Identifying typologies of rural areas based on the importance of different public goods and bads

Marconi V.[1], Viaggi D.[1] and Raggi M.[2]

[1] University of Bologna/Department of Agricultural Sciences, viale Fanin 50, Bologna, Italy

[2] University of Bologna/Department of Statistics, via delle Belle Arti 41, Bologna, Italy

v.marconi@unibo.it

Summary

The provision of public goods by agriculture and forestry has been one of the major topics of the policy debate in recent decades. From an economic point of view, public intervention related to pubic goods is justified by the fact that, due to their nature, markets do not provide prices for public goods and, as a consequence, do not allow to reach an optimal level of provision. Research has tried to deal with this topic in different ways. One pathway tries to attach a value to public goods provision to support related decision making, either using monetary or non monetary techniques. In this study we try to address those issues through the identification of typologies of rural areas within Europe based on the relevance assigned by local stakeholders operating in the field of agriculture and forestry in different European countries to different bundles of public goods and bads. In this survey, the PGBs provided by agriculture and forestry that stakeholders scored the highest are considered to be a proxy of society demand for those PGBs. The results indicated that water-related issues are the most relevant environmental concerns in the context of agriculture and forestry. However, we highlighted different relevance of PGs across regions, consistently with most of the studies addressing this issue and with known evidence about the variety of different local conditions in the EU. We identified a large group of respondents attributing a greater relevance to the Public Goods with more prounonced social dimension (in particular 'rural viability and vitality') with respect to the more environmental. The same group of respondents also assigned a greater importance to a few environmental Public Bads (e.g. 'Biodiversity losses') suggesting that PGBs are perceived as linked to specific components of the Socio-Ecological Capital (e.g. water), which are qualified depending on (threshold-related) levels.

Keywords: public goods, stakeholder analysis

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[1] University of Bologna/Department of Agricultural Sciences, viale Fanin 50, Bologna, Italy

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1. INTRODUCTION

Agriculture and forestry are the dominant form of landuse, respectively covering 38% and 31% of the world's land surface (The World Bank, 2015). A rapidly growing world population, however, forcing trade-offs between the production of food, biodiversity and habitat conservation, and mitigation of climate change (Phalan et al., 2001). Therefore, agriculture and forestry are increasingly expected to deliver multiple environmental and social benefits (Duke et al., 2012; Bennet et al., 2015) and the provision of public goods by agriculture and forestry has been one of the major topics of the agricultural policy debate in recent decades. Currently the EU Common Agricultural Policy incorporates a number of instruments related to public good-type issues, greening and cross-compliance in the first pillar to agro-climate measures in the second pillar. The latter represents a policy focus on multifunctional agriculture (OECD, 2012), in contrast with land preservation strategies. Evidences suggest that both the promotion of sustainable management practices and the adoption of land preservation areas deliver multiple benefits to the communities in which the agricultural land exists and beyond them (Loomis et al.; 2000; Duke et al., 2012).

From an economic point of view, public intervention related to pubic goods is justified by the fact that, due to their nature, markets do not provide prices for public goods and, as a consequence, do not allow to reach an optimal level of provision. Research has tried to deal with this topic in different ways. One pathway tries to attach a value to public goods provision to support related decision-making, either using monetary or non-monetary techniques (e.g. as an utility/relevance score). One difficulty of these exercises is that public goods values are rather site- and context-specific, so that value generated for a specific issue/decision may be hardly generalised/transferred. In addition, a problem arises due to the fact that demand and supply are difficult to observe separately from each other. In practice, the relevance of the public goods tends to mix up with the size of the discrepancy between desired level of public good and the actual supply. In addition, effects of agriculture on several public good dimensions (e.g. water) are seen as either public goods or bads depending on thresholds of agricultural practices or ecosystem status (e.g. nutrient use or water status). Hereafter public goods and bads are denoted by PGs and PBs, respectively; Public gods and bads by PGBs.

Another stream of literature tend to quantify public goods through physical measures, possibly made spatially explicit. The results of this mapping activities, as also evident from Marconi et al., 2016, is often characterised by a combination of very specific information, which is however difficult to interpret on the aggregate, especially lacking the ability of combining insights from multiple PGs in the same area. These gaps limits our understanding of what agricultural and forestry deliver to society, thus undermining the capacity of research to support policy and management. As a consequence, key research challenges are linked to the comprehension of the interplay of biophysical, ecological and social components in the co-production of public goods, the understanding of how benefits are distributed among stakeholder groups, and

the identification of governance strategies enabling the provision of public goods in complex socio-economic structures (Bennett et al., 2015). In strict connection, the EC has recently indicated the strategic priorities for agricultural and forestry research: deeper and more solid assessment of collateral (non-market) goods produced by agriculture, such as environmental protection and social benefits; local strategies to enhance synergies which favour the co-production of private and public goods and help adapting to climate change and food security challenges simultaneously (EC, 2014).

