An integrated multi-source approach to calculate the FAO Sustainable Goal 2.4.1

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Abstract

The definition of the SDG 2.4.1 is the proportion of agricultural area under productive and sustainable agriculture. The methodology covers the three pillars of farms' sustainability (economic, environmental, and social) and requires the availability of several data at the single farm level covering 11 indicators. Calculations are often difficult because many data are missing or not updated, even in developed countries. In this framework, we propose an integrated multi-source approach to calculate the SDG 2.4.1 in Italy, based on surveys managed by ISTAT. The main data source is the new sample multipurpose survey (referred to 2024). This survey collected many indicators concerning agriculture sustainability. Additional sources are the sample Integrated Farm Statistics survey (referred to 2023) and the Agriculture Census (referred to 2020), that provided the reference frame used for weighting sample data. Compared with the original FAO methodology, we suggest a novel approach: new proposals concern both the list of sustainability sub-indicators used and the methodology for calculations. The results show that, in 2024, in Italy the share of agricultural area managed with a "desirable" sustainability level (the green traffic light) was 50,5%, managed by the 35,9% of farms. Economic sustainability characterized a larger share of land (67,0%) rather than environmental and social sustainability.

Keywords: agricultural holding; census of agriculture; multipurpose survey; sustainability.

1. The SDG 2.4.1[1]

Sustainable agriculture is a focus target of the Sustainable Development Goals (SDGs), with the development of SDG Indicator 2.4.1 to assess the progress towards sustainable agriculture at national and global levels. The definition of indicator 2.4.1 is the proportion of agricultural area under productive and sustainable agriculture: the ratio between the area under productive and sustainable agriculture and the agricultural land area. Indicator 2.4.1 reflects the multiple

[1] The text and all material included in this paper is free from any Copyrights violations. Elaborations are based on ISTAT and CREA data.

dimensions of sustainability: economic, environmental, and social. A set of 11 sub-indicators are defined, organised in themes, each mapped to one of the three dimensions [1]. Data collected from the agricultural holdings are aggregated at national level by sub-indicator, and reported via a dashboard using a traffic-light approach to indicate sustainability status. The dashboard allows countries to easily visualize their performance in terms of the different sustainability dimensions and themes, and therefore understand where their policy efforts may best be focused. Using sustainability criteria and thresholds, the results for each sub-indicator are presented along a spectrum – desirable (green), acceptable (yellow), unsustainable (red). Finally, the overall (desirable) sustainability level for a country – the SDG 2.4.1 – is given by the lowest among the 11 single desirable levels. Gennari and Navarro [2] underlined that what we may now take as a given as regards the SDG 2.4.1 is the result of a long and arduous process of methodological development that involved a series of difficult decisions on numerous methodological aspects. On behalf of the Food and Agriculture Organization of the United Nations (FAO), the authors provided supporting documentation for the key methodological decisions, particularly with regard to the definition of agricultural sustainability, the choice of the scale of the sustainability assessment and the data collection instrument; the sub-indicators within each dimension; the criteria to assess the sustainability level of the farm with respect to each sub-indicator; and the modality of synthesizing the information.

However, despite the efforts from the FAO, up to now the low availability of data has been a challenge for measuring agricultural sustainability with SDG Indicator 2.4.1. Even developed countries – Italy is one among them – could not calculate the SDG 2.4.1. One of the most notable efforts was the development of a proxy indicator coordinated by FAO. The contributions and limitations of the proxy were analysed in [3]. The proxy approach significantly improves data availability and enables trend analysis and sub-indicator-level comparisons. However, concerns remain about the ambiguity in its scoring methodology and the methodological management of missing data, which may disproportionately affect countries with relatively weaker statistical capacity. Until today, the main criticisms of the FAO approach are given by quality and completeness of available data and some methodological issues that may lead to biased results.

