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12 The measurement of the development sustainability in agriculture: experiencing the web of statistical indicators¹

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'I will conclude with a final observation about the importance of indicators. Therefore, by implication, we play a critical role in measuring the effectiveness of public policy and private business decisions that influence national agricultural performance.'

R. Ronald Bosecker

International Interests In Agricultural And Rural Statistics
ICAS III *'Measuring Sustainable Agriculture Indicators'*

The sustainable character of the economic development process ranks among the most critical issues of the statistical system integration into their economic environment. Indeed, the World Summit for Sustainable Development, organised in Johannesburg from 26th August to 4th September 2002, reaffirms the

¹ The authors thank Georges Decaudin, sub-director for the statistics of farms and forest with SCEES, Christian Gay, operations manager for international affairs at SCEES and Céline Rouquette sub-director for syntheses and incomes with SCEES, for their attentive second reading of this text, while remaining the sole responsible for the possible errors or omissions. This work profits from a financial support granted under the *Impacts* project of the Agriculture and Sustainable Development (ADD) program of the French National Agency of Research (ANR). This text is a revised version of our communication to the Fourth International Conference On Agriculture Statistics (ICAS IV) held from 22 to 24 October 2007 in Beijing, China.

commitment of the international community for sustainable development and invites in its analysis and statistics action plan¹ to reinforce the national and regional information services which refer to the policies and measurements of sustainable development (§ 129), while encouraging further work on the indicators (§ 130 and 131).

12.1 The genesis of the sustainable development concept

In the recent history of the theories of economic development, the concept of sustainability is for the first time explicitly associated with that of growth by the economist Walt Whitman Rostow to qualify one of the phases of economic development while speaking about the takeoff towards self-sustained growth.² The problems of sustainable development are already embedded in the Club of Rome³ theses about the limits to growth,⁴ which will be spread at the end of the Sixties by the Meadows report. During the Seventies, in answer to this radical calling into question of the development idea, taking the environment into account as a critical factor is establishing through the development of strategies of ecological development or 'ecodevelopment'.⁵

A concept suggested in 1987 by the United Nations, sustainable development is defined as a type of development likely to ensure the needs for the present generations without compromising the possibilities offered to the future generations. It supposes the coherence of public policies followed by the various geopolitical entities, at the global level (continental block, under-regions, nations) as well as local one (districts, counties). The World Commission Report on the Environment and the Development, chaired by Gro Harlem Brundtland,⁶ alerting the General Assembly of the United Nations to the accelerated degradation of natural resources and its negative impact on economic and

¹ cf. www.agora21.org/johannesburg/rapports/plan-action.pdf, Means of execution, p. 76.

² W.W.Rostow (1956) 'The Takeoff into Growth Coil-Sustained', *Economic Newspaper*, n°66, pp. 25-48.

³ The Club of Rome, founded on 1968 April 8, by Aurelio Peccei and Alexander King, is a non-governmental organisation sensitising the governmental leaders with the complex problems of the development (<www.clubofrome.org>).

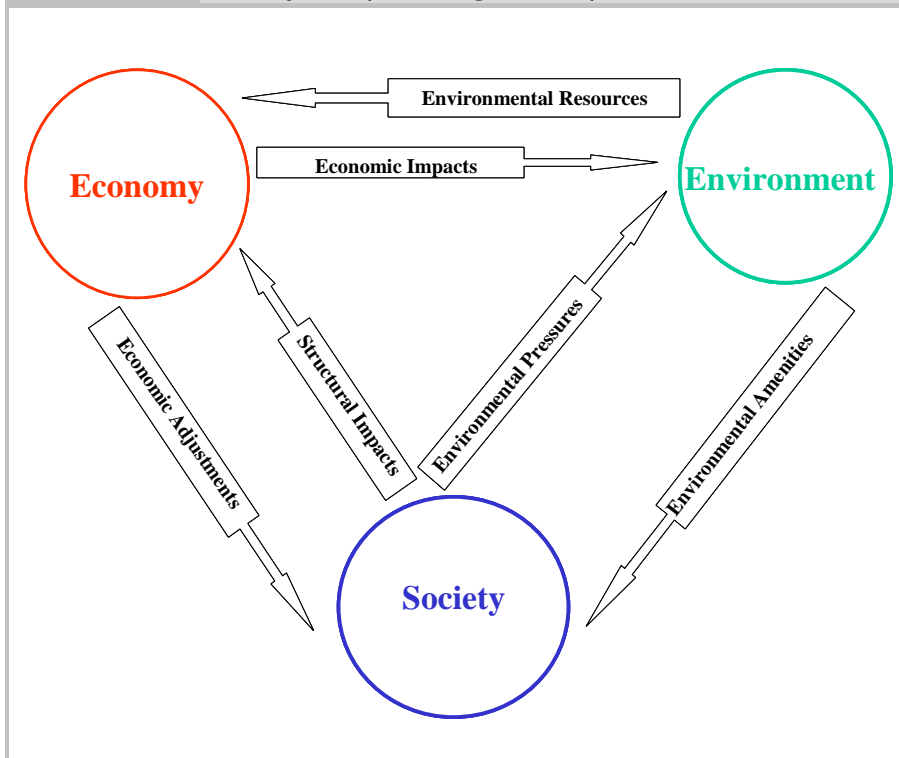
⁴ *The Limits to Growth*. Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III, Universe Books, New York, 1972.

⁵ Strategies reaffirming the objective of the development in a reorientation of the priorities and methods integrating environmental protection and of the natural resources, cf. Sachs, I. (1974). 'Environnement et styles de développement,' *Annales-Economies, Sociétés, Civilisations*, (3), pp. 553-570.

⁶ *Our Common Future (The Brundtland Report)*, World Commission on Environment and Development, Oxford University Press, 1987.

social development, has led to the A/RES/38/161¹ resolution recommending the implementation of environmental policies likely to guarantee a sustainable development. Five years later, Agenda 21,² a program resulting from the United Nations Conference on Environment and Development held with the Summit of the Earth in Rio de Janeiro in 1992, specifies that the concept of sustainable development defined by the Brundtland report rests on the harmonious integration of the economic, environmental and social spheres.

Figure 12.1 Interactions between the three spheres of sustainable development (according to OECD)



¹ A/RES/38/161 - Process of preparation of the Environmental Perspective to the Year 2000 and Beyond, General Assembly of the United Nations, 1983, September, 19.

² Action 21, Rio Declaration on environment and development, The United Nations Conference on Environment and Development, the United Nations, New York, 1993.

<www.un.org/documents/ga/conf151/aconf15126-1annex1.htm>

12.2 New deals for the South: the Millennium Development Goals

Issued in 2000 under the aegis of the Program of the United Nations for Development (UNDP), the eight Millennium Development Goals¹ (MDG) from here to 2015 are clearly within the perspective of sustainable development, in particular explicitly for the MDG 7 'To ensure a sustainable environment' and MDG 8 'To set up a world partnership for the development'. Bringing up to date and carrying out the synthesis of the specific objectives of the UNDP and the Program of the United Nations for Environment (PNUJ), the MDGs were devised with an aim of breaking with the underdevelopment of the southern countries while limiting the perverse effects of an uncontrolled economic development and a too brutal growth: climate change, disappearance of the primary forests, desertification, decline of the bio-diversity.

Focusing on the problems facing by the southern countries, the Millennium Development Strategy favour the reduction of hunger and poverty (MDG 1), primary education (MDG 2), the gender equality and women empowerment (MDG 3), the reduction of child mortality (MDG 4) and maternal health (MDG 5). Thus, some targets such as those of the MDG 6 (malaria) can appear less priority to bestow a sustainable character on human development, in the northern countries. Nevertheless, this divergence between North and South, perfectly legitimate at the development goal level, constitutes an additional source of difficulties for the evaluation, the comparison and the coordination of the government policies between international partners.

12.3 Structure, relevance and inflation of the indicators of sustainable development

The indicators are tools answering three key objectives: to simplify systemic complexity by integrating information to describe studied systems qualitatively and quantitatively, in order to be able to communicate operational information necessary to decision making by the actors of sustainable development.

12.3.1 Synthetic indicators of sustainable development

¹ In 2002, Kofi Annan, General Secretary of the United Nations, charges an independent commission (Millennium Project) with proposing an action plan to achieve the Goals of the Millennium. In 2005, Jeffrey Sachs, chairing the Millennium Project, submits the final report, entitled 'Investing in Development: With Practical Plan to Achieve the Millennium Development Goals', cf. <www.unmillenniumproject.org/reports>

The communication about the objectives of sustainable development directed towards the citizens requires a selection of indicators understandable by all and likely to gain the support of the majority in order to influence the individual behaviours, thus increasing the effects of the incentive measures. Synthetic indicators like gross domestic product (GDP) per capita adjusted for the depreciation of the natural capital,¹ are classically used. Other synthetic indicators such as the 'adjusted clear saving'² are used by the World Bank to take better into account some commercial or non-commercial components more or less ignored by the GDP. Alternate indicators, like the 'ecological footprint'³ largely popularised by some non governmental organisations (NGO) or that of the 'economic well-being'⁴ resulting from academic work still present an experimental character, the estimates being available only for some countries sometimes for lack of consensus on the methodology of estimate or reliable statistical data to estimate some components.