In this paper we try to add to the literature partially overcoming these limitations through a stakeholder based exercise. Local stakeholders were engaged in According to the scientific literature, stakeholders' involvement in environmental management has recently increased being a practical and cost-saving instrument of evaluating alternative policy prescriptions and/or management options (Targetti et al., 2016; Rutgers et al., 2012), when ad hoc technical studies are not neither available nor affordable due to low budget and time limitations (Kuhnert et al., 2010; Reed, 2008). High levels of stakeholder participation and the integration of local knowledge into management are included within the essential principles of the Ecosystem Approach (Kenter, 2016), as strategy for the integrated management natural resources promoting sustainable and equitable use (CBD, 2004). In addition, interactive knowledge creation and exchange models, and the adoption of territorial based approaches, paying attention to local specificities, are recommended for research facing the challenges of sustainability in agriculture and forestry systems (EC, 2014).

In this paper we address the issues above through the identification of typologies of public good provision based on stakeholders' importance weights assigned to a set of public goods and bads, and try to establish a link with policy prescriptions, in terms of most relevant/suitable policy instrument, to each profile of public goods concern.

More specifically, the objectives of the paper are the following:

a) to identify perceived typologies of rural areas within Europe based on the relevance of different bundles of public goods;

b) to disentagle the role of agriculture and forestry as providers of combinations of PGs and/or PBs;

The paper is structured as follows. In the next section (section 2) the methodology is illustrated, followed by the overview on the considered Case Study Regions and the scientific literature on the topic (section 3). Section 4 illustrates the results, followed by a discussion section (section 5) and by concluding remarks (section 6).

2. METHODS

2.1. Stakeholder survey

A survey was carried out to collect information from the stakeholders in order to estimate and map social demand for public good provision from agriculture and forestry across Europe. To provide a structure to the survey, public goods considered as connected in pairs to underlying Socia-Ecosystem Capital (SEC) items. Rural landscape, rural biodiversity, water, air, soil, climate change, geohazards, rural communities, rural products, livestock are the 10 elements of the SEC to which the definitions of PGs and PBs are referred to. In this framework, PGs and PBs provided by agriculture and forestry can be considered two opposite sides of the same issue. In particular, PGs include both the existence itself of certain goods (e.g. clean water) and the processes aiming at preserving or enhancing those goods (e.g. adoption of low input farming techniques). On the opposite, PBs are the processes that endanger the existence of public good, ranging from environmental, as clean water/air, to social, as the vibrant rural communities (e.g. the misuse of pesticides,

the degradation that follows land abandonment). In stakeholders' perceptions, a correlation appears to exist between some public good and bads in the context of the same issues. The PGs provided by agriculture and forestry are selected integrating the lists identified by Cooper (2009) and ENRD (2010). A further result of the survey is the identification of the most relevant PGBs and the most useful policy instrument from the point of view of local stakeholders.

The stakeholders of the 9 case study regions were approached with a request to fill in a multiple choice questionnaire. The stakeholder survey aimed at gathering their views on several issues concerning PGBs in the context of agriculture and forestry: definition of PGs, local relevance of PGBs, preferential locations, governance mechanisms usable for improving the provision of PGs and reducing the provision of PBs. The questionnaire used in the survey consists of two main sections: the first including 7 questions on PGs and the second including a restricted number (5 out of 7) of the same questions but referred to PBs. The respondents of the stakeholder questionnaire were first asked to give a 0-9 score to the single PGs (section 1 of the questionnaire), then they were asked to give a 0-9 score to the single PBs (section 2 of the questionnaire). A total number of 101 stakeholders answered to the survey, however there was a considerable attrition rate and not all the respondents completed the questionnaire. The total number of the respondents answered to the question for PGs, while only 70% of respondents also answered to the same question for PBs. The composition of the sample of respondents is described in the results section.

Stakeholders were asked to score the relevance of the given set of PGs and PBs in their regions. The opinions of stakeholders on the most suitable governance mechanisms (GMs) for the management of PGBs were elicited through dedicated questions. Stakeholders were asked to select the most usable GMs among the same given list for each of the considered PGs and PBs, in two separate questions. The list of GMs is composed by the answers given by a reduced number of stakeholders (1-2 per CSRs) to the same questions during face-to-face interviews. Those answers were reworked trying to identify general categories of GMs among the options described by the respondents. Finally, those general categories were integrated with other categories of GMs described in the scientific literature when missing in the stakeholders' answers. The answers collected through the multiple choice questionnaire were used to rank the GMs indicated as useful for the PGBs based on the frequency of selection.

