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An indicator of well-being for Italian agriculture

Mafalda Monda[1], Giuliano Gabrieli[2], Matteo Mazziotta[3]

[1] *DG Joint Research Centre, European Commission - Bruxelles*
[2] *CREA - Research Centre for Agricultural Policies and Bioeconomy - Italy*
[3] *ISTAT - Italy*

Abstract. The paper presents a composite indicator of well-being for Italian agriculture.Well-being is defined as the health condition of the agricultural sector from the point of view of farmers. The indicator is based on four dimensions: social, environmental, institutional and economic, allowing comparability of well-being at regional level. The novelty of the approach consists in presenting a well-being indicator at sectorial level, by applying a new method of aggregation, the Adjusted Mazziotta-Pareto index (2016). It is a non-compensatory approach for summarizing a set of individual indicators which accounts for unbalanced distribution among the indicators. Results show that central and northern regions are in the top ten for the regional agricultural well-being in years 2013 and 2016.

Keywords: well-being, farmers, agriculture, sustainability, composite index.
JEL codes: Q01, R11, Q18.

1. INTRODUCTION

The role of statistical indicators as tools that allow the evaluation and orientation of public policies has changed over time, thanks to data availability and the development of new methods enabling synthesizing complex and multidimensional phenomena. The constructing of composite indicators comes under the discussion, carried out in the international arena, that the country development cannot be measured by considering only economic aspects.

Indeed, the gross domestic product (GDP) is not a suitable indicator for complex concepts such as well-being and sustainability. For this reason, in the last years, composite indicators have been constructed to evaluate country's well-being, in broader terms, taking into consideration social and environmental aspects (e.g.: the Waterloo University's Canadian Index of Well-being, the Measures of Australia's Progress, the Buthan Gross National Happiness Index, the Economist Intelligence Unit's Quality of life).

In 1990, the UN's human development index was built by considering three individual indicators such as the per capita income, the life expectancy and the level of education. The human development index has included other

aspects such as the environmental sustainability which is considered of fundamental importance in order to measure country life conditions.

The objective of this paper is to build a composite indicator of well-being for Italian agriculture. The indicator wants to describe the health condition of the agricultural sector from the point of view of farmersat regional level. It is constructed on 4 dimensions (social, environmental, institutional and economic), taking into account subjective aspects of well-being (e.g.: perception of environmental conditions) as well as dimensions not overlooked before (e.g. institutional aspects). The indicator allows us to measure the well-being of an economic sector in a new perspective that is complementary to that one derived from the human well-being indicator at country level.

2. AN OVERVIEW OF THE ECONOMIC LITERATURE ON COMPOSITE INDICATORS OF WELL-BEING AND SUSTAINABILITY

In June 2007 the European commission, the OECD, the organization of Islamic conference, the United Nations for development (UNDP) and the World Bank adopted the Istanbul declaration that stated the need to measure social development in every country of the world, going beyond the conventional measures such as the gross domestic product per capita (GDP).

In line with this, the Stiglitz-Sen-Fitoussi Commission proposed to shift the focus from the measurement of economic production to people's well-being by considering aspects linked to environmental, economic and social sustainability.

In 2010, following the inclusion of the Stiglitz-Sen-Fitoussi Commission's recommendations in the memorandum of Sofia, the measurement of well-being entered the official statistics.

2.1. Indicators of "Sustainability"

A number of sustainability indicators have been developed in the last years, on the basis of the United Nations Brundtland Commission's definition of sustainability. It states: "meeting the needs of the present without compromising the ability of future generations to meet their own needs." (WCED, 1987).

However, the definition of sustainability varies considerably when applied to the agricultural sector (Binder *et al.*, 2010). This is due to the existence of alternative agriculture such as organic, regenerative and ecological (Lockeretz, 1988) and to the variability of agricultural aspects in different regional and country contexts (Zhen, Routray, 2003).

Agricultural production impacts on the environment and the quality of life in rural areas with social and economic implications. For this, most definitions of agricultural sustainability take into consideration three pillars of sustainability and according with them group sustainability indicators in three dimensions: social, economic and environmental (Lebacq *et al.*, 2013).

Specifically, economic indicators of sustainability focus on yields, input expenditures, income derived by on-farm and off-farm activities and land ownership (Becker, 1997; Herzog, Gotsch, 1998; Karami, 1995; Nambiar *et al.*, 2001; Rasul, Tapa, 2004; Nijkamp, Vreeker, 2000; Van Cauwenbergh *et al.*, 2007). Furthermore, economic sustainability indicators also examine changes in yields and total factor productivity (Lynam, Herdt, 1989). Other sustainability indicators consider salaries paid to farm workers and employment opportunities (Herzog, Gotsch, 1998; Rasul, Tapa, 2004) as part of the economic dimension.

Environmental indicators of sustainability are linked with physical and chemical input use (pesticides, herbicides, fungicides), efficiency in the use of inputs, soil erosion and energy use (Hayati, 1995; Ingels *et al.,* 1997; Nambiar *et al.,* 2001; Comer *et al.,* 1999; Van Cauwenbergh *et al.,* 2007). In this context, the sustainable management of land and water resources is one of the major requirement for a sustainable agriculture (Hayati *et al.*, 2010).

Sustainability indicators also include the social dimension by considering aspects such as: the education level of the household members (Herzog, Gotsch, 1998; Van Cauwenbergh *et al.,* 2007), the nutritional status of the farmers' family members (Herzog, Gotsch, 1998; Rasul, Tapa, 2004; Van Cauwenbergh *et al.,* 2007) and social equity (Becker, 1997; Rigby *et al.,* 2001; Rasul, Tapa, 2004).

While the majority of existing research considers the sustainability indicators separately, few studies have proposed to synthetize them in one composite indicator (Valko, 2016) thus facilitating country and region comparability.

