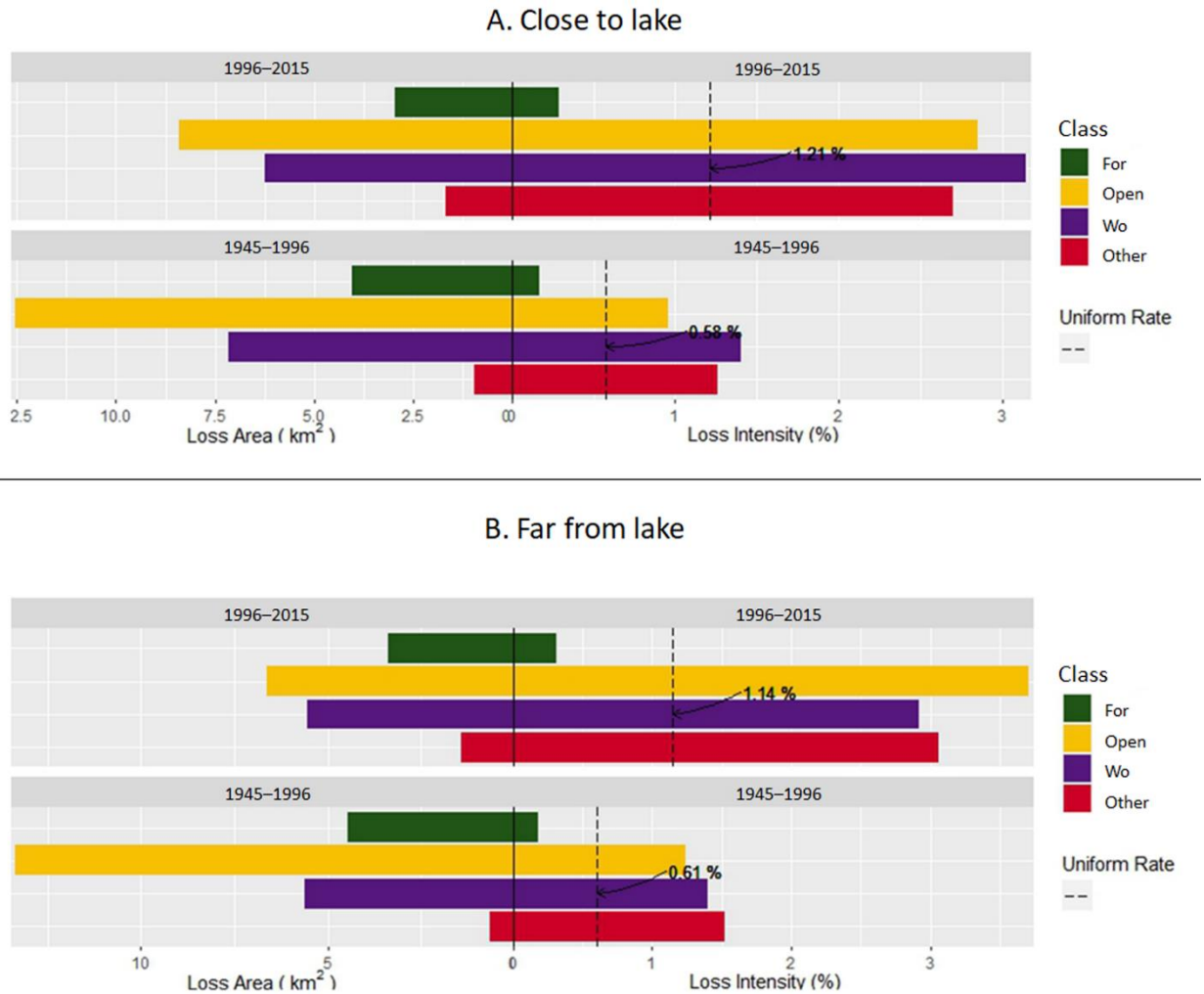

Figure S12. LULC class level intensity analysis for area loss for the two types of municipal districts (A: close to lake, B: far from lake), for the periods 1945-1996 and 1996-2015. Bars that extend to the left of zero axis show the gross surface loss for each LULC class. Bars that extend to the left of zero axis show the intensity of loss for each class. The vertical, dashed line at the right part of the plot depict the hypothesized uniform intensity across the total landscape of the study area. Classes with bars extending beyond this line are considered as having active gains, while those with bars before that line are considered as having dormant gains. For: Forest, Open: Open habitat, Wo: Woodland, Other: urban, water and rock land cover classes.

Table S1. Biophysical and socio-economic data used as explanatory variables in the RF model.