In spite of their teaching qualities, these synthetic indicators are too general for a follow-up targeting the specific objectives of the environmental public policies. One then calls upon composite indicators like those of the 'human

development index'¹ of the Program of the United Nations for the Development (UNDP), or like the index of environmental sustainability (*Esf*) of the Davos Forum.

¹ In 2002, the GDP does not take into account the exhaustion of the natural resources and consumption and environmental pollutions due to the production activities. Moreover, the 'defensive' expenditure devoted to environmental protection induces an increase in GDP. In the same way, the restorations even partial of a degraded environment lead to an artificial increase in the GDP. In order to take into account these effects, two corrections of the GDP were proposed: i) GDP reduced by the natural capital depreciation, denominated as 'green' GDP; ii) 'green' GDP reduced by expenditure restorers and defensives, denominated as 'sustainable' GDP.

² The 'adjusted clear saving' is defined as the clear saving increased of the expenditure of education but decreased by the consumption of fixed assets and the damage in the natural resources (e.g., production of gas with greenhouse effect). This adjustment leads to an estimate being able to represent only half of the monetary saving (Esty D.C., 'Toward dated-driven environmentalism: The Environmental Sustainability Index'. *The Environmental Law Reporter* n° 31, pp. 10603-10612, 2001).

³ The 'ecological footprint' measures for an individual or a population surface necessary for the production of the main resources consumed by this population and to the absorption of waste ('Ecological footprints and appropriated carrying capacity: what urban economics leaves out', William E. Rees, *Environment and Urbanization* n° 4, pp 121-130, 1992).

⁴ Osberg, Lars and Andrew Sharpe (2002) « An Index of Economic Well-being for Selected OECD Countries», *Review of Income and Wealth*, Ser. 48, n° 3, pp. 291-316.

¹ Since the first report on human development in 1990, the UNDP proposes a family of composite indicators allowing a progress evaluation of human development by country: the indicator of human development (HDI), the indicators of human poverty declined in two versions (HPI1 for the developing countries, HPI2 for the developed countries), the indicator measuring the inequality of gender (GDI)

12.3.2 The development of environmental accountancy

The objective of the international framework of environmental accountancy (SEEA³) is to provide an integrated and coherent framework of the relations between economy and environment, while bringing closer physical and monetary data and by connecting flows to stocks. In this context, a certain number of tools has been developed according to the countries to try to connect economic activities and environmental pressures, among which figure the development of national accounts increased by environmental accounts, comparing economic data with physical data according to the activity sector. Thus, the NAMEA⁴ methodology developed by CSO, the Netherlands Statistical Office, at the end of the Eighties is based on the development of input-output tables from national accounting increased by environmental accounts expressed in physical units. The accountancy of material flows counts the entirety of the material flow entering in and going out of the economy. When related to economic aggregates such as the GDP, the accounts of material flow⁵ inform about the productivity of the resources mobilized in running the economy.

and the measure it of women responsibility (GEM), cf. www.hdr.undp.org/hdr2006/statistics/indices.

² Environmental Sustainability Index (*Esi*), joint initiative of the Yale Centre for Environmental Law and Policy (YCELP) and of the Columbia University Centre for International Earth Science Information Network (CIESIN), evaluates for 146 countries according to 21 criteria 'the capacity to protect the environment in the next decades'. In this evaluation, published in the World economic forum 2005 in Davos, the first place goes to Finland and the last one to North Korea.

³ *System of integrated Environmental and Economic Accounting*

⁴ *National Accounting Matrix including Environmental Accounts*

⁵ Material Flow Accounts (MFA), cf. Accounts Department environmental and economic integrated. Handbook of the operations. Methodological studies, Series F n°78, the United Nations, 2001, (www.unstats.un.org/unsd/publication/SeriesF).

12.3.3 Sustainable development strategies as conceptual frameworks for the development of indicators

The follow-up of the governmental measures in favour of sustainable development with an aim of evaluation of the public policies assumes to decree technical standards on the basis of the posted and scientific knowledge available then to work out batteries of indicators reliable statistics and detailed objectives, usable by the specialists for thorough analyses. In order to claim relevance, the intrinsically multidimensional character of sustainable development (cf. figure 12.1, multiplicity of the interactions between the three spheres of development) leads necessarily to providing a rather broad range of indicators. One must also face the multiplication and the diversity of the reference systems promulgated by the various sustainability observatories, which they are regional offices, governmental institutes or international programs. From the 45 indicators presented in 2003 by the French Institute for the Environment (Ifen), to the 155 indicators proposed in 2005 by the European Union (EU), to the 900 World Bank indicators on development in 2007,¹ these reference systems have reached a level of complexity that makes difficult any attempt at synthesis.

It is thus necessary to establish conceptual frameworks in order to be able to manage this complexity by organising it so that the selected indicators can be easily put in relation to the objectives of the public policies in order to be exploitable directly by the decision makers in the public sphere concerned. Carried out by OECD, the inventory² of the batteries of sustainable development indicators shows that in order to be able to reconcile legibility and precision, the national and international institutes of statistics structure the battery of indicators in a hierarchy of topics and sub-topics. The existence of theme sets makes it possible to structure work by groups of indicators and induced statistical series.

The national strategies of sustainable development (*SNDD*) have vocation to federate the public policies followed in each sphere of the development in order to make sure of the compatibility between the objectives of economic growth, environmental protection and social wellbeing.

¹ World Development Indicators 2007
<http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS>

² « Overview of Sustainable Development Indicators Used by National and International Agencies », J. L. Hass, F. Brunvoll et Henning Hoie, *Statistics Working Paper 2002/2*, OCDE, cf. <http://www.oecd.org>

Thus, certain countries rely explicitly on their *SNDD* to structure their battery of indicators: it is the case of Austria mobilising 48 indicators to estimate the progress carried out in the achievement of the 20 key objectives stated in its *SNDD*. Other States like Canada or Norway, pioneers on the matter, decline the concept of capital according to various dimensions of the development in as many national credits than it is desirable (financial, but also natural, human, and social capital, even by subdividing it in produced credits), which makes it possible to reason in terms of stocks and flow. For example, Norway evaluates its natural capital in renewable terms of resources and ecosystems while the financial capital is evaluated in terms of savings adjusted for petroleum consumption and net income per capita. OECD also adopted this approach for its series of fundamental indicators of sustainable development,¹ which are organised in environmental credits, active economic and human capital.

In 1995, the Commission of the United Nations for Sustainable Development has adopted a list of 134 indicators organised in three sections: driving forces, state and answers. The relevance and the feasibility of these indicators were tested in 1998 by a panel of applicant countries (Germany, Austria, Belgium, Finland, France, the United Kingdom) in co-operation with developing countries (Morocco and Tunisia for France). Among the encountered problems, appeared the absence of statistical data for some indicators, the methodological problems of estimation for others, and finally the difficulties of interpretation in the comparisons. By way of example, the rate of households equipped with a fixed phone does not have the same significance for a Tunisian or French village. Since, the United Nations gradually gave up proposing universalist indicators.

From now on, the 138 basic indicators of the United Nations are gathered around a core of 58 indicators structured according to four chapters subdivided in topics: social (education, equity, housing, population, health, safety); environment (atmosphere, bio-diversity, land water, seas, soils); economy (mode of consumption and production, economic structures); institutions (institutional frame, potentialities of the material and cultural infrastructures). These indicators are implicitly designed in reference to the objectives of the special programs of the United Nations. At the regional level, the EU worked out a pyramidal hierarchy of indicators on the basis of European strategy endeavouring to integrate the strategies of the Member States.

12.4 Sustainable development and the integration of European statistical systems

¹ Développement durable. Les grandes questions, OECD, 2001.

Signing the declaration of Rio, the EU subscribed to the commitments stated by Agenda 21, in particular to the development of indicators of sustainable development (chapter 40) in order to be able to coordinate the *SNDD* on the basis of information exchange between States. Thus, the European Council of Gothenburg adopted in June 2001 a European strategy of sustainable development (*SEDD*), explicitly mentioned in article 2 of the Treaty establishing the EU. The *SEDD*, evaluated then renewed by the European Council of June 2006, envisages a battery of indicators to ensure and to determine the follow-up of priorities that are articulated with the strategy of Lisbon.¹ This battery comprises 155 indicators organised into a pyramidal hierarchy on 3 levels: the first level (topics) is that of the sustainable development strategy, that is to say 12 indicator-keys; the second level (sub-topics) corresponds to the sustainable development policies, that is to say 45 priority indicators; the third level (actions) is associated with the evaluations of the sustainable development policies and with the analysis of their interrelationships, that is to say 98 analytical indicators. In order to integrate the European sector policies within the *SEDD*, the task force European mobilized, in addition to work of UN² and those of OECD,³ the structural indicators of the Lisbon strategy and the specific batteries of indicators, in particular those on the integration of the environmental concerns (*Irena*⁴) in the common agricultural policy (CAP), but also the European indicators of health (*Ech*), those of ageing (*CPS*⁵), of poverty and social exclusion (*Laeken*⁶) and those on the effects of transport on the environment (*Term*).

