Table S1. Main methodologies proposed in the literature for the assessment of agriculture sustainability

Methodology, References	Purpose, Spatial scale, Proponents	Sustainability dimension, number and name of indicators				Procedure to evaluate the overall sustainability performance
		Environmental	Economic	Social	Governance	
ISAP Indicators Sustainability Agriculture Practices; Rigby et al. (2001)	Construction and application of indicators to study the impact of farming practices on farm sustainability. Applied at a sample of 237 horticultures farms in UK. (Developed by academic research)	5 Seed source, Pest/ disease control, Weed control, Maintenance of soil fertility, Crop management.				Weighting and scoring of indicator results.
AFI: Agri-environmental Footprint Index ; Purvis et al. (2009) Dabkiene et al. (2021	A tool to identify the current state of the environmental situation and to track the changes and achievements on farms. Applied at a sample of 1,300 Lithuanian farms.	13 Fertilizers use, Crop protection use, GHG emissions, Energy intensity, Environment-friendly farming, Water use, Shannon Evenness Index, Legumes area, Meadows and pastures, Livestock density, Forest area, Accessibility (farm tourism), Education (positive impact on farms' environmental sustainability).				Weighting and scoring of indicator results.
Zhen and Routray (2003)	Proposed set of operational indicators for measuring agricultural sustainability at the farm level in developing countries. (Developed by academic research)	5 Amount of chemical fertilizers and pesticides used per unit of cropped land, Amount of irrigation water used per unit of cropped land, Depth of groundwater table, Quality of groundwater for irrigation, Water use efficiency, Nitrate content of groundwater and crops.	3 Productivity, Profitability, Stability of farming activities.	4 Food self-sufficiency, Equality in food and income distribution, Equal access to resources, Farmers' knowledge and awareness on resource conservation.		Comparison of indicator results with reference values.
Rasul and Thapa (2004)	Study of the sustainability of conventional and ecological farming systems, applied at the farm level in Bangladesh. (Developed by academic research)	5 Land-use pattern, Cropping pattern, Soil fertility management, Pest and disease management, Soil fertility status.	3 Land productivity, Yield stability, Profitability from staple crops	4 Input self-sufficiency, Equity, Food security, Risks and uncertainties involved in crop cultivation		Simple statistical approach to compare the two systems.
RISE Response-inducing Sustainability	Method for sustainability assessment at the farm level in developing countries such as	7 Energy, Water quantity and quality, Soil, Biodiversity, N&P	3 Economic stability, Economic efficiency,	2 Working conditions, Social security.		Weighting and scoring of indicator

evaluation; Häni et al. (2003, 2006)	Armenia, Colombia, China, India, Kenia, , Côte d'Ivoire. (Developed by academic research, social groups, public administrations and agro-industry sectors)	emission potential, Plant protection, Waste.	Local economy.			results.
IDEA Indicateurs de Durabilité des Exploitations Agricoles ; Zahm et al. (2008); Baccar et al. (2016); M'Hamdi et al. (2009); Salas-Reyes et al. (2015).	Operational tool for sustainability assessment, designed as a self-assessment tool for farmers and for policy makers. Applied at farm level, in France, Tunisia, Morocco and Mexico. (Developed by academic research)	19 Diversity of annual or temporary crops, Diversity of perennial crops, Diversity of associated vegetation, Animal diversity, Enhancement and conservation of genetic heritage, Cropping patterns, Dimension of fields, Organic matter management, Ecological buffer zones, Measures to protect the natural heritage, Stocking rate, Fodder area management, Fertilization, Effluent processing, Pesticides and veterinary products, Animal well-being, Soil resource protection, Water resource protection, Energy dependence.	6 Available income per worker compared with the national legal minimum wage, Economic specialization rate, Financial autonomy, Reliance on direct subsidies from CAP and indirect economic impact of milk and sugar quotas, Total assets minus lands value by non-salaried worker unit, Operating expenses as a proportion of total production value.	15 Quality of foodstuffs produced, Enhancement of buildings and landscape heritage, Processing of non-organic waste, Accessibility of space, Social involvement, Short trade, Services and multi-activities, Contribution to employment, Collective work, Probable farm sustainability, Contribution to world food balance, Animal welfare, Training-education, Labor intensity, Quality of life, Isolation, Quality of buildings.		Weighting and scoring of indicator results.
SAFE Sustainability assessment of farming and the environment; Van Cauwen- bergh et al. (2007)	Framework for sustainability assessment of agricultural systems. Applied at the field, farm, and larger spatial levels (Developed by academic research)	22 Air quality, Wind speed, Soil loss, Soil chemical quality, Soil physical quality, Soil mass flux (mudflows, landslides), Supply of adequate amount of surface water, Supply of adequate amount of soil water, Supply of adequate amount of groundwater, Supply of surface water of adequate quality, Supply of soil water of adequate quality, Supply of groundwater of adequate quality, Flooding and runoff regulation of the agro-ecosystem, Supply of adequate amount of exergy, Energy flow is adequately buffered, Level of planned biodiversity, Level of functional part of spontaneous biodiversity, Level of heritage part of spontaneous biodiversity,	10 Farm income, Dependency on direct and indirect subsidies, Dependency on external finance, Economic efficiency of Agricultural activities, Technic efficiency of Agricultural activities, Market activities, Farmer's professional training, Inter-generational continuation of farming, Land tenure arrangements, Adaptability of the farm.	21 Labor conditions, Health of the farming community, Education of farmers and farm workers, Internal family situation, Including equality in the man–woman relation, Family access to and use of social infrastructures and services, Family access to and participation in local activities, Family integration in the local and agricultural society, Farmer's feeling of independence, Amenities level, Pollution levels, Acceptability of production methods, Quality and taste of food, Equity, Stakeholder involvement, Educational and scientific value features, Cultural, spiritual and aesthetic heritage value features.		Comparison of indicator results with reference values.

