Classification of rural areas in Europe using social sustainability indicators

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Summary

Social sustainability is "one of the three legs of the sustainability stool" (the other two are environmental and economic. There is limited literature that focuses on social sustainability to the extent that a comprehensive study of this concept is still missing. As a result, there have been very few attempts to define social sustainability as an independent dimension of sustainable development. Social sustainability is related to social capital, social inclusion, social exclusion and social cohesion in rural economies, terms that are measured by relevant social sustainability indicators. This paper aims to measure these indicators and to compare them. In order to measure these indicators, a household survey carried out in the context of the research project CAP-IRE. This survey included eleven case study areas in nine case study areas of the European Union. From the results of this survey we measured a set of economic and social sustainability indicators. We have selected the main social sustainability indicators on which we based on to proceed to the ranking of the eleven European rural areas.

Keywords: ranking; rural areas; indicators; multicriteria analysis; social sustainability

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1. INTRODUCTION

Common Agricultural Policy (CAP) continues to play a major role in affecting agriculture and agricultural production, and the farming population. The overall economic contribution of farm-households in rural areas depends on the weight of agriculture in each area. In CAP reform, the focus on non-protected national markets and the enlargement of the European Union are creating a new reality for agriculture and rural areas in general. The policies of the European Union (EU) highlight the multi-functional role of the rural areas, which extends beyond the role of agriculture to also include other activities. Additionally, the issue of maintaining economically vital rural communities, particularly in disadvantaged regions where alternative income opportunities were limited, is a traditional argument connected to Common Agricultural Policy (CAP) (Manos, Bournaris and Chatzinikolaou, 2011).

A Communication about the CAP post 2013 (COM 672, 2010) suggests three main objectives for the future CAP. The third objective "Balanced territorial development" aims to support rural employment and maintaining the social fabric of rural areas, to improve the rural economy and promote diversification to enable local actors to unlock their potential and to optimize the use of additional local resources and finally to allow for structural diversity in the farming systems, improve the conditions for small farms and develop local markets.

In order to assess agricultural sustainability, many methodological approaches have been proposed (Caballero, Gil and Fernandez-Santos, 2008; Haughton et al., 2009); however the majority of studies analyzing sustainability indicators focuses on environmental sustainability and omits socio-economic aspects (Dantsis et al., 2010). The term 'sustainable development' is not clearly defined, and instead a multitude of definitions are available (COM, 2001). However, the commonality of most definitions is a reference to at least three dimensions of sustainability - ecological, economic, and social dimensions. (Sattler et al., 2010)

There is a major difficulty in formulating CAP policy is the diversity of farming in member states in terms of the structure, the size of farms and households and the social sustainability of population.

In the context of the research project entitled CAP-IRE (Assessing the multiple Impacts of the Common Agricultural Policy on Rural Economies), which is a European FP7 funded project; there was an attempt to assess the multiple impacts of the CAP in eleven European rural areas. Also the assessment of present trends on social sustainability and the social impacts of policy change of the CAP in rural areas were presented. More specifically, there was an attempt to group and rank the selected case study areas using a set of social sustainability indicators (SSI).

In order to measure these SSI, a household survey carried out, in order to collect empirical information about present and future trends of changes in farms and the effects of the CAP and its reform on such

changes. The survey provided the data for the statistical/econometric analysis, in order to study social sustainability in rural areas. The survey included a questionnaire submitted to a large sample of farm households and requested information related to both farm and non-farm activities.

In this paper (a) we briefly outline the core concept of the CAP-IRE approach for the assess of the social impacts, and (b) for the remainder of the paper focus on the application of Multicriteria Analysis PROMETHEE II, in order to classify the case study areas according to the 24 proposed SSI. Social sustainability classification is a proposed method to help decision makers to interpret local perceptions to establish priorities or simply compare a mixture of different information which otherwise would be more difficult to interpret.

The structure of the paper is as follows: Section 2 describes briefly the methodology that has been applied, in Section 3, the case studies and the data are presented. In Section 4, the PROMETHEE method was applied for the ranking of the 11 case studies and the results are presented and, finally in Section 5, we discuss the differences between the case studies, according to the selected SSI. The final section summarizes the paper and suggests potential future directions in the implementation of social policy measures.