Graph 2 The pyramidal hierarchy of sustainable indicators in Europe (according to Insee)

¹ The European Council of Lisbon (March 2000) laid down the following strategic objective: to make European Union the 'economy of knowledge the most competitive and most dynamic of the world from here at 2010, capable of a durable economic growth accompanied by a quantitative and qualitative improvement of employment and by a greater social cohesion'.

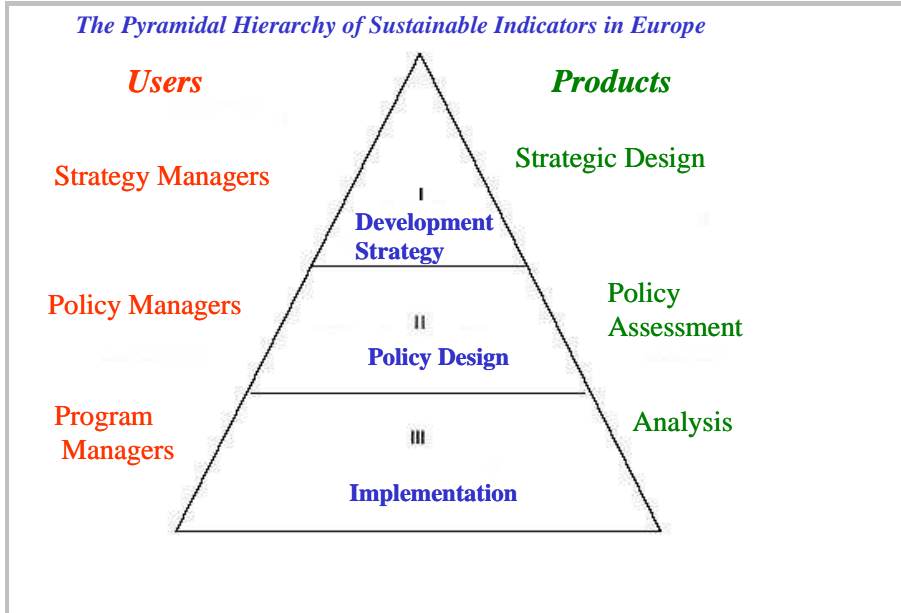
² *Indicators of Sustainable Development*. (<www.un.org/esa/sustdev/natlinfo/indicators/isd.htm>), 2006.

³ *Indicateurs clés d'environnement de l'OCDE* (<www.oecd.org/dataoecd/33/0/31558903.pdf>), 2004.

⁴ *Indicator reporting on the integration of environmental concerns into agricultural policy* (<www.eea.europa.eu/projects/irena>), 1995-2007.

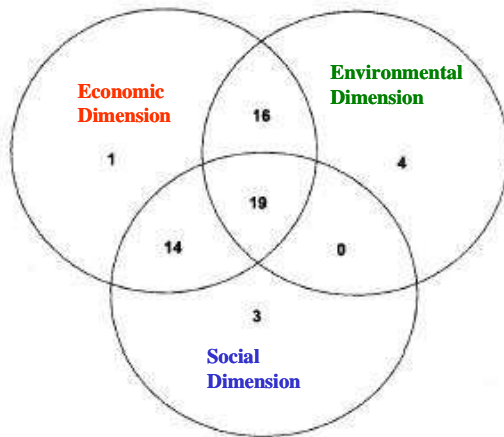
⁵ 'Committee of social protection'.

⁶ European indicators on the poverty and social exclusion validated at the Summit of Laeken-Brussels (December 2001). The revised list of Laeken indicators includes 11 primary education indicators exploring essential dimensions of poverty (income, employment, education, health) and 9 secondary indicators for the analysis of social situations and welfare transfers.



Graph 3 The 3-dimensional integration of sustainable development indicators (according to Insee)

3-dimensional integration of sustainable development indicators



The analysis of the pyramidal battery of the European indicators of sustainable development (*IEDD*) shows that social and environmental dimensions are not neglected. But, as an example of potential flaws in the European system of indicators, let us consider (cf. graph 3) the figures of indicators involved in the three spheres of sustainable development, at level 1 (for strategy) and level 2 (for policy): there are plenty of economic indicators (50 out of the 57 indicators). A second remark is the low number of « pure » indicators (8) and any indicator belonging both to the social dimension and to the environmental one.

The same criticisms have been recently addressed to *Inra*, the French national agronomic research institute, for the 2013 Prospective Exercise, with respect to French Agriculture missions.

For all this, some topics (good governance, total partnership) remain rather little explored by the public statistics because the methodology of investigation remains to be improved if not to be designed for a great part. Thus, the rate of participation in the European elections measures the degree of confidence of the citizen in the EU institutions: the use of tools such as Eurobarometer¹ should make it possible to improve this measurement.

With regards to the environmental indicators, it is also difficult to propose a synthetic indicator of the bio-diversity in the current state of knowledge. Thus, the specific bio-diversity is measured by the evaluation of the sole stock in the North Atlantic as a species threatened by over-fishing (priority indicator). The ecosystem biodiversity is evaluated on the basis of the evolution of the common bird populations (key indicator),² their rarefaction alerting on imbalances of the ecosystems, which shelter them. Measurement can be indirect: for example for the natural resource management: in order to follow the presence of pollutants of the soil, the system of the *IEDD* is based on the percentage of soil exposed to the risk of contamination, in terms of total area. The dangers of eutrophication³ are announced by an indicator of organic material emission such as a biochemical requirement of oxygen in the rivers.

¹ *Eurobarometer standard* n°67. The public opinion in the European Union, 2007, April-May. European commission, 2007, June (<www.ec.europa.eu/public_opinion/archives/eb>).

² Program STOC, temporal follow-up of common birds: larks, sparrows, and other endemic species of birds of the fields.

³ Excessive development of algae stimulated by nitrates resulting from the contributions of nitrate fertilizers.

The impact of the socio-economic activities on the diversity of the European landscapes is measured by two indicators based on the European investigation Lucas¹ of visual observation of geo-referenced points.

The works in progress relates to the necessary integration of the *IEDD* into the common tool of the European statistics, following the requests addressed by the European Council to Eurostat and to the national statistical institutes. Initially, it would be advisable to bring closer these *IEDD* indicators to those worked out for agriculture (*Irena*) and to those for industry (key environmental indicators of OECD).

Secondly, the Commission has recommended supplementing the structural indicators of the Lisbon strategy by 34 environmental indicators, following the February 2005 revival. Thus, there is an opportunity to integrate the Lisbon strategy into the *SEDD*. According to the task force report 'the principal weakness [note: of the *IEDD* system] lies in the absence of indicators measuring at the same time the social dimension and the environmental dimension'. The adoption in June 2006 by the EU of a new sustainable development strategy implies the revision of the *IEDD* battery at the end of 2007, to take into account the former evaluation and the *SEDD* reformulation.

12.5 Characteristics of national systems: the French context

12.5.1 Genesis and development of the statistics with environmental vocation

In France, if the creation of *Ifen*, the French Institute for the Environment, in 1991¹ constituted a decisive stage in the implementation by the public

¹ *Land Use/Cover Area frame Statistical survey*. The implementation of this project is consecutive with the Decision 1445/2000/EC of the European Parliament and the Council of May 22, 2000 on the application of spatial investigations and satellite imagery techniques to agricultural statistics from 1999 to 2003, prolonged until 2007 by the Decision 2066/2003/EC of 10 November 2003 and extended to the ten new Member States by the Decision 786/2004/EC of 21 April 2004. In 2001, Lucas covered 13 Member States of the EU. In 2002, because of the foot-and-mouth disease, Lucas was differed in United Kingdom and Ireland like in Estonia, Hungary and Slovenia. The investigation was renewed in 2003 in all the Member States of EU-15 as in Hungary, allowing at constant methodology the comparison of the changes occurred in the occupation of soils between 2003 and 2001. Some statistical problems related to the quality of the estimates arose from editions 2001 and 2003 so much because of the survey methodology adopted (impossibility of using a suitable stratification) that comparability of the collected environmental parameters, even, need for improving the cost ratio/effectiveness of investigations and for reaching the appropriate mid-July date to provide statistical data.

