The Sustainability of Italian Agriculture: A Pilot Project

Trisorio A.[1]

Abstract

This paper provides a first attempt to assess the progress of Italian agriculture towards the path of sustainability. A set of indicators has been implemented taking into account social, economic and environmental dimensions of agriculture. Indicators may help policy maker in addressing and targeting policies, identifying possible priorities to which address financial resources. The paper concludes suggesting a possible solution to the problem of aggregation finalised at a synthetic representation of the progress towards sustainability.

Keywords: sustainability assessment, sustainability indicators, Italian agriculture

1 Introduction

The purpose of this contribution is the assessment of the progress of Italian agriculture towards the path of sustainability, through the selection and implementation of a set of indicators.

Sustainable development at sectoral (i.e. agriculture) and territorial (rural areas) level represents a priority objective of the European Union strategy, as can be derived from many of the most recent documents, where one finds that “all policies” - such as those implemented through Structural Funds - “must have sustainable development as their core concern” (Commission of the European Communities, 2001), and that “sustainable development is a priority at all levels of public governance, and increasing awareness in the private sector” (Commission of the European Communities, 2003).

Early studies on sustainability were developed by the United Nations immediately after the UN Conference on Environment and Development, the Rio Summit held in 1992. It followed the work of OECD during the nineties, which adopted the PSR - *Pressure, State, Response* framework to represent agriculture-environment relationship. Together with the activities of the Joint Research Centre and EUROSTAT, the European Commission has developed a series of indicators aimed at assessing the V Framework Programme progress. Important studies on sustainability were produced also at national level; among these we find the experience of Australia (Commonwealth of Australia, 1998), Finland (Aakkula, 2000), United Kingdom (MAFF, 2000) and Canada (McRae T. *et al*., 2000).

What comes out is that there is no universally agreed definition of the concept of sustainability, nor general consensus on its representation. Even if one starts from a common base concept, the parameters chosen to describe and to analyse “sustainability” vary according to context, data availability, and researcher background.

Indeed a crucial aspect attains the definition of sustainability. That is, elaborate a new definition or make a choice within both the numerous definitions one finds in literature, and the subsequent meanings and interpretations.

In this contribution we adopt the definition included in the Brundtland report (WCED, 1987, p. 43). The latter is the most widely quoted and generally accepted, especially at institutional level. According to this very broad definition “sustainable” is that “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. This approach to sustainability underpins an opportunities-based view. The idea of preservation of

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opportunities implies the maintenance of the productive potential of the economy. The latter will be achieved if variations in the stock of productive assets (labour and all other productive resources) allow output non-declining over time. Moreover, this definition implies problems of substitutability between productive assets, raising the issue of distinction between strong and weak sustainability.[2] Whatever the adopted definition, the "operational" interpretation of the concept of sustainability includes a multidimensional dimension: environmental, social and economical.

Further defining problems and complexities emerge expressing the notion of sustainability with reference to a particular economic sector, namely the agriculture. In order to provide useful insight for policy makers, avoiding sectoral policy inconsistency, it is, indeed, necessary to take into account interactions between agriculture and other economic sectors, being the sustainability of the economic system as a whole the ultimate aim.

In this contribution we analyse sustainability in its three dimensions, namely economic, social and environmental, with reference to the agricultural activity, taking into account the rural areas.

Territorial dimension is taken into account recognising that interactions between the environment, the economy and society are linked to both regional specificity and geographical differences.

To take informed decisions policy makers need to be supported with a tool allowing the measurement of possible progress towards policy objectives, such as sustainability. Within the available tools, we consider indicators one of the most appropriate to this aim.

Indicators are generally accepted as a "vehicle for summarising, or otherwise simplifying and communicating information about phenomena that is of importance to decision-makers" (Moxey *et al.,* 1998). Indeed they are valid tools in the process of policy monitoring and evaluating, allowing to investigate on how policy measures and economic activities respond to sustainability concern. "Indicators provide the basis for assessing progress towards the long-term objective of sustainable development. Long-term targets only have meanings as policy goals if progress towards them can be assessed objectively" (European Commission, 2001). Moreover, they can help in highlighting the trade-offs between the three dimensions of sustainability (i.e. economic, social and environmental), and between sectors of economic activity; thus providing a basis for policy recommendation.