2.2. Composite indicators of "well-being"

There are various approaches to the measurement of well-being which are based on various methods to combine individual indicators. Several authors have explored challenges in constructing an indicator of well-being identifying, among the major difficulties, the reliability and availability of data; the methodology to be applied

which can vary depending on the objectives and data; the selection of relevant indicators which may cover subjective and objective aspects of well-being. Among them we can find the index of sustainable economic welfare (ISEW), the Genuine Savings (Hamilton, 1994 and 1996) and the measure of economic welfare (MEW).

The ISEW, introduced by Daly and Cobb (1989), has been conceived as a substitute measure for the GDP integrating the traditional measures of macroeconomic performance with social and environmental aspects, taking into account inequalities in the income distribution.

In 1995, the ISEW was reviewed and renamed the Genuine progress indicator (GPI) (Talberth *et al.*, 2007) with the objective to measure the country's progress taking into account environmental degradation, pollution, depletion of resources and other costs. However, the difficulties to quantify these costs and the subjectivity of selecting the indicators that form the basis of the index are among the main limits of both ISEW and GPI.

The measure of economic welfare (MEW), proposed by Nordhaus and Tobin (1972) wants to measure welfare by calculating the consumptions of goods and services while subtracting some costs such as pollution.

The criticism raised around the capacity of these indicators to reflect economic welfare and sustainability (Giannetti *et al.*, 2015) led to the application of non-monetary approaches to measure country progress. Some examples are: the physical quality life index (PQLI), the Gross national Happiness (GNH) and the Happy Planet Index (HPI).

The PQLI is based on the assumption that nations could have a poor life quality despite high income per capita. For this, it considers measures such as infant mortality, life expectancy and basic literacy, excluding income or other measures of economic well-being.

In line with it, the GNH, firstly suggested by the king of Buthan in 1980, measures the general people well-being or happiness on the basis of indicators belonging to four pillars: the conservation of natural environment, the promotion of cultural values and sustainable development and proper governance. In particular, used indicators are: time use, living standards, good governance, community vitality, health, education.

Finally, in 2006 the New Economic Foundation launched the HPI based on three dimensions: life expectancy at birth, life satisfaction and ecological footprint.

In Italy, the Indicator of equitable and sustainable well-being (BES) was introduced in 2010, with the ambitious objective of measuring the human well-being by considering important aspects related to people's lives, together with the equity in the distribution of well-being among people and the sustainability among generations (Bacchini, Baldazzi, Morrone, Savioli, Sorvillo, Tinto, 2016).

Indicators of equitable and sustainable well-being currently cover 12 dimensions, taking into consideration subjective and objective aspects. Subjective indicators allow the capture of perceptions of individuals. Objective indicators synthesize aspects related to the representativeness of political Institutions, territorial conditions and human health.

3. ISSUES IN BUILDING COMPOSITE INDICATORS

There are some issues in composite indicators to be taken into account for their construction. Firstly, composite indicators allow the aggregation of a large amount of information. This could make them incapable to reflect complexities of phenomena they want to measure.

Furthermore, composite indicators may suffer from methodological difficulties due to the number of decisions to be taken for their construction (Freudenberg 2003). Each step needed for building composite indicatorshas a number of issues, the most controversial of which concern the selection of indicators and their aggregation.

Regarding the indicators' selection, there is no a universally agreed set of indicators for any given phenomenon. Variables to incorporate in composite indicators are, generally, subjective. Furthermore, indicators should be carefully chosen on the basis of their soundness, measurability, and relevance to the phenomenon being measured (Saltelli, 2007). However, relevant data maybe not available or not comparable across domains, countries or areas.

Regarding the aggregation of indicators, it is possible to distinguish two approaches: compensatory and non-compensatory. The compensatory approach considers individual indicators as substitutable thus a deficit in one dimension can be compensated by a surplus in another one.

This approach involves the use of linear functions such as the arithmetic mean. The non-compensatory approach is based on the assumption of non-substitutability of indicators that implies all the dimensions of the phenomenon must be balanced. In this case, unbalance-adjusted functions are generally applied to take into accountunbalances in terms of penalization.

4. THE THEORETICAL FRAMEWORK

The objective of this paper is to develop a composite indicator of well-being for the agricultural sector in Ita-

ly. The following paragraphs clarify the concept of agricultural well-being adopted for the construction of this indicator, the indicators selected for this purpose and, finally, the method applied for their aggregation.

4.1. The definition of agricultural well-being

The definition of agricultural well-being adopted in this work is based on the explored literature on composite indicators of well-being and sustainability. It refers to the health condition of the Italian agricultural sector measured as its capacity to survive crisis by diversifying farm income, intensifying trade, producing good quality products, using good quality inputs (water resources, soil etc.), regularly employing young people and well educated farmers. Furthermore, well-being in agriculture increases thanks to the availability of infrastructural services, enabling developing economic activities, the research that supports the agricultural activity's progress and the efficiency of public services which has positive effects on farm competitiveness.

4.2. The selection of indicators

In order to put into practice the above mentioned definition of agricultural well-being, objective aspects (economy, environmental conditions…) as well as subjective aspects of well-being (e.g.: positive judgement of future perspectives) have been taken into account. This led to a selection of 48 indicators[1] covering the following four dimensions: economic, social, environmental and institutional.

The economic dimension of well-being takes into account farm performances (e.g. value added) and factor productivity (e.g. capital productivity…) as well as other elements related to the farming activities, for example, the number of farms with quality products (e.g. DOP.). Factors linked to the regional context have been also taken into account in this dimension such as: the regional openness to international trade and the firm birth rate.

The environmental dimension includes indicators that focus on physical conditions of the environment (e.g.: regional areas under organic farming, extension of protected natural areas…), as well as the intensity of phytosanitary products' and fertilizers' uses. Subjective aspects are included in this dimension for example: citizens' concerns about landscape deterioration and biodiversity loss, and the level of satisfaction for the environmental conditions.

The social dimension of agricultural well-being is composed of indicators that are able to capture elements of the social structure where farmers operate such as: the rate of irregular employment in agriculture, the percentage of women agricultural workers, the number of farmers aged less than 44 and those who operate in disadvantaged rural areas. Subjective elements have also been considered such as: the level of generalized trust in people and the level of people's involvement in social activities (meetings with cultural and ecological associations…).

