Appendix 1 | ES and drivers' indicators.

We based the selection of ES and drivers on their relevance for the agricultural landscapes of the Entre Douro Minho (EDM) region. In appendix 1, we present the ES and drivers (Figure A1.1), their description and rationale (Table A1.1) and analyses conducted to evaluate correlation and collinearity within services and drivers (Table A1.2, A1.3, A1.4). We also present the results from the calculation of ES multifunctionality for the parishes of the EDM (Figure A1.2).

Table A1.1 – List of indicators of targeted ecosystem services and socio-ecological drivers. Variables are presented according to the category of ecosystem service or driver together with their respective acronyms and a description of each variable. Sources of data, units and respective spatial resolution and time period of reference are also presented.

Category		Variable	Acronym	Type	Description / Rationale	Source	Unit	Spatial resolution	Time period
Ecosystem service	Provisioning	Food crops	FoodCrops	Supply	Total cultivated area of annual and permanent crops, excluding feed crops. Food production as a service provided by agriculture. Standardized by parish area. Original values ranging from 0 to 403, average 54,6 ha/ha.	INE	ha/ha	Parish	2009
		Cattle	Cattle	Supply	Number of bovine cattle. Food production as a service provided by agriculture. Standardized by parish area. Original values ranging from 0 to 6190, average 133,2/ha.	INE	n/ha	Parish	2009
		Wine	Wine	Supply	Vineyard cultivated area. Wine production is a service provided by agriculture. Standardized by parish area. Original values ranging from 0 to 220, average 21,4 ha/ha.	INE	ha/ha	Parish	2009

	Regulation	Carbon sequestration	Carbseq	Supply	Medium value of Potential carbon sequestration modelled based on land use. Carbon is sequestered in soils of forests and areas with natural vegetation, and emitted by croplands, pastures and parts of wetlands. Original values ranging from -46 to 79, average 8,1 Mg C/ha.	Schulp et al. (2008)*	Mg C/ha	1x1 km	2000-2010
		Erosion prevention	ErsPr	Supply	Medium value of protection of land cover against erosion in areas prone to erosion. Different types of vegetation are associated with different levels of protection against erosion. Original values ranging from 0 to 240, average 38,7 ton/ha.	Perez-Soba et al. (2010)*	ton/ha	1x1 km	2000-2010
		Pollination	Pollin	Supply	Medium value of Modelled probability of bees visiting crops from their available habitat. Pollination is an important ecosystem service to agriculture that is provided by natural habitats in agricultural landscapes (Power, 2010). Original values ranging from 77,6 to 99,5, average 95.2%.	Schulp et al. (2014)*	%	1x1 km	2000-2010
	Cultural	Nature tourism	NatTour	Supply	Medium value of Supply of assets for tourism supported by ecosystems. Agricultural landscapes are often linked with tourism through provision of scenic beauty and their respective recreation potential (van Berkel and Verburg, 2014). Original values ranging from 1166 to 7833, average 3284,8.	van Berkel and Verburg (2011)*	index 0-1	1x1 km	1999-2010
	Biodiversity	Farmland birds	FarmBirds	Supply	Medium value of Species richness of farmland birds. Farmland bird richness is a commonly used indicator of biodiversity in agricultural land, being recognized as a criterion to designate landscapes under legal protection (Gregory et al., 2005, Halada et al., 2011). Original values ranging from 0 to 11,4, average 4,0.	Tucker et al. (2013)*	n	1x1 km	2000-2010
Ecosystem's services driver	Biophysical/ ecological/ Social	Number of farmers	FarmerN	Farming intensity	The number of farmers. Used as proxy for both the presence and intensity of agricultural management. Standardized by	INE	n/ha	Parish	2009

