Land Use Policy 77 (2018) 344–353

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

EU's rural development policy at the regional level—Are expenditures for natural capital linked with territorial needs?

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ARTICLE INFO

Keywords:
Natural capital
Common agricultural policy
Regional typology
Logit model
Spatial dependency
Territorial development

ABSTRACT

The restoration and improvement of natural capital (NC) in rural areas represents one of the main objectives of the EU's rural development policy (RDP). In addition to creating environmental and biodiversity benefits, NC represents an important territorial asset and a basis to generate socio-economic second-order effects for economic competitiveness and rural viability. However, the regional capability to valorise NC depends on the specific regional context, needs and potentials, as well as targeted policy support. It has therefore been questioned whether RDP sufficiently considers territorial aspects. Based on a previous study, which distinguished RDP (2007–2013) funding priorities and regional expenditure patterns, this paper focusses on European regions (NUTS2/3) characterised by above-average relative expenditures for measures related to NC support.

Building upon the hypothesis that priority setting in regional RDP programming and expenditures depends on the regional context, this study aimed to improve the understanding of priority setting in NC support in relationship to other RD objectives by taking a closer look at the conditions of regions and their communalities. By analysing the variances and spatial dependencies of regional socio-economic, environmental and agricultural framework conditions and applying statistical logit models, this study found that the probability to adopt specific NC-oriented expenditure patterns in a region can only be partly explained by these factors. While environmental variables, such as designated areas and High Nature Value (HNV) farmland, do not drive high NC expenditures, factors representing agricultural structures and conditions seem to have a larger influence. Regional RDP expenditure pattern showed an additional strong dependency from spatial association factors.

1. Introduction

1.1. Natural capital as regional asset

The notion of natural capital (NC) has been introduced as an important approach to economically value the contribution of natural resources to the provision of ecosystem services (ES), a key factor for human well-being (Costanza and Daly, 1992; Daily et al., 2009; Haines-Young and Potschin, 2010). NC is not only provided by natural ecosystems but also by agricultural landscapes, depending on their structure and on the composition of ecosystem patches (Ungaro et al., 2014; van Zanten et al., 2014). Due to the expansion and intensification of anthropogenic use, many ecosystems, including agricultural landscapes, have seen tremendous natural resource depletion and a degradation in their capability to contribute to biodiversity, climate or natural resource conservation objectives (MEA, 2005; Tscharntke et al., 2005). Therefore, the restoration and improvement of NC, e.g., through the protection of ecologically sensitive landscapes, such as High Nature Value (HNV) farmland, water catchments or the Natura 2000 network, enhances ecosystem integrity and the ES provision (Uthes and Matzdorf, 2013).

Beyond environmental goals, investments in nature and landscape are increasingly understood in a more integrative way as resources for the ecological modernisation of the rural economy (Kitchen and Marsden, 2009) and as contributions to rural development in a socio-economic sense by improving rural competitiveness and human well-being (Häfner et al., forthcoming; Manrique et al., 2015; Schaller et al., forthcoming). In this sense, various narratives and rural development options have been distinguished, mainly around ecological conservation, agriculture-based development and post-productive commodification, including tourism, diversification and quality production (Ghazoul et al., 2009; Lange et al., 2013). In addition, for the farming activity itself, NC investments and improvements to environmental sustainability, e.g., through agri-environmental measures (AEM) or afforestation, represent a value. NC enhancement provides ES, such as water and nutrient cycles, pollination and the prevention of soil

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https://doi.org/10.1016/j.landusepol.2018.05.053
Received 17 January 2018; Received in revised form 23 May 2018; Accepted 25 May 2018
0264-8377/

erosion. Agriculture is herewith not only a provider of ES but also a direct beneficiary of ES (Small et al., 2017).

1.2. Natural capital funding, rural development and territorial demands

The European Union (EU) has acknowledged the importance of NC as a territorial asset and public good, as it represents a major objective of the EU's Rural Development Policy (RDP). (EC, 2005, 2017). The EU regulation on support for rural development (EC, 2005) requires at least 25% of the budget at the programming level to be spent on agri-environmental schemes (AES). Despite the primary environmental targets to improve landscape and natural conditions, these investments may have additional socio-economic second-order effects, which are usually not considered in the policies' objectives (Schaller et al., forthcoming). These often occur without the explicit targeting or consideration of the regional capacities to valorise NC. Previous studies have highlighted the relevance of an integrated place-based approach to rural development that accounts for regional characteristics, incl. strengths, weaknesses and development potentials and capabilities (Copus et al., 2011; OECD, 2006; Wilson, 2009; Zasada et al., 2017).

The regional socio-economic situation, such as regional economic performance, social welfare or proximity to urban markets, can serve as a trigger for rural development and the valorisation of NC (Lange et al., 2013; Zasada et al., 2013). On the other hand, depopulation, demographic change and the social and economic marginalisation of peripheral rural areas hamper the ability to valorise natural assets (Pinto-Correia and Carvalho-Ribeiro, 2012). The natural and environmental conditions and/or the prevalence of ecologically valued areas, such as Natura 2000 areas or HNV farmland, determine the potential to target rural development policies towards nature conservation or rural tourism (van Berkel and Verburg, 2011). Rooted in agricultural policy, the RDP is strongly linked to the primary sector. Especially modernisation and diversification but also environmental measures mainly address agriculture and forestry directly and therefore take the specific land use, i.e., arable land or grassland, the intensity of production and farm household and business structures, closely into consideration (Dalgaard et al., 2007; Viaggi et al., 2013).

Although a widespread acknowledgement of the diversity of European regions with different territorial potentials and challenges exists (ESPON and Nordregio, 2010), this territorial variability is only weakly reflected by the RDP (mainly through less-favoured area (LFA) schemes). Most other measures are horizontal in their spatial effect and are not targeted to specific territorial needs (Copus and Dax, 2010; Dax and Copus, 2016). As analysed by Copus and Dax (2010), throughout all its reforms, the CAP (and with it the RDP) has not seriously considered territorial aspects in its policy design, despite the strong territorial agenda of European spatial policies (EC, 1999, 2007). A number of reasons, such as path dependency and the lock-in of policy-making (Dax, 2015), the voluntary nature of measure implementation (Piorr and Viaggi, 2015), the disintegration of rural, regional and cohesion policies (Copus et al., 2013) or the effects of a limited information basis and corporate clientelism (Marsden, 2003, p.118 ff.), have led to RDP designs, which lack compliance with the regional situation.