Finally, the institutional dimension is based on indicators taking into account the level of public support to farmers, the farmers' access to credit, as well as the amount of public expenditures in infrastructural services, agricultural research and technical assistance. Elements concerning the regional context are also included in this dimension such as: the level of accessibility to regional services and irregularities in electric power distribution. Individual indicators also capture subjective factors for example: the level of trust in Institutions and the political and civic participation.

The choice of indicators included in the composite index was limited by the data available in years 2013 and 2016 at regional level. Indeed, data used mainly derived from the database of the Italian National Institute of Statistics (ISTAT). It provides information on the Italian agricultural sector coming from official data (e.g.: national account data) and specific surveys (e.g. labor force survey; survey on aspects of daily life). Other data sources were also used (e.g.: farm accounting data network…).

4.3. The method

The method applied for building the composite indicator of well-being for the Italian agriculture is the Adjusted Mazziotta-Pareto (AMPI)[2]. It is a non-compensatory approach that is an extension of the Mazziotta-Pareto Index (MPI+/-).

The Mazziotta-Pareto Index (MPI) is based on a standardization of the individual indicators, at the reference time, that makes the indicators independent of the variability[3] allowing only relative comparisons over

[1] See Appendix.

[2] We used the software COMIC for the calculation of the composite indicator of agricultural well-being. COMIC was developed by the working group on the composite indicator of equitable and sustainable well-being within the Italian Institute of statistics. Its application requires the basic version of SAS System (ver. 9.1). The software allows the construction, analysis and validation of composite indicators.

[3] The normalized indicators have a mean of 100 and a standard deviation of 10.

time. The Adjusted Mazziotta-Pareto (AMPI) performs absolute comparison over time by re-scaling individual indicators in the range (70; 130) according to two goal posts, i.e., a minimum and a maximum value which represent the possible range of each indicator for all time periods and for all units (Mazziotta, 2016).

Given the matrix $X=\{x_{ij}\}$ with n rows (units) and m columns (indicators), we calculate the matrix R of normalized scores r_{ij} as follow:

$$r_{ij} = \begin{cases} \frac{(x_{ij} - \text{Min}_{x_j})}{\text{Max}_{x_j} - \text{Min}_{x_j}} * 60 + 70 \text{ , if the indicator's polarity is positive;} \\ \frac{\left(\text{Max}_{x_j} - x_{ij}\right)}{\text{Max}_{x_j} - \text{Min}_{x_j}} * 60 + 70, \text{if the indicator's polarity is negative;} \end{cases}$$

where x_{ij} is the value of the indicator j for the unit i and Min_{x_j} and Max_{x_j} are the "goalposts" for the indicator j. Denoting with Inf_{x_j} and Sup_{x_j} the overall minimum and maximum of the indicator j across all units and all years and with Ref_{x_j} the reference value for the indicator j, the "goalposts" are defined as:

$$\begin{cases} \text{Min}_{x_j} = \text{Ref}_{x_j} - \Delta \\ \text{Max}_{x_j} = \text{Ref}_{x_j} - \Delta \end{cases}$$

where: $\Delta=(\text{Sup}_{x_j}-\text{Inf}_{x_j})/2$

Values will fall approximately in the range (70; 130) while 100 represents the reference value (the Italian average in a given year). Denoting with , and respectively, the mean, the standard deviation and the coefficient of variation for the normalized values for the unit i, the generalized form of the Adjusted MPI is given by:

$$\text{AMPI}_i^{+/-} = \text{M}_{r_i} \pm (\text{S}_{r_i} * \text{cv}_i)$$

Where:

$$\text{cv}_i = \frac{\text{S}_{r_i}}{\text{M}_{r_i}}$$

The sign of the indicator depends on the nature of the phenomenon. The negative sign is applied if the composite indicator is positively related to the construct of well-being while the positive sign is used when the indicator is negatively related to the well-being (Mazziotta, Pareto, 2016).

The composite indicator is the arithmetic average to which a penalty is applied with the objective to penalize statistical units that show unbalanced distribution of values in each dimension and over time. Two components explain together the indicator's results: the first one captures the average effect (additive component); the second one is the penalty effect (due to unbalance). The penalty coefficient takes into account the horizontal variability of each indicator *j* per unit *i* by applying a penalty to units that show more unbalanced values than others.

4.4. Limitations of the method

A composite indicator is a measure, generally expressed in quantitative form and composed of several variables, capable of summarizing the trend of the phenomenon to which it refers. The composite indicator is not the phenomenon, but it represents and summarizes the behavior of the more complex phenomenon that we must monitor and evaluate. An example that gives the idea: the individual indicator is the finger reaching towards the sky … but the phenomenon is the star! (Terzi *et al.*, 2021). In general, when you decide to reduce the dimensions in space, you have few certainties: an approximation error is being made and the perfect composite index does not exist (Mazziotta, Pareto, 2020).

However, in the literature composite indices are widely used as they help to better read the complex reality and therefore to make relevant decisions for citizens. As mentioned, every composite indicator has strengths and weaknesses: the role of the researcher is to adapt the methodology to the phenomenon being measured.

The growing diffusion of AMPI method demonstrates that the methodology is robust and adaptable to many scientific contexts. As mentioned, AMPI is particularly recommended when the individual indicators are not substitutable and therefore it is essential that there is no compensation between them (De Muro *et al.*, 2011). The only precaution that must be kept under control is the choice of the base year if the data are in time series. Since the penalty occurs according to the variability with respect to the reference year, it seems desirable that the latter present a stable situation and that, therefore, is not subject to shocks that could affect the results of the entire time series. In the event that the base year is stable, it is easier to appreciate the trend of the composite index over time when the penalties due to the imbalances of the individual indicators are applied (Mazziotta, Pareto, 2016).

5. RESULTS

The results obtained for each dimension are reported in the following paragraphs together with the description of their aggregation in one composite indicator.

5.1. The economic dimension

In 2013, results for the economic dimension (Tab. 1) show how both northern and southern regions are in the top ten of the regional classification.