In this paper, after a short resume of the boundless literature concerned with the definition and the measurement of agriculture sustainability (section 2), sections 3 and 4 will focus on an alternative approach for calculating the SDG 2.4.1, based on an alternative methodology and data collected by the new agriculture multipurpose survey carried out in Italy in 2025. After the analysis of main results (section 5), they are discussed in section 6, that proposes some perspective conclusions.

2. Brief literature review

Within the vast literature on sustainable agriculture, it is possible to distinguish the works that are more concerned with the general principles that inspire the concept of agricultural sustainability from those that are more oriented towards proposing empirical applications based on farms' data. As regards the former issue, several works remarked on the need to focus on specific sustainability dimensions. Hansen [4] underlined that agriculture sustainability can be interpreted according to two broad concepts: as an approach to agriculture developed in response to concerns about impacts of agriculture, or as a property of agriculture developed in response to concerns about threats to agriculture. In order for sustainability to be a useful criterion for guiding change in agriculture, its characterization should be quantitative and system-oriented. Velten *et al*. [5] conducted a

structured literature review in combination with a cluster analysis in order to identify the overall ideas and aspects associated with sustainable agriculture. Within the three broad dimensions (economic, social, and environmental) the authors identified 16 main themes, divided into goal themes, strategy themes, and action themes. Latruffe *et al.* [6] remarked that the environmental pillar has undergone an 'indicator explosion', due to the multitude of themes covered and the attention given by society to this dimension of sustainability. By contrast, economic indicators target a relatively small number of themes. Social indicators typically cover two main sustainability issues: the farming community and society as a whole, being their measurement challenging as they are often qualitative and subjective. Lampridi *et al*. [7] proposed a methodological framework implemented for the systematic literature review of 38 crop agricultural sustainability assessment studies at farm-level. The investigation revealed that the most used methods include indicator-based tools, frameworks, and indexes, followed by multicriteria methods. Stakeholder participation is proved crucial in the determination of the level of sustainability. Muie [8] underlined that the use of novel approaches and practices such as smart agriculture, organic farming, biodynamic agriculture, sustainable intensification, and regenerative agriculture has been proven to safeguard agricultural sustainability and should be implemented for ecological sustainability and food security. These goals lead to the keyword *innovation*, which is one of the indicators introduced in Section 4. Bathaei and Štreimikiene [9] identified a total of 101 indicators found in previous studies for the three broad dimensions. In order to measure sustainable agriculture, the paper proposes a reclassification of the wide set of indicators according to eight main typologies: technology, market access, prices (economic dimension), farm structure, pollution, soil (environmental), quality of products, and farmers' rights (social).

As regards results derived by empirical applications – the latter issue concerned with sustainability – Zahm *et al*. [10] applied the IDEA method, based on 41 sustainability indicators covering the three dimensions of sustainability, using French case studies. They used the FADN[2] network as a possibility to assess the sustainability level of different farming systems. The conclusion was that there is not just one farm sustainability model, and therefore the indicators must be adapted to local farming before using the methodology. Reig-Martínez *et al.* [11] proposed composite indicators for different aspects - social, economic, environmental, and global - of farm sustainability using a methodological approach that combines data envelopment analysis and multicriteria decision making methods. Based on a database of 163 farms located in the Spanish Campos County, the authors used 12 individual indicators of sustainability and showed that both economic and environmental composite sustainability indicators are positively correlated, but that this is not the case for the social indicator. Longhitano *et al.* [12] built up a set of 26 sustainability indicators derived from the FADN database, some of which are monetary-valued, while others are social and environmental. Based on a multi-criteria matrix, a sustainability farm index was calculated at the farm level. The methodology was applied to the regional FADN sample of Veneto as of 2009. Wrzaszcz and Zegar [13] measured the economic sustainability of farms in Poland based on agricultural census data. They used the indicators of economic sustainability: land productivity, labour profitability, farm market activity, and sources of households' income and maintenance. The results show that economic and environmental goals are complementary at the farm level and

[2] FADN is the Farm Accountancy Data Network survey carried out by CREA in Italy. This survey does not observe the smallest farms, which are those often characterized by serious sustainability problems.