2. METHODOLOGY

This paper deals with a comparison of social impacts in rural areas, and multiple criteria have to been considered in this process. Several Multicriteria methods are available in the literature, but out ranking method is suitable for this concept, since the concept should be based on the pair wise comparison of the study areas. In the present study, PROMETHEE II, an outranking method is used as a MCDM method for the ranking of the study areas. Since the mathematical model in PROMETHEE is relatively easy for the decision makers to understand and, it can easily find out the preferences among multiple decisions, PROMETHEE methods occupies an significant place among the outranking methods. (Vinodh and Girubha, 2012).

The PROMETHEE I (partial ranking) and PROMETHEE II (complete ranking) were developed by J.P. Brans and presented for the first time in 1982 at a conference organized by R. Nadeau and M. Landry at the Université Laval, Québec, Canada (L'Ingéniérie de la Décision. Elaboration d'instruments d'Aide à la Décision). The same year several applications using this methodology were already treated by G. Davignon in the field of Heath care. A few years later J.P. Brans and B. Mareschal developed PROMETHEE III (ranking based on intervals) and PROMETHEE IV (continuous case) (Brans and Mareschal, 1991). In 1992 and 1994, J.P. Brans and B. Mareschal further suggested two nice extensions: PROMETHEE V (MCDA including segmentation constraints) and PROMETHEE VI (representation of the human brain).

A considerable number of successful applications has been treated by the PROMETHEE methodology in various fields such as Banking, Industrial Location, Manpower planning, Water resources, Investments, Medicine, Chemistry, Health care, Tourism and Dynamic management. More specifically, Albadvi, (2004) applied PROMETHEE II, in order to formulate national information technology strategies; Albadvi et al. (2007) applied this method for decision making in stock trading. Andreopoulou et al. (2008, 2009) applied Promethee for the assessment and optimization of e-commerce websites. Moreover, Siskos and Grigoroudis (2002) used Promethee II in order to evaluate the criteria of the venture capital investment activity.

In the context of Agriculture, several publications have used multicriteria analysis PROMETHEE (Behzadian et al., 2010). Wolfslehner et. al, (2011) based on a PROMETHEE II algorithm, calculated relative sustainability impact rating. Koutroumanidis, Papathanasiou and Manos (2002) apllied Promethee II

in order to perform comparison of productivity and ranking of agricultural regions of Greece. Morever, Madlenera et. al, (2007) used PROMETHEE method to compare and rank different energy scenarios according to 16 economic, social, environmental, and technological criteria. Brans, Vinke and Mareschal, (1986) considered the following multicriteria problem:

$$Max\{f_1(a), \dots f_k(a), \backslash\, a \in K\} \qquad (1)$$

where K is a finite set of actions and $f_i, i = 1, \dots k$, are k criteria to be maximized.

The PROMETHEE methods include two phases (Roy, 1968) (Roy, 1996):

- the construction of an outranking relation on k,
- the exploitation of this relation in order to give an answer to (1).

In the first phase, a valued outranking relation based on a generalization of the notion of criterion is considered: a preference index is defined and a valued outranking graph, representing the preferences of the decision maker, is obtained (Roy, 1991). The exploitation of the outranking relation is realized by considering for each action a positive and a negative flow in the valued outranking graph: a partial preorder (PROMETHEE I) or a complete preorder (PROMETHEE II) on the set of possible actions can be proposed to the decision maker in order to achieve the decision problem. Only a few parameters are to be fixed in these methods and the most of them have an economic signification so that the decision maker is able to determine their values easily. Furthermore, some small deviations in the determination of these values do not often induce important modifications of the obtained rankings.