In particular, in the south, Apulia and Sicily occupy, respectively, the first and second positions, followed by Calabria in 4th position. In the north, Veneto (3rd), Emilia Romagna (5th) and Trentino-South Tirol (6th) have the highest positions.

This is according to the combined effect of four indicators which are the most influential: farms with owned land, trade openness, number of quality products and producers which assume values particularly high in the above mentioned areas. However, the northern regions show higher penalties than southern ones due to the unbalanced values of their individual indicators. This is because indicators belonging to the economic dimension reflect structural factors of regional economies (e.g.: extension of utilized agricultural area) as well as farm performances (e.g.: agricultural value added).

Furthermore, indicators are affected by the economic cycle and natural events (e.g.: climate change) that are responsible for the variability of regional position between 2013 and 2016. Indeed, in 2016, southern regions were getting worse with Apulia shifting to the second position, Sicily which moved into 5th position and Campania which moved from 7th to 9th. Analogously, in the north, Veneto moved to 6th position and Trentino-South Tirol to 13th. The only exception is Emilia Romagna which moved up 4 positions, upgrading from the 5th to 1st.

5.2. The environmental dimension

In 2013 the environmental dimension of agricultural well-being (Tab. 2) shows the best results in southern regions (Calabria 2nd, Apulia 3rd, Sicily 4th, Molise 5th, Basilicata 6th and Abruzzo 7th) while the worst ones are those attributable to northern territories (Lombardy 21st, Veneto 20th, Liguria 19th and Emilia Romagna 18th). This is ascribable to production varieties and methods applied but also to opinions about regional environmental conditions that are among the most influential indicators.

In particular, regional livestock numbers are responsible for positions occupied by northern regions. Live-

Tab. 1. Results for the economic dimension.

REGION	AMPI		RANK	
	2013	2016	2013	2016
Abruzzo	93.9	92.7	16	19
Basilicata	93.3	98.1	18	15
Calabria	104.2	108.6	4	3
Campania	103.1	103.7	7	9
Emilia-Romagna	103.7	112.3	5	1
Friuli-Venezia Giulia	91.6	94.9	19	18
Lazio	101.2	105.6	10	7
Liguria	95.0	100.2	14	14
Lombardy	101.9	105.0	9	8
Marche	93.7	95.1	17	17
Molise	91.1	92.6	20	20
Piedmont	97.6	102.6	13	11
Apulia	106.0	110.6	1	2
Sardinia	98.3	101.0	12	12
Sicily	105.5	106.5	2	5
Tuscany	102.4	107.2	8	4
Trentino-South Tyrol	103.5	100.8	6	13
Umbria	94.2	96.1	15	16
Aosta Valley	89.3	85.6	21	21
Veneto	105.2	106.4	3	6
ITALY	**100.0**	**102.6**	-	-

Source: Authors' elaboration on ISTAT and CREA data.

Tab. 2. Results for the environmental dimension.

REGION	AMPI		RANK	
	2013	2016	2013	2016
Abruzzo	102.2	99.9	7	5
Basilicata	102.6	101.3	6	4
Calabria	103.9	102.9	2	2
Campania	98.3	97.6	14	16
Emilia-Romagna	94.3	97.0	18	17
Friuli-Venezia Giulia	94.5	95.5	17	18
Lazio	97.3	97.6	16	15
Liguria	93.9	87.1	19	21
Lombardy	92.7	93.5	21	19
Marche	99.7	98.6	12	11
Molise	103.4	103.1	5	1
Piedmont	102.0	97.8	9	14
Apulia	103.9	102.9	3	3
Sardinia	98.3	98.6	13	10
Sicily	103.7	99.2	4	7
Tuscany	102.0	98.7	8	9
Trentino-South Tyrol	100.2	99.8	10	6
Umbria	98.2	98.1	15	13
Aosta Valley	105.0	98.4	1	12
Veneto	93.5	90.6	20	20
ITALY	**100.0**	**99.0**	-	-

Source: Authors' elaboration on ISTAT and CREA data.

stock productions are widespread in those territories thus negatively impacting on the environmental dimension of agricultural well-being. This is in addition to production methods which require more use of phytosanitary products per hectare of cultivated land in northern regions. Penalties show higher values in northern regions and, in particular, in Aosta Valley as a consequence of non-homogeneous values of their individual indicators.

On the opposite side, southern regions show a better score of subjective indicators related to the concerns for the loss of biodiversity and degradation of land. This suggests that an improved quality of life and a better conservation of natural resources are among the major advantages for farms which operate in these areas. An upgrade in the positions of southern regions is observed in 2016, with Molise shifting from 5th to 1st position, Basilicata moving from 6th to 4th and Sardinia from 13th to 10th mainly as result of a minor concerns for the loss of biodiversity.

5.3. The social dimension

In 2013, Tuscany occupied the first position in the regional classification related to the social dimensionof the agricultural well-being (Tab. 3), followed by Umbria and Lazio. In general, central regions show better results of the social dimension of the agricultural well-being. This is the consequence of the high number of farmers that operate in disadvantaged rural areas, thus contributing to their social and economic development, as well as the high percentage of people who believe their personal situation will improve in the next 5 years.

The indicator related to the percentage of farms with family labor also contributes to increase agricultural well-being in the above mentioned regions together with the high number of farmers aged less than 44 years. On the opposite side, the majority of southern regions (Calabria, Campania, Molise, Apulia and Sicily) show low values of the social dimension of agricultural well-being. Northern regions have medium values of well-being except for Trentino-South Tirol and Emilia Romagna that are in the 4th and 6th positions of the regional classification.

These results are confirmed in 2016, with central regions reporting the best results for the agricultural well-being while the southern ones showed a further worsening. Basilicata shifted from 7th to 9th position, Abruzzo lost 5 positions (from 5th to 10th) and Sardinia shifted from 8th to 14th position mainly due to the reduction in the number of farmers that operate in disadvantages rural areas.

Tab. 3. Results for the social dimension.