Previous analyses of RDP spending data in the EU at the regional level have revealed that a large intra-regional heterogeneity of spending priorities is observable in many European regions (Copus and Dax, 2010; Zasada et al., 2015). A number of studies have aimed to spatially link RDP implementation with regional socio-economic and environmental performances. Focussing on regional labour effects, Bonfiglio et al. (2016) and Smit et al. (2015) analysed policy effects at the NUTS3 and NUTS2 levels, respectively, while also considering spill-over effects from neighbouring regions. Others, such as Desjeux et al. (2015) or Marconi et al. (2015) applied spatial econometrics methods to assess the effects of AEM on the environmental performance, i.e., HNV farmland indicators and nitrogen fertilisation at national and regional scales. Aiming for a broader approach to the analysis of the regional performance of the RDP, with its multiple and complex objective settings, Uthes et al. (2017) differentiated region types based on their RDP expenditure pattern, and, either focussing on competitiveness, the environment, rural viability or equal spending, applied the objective and context-related CMEF (Common Monitoring and Evaluation Framework) indicators at the NUTS2 level. Despite these efforts, a broad-based assessment of the matches or mismatches between regional demands and potentials and policy spending patterns is missing.

1.3. Objective

In this study, a regional typology of RDP funding priorities, which was previously developed by Zasada et al. (2015), is applied, focussing on regions with high NC funding. The main objective of the paper is to analyse the extent to which region types (RTs) representing a certain RDP funding pattern can be associated with the regional agricultural, environmental and socio-economic situation. This objective is addressed by investigating the following research questions: (i) How do regional contexts, potentials and development needs vary between regions with high and low shares of NC expenditures? To what extent do variations exist among different joint valorisation approaches of high NC-spending regions? (ii) Can the assignment of regions to specific funding types be explained by regional characteristics, and to what extent can the objective regional targeting of RDPs be observed? (iii) Are regional RDP expenditure patterns subject to spatial dependencies, either through macro-scale locations or through local neighbourhood association?

2. Datasets and methodology

2.1. RDP expenditures in 2007–2011 at the NUTS3 level

The analysis in this paper is based on a previous study of Zasada et al. (2015), which developed a typology of EU27 regions using factor and cluster analysis that featured similar RDP support priorities. The approach considered six funding categories and emphasized the differentiation between policy measures for the investment in territorial capital and measures for the investment in capacity building to enhance the region's ability to effectively use these assets. Both strategies demonstrate valorisation approaches to socio-economic development and are considered two complementary cornerstones of a place-based approach to rural development.

Among the territorial assets, natural capital (NC) has been addressed by the RDP, along with physical and human capital. Mainly, AES, afforestation and Natura 2000 payments are grouped under the umbrella of NC investments. Within capacity building measures, three valorisation strategies are distinguished: the 'stabilisation', 'modernisation' and 'restructuring' of rural economies. 'Restructuring' covers measures for added value creation, diversification and tourism development. 'Modernisation' refers to investment in farm holdings enhancing agricultural specialisation and competitiveness, and 'stabilisation' addresses rural areas with disadvantaged conditions aiming at the continuation of agricultural activity as a main pillar of the rural economy (Rivalori et al., 2017; Zasada et al., 2015).

The 'stabilisation' approach includes funding themes, such as payments for LFA and for adaptation to European Community standards; the 'modernisation' approach includes farm modernisation, cooperation for the implementation of new products, processes and technologies, and LEADER activities strengthening competitiveness; and the 'restructuring' approach includes support for producer groups, food quality schemes and diversification into non-agricultural activities, including LEADER diversification support (Zasada et al., 2015).

Regional expenditure data of the European Agricultural Fund for Rural Development (EAFRD) and the Temporary Rural Development Instrument (TRDI) funds for the years 2007–2011, which were obtained from the Clearance of Audit Trail System (CATS) of the European

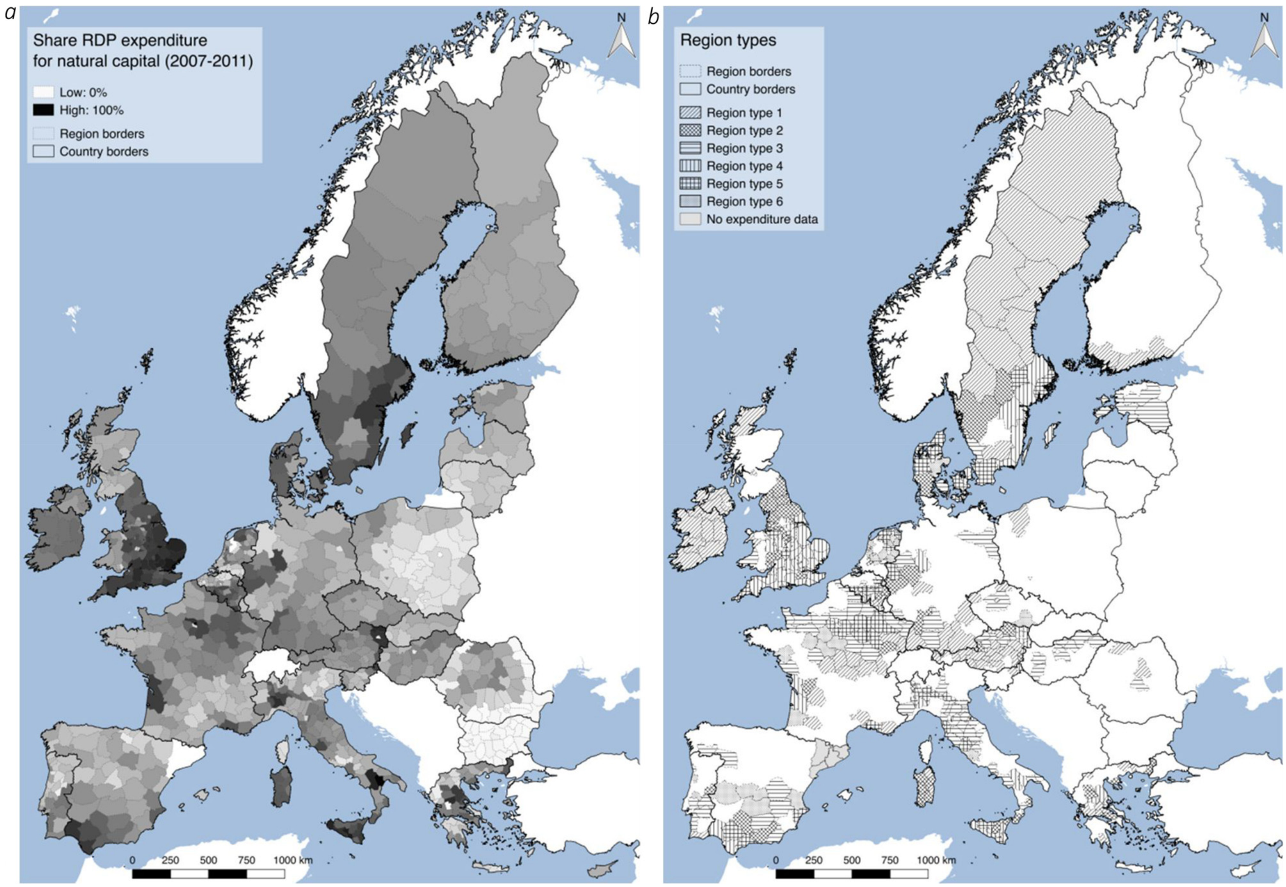

Fig. 1. (a) Share of RDP expenditure for Natural Capital (NC) 2007–11, in %. Source: adapted from Zasada et al. (2015). (b). Six selected region types (RTs) with the highest average share of NC funding. Source: elaboration by the present work based on Zasada et al. (2015).

