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Development of new methodologies and\or tools for measurement of sustainability in rural areas

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Objective – Topics to be addressed

- The project will provide a background to the measurement of sustainability in rural areas:
  - Literature review on the concept – dimensions of Sustainable Development (SD)
  - Research on existing methods and analytical frameworks that try to assess the progress towards SD.
  - Review on existing methodologies according to tools
  - Development of a framework for evaluating existing indicators
  - Define and select the “best – needed” SDI/ extension\combination
- Contribute at regional and national level to develop and apply Sustainable Development Indicators (SDI)

Sustainable Development

- The concept of SD is an approach to development that looks to **balance** different, and often competing, **needs** against an awareness of the environmental, social and economic limitations we face as a society.

"SD is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

  - *the essential needs of the world's poor, to which overriding priority should be given;*
  - *the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.*

- Proponents of SD differ in their emphases on **what is to be sustained**, **what is to be developed**, how to link environment and development, and for how long.

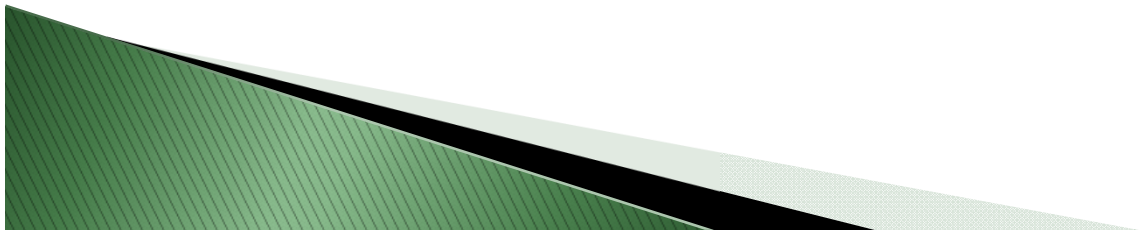
Monitoring Sustainable Development

- Measuring progress towards SD is an integral part of the EU SDS, and it is Eurostat's task to produce a **monitoring report** every two years.

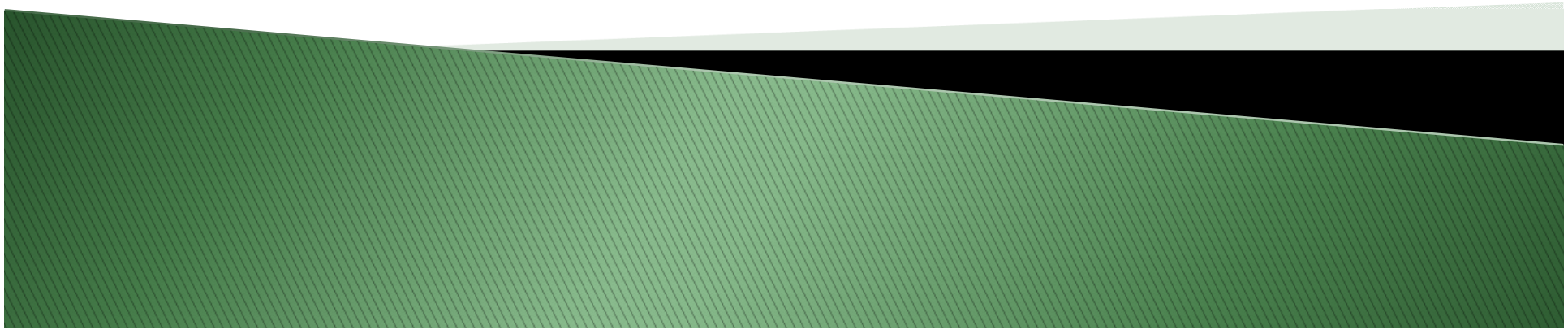
- In order to contribute to these progress reports, Eurostat has developed a set of **Sustainable Development Indicators (SDI).**

- All these reports chart progress in the implementation of the strategy's objectives and **key challenges**.

- SD still remains a **fundamental objective** of the European Union. The strategy will continue to provide a long-term vision and constitute the policy framework for policies and strategies.