The preference structure of PROMETHEE is based on pair wise comparisons. In this case the deviation between the evaluations of two alternatives on a particular criterion is considered. The preference index for each pair of alternatives $a, b \in K$, ranges between 0 and 1. The higher it is (closer to 1) the higher the strength of the preference for a over b is. The function P represents the intensity of preference of action a with regard to action b and such that:

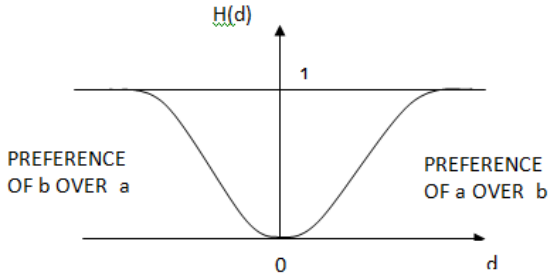
- $P(a,b) = 0$ means an indifference between a and b, or no preference of a over b;
- $P(a,b) \sim 0$ means weak preference of a over b;
- $P(a,b) \sim 1$ means strong preference of a a over b;
- $P(a,b) = 1$ means strict preference of a over b.

For each criterion f we consider a generalized criterion defined by f and a corresponding preference function P.

$H(d)$ is an increasing function of the difference d between the performances of alternatives a and b on each criterion. $H(d)$ is a type of preference intensity (Vincke, 1992). This function is represented by figure 1.

$$H(d) = \begin{cases} P(a,b), & d \geq 0, \\ P(b,a), & d \leq 0. \end{cases} \qquad (2)$$

Figure 1: The Function H(d).



The $H(d)$ function can be of various different forms, depending upon the judgment policy of the decision maker (Kalogeras et al., 2005). Generally, six forms of the $H(d)$ function are commonly used. (Brans et al., 1998) suppose that the decision maker has specified a preference function P, and weight π_i for each criterion $f, (i = 1 \ldots . k)$ of problem (1). The weight π_i is a measure of the relative importance of criterion f_i if all the criteria have the same importance for the decision maker, all weights can be taken equal.

The multicriteria preference index Π is then defined as the weighted average of the preference functions P_i:

$$\Pi(a,b) = \frac{\sum_{i=1}^{k} \pi_i P_i(a,b)}{\sum_{i=1}^{k} \pi_i} \qquad (3)$$

$\Pi(a,b)$ represents the intensity of preference of the decision maker of action a over action b, when considering simultaneously all the criteria. It is a figure between 0 and 1 and:

- $\Pi(a,b) = 0$ denotes a weak preference of a over b for all the criteria,
- $\Pi(a,b) = 1$ denotes a strong preference of a over b for all the criteria.

This preference index determines a valued outranking relation on the set K of actions. This relation can be represented as a valued outranking graph, the nodes of which are the actions of K. When each alternative is facing other alternatives in K, the following outranking flows are defined:

The positive outranking flow: $\varphi^+(a) = \sum_{b \in k} \Pi(a,b)$ (4)

The positive outranking flow expresses how an alternative is outranking all the others. It is its power, its outranking character. The higher the $\varphi^+(a)$, the better the alternative.

The negative outranking flow: $\varphi^-(a) = \sum_{b \in k} \Pi(b,a)$ (5)

The negative outranking flow expresses how an alternative is outranked by all the others. It is its weakness, its outranked character. The lower the $\varphi^-(a)$, the better the alternative.

The net outranking flow can is the balance between the positive and the negative outranking flows. The higher the net flow, the better the alternative: $\varphi(a) = \varphi^+(a) - \varphi^-(a)$ (6)

3. AREA OF STUDY AND DATA

A household survey carried out, in the context of CAP-IRE project, in order to collect empirical information about present and future trends of changes in farms and the effects of the CAP and its reform on

such changes. The survey provided the data for the statistical/econometric analysis, in order to study social sustainability in rural areas. The data for this paper came from the results of this survey for the 11 case study areas (table 4, Appendix). The survey included a questionnaire submitted to a large sample of farm households and requested information related to both farm and non-farm activities. Eurostat uses many indicators in order to describe social sustainability by measuring social phenomena such as demographic changes, employment, social cohesion, social inclusion and social capital. Social sustainability is related to social capital, social inclusion, social exclusion and social cohesion in rural economies, terms that are measured by relevant SSI (Slee, 2007). In order to select a set of representative indicators, an extended literature review was completed (OECD, 2001). Social sustainability focuses on the personal assets like education, skills, experience, consumption, income and employment and comprises every citizen's right to actively participate in the society as an essential element. For this reason and in the framework of CAP-IRE project, we have measured 24 SSI regarding farm structure, education, skills, employment, and income. The social indicators list was built taking into account two main and different factors: (i) the specificity of rurality; (ii) the availability of data. The proposed SSI are those that can give sufficient estimations of the social dimension in rural areas. These indicators have been examined in practice, reflecting the balance between the ideal and the constraints of data availability. The eleven European Union rural areas are presented in table 1. The selected SSI are presented in table 2.