Commission, DG Agriculture, were used in the study of Zasada et al. (2015). 75 individual measures derived from this database were thematically grouped into the six funding priorities. NC represents the main RDP funding priority in terms of expenditure volume, with AES, including extensive grassland and organic farming schemes covering 84% of the overall NC investments. Subsequently, 878 regions (NUTS2/3) of EU27 were grouped based on combinations of funding priorities (Zasada et al., 2015).

This paper focussed on the six RTs (N = 409 regions, 46.6% of all regions, Fig. 1b) with the highest NC shares among the total regional RDP payments. The payment shares of the individual regions range between 22.5% and 100%. Fig. 1a shows the regional shares of NC funding across all regions. Beyond the emphasis on NC, the RTs are characterised by differences in the combinations of the five other funding priorities. RT1 (NC + large stabilisation) and RT2 (large NC + stabilisation) combine the NC priority with stabilisation. RT3 (NC + modernisation) more broadly covers all topics, with a focus on NC and modernisation. RT4 (large NC nearly exclusively) and RT5 (large NC + human capital + modernisation) spend large shares of RDP support on NC, with only marginal expenditures on other themes. RT6 (NC + restructuring + human capital) exhibits a more pronounced tendency to combine NC support with human capital and restructuring measures. Fig. 2 provides an overview of the average funding composition in the different RTs. Fig. 1b indicates the geographic distribution across the EU, indicating that some countries in Eastern Europe and even larger and heterogeneous regions, such as Germany, Southern France and Northern Spain, are not part of the six RTs. Considering that the original typology consists of 20 RTs reveals that the remaining regions are a heterogenic composition of regions, which have very different RDP funding patterns, partly with a pronounced focus on stabilisation measures (see Zasada et al. (2015)).

2.2. Variable selection and database

Based on the hypothesis that the regional RDP programming and expenditures depend on the regional context situation and development potentials targeted by the RDP, 21 exogenous explanatory variables were applied (see Table 1). These cover the regional agricultural, environmental and socio-economic situation, representing context and objective indicators for rural development. The variables were selected from a larger list of indicators using a correlation analysis to ensure a broad coverage of rural development issues while also reducing redundancy. The data were retrieved from European statistical and spatial databases, including EUROSTAT (2018), EEA (2009, 2011, 2012) and the Database of Origin and Registration (DOOR) (EC, 2014) for the PDO/PGI indications. For the Natura 2000 areas and the LFA, indicators were included that were already closely linked to larger spatial designations for specific RDP schemes. Extensively used agricultural areas (EXT) and probability of camping (CAMP), as an indicator of the suitability for outdoor tourism, represented data layers derived from spatial modelling studies that downscaled original data (van Berkel and Verburg, 2011; van der Zanden et al., 2016). In a few cases, the medium values of years before and after 2007 or values of the next highest geographical level were used as representative data to cover data gaps for individual years.

2.3. Analysis of spatial dependency

The examination of the spatial distribution of regional NC spending shares (Fig. 1a) and the six RTs (Fig. 1b) reveal a substantial spatial

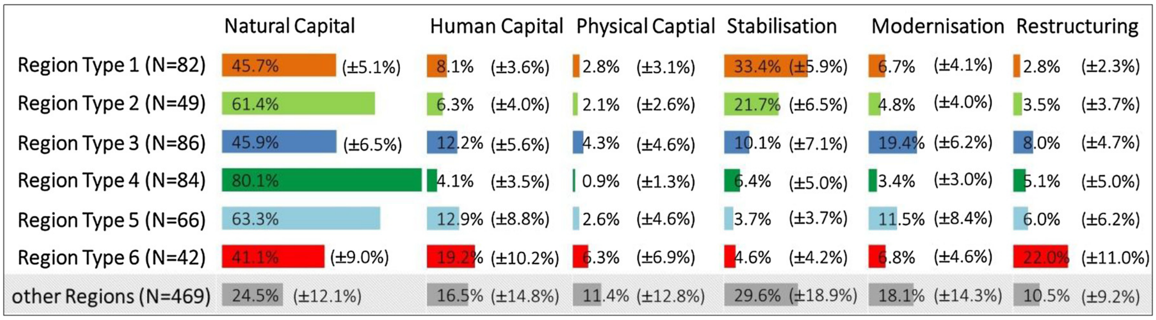

Fig. 2. Regional payment shares of region types (RTs) per funding priority. Average values in % (standard deviation).
Note: RT codes have been changed from the previous study (Zasada et al., 2015): RT1 = 1.3; RT2 = 2.2; RT3 = 3.3; RT4 = 2.1; RT5 = 2.3; RT6 = 3.1.

clustering. This could be related to either the effect of the explanatory variables or the association with a certain programming unit or macro-scale location within the EU, e.g., Eastern Europe, independent from the observed explanatory variables. To account for the latter, the construction of an additional autocorrelation factor to be included in the statistical modelling is useful. Therefore, a spatial autocorrelation analysis of the regional NC spending shares was carried out using the GeoDa software package. To analyse the relationship of a region to all of its direct neighbours, a spatial weight matrix was employed based on queen continuity logic of the first order. First, a spatially lagged variable of the NC spending share variable was included, representing the weighted sum of the values of the neighbouring regions. In a second step, a bivariate spatial correlation between the NC share variable (x) and its spatially lagged version (y) was applied. A more detailed description of the methodology can be found in the GeoDa documentation (Anselin, 2017). The resulting scatter plot and a Global Moran's I value of 0.758 indicate a spatial trend in the NC value distribution. This means that there is a tendency of spatial clustering of regions with similar NC spending shares, i.e., spatial autocorrelation effects (Anselin, 1995).

In the next step, binary, non-metric scaled data (whether or not a region belongs to a certain RT) were used in a spatial dependency analysis by applying join count statistics as the local index of spatial association based on the approach by Congdon (2016). For each region, the proportions of neighbouring regions belonging to high NC-spending regions (step 1) and to specific RTs among the high-spending regions (step 2) were calculated. The resulting join count index was included in the statistical modelling later as an additional explanatory variable.