¹ Created by the Decree n° 91-1177 of 18 November 1991, the French Institute for the Environment (*Ifen*) received the statute of public corporation of the State in administrative matter, placed under the

statistical system of the recommendations put forth by the Gruson's report (1974)² then Ader's (1982)³ as regards environmental information, it was necessary to await the law of February 2, 1995 (known as 'Barnier's law') so that are registered in the national legislation the four principles founding the national strategy of sustainable development: prevention at the source; polluter-payer; participation and precaution. The principle of prevention at the source implies that the whole of the departmental statistical services (*SSM*) can be seized of specific information request in the investigations coordinated by the National council of statistical data (*Cnis*⁴). Formulated by OECD since 1972, the polluter pays principle has led to the creation of a satellite account relating to the environmental economics and the introduction of an Audit Committee for environmental economics. The taking into account of the environmental costs is carried out by way of the impact studies in the evaluations of public policies, the law of orientation, installation and sustainable development of the territory (known as 'Voynet's law') having imposed it in June 1999, in particular at the local level, by an implementation under the aegis of the Councils of development for rural and urban areas. The principle of participation supposes that the access to information is facilitated for each citizen. The convention of Aarhus, writing this principle within the framework of the Economic Conference of the United Nations for Europe, was ratified by France in October 2002, and was transformed into Community legislation by the Directive issued on 28 January 2003. Lastly, the precautionary principle forces the continuation of research in natural and social science to lead to a better statistical knowledge of the environmental state.

As a statistical service with national competence of the Ministry for Ecology, Sustainable Development and Environmental Planning, *Ifen* in charge of producing and disseminating environmental information in France, is the French correspondent of the European Agency for environment (AEE). The work of *Ifen* on the environment is articulated according to three dimensions: the state and evolution of the natural environments and the biodiversity; pressures exerted on

supervision of the ministry in charge of the environment. On January 2005, *Ifen* became a service with national competence, directly attached to the Minister for Ecology (decree n° 2004-936 of 30 August 2004).

² *Rapport d'activité du Groupe Interministériel d'Évaluation de l'Environnement*, Claude Gruson, La Documentation française, Paris, July 1974.

³ *Les statistiques de l'environnement, Rapport de mission au ministre de l'Environnement*, Gérard Ader, Insee, Paris, 1982, 239 p.

⁴ Created by the decree 84-628 of 17 July 1984, *Cnis* coordinates the statistical surveys of the public services in order to guarantee their economic and social relevance, ensuring the dialogue between producers and users of the public statistics with regards to the modified law 51-711 of 7 June 1951, 'about the obligation, coordination and the secrecy regarding statistics'.

the environment by the economic and human activities; impacts of the environment on the economy and the society. On a primarily pragmatic basis (statistical sources available, needs for information for the citizen and international comparisons), the ad-hoc interdepartmental work group controlled by the General Planning Committee retained 45 national indicators¹ including 12 leading indicators finally selected in November 2006² as much as possible to approach level 1 of the *IEDD*.

12.5.2 Tools of observation of the territory

In order to be able to measure the artificiality³ of natural space from the point of view of sustainable planning of the territory, France has acquired two tools of observation on complementary scales of resolution, which are the Teruti annual survey and the Corine Land Cover inventory.

The *Teruti* (use of the territory) annual survey, realised by SCEES,⁴ the statistical service of the Ministry for Agriculture and Fishing, makes it possible to know and monitor the distribution of the territory according to various criteria, from a sample of geo-referenced 'points' which an investigator goes on. The nomenclature of this investigation was conceived originally to describe the occupation and the land use, in particular by agriculture. Each point is described at the same time in a physical manner (surfaces occupied by crops, meadows, waste lands, moors, forests and other natural spaces, developed sites, roads, etc) and a functional one (agriculture, highway network, habitat, etc). Stemming from an area sample survey on the basis of a mesh of 144 km², marked out by 8 segments, made up each of 10 observation points (cf. graph 2), the surface estimates obtained are affected of a computable relative error, namely less than 5% for the 35 major categories of the physical nomenclature covering 95% of the national territory. The categories whose error is greater than 10% are relating to zones of lesser importance (less than 55,000 ha), apart from the salt marshes (88,000 ha) and the closed areas (127,000 ha) which can however be of some environmental interest, locally.

¹ *45 indicators of sustainable development: a contribution from Ifen*, Etudes et Travaux n°41, Ifen, 143 p.

² *Agir dans la dynamique européenne : douze indicateurs « phares » de développement durable*, Stratégie nationale de développement durable 2003-2008, Services du Premier Ministre, November 2006, 27 p., (<www.developpementdurable.gouv.fr>).

³ Term indicating the extension of the peri-urban and urban areas to the detriment of natural environments favourable to biodiversity like littoral or other agricultural surfaces such as bocage or meadows.

⁴ 'Service central des enquêtes et études statistiques' (Statistical Office of the French Agriculture Department).

The 2006 Corine Land Cover¹ inventory (CLC 2006) carried out for France by *Ifen* in collaboration with the European Agency of Environment (AEE) will make it possible to shed light on the evolutions which have occurred since 2000 as regards occupation of space, relating to in particular the evaluation of the dynamics of urban sprawl and its impact on the artificiality of the territories. The territory is analysed on the basis of satellite images like a sum of polygons distinguishing forests, urban fabric, natural environments, etc. Contrary to *Teruti*, the nomenclature of description is quite limited but however envisages mixed zones (bocage, for example) combining several types of occupation. Corine Land Cover does better to provide results for relatively fine geographical levels: objects described starting from a surface of more than 25 hectares. Combined with inventory CLC 2000,² the operation 2006 should constitute a reference index to appreciate the changes occurred on the coast line or having affected the agricultural territories. Lastly, the availability of a high-resolution product within the framework of the operation 2006 will contribute to raising the uncertainty, which surrounds the areas occupied by the forests.

Distributed according to the 6 criteria of sustainable management of Helsinki,³ the indicators of sustainable management of the French forests 2005⁴ of the National Forest Inventory (*IFM*) present the 35 quantitative

Graph 4	Grid diagram by Teruti covering the metropolitan French territory (according to SCEES)
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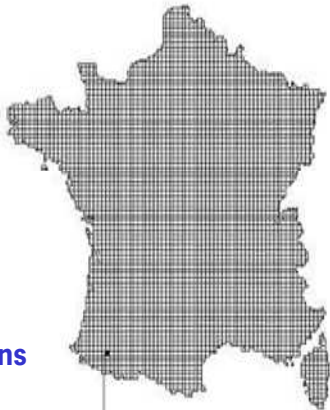
¹ The Corine Land Cover geographical database is produced within the framework of the European programme of Coordination of information on the environment (Corine). This biophysics geo-referred inventory provides information on the various modes of occupation of soils for the 29 European States and the coastal strips of Morocco and Tunisia. *Ifen* is charged to ensure production, maintenance and diffusion of Corine Land Cover in France.

² The Corine Land Cover 2000 database (CLC 2000), carried out on the basis of satellite images starting from 2000, constitutes a framework of reference of soil occupation, near by the date to the censuses of population (1999) and agriculture (2000). A first release of the database, known as CLC 1990, carried out on the basis of images acquired between 1987 and 1994, was rectified for comparisons with CLC 2000.

³ Ministerial conference for the protection of forests in Europe (1993). These criteria are: i) conservation and suitable improvement of the forest resources and their contribution to the world cycles of carbon; ii) maintenance of the health and the vitality of the forest ecosystems; iii) maintenance and encouragement of production functions in forests (wood and not wood); iv) maintenance, conservation and suitable improvement of biological diversity in the forest ecosystems; v) maintenance and suitable improvement of protection functions in the management of forests (in particular soil and water); vi) maintenance of other benefit and socio-economic conditions.

⁴ *Indicators for the sustainable management of French forests*, IFN, 2005, 136 p. www.ifn.fr

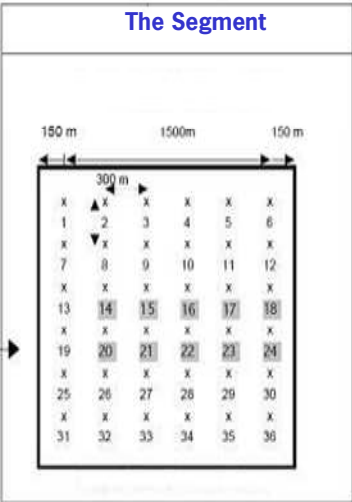
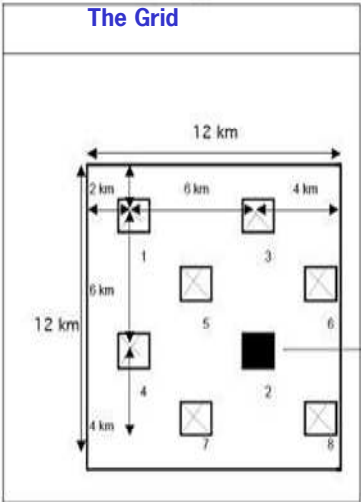
The French metropolitan territory



4,700 grids

8 positions by grid

10 sampled points by segment



indicators adopted by the Vienna Conference in 2003. This list was supplemented by 21 indicators, of which some constitute an innovation, making it possible to take into account the specificity of the French forest. A systematic methodology of survey should allow a yearly national forest Inventory and a better precision in its results. Currently, the inventory is generalized and synchronous in the whole French territory, instead of a partial inventory but repeated during the decade. The change of method making it possible to have homogeneous annual data will in the future facilitate the follow-up and the evolution of many indicators.