				parish area. Original values ranging from 0 to 264, average 57,2/ha.				
	Farm size	Farmsize	Farming intensity	Average size of farms is a proxy for the intensity of agricultural management and respective provision of services. Original values ranging from 0,5 to 349,4, average 5,8 ha.	INE	ha	Parish	2009
	Production value	ProdValue	Farming intensity	Sum of average monetary values of the agricultural activity of production units per parish area. May indicate intensity of agricultural management. Original values ranging from 3037 to 9766484, average 314820,3 10^3 Euros/ ha.	INE	10^3 Euros/ ha	Parish	2009
	Specialization Index	SpInd	Farming intensity	Agricultural area under specialized technical-economic orientation in relation to the total utilized agricultural area. Values varying from 0 to 1. May indicate intensity of agricultural management. Original values ranging from 0 to 1105,7, average 7,4.	INE	NA	Parish	2009
	Land use diversity	SEI	Landscape composition	Landscape patterns expressed as the Shannon Evenness Index. The Shannon Evenness index accounts for the diversity of land use types and the evenness of their distribution. Values varying from 0 to 1. Diversity of land uses may contribute to local multifunctionality, and thus wider delivery of services. Original values ranging from 0.2 to 0.9, average 0,7.	DGT	NA	Parish	2007
	Landscape edge density	ED	Landscape composition	Density of edges in relation to the parish area is relevant to wildlife maintenance as they may constitute semi-natural areas. Original values ranging from 79. 3 to 384.5, average 205,4 m/ha.	DGT	m/ha	Parish	2007

*Gather from http://www.provide-project.eu/

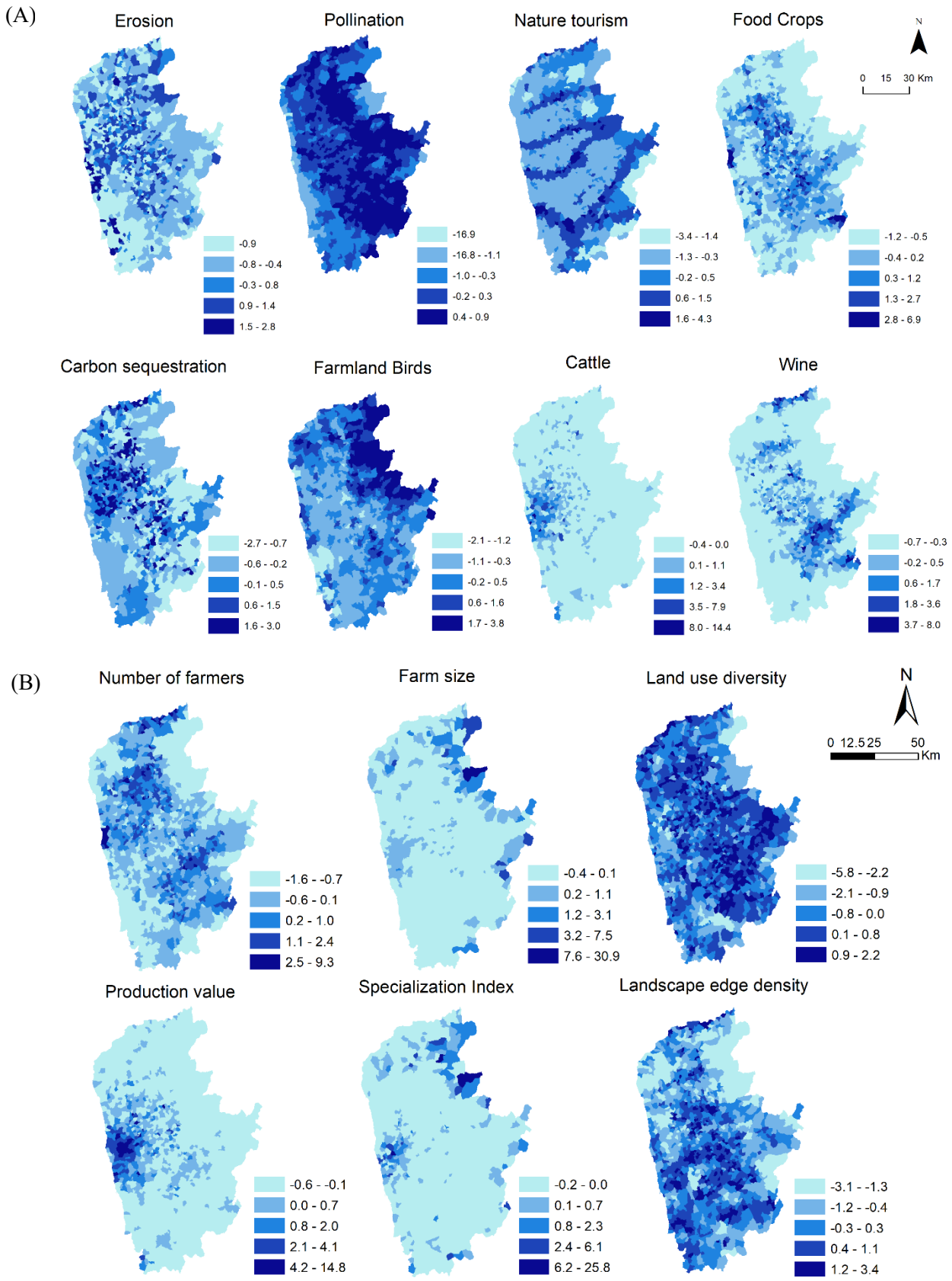
(A)
Erosion
-0.9
-0.8 - -0.4
-0.3 - 0.8
0.9 - 1.4
1.5 - 2.8
Pollination
-16.9
-16.8 - -1.1
-1.0 - -0.3
-0.2 - 0.3
0.4 - 0.9
Nature tourism
-3.4 - -1.4
-1.3 - -0.3
-0.2 - 0.5
0.6 - 1.5
1.6 - 4.3
Food Crops
-1.2 - -0.5
-0.4 - 0.2
0.3 - 1.2
1.3 - 2.7
2.8 - 6.9
N
0 15 30 Km
Carbon sequestration
-2.7 - -0.7
-0.6 - -0.2
-0.1 - 0.5
0.6 - 1.5
1.6 - 3.0
Farmland Birds
-2.1 - -1.2
-1.1 - -0.3
-0.2 - 0.5
0.6 - 1.6
1.7 - 3.8
Cattle
-0.4 - 0.0
0.1 - 1.1
1.2 - 3.4
3.5 - 7.9
8.0 - 14.4
Wine
-0.7 - -0.3
-0.2 - 0.5
0.6 - 1.7
1.8 - 3.6
3.7 - 8.0
(B)
Number of farmers
-1.6 - -0.7
-0.6 - 0.1
0.2 - 1.0
1.1 - 2.4
2.5 - 9.3
Farm size
-0.4 - 0.1
0.2 - 1.1
1.2 - 3.1
3.2 - 7.5
7.6 - 30.9
Land use diversity
-5.8 - -2.2
-2.1 - -0.9
-0.8 - 0.0
0.1 - 0.8
0.9 - 2.2
N
0 12.5 25 50
Km
Production value
-0.6 - -0.1
0.0 - 0.7
0.8 - 2.0
2.1 - 4.1
4.2 - 14.8
Specialization Index
-0.2 - 0.0
0.1 - 0.7
0.8 - 2.3
2.4 - 6.1
6.2 - 25.8
Landscape edge density
-3.1 - -1.3
-1.2 - -0.4
-0.3 - 0.3
0.4 - 1.1
1.2 - 3.4