2.4. Statistical modelling

For the statistical analysis, an explorative approach followed by a regression analysis identified possible patterns and relationships between the RDP funding and regional characteristics. In the first step, RT differences in the explanatory variables were assessed using analysis of variance (ANOVA). Statistically significant differences between distinct groups were identified by using different testing measures, including the Levene test for equality of variances, the Scheffé and Tamhane T_2 methods for multiple group comparison post hoc testing and the Kruskal-Wallis test for non-continuous variables. For the interpretation of the analysis results, the non-Gaussian value distribution of the explanatory variables was taken into consideration. Regions were then characterised by key variables.

In the second step, logit regression models were applied in order to analyse how the variables determined the probability of a region to exhibit a specific NC expenditure pattern, manifesting in cluster membership. First, a binary logit regression model explained the likelihood of choosing an above-average share of NC expenditures. Second, to differentiate the effects of regional characteristics for different NC valorisation approaches, which were reflected in the six RTs, a multinomial logit model was estimated among the 409 regions belonging to these RTs. Due to the non-linear character of the regression models, the

Table 1
Description of independent exogenous variables.

Variable	Description	Year	RD Topic	Source
HSIZE	UAA (Utilised agricultural area) per holding, in ha	2007	Agriculture	(EUROSTAT)
5HA	Share of holdings with < 5 ha UAA, in %	2007	Agriculture	(EUROSTAT)
100ESU	Share of holdings with ≥100 ESU (European size unit), in %	2007	Agriculture	(EUROSTAT)
GRAZE	Share of specialised grazing livestock holdings, in %	2007	Agriculture	(EUROSTAT)
LIVEST	Share of holdings with livestock, in %	2007	Agriculture	(EUROSTAT)
GVAAGR	Gross value added share of primary sector, in %	2007	Agriculture	(EUROSTAT)
AGREDU	Share of holders with formal agricultural education, in %	2007	Agriculture	(EUROSTAT)
AA	Share of agricultural areas, in %	2007	Environment & Landscape	(EUROSTAT)
PGL	Share of permanent grassland, in %	2007	Environment & Landscape	(EUROSTAT)
LFA	Share of farms in less favoured areas, in %	2009	Environment & Landscape	(EUROSTAT)
LFAM	Share of farms in less favoured areas (mountain), in %	2009	Environment & Landscape	(EUROSTAT)
EXT	Share of extensive used agricultural areas, in %	2016	Environment & Landscape	(van der Zanden et al., 2016)
HNV	Share of HNV-farmland areas, based on CLC 2006 data, in %	2006	Environment & Landscape	(EEA) based on (Paracchini et al., 2008)
N2000	Share of Natura 2000 areas, in %	2011	Environment & Landscape	(EEA)
POPDEN	Population density, in capita*km^{-2}	2007	Socio-economic context	(EUROSTAT)
PPP	Purchasing power parities per capita, in % of EU average	2007	Socio-economic context	(EUROSTAT)
UNEMPL	Unemployment rate, in %	2007	Socio-economic context	(EUROSTAT)
POP65	Share of population age 65 and higher, in %	2007	Socio-economic context	(EUROSTAT)
TOUR	Accommodation establishments per 1000 capita	2007	Rural Development	(EUROSTAT)
CAMP	Regional mean value of probability of camping index	2008	Rural Development	(ASCI, 2008; van Berkel and Verburg, 2011)
PDOPGI	No. of registered PDO (protected designation of origin) and PGI (protected geographical indication)	2014	Rural Development	(EU DOOR)

influence of the exogenous variables (as measured in standard deviations) on the probability of belonging to the selected RTs was most suitably represented by the average marginal effect coefficient, which mathematically expressed the average sample reaction to an increase of 1 unit in an exogenous variable. A value of 1.0 increased the probability by 100% of the points.

In addition to the selected explanatory variables, dummy variables representing the regional locations within Europe (Eastern Europe, Southern Europe) were included as controls in order to reduce the unobserved heterogeneity in spending due to priorities set at the country level. To account for possible neighbourhood effects, similarity with neighbouring regions (represented by join counts statistics) was also included as an additional regressor. Due to missing values, 19 and 7 observations had to be excluded in the two models. To make coefficients more comparable z-standardised values of the explanatory variables are used. The statistical modelling was carried out within the software package STATA.

3. Results and discussion

3.1. Explaining regions with high natural capital funding

Using mean value comparisons, the differences were analysed between regions with high and low natural capital (NC) funding shares (see Table 2). For regions spending larger shares of their RDP budgets for NC, the primary sector played a much smaller role in terms of the regional gross value added (GVAAGR). They were characterised by smaller shares of less favoured (LFA, LFAM), Natura 2000, and extensively used (EXT) areas and HNV farmland. Population density (POPDENS) and purchasing power (PPP) were higher in regions with high NC spending than in regions with low NC spending. Agricultural areas and individual farms were larger in high NC-spending regions, both in terms of area (HSIZE) and in economic terms (100ESU).

To account for the effects of the selected variables on belonging to a region with a high NC spending share within the regional RDP, a binary logit model (BLM) was applied, testing for a non-spatial setup (model 1), macro-regional association (model 2) and local neighbourhood association (model 3) (see Table 3). Apparently, the model fit of non-spatial model 1 (McFadden $R^2 = 0.177$) increased when regional spatial association factors were included (model 2; $R^2 = 0.203$). When the join count index was included as a local association factor in model 3 (McFadden $R^2 = 0.381$), the regional association influence was clearly suppressed in size and became statistically insignificant.

Beyond the spatial association factors, further explanatory variables accounted for statistically significant influences on the probability that a region had an NC focus. The important determinants were the prevalence of small-scale farming (5HA, positive), a larger economic farm size (100ESU, negative), livestock holding (LIVEST, negative) and grazing livestock systems (GRAZE, positive). Amongst the landscape and farming condition variables, the less favoured areas (LFA, LFAM) showed a significant inverse relationship throughout the models. Except for population density (in model 2 and 3), the socio-economic variables showed only marginal effects. Their coefficients were relatively robust across the models in terms of statistical significance and the direction of the coefficient, but the coefficients decreased in the regional and spatial models. This indicates that the first effect might be due to a correlation with an omitted variable. Factors representing the direct NC funding objectives, such as N2000 and grassland areas and extensive and HNV farmland, showed no clear significant influence, despite the fact that they were partly linked to a specific area designation.