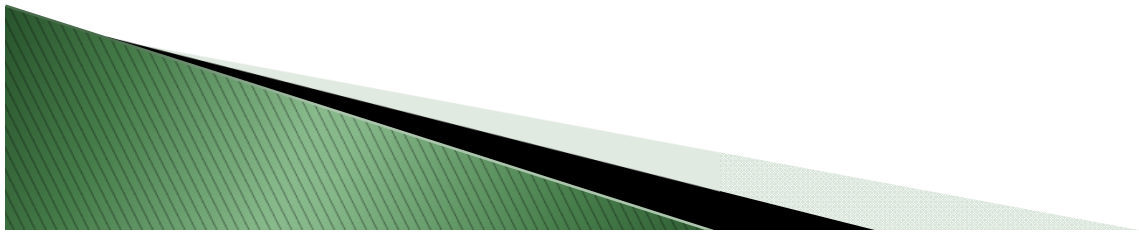


Review of methodologies and tools which seek to deliver sustainable areas



Classification of Studies

- Sixteen studies have been reviewed, analyzed and classified, according to their objective and tools.
- Only methods that were sufficiently different from each other, well documented and showing proof have been used.
- The aim of this classification is to point out in what ways, and to what extend the three dimensions of SD are incorporated and to examine if they are equally prioritized.



Classification of the studies according to their objectives

Objective of the Studies	Number of Studies	Percentage
Focus only on environmental sustainability, or assessing environmental impacts	7	43.75%
Attempts to assess or measure all three dimensions of sustainability (economic, environmental, social)	6	37.50%
Different approaches to measure or assess sustainability. (Consistency between socio-economic indicators and climate change, assessment of ecological and economic sustainability or economic valuation of sustainability indicators.	3	18.75%
Total	16	100%

Classification of the studies according to the methodologies and tools

Environmental, Economic and Social Sustainability		
Author	**Objective**	**Methodologies and Tools**
Paracchini et. al. 2011	integrated economic, environmental and social issues across a variety of sectors	operational multi-scale framework, which comprises the assessment in the three dimensions of sustainability
Gomez-Limon and Sanchez-Fernandez 2010	evaluated the three dimensions sustainability of farms by means of composite indicators	16 indicators that cover the three components of the sustainability concept
Zahm et. al. 2008	designed a self-assessment tool based on the IDEA method to support sustainable agriculture	41 indicators covering the three dimensions of sustainability
Van Cauwenbergh et. al. 2007	proposed a framework for sustainability assessment of agricultural systems, encompassed the three dimensions of sustainability	the framework is composed of principles, criteria, indicators and reference values in a structured way
Rasul and Thapa 2004	examined the sustainability in terms of environmental soundness, economic viability and social acceptability	12 indicators covering the three dimensions of sustainability
Glaser and Diele 2004	presented some central aspects for the assessment of the three dimensions of sustainability	criteria from biology, economics and sociology

Environmental Sustainability		
Author	**Objective**	**Methodologies and Tools**
Halberg et. al. 2005	selected ten input-output IOA systems as effective tools for Agri-environmental improvement	environmental indicators based on good agricultural practices (GAP)
Lundin and Morrison 2002	presented a procedure which measures environmental sustainability of urban water system, based on LCA methodology	indicators, which best reflect environmental sustainability
Girardin et. al 2000	adopted an interaction matrix to evaluate the effects of farmer production practices on the agro-ecosystem.	Agro-Ecological Indicators AEI) and Indicators of Environmental Impact (IEI)
Onate et. al. 2000	tried to evaluate the potential effects of Agri-environmental Regulation	Agri-environmental indicators (AEIs)
Haas et al. 2000	adapted the LCA method, for assessing the environmental impact of production processes	the whole farm level, efficiently and feasibly assessing all relevant environmental impacts
Rossing et. al. 1997	tried to measure ecological sustainability taking into account recent changes in practices in the farm	Farmer Sustainability Index (FSI), a single value reflecting ecological sustainability.
Taylor et. al. 1993	designed a framework for environmentally friendly flower bulb production systems	1 economic, 2 environmental objectives and various socio-economic constraints

Additional Studies		
Author	**Objective**	**Methodologies and Tools**
Abildtrup et. al. 2006	presented an approach for the construction of socio-economic scenarios required for the analysis of climate change impacts	scenarios that ensured internal consistency between the evolution of socio-economics and climate change
Pannell and Glenn 2000	presented a conceptual framework for the economic valuation and prioritization of sustainability indicators	the framework was based on Bayesian decision theory calculate the value of information under conditions of uncertainty
Biewinga and van der Bijl 1996	tried to assess ecological and economic sustainability of growing and conversion of crops to energy	environmental and additional economic indicators specific for agricultural production systems.

Indicators for the assessment of environmental sustainability

Author	Indicators
Halberg et. al. 2005	1. Nutrient use (Surplus N and P, Efficiency % output input 2. Energy use (Direct energy, MJ or MJ, Total energy Use) 3. Pesticide use (Treatment frequency index, Environmental impact points)
Onate et. al. 2000	Land-use level 1. Scrubs - Area of scrub 2. Barren - land Area of barren land 3. Grassland - Area of grassland 4. Crops - (Arable area-Fallow area) 5. Fallow land - Area of fallow land 6. Irrigated land - Area of irrigated crops 7. Tree plantations - Area of tree plantations 8. Crop boundaries - Area (length) of boundaries 9. Hedgerows Area - (length) of hedgerows 10. Crops to fallow - Area converted 11. Fallow to crops - Area converted 12. Arable to tree plantations - Area converted 13. Arable to abandoned - Area converted Management level 1. Grain legume crops - Area of grain legume 2. Crops diversity - No. of crops with >5% of FA or GA 3. Fertilizers use Kg 4. Sprayers use Kg 5. Grazing stock density 6. Date of harvest

Author	Indicators
Lundin and Morrison 2002	1. Withdrawal – Annual freshwater withdrawal/annual available volume 2. Water consumption – Use per capita per day 3. Treatment – Chemical and energy use for water supply 4. Distribution – Leakage (unaccounted water/produced water) 5. Reuse of water – Reused water 6. Production – Wastewater production per day 7. Treatment –performance Removal of BOD5, P, N 8. Loads to receiving water – Loads of BOD5, P and N 9. Resource use – Chemical and energy use for wastewater treatment 10. Recycling of nutrients – Amount of P and N recycled 11. Quality of sludge – Cadmium content in sludge 12. Energy recovery –Energy recovered, heating and power
Haas et al. 2000	1. Resource consumption – Use of primary energy, Use of P– & K– fertiliser 2. Global warming potential – CO, CH,, N20–emission 3. Soil function/strain Accumulation of heavy metals, NH~, NO x, SO2–emission 4. Water quality – N–fertilising, N–farmgate–balance, potential of nitrate leaching, 5. P–fertilising, P–balance, % of drained area 6. Human and ecotoxicity – Application of herbicides and antibiotics, potential of nitrate leaching, NH3 emission 7. Biodiversity – Grassland (number of species, date of first cut), hedges & field margins (density, diversity, state, care) 8. Landscape image Grassland, hedges & field margins, grazing animals (period, breed, alpine cattle keeping), layout of farmstead (regional type, buildings) 9. Animal husbandry – Housing system & conditions, herd management (e.g. lightness, spacing, grazing season, care)