		Level of diversity of habitats, Level of functional quality of habitats, Flow of biotic resources is adequately buffered.				
Bechini and Castoldi (2010)	Evaluation of the effect of cropping systems management on environment and on economic profitability in northern Italy. Applied at farm level. (Developed by academic research)	9 Nitrogen soil surface balance, Phosphorus soil surface balance, Fossil energy input, Energy output, Dependency of food and feed production on non-renewable energy Load Index algae, Load Index crustaceans, Load Index fish, Load Index rats, Environmental exposure (air), Environmental exposure (soil), Environmental exposure (groundwater), Crop sequence indicator, Soil cover index, Soil organic carbon indicator.	3 Variable costs, Gross income, Gross margin.			Simple statistical approach to compare the two systems.
SAFA Sustainability assessment of food and agriculture systems; FAO (2013a, 2013b); Al Shamsi et al. (2019)	Framework for sustainability assessment of the value chain in agricultural production, that can be used as a self-evaluation tool for producers and food manufacturers. Applied in many countries of the world, at farm and larger scales. (Developed by Food and Agriculture Organization of the United Nations FAO)	6 Atmosphere, Water, Land, Biodiversity, Materials and energy, Animal Welfare.	4 Investment, Vulnerability, Product quality and information, Local economy.	6 Decent livelihood, Fair Trading practices, Labor rights, Equity, Human Safety and health, Cultural diversity.	5 Corporate ethics, Accountability, Participation, Rule of law, Holistic management.	Comparison of indicator results with reference values.
SOSTARE Analysis of farm technical efficiency and impacts on environmental and economic sustainability (Paracchini et al., 2015)	Diagnostic tool for farmers and advisory services to assess general sustainability performance at farm level (Developed by academic research)	7 Cropping system and soil fertility, Nutrient application and management, Consumption of non-renewable energy, Water resource management, Agrochemical management, Natural value of the farm, Functional landscape pattern.	5 Value of production, Value added, Farm household income, Independence from CAP subsidies, Farm business diversification.			Weighting and scoring of indicator results.
MOTIFS Monitoring tool for integrated farm Sustainability; Meul et al., (2008)	Indicator-based monitoring tool for integrated farm sustainability. Applied in Flemish dairy farms	10 Use of inputs: Pesticides, Energy, Water, Nutrient. Quality of natural resources: Soil quality, Water quality, Air	7 Productivity and efficiency: Labor productivity, Capital productivity, Land	7 Internal social sustainability: Professional pride, Decision latitude, Care. External social sustainability: Animal		Weighting and scoring of indicator results.