3.2. Explaining regional RDP funding pattern

Comparing the six RTs with the high NC spending separately, substantial regional differences for many of the considered variables can be observed. Not all variables show statistically significant differences between all RTs in the ANOVA (see Table 2). To investigate the probability of a high NC-spending region belonging to one of the six RTs, a multi-nominal logit model was applied to estimate the effects of the regional explanatory variables and spatial association variables (see Table 4). The regional association variables for Eastern (EE_DUMMY) and Southern Europe (SE_DUMMY) were significant for one (2) and three RTs (2, 3 and 4), respectively. The six neighbourhood association variables (one for each of the RTs) show a general pattern indicating that there was a significant influence mainly on neighbourhoods with the same RT, indicating spatial autocorrelation effects. For each of the six outcomes, average marginal effect coefficients were provided. It

Table 2
Comparison of the mean values of the explanatory variables of RTs.

	Low NC	High NC	RT1	RT2	RT3	RT4	RT5	RT6
	(N = 469)	(N = 409)	(N = 82)	(N = 49)	(N = 86)	(N = 84)	(N = 66)	(N = 42)
HSIZE	25.3 *	34.6 *	35.5	27.7	28.4	43.6	36.7	32.7
5HA	59.7 *	41.9 *	32.7 *(2,3)	48.3 *(1)	51.6 *(1,5)	42.6	37.8 *(3)	37.4
100ESU	5.0 *	9.5 *	3.5 *(4,5,6)	6.1 *(5,6)	7.1 *(5,6)	10.9 *(1)	16.2 *(1,2,3)	16.9 *(1,2,3)
GRAZE	25.9 *	35.7 *	52.7 *(3,4,5)	37.4	24.8 *(1)	33.6 *(1)	29.0 *(1)	37.4
LIVEST	66.9 *	58.6 *	71.0 *(2,4,5)	55.6 *(1)	60.3	51.3 *(1)	52.8 *(1)	58.7
GVAAGR	4.4 *	2.7 *	3.3	3.1	3.5 *(4)	2.0 *(3)	2.0	1.8
AGREDU	12.6 *	15.3 *	17.0	10.7	16.2	14.7	16.4	14.9
AA	40.6 *	45.0 *	37.5 *(4,5)	44.5	45.4	49.1 *(1)	48.8 *(1)	45.0
PGL	33.9	35.5	50.6 *(3,4,5)	44.0	28.2 *(1)	27.5 *(1)	28.7 *(1)	37.3
LFA	52.0 *	38.5 *	79.7 *(all)	53.2 *(1,4,5,6)	43.4 *(1,4,5,6)	15.2 *(1,2,3)	15.2 *(1,2,3)	14.1 *(1,2,3)
LFAM	25.8 *	14.5 *	35.9 *(all)	16.8 *(1)	14.9 *(1)	3.2 *(1)	7.9 *(1)	2.4 *(1)
EXT	39.1 *	25.4 *	37.1 *(4,5,6)	28.3	32.0	16.6 *(1)	18.4 *(1)	13.9 *(1)
HNV	19.0 *	14.8 *	22.1 *(4,5,6)	24.1 *(4,5,6)	14.9	8.5 *(1,2)	8.5 *(1,2)	11.4 *(1,2)
N2000	21.3 *	15.5 *	18.5 *(4)	17.8	17.8	11.4 *(1)	12.5	15.3
POPDENS	419.7	465.4	124.3 *(4)	365.1	352.7	735.2 *(1)	557.0	795.7
PPP	80.4 *	97.4 *	95.0	90.7	96.5	97.4	101.1	105.8
UNEMPL	8.8 *	7.6 *	7.1	8.8	8.1	7.3	7.9	6.3
POP65	17.5	17.5	17.3	18.7	18.2	17.0	17.3	16.7
TOUR	1.7	1.6	2.8 *(4)	2.1	1.5	1.0 *(1)	1.1	0.7
CAMP	1.2 *	1.4 *	1.4	1.5	1.4	1.1	1.4	1.5
PDOPGI	3.2	3.5	3.3	3.7	5.3 *(4,5)	2.2 *(3)	3.0 *(3)	3.6

* Significant difference, minimum value 0.05; based on t-tests for the comparison of the low and high NC regions and based on ANOVA post hoc test for the comparison of the six RTs; number in brackets indicate significantly different RTs.

Table 3
Binary logit model (with and without the spatial association component) explaining the probability of belonging to a region type (RT) with high NC spending (N = 859).

Variable[a]	Model 1 (Non-spatial)[d] dy/dx[b]	Model 1 p-value	Model 2 (Regional)[e] dy/dx[b]	Model 2 p-value	Model 3 (Spatial)[f] dy/dx[b]	Model 3 p-value
HSIZE	0.021	(0.277)	−0.018	(0.345)	0.001	(0.976)
5HA	**−0.125**	**(0.000)**	**−0.082**	**(0.013)**	**−0.093**	**(0.001)**
100ESU	−0.028	(0.201)	**−0.054**	**(0.016)**	**−0.039**	**(0.049)**
GRAZE	**0.106**	**(0.002)**	0.051	(0.158)	−0.025	(0.413)
LIVEST	**−0.147**	**(0.000)**	**−0.095**	**(0.000)**	**−0.035**	**(0.061)**
GVAAGR	−0.019	(0.425)	0.004	(0.881)	0.014	(0.489)
AGREDU	−0.022	(0.272)	−0.009	(0.682)	−0.018	(0.320)
AA	0.008	(0.708)	0.011	(0.621)	0.002	(0.916)
PGL	−0.006	(0.849)	0.019	(0.520)	0.028	(0.276)
LFA	**−0.086**	**(0.001)**	**−0.090**	**(0.001)**	**−0.057**	**(0.010)**
LFAM	**−0.049**	**(0.026)**	**−0.061**	**(0.005)**	−0.028	(0.150)
EXT	0.011	(0.617)	**0.037**	**(0.087)**	0.014	(0.437)
HNV	0.002	(0.949)	0.021	(0.365)	−0.000	(0.986)
N2000	−0.005	(0.815)	0.006	(0.791)	0.010	(0.556)
POPDENS	−0.040	(0.147)	**−0.057**	**(0.044)**	**−0.043**	**(0.085)**
GVAAGR	−0.019	(0.425)	0.004	(0.881)	0.014	(0.489)
PPP	0.019	(0.473)	−0.006	(0.829)	0.001	(0.947)
UNEMPL	−0.022	(0.285)	−0.012	(0.563)	−0.007	(0.691)
POP65	0.007	(0.710)	−0.030	(0.133)	−0.000	(0.997)
TOUR	−0.004	(0.840)	−0.010	(0.557)	0.007	(0.634)
CAMP	−0.011	(0.575)	−0.010	(0.590)	−0.001	(0.969)
PDOPGI	0.027	(0.114)	0.003	(0.874)	0.006	(0.671)
EE_DUMMY	———	———	**−0.418**	**(0.000)**	−0.124	(0.102)
SE_DUMMY	———	———	−0.022	(0.794)	−0.016	(0.803)
JOIN_COUNT[c]	———	———	———	———	**0.208**	**(0.000)**
AIC[g]	***1018.707***		***989.658***		***780.197***	
Mc Fadden R^2	***0.177***		***0.203***		***0.381***	

Variables with a p-value > 0.1 are marked in bold.
[a] Standardised covariate values.
[b] Average Marginal effect (average change in probability of y when x increases by one unit here one standard deviation).
[c] Join_count: Share of neighbouring regions with high NC spending.
[d] Model without spatial variables.
[e] Model including spatial variables of regional association (EE/SE_DUMMY).
[f] Model including spatial variables of regional association (EE/SE_DUMMY) and local association (JOINCOUNT).
[g] Akaike information criterion (AIC).

should be noted that a one unit increase in the cumulative probability of an explanatory variable across all six options equals 0, as the probabilities for a region for the six RTs must add up to 1.