2.2. Cluster analysis

The identification of typologies of rural areas within Europe was accomplished performing a clustering exercise based on the outcomes of the stakeholder survey. Then, the clusters identified has been characterized according to the provenance of the stakeholders composing each cluster.

The scores attributed to the total number of PGBs by each respondent were successively converted into weights expressed in the 0-1 range by computing a ratio between the individuals core and the some of the scores given to all the PGs. Those weights expressing the relevance of 10 PGs and 10 PBs provided by agriculture and forestry were used as variables for the clustering exercises.

The cluster analysis aims at the identification of typologies of rural areas within Europe and consists of a two-stages analysis: first, a clustering exercise was performed focusing only on the relevance attributed to the PGs, then a second analysis was performed including the total number of PGBs scored by the respondents. Two analysis with different cluster variables were performed due to the fact that only 70% of the respondents answered to the second part of the questionnaire focused on the PBs. Thus, performing only one analysis would lead to the loss of the information concerning the relevance of PBs or to the loss of 30% of the observations if considering only the respondents answering to both sections. Besides the difference in the number and nature of the cluster variables, both the cluster analysis followed the same methodology, which can be described as follows. A hierarchical clustering analysis was performed as an explorative tool, in

order to obtain a dendrogram showing the sequence and structure of cluster aggregations. This preliminary clustering exercise followed the Ward's method with Gower distance (this algorithm was used because of the discrete nature of the cluster variables). The analysis of the dendrogram supported the selection of the number of clusters. The most distinct solution identified was used to fix the number of clusters when computing a second, non-hierarchical cluster analysis. This second cluster analysis, following the k-means method (Gower distance), was performed in order to obtain the centres and the sizes of the clusters and improve the distinction between clusters. Finally, the identification of typologies of rural areas within Europe was accomplished matching the relevance attributed to bundles of PGBs with the country of provenance of the stakeholders composing each cluster.

2.3.   *Correlation analysis*

The role of agriculture and forestry as providers of PGBs was estimated by linking the weights assigned by stakeholders to the PGs and the PBs to the same element of the SEC (e.g. air or landscape). Those links were analysed by means of a pairwise correlation analysis at first. This analysis was done in order to identify statistically significant relations, and the sign of the correlation coefficient in significant relations. Then, a second pairwise analysis was performed by computing the difference between the weights attributed to PGs and the PBs related to the same SEC. The results of this computation are displayed trough a boxplot chart, which easily allows the identification of positive and negative median values for each SEC. Roughly speaking, positive median values indicate positive net effects of agriculture and forestry on the given SEC (e.g. soil or rural vitality), while the negative hints at the opposite. For example, if the median value of the difference of the scores attributed to the PGs and the PBs of the same element of the SEC (e.g. farmland biodiversity) is -0.01, this suggest that stakeholders consider agriculture and forestry to have an overall negative effect on this given element.

3. CASE STUDY REGIONS

This exercise is based on the involvement of Local stakeholders from nine Case Study Regions (CSR) each located in a different European country namely: Italy, Germany, Spain, Finland, Estonia, Romania, Bulgaria, Poland, Czech Republic. In this section we provide a short description of each CSR.

The Finnish CSR is North Ostrobothnia (NUTS3 FI1D6), in Northern Finland, where 88% of the land is covered by forests. Typical elements of landscape are hills in the northeastern side, rivers and river valleys in the western side, and flat peatland areas in the center of the region. The Spanish CSR is Andalusia, in southern Spain, which hosts a wide variety of agroforestry landscapes, especially including olive groves (with more than 1.5 million ha), 'dehesa' agroforestry and livestock system (around 1 million ha), winter rainfed cereal systems and different types of irrigated agricultural systems.

The Italian CSR is Emilia-Romagna region, located in the north-eastern side of the country. Agricultural areas cover the 60% of the regional land, which is mainly cultivated at intensive arable crops (42% of the regional UAA). Agricultural systems in Emilia-Romagna are mostly oriented towards high-quality traditional and local production and have been recently characterized by a process of abandonment of small and marginal farms in favour of an increase in farm size (+36%).

The German CSR is located in the Federal State of Brandenburg (NUTS2), County of Märkisch-Oderland (NUTS3). The CSR is a Nature Park where forested areas are under nature conservation measures and which are surrounded by agricultural areas. Environmental issues are water scarcity, soil functionality (water retention, wind erosion), loss of biodiversity habitats and carbon stocks due to water management. The Estonian CSR is the Harju County, which includes the capital city of Tallinn. More than 25% of the total

rural population of Estonia lives in this area, however quite few of them are employed in farming. 51% of the regional is covered by forests representing the nearest recreation area for urban population with its nature parks and the Rebala Heritage Reserve.