REGION	AMPI		RANK	
	2013	2016	2013	2016
Abruzzo	101.6	100.9	5	10
Basilicata	100.6	101.0	7	9
Calabria	96.5	94.6	17	19
Campania	94.3	97.4	19	17
Emilia-Romagna	100.9	99.9	6	12
Friuli-Venezia Giulia	97.0	99.5	16	13
Lazio	102.9	103.8	3	3
Liguria	99.1	102.3	11	5
Lombardy	99.9	98.4	10	16
Marche	98.5	102.1	14	7
Molise	98.2	101.4	15	8
Piedmont	99.1	100.5	12	11
Apulia	95.3	96.0	18	18
Sardinia	100.5	99.2	8	14
Sicily	92.7	90.6	20	20
Tuscany	109.0	108.0	1	1
Trentino-South Tyrol	102.6	103.6	4	4
Umbria	106.0	106.9	2	2
Aosta Valley	100.2	102.1	9	6
Veneto	98.8	99.1	13	15
ITALY	**100.0**	**99.9**	-	-

Source: Authors' elaboration on ISTAT and CREA data.

5.4. The Institutional dimension

The Institutional dimension of the agricultural well-being (Tab. 4) shows values particularly high in the northern regions where, in 2013, they led the regional classification with Piedmont occupying first position, followed by Lombardy (2nd) and Trentino-South Tirol (3rd).

This result is ascribable to the regional level of expenditure related to agricultural research and development as well as the expenditure related to infrastructural services provided to farmers that are the most influential indicators.

Furthermore, in southern regions the observed high level of agricultural public expenditure (e.g.: Sicily) is offset by a higher degree of technical problems that farmers have to cope with, for example: irregularities in electric power distribution and difficulties to reach some basic services, thus placing these regions at the bottom of the regional classification.

These positions are confirmed by 2016's results with few changes due to the economic cycle's effects and public expenditure dynamics at regional level (e.g.: commitments and co-financing mechanisms) which also reflect into penalties attributed to Italian regions.

Fig. 4. Results for the Institutional dimension.

REGION	AMPI		RANK	
	2013	2016	2013	2016
Abruzzo	96.7	94.1	14	14
Basilicata	90.8	92.2	17	16
Calabria	85.8	89.4	20	20
Campania	86.6	90.6	19	18
Emilia-Romagna	102.0	102.3	5	5
Friuli-Venezia Giulia	100.9	98.0	9	11
Lazio	99.6	101.5	10	6
Liguria	100.9	101.1	8	7
Lombardy	107.4	109.7	2	1
Marche	97.1	96.6	13	13
Molise	98.5	92.2	12	15
Piedmont	113.4	105.9	1	2
Apulia	90.0	90.4	18	19
Sardinia	101.4	104.1	7	4
Sicily	92.5	91.5	16	17
Tuscany	99.3	99.5	11	9
Trentino-South Tyrol	104.5	105.1	3	3
Umbria	96.5	97.4	15	12
Aosta Valley	104.0	98.5	4	10
Veneto	101.5	100.0	6	8
ITALY	**100.0**	**99.4**	-	-

Source: Authors' elaboration on ISTAT and CREA data.

5.5. The composite indicator of agricultural well-being for 2013 and 2016

By synthetizing the four dimensions (economic, environmental, social and institutional) we obtain the composite indicator of agricultural well-being for 2013 and 2016 (Tab. 5). Tuscany is in the first position of the regional classification in both years, followed by Trentino-South Tirol in 2013 and Emilia Romagna in 2016. In general, the composite indicator shows better performances in central and northern regions than southern ones, with the exception of Sardinia which held the 7th position in both years.

The presence of the same regions in the top ten of the regional classifications in 2013 and 2016 indicates that the agricultural well-being is stable and high in the above mentioned territories, despite climate change and other challenges affecting the primary sector. Furthermore, many elements contribute to this result, such as the social structure, the efficiency of local administration and the quality of regional expenditures. Theyimpact positively on the quality of farmers' life and the development of their activities.

This is why southern regions such as Sicily, Apulia and Calabria with good performances in more than one dimension of the agricultural well-being (economic and environmental) don't find good positions in the final classification.

6. DISCUSSION

The composite indicator for the Italian agricultural well-being allows us to understand trends in agricultural well-being at regional level, emphasizing its main determinants.

Results are comparable to those emerged in a study (Greco *et al.*, 2013) that assesses the multifunctionality[4] of agriculture in Italian regions by building a composite indicator of multifunctionality. Even if the latter measures a different concept than the indicator of well-being, the two indicators have some commonalities that are worth exploring in a comparative perspective.

Specifically, the composite indicator of multifunctionality is built on 5 pillars/dimensions such as: 1. Landscape conservation 2. Diversification of farm activities 3. Environment 4. Food quality 5. Land protection. Analogously, the composite indicator of agricultural well-being is based on 4 dimensions: economic, environmental, social and institutional. Some of them include and group individual indicators belonging to different pillars of the composite indicator of multifunctionality.

The composite indicator of multifunctionality uses the MPI (+) method (De Muro *et al.*, 2011) that is based on a penalized mean of standardized values. The composite indicator of agricultural well-being is based on the AMPI (+) which represents an extension of the MPI (+) method since it allows time comparisons.

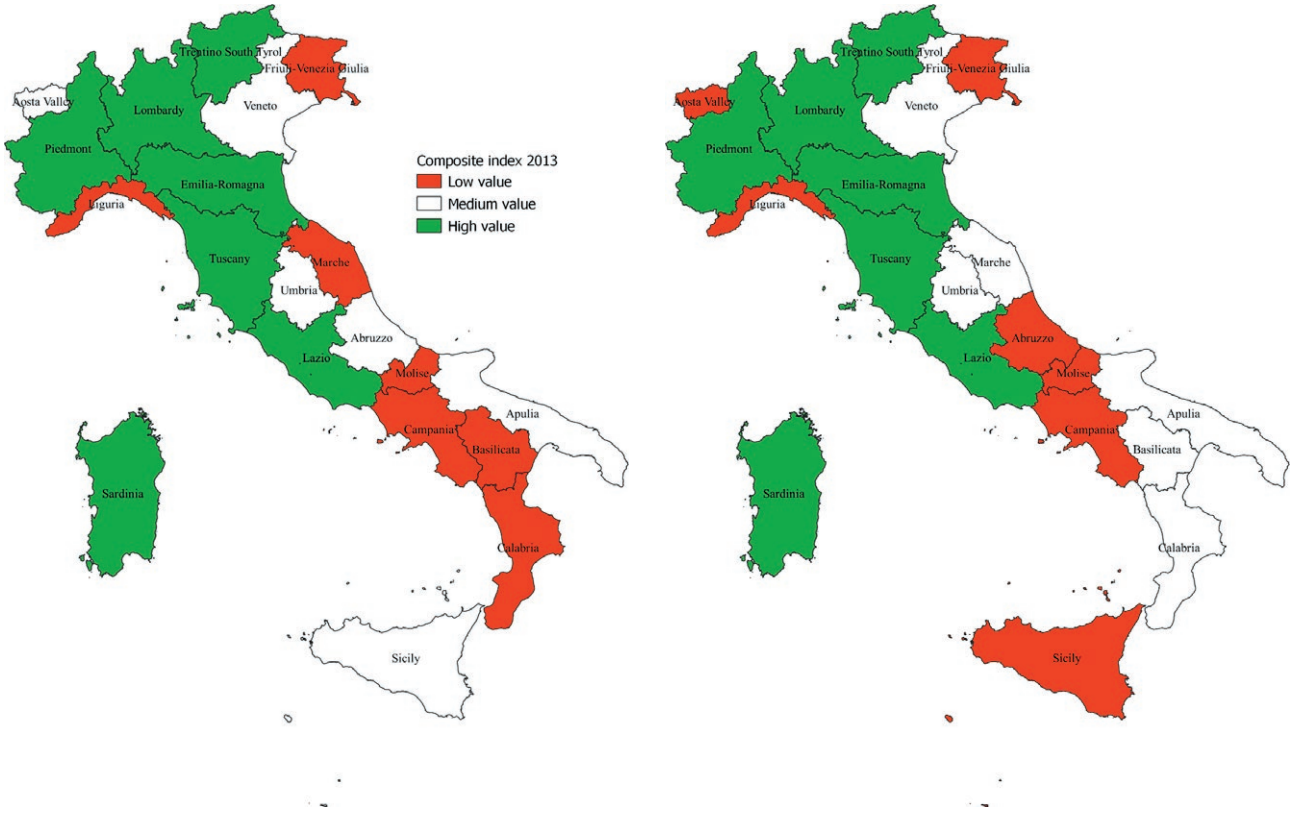
Results for the composite indicator of multifunctionality show that northern and central regions display better results that southern ones. Analogously happens for the composite indicator for agricultural well-being. This is attributable to the role of disadvantaged rural areas in northern and central regions that contribute to the development of farm activities' diversification for the composite indicator of multifuncitionality. The high number of farmers that operate in disadvantaged rural areas is responsible for the good performances of the composite indicator of agricultural well-being in northern and central regions.

[4] Multifunctional agriculture refers to the fact that "beyond its primary function of producing food and fibre, agricultural activity can also shape the landscape, provide environmental benefits such as land conservation, the sustainable management of renewable natural resources and the preservation of biodiversity, and contribute to the socio-economic viability of many rural areas" (OECD, 2001).

Fig. 5. The composite indicator of agricultural well-being.

REGION	AMPI		RANK		LEVEL	
	2013	2016	2013	2016	2013	2016
Abruzzo	98.5	96.8	11	18	Medium	Low
Basilicata	96.6	98.0	18	12	Low	Medium
Calabria	97.0	98.3	17	11	Low	Medium
Campania	95.2	97.1	20	15	Low	Low
Emilia-Romagna	100.1	102.5	6	2	High	High
Friuli-Venezia Giulia	95.9	97.0	19	17	Low	Low
Lazio	100.2	102	4	4	High	High
Liguria	97.2	97.3	16	14	Low	Low
Lombardy	100.2	101.3	5	6	High	High
Marche	97.2	98.0	15	13	Low	Medium
Molise	97.6	97.1	14	16	Low	Low
Piedmont	102.6	101.6	3	5	High	High
Apulia	98.4	99.4	12	9	Medium	Medium
Sardinia	99.6	100.7	7	7	High	High
Sicily	98.2	96.5	13	19	Medium	Low
Tuscany	103.0	103.2	1	1	High	High
Trentino South Tyrol	102.7	102.3	2	3	High	High
Umbria	98.5	99.5	10	8	Medium	Medium
Aosta Valley	99.2	95.8	9	20	Medium	Low
Veneto	99.5	98.7	8	10	Medium	Medium
ITALY	**100.0**	**100.2**	-	-	-	-

Source: Authors' elaboration on ISTAT and CREA data.



Furthermore, the composite indicator of multifunctionality shows better results in northern regions for the pillars related to farm activities' diversification. This is due to farms with activities such agritourism, production of renewable energy and other activities that assume values particularly high in the above mentioned areas. The same happens for the composite indicator of multifunctionality food quality's pillar due to the high number of quality products and producers operating in northern regions.

The composite indicator for agricultural well-being accounts for farm activities' diversification and food quality in the economic dimension. However, other elements are also taken into consideration in it such as: farm performances (e.g.: agricultural value added) and structural factors of regional economies (e.g.: extension of utilized agricultural area, trade openness). This is why the composite indicator of agricultural well-being shows that some southern regions as well as northern regions are in good positions in the regional classification for the economic dimension.

Furthermore, a part of southern regions hold higher positions for the pillar "landscape conservation" and "biodiversity protection" for the composite indicator of multifuctionality. These results are partially in line with those of the composite indicator of agricultural well-being that includes individual indicators for landscape conservation and biodiversity protection in the environmental dimension.

Indeed, results show that southern regions are at the top of the regional classification for this dimension of agricultural well-being. However, this is due to a better score displaying for subjective indicators such as the concerns for the loss of biodiversity and land degradation.