2 Indicators selection process

In the process of selecting indicators we mainly refer to European Commission documents such as "A Framework for Indicators for the Economic and Social Dimensions of Sustainable Agriculture and Rural Development" for the socio-economic dimension; and "Indicators for the Integration of Environmental Concerns into the Common Agricultural Policy" together with international experience within OECD (Organisation for Economic Co-operation and Development), EEA (European Environmental Agency), ECNC (European Centre for Nature Conservation) for the indicators referring to the environmental dimension.

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[2] Capital assets (K) take three forms: 1) man made capital (reproducible capital) K_M; 2) human capital (stock of knowledge and skills) K_H; 3) natural capital (any natural asset yielding a flow of ecological services with economic value over time) K_N. A criterion for sustainability is a non declining capital stock: the "constant capital" rule. A first variant of this criterion is the "weak sustainability" rule, assuming substitution possibilities between component parts of capital. Therefore development is sustainable even if some component (such as natural capital) is declining, provided the total capital stock is not falling. Much of the ecological literature denies this substitutability, at least across some classes of natural capital. It therefore applies a second variant of the "constant capital" rule: the "strong sustainability" rule. The latter requires that K_N be held constant (or increasing) within the more general constraint that K be constant (or increasing). A modified version of the "strong sustainability" rule derives from the assignation of particular importance to some parts of natural capital (defined critical natural capital K^*_N), those providing valuable and non-substitutable environmental services, the "life support" functions to ecosystems. According to this modified version of "strong sustainability" rule is this critical natural capital K^*_N that is constrained to be non decreasing through time. The use of the remaining components of natural capital can than be analysed according to a weak sustainability approach (Atkinson and Pearce, 1993, Pearce and Atkinson, 1995).

The choice to strongly refer to indicators proposed by the European Commission and by international organisations is aimed at: a) testing them according to data currently available at Italian level; b) allowing international comparisons.

The *economic dimension* mainly refers to: a) the efficient use of resources; b) competitiveness and vitality of agricultural sector; c) the contribution of agriculture to the development and conservation of rural areas; d) the diversification of income sources within farm families.

The *social dimension* refers to equity meant as “equal opportunities”, not only at territorial level (among rural and no rural areas), but also at sectoral level (among agriculture and other economic sectors) and among social groups. Issues included in this dimension are those linked to employment opportunities and to farmers access to resources and social services. Indicators are mostly related to the characteristics of human capital.

The *environmental dimension* refers to natural resources management and conservation. Environmental system is analysed on the basis of a list of policy relevant environmental objectives[3] – conservation of landscape and biodiversity, protection of water resources, soil and air. Indicators refer to the *Driving forces, Pressure, State, Impact, Response* model; the latter allowing to appropriately structure and organise the environmental information.

For each dimension a group of priority objectives has been identified, so that indicators are selected referring to these objectives. Indicators are implemented on the basis of data that are currently available. The constraint of data availability allow to verify current possibilities of a “sustainability analysis”.

Referring to time dimension indicators rely on time series as long as possible – in most cases at least five years. The appropriate length for data time series depends on type of indicator. In some cases time series are shorter than required. This is especially the case of environmental data which refer to issues only recently identified by our society as important and therefore to be measured and assessed. In these cases we consider indicators anyway, in order to establish a baseline for assessing trends in the future.

As to the space dimension the geographical unit refers to administrative boundaries at as small level as possible (regional, municipal).

Each indicator is presented[4] using two graphs showing trends by macro-region, that is Northern, North-East, North-West, Middle, South and Islands, and by administrative region. It follows a synthetic representation, through Chernoff icon, showing the progress by macro-region performed by the indicator, individually considered, towards the path of sustainability.

The lack of fully developed indicators did not preclude an issue or indicator from being considered.

3 Indicators classification process

The overall number of indicators calculated is 38.