RT1, mainly located in the Northern and Western European fringes and the Central European (midrange) mountainous regions, was characterised by the highest shares of LFA, LFAM and the environmental indicators PGL, EXT, HNV and Natura 2000. Among the socio-economic indicators, regions of this type showed a particularly low population density and a high level of tourism activities (TOUR, CAMP). The agricultural structure was characterised by an extensive but small economic size (5HA, 100ESU), with a strong focus on the livestock holding, particularly the grazing livestock. The probability of belonging to RT1 significantly decreased with the regional income level (PPP) and the agricultural area (AA) share. The PPP and AA indicators also showed the largest influences, with values of 5 and 7 percentage points, respectively, in the MNL model. The probability also increased with the share of LFA/LFAM and agricultural area (HSIZE), indicating a link to disadvantaged regions, both economically and in terms of the agricultural conditions.

RT2 encompassed a larger range of regions, mainly from the north of England and the Mediterranean. It showed similar explanatory variable characteristics as RT1, but they were mostly less pronounced. The main differences between RT2 regions and those of other RTs were the high HNV farmland share, their large share of small farms, and their focus on grassland farming. The prevalence of livestock farming, grazing livestock, LFA and an ageing population significantly increased the propensity of a region to belong to RT2. It was particularly noticeable that, in this case, both macro-regional association indicators (EE/SE_DUMMY) were highly negative (-0.20/-0.14).

RT3 was found in very different regions across many member states, with a spatial clustering in central Italy, the Southern Iberian Peninsula and France to Estonia. The agricultural sector, which played a comparably important role for the regional economy, was characterised by a very small-scale structure (51.6% of holdings < 5 ha UAA, 7.1% of holdings > 100 ESU) and a relatively large share of LFA farms and extensive agriculture. At the same time, these regions accounted for strong food traditions, as indicated by the highest number of regional PDO and PGI indications, accounting for the high agricultural productivity (GVAAGR). The probability for RT3 was positively associated with the regional economic relevance of the primary sector and the extent of the N2000 areas, which seems to closely comply with the funding priorities of NC and modernisation. It is the only RT for which the N2000 areas had a substantial influence on the probability (0.097).

Almost exclusively focussing on NC, RT4 was found in large parts of England (midlands and the south), western Sweden and in regions dispersed around the Mediterranean. These regions frequently had intensive agriculture and economically strong farms. There had rather low shares of N2000 (11.4%) and permanent grassland areas (27.5%) and extensive and HNV farmland (8.5%). With a high population density of 735 capita per km^2, these regions represent the most urbanised group among all regions. Despite the highest share of farmland within the total area, the large average farm sizes and the limited LFA, agriculture contributed only marginally to the regional gross value added (2.0%). In the MNL model, RT4 was positively but not

Table 4
Multi-nominal logit (MNL) model explaining the probability of belonging to specific region types (RTs) with a specific RDP design among regions with high NC spending (N = 402).

	RT1 (N = 82)		RT2 (N = 49)		RT3 (N = 86)		RT4 (N = 84)		RT5 (N = 66)		RT6 (N = 42)	
Variable[a]	dy/dx[b]	(p-value)	dy/dx[b]	(p-value)	dy/dx[b]	(p-value)	dy/dx[b]	(p-value)	dy/dx[b]	(p-value)	dy/dx[b]	(p-value)
HSIZE	**0.050**	**(0.070)**	−0.019	(0.546)	0.021	(0.461)	−0.034	(0.284)	−0.011	(0.668)	−0.007	(0.731)
5HA	0.040	(0.175)	−0.013	(0.709)	**−0.087**	**(0.041)**	**−0.094**	**(0.042)**	**0.108**	**(0.034)**	0.046	(0.210)
100ESU	−0.007	(0.752)	−0.004	(0.862)	0.046	(0.112)	−0.026	(0.420)	0.034	(0.288)	−0.042	(0.140)
GRAZE	0.027	(0.187)	**0.043**	**(0.061)**	−0.048	(0.128)	0.039	(0.328)	−0.035	(0.404)	−0.026	(0.382)
LIVEST	−0.028	(0.135)	**0.043**	**(0.050)**	0.025	(0.302)	−0.029	(0.389)	0.032	(0.288)	**−0.044**	**(0.085)**
AGREDU	−0.012	(0.497)	−0.013	(0.553)	−0.013	(0.613)	0.026	(0.327)	−0.011	(0.713)	0.023	(0.311)
AA	**−0.071**	**(0.008)**	0.015	(0.568)	**0.056**	**(0.102)**	0.032	(0.309)	−0.008	(0.796)	−0.024	(0.352)
PGL	0.007	(0.764)	−0.003	(0.923)	0.002	(0.967)	0.056	(0.128)	−0.058	(0.211)	−0.004	(0.898)
LFA	**0.042**	**(0.068)**	**0.046**	**(0.103)**	0.030	(0.374)	−0.035	(0.384)	**−0.098**	**(0.043)**	0.015	(0.674)
LFAM	**0.042**	**(0.058)**	0.005	(0.859)	0.031	(0.401)	−0.031	(0.587)	0.050	(0.373)	−0.096	(0.095)
EXT	−0.049	(0.216)	0.060	(0.176)	0.039	(0.380)	0.041	(0.351)	**−0.116**	**(0.005)**	0.026	(0.468)
HNV	−0.005	(0.896)	0.023	(0.573)	0.023	(0.624)	0.067	(0.129)	**−0.112**	**(0.025)**	0.003	(0.940)
N2000	−0.015	(0.606)	−0.014	(0.625)	**0.097**	**(0.001)**	−0.015	(0.595)	−0.031	(0.311)	−0.021	(0.357)
POPDENS	−0.028	(0.504)	−0.007	(0.865)	−0.010	(0.816)	0.028	(0.488)	−0.010	(0.799)	0.027	(0.331)
GVAAGR	0.008	(0.755)	0.006	(0.840)	**0.097**	**(0.002)**	0.011	(0.771)	**−0.073**	**(0.080)**	−0.050	(0.190)
PPP	**−0.054**	**(0.099)**	0.044	(0.137)	0.052	(0.108)	−0.035	(0.312)	0.002	(0.947)	−0.009	(0.689)
UNEMPL	−0.023	(0.265)	0.024	(0.333)	−0.015	(0.578)	0.010	(0.736)	0.039	(0.167)	−0.034	(0.201)
POP65	−0.027	(0.185)	**0.043**	**(0.079)**	**−0.072**	**(0.007)**	−0.011	(0.711)	**0.047**	**(0.076)**	0.020	(0.322)
TOUR	0.002	(0.891)	0.002	(0.929)	0.029	(0.365)	−0.046	(0.337)	**0.077**	**(0.061)**	−0.065	(0.246)
CAMP	−0.067	(0.120)	−0.005	(0.875)	−0.005	(0.906)	**−0.053**	**(0.092)**	**0.088**	**(0.003)**	**0.042**	**(0.090)**
PDOPGI	0.019	(0.228)	−0.013	(0.524)	0.021	(0.285)	0.006	(0.842)	**−0.068**	**(0.024)**	**0.036**	**(0.057)**
EE_DUMMY	0.005	(0.955)	**−0.196**	**(0.002)**	0.075	(0.509)	−0.102	(0.413)	0.191	(0.332)	0.026	(0.836)
SE_DUMMY	−0.077	(0.321)	**−0.139**	**(0.061)**	0.101	(0.302)	**−0.149**	**(0.040)**	**0.243**	**(0.043)**	0.021	(0.826)
JOINCOUNT_R1[c]	**0.027**	**(0.042)**	0.003	(0.897)	−0.033	(0.173)	0.011	(0.712)	0.049	(0.148)	−0.056	(0.120)
JOINCOUNT_R2[c]	−0.009	(0.455)	**0.022**	**(0.051)**	−0.028	(0.144)	−0.002	(0.919)	0.022	(0.209)	−0.006	(0.674)
JOINCOUNT_R3[c]	−0.026	(0.096)	−0.013	(0.539)	**0.027**	**(0.094)**	−0.037	(0.203)	**0.053**	**(0.018)**	−0.003	(0.862)
JOINCOUNT_R4[c]	**−0.059**	**(0.016)**	0.032	(0.077)	**−0.078**	**(0.015)**	**0.062**	**(0.001)**	**0.061**	**(0.006)**	−0.017	(0.303)
JOINCOUNT_R5[c]	**−0.055**	**(0.018)**	0.014	(0.443)	0.010	(0.606)	0.014	(0.417)	**0.036**	**(0.016)**	−0.018	(0.150)
JOINCOUNT_R6[c]	−0.021	(0.394)	0.015	(0.436)	−0.012	(0.541)	−0.011	(0.546)	0.014	(0.374)	0.015	(0.172)
AIC[d]	***1063.992***											
Mc Fadden R^2	***0.459***											