that economically sustainable farms often conduct pro-environmental agricultural activities. Dos Santos *et al.* [14] analysed the agricultural sustainability of the twenty-eight Member States of the EU. The findings showed the importance of economic subsidies due to the Common Agricultural Policy (CAP) in assessing certain sustainability standards. While the CAP has a positive impact on economic sustainability in Centre-Europe countries, the Mediterranean countries present more contribution in environmental terms. The highest contribution in terms of creating rural jobs is found in Eastern countries. Buttinelli *et al.* [15] assessed the financial sustainability of organic farms compared to conventional ones. Based on the FADN data, the analysis showed that financial sustainability is greater for organic farms than conventional farms, and in several cases, the level reached by the former is very high, especially in mixed types of farming. Coppola *et al.* [16] proposed a principal component analysis in order to build an economic sustainability index applied to 6 thousand FADN farms and based on three indicators: an efficiency indicator; an indicator of the ability of the farm to remunerate the entrepreneur's production factors; an indicator of the farm's income capacity. Gismondi [17] proposed a methodology for estimating the degree of sustainability of the Italian agricultural holdings based on the 2020 census microdata. The methodology used five census macro-indicators referable to specific strategic farm features connected to economic, environmental and social sustainability. The number of sustainability dimensions owned by each farm was the basis of the classification methodology.

3. Some criticisms of the FAO methodology

The SDG 2.4.1 is the percent ratio between the area under productive and sustainable agriculture and the total agricultural land area. The denominator is the sum of the agricultural land area (as defined by FAO) utilized by agricultural holdings that are owned (excluding rented-out), rented-in, leased, sharecropped or borrowed. The calculation of the numerator is quite complex and requires the calculation of 11 sustainability indicators. A specific sustainable area must be calculated for each of the 11 main themes concerned with agriculture sustainability, listed in the first column of the Table 1. Within each theme's framework, the "traffic light" approach is used, in which three sustainability levels are considered for each sub-indicator: green (desirable); yellow (acceptable); red (unsustainable). After calculating the percentage of land area with a desirable sustainability level for each single theme (green), FAO defines the SDG 2.4.1 as the lowest among the 11 levels of desirable sustainability calculated previously. The overall unsustainability level (red) is given by the largest among the 11 unsustainability levels calculated previously. The overall acceptable sustainability level (orange) follows straightforwardly. The complete list of 41 indicators to be taken into account according to FAO is given in the second column of the Table 1, while the column 3 summarizes the sustainability rules adopted (more details are available in [1]). There are 3 main critical issues of the FAO methodology to be pointed out.

1. The methodology is based on the calculation of 41 sub-indicators referring to the 11 indicators covering the three main themes. On the one hand, it is extremely difficult for a single country to calculate them all. On the other, the high fragmentation of the different profiles that determine sustainability can reduce the statistical robustness of the results obtained. This risk is exacerbated when it is necessary to somehow estimate all the unavailable sub-indicators. In the European Union context, the main Regulations concerned with agriculture statistics (IFS and SAIO) collect only a small portion of the data needed to calculate the 41 sub-indicators. In particular, they do not collect data relating to economic sustainability and food security.

Table 1 – Main themes and indicators for the calculation of SDG 2.4.1 recommended by FAO

Main theme (FAO)		Indicators	Sustainability rules
1.Land productivity	1	Farm output value per hectare	Beyond, between or above thresholds
2.Net farm income	1	Net farm income evaluated along the last 3 years	Positive or negative
3.Risk mitigation mechanisms	1	Access to credit	Number of indicators = YES
	2	Access to insurance	
	3	Utilized agricultural area occupied by the main cultivation explains not more than 66% of the utilized agricultural area	
4.Prevalence of soil degradation	1	Soil erosion	Area affected by any of the degradation factors below, between or above thresholds
	2	Reduction in soil fertility	
	3	Salinization of irrigated land	
	4	Waterlogging	
5.Variation in water availability	1	The farmer uses water to irrigate crops on at least 10 percent of the agriculture area	Specific combinations of the 3 indicators
	2	The farmer is aware about issues of water availability in the area of the farm and notices a reduction in water availability over time	
	3	There are organizations (working effectively) in charge of allocating water among users	
6.Management of fertilizers	1	Farm follows protocols as per extension service or retail outlet directions or regulations, not exceeding recommended doses	Number of indicators = YES
	2	Farm uses organic source of nutrients alone, or in combination with synthetic or mineral fertilizers	
	3	Farm uses legumes as a cover crop, or component of a multi/crop or pasture system to reduce fertilizer inputs	
	4	Farm distributes synthetic or mineral fertilizer application over the growing period	
	5	Farm evaluates soil type and climate in deciding fertilizer application doses and frequencies	
	6	Farm uses soil sampling at least every five years to perform nutrient budget	
	7	Farm performs site-specific nutrient management or precision farming	
	8	Farm uses buffer strips along water courses	
7.Management of pesticides	1	Adherence to label directions for pesticide use	Specific combinations of the 10 indicators
	2	Maintenance and cleansing of protection equipment after use	
	3	Safe disposal of waste (cartons, bottles and bags).	
	4	Adherence to label directions for pesticide application	
	5	Adopt any of these good agricultural practices: adjust planting time, apply crop spacing, crop rotation, mixed cropping or inter-cropping;	
	6	Performing biological pest control or use bio-pesticides	
	7	Adopting pasture rotation to suppress livestock pest population	
	8	Systematic removal of plant parts attacked by pests	
	9	Maintenance and cleansing of spray equipment after use	
	10	Farm uses one pesticide no more than two times or in mixture in a season	
8.Use of agro-biodiversity supportive practices	1	Farm leaves at least 10 percent of the holding area for natural or diverse vegetation	Number of indicators = YES
	2	Farm does not use medically important antimicrobials as growth promoters	
	3	At least two of the following contribute to farm production: 1) temporary crops; 2) pasture; 3) permanent crops; 4) trees on farm; 5) livestock or animal products; 6) aquaculture	
	4	Farm practices crop or crop/pasture rotation involving at least two crops or crops and pastures on at least 80 percent of the farm cultivated area over a period of three years	
	5	Livestock includes locally adapted breeds	
9.Wage rate in agriculture	1	Daily wage rate of unskilled hired labour = (Total annual compensation)/(Total annual hours worked) x 8 hours	Wage rate below, equal to or above the national wage rate
10.Food insecurity experience scale	1	Food security level, based on the Food Insecurity Experience Scale	Mild, moderate or severe food insecurity
11.Secure tenure rights to land	1	Formal document issued by the land registry/cadastral agency	Specific combinations of the 4 indicators
	2	Name of the holder listed as owner/use right holder on legally recognized documents	
	3	Rights to sell any of the parcel of the holding	
	4	Rights to bequeath any of the parcel of the holding	

2. The FAO methodology is based on the use of various thresholds beyond which a farm is considered sustainable. In one particular case (farm output value per hectare), the methodology classifies farms based on relative thresholds, depending on the distribution of the target indicator among the farms' population. Broadly speaking, the choice of thresholds can be too subjective. In particular, the use of relative thresholds tends to penalize a high share of farms, due to the presence of a few very large units, and implies different absolute thresholds in different countries, which can limit the international comparability of results. For these reasons, the alternative methodology (section 6) is not based on thresholds, but on whether one or more of a series of requirements is met at the single farm level.
3. The FAO criterion assigns each country a final level of sustainability (SDG 2.4.1) equal to the lowest among the sustainability levels associated with the 11 indicators considered. This choice arises from the need for each country to ensure high sustainability for each of the 11 dimensions. However, this may be an extremely penalizing technical choice that could provide incorrect indications regarding the average level of agricultural sustainability of a country.