The Romanian CSR is the North-East Region, which is characterized by low productivity for most crops due to fragmentation of farmland ownership, aging workforce accompanied by a migration of young people to urban areas and results in a high degree of poverty for small farmers. The main environmental problems are linked to deforesting, with implications in amplifying the land slips and soil erosion.

The Bulgarian CSR is the South Central region, where 48.1% of the land is represented by agricultural areas (mainly arable and grassland) and 45.1% by forest areas. The region has well developed livestock. Agriculture delivers many public goods which are highly valued in the region: agricultural landscapes, farmland biodiversity, water quality and availability. However, soil erosion affects 80% of the agricultural land.

The Poland CSR is represented by the Podlasie region, where agricultural areas constitute 53% of the region and forests constitute 31%. The region is predominantly rural and a significant number of municipalities fall within the Nature 2000 areas. The number of farms recently declined by 14%. The farms are, on average, small and oriented towards high quality production. Environmental issues are water quality pollution and biodiversity losses due to the recent intensification of agriculture and urban expansion.

The first part of the case study area of the Czech Republic, 'Česká Lípa', is situated in northern Bohemia, while the second part 'Děčín' is situated in the Northeast of the district Ústecký kraj. Both parts of the CSR are especially attractive to tourists due to their large amount of culturally rich sites such as nature reserves and nature monuments. Environmental issues are water scarcity due to climate change and soil pollution in the former military base.

4. RESULTS

4.1.   *Description of the sample of respondents*

The survey was filled in by a total number of 101 respondents, 65 out of which indicated 'agriculture' as their area of expertise, whereas 36 indicated 'forestry'. The respondents belong to the local stakeholders and expert platform (CS-SP) of 9 out 13 CSRs of the PROVIDE project. The composition of the sample according to the professional categories represented by the respondents is synthetized in the chart of figure 1, showing that stakeholders are mostly public officers working on regional or national institutes (33% of the total sample) or researchers in the field of agriculture and forestry or related (32%). Other less represented professional categories are the following, in order of decreasing share of the respondents sample: members of NGOs (13%), mainly in the field of nature conservation or local development); farm consultants and agronomists (8%); employees in agri-food firm and industries (6%); representatives of farmers/foresters associations (5%); farmers and foresters (3%).

Figure 1. Composition of the surveyed sample of stakeholders: % shares of job categories represented
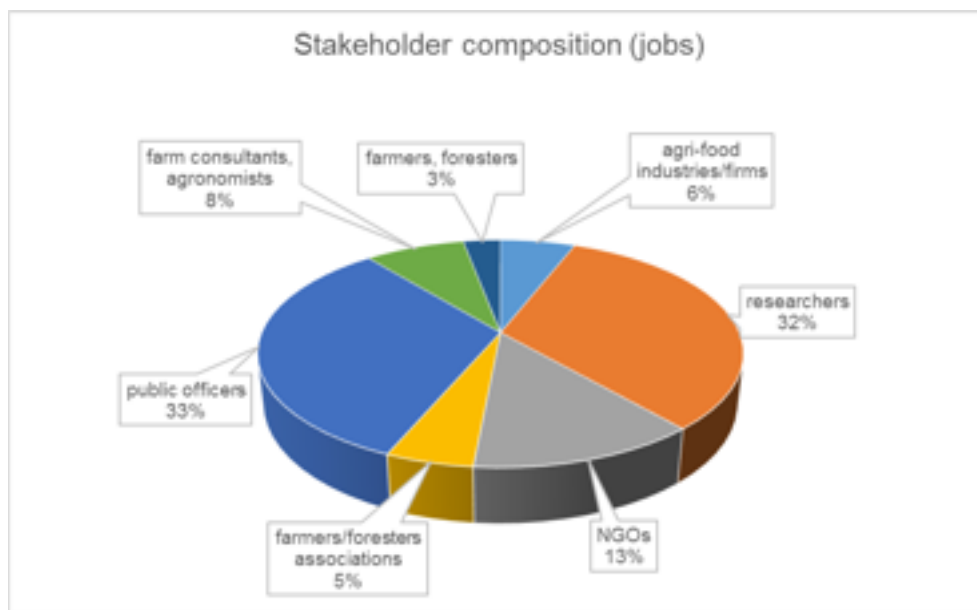
Concerning the composition of the sample according to the EU country, the Italian CSR, Emilia-Romagna region, is the most represented region (21.78 % of the total sample), followed by the Romanian, and the polish, CSRs (14.85% and 12.87%, respectively). All the remaining countries holds a share lower than 10% of the total sample.

4.2. *Identification of typologies of areas based on the relevance of bundles of public goods*

The number of respondents and statistical descriptives of the stakeholders' weights, such as mean, standard deviation (S.D.), minimum (min) and maximum (max) values, median (p50) and variance, are synthetized in the Appendix 1 for all of the 20 PGBs analysed. On the whole, the greatest mean relevance (0.11) has been attributed to 'Landscape and scenery' and 'Water quality and availability', the latest also shows the greatest median value (0.11) among PGs. Concerning PBs, the greatest mean (0.12) and median (0.11) relevance was attributed to 'Soil erosion' and to 'Biodiversity losses', followed by 'Water quality and availability' which achieved a mean and median relevance of 0.11. Thus, 'Water' is the only issue indicated as both the most relevant PG and a very relevant PBs provided by agriculture and forestry. A much greater internal variability characterizes the scores attributed to PBs with respect to those attributed to PGs, as it is proven by the resulting standard deviations which are in the 0.2-0.3 range for all of the PGs and in the 0.3-0.5 range for the majority of PBs, with the exception of 'Soil erosion' showing the greatest variability of attributed scores (standard deviation equals 0.6).

As stated before a clustering exercises was performed in order to identify different typologies of (judgement on) rural areas in Europe. The analysis (named Clu_PGs hereafter) was made on the basis of the weighted relevance attributed by stakeholders to the PGs only (10 cluster variables). The results of the cluster analyses indicates the number of 4 clusters as the most distinctive solution. The size of the total samples analysed and the name and the numerousity of the clusters are synthetized in Table 1. A large cluster including half or more of the surveyed stakeholders was identified (Clu_1 in Clu_PGs). The largest clusters are composed by the stakeholders assigning a homogeneous level of relevance to the PGs (almost equal to 0.1). This outcome is clearly displayed by the blue lines in the spider graphs of Figure 2 and it is expressed

by the centers of those clusters (Clu_1), which ranges from 0.09 to 0.11 for all of the cluster variables in Table 1.

Figure 2 – Spider graph showing the cluster variables (PGs)
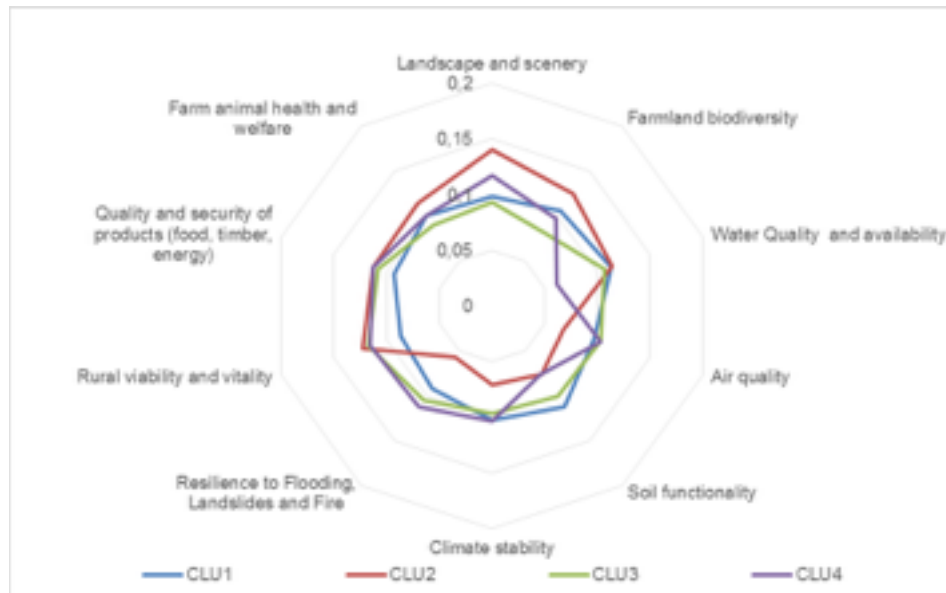
In Clu_PGs, the secondmost larger cluster includes one out of four of the stakeholders (Clu_3, Table 1). The centers of this cluster indicates that it is composed by the respondents attributing a slightly greater relevance to the PG 'rural viability and vitality' (0.12) and slightly lower relevance to 'farmland biodiversity' (0.08), while all of the remaining PGs have received almost homogeneous scores (0.1-0.11, Table 2). Those features characterising Clu_3 are also displayed through the green line in the spider graph of Figure 3. The thirdmost larger cluster (Clu_2, Table 1) is composed by stakeholders considering more relevant the PGs that have more pronounced local and social dimension ('rural viability and vitality' and 'landscape and scenery', see Table 2) with respect to the more environmental PGs (with the exception of 'water quality and quantity' and 'farmalnd biodiversity'). The smallest cluster (Clu_4, Table 1) represents 10% of the total sample of respondents, and in particular those indicating the more 'rural viability and vitality' and 'landscape and scenery'as the most relevant PGs, with especially low values for water and soil PGs (see Table 2).

In Clu_PGBs, the secondmost large clusters includes one fifth of the stakeholders (Clu_4, Table 1). The centers of this cluster indicates that it is composed by the respondents attributing a greater relevance to the PGs that have more pronounced social dimension ('rural viability and vitality', 'landscape and scenery', 'quality and security of products', see Table 2) with respect to the more environmental PGs (with the exception of 'farmland biodiversity'). This trend is comparable to that observed for Clu_3 of the previous clustering exercise, but this second exercise also allows the analysis of the relevance attributed to the PBs (Table 2). The stakeholders grouped in Clu_4 assigned a greater importance to a few environmental PBs provided by agriculture and forestry: 'Biodiversity losses', 'Water resources pollution and depletion'and 'Soil erosion'. Thus, those respondents indicated that agriculture and forestry deliver PGs useful for the socio-economic development of the rural areas where they operate, but simultaneously provide damages to natural resources such as water, soil and biodiversity. Limiting to the PGs, those features characterizing Clu_4 are also displayed through the purple line in the spider graph of Figure 3 (right). The thirdmost large cluster (Clu_3, Table 1) is composed by stakeholders considering the PGs characterized by a more environmental (and global) dimension as slightly more relevant than the others ('farmland biodiversity',

'climate stability' and 'soil functionality', Table 2). Among PBs the same respondents indicated that the 'Increase of flood and wild fire risk' is by far the most relevant environmental issue associated with agriculture and forestry, while 'Poor quality and security of products' and 'Degradation of animal health and welfare' are the most relevant socio-economics aspects (Table 2). The smallest cluster (Clu_2, Table 1) is composed by only 2 respondents, who attributed a greatest relevance to 'rural viability and vitality' and 'water quality and quantity' among PGs (see red line in Figure 3, right), and to 'Biodiversity losses', 'Soil erosion' and Increase of flood and wild fire risk' among PBs (Table 2).

Table 1 – Centers of the cluster variables: cluster analysis Clu_PGs

Cluster name	Clu_1	Clu_2	Clu_3	Clu_4
Cluster numerousity	*48*	*17*	*25*	*11*
Landscape and scenery	0.10	**0.14**	0.09	**0.12**
Farmland biodiversity	0.11	0.12	**0.08**	0.10
Water Quality and availability	0.11	0.11	0.11	0.06
Air quality	0.10	0.07	0.10	0.10
Soil functionality	0.11	0.08	0.10	0.08
Climate stability	0.10	0.07	0.10	0.10
Resilience to Flooding, Landslides and Fire	0.09	0.06	0.10	0.11
Rural viability and vitality	0.09	**0.12**	**0.12**	**0.12**
Quality and security of products (food, timber, energy)	0.09	0.11	0.11	0.11
Farm animal health and welfare	0.10	0.11	0.09	0.10

The clusters so identified, have been characterised based on different background features. First of all they have been analysed based on the composition per CSR of the stakeholders grouped in each of them. Concerning the first clustering exercice, Clu_PGs, the countries more represented in the largest cluster (clu_1) are: Italy (33%), Romania (21%) and Poland (17%), see Table 2. The secondomost large cluster (clu_3) is mainly composed by stakeholders operating in Italy, Romania and Bulgaria (20% each). Germany (35%) and Finland (18%) are the most represented in clu_2, while clu_4 is largely dominated by Spanish stakeholders and subordinately by Estonian respondents (Table 2).

Table 2 – Cluster composition by country of the respondents (cluster analysis Clu_PGs)

Cluster	IT	DE	ES	FI	EE	RO	BG	PL	CZ	Total
1	**33%**	2%	2%	4%	6%	**21%**	10%	**17%**	4%	100%
2	6%	**35%**	12%	**18%**	12%	0%	0%	12%	6%	100%
3	**20%**	0%	4%	12%	8%	**20%**	**20%**	8%	8%	100%
4	0%	0%	**55%**	9%	**18%**	0%	0%	9%	9%	100%
Total	**22%**	**7%**	**10%**	**9%**	**9%**	**15%**	**10%**	**13%**	6%	**100%**

In addition to the country of provenance of the stakeholders, the elements of the landscape indicated as preferential location for the provision of PGs and PBs in their CSRs could be considered as another determinant of the clusters structure. When considering only the elements of the landscape indicated as preferential locations for the provision of PGs, it is possible to observe many similarities but also some differences among the clusters obtained through Clu_PGs (Table 3). In particular, 'riverside and valleys', 'forest and woodlands' and 'almost homogeneously widespread' were indicated among the preferential locations for the provision of PGs by the stakeholders of all of the clusters. Differently, 'hilly areas' and 'mountain areas' were given more importance with respect to the other elements of the landscape mainly by the stakeholders belonging to Clu_1. In addition to those most common to all the cluster, the stakeholders of Clu_2 and Clu_4 indicated as preferential locations also 'meadow and pastures', while those belonging to Clu_3 indicated also 'plain areas'. 'Specific production areas' were indicated as relatively relevant areas for the provision of PGs only by the stakeholders of Clu_4.

Table 3 - Cluster composition by selection of landscape elements as providers of PGs

Cluster PGs	Clu_1	Clu_2	Clu_3	Clu_4	Total (sample)
On the riversides and river valleys	13%	**17%**	14%	11%	14%
Hilly areas	12%	8%	7%	6%	10%
Mountain areas	**13%**	2%	11%	9%	10%
Plain areas	10%	12%	**15%**	9%	11%
Specific production areas	9%	3%	8%	**11%**	8%
Meadow and pasture areas	10%	**20%**	11%	14%	12%
Areas with cultural and historical values	8%	6%	4%	8%	7%
Almost homogeneously widespread	**13%**	13%	12%	**14%**	13%
Forest and woodland	**13%**	**19%**	**18%**	**18%**	15%
Total (cluster)	**100%**	**100%**	**100%**	**100%**	**100%**

4.3.   *Disentanglement of the role of agriculture and forestry as providers of PGs and/or PBs*

The results of the correlation analysis indicate that there are statistically significant relations for the following elements of SEC: rural landscape, air, geohazards (floodings, landslides, wildfire), rural communities and rural products (see bold lines in Table 4). According to the (weighted) relevance assigned by stakeholders to both the PGs and PBs associated with each of those issues, a positive link exists between the PGs and the PBs related to rural landscape, air, and geohazards. This means that the relevance attributed to the provision of the public goods related to those issues in their CSRs increases accordingly to that of the associated provision of public bads. On the contrary, a negative relation characterizes the relevance of PGs and PBs associated with the issues of rural communities and rural products (see negative correlation coefficients in table 4). This hints at the fact that in the CSRs where the PGs related to rural vitality and/or rural products are relevant, the associated PBs are not and viceversa. The differences in the relations found among associated PGBs lead to the identification of different roles attributed to agriculture and forestry by the stakeholders.

In details, the results of the joint analysis of the (weighted relevance) attributed to associated PGBs (see method section for details), if the relevance on the positive side is assumed to compensate for the relevance on the negative side, indicate that an overall neutral effect of agriculture and forestry is acknowledged for many of the issues, as it expressed by the boxplot diagrams of Figure 3 showing median values equal to zero. In the chart, the median value (expressed by the central line of the boxplots) is negative if the net effect of agriculture and forestry on a given issue is considered to be negative (e.g. soil and biodiversity), and positive if the net effect is considered to be positive (e.g. rural communities, rural products, livestock conditions).

Table 4 – Pairwise correlation among the relative relevance attributed to PGs and PBs related to the same topic

Elements of SEC	Goods_n	Bads_n	Corr. Coefficient	Significance
Rural landscape	Landscape and scenery	Landscape degradation	**0.412**	**0.000**
Rural biodiversity	Farmland biodiversity	Biodiversity losses	0.084	0.493
Water	Water Quality and availability	Water resources pollution and depletion	-0.072	0.557
Air	Air quality	Air pollution	**0.233**	**0.054**
Soil	Soil functionality	Soil erosion	-0.090	0.462
Climate change	Climate stability	Climate degradation	0.073	0.552
Geohazards	Resilience to Flooding, Landslides and Fire	Increase of flood and wild fire risk	**0.329**	**0.006**
Rural communities	Rural viability and vitality	Degradation of abandoned land	**-0.206**	**0.089**
Rural products	Quality and security of products (food, timber, energy)	Poor productions quality and distribution	**-0.348**	**0.003**
Livestock	Farm animal health and welfare	Degradation of animal health and welfare	0.132	0.279