Figure A1.1 - Distribution of the z-score values obtained for individual ES indicators (A) and ES drivers (B) across the 1326 municipalities in the Entre Douro e Minho Agrarian Region. Dark blues represent higher delivery and light blues a lower delivery of the service.

Table A1.2 - Results from the Variance inflation factor (VIF) of ecosystem services (ES) and drivers.

ES	Carbseq	ErsPr	Pollin	NatTour	FarmBirds	FoodCrops	Wine	Cattle
VIF	1.23	1.23	1.11	1.05	1.12	1.23	1.26	1.04

Drivers	SEI	ED	FarmerN	Farmsize	SpInd	ProdValue
VIF	1.38	1.38	1.17	2.54	2.59	1.18

Table A1.3 - Results from the correlation analysis of pairs of ecosystem services with the Spearman correlation test. Significance at $p < 0.05$ denoted by * and at $p < 0.01$ by **.

	ErsPr	Pollin	NatTour	FarmBirds	FoodCrops	Wine	Cattle
Carbseq	0.18**	-0.01	0.00	-0.27**	0.18**	0.22**	0.23**
ErsPr		0.25**	0.06*	0.26**	0.30**	0.27**	0.21**
Pollin			0.15**	0.28**	0.32**	0.47**	-0.02
NatTour				0.13**	0.07*	0.25**	-0.10**
FarmBirds					-0.04	0.07*	-0.14**
FoodCrops						0.57**	0.22**
Wine							0.09**

Table A1.4 - Results from the correlation analysis of pairs of drivers with the Spearman correlation test. Significance at $p < 0.05$ denoted by * and at $p < 0.01$ by **.