Table 1. Case Study Areas.

	Case Study Area	Country
X1	Emilia-Romagna (IT)	Italy
X2	Noord-Holland (NL)	Netherlands
X3	Macedonia-Thrace (GR)	Greece
X4	Podlaskie (PL)	Poland
X5	North East Scotland (UK)	United Kingdom
X6	Andalusia (ES)	Spain
X7	South-East Planning Region (BG)	Bulgaria
X8	Centre (FR1)	France
X9	Midi-Pyrenees (FR2)	France
X10	Lahn-Dill-District (DE1)	Germany
X11	Ostprignitz-Ruppin (DE2)	Germany

Source: own elaboration

Table 2. Proposed Social Sustainability Indicators.

	Social Sustainability Indicators
K1	Members of household working on the agricultural holding full time
K2	Members of household working on the agricultural holding part time
K3	Off-farm activities
K4	Lifelong learning (Education Level of the respondent)
K5	Lifelong learning (Formal Agricultural Education)
K6	Percentage of total household revenue from farming
K7	Members of a sports club, recreation or other social organization
K8	Members of the farmers union or other farming pressure group
K9	Members of a nature conservation organization or environmental organization
K10	Using Internet for buy production means
K11	Using Internet for sell products
K12	Household members younger than 18
K13	Early school leavers
K14	Household members older than 65
K15	Male members of household
K16	Female members of household
K17	Household members 18-65
K18	Full time male employees
K19	Part time male employees
K20	Full time female employees

K21	Part time female employees
K22	Employees who are citizens from other EU countries
K23	Employees who are citizens from non EU countries
K24	Long term Unemployment

Source: own elaboration

4. RESULTS

The multi-criteria method PROMETHE II was applied as a part of the theory of relevance superiority. The shape of the $H(d)$function selected is the Gaussian form (Gaussian criterion) defined as follows:

$$H(d) = 1 - exp\{-d^2/2\sigma^2\} \qquad (7)$$

where d is the difference among the case study areas a and b $[d = f(a) = f(b)]$ and σ is the standard deviation of all differences d and for each criterion.

The multicriteria indicator of preference $\Pi(a, b)$ which is a weighted mean, of the preference functions $P(a, b)$ with weights π_i for each criterion, express the superiority of the case study a against case study b after all the criteria tested.

We received 50 scenarios of weights and on each scenario of weights we receive 10 scenarios on the standard deviation of σ distribution of Gauss. The 10 scenarios σ oscillate from 0.25s until 2.5s with step 0.25s, where s the standard deviation of all differences d for the each criterion. Globally we take 500 prices for each net flow per case study and find the medium price (Koutroumanidis et al., 2002).The ranking of the eleven case studies as obtained from the net flows, is presented in table 3.

The study area ranked in first place is Noord-Holland (NL). According to the results of the analysis we observe that Ostprignitz-Ruppin (DE2) and Centre (FR1) have also high positive net flows and possess the second and third place, respectively. Positive net flows have also South-East Planning Region (BG) North East Scotland (UK)and Macedonia-Thrace (GR), and this is due to the fact that, study areas have similar characteristics. The next positions in the ranking belong to Midi-Pyrenees (FR2) and Lahn-Dill-District (DE1) with small negative net flows around 0. At the lowest positions we find the group of Andalusia (ES), Podlaskie (PL) and Emilia-Romagna (IT) with negative net flows.

Table 3. Ranking of the 11 Case Study Areas.