5. Data sources

In the first half of 2025 ISTAT carried out the agriculture multipurpose survey (MUL), referred to 2024. The survey is new and aimed to collect non-quantitative information on aspects of farms' life that are little investigated within official statistics. Questions concerned the following topics: identification and management of business risks; other gainful activities; innovation; sustainability; water resources. The information refers to the 2023-2024 agricultural year and includes forecasts for the 2024-2025 year, which was ongoing during data collection. In addition to questions mentioned above, the questionnaire included information on the farm's activity status, land location, class of utilized agricultural area, presence of livestock, the destination of final production, and sources of income. The theoretical sample included 55.008 farms, of which around 42 thousand useful responses.

Additional sources are the sample Integrated Farm Statistics survey (IFS, referred to 2023) and the agriculture census (referred to 2020). Both IFS and the census find their regulatory basis in [18] and are harmonized at the EU level. IFS had the purpose of updating the 2020 agriculture census data, even though on sample basis. The main difference between IFS and the census, compared with MUL, is that the formers include several mandatory questions aimed to update the main structural data on the farms in a country, rather than to investigate issues concerned with agriculture sustainability. However, IFS includes some questions connected to sustainability as well, while the census provided an important economic indicator (standard output) as well as the basic frame for weighting sample data. The use of sample surveys data allows classifying the degree of sustainability only for the sample units. However, each sample unit is assigned a weight, which represents the number of farms in the population it represents. This weight transfers the sustainability level of each sample unit to the number of population units expressed by the weight associated with that unit.

6. The novel methodology

The new methodology draws directly on FAO's conceptual framework, based on three main dimensions and 11 main themes. The most important difference concerns the selection of

indicators. While FAO proposes 41 indicators, chosen based on relevant theoretical evaluations, but which often seem too distant from an objective assessment of the indicators' actual calculability, the new methodology follows the opposite pattern: it starts from the set of calculable indicators and seeks to connect them with the main dimensions and themes on which FAO bases its concept of agricultural sustainability. The new indicators are 20 and are listed in the Table 2. Among them, one is equal to 100% by default (Secure tenure rights to land) and 5 are connected to more than one single theme (Prevalence of soil degradation, Management of fertilizers, Management of pesticides, Use of agro-biodiversity supportive practices). In the Table 2 these indicators are indicated with the same colour. The most part of indicators can be calculated based on the multipurpose survey (16 indicators), while 3 indicators derived from the IFS 2023 survey, the FADN survey and/or the agriculture census 2020. Given the indicators, for each theme sustainability is assessed according to a dichotomous perspective: possession or not of one specific requirement or at least one among more requirements, thus being very simple to calculate and to explain. The logical sustainability rules are described in the last column of the Table 2.

For each theme, to calculate the percentage of sustainable agricultural area compared to the total agricultural area, simply add to the numerator the areas of the farms that are sustainable for that particular theme. Since the multipurpose survey is a sample-based one, both the sustainable and total areas are obtained by adding each other the products of each individual farm's area and its respective sample weight.

The fact that the same indicator can be used multiple times for different themes arises for two reasons. The first is the impossibility of calculating a very large number of indicators (such as the 41 indicators in the FAO methodology). The second is that some themes are interconnected (main themes 4, 6, 7, and 8), therefore the same indicator impacts different environmental sustainability themes.

The new methodology does not allow for the identification of a "yellow" zone, the agricultural land managed with an intermediate (acceptable) degree of sustainability between the desirable and the unsustainable. This is an aspect that could be improved based on further developments of the methodology. However, it should be noted that the methodology proposed in this context reduces the degree of subjectivity associated with choosing the thresholds within which an agricultural business is assigned an acceptable level of sustainability.

There are two further and important key issues concerned with the novel methodology: coverage and replicability. As regards the former, the methodology can be applied to all farms active in a country, even though on a sample basis. This is an important peculiarity, because the vast majority of applications known in the literature are based on an even larger number of indicators, but are calculable only for a small subset of farms, that are not always representative subsets of the entire population of farms. As regards the latter, the procedure can be repeated every three years, since the next edition of the multipurpose survey will refer to 2026. Clearly, in order to be able to calculate SDG 2.4.1 on an annual basis, a procedure aimed at estimating this indicator in the intermediate years between two consecutive editions of the multipurpose survey will have to be defined.

A weakness of the new methodology may be the lack of detailed indicators relating to some themes, such as 1, 2 and 10. There is room for improvement if it will be possible to further integrate the FADN survey and some food security indicators measured on individuals with the multipurpose survey.

Table 2 – Main themes, indicators, data sources and logical rules concerned with the calculation of SGD 2.4.1 in Italy - 2024

Main theme	Indicators	Source	Logical rule
1.Farm output value per hectare (compared with a threshold)	Standard production and total agricultural area. The indicator is the ratio between standard production and area. Standard production is a proxy of farm output value	IFS 2023 (total agricultural area) and census of agriculture 2020 (standard production)	Sustainable farm if the legal status is not individual entrepreneurship or partnership; otherwise, if standard production ≥ 2/3 of the poverty threshold in 2023
2.Net farm income (along the last 3 years)	Net farm income is not available. Therefore, a specific logical rule is used as proxy	Agriculture multipurpose survey 2024	Sustainable farm if the farm foresees growth or stability of production
3.Risk mitigation mechanisms	Problems concerned with access to credit	Agriculture multipurpose survey 2024	Sustainable farm if the farm declares not to have (or to have few) problems concerned with access to credit and/or if the main cultivation explains not more than 66% of the utilized agricultural area
	Utilized agricultural area occupied by the main cultivation explains not more than 66% of the utilized agricultural area	Census of agriculture 2020 and IFS 2023	
4.Prevalence of soil degradation	The farm is organic of plans to adopt organic farming within the next 2 years	Agriculture multipurpose survey 2024	Sustainable farm if the farm answers YES to at least one of the questions
	The farm uses conservative management of the soil		
	The farm is reducing the use of plant protection products		
	The farm is reducing the losses of nutrients in the soil		
	The farm is reducing the use of fertilizers		
	The farm re-uses production residues and waste		
5.Variation in water availability	That farm did not face problems due to irrigation, or had problems but adopted measures with the goal of contrasting them	Agriculture multipurpose survey 2024	Sustainable farm if the farm answers YES to one of the questions
6.Management of fertilizers	The farm is organic of plans to adopt organic farming within the next 2 years	Agriculture multipurpose survey 2024	Sustainable farm if the farm answers YES to at least one of the questions
	The farm is reducing the use of fertilizers		
7.Management of pesticides	The farm is organic of plans to adopt organic farming within the next 2 years	Agriculture multipurpose survey 2024	Sustainable farm if the farm answers YES to at least one of the questions
	The farm is reducing the use of plant protection products		
8.Use of agro-biodiversity supportive practices	The farm is organic of plans to adopt organic farming within the next 2 years	Agriculture multipurpose survey 2024	Sustainable farm if the farm answers YES to at least one of the questions
	The farm uses conservative management of the soil		
	The farm is reducing the use of fertilizers		
	The farm re-uses production residues and waste		
9.Wage rate in agriculture	Average wage per hour worked (compared with a threshold)	FADN survey 2023 and IFS 2023 (for the estimation of wages concerning farms with less than 8.000 euro of standard output)	Sustainable farm if the average wages paid per employee ≥ minimum wage established by the national labour contract
10.Food insecurity experience scale	The farm is agri-tourism, educational farm, or care farm	Agriculture multipurpose survey 2024 and IFS 2023	Sustainable farm if the farm answers YES to at least one of the questions
	The farm manages other gainful activities with the goal of enhancing typical products of the territory		
	The farm introduced innovations connected to food security and supply chain traceability		
	Within the next year the farm is going to introduce innovations connected to food security and supply chain traceability		
	The farm introduced innovations that enforce technical skills of the workforce		
	The farm manager attended training courses on 4.0 agriculture		
	The farm is going to reduce the use of antimicrobial products		
11.Secure tenure rights to land	In Italy the 100% of farms have secure rights to land		