	ED	FarmerN	Farmsize	SpInd	ProdValue
SEI	0.43**	0.26**	-0.11**	-0.16**	-0.09**
ED		0.21**	-0.14**	-0.14**	0.25*
FarmerN			-0.21**	-0.14**	0.52**
Farmsize				0.68**	0.30
SpInd					0.30**

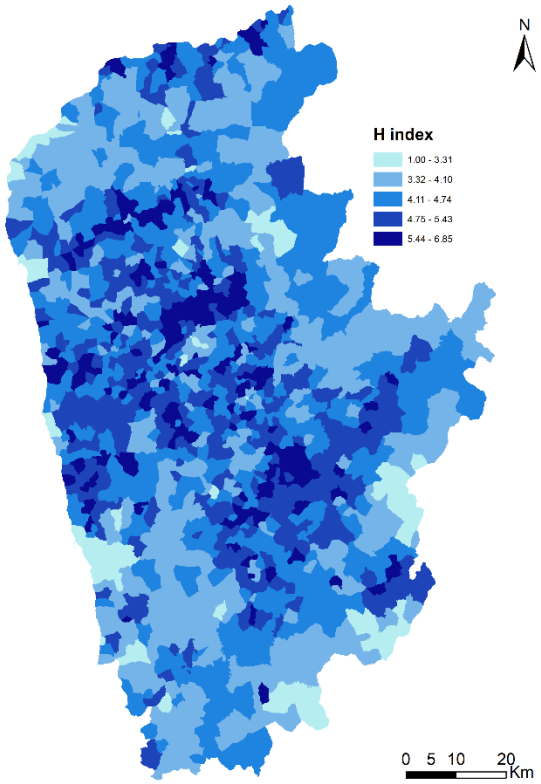

Figure A1.2 – Multifunctionality of parishes described by the transformation (H) of the Gini–Simpson's index (S) (H index) for each parish of the EDM. Dark blues represent higher delivery and light blues a lower delivery of H index.

LITERATURE CITED

Gregory, R. D., A. V. Strien, P. Vorisek, A. W. G. Meyling, D. G. Noble, R. P. B. Foppen & D. W. Gibbons 2005. Developing indicators for European birds. Philosophical Transactions of the Royal Society B: Biological Sciences, 360, 269-288. doi:10.1098/rstb.2004.1602

Halada, L., D. Evans, C. Romão & J.-E. Petersen 2011. Which habitats of European importance depend on agricultural practices? Biodiversity and Conservation, 20, 2365-2378. https://doi.org/10.1007/s10531-011-9989-z

Perez-Soba, M., P. Verburg, E. Koomen, M. Hilferink, P. Benito, J. Lesschen & M. Banse 2010. Land use modelling-implementation; Preserving and enhancing the environmental benefits of land-user services. Geodan Next, Wageningen.

Power, A. G. 2010. Ecosystem services and agriculture: tradeoffs and synergies. Philosophical Transactions of the Royal Society B: Biological Sciences, 365, 2959-2971. doi:10.1098/rstb.2010.0143

Schulp, C. J. E., S. Lautenbach & P. H. Verburg 2014. Quantifying and mapping ecosystem services: Demand and supply of pollination in the European Union. Ecological Indicators, 36, 131-141. https://doi.org/10.1016/j.ecolind.2013.07.014

Schulp, C. J. E., G.-J. Nabuurs & P. H. Verburg 2008. Future carbon sequestration in Europe—Effects of land use change. Agriculture, Ecosystems & Environment, 127, 251-264. https://doi.org/10.1016/j.agee.2008.04.010

Tucker, G., B. Allen, M. Conway, I. Dickie, K. Hart, M. Rayment, C. Schulp & A. Van Teeffelen 2013. Policy options for an EU no net loss initiative. Report to the European Commission. Institute for European Environmental Policy, London.

Van Berkel, D. B. & P. H. Verburg 2011. Sensitising rural policy: Assessing spatial variation in rural development options for Europe. Land Use Policy, 28, 447-459. https://doi.org/10.1016/j.landusepol.2010.09.002

Van Berkel, D. B. & P. H. Verburg 2014. Spatial quantification and valuation of cultural ecosystem services in an agricultural landscape. Ecological Indicators, 37, 163-174. https://doi.org/10.1016/j.ecolind.2012.06.025