Ranking	Case Study Area	Net Flow (Φ)
1	Noord-Holland (NL)	0,96528
2	Ostprignitz-Ruppin (DE2)	0,84749
3	Centre (FR1)	0,70558
4	South-East Planning Region (BG)	0,63231
5	North East Scotland (UK)	0,10686
6	Macedonia-Thrace (GR)	0,07548
7	Midi-Pyrenees (FR2)	-0,02035
8	Lahn-Dill-District (DE1)	-0,05086
9	Andalusia (ES)	-0,42782
10	Podlaskie (PL)	-1,27386
11	Emilia-Romagna (IT)	-1,56012

Source: own elaboration

5. DISCUSSION

Most of the rural development policies still keep a marked influence in rural areas. This paper taking into account the issues raised by the Communication 272/2010: the CAP towards 2020, in which one of the main recommended strategic aims is: to maintain viable rural communities, for whom farming is an important economic activity; this delivers multiple economic, social, environmental and territorial benefits. Within CAP-IRE project, the focus was on the effects of CAP policy on social sustainability, by measuring SSI such as demographic changes, employment, social cohesion, social inclusion and social capital. The main idea was to collect information about future trends and the effects of the CAP through stated/intended behaviour, following some examples available in the literature. The focus was also on the future of rural households and farms, and how this would be affected my major changes in the Common Agricultural Policy. The Survey that carried out in the context of the project provided the data for the statistical/econometric analysis, in order to study social sustainability in rural areas. More specifically this paper used the data from this survey A to study the effects of household behavior by measuring the proposed SSI, demographic changes, employment, social cohesion, social inclusion and social capital. Multicriteria Method PROMETHEE II was applied for the comparison and ranking of the eleven case study areas based on the selected SSI. This ranking permits to point out some specific problems that characterize rural areas and determine specific problems for the rural population. This set of problems includes several difficulties linked to demography, remoteness, education, and to some special features of the labour market.

As can be seen from the results of the PROMETHEE II we observe that Noord-Holland (NL) is first in the ranking of the case study areas concerning the proposed SSI. Ostprignitz-Ruppin (DE2) and Centre (FR1) possess respectively the second and third place, and South-East Planning Region (BG) possesses the fourth place. These case study areas possess the first places in the ranking because they have the higher rates in the most indicators. More specifically, Noord-Holland (NL) has the highest rate in off farm activities, participation to nature conservation organizations or other environmental organizations, using internet for buying production means and household members younger than 18. Ostprignitz-Ruppin (DE2) has the highest rate in education level of the respondent and in full time female employees. Centre (FR1) has the highest rate in formal agricultural education, in using internet for selling products and the lowest rate in household members older than 65. Furthermore, South-East Planning Region (BG) has the highest rate in full time male employees and the second higher rate in full time female employees. Moreover, North East Scotland (UK) possesses the fifth place in the ranking, and has high rates in the most of the indicators and the lowest rate in early school leavers, which is an indicator with negative impact. It is lower in the ranking because of the low rate in using internet for buying production means or for selling products.

Macedonia and Thrace (GR) has the highest rate in members of the household working in the agricultural holding. Also, has the highest rate in percentage of the total household revenue that comes from farming and in part time male employees. The sixth place in the ranking is due to the highest rate in early school leavers and the lowest rate in education level of the respondent. Macedonia and Thrace has also low rates in participation to any social networks and in using internet. Podlaskie (PL) possesses the tenth place in the ranking, while it has the lowest rate by far in participation to farmers union or other farming pressure group, in participation to sports club, or other social organizations, or to environmental organizations, in using internet for buying production means in male employees working full time and in part time male or female employees. Podlaskie (PL) has also the second higher rate in household members older than 65 and the third lower rate in off-farm activities.

Midi-Pyrenees (FR2) and Lahn-Dill-District (DE1) present negative net flows and possess the seventh and eighth place respectively.

Finally, Andalusia (ES) and Emilia-Romagna (IT) possess lower places on the ranking. Andalusia (ES) possesses the ninth place in the ranking, and it has the lowest rate by far in off-farm activities, and the highest rate by far in long term unemployment rate. Moreover, Emilia-Romagna (IT) possesses the eleventh place in the ranking, because it has low rates in most of the selected SSI. It has the lowest rate in many indicators, such as formal agricultural education, percentage of the total household revenue that comes from farming, using internet for selling products, household members younger than 18 and household members older than 65. Moreover, Emilia-Romagna (IT) has the second lower rate in some indicators (off- farm activities, education level of the respondent and using internet for buying production means) and the second higher rate in early school leavers.