	(Developed by academic research)	quality. Biodiversity: Genetic diversity. Species diversity, Habitat diversity.	productivity, Efficiency. Profitability: Labor profitability, Return on equity. Risk: Return on assets.	health and welfare, Landscape management, Social services: Disposable income, Entrepreneurship.		
SIRIUS Sustainable Irrigation water management and River-basin governance: Implementing User-driven Services; Antunes et al. (2017)	Framework and indicators for the assessment of sustainability of irrigated agricultural systems. Applied in 10 pilot areas in eight different countries at the irrigation perimeter and watershed scale. (Developed by international academic researchers, with public and private company).	10 Water availability, Variability of water resources, Water consumption and use, Water quality, Biodiversity enhancement farming system, Soil structure, Salinization of soils, Soil quality (chemical), Land degradation, Climate change.	5 Revenues and costs, Household vulnerability, Water dependency, Self-reliance, Adoption of risk minimization strategies, Water tariffs and taxes.	10 Wages, Working conditions, Working hours, Gender equality, Reduction of discrimination and inequalities, Educational level of population, Medical cares, Social security, Population dynamics, Social commitments.	5 Commitment, Rule of law, Conflict management and water allocation, Water governance capacity, Public participations in water resources management.	Comparison of indicator results with reference values.
PSDCIFASA Problem-oriented Status-Driver Composite Indicator-base Framework of Agricultural Sustainability Assessment; Alipour et al. (2018)	Tool for empirical assessment of agricultural sustainability in a south-east Iran province. Applied at farm and large levels (Developed by academic research)	4 Groundwater Depletion, Agrochemicals use, Biodiversity	3 Farm income, Insurance, Crop productivity	9 Food self-sufficiency, Discriminatory employment, Access to extension services, Technology availability and application, Levels of poverty, Population growth, Farm size, Education level, Urbanization.	2 Governance and institutional capacities, Producer organizations and social capital as participation	Weighting and scoring of indicator results.
SEAMLESS System for Environmental and Agricultural Modelling, Linking European Science and Society; Van Ittersum et al. (2008)	Framework for interactions between environment, economy and rural development. Applied in different EU countries at field and farm levels. (Developed by international academic researchers)	3 Soil organic matter, Nitrate leaching Crop diversity	5 Gross agricultural income, Budgetary costs of CAP first pillar, Producer and consumer prices of commodities, Production of main agricultural commodities, Farm income.	1 Agricultural employment (agricultural working units)		Weighting and scoring of indicator results.
MESMIS Evaluating the sustainability of complex socio-environmental systems; López- Ridaura et al. (2002)	Operational framework to offer guidelines in the selection of a specific indicator. Applied in more than 20 case studies in Mexico and Latin America. (Developed by a multi-institutional team in	9 Nutrient balances, Erosion levels, Biophysical characteristics of soils (i.e. compaction, percentage of organic matter), Yield trends, Number of species grown, Income per species, Incidence of pest, Diseases and Weeds.	5 Yields, Quality of products, Cost/benefit ratio, Economic return to labour, Variation of input and output prices (e.g. coefficient of variation of input/output).	4 Adoption of new alternatives and/or farmers permanence within a system, capacity building activities, proportion of area with an adopted technology. Initial investment costs share of benefits by different farmer groups. Participation in the		Comparison of indicator results with reference values.

	Mexico)			design/implementation and evaluation of alternatives, degree of participation in the decision-making process. Cost of external inputs, use of external resources.		
LCA Life Cycle Assessment approach, used to assess the environmental Sustainability of agriculture products, such as wheat (Brentrup et al. 2004), sugar beet (Tzilivakis et al. 2005), and rice (Hokazono and Hayashi 2012; Roy et al. 2005; Roy et al. 2007, Nabavi-Pelesaraei et al. 2018, Habibi et al., 2019).	Environmental sustainability assessment of agricultural production at farm level. (Developed by International Organization for Standardization ISO).	18 Climate change (CC), Ozone depletion (OD), Terrestrial acidification (TA), Freshwater eutrophication (FE), Marine eutrophication (ME), Human toxicity (HT) Photochemical oxidant formation (POF), Particulate matter formation (PMF), Terrestrial eco-toxicity (TET), Freshwater eco-toxicity (FET), Marine eco-toxicity (MET), Ionizing radiation (IR), Agricultural land occupation (ALO), Urban land occupation (ULO), Natural land transformation (NLT), Water depletion (WD), Mineral resource depletion (MRD), Fossil fuel depletion (FD).				Weighting and scoring of indicator results.
SRP: Sustainable Rice Platform methodology; SRP Performance Indicators, Version 1.0, 2015; Version 2.0, 2019a; Version 2.1, 2020a; Stuart et al., 2018; Devkota et al., 2019.	Indicators system specifically built to assess the sustainability of rice production. Developed by researchers from UNEP, IRRI and GIZ, public and private stakeholders, and NGOs.	5 Water productivity and quality, N-use efficiency, P-use efficiency, Biodiversity, Greenhouse gas emission.	3 Profitability, Labour productivity, Productivity: grain yield.	4 Food safety, Worker health and safety, Child labour and youth engagement, Women empowerment.		Comparison of indicator results with reference values.