12.5.3 Framework of reference for the administration of the water resource and the follow-up of the irrigation

Intended to answer the new requirements of the European parent water directive on 23 October 2000, the water information system (*SIE*) succeeded the domestic network of the data on the water, itself set up following the 3 January 1992 Water Act. The objective of the *SIE* is to give a progress report on the whole of the needs for data in the field of water. From this point of view, the Service of national administration of the data and framework of reference on water (*Sandre*) worked out a common language for the data on water because the public actors are numerous: Ministry for Ecology and Sustainable Development, Regional Management of the Social and Sanitary Affairs, local departments of Agricultures and Fishing, Higher Council for Fishing, French Institute of Research for the Exploitation of the Sea (*Ifremer*), Water Agencies, Office of Geological and Mining Research, Research Institute for the Engineering of Agriculture and the Environment (*Cemagref*), local government agencies, federations of the fishing for leisure, Coast Line Cell for the monitoring of water quality. Thus, a certain number of geographical frameworks of reference for water were born: the hydrographical framework of reference for surface fresh water, the hydro geologic framework of reference for subterranean water, the framework of reference for the water masses, etc.

In a context where the risk of drought is more probable, agriculture must be regarded at the same time a contributor and as a consumer of the water resource on a territory scale. Because of complementarities between irrigated agriculture and rainfed agriculture, these two functions are interdependent within a territory of quantitative management of water and must be analysed simultaneously and spatially on a basin scale.

The irrigation initially developed in the zones with arid tendency profiting from contributions of mountain water (e.g. basin of the Rhone in the South-east of France). It has been then extended to other areas, by an active policy of the

installation (flood barriers, hill reserves), of investments in the networks of irrigation as in the individual irrigation and of development of the resources locally available: individual pumping into underground water-level and river.

The most complete statistical data relates to the irrigated surfaces, which are quantified in the successive censuses of agriculture (1970, 1979, 1988, 2000) and in the inter-census surveys on the structure of the farms ('Farm Structure Survey'), like through the CAP declarations for the surface in cereals, oilseeds and protein crops. With regards to consumed volumes of water, one has only recent data, based on the irrigation royalties paid to the Water Agencies, but very unequally accessible and studied. For the quantities brought per hectare, information is limited to that provided by the *SCEES* 'Cultivation methods' survey for 2001 (rather wet year), and to data for more restricted zones. The sampling data for irrigation provided by the Water Agencies was regarded as not fully reliable before 2000 (in particular because of the possible undervaluation of the surfaces declared with the fixed price, still important at this time).

The generalisation of the volume-meters has made it possible for a few years to estimate with a better precision the volumes actually sampled, via in particular the use of various statistical databases (Agricultural Census, *SCEES* practical cropping at farm survey, CAP declarations, etc). The professional literature and the studies produced by the Chambers of Agriculture (*Chambres d'Agriculture*) offer more specific information in addition, and field studies undertaken by the *Cemagref* can also be used. The integration of the sources of available data at the national level within the same datawarehouse could constitute a significant advance for the study of the practices of irrigation in France, a point already underlined in the *CGGREF* report² in 2005, even if progress was already recorded, in particular via the reorganisation of the regional statistical services of the ministry for Agriculture.

¹ *Cemagref* is a public research institute that targets results directly useable in land and water management.

² The *CGGREF* is the National Audit Council for the French ministry for Agriculture.

12.5.4 Quality of the soils, management of waste and exposure to risks

How can an environmental pressure measurement be obtained on the soils when that exerted by the population is provided at the municipality level and that of the livestock units is provided at the municipality cluster level ('*canton*')? The Network for the Measurement of the Quality of Soils (*RMQS*) takes samples of soils on more than 2,000 sites distributed uniformly over the French territory according to a square grid of 16 km x 16 km. The grid of the *RMQS* represents 25,600 ha, indeed a spatial unit small enough to allow a comparative study of the distribution of the environmental pressures at the national level and large enough to authorize the aggregation of the various indicators within this one.

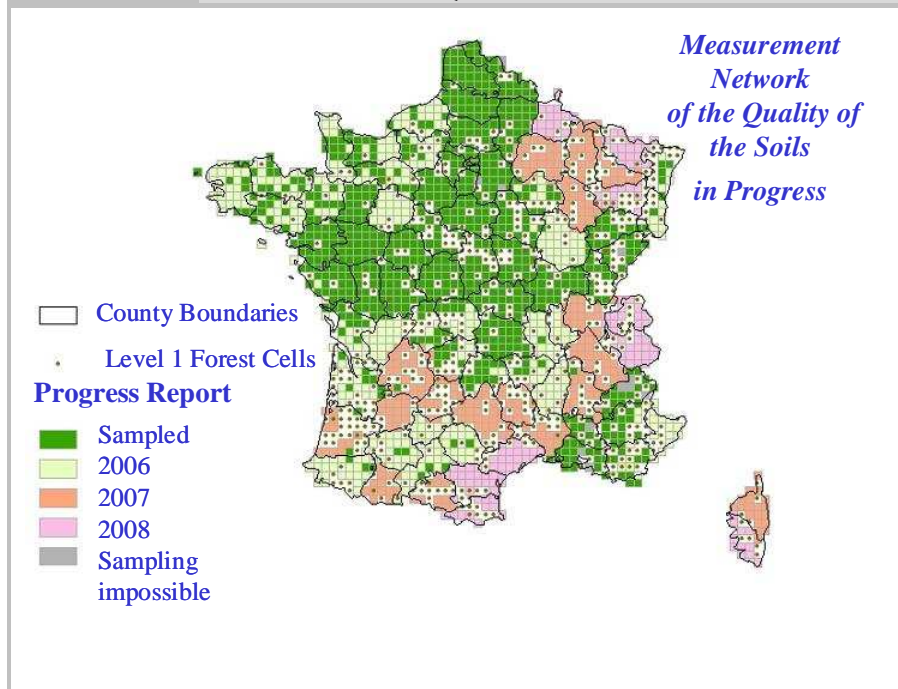
The battery of the environmental indicators for the *RMQS* is defined on the basis of the European indicators elaborated by the European Agency of the Environment, supplemented at the national level by *Ifen* and *Inra*, that is to say on the whole more than one hundred indicators and components. The battery of indicators is structured in three types according to the model 'Pressure-State-Response' (PSR) developed by OECD, that is to say: pressure measures such as the density of the highway network, the population, the number of cattle units; indicators of state like the percentage of carbon in the soils, the texture of the soils, the drained surface; and indicators of response such as the number of measuring sites of plant health products, and the progress report of the *RMQS*.

Model PSR was amended by the European Agency of the Environment in a model 'Driving Forces-Pressure-State-Impact-Response' (DPSIR). The environmental indicators of the *RMQS* are computed on the basis of multiple national databases (Corine Land Cover, digital model of altitude, France pedology map, agricultural census, population census, base of polluted sites and soils, database of the French hydro-geological Framework of Reference, etc.). Among the challenges that the French national statistical system attempts to raise, figures Regulation 2150/2002 of the Parliament and the European Council of 25 November 2002 determining the statistical data that the Member States must provide on production, valorisation and waste disposal. The next answer concerning the year 2006 must be sent in June 2008. A work group controlled by *Ifen* was formed in order to better fulfil the requirements of this European regulation, in particular by direct surveying of the companies in trade and industry, of the estimates in agriculture and services, a better

¹ The *RMQS* is managed by the *SOL* scientific consortium in which *Ifen* collaborates with the Agency of Environment and Control of Energy (*Ademe*), *Inra* and the Research Institute for Development (*IRD*).

Graph 5

Progress report of the RMQS (according to the SOL Scientific Consortium)



exploitation of the dangerous waste declarations from the companies and waste processing installations. In this context, the complete cover of the territory by the Network for the Measurement of the Quality of Soils (*RMQS*) is planned for 2009.

Another challenge, there is an important demand for a better knowledge of the human and economic stakes of the zones exposed to the harmful effects and the natural and technological risks. It is desirable that sources, such as the population census or the *Sirene*¹ repertory of companies, can be mobilized to obtain a better knowledge of the floodplain situation, and of the zones exposed to noise or harmful effects and industrial risks. The test study on the evaluation of the zones vulnerable to the flood risk in the French county ('*département*') of Loiret has led to the development of a methodology and a set of treatments making it possible to estimate the number of inhabitants and residences present on the floodplains, according to whether the commune is covered or not by the

¹ National identification system of the natural and moral persons and their establishments (articles R. 123-220 with R. 123-234, D. 123-235 and D. 123-236 of the commercial law) articulated around the repertory of companies and establishments. The management of this repertory is entrusted to *Insee*.