To conclude, the results show that in rural areas the relevance of agriculture is still significant in terms of employment and labour opportunities. On the contrary, many of rural areas have become increasingly driven by factors outside agriculture due to diversification of the socio-economic structure (European Commission, 2008), (Chandrasekera and Wijayaratna 2002), (European Commission, 2003). Moreover, for many rural areas agriculture will be certain factor in labor market dynamics and will be able to play an important role regarding the themes of social sustainability. The methodology applied in this study may have shortcomings in measuring all the dimensions of social sustainability but it could be a tool for policy makers in policy design. According to Mattas et. al (2008), despite remarkable differences among rural areas, it has been shown that the effective implementation of social policy measures becomes important for regions characterized by rural diversities (OECD, 2011), (Vasilescu, 2008), (Meijerink and Roza, 2007). The contribution of this study helps the policy makers to define these diversities in order to apply their policies. These policies should be distinguished relative to different circumstances and specifically they should be more flexible taking into account the social particularities affecting the specific contexts they are applied.

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8. APPENDIX

Table 4. Multicriteria table (rates)

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21	K22	K23	K24
X1	80,7	39,7	9,0	36,4	22,7	40,8	89,7	19,0	5,3	4,0	0,7	12,1	-63,3	-29,7	53,4	46,6	58,2	9,4	11,5	3,7	7,5	4,3	4,7	3,4
X2	88,7	66,0	45,3	75,0	74,3	74,9	78,7	50,0	31,7	38,7	12,0	44,0	-22,3	-6,2	53,8	46,2	49,8	17,7	25,0	2,7	12,7	7,3	0,7	0,1
X3	100	57,7	12,0	21,7	47,3	94,7	53,3	22,7	1,7	8,0	3,3	16,8	-78,0	-5,3	50,5	49,5	77,9	32,0	57,3	3,0	4,7	12,7	63,7	4,3
X4	95,6	47,8	10,0	85,1	93,2	86,4	7,6	0,8	0,0	2,4	0,8	26,7	-14,9	-23,6	51,1	48,9	49,7	6,4	2,4	2,4	0,8	0,0	0,0	0,1
X5	86,9	47,6	36,9	92,2	43,5	73,7	52,4	45,8	12,5	17,3	4,2	16,6	-1,2	-14,6	56,0	44,0	68,8	25,7	17,5	1,8	1,8	2,4	1,2	0,4
X6	51,7	60,7	3,0	44,3	23,9	48,4	55,7	13,9	2,0	4,5	2,0	28,4	-55,2	-10,8	51,1	48,9	60,8	13,4	66,5	1,0	47,5	15,9	4,0	9,0
X7	89,4	39,2	13,7	92,3	45,4	74,5	23,4	1,5	1,5	25,3	19,8	16,8	-7,7	-9,7	51,4	48,6	73,5	52,4	29,5	22,8	7,2	0,0	0,0	3,9
X8	95,7	18,6	24,3	78,6	97,1	70,3	72,1	63,6	7,1	20,0	24,3	24,4	-21,4	-1,0	56,4	43,6	74,6	18,2	11,7	4,4	3,6	0,0	0,0	0,3
X9	93,5	25,8	21,9	60,6	90,3	71,5	69,0	69,0	10,3	15,5	10,3	24,2	-39,4	-8,1	55,8	44,2	67,7	10,3	23,2	1,9	10,3	0,6	1,9	0,8
X10	21,4	85,5	10,7	70,7	25,6	11,2	76,1	76,1	21,4	28,2	2,6	19,4	-27,6	-10,9	53,4	46,6	69,7	8,2	19,8	3,2	8,4	3,4	0,0	0,0
X11	66,3	40,0	35,7	95,1	84,4	46,5	48,1	48,1	10,6	29,4	15,6	17,4	-3,1	-12,3	50,1	49,9	70,3	34,6	17,6	23,3	16,4	5,0	1,3	3,0