7. Main results

The results obtained by applying the new methodology (Table 3) indicate very different levels of sustainability depending on the main theme considered. Overall, the greatest critical issues characterize some issues related to environmental sustainability (management of fertilizers and pesticides, agro-biodiversity supporting practices) and the food insecurity experience scale. On the other hand, a quite high sustainability level characterizes the first three main themes, related to economic sustainability. The degree of heterogeneity increases when the main theme considered varies if we move from counting the number of sustainable farms in relation to the total to measuring the surface area, livestock or sustainable workforce. The only themes for which the degree of sustainability remains rather steady when moving from the counting of sustainable units to the estimation of sustainable surfaces, livestock or workforce are risk mitigation mechanism, prevalence of soil degradation and variation in water availability. Overall, the sustainability level (based on the percent share of sustainable land) varies from the lowest 50,5% (food insecurity experience scale) to the largest 91,8% (prevalence of soil degradation).
According to the FAO recommendations, the SDG 2.4.1 is equal to 50,5% (Table 4), that is the lowest among the 11 sustainability levels calculated in the third column of the Table 3. It is evident the quite larger sustainability of the economic dimension (67,0%) compared to the environmental (51,4%) and the social dimension (50,5%). If SDG indicator 2.4.1 were calculated as the average of the 11 sustainability indicators related to the individual main themes rather than as the minimum among the 11, the result would be 71,9%, a much higher level. On the one hand, calculating SDG 2.4.1 based on the minimum of 11 thematic indicators can be detrimental. On the other hand, using the arithmetic mean of 11 indicators may miss some critical issues, such as the low levels of sustainability that characterize some environmental and social sustainability issues. Overall, it can be useful to calculate both indicators: the greater the difference between the two indicators, the less representative the average of 11 indicators is, as it summarizes very different sustainability performances.

Table 3 – Percentage share of sustainable farms, utilized agricultural area, livestock units and annual working units of sustainable farms for each main theme in Italy - 2024

Main theme	Number of farms	Utilized agricultural area	Livestock units	Annual working units
1.Farm output value per hectare	63,2	78,8	94,4	84,5
2.Net farm income	63,9	67,0	70,8	69,6
3.Risk mitigation mechanisms	76,7	81,9	82,6	81,2
4.Prevalence of soil degradation	90,5	91,8	92,3	92,3
5.Variation in water availability	77,2	75,2	78,2	77,9
6.Management of fertilizers	39,5	51,4	51,6	51,6
7.Management of pesticides	40,8	51,6	51,5	52,5
8.Agro-biodiversity supportive practices	41,6	55,7	56,0	53,6
9.Wage rate in agriculture	62,5	87,0	88,0	83,7
10.Food insecurity experience scale	35,9	50,5	58,5	52,2
11.Secure tenure rights to land	100,0	100,0	100,0	100,0

Table 4 – The sustainability indicator SDG 2.4.1 by dimension using the FAO criterion and the arithmetic average criterion in Italy - 2024

Dimension	FAO criterion		Arithmetic average criterion	
	Number of farms	Agricultural utilized area	Number of farms	Agricultural utilized area
Global sustainability (SDG 2.4.1)	**35,9**	**50,5**	**62,9**	**71,9**
Economic sustainability	63,9	67,0	67,9	75,9
Environmental sustainability	39,5	51,4	57,9	66,1
Social sustainability	35,9	50,5	65,1	79,2

If we analyse the profile of sustainable farms (Table 5), important evidence emerges, perhaps even predictable, which shows how agricultural sustainability follows very different dynamics depending on the geographical location, the size of the company and the type of agricultural activity conducted. The SDG 2.4.1 indicator decreases when moving from the North (57.8%) to the South (43.9%), and similar results are obtained by applying the arithmetic mean criterion instead of the FAO criterion (75.4% versus 68.4%). Small farms are quite less sustainable than big farms (33,4% against 60,8%). Farms that manage both cultivations and livestock ("farmers and herders") are much more sustainable (53,8%) than only farmers (45,3%) and only herders (34,1%). Based on these results, it is clear that in order to raise the overall level of agricultural sustainability, targeted intervention policies are needed, which can enable specific types of farmers to improve their performance, especially with regards to environmental and social sustainability.