Indicators for the assessment of the 3 dimensions of sustainability

Author	Indicators		
	Economic	Environmental	Social
Paracchini et. al. 2011	1. Residential Ind. Services 2. Land based Production 3. Infrastructure	4. Abiotic Resources 5. Provision Habitat 6. Ecosystem Processes	7. Work 8. Health & Recreation 9. Culture
Zahm et. al. 2008	1. Available income per worker compared with the national legal minimum wage 2. Economic specialization rate 3. Financial autonomy 4. Reliance on direct subsidies from CAP and indirect economic impact of milk and sugar quotas 5. Total assets minus lands value by non salaried worker unit 6. Operating expenses as a proportion of total production value	7. Diversity of annual or temporary crops 8. Diversity of perennial crops 9. Diversity of associated vegetation 10. Animal diversity 11. Enhancement and conservation of genetic heritage 12. Cropping patterns 13. Dimension of fields 14. Organic matter management 15. Ecological buffer zones 16. Measures to protect the natural heritage 17. Stocking rate 18. Fodder area management 19. Fertilization 20. Effluent processing 21. Pesticides and veterinary products 22. Animal well-being 23. Soil resource protection 24. Water resource protection 25. Energy dependence	26. Quality of foodstuffs produced 27. Enhancement of buildings and landscape heritage 28. Processing of non-organic waste 29. Accessibility of space 30. Social involvement 31. Services, multi-activities 32. Contribution to employment 33. Collective work 34. Organisation of space 35. Probable farm sustainability 36. Contribution to world food balance 37. Training 38. Labour intensity 39. Quality of life 40. Isolation 41. Reception, hygiene and safety

Author	Indicators		
	Economic	Environmental	Social
Gomez-Limon and Sanchez-Fernandez 2010	1. Income of agricultural producers 2. Contribution of agriculture to GDP 3. Insured area	4. Economic dependence on agricultural activity 5. Specialization 6. Mean area per plot 7. Soil cover 8. Nitrogen balance 9. Phosphorus balance 10. Pesticide risk 11. Use of irrigation water 12. Energy balance 13. Agro-environmental subsidy areas	14. Agricultural employment 15. Stability of work-force 16. Risk of abandonment of agricultural activity
Van Cauwenbergh et. al. 2007	1. Farm income 2. Dependency on direct and indirect subsidies 3. Dependency on external finance 4. Agricultural activities 5. Market activities 6. Farmer's professional training 7. Inter-generational continuation of farming activity 8. Land tenure arrangements 9. Adaptability of the farm	10. Supply (flow) of quality air function 11. Supply (stock) of soil function 12. Supply (flow) of water function 13. Water flow buffering function 14. Supply (flow) of energy function 15. Supply (stock) of biotic resources 16. Supply (stock) of habitat function 17. Biotic resource flow buffering function	18. Food security and safety 19. Physical well-being of the farming community function 20. Psychological well-being of the farming community function 21. Well-being of the society
Rasul and Thapa 2004	1. Land productivity 2. Yield stability and profitability	3. Land-use pattern 4. Cropping pattern 5. Soil fertility management, 6. Pest and disease management 7. Soil fertility status	8. Input self-sufficiency 9. Equity 10. Food security 11. Risks and uncertainties involved in crop cultivation

Remarks

- The different dimensions of SD have not been **equally prioritized.**
- The division of indicators emphasizes the **multi-dimensional nature** of SD and reflects the importance of integrating its dimensions.
- Measurement of sustainability needs a set of **multidimensional indicators.**
- A conceptual approach is still missing from the literature. There is a plethora of objectives, strategies, measurements but with little regard for the equal selection of indicators.

Next Steps

1. Development of a hierarchical **framework** based on different themes, according to the policy priorities of the SDS
2. **Define criteria** for the selection of the best-needed SDI in each theme:
   - Data availability and reliability
   - Suitability of the data
   - Interlinkage relationships between the dimensions
3. Define **a comparative basis** for better understanding of drivers and goals of each practice
4. **Development a set of SDI** (new/extension/combination), for making operational the measurement of sustainability.
5. Contribute to the research towards a sustainable knowledge society through the development of a framework of Sustainable Development Indicators.

Methodology

- Multivariate analysis, (grouping and classification) of methodologies and tools, to point out in what ways, and to what extend the three dimensions are incorporated within SD

- Multicriteria analysis based on Multicriteria Decision Making in order to evaluate the existing tools – selection of appropriate indicators – simulation of the most realistic decision process such as **optimum set of SDI.**

Thank you