Subjective aspects have not been taken into account in the composite indicator of multifunctionality, representing the main difference between the two indicators. In addition the composite indicator of multifunctionality does not consider the institutional dimension, which is conversely included in the composite indicator of agricultural well-being. This dimension accounts for the efficiency of public administration and other elements able to impact on the development of farmers' activities at regional level. This offers a broader perspective of the well-being in agriculture from the farmers' point of view.

7. CONCLUSIONS

The experience of well-being indicators has been largely developed for many years starting from the definition of well-being in a broader sense as a multidimensional phenomenon which emphasizes the human/citizen perspective.

Recently, it has become a central topic for research institutions and national and international organizations due to the fact they are easy to understand and are a good communication tool, allowing aggregation of a huge amount of information in only one measure.

However, composite indicators may be incapable to reflect complexities of phenomena such as well-being. In this sense, the construction of a well-being indicator at sectorial level, is something new in the research arena that may help to complementthe multisectorial perspective offered by the traditional well-being measures.

The example of a composite indicator of well-being for the Italian agriculture, presented in this paper, allows stakeholders to focus on points of strengths and weaknesses of the agricultural sector.

Results for the composite indicator underline the presence of the same regions in the top ten of the regional classifications in 2013 and 2016. This indicates that the agricultural well-being is stable among regions and variabilities in their positions are mainly attributable to external factors affecting the primary sector (climate change, economic cycle…).

This is in line with the results of equitable and sustainable well-being indicators, published by the Italian National Institute of Statistics, that shows how southern regions are at the bottom of the regional classification for quality of life as a consequence of structural problems affecting those living in the south of Italy.

This indicator could be further refined by including new dimensions other than economic, social, environmental and institutional. It could be developed by taking into account subjective aspects of well-being such as: the satisfaction for the farming job, access to land and farm bureaucratic burden.

New indicators and dimensions should be able to capture elements of the agricultural well-being that have not been covered yet, and would provide deeper understanding of sector-related problems in order to intervene in an appropriate manner.

Sectorial indicators of well-being could assume a relevant role in the near future, considering the challenges that economic sectors are facing worldwide such as: climate change, pandemic crisis, depletion of natural resources. They may allow policy makers to find targeted solutions by taking into account needs, problems and perceptions of operators working in economic sectors, helping to improve public policies.

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APPENDIX

Economic Dimension			
	Yields	Polarity	
1		Agricultural value added per ha (crop -specialist holdings)	+
	Data source	Farm Accounting data network (Italy)	
	Livestock productivity	Polarity	
2		Agricultural value added per livestock unit (livestock-specialist holdings)	+
	Data source	Farm Accounting data network (Italy)	
	Labour productivity	Polarity	
3		Agricultural value added per work unit(LU)	+
	Data source	Farm Accounting data network (Italy)	
	Capital productivity	Polarity	
4		Agricultural value added/ Farm Net Capital	+
	Data source	Farm Accounting data network (Italy)	
	Agricultural value added	Polarity	
5		Agricultural value added at basic prices (mil. Euros)	+
	Data source	National account data (Italian National Institute of Statistics)	
	Openness to international trade index	Polarity	
6		(Import + Export) / Agricultural value added	+
	Data source	COMTRADE database and National account data (Italian National Institute of Statistics)	
	Farm birth rate	Polarity	
7		Number of new farms in a given yearas a percentage of the total number farms	+
	Data source	Infocamere, Firmregister	
	Agricultural workers' wages	Polarity	
8		Wagesin euros	+
	Data source	National account data (Italian National Institute of Statistics)	
	Quality products	Polarity	
8		Number of quality products	+
	Data source	Quality products' database (Italian National Institute of Statistics)	
	Farms with quality products	Polarity	
10		Number of farms with quality products	+
	Data source	Quality producers' database (Italian National Institute of Statistics)	
	Farms with own land	Polarity	
11		Number of farms with own land as a percentage of the total	+
	Data source	Survey on farm structure (Italian National Institute of Statistics)	
	Farms with other farming-related activities	Polarity	
12		Number of farms with other farming-related activitiesas a percentage of the total	+
	Data source	Survey on farm structure (Italian National Institute of Statistics)	
Environmental Dimension			
	Satisfaction for the environmental conditions	Polarity	
1		Percentage of people aged 14 and over very or quite satisfied of the environmental situation (air, water, noise) of the area where they live on total population aged 14 and over	+
	Data source	Survey on every-day life aspects (Italian National Institute of Statistics)	

	Energy from renewable sources	Polarity	
2		Percentage of energy consumptions coveredby renewable sources	+
	Data source	Terna	
	Fertilizer use	Polarity	
3		Quantity of fertilizers (Ton) / Utilized agricultural area (ha)	-
	Data source	Fertilizer database (Italian National Institute of Statistics)	
	Phytosanitary use	Polarity	
4		Quantity of phytosanitary products (Ton) / Utilized agricultural area (ha)	-
	Data source	Fertilizer database (Italian National Institute of Statistics)	
	Regional area under organic farming	Polarity	
5		Extension of agricultural areaunder organic farming (ha)	+
	Data source	SINAB	
	Livestock	Polarity	
6		Livestock units (LSU)	-
	Data source	Italian Farm structure Survey (Italian National Institute of Statistics)	
	Protected naturalareas	Polarity	
7		Percentage share of terrestrial protected natural areas included in Italian Official List of Protected Areas (Euap) and Natura 2000 Network	+
	Data source	Annex of environmental data, ISPRA	
	Utilizedagricultural area	Polarity	
8		Extension of utilized agricultural area (ha)	+
	Data source	Farm Accounting data network (Italy)	
	Farms with renewable energy production	Polarity	
9		Number of farms with renewable energy production as a percentage of the total number of farms	+
	Data source	Italian Farm structure Survey (Italian National Institute of Statistics)	
	Irrigated agricultural area	Polarity	
10		Irrigated agricultural area as a percentage of Irrigable agricultural area	+
	Data source	Italian Farm structure Survey (Italian National Institute of Statistics)	
	Impact of forest fires	Polarity	
11		Burnt forest area (wooded and non-wooded) per 1,000 sq.km	-
	Data source	Equitable and sustainable well-being indicators (Italian National Institute of Statistics)	
	Concern aboutlandscapedeterioration	Polarity	
12		Proportion of population reporting, among the environmental problems for which they express more concern, the decay of landscape due to overbuilding	-
	Data source	Equitable and sustainable well-being indicators, Italian National Institute of Statistics	
	Concern for biodiversity loss	Polarity	
13		Percentage of people aged 14 and over who believe that biodiversity loss is among the five most important environmental problems on total population aged 14 and over	-
	Data source	Equitable and sustainable well-being indicators, Italian National Institute of Statistics	
Social dimension			
	Farmers agedlessthan 44	Polarity	
1		Number of farmers aged less than 44	+
	Data source	Tax return data, (Italian Ministry of economics and finance)	
	Agricultural workers	Polarity	
2		Number of agricultural workers	+
	Data source	National account data, (Italian National Institute of Statistics)	