[a] z standardised score.
[b] Average Marginal Effect (average change in the probability of y when x increases by one unit, here one standard deviation).
[c] Join_count: Share of neighbouring regions belonging to RT1, RT2, etc.
[d] Akaike information criterion (AIC).

significantly related to the share of HNV farmland (0.067) and was otherwise only negatively related to small-scale farm structures and the macro-regional association factor for southern Europe. Regions in the southern part of the UK, with their extensive environmental sensitive areas (ESAs) and Countryside Stewardship Scheme, are typical examples of this pattern.

RT5 was found in north-eastern France, southern Sweden, Denmark and the Netherlands. The explanatory variables depicted a rather similar patter to that of RT4, but less urban areas and with more holdings of a large economic size (> 100 ESU). Tourism-oriented variables (TOUR, CAMP), small-scale farming and regional associations to southern Europe positively influenced the probability of RT5, whereas HNV and extensive farmland shares, both with relatively large coefficients (0.11), as well as the economic relevance of the primary sector had significantly negative effects. In addition, the choice of RDP funding patterns for RT5 regions was very much affected by the neighbouring regions with similar funding patterns (RTs 3, 4 & 5).

RT6, which was located, e.g., in central France and Spain and in Dutch regions, was characterised by the highest average population density (795.7) and purchasing power (105.8). For the overall economy, the farming sector accounted only for a marginal contribution (1.8%), despite the large share of economically large holdings (17.0% holdings > 100ESU). Another important aspect of this RT is the very low farmland shares in less-favoured areas and extensive and high-nature farmland. Thus, the restructuring of the primary sector activities in combination with NC support represents the domain of regions with developed and competitive agriculture and a high accessibility to nearby urban markets. As the MNL model shows, the propensity for RT6 was only positively affected by the prevalence of camping areas and regional product labels (PGO/PGI). Here, there is some indication that the pattern of the RDP spending followed the given territorial development potentials.

4. Discussion and conclusion

The model estimations explaining whether regions belonged to high NC support regions and to RTs with a specific RDP funding portfolio revealed the existence of a certain degree of dependency on socio-economic, agricultural and landscape-related indicators. The comparison between regions with low and high shares of NC showed that the latter were characterised by higher population densities and purchasing power. Farms of larger economic sizes prevailed, but agriculture contributed less to these regions' added value. Those regions spending higher RD funding shares for NC had fewer environmentally protected areas and less ecologically valuable farmland. This overall picture suggests that NC investments are something regions need be able to afford (see higher purchasing power) where there is a pronounced societal demand for the sustenance of environmental quality (see high population density), such as in or near metropolitan regions (Zasada, 2011). In addition, the prevalence of livestock farming as a rather intensive type of agricultural system and of economically large farms, particularly in the case of RT3 (NC + modernisation), can be interpreted as a double strategy of farm transitions and buffering environmental burdens, following a sustainable intensification pathway (Weltin et al., 2018).

Throughout the estimated logit models, a significant influence on the probability of high NC spending was found for farm structure indicators, such as smallholder farms, economic farm sizes and agriculture in LFA. The comparably high and inverse effects of small-scale farming confirm earlier research on farm participation in AES (Lastra-Bravo et al., 2015; Pavlis et al., 2016). However, these findings only reflect the current practice of the voluntary uptake of measures, which lacks spatial or group targeting, regardless of the level of NC, and, in combination with other RD topics, would be desired or effective in certain regions. The significance of the LFA prevalence reflects the role of the stabilisation topic in the RD funding pattern of RTs 1 and 2. There, financial support is distributed directly to farmers, who maintain agricultural land use under disadvantaged conditions, preserving income opportunities and preventing land abandonment; in addition, financial support is a precondition for agri-environmental management.