	Explanatory Variables	Type	Unit	Source
Biophysical	Altitude	Quantitative	meters (m)	opendem.info
	Slope Percentage	Quantitative	percentage (%)	DEM generated
	Heat Load	Quantitative	megajoule/square centimeter/year (MJ * cm^{-2} * yr^{-1})	DEM generated
	Soil Organic Carbon	Quantitative	decigrams/ gram (dg/kg)	soilgrids.org
	Soil Water pH	Quantitative	pH * 10	soilgrids.org
	Sand	Quantitative	grams/kilogram (g/kg)	soilgrids.org
	Silt	Quantitative	grams/kilogram (g/kg)	soilgrids.org
	Clay	Quantitative	grams/kilogram (g/kg)	soilgrids.org
	Soil Depth	Ordinal	I-VIII	Nakos, 1991
	Soil Erosion	Ordinal	I-VIII	Nakos, 1991
	Geological Substrate Type	Categorical	I-IV	Nakos, 1991
Socioeconomic	Proximity to villages	Quantitative	meters (m)	ELSTAT generated
	Population Density	Quantitative	number of people/hectare (n/ha)	ELSTAT
	Livestock Density	Quantitative	number of animals/hectare (n/ha)	ELSTAT + OPEKEPE
	Cattle Density	Quantitative	number of animals/hectare (n/ha)	ELSTAT + OPEKEPE
	Goat-Sheep Density	Quantitative	number of animals/hectare (n/ha)	ELSTAT + OPEKEPE

Table S2. Transition matrices and LULC classes cover data for the two types of municipal districts, close to lake and far from lake, (left part of tables) for the periods A: 1945 to 1996, B: 1996 to 2015, and C: 1945 to 2015. Transition matrix values represent the percentage of LULC classes. The right part of the tables (separated for the left part by a vertical line) presents the area of each land cover class (in hectares and in percentage of total surface of the study area) at the starting and end years of the period, as well as the difference between them (again in hectares and percentage values).

Close to Lake

A: 1945-1996	**Forest**	**Woodland**	**Open habitat**	**Other**	**1945 (ha)**	**1996 (ha)**	**Δ (ha)**	**1945%**	**1996%**	**Δ %**
Forest	0.91	0.03	0.03	0.03	3242.5	3789	546.5	55.69	65.08	9.39
Woodland	0.55	0.29	0.10	0.06	695.56	726.44	30.88	11.95	12.48	0.53
Open habitat	0.23	0.22	0.51	0.04	1778.81	1079.31	-699.5	30.55	18.54	-12.01
Other	0.31	0.25	0.08	0.36	105.12	227.25	122.12	1.81	3.90	2.10
B: 1996-2015	**Forest**	**Woodland**	**Open habitat**	**Other**	**1996 (ha)**	**2015 (ha)**	**Δ (ha)**	**1996%**	**2015%**	**Δ %**
Forest	0.95	0.04	0.01	0.01	3789	4213.62	424.62	65.08	72.37	7.29
Woodland	0.47	0.40	0.08	0.05	726.44	790.25	63.81	12.48	13.57	1.10
Open habitat	0.21	0.30	0.46	0.04	1079.31	591.44	-487.88	18.54	10.16	-8.38
Other	0.28	0.18	0.05	0.49	227.25	226.69	-0.56	3.90	3.89	-0.01
C: 1945-2015	**Forest**	**Woodland**	**Open habitat**	**Other**	**1945 (ha)**	**2015 (ha)**	**Δ (ha)**	**1945%**	**2015%**	**Δ %**
Forest	0.93	0.03	0.02	0.02	3242.5	4213.62	971.12	55.69	72.37	16.68
Woodland	0.69	0.21	0.05	0.06	695.56	790.25	94.69	11.95	13.57	1.63
Open habitat	0.38	0.29	0.28	0.04	1778.81	591.44	-1187.38	30.55	10.16	-20.39
Other	0.37	0.22	0.05	0.36	105.12	226.69	121.56	1.81	3.89	2.09

Far from Lake

A: 1945-1996	**Forest**	**Woodland**	**Open habitat**	**Other**	**1945 (ha)**	**1996 (ha)**	**Δ (ha)**	**1945%**	**1996%**	**Δ %**
Forest	0.91	0.04	0.02	0.03	3346.88	3902.81	555.94	61.79	72.05	10.26
Woodland	0.59	0.29	0.08	0.04	545.69	691.94	146.25	10.07	12.77	2.70
Open habitat	0.35	0.26	0.37	0.03	1465.31	653.25	-812.06	27.05	12.06	-14.99
Other	0.59	0.15	0.04	0.23	58.56	168.44	109.88	1.08	3.11	2.03
B: 1996-2015	**Forest**	**Woodland**	**Open habitat**	**Other**	**1996 (ha)**	**2015 (ha)**	**Δ (ha)**	**1996%**	**2015%**	**Δ %**
Forest	0.94	0.05	0.00	0.01	3902.81	4223.44	320.62	72.05	77.97	5.92
Woodland	0.50	0.45	0.02	0.03	691.94	830.38	138.44	12.77	15.33	2.56

Open habitat	0.23	0.46	0.30	0.01	653.25	226.19	-427.06	12.06	4.18	-7.88
Other	0.34	0.21	0.02	0.42	168.44	136.44	-32	3.11	2.52	-0.59
C: 1945-2015	**Forest**	**Woodland**	**Open habitat**	**Other**	**1945 (ha)**	**2015 (ha)**	**Δ (ha)**	**1945%**	**2015%**	**Δ %**
Forest	0.93	0.05	0.00	0.02	3346.88	4223.44	876.56	61.79	77.97	16.18
Woodland	0.66	0.28	0.02	0.04	545.69	830.38	284.69	10.07	15.33	5.26
Open habitat	0.49	0.35	0.14	0.03	1465.31	226.19	-1239.12	27.05	4.18	-22.88
Other	0.64	0.13	0.02	0.21	58.56	136.44	77.88	1.08	2.52	1.44