Insee Inventory of Buildings (*R//*). In the communes of more than 10,000 inhabitants for whom *R//* is available, this administrative data then makes it possible to characterize populations (population pyramid, occupational and professional status) and the stakes such as economic activities and public equipments.

Lastly, the knowledge of material flows and the productivity of resources are gaining increasing importance within the framework of the international approach for sustainable development, as the promotion efforts carried out by OECD and Eurostat testify some.

The first estimates for France should be available at the end of 2007. In 2008, *Ifen* will be implied in the biannual supply of NAMEA matrices, according to the Eurostat recommendation.

12.6 Towards individual indicators of sustainability at the farm level: the IDERICA experiment

Under the combined pressure of the new trends of consumption, evolution of the rules of the international business, widening of the EU to the Central and Eastern European countries, French agriculture has been led to re-examine a certain number of its orientations. The current context of redefinition of the CAP proposes a renewed framework which one can synthesize as follows: a more competitive European agriculture and an agricultural policy more favourable to international trade, more focused on the consumer needs and nevertheless more respectful of the environment and natural resources.

12.6.1 Farm, a nodal organisational entity

Facing these challenges, the program 'Agriculture and Sustainable Development' of the National Agency of Research (*ANR*)² stresses that the farm constitutes an organisational entity impossible to overlook as a meeting point of public policies, and the market mechanisms, with respect to the economic, environmental, social and territorial issues. The instruments and the models established during the last decades to study and accompany the evolution of

¹ The Inventory of Buildings (*R//*) is a geographical database including the set of addresses and their geographical location for the communes of 10,000 inhabitants or more. It contains the addresses of dwelling, the establishment *SIRENs*, the communities and in the medium-term, the urban equipment.

² Agriculture and Sustainable Development (*ADD*) is a federalising development and research program of which the ambition is to renew and widen the manner of apprehending the agricultural activities on the basis of sustainable development stakes, cf. <www.agence-nationale-recherche.fr>.

the farms must however be re-examined in order to take account of the transformations in progress, whether it is the context, the goals pursued or the types of innovation which have to be taken into account.

The identification of the relevant indicators of sustainability at the farm level requires a critical survey of the increasing literature on the indicators, their methodologies of development, the advantages and the disadvantages of each method of analysis.¹ Once these indicators have been clearly identified, it will be possible to work on the construction of proxies of the ideal indicators when the latter cannot be computed on the basis of available statistical data, i.e. individual information extracted from public surveys on agriculture (*RICA*FADN, Agricultural Census, Farm Structure Surveys, etc). Indeed, many indicators of sustainability require the recourse to specific data, which cannot only be obtained by individual surveying of farmers. In addition to the recourse to the economic, bio-technical and environmental processes which generate them, one can also imagine the design of proxies on statistical bases, for example by identification of robust statistical relations between the indicators provided by the data of investigations and the proxies designed on the basis of the official statistics. It is in particular within the framework of these problems that the *IDERICA* experiment was undertaken.

12.6.2 Lessons from the *IDERICA* experiment

Among the studies carried out on the measurement of sustainability on the basis of individual information extracted from public surveys on agriculture, appears the Exploratory study on the characterisation and the follow-up of the sustainability of French farm holdings (*IDERICA*²). The objectives laid down for this programme of studies by the French Department of Agriculture were: i) to consider the current elements of sustainability of French agriculture; ii) to define the criteria (and the corresponding indicators) allowing to carry out a follow-up of the most sustainable farm holdings on the environmental, social and economic level for each technical-economic orientation of production; iii) to

¹ A critical work survey of durability evaluation methodologies was undertaken within the framework of the *ADD/Impacts* program, cf. 'Analysis of 15 years of agriculture sustainability methods evaluation', Rosnoblet J., Girardin P., Weinzaepflen E., Bockstaller C., *IXth ESA Symposium*, Warsaw, 2006.

² *IDERICA, étude prospective sur la caractérisation et le suivi de la durabilité des exploitations agricoles françaises*, Direction des Affaires Financières - DAF - Institut national polytechnique de Lorraine - P.Girardin ; C.Mouchet ; F.Schneider ; P.Viaux ; L.Vilain ; P.Bossard - December 2004, 72 p.

make territorial analyses. This study generalises the *IDEA* method¹ to quantify the sustainability of French farm holdings at the national scale on the basis of the French Farm Accounting Data Network (*RICA*) and of the agricultural census for 2000 (RA 2000). It shows that the sustainability of the farm holdings within each dominant production and each area is variable, and that margins of progression exist whatever the systems of production and their localisation. According to the evaluation report of *Coperci*,² it must be regarded a stage in research on appreciation of the sustainability of the farm holdings and not as a result. Indeed, with regards to the *IDEA* method there are problems of measurement resulting from some imbalance between the three scales of sustainability.

Thus, only 7 indicators out of the 16 indicators of the socio-territorial sustainability scale can be indicated according to the *IDERICA* methodology whereas 13 indicators out of 19 for the agro-ecological sustainability scale and all 6 indicators of the sustainability economic scale. Because of the aggregation criterion, which retains the minimum of the scores obtained for each scale, the value of the synthetic indicator of sustainability (*ISD*) is equal to the lowest scores obtained by the farm holdings according to the three selected scales of sustainability (agro-ecological, socio-territorial, economic). The result is almost always a mechanical alignment of the synthetic indicator of sustainability with the sum of the indicators for the socio-territorial sustainability scale.

A complementary study³ based on the multidimensional analysis of the scores however showed that the variability of the scores in the universe of French farms is organised according to the following two major dimensions: the first opposes agro-environmental sustainability and economic sustainability, the second opposes temporary crops and permanent crops.

On the basis of barycentres of the *IDERICA* multidimensional analysis individual scores for each type of farming, the hierarchical clustering allows us to propose a typology of the farm holdings in the forms of large technical-economic orientations ('*GOTEX*') as relevant clusters for the measurement of sustainability.

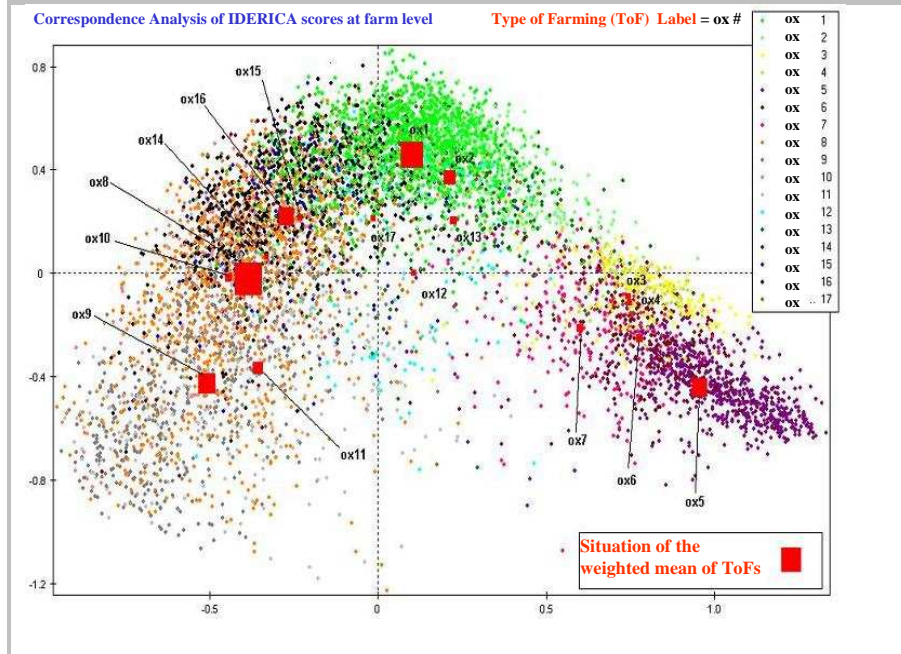
Graph 6 Multidimensional sustainability of the French farm holdings

¹ 'La méthode *IDEA*', *Indicateurs de durabilité des exploitations agricoles*, 2003, Educagri Editions, Dijon.

² Comité Permanent de Coordination des Inspections du ministère de l'Agriculture, *Evaluation de l'étude prospective sur la caractérisation et le suivi de la durabilité des exploitations agricoles françaises*, Report by A. Barbaroux, J.-P. Roubaud, Ministère de l'Agriculture, June 2005, 5 p.

³ *Etude d'une méthode de quantification de la durabilité des exploitations agricoles françaises*, Ambroise M., Beaujour M., Robert A. and Sauvadet L., directed by D. Desbois, *Ecole Nationale de la Statistique et de l'Analyse de l'Information*, 2005.

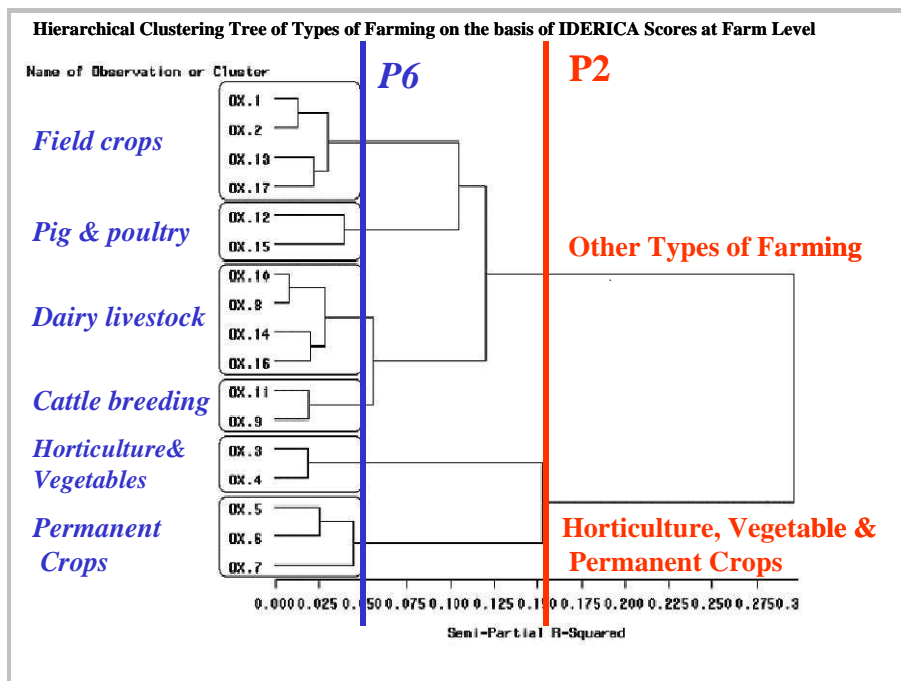
analyzes according to IDERICA



Reading the graph: in the factorial design crossing the first two axes of the analysis of the multiple correspondence, the farms scattergram presents a 'Guttman effect' of score ordination, which is interpreted as follows: at the ends of the individual scattergram scored rather well, in South-West of the graph thanks to good scores on the agro-environmental scale are, in South-East of the graph thanks to the scores obtained on the economic scale; at the centre of the scattergram, North of the graph, are the individuals rather badly scored. The horizontal axis (first factorial axis), interpretable general component of durability, seems very related to the Type of Farming (ToF).

ToF Nomenclature of farms in 17 categories (ox): ox1, Cereals, oilseeds, protein crops; ox2, Other field crops; ox3, Vegetable cropping; ox4, Flowers and other horticulture; ox5, Quality wine; ox6, Other vine growing; ox7, Fruits and other permanent crops; ox8, Dairy farms; ox9, Cattle rearing and fattening; ox10, Dairying, rearing and fattening; ox11, Ovine, caprine and other herbivores; ox12, Granivores; ox13, Mixed-cropping; ox14, Mixed livestock, mainly grazing; ox 15, Mixed livestock, mainly granivores; ox 16, Field crops - grazing livestock combined ; ox17, Various crops and livestock combined.

Graph 7 **Typological clustering of the types of farming according to the IDERICA measurement of sustainability**



Reading of the graph: the dendrogram resulting from hierarchical classification makes it possible to distinguish two partitions; the finest partition comprises 6 large technical-economic orientations (field crops, pig and poultry, dairy livestock, cattle rearing, vegetable cropping and horticulture, permanent crops); the coarsest partition opposes in two classes horticulture and permanent crops to the other types of farming (OX).

The complementary analyses carried out for each main technical-economic trend considered, suggest that it would be possible to work out, by means of a suitable weighting of the battery of scores, an individual indicator of sustainability which is specific to each type of agricultural activity. The conclusions of this study suggest that the individual measurement of the farm sustainability can be broken up according to a general factor particular to the productive profile of the farm holding and factors specific to the various types of agricultural activity.

Thus, the results of this study show that the multidimensional analysis makes it possible to extract, in the dimension specific to the indicators of sustainability on the one hand, the synthetic indexes of sustainability and, on the other hand in the dimension specific to the farms, a typology of the types of farming, which is adapted to the measurement of sustainability.

12.6.3 The problem of coupling the measurement devices on various territorial scales

However, in terms of the degree of completion of the agro-environmental goals, the mobilised statistical sources do not make it possible to fully exploit the micro-level *IDEA* methodology of sustainability evaluation. Moreover, the sampling of the *RICA*, designed to ensure a statistical representativeness at level 2 of the NUTS¹ (area), is insufficient to incorporate these measurements of sustainability at the most appropriate territorial scale which could be that of the Small Agricultural Area (SAA). Thus, a territorial measurement of the farm sustainability s supposes the adaptation and the coupling of the existing devices of investigation, the mobilisation of administrative data and the implementation of satellite devices for further enquiry (e.g., installation of a technical-economic probe on the management of inputs).

12.7 Future challenges for the French statistical system in the measurement of sustainability

12.7.1 To meet the commitments made as regards the environment for the development of the acquired community know-how in agricultural statistics

Even if the budgetary commitments, undertaken by the European Council in December 2005 regarding the CAP over the period 2007-2013 did not reach the level desired by the Commission to finance the second pillar devoted to the environment and rural development, new orientations are gradually implemented to preserve the natural resources (reduction of inputs - plant health and manure, saving of water and energy, management of the bio-diversity), and to limit the health hazards (e.g. fight against the mycotoxins, or detection of residues related to the veterinary or plant health treatments in food). Thus, following the European statistical regulation on waste, a new European statistical Regulation on the marketing and the use of pesticides could be adopted in 2008¹ and

¹ The Nomenclature of the statistical territorial units subdivides the countries of the European Union and Switzerland in areas, definite for the needs of public statistics on the basis of administrative unit clusters, according to the population living in the corresponding country, cf. Regulation of the Parliament and European Council (EC) n° 1059/2003 on 26 May 2003. This nomenclature is structured according to 3 levels: NUTS 3 (from 150,000 to 800,000 inhabitants); NUTS 2 (from 800,000 to 3,000 inhabitants); NUTS 1 (from 3 to 7 million inhabitants).

¹ Europa Press Releases (<www.europa.eu/rapid/>) IP/07/970, Brussels/Luxembourg, on 28 June 2007. ¹ Water quality standards. The Commission welcomes the political agreement on water quality standards which will reinforce the Water Framework Directive, the cornerstone of the European Union's water protection policy. The agreement endorses the core elements of the Commission

generate work in 2009. The year 2008 will be also that of the first supply of accounts of material flows, in accordance with the new Eurostat regulation.

12.7.2 To follow the adaptation of agriculture to climate changes

Over a long period, among the determinants of the evolution of the agricultural sector, one can quote them technological innovations in particular in biotechnology, the increasing internationalisation of the agricultural markets, the industrialisation and 'tertiarisation' of agriculture (vertical integration, formalisation by contract in the sector, development of the service dimension), multi-functionality of agriculture (environmental impact, capacity required to provide a public good) and, as a more recent concern, climate change.

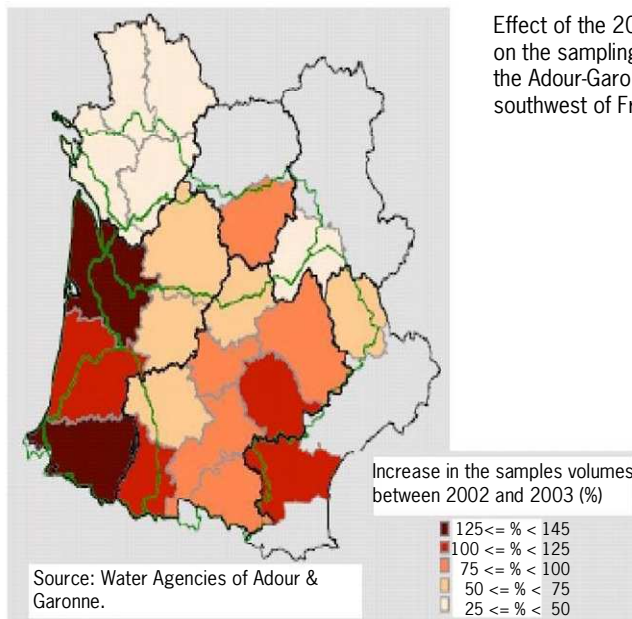
Indeed, the Intergovernmental Panel on Climate Change (*IPCC*²) envisages an increase in the variability of the climate, regarding as probable the increase in the risks of summer drought on the majority of the continental terrestrial zones of average altitude. Taking into account global warming, the adaptation of agriculture to climate change, in particular to the episodes of drought, is likely to become a crucial question for the next decades.

proposal (see IP/06/1007), including environmental quality standards and the phasing out of some substances. The new directive will establish limits for concentrations of substances such as pesticides, heavy metals and biocides found in surface water ' (underlined by the authors).

² The Intergovernmental Panel on Climate Change and Albert Arnold Gore Jr. were jointly awarded of the Nobel Peace Prize 'for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change', on 10 December 2007 at Oslo (cf. www.ipcc.ch/).

Graph 8

Effect of the 2003 drought on the taking away of water in the Adour-Garonne basin (according to Inra)



The collective scientific report entitled 'To reduce the vulnerability of agriculture to an increased risk of lack of water', financed by the French ministry of Agriculture and Fishing and controlled by *Inra*, announces the defect of databases necessary to the use of analytical tools available like the cropping models. The report of this expertise recommends the establishment of hydrous assessments of the watersheds on the basis of most plausible crossing (soils) X (climates) X (farming systems), with micro-economic studies prioritising knowledge of the costs and the benefit of irrigation and, more generally, the economic control of the choices of farming systems and of technical equipment of irrigated perimeters. The collection and the management of the necessary information for such studies will be under supervision of regionalized geographical information systems to be implemented in the southernmost French areas. Moreover, this collective scientific report recognizes that the insufficient development and organization of the sources of available data at the national level as regards irrigation hamper the study of irrigation practices in France, already underlined in the report of the General Council for Rural Engineering, Water Resources and Forestry (*CGGREF* 2005), even if progress

proves to be real (via the statistical services of Regional Offices for Agriculture and Forest in particular).

Thus, the information relating to water consumption by irrigation on the scale of a plot, a farm holding, or a territory are largely lacking, the sampling data from the Water Agencies have to be analysed with precaution because of a non-exhaustive cover. The generalisation of the volume-meters will in the future make it possible to provide more detailed evaluations.

To attenuate the impact of a drought risk materialisation, one can resort to changing the irrigation technology used (the adoption of drip irrigation), changing farming systems (crop rotation, variety) but also to the covering of risk by a system of crop insurances, even compensating for agricultural disasters.

12.7.3 To accompany the systems aiming at reducing the exposure of the agricultural producers to the risks

In France, the protective system against agricultural disasters dated from the Framework Laws on Agriculture of 1960 and 1962 and a specific law of 1964. Since then, the nature of the risks and economic realities have evolved: the intensification and the specialisation of the farm holdings expose them to more important risks; the health hazards take up an increased importance; the economic risk, in particular the market risk, increases because of - globalisation and the deregulation of the agricultural markets. Thus, this evolution of the risks making the system of 1964 increasingly unsuited, the Framework Laws on Agriculture of 5 January 2006 reinforced the capacity of the holdings to be guarded against the risks, in particular by adapting the legislative framework so that insurance-harvest can be generalised to cover all the agricultural productions and over all the territory.

The determination of the levels of premium and compensation supposes being able to quickly deliver reliable estimates concerning surfaces, the outputs and the prices observed. The more so as the economic losses relative to these risks can be very important: for example, the losses incurred by the producers at the time of drought 2003 were estimated at €13 billion for the European Union and at €4 billion for France.

It proves that, for the estimate of the amount of compensation for the losses due to the drought of 2003 in France, the Statistical Office of the Ministry for Agriculture was widely involved. The *Teruti* survey on the use of the territory (direct observation of 555,000 points) was used for the estimate of surfaces jointly to an investigation into the average yields registered after harvest

concerning 9,000 owners, in addition to the mobilization of data from administrative registers. In 2004, *Teruti* got up to 155,000 points of observation, while keeping a satisfying level of precision in the estimates of surface areas since the 35 major stations of the detailed physical nomenclature record a relative error lower than 5%, these stations covering 95% of the national territory in 2004.¹ Sometimes thus, the introduction of methodological innovations for an optimal use of the means reserved for the public statistics makes it possible to realize substantial savings. In the case of a crop insurance covering the variability of the outputs for an agricultural produce, the study of the statistical properties of such an insurance product (average and variance of the allowances, correlation of individual allowances) supposes having outputs of reference on an adequate temporal basis and for a rather fine level of territorial division as well as individual yields resulting from a constant sample of farms over the period of reference.

Whether it concerns the prevention of risk or of the answer to the risk materialisation, these examples show that the capacities of the agricultural statistical services are strongly mobilised to ensure the availability of unbiased statistical data oriented towards operational use. Indeed, asymmetries of information were identified like one of the main obstacles to the development of the systems of harvest insurance.

12.7.4 To reconcile European agriculture with society: the framework of multi-functionality

Multi-functionality, as a political concept, can be seen as a means of reconciling European agriculture with society by providing an analytical framework of reference likely to support the increase in sustainability while contributing to the key goals of the European strategy of sustainable development: equitable regional development, health and food safety, conservation of natural resources, diversification of the incomes in the rural environment and global sustainability.

Thus, within the framework of the multilateral negotiations within WTO on the trade of agricultural produce,² the concept of multi-functionality, emerging as of

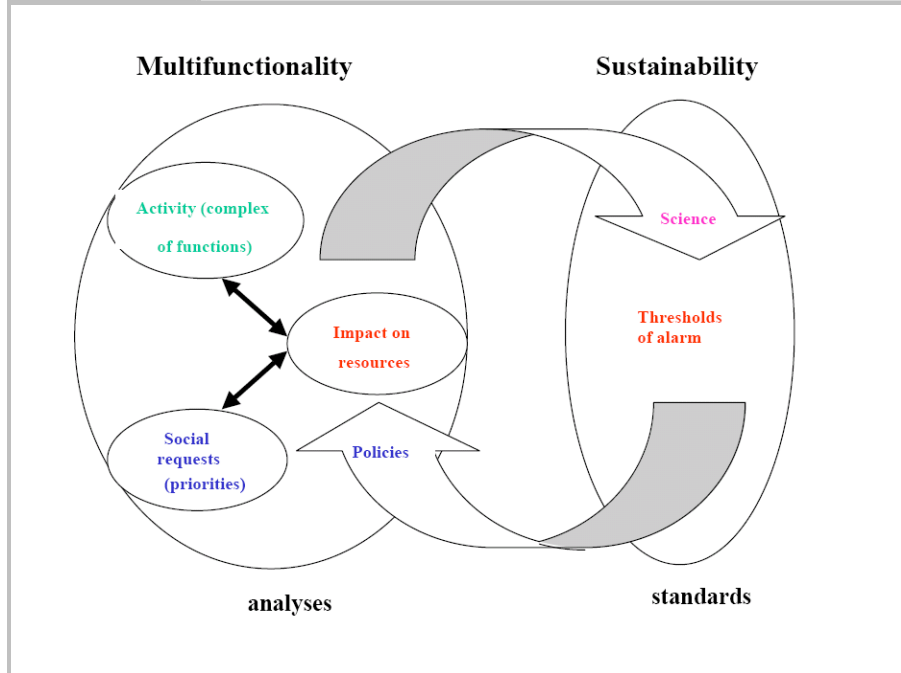
¹ In fact, the precision in the estimates depends more on the number of primary education units in the spatial survey than on the number of observation points per primary unit.

² On 5 February 2007, World Trade Organisation Director-General Pascal Lamy, in an address to the UNEP Global Ministerial Environment Forum in Nairobi, warned that a failure of the Doha negotiations 'would strengthen the hand of all those who argue that economic growth should proceed unchecked' without regard for the environment. He stressed that 'trade, and indeed the WTO, must be made to deliver sustainable development' cf. www.wto.org

the eighties, has aroused increasing attention during the last decade in the discussions relating to the changes of orientation of agricultural policies. Multi-functionality intervenes in the problems of sustainable development at the heart of the adjustments which take place between productive complexes and social demands, the bond between multi-functionality and sustainability being established because of the impacts that the activities can have on the resources. From this point of view, multi-functionality provides an analytical framework enabling us to make the concept of sustainability operational on the basis of the functions filled by agriculture.

Graph 9

**Relations between sustainability and multi-functionality
(according to Multiagri ¹)**



The analytical framework makes it possible to specify the functions on the basis of the social demand and the combination of activities. The study of the systemic attributes concerned with these functions (for example at the farm level, production, tourism and the protection of water resources) should make it possible to evaluate the modifications intervening in the combination of concerned attributes, to simulate the impact, which a policy change could induce on these combinations, and thus to explore a set of potential inflections while answering the normative question about the alarm thresholds.

¹ Cairol, D., Perret, E., Turpin, N., 2006. 'Results of the Multiagri project concerning indicators of multi-functionality and their relevance for SEAMLESS-IF', *SEAMLESS Report # 11*, SEAMLESS integrated project, EU 6th Framework Programme, contract no. 010036-2, <http://www.SEAMLESS-IP.org>, 100 pp, ISBN no. 90-8585-040-1.