The first 13 are of a socio-economic nature. They aim at analysing: a) production efficiency of the agricultural sector; b) its capacity to create employment; and c) its ability to contribute to the maintenance of rural areas. The selection of indicators related to these issues is still in progress.

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[3] In example, according to the 6th Environmental Action Plan, soil protection, air quality and the sustainable use and management of natural resources are considered by EC as central issues.

[4] In the INEA Report, *The Sustainibility of Italian Agriculture* on which this paper is based.

The remaining 25 indicators give information on the impact of agriculture on the five components[5] we structure the analysis of the environment, according to the policy relevant environmental objectives previously identified.

Soil is considered as a dynamic and not renewable natural resource. Exploitation by agriculture has contributed to the degradation of its chemical, physical and biological characteristics. The indicators selected aim to evaluate the agriculture - soil linkages through measures that highlight the pressure on soil deriving from animal breeding, fertiliser and pesticide use, excess of pollutants.

The evaluation of the impact of the agricultural activity on *air quality* is more complex. Even if agriculture is not the main source of emissions to the atmosphere, it influences the reduction of the ozone layer through gas emissions (methane, carbon dioxide and ammonia) and energy consumption. Indicators related to air quality aim to evaluate the pressure of agriculture, mainly through the measurement of the amount of gas emissions.

Also the agriculture-water relationship shows a complex picture, due to difficulties found in isolating the impact exclusively derived from agricultural activities. The evaluation of sustainability of *water use* in agriculture has been performed taking into account aspects linked to: 1) the use of water resources and their management (i.e. the technology used and the different supply sources) as to the quantity side; 2) water resources pollution (nutrient balance and nutrient leaching) as to the quality side.

According to the Convention on Biological Diversity[6], "*biological diversity* means the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". It can be analysed in terms of: a) *genetic diversity* ("within species"), referring to the diversity of fundamental genes within domesticated species (plant or livestock) and wild relatives; b) s*pecies diversity* ("between species"), that is the number and population of wild species (fauna and flora) affected by agriculture, including soil biota and the effects of non-native species on agriculture; c) e*cosystem diversity* ("of ecosystem") referring to the diversity of species, processes and ecological functions observed in different ecosystems which are "formed by populations of species relevant to agriculture or species communities dependent on agricultural habitats" (OECD, 2001). The selected indicators make reference mainly to the last two issues, because data currently available does not allow cover genetic diversity.

The *landscape* issue is both similar[7] and related to that of biodiversity. It is mainly analysed through indirect indicators, such as concentration and intensification of agricultural activity, being pressure factors cause of land shape variations.

Inclusion of indicators under one or another issues is a matter of interpretation and perspective. Categorisation is not rigid, and a number of indicators can indeed fall into other issues depending on the question they have to answer. Moreover "a balance among the number of economic, environmental and social indicators is not necessarily required given the different degree of aggregation, the inexact categorisation of indicators, and uncertainties about the most appropriate measures to use" (U.S. Interagency Working Group on Sustainable Development Indicators, 1998).

Furthermore, a set of indicators is valid for a certain point in time, and it should be flexible to include the possibility to be changed as priorities shift or our base of knowledge expand. Taking into account the previous aspects our set of indicators has been built without rigidity elements.

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[5] The environmental components considered are the following: soil, atmosphere, water resources, biodiversity, landscape.

[6] Convention ratified at the UN Conference on Environment and Development, at Rio, Brazil, in 1992.

[7] There are similarities in complexity and in the kind of linkages to agriculture.

The three dimensions (environmental, economic and social) were in a first stage separately analysed. As previously pointed out, for each dimension a group of priority objectives was identified, the indicators referring to these objectives.

In order to be possibly compared with the results coming from the international experiences previously cited, the indicators were classified using the DPSIR (*Driving forces, Pressure, State, Impact, Response*) scheme, representing the causal chain of relationship among agriculture and the three dimensions considered. This framework was extended from the environmental dimension to the social and economic ones.

According to EEA, the *driving forces* (D) are the primary causes of environmental impact. The *pressure indicators* (P) directly regard the causes of problems and refer to the human actions that produce environmental impacts. The *state indicators* (S) describe the environmental conditions regarding quality and quantities of natural resources. The *impact indicators* (I) refer to variations of state and effects on human activities. The *response indicators* (R) are the measures adopted in order to face policy problems (i.e. agri-environmental measures, more restrictive regulations); they refer to the society actions towards environmental changes. Society responses can be distinguished in: 1) actions to prevent and reduce negative impacts derived from human activity; 2) actions to restore environmental damages, 3) actions to preserve or restore environmental resources.

The selected indicators classified according to the scheme above described are presented in Table 1.

Table 1: Classification of indicators

		Social dimension	***DPSIR***
1	**Human capital**	Agricultural employment	D
2		Ageing index	D
3		Educational level of farmers	D
4	**Equal opportunities**	Differences among female and male employment shares	D
5		Rural population	D
		Economic dimension	
6	**Efficiency**	Labour profitability	D
7		Land profitability	D
8		Labour productivity	D
9		Land productivity	D
10	**Vitality**	Marginalisation	D
11		Diversification of farmer labour	D
12	**Competitiveness**	Incidence of agricultural value added on total value added	D
13		Fixed investment in agriculture	D
		Environmental dimension	
14	**Soil**	Livestock units per hectare	P
15		Stock per breed	P
16		Phosphorus balance	P
17		Pesticide use	P
18	**Air**	Emissions of methane (CH_4)	P
19		Emissions of ammonia (NH_3)	P
20		Emissions of carbon dioxide (CO_2)	P
21		Direct use of energy	P
22	**Water quality**	Nitrogen balance	P
23		Potential nitrate leaching	P
24		Nutrient use	P
25		Use of fertilising schemes	P
26	**Water quantity**	Irrigation systems	P
27		Irrigated area	D
28		Source of water supply	P
29	**Biodiversity**	Protected area	R
30		Species at risk or extinct	I

31		Fired walls area	P
32		Organic farming	R
33		Agri-environmental schemes	R
34	**Landscape**	Agricultural Utilised Area	S
35		Forest cover index	S
36		Agricultural intensity	P
37		Concentration	P
38		Man made and natural elements	P

Some of the selected indicators suffer from several limitations such as the presence of data gaps, the intrinsic quality, geographic limits.

The level of detail is regional, while the length of time series is not uniform, but varies depending on available statistics. As above described, indicators has been calculated both at regional and macro-regional level[8].

Data are based on official national statistics. This represents on one hand, a constraint of the analysis, on the other, it provides a picture of the current possibility to implement indicators proposed at international level.

Most of data come from the National Institute of Statistic (ISTAT). Energy consumption data come from the FADN[9] database. Organic production data come from the Biobank database. Specie conditions data are WWF statistics.

Indicators mainly derive from simple mathematical operations among data above mentioned. In some cases, concerning in particular environmental indicators such as nitrogen balance, phosphorus balance, carbon dioxide emissions, methane emissions and ammonia emissions, indicators come as output of an economic-ecological model named ELBA, an Italian revised version of CAPRI model (a model designed at EU level).

Indicators are organised by schedule. Each of them is divided into two sections. The first contains general information on the issue under examination; the second describes trends in the various Italian regions and macro-regions. Comparison among regions is made using both graphics in order to immediately view the trend over time, and a schematic representation (Chernoff icon) of the progress of Italian agriculture towards sustainability (see box 1).

Box 1: Schematic representation of agriculture progress towards sustainability

☺ = Positive

😐 = Invariant

☹ = Negative

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[8] Macro-regions include the following Regions:
North-west: Piemonte, Valle d'Aosta, Lombardia, Liguria.
North-east: Trentino-Alto Adige, Veneto, Friuli Venezia Giulia, Emilia Romagna.
Centre: Toscana, Umbria, Marche, Lazio.
South and Islands: Abruzzo, Molise, Campania, Basilicata, Puglia, Calabria, Sicilia, Sardegna.

[9] Farm Accountancy Data Network, implemented in Italy by INEA.