Figure 3 - Boxplot representing the net effect of agriculture and forestry on the considered topics
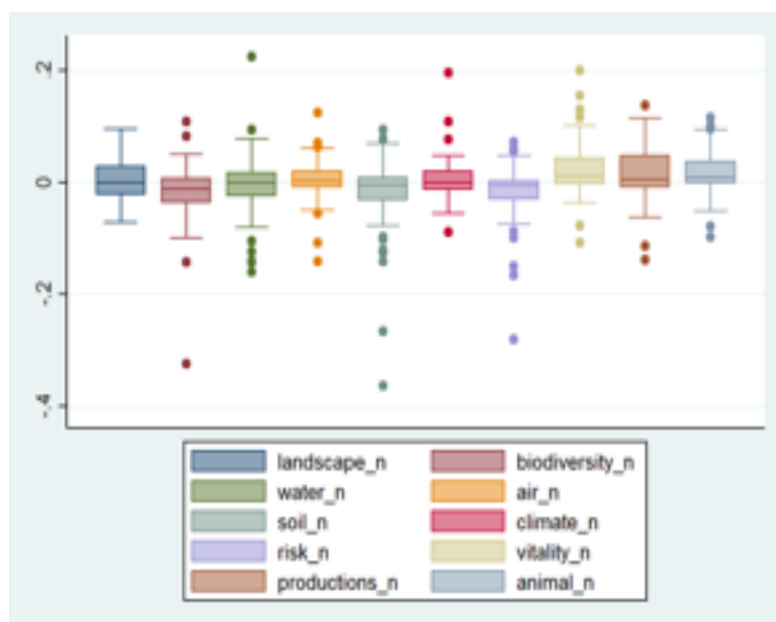
5. DISCUSSION

An understanding of the heterogeneity of rural areas in terms of local relevance of different PGBs is essential to thinking about public good provision from agriculture and forestry, future land use planning and stewardship of public lands. In this paper, the PGBs provided by agriculture and forestry that stakeholders scored the highest are considered to be a proxy of society demand for those PGBs (or, more realistically of the relevance of discrepancy between demand and supply of goods). The cluster analysis identified some typologies of rural areas within Europe.

Results are difficult to compare with others in the literature, as there are no really comparable studies available. The results seem consistent with Ahtiainen et al. (2015) that found a substantial distribution of relevance across different objectives of agriculture (though not explicitly identified as public goods type). Also, our results confirm the outcome of Ahtiainen et al. (2015) that resources-based public goods (e.g. water) tend to receive a higher weight. On the other hand, we confirm different relevance of public goods across regions, consistent with most of the studies addressing this issue and with well-known evidence about the variety of different local conditions in the EU (Bartolini et al., 2011).

The main limitations associated to the approach followed in this study are linked to the coverage of the sample: in spite of the good number of stakeholders interviewed compared to many stakeholder-based studies, the sample is still far from guaranteeing a totally satisfactory coverage of EU territories and different stakeholders background. In particular, biases are due to the partly unbalanced distribution of expertise among stakeholders of different countries (e.g. a majority of public officers compose the Italian group, while all the Spanish stakeholders are researchers). This does not allow a complete distinction between regional and expertise effect.

In addition, the intermediate (regional) scale does not allow to incorporate the heterogeneity of very local problems.

Other limitations concern the methodological choices, and especially the calculation of weights which followed a score-based approach. This is widely used in the area of multicriteria approaches and general survey. While according to the literature, there is not a preferential approach for the elicitation of weights, the one used here can be considered less robust in identifying the relative importance of different public goods, at least because of the likelihood of allineation around central values, compared with methods such as pairwise comparison. The use of this method was however not possible here due to the number of indicators.

Other limitations come from the fact of using of stakeholders. Studies pursuing similar objectives adopt indeed a very wide methodologies, ranging from the computation of spatial explicit indicators to the monetary valuation, that can indeed be seen as complementary to this study. While our choice is motivated by the attempt to use stekeholders to get insights on issues that are difficult to manage with alternative methods, we acknowledge that this approach can oversimplify or miss some points, e.g. the precise spatial distribution of phenomena or the precise monetary value of public goods. Indeed these would be very suitable to be analysed in follow-ups of this study.

6. CONCLUSIONS

Several conclusions can be drawn from this exercise based on a survey of stakeholders operating in the field of agriculture and forestry in different European countries and identification of typologies of views on regional relevance of public goods and bads. First, water-related issues are the most relevant environmental concerns in the context of agriculture and forestry; however on average of respondents and at regional scale, the relevance of the different public goods identified is rather homogeneously distributed. On the contrary, there is a relevant heterogeneity across areas and individuals views. This supports the identification of different typologies of rural areas in terms of relevance of different bundles of PGBs.

Specific issues linked to different types of PGBs can be handled through specific governance mechanisms; however the large majority of PGs tend to be associated to similar instruments, namely PES. The results show that positive and negative public goods are in the majority of cases linked to specific components of Socio-Ecological Capital (e.g. water), so that the perception of positive and negative public goods and services as (threshold-related) levels or direction of effect of such flow is a major qualifier of the PGBs detection.

However, it is likely that the real issue to promote the production of PGs it is not the instrument per se, but rather the detailed implementation solution in each context.

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