The results also show a close relationship between NC spending and specialisation in grazing systems, but not with the share of permanent grassland. Only in the regional model the prevalence of extensive farming systems has a weak positive association, so that no strong NC focus on extensive grassland systems can be assumed. Despite the fact that they are partly linked to specific area designations, the association of NC spending to other environmental indicators, such as N2000 areas or HNV farmland, is mainly insignificant. This suggests a misallocation pattern, as especially those areas should be given a high NC funding priority to maintain their ecological value. However, as Uthes et al. (2017) point out, the HNV indicator needs to be used with caution, as different definitions and monitoring approaches exist throughout the various member states, compromising its comparability.

Socio-economic indicators also showed mainly insignificant effects. In particular, the narrow focus of the RDP measure beneficiaries (who were mainly farmers and not regional administrations or other rural actors) on agricultural issues, instead of the region as a whole, must be considered as a region for the observed insignificance. These findings support some of the criticisms that RDP programming lacks targetedness to local needs and potentials (Copus and Dax, 2010; Piorr and Viaggi, 2015). RDP must be understood as only one pillar within a wider territorial development policy portfolio that includes regional, structural and investment funds, which share similar objectives and lack horizontal coordination (Copus et al., 2013). Another explanation for why only a few variables can be associated with high NC spending is related to the heterogeneity of these regions, with regard to how they valorise and combine different RDP funding priorities.

In addition to NC and stabilisation, other rural development objectives, such as agricultural modernisation or the restructuring of the rural economy, seem marginalised when combined with NC investment. RTs 5 and 6 represent notable exceptions. The propensity to belong to these regions was positively related to their demography, tourism and regional marketing variables, providing some indication that the pattern of the RDP spending follows the given territorial development potentials. Several recent studies have highlighted the role of diversification as a strategy to improve the exploitation of market potentials, such as in an urban proximity context (Pölling and Mergenthaler, 2017), though the combination of agri-environmental and high value production (Rivalori et al., 2017) or through diversification as a risk reduction mechanism (Weltin et al., 2017). However, due to the high variability of the specific regional funding patterns and explanatory variables, it is difficult to derive a consistent picture and to identify additional influencing regional characteristics.

The spatial neighbourhood and macro-regional association indicators accounted for the largest explanatory value in the statistical models. In particular, the factor for Eastern Europe accounted for a large and significant inverse effect on the probability of belonging to a region with high NC spending (-41.8% points). This highlights the specific situation of the Central and Eastern European (CEE) countries, where larger shares of the RDP funding were dedicated to investments with various scopes of physical capital and to modernisation and stabilisation, whereas NC had only a subordinated priority. After their accession to the EU in 2004 and 2007, CEE countries needed – and still need – to increase agricultural productivity, while complying with natural resource use regulations. Therefore, their policy makers and farmers are pursuing a catching-up process in terms of increases in productivity and structural changes in the farming sector, with more priority given to a conventional production model (Leal Filho, 2004, p.5ff.). However, there has been criticism that the EU's RDP has been insufficiently aligned to the needs of the new member states and the specific requirements for the transformation of their agricultural sectors and rural areas (Gorton et al., 2009). This raises questions about whether the relevance of institutional, agency and human capital factors for the transformation process of the agricultural sector (Gorton and Davidova, 2004) are sufficiently taken into consideration.

The strong influence of the spatial neighbourhood association factor is in turn explained by the probability of neighbouring regions to belong to the same RDP programming unit, whether at the member state or high regional level. Although RDP spending depends on uptake behaviours by local farmers and stakeholders, superior decisions about budget allocations to measures are carried out at a policy level. However, territorial variability below the programming unit level seems to be only partly depicted by the RDP expenditure pattern.

In conclusion, due to the specific design of this study, with its spatial and thematic aggregation (over six funding priorities) of RDP payments, scale dependency (Desjeux et al., 2015) and complexity of policy objectives, intervention logic and causal effects (Uthes et al., 2017), the sensitivity of the approach for individual measures of very local conditions is limited. For a more detailed analysis, existing environmental data gaps (Uthes et al., 2017) must be overcome. Beyond this, the estimated models leave room for additional effects that are not controlled for in this study, such as individual decision making by farmers. As RDP funding trickles down from the EU and programming unit level to the farm level, where most of the measures are adopted on a voluntary basis, the final distribution of the RDP expenditure represents a mixture of the different decision-making units, in which farmers play a major role (Piorr and Viaggi, 2015). Beyond this, the consideration of factors, such as the existing infrastructure, the knowledge and innovation capacity, the political orientation and evolutionary development and path dependency effects (Kirk et al., 2007) might provide interesting insights into RDP implementation.

The consideration of spatial association variables additionally showed a strong dependency on the RDP situation of neighbouring regions and the macro-regional location. Less favoured areas and farm structural factors, rather than agriculture-related indicators, were found to be influential throughout the models, which was, to a lesser degree, also the case for the socio-economic and environmental factors characterising the region. A clear and robust association between the RDP spending pattern derived by combining NC with other funding themes and the specific regional agricultural, environmental and socio-economic conditions was hardly given. Regions with areas of high ecological value were less likely to be associated with high priority NC investments. Instead, high NC investments were found in economically developed regions with intensified agriculture, either to address ecological degradation or to improve the environmental quality in urbanised regions.

These findings support the envisaged strengthening of the responsibilities of the EU member states in the programme design for the CAP after 2020 (EC, 2017), which holds some potential to allow the adaption of objectives and requirements to regional conditions and needs, if accompanied with further environmental regulations and path-dependencies at national and regional level are overcome. Tt is necessary that member states and/or the programming units are better able to enhance regional targeting. Especially in large countries such as France or Germany, this remains challenging.

Thus, to achieve better regional targeting of RDP spending, one must consider different premises according to the valorisation path a region is supposed to choose, as manifested through coupled expenditure priorities representing distinct strategies. Regardless of this more differentiated picture of MNL modelling, it is difficult to argue for clear relationships between the prevailing regional characteristics, demands and development potentials and the thematical priority settings in regional RDP spending. The improvement of the model quality and more differentiated insights may be expected when individual beneficiary data and more spatially explicit, locally disaggregated data are available. Nevertheless, a greater understanding about the causal links between policy implementation, policy effectiveness, the impact of the policy on the development of rural areas and the role of institutions is needed. In any case, this study highlights that, to improve consistency between regional demands and requirements and RDP funding distribution, the regional level should receive more attention in the programming and spatial targeting of the RDP.

Acknowledgements

The authors acknowledge funding from the European Commission (FP7, H2020) projects SPARD (Spatial Analysis of Rural Development Measures; GA No. 244944), CLAIM (Supporting the role of the Common agricultural policy in LAndscape valorisation; GA No. 222738) and PROVIDE (PROVIding smart DElivery of public goods by EU agriculture and forestry; GA No. 633838).

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