3 First results

38 indicators are implemented. For each of them trend over time and comparisons among regions are made. In addition, a schematic representation offers the “position” of indicator values, singly analysed, towards sustainability.

Indicators show that most progresses have to be done within the social and the environmental dimensions. With reference to the first dimension, some problems emerge in rural areas; with respect to the latter, particularly weak are the biodiversity and landscape issues, while progresses are performed in terms of soil and water pollution reduction.

By examining the three groups of indicators it is possible to obtain insight on the conditions and approaches that could support sustainable agriculture. These first results may help policy maker in addressing and targeting policies, identifying possible priorities to which address financial resources.

4 Final remarks and future developments

This paper presents a first attempt to show progress of Italian agriculture towards the path of sustainability, through the implementation of a set of indicators. The latter refers to a precise point in time, is flexible and subject to variations as political priorities and social values shift, and knowledge expands.

Indicators represent one way of monitoring sustainable development; they are a tool to assess whether patterns of economic activity are likely to satisfy sustainability objectives, and to provide a basis for policy recommendation. They help to highlight the trade-off among the three dimensions (economic, social and environmental), and among sectors of economic activity.

The process of selection of indicators has been limited by constraints related to data availability, spatial and timing aggregation. This raises the issue of consistent representation of real path of developments; in fact indicators are often data-generated rather than problem generated, limiting their potential in decision making.

With regard to the issues of interpretation and adoption of indicators it is crucial to identify necessary and sufficient condition for sustainability.

Indeed, the assessment of possible progress towards sustainability can not be done before the definition of: a) priority objectives, in the field of economics, environment and society, based on society values and goals; and b) targets and thresholds for each indicator. The first is mainly linked to policy decision; it is useful in setting the relative importance (and possibly weighting) of various sustainability issues and indicators. The latter can be suggested by scientists; and it is useful in interpreting the direction of certain developments and trends (distance to-target-method). Especially with reference to the environment, characterised by uncertainties, irreversibility and ignorance, some form of risk averse, precautionary behaviour is probably warranted.

The definition of “sustainability criteria” for each of the three dimensions (e.g. economic, social and environmental), and for them altogether, would allow to reach a complete view of the picture, taking into account the simultaneous progress of the three dimensions. Indeed, in order to be included in the decision making process indicators are to be compared with some pre-specified value, e.g. thresholds and targets.

Though aware of the importance of thresholds or targets to indicators interpretation, we prefer to leave up this task to policy makers and/or experts in the indicator fields. Therefore a first assessment of the progress of Italian agriculture towards sustainability has been simply based on trends or state of indicators.

Only the simultaneous pursuing (or approaching to the solution) of all objectives assure that a more general objective of sustainability is achieved. Further work is then needed on the ground of aggregation in order to build a synthetic representation of the progress towards sustainability. We are at the first stage of some basic reasoning on this topic. Aggregation is a way to simplify the information in order to make it easily understandable and usable by decision-makers, asking for small number of indices. Indeed, a synthetic representation of the sustainability of agriculture would facilitate the inclusion of this complex issue into policy concern. Nevertheless, in the case of sustainability indicators the use of compensatory methods of aggregation (e.g. weighting means) would bias information because of the holistic nature of the issue.

A possible solution to obtain an overall picture of the progress towards sustainability can be to resort to the concept of the *dashboard*[10]. It indeed allows to control indicators all together, both overcoming the problem of operations on indicators which would have introduced further subjectivity to the process of assessment, and assuring more transparency to the process. Moreover it gives the idea of the complexity of the issue of sustainability and of the impossibility to provide a univocal evaluation on it.

A step forward would be the analysis of the sustainability of the whole economic system shifting the focus from one sector to all the sectors of the economic system.

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[10] This approach has been proposed by IISD/Consultative Group on Sustainable Development Indicators. "Using the metaphor of a vehicle's instrument panel, it displays country-specific assessments of economic, environmental, social and institutional performance toward (or away from) sustainability" (http://www.iisd.org/cgsdi/dashboard.htm). See also U.S. Interagency Working Group on Sustainable Development Indicators, 1998.

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