Table 5 – The sustainability indicator SDG 2.4.1 in some sub-populations of farms using the FAO criterion and the arithmetic average criterion in Italy - 2024

Stratification criterion	FAO criterion		Arithmetic average criterion	
	Number of farms	Agricultural utilized area	Number of farms	Agricultural utilized area
North	42,1	57,8	68,8	75,4
Centre	38,8	51,6	66,0	75,1
South	30,5	43,9	59,0	68,4
Islands	34,7	45,5	58,5	67,6
Small farms (until 10 hectares)	30,2	33,4	59,3	66,2
Medium farms (from 10,1 to 50 hectares)	48,1	49,5	70,8	72,1
Big farms (more than 50 hectares)	59,3	60,8	77,6	79,1
Farmers	32,2	45,3	60,9	69,4
Herders	24,4	34,1	63,0	66,4
Farmers and herders	49,4	53,8	72,6	76,6

8. Discussion and perspective conclusions

The methodology proposed in this work aims at the overall evaluation of the degree of sustainability of the Italian farms, according to the SDG 2.4.1 framework. The methodology follows the definitions and the recommendations by FAO, and proposes some innovations

concerning both the list of statistical indicators used and the calculation methodology. The methodology requires the availability of indicators at the single farm level, based on census or sample surveys. Even though the most part of indicators derive from a unique source (the agriculture multipurpose survey), some indicators are based on information coming from additional data sources as well. The logical framework is founded on 3 sustainability dimensions (economic, environmental, social), 11 main themes and 21 indicators, referred to 2024. A specific sustainability indicator – expressed by the percent ratio between sustainable agricultural land and total land – is calculated for each main theme: each farm is sustainable if satisfies a specific requisite or has at least one among a list of requisites.

The methodology can be considered a proxy of the original SDG 2.4.1 defined by FAO. It does not claim to be final or to establish a model of sustainability that must never be changed. The 21 indicators available from the multipurpose survey cover the three main dimensions of sustainability only in part because the multipurpose survey was not just planned for estimating agriculture sustainability. Moreover, the use of the same indicator for different sustainability dimensions may be a criticism, due to the lack of enough sustainability indicators compared to the 41 proposed by FAO. On the other hand, some dimensions are overlapping each other – especially as regards the environmental dimension – and we must acknowledge that the same indicator – as the reduction of fertilizers – can have a positive direct or not direct impact on reduction of soil degradation as well as on increasing bio-diversity. A further limitation is the survey periodicity: the next edition will refer to 2027, while the next agriculture census referred to 2030 should include specific questions on sustainability. The main gaps characterize those years without any specific data sources (as 2025 and 2026 for instance, then 2028 and 2029). For this reason, it is extremely important to increase collaboration between institutions that, in various ways and for different purposes, manage information bases, including administrative ones, relating to agricultural sustainability, in order to build up estimation models able to produce proxy estimations of the SDG 2.4.1 in a yearly basis.

The convergence process that should reduce the old North-South gap in Italy is certainly underway, but it is necessary to monitor its speed and territorial capillarity based on quantitative indicators available each year. Agricultural systems, still divided into two large blocks – the predominantly modern market holdings and those small and oriented towards self-consumption – will be not sustainable anymore. The Common Agricultural Policy should improve farms' sustainability and reduce territorial gaps quickly, otherwise the survival of many small farms will be at serious risk.

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