	Women farmers	Polarità	
3		Women farmers as a percentage of total number of farmers	+
	Data source	National account data, (Italian National Institute of Statistics)	
	Women agricultural workers	Polarity	
4		Women agricultural workers s as a percentage of total agricultural workers	+
	Data source	National account data, (Italian National Institute of Statistics)	
	Irregular employment rate in agriculture	Polarity	
5		Number of irregular agricultural workers as percentageof the total agricultural workers	-
	Data source	National account data, (Italian National Institute of Statistics)	
	Farmers in disadvantaged rural areas	Polarity	
6		Number of farmers in disadvantaged rural areas as a percentage of total number of farmers	+
	Data source	Data on workers in agriculture, (Italian National Institute of providence)	
	Agritourism	Polarity	
7		Number of agritourisms	+
	Data source	Italian Farm structure Survey, (Italian National Institute of Statistics)	
	Farms with family labor force	Polarity	
8		Number of farms with family labor force as a percentage of the total	+
	Data source	Italian Farm structure Survey, (Italian National Institute of Statistics)	
	Farmers with a degree or professional agricultural training	Polarity	
9		Number of farmers with a degree or professional agricultural training as a percentage of the total number of farmers	+
	Data source	Italian Farm structure Survey, (Italian National Institute of Statistics)	
	Positive jugement on future perspectives	Polarity	
10		Percentage of people aged 14 and over which believe their personal situation will improve in the next 5 years on total population aged 14 and over.	+
	Data source	Equitable and sustainable well-being (Italian National Institute of Statistics)	
	Generalized trust	Polarity	
11		Percentage of people aged 14 and over that feel that most people are worthy of trust on the total population aged 14 and over.	+
	Data source	Equitable and sustainable well-being (Italian National Institute of Statistics)	
	Social participation	Polarity	
12		People aged 14 and over that have performed at least one social participation activity in the last 12 months on total population aged 14 and over. The activities in question are: participation in meetings of associations (cultural/recreational, ecological, civil rights, peace); participation in meetings of trade union organizations, professional or trade associations; meetings of political parties and/or performance of free activities for a party; payment of a monthly or quarterly fee for a sports club	+
	Data source	Equitable and sustainable well-being (Italian National Institute of Statistics)	
Institutional dimension			
	Public expenditures in research and technical assistance	Polarity	
1		Amount of regional public expenditure in research and technical assistance (mil. euros)	+
	Data source	Agricultural public expenditure Database(Council for research in agriculture and economics)	

	Farm support	Polarity	
2		Amount offarm support as a percentage ofagricultural value added	+
	Data source	Agricultural public expenditure Database (Council for research in agriculture and economics), national account data (Italian Institute of Statistics)	
	Long-term loans for farm investments	Polarity	
3		Amount oflong-term loans for farm investments (mil. euros)	+
	Data sources	Bank of Italy	
	Public expenditures in infrastructural services for farmers	Polarità	
4		Amount of regional public expendituresin infrastructural services for farmers (mil. euros)	+
	Data source	Agricultural public expenditure Database on (Council for research in agriculture and economics)	
	Regional public expenditures	Polarity	
5		Amount of regional public expenditure (mil.euros)	+
	Data source	Agricultural public expenditure Database (Council for research in agriculture and economics)	
	Irregularities in electric power distribution	Polarity	
6	Unit	Frequency of accidental long lasting electric power cuts (cuts without notice longer than 3 minutes) (average number per consumer).	-
	Data source	Authority for Electricity gas and water system	
	Impact of knowledge workers on employment	Polarity	
7		Percentage of employees with tertiary education (ISCED 5-6-7-8) in scientific-technological occupations (ISCO 2-3) on total employees	+
	Data source	Labour force survey, (Italian National Institute of Statistics)	
	Trust in other institutions	Polarity	
8		Average score of trust in the police and the fire brigade (on a scale from 0 to 10) expressed by people aged 14 and over	+
	Data source	Survey on Aspects of daily life (Italian National Institute of Statistics)	
	Civic and politicalparticipation	Polarity	
9		People aged 14 and over who perform at least one of the activities of civic and political participation on total population aged 14 and over. The activities in question are: The activities in question are: to speak about politics at least once a week; to inform of the facts of Italian politics at least once a week; to attend online consultation or voting on social issues (civic) or political (e.g. urban planning, sign a petition) at least once in the 3 months prior to the interview, to read and to post opinions on social or political issues on the web at least once in the 3 months preceding the interview.	+
	Data source	Survey on Aspects of daily life (Italian National Institute of Statistics)	
	Trust in other institutions	Polarity	
10		Average score of trust in the police and the fire brigade (on a scale from 0 to 10) expressed by people aged 14 and over	+
	Data source	Survey on Aspects of daily life (Italian National Institute of Statistics)	
	Composite indicator of service accessibility	Polarity	
11		Percentage of households who find very difficult to reach some basic services (pharmacy, emergency room, post office, police, municipal offices, crèches, nursery, primary and secondary school, market and supermarket).	-
	Data source	Survey on Aspects of daily life (Italian National Institute of Statistics)	