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## RESEARCH IN ECONOMICS AND RURAL SOCIOLOGY

### **Defining sustainable development objectives: a difficult exercise**

*The concept of sustainable development requires us to pass on capital to future generations allowing them to meet their economic, environmental and social needs. Defining the nature of that “capital” and how to protect it is a difficult task which can be tackled either through an approach based on prices reflecting the relative value of the various assets, or through a more physical approach based on indicators associated with quantities of assets to be protected. Usually, economists favour the former approach, but they also have methods to describe the necessary trade-off between conflicting factors, and the way of reaching these factors in time, when the second approach is chosen. These methods provide decision-making tools to define socially the thresholds that we wish to impose on the sustainability indicators.*

### **The sustainable development issue**

At the beginning of this 21<sup>st</sup> century, agriculture must take up the contradictory challenges of world food safety, biomass production for energy purposes, landscape maintenance and conservation of ecosystems without, however, compromising future production capacities (including ecological and social capacities). There are two types of levers to get players in agriculture around the world to take up these challenges: market incentives and regulations. In times of increasing prices, the market can favour agricultural production. This may have negative consequences on other issues, such as pollution, if the increase in production implies intensification or loss of natural habitats when production demands land-use conversion. These market effects may also have positive consequences when they are connected with demand for goods that are produced in an environmentally-friendly way, such as is the case with the emergence of “organic farming”. Consumer behaviour results in so-called “sustainable” consumer demand. By incentive mechanisms (tax or subsidies) or regulations (pollution thresholds, natural reserve areas) public policies may influence agricultural production.

From that point of view, it is possible to favour sustainable development, for instance, by supporting land uses that are beneficial to the conservation of biodiversity. These trade-offs reflect the social choices regarding the things to be kept for sustainable development.

Usually, defining the objectives of sustainable development implies two challenges. The first is to reconcile potentially contradictory social, environmental and economic objectives. The second is to take account of the issue of intergenerational equity. The Brundtland (1987) report describes sustainable development as “development which meets current needs without compromising the capacity of the future generation to meet theirs.” This implies knowing what must be kept for future generations. The answer to that question requires thought on how these objectives may be defined. Two approaches can be compared: the single-criterion approach focusing on a value, and the multi-criteria approach with sustainability indicators.

## **The economic conceptions of sustainable development and their theoretical implications**

Being an “intergenerational transmission”, the nature of what is being protected by sustainable development amounts to *capital*. Therefore, the question is choosing the type of capital that we wish to protect for future generations, a manufactured or natural capital, for instance. In the economic literature, there are two main answers to that question, connected with the paradigms of weak and strong sustainability (Neumayer, 2010; Martinet, 2012).

Weak sustainability advocates the preservation well-being over time. This well-being is obtained both by the goods consumed and environmental amenities. It is usually assumed that an increase in one component of well-being may compensate for a reduction in another. As a consequence, it is not necessary to protect a given resource or stock of capital over time, but the “general capacity of the economy to produce well-being” (Solow, 1993). Therefore, natural assets have no particular status. They will only be protected if their preservation value is higher than their value in use.

The supporters of strong sustainability are opposed to that view mainly on the point that natural assets and manufactured assets are complementary rather than substitutable, be it in the production of goods and services<sup>1</sup> or in agents’ preferences.<sup>2</sup> They advocate the conservation of natural assets for what they are. There ensues the definition of a list of environmental assets and services to be preserved. These assets are assessed by indicators.

### **An approach through aggregated value or a multicriterion approach**

One of the main differences between the two conceptions lies in their degree of abstraction. This influences the nature of what is to be protected and the way of defining it.

The weak sustainability approach usually defines a notion of aggregated value with the help of an

intertemporal sustainability criterion.<sup>3</sup> Development, then, is “sustainable” if the trend in that value over time shows a concern for the well-being of future generations. The protection of that “aggregated capital” is characterized by net investment (or genuine savings rate) which records investments in productive assets, but also material investments (mechanisation) and in human knowledge (genetic selection and improvement of agricultural practices), and the possible depreciation of natural assets caused by current production (soil erosion or over-exploitation of ground-water). Therefore, the difficulty is having a “price” system to keep such accounts.

Conversely, the strong sustainability approach attempts to define critical inventories of capital to be protected to keep certain services (particularly the ecological ecosystem). So, this approach is a multicriteria one, since it deals separately with each dimension of sustainable development through specific indicators (each one in its own unit of measurement). Therefore, it is not based on prices, but on quantities, which poses the problem of the aggregation of these various indicators into a simplified composite measurement.

So, we see that sustainable development either consists in conservation of a “general” value, or in conservation of certain particular attributes of the economy.

### **An approach through prices or quantities**

A policy based on prices will consist in assessing the social value in natural assets, and integrating that value into the classical economic calculation (cost-benefit analysis). To do so, we modify market prices with the help of economic tools to bring them closer to optimal prices (values corresponding to the socially optimal state of the environment). So, the individual decisions, enlightened by these corrected prices, lead to the “decentralized” sustainable optimum. However, we can wonder what happens when the concept of value is not the “right one”, in the sense that we have a poor interpretation of sustainable development factors, such as the scale of environmental problems), or does not represent the needs of the future generation properly.

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<sup>1</sup> To what extent can we replace natural assets by capital accumulated in production?

<sup>2</sup> To what extent can increasing consumption in goods and services compensate for environmental damage?

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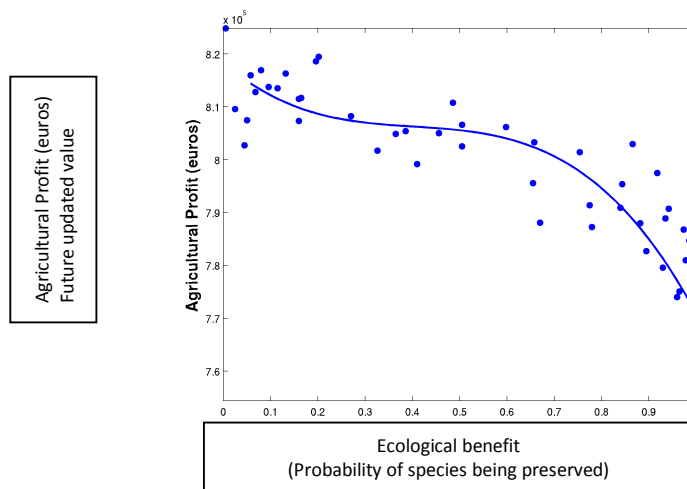
<sup>3</sup> See, in this same seminar, the contribution of Charles Figuière and Mabel Tidball on the criteria of equity between generations.

Therefore, economic agents receive the wrong “signals” and some of the natural assets that should have been protected may be lost irreversibly. Moreover, there is always uncertainty as to the quantitative outcome of a price policy. The ecological objectives may not be reached *ex post*.

Figure 1 represents an example of the trade-off necessary between conflicting issues linked to agricultural production. This figure from

Barraquand and Martinet (2011) gives the (stochastic) production possibility frontier between agricultural profit (in present euro) and the preservation of an animal species (probability of a species continuing to exist in the landscape). Each of the points is the average outcome of a different subsidy policy for extensive agriculture (meadow). The higher the subsidy, the greater the probability of the species being preserved increases to the detriment of agricultural profit.

**Figure 1:** Trade-off between agricultural profit and ecological benefit



Source: Barraquand and Martinet (2011) – modified.

This production possibility frontier could be used in a cost-benefit analysis of the biodiversity conservation measures (approach by prices) in order to define an optimal biodiversity conservation policy in agro-ecosystems. However, it would require knowledge of the "value" of the species studied (or more particularly, the value of the probability of the preservation of the species). Now, it is not easy to assess the value of species, and more generally the value of a non-merchant asset.

A policy based on quantities has the advantage of clearly defining the objectives to be reached. It seems more pragmatic, because it defines what must be preserved directly. Within the framework of the previous example regarding farming and biodiversity conservation, this approach would, for instance, consist in defining the minimal level of ecological benefit which we wish to achieve in the agricultural territory being studied. Naturally,

there is a risk that the current generation might make a mistake in defining the natural assets to be preserved for future generations. It is also necessary to note that such a policy based on the quantities to be protected infers uncertainty as to the conservation costs which may turn out to be higher than the costs assessed *ex ante*. Even by adopting cost-effective measures, we do not necessarily know how to assess the necessary cost to reach the quantitative objective.

### How to define sustainability thresholds

In practice, the problem of sustainable development is often approached by means of indicators assessing the performance of the system being studied on certain issues. These indicators can be used to define sustainable development objectives when associated with thresholds not to be exceeded. For agriculture, on a global scale, these objectives could be expressed as minimal

production of food, conservation of a minimal biodiversity level, and the preservation of water quality (as a maximal threshold of nitrate pollution).

This approach is somewhat attractive because it provides a good reflection of the various factors in sustainable development, and the thresholds may represent the various generations' needs in these factors. The theoretical consequences of such an approach, however, are not insignificant. First of all, based as it is on indicators and thresholds, this approach does not give priority to any one of the issues over the others. All the defined factors in sustainable development must be satisfied. Besides, if we require these objectives to be fulfilled at all times, there is no priority of one generation over the others. The thresholds represent the minimal rights to the various components in sustainable development. These rights are guaranteed to all generations, which are handled anonymously from a perspective of intergenerational equity (Martinet, 2011).

This quantitative approach has true advantages in addressing the problem of sustainable development. However these advantages must not hide the limits. Although, in principle, the definition of a set of sustainability thresholds can address each factor independently, we must take into account the conflicts between such factors, if we want to choose thresholds that can be reached. Indeed, it is difficult to imagine increasing one particular objective without having, at some point, to make trade-offs on the other stakes. A first step in the decision-making process is to define all the reachable thresholds of sustainability. This set reveals the trade-offs necessary between the conflicting stakes, that is to say how much we must reduce some of the objectives when we wish to increase some of the others. Second, the choice of particular sustainability thresholds within the whole set reveals the trade-offs between the associated factors (usually made by a public decision-maker). If there is any trade-off between the quantities of thresholds, it implies the existence of preferences between the different factors, if only implicitly. These preferences show a notion of social value of sustainable issues (Martinet, 2011), and therefore the use of indicators and quantities does not allow us to avoid defining values. In the end, it is interesting to note that, when we wish to have some sustainability constraints to be observed and coordinate decentralized economic action,

economic incentives remain an effective means. Theoretically, approaches through prices and approaches through quantities are connected.

### **New opportunities and temporal consistency of public policies**

Defining the objectives of sustainable development by means of constraints on indicators involves another consequence: this approach may not be consistent in temporal terms. Once the trade-offs between factors have been made at an initial date (initial choice of objectives), developments in the economy (changes in the inventory of physical and natural assets) will change all the reachable objectives. So, some objectives which were initially reachable will no longer be so, further to choices with irreversible consequences (for instance, the destruction of an ecosystem). Symmetrically, new opportunities can appear and enable certain thresholds to be reached which were not possible hitherto. Then, the decision-maker (or society) may wish to modify his initial arbitrations, and choose new thresholds of sustainability.

Figure 2 presents an example of this phenomenon, inspired by Martinet (2011). This example corresponds to a model in which a non-renewable resource (oil type) is used together with the capital to produce a homogeneous aggregated good. Production is invested or consumed. Two sustainability objectives are taken into consideration: a guaranteed level of consumption over time and a minimal level of resources to be conserved. To protect such a non-renewable resource may be an objective if, for example, the environment is degraded by extraction of the resource.<sup>4</sup> If we consider the objectives effective in the Pareto<sup>5</sup> sense, the figure shows that to increase one objective on the initial frontier of all the possible objectives (full curve), it is necessary to reduce another one. Besides, along the economic trajectory to reach an initial objective chosen according to all the objectives that could be reached initially, all the objectives that can be reached from the new states change (curve in the dotted lines). Naturally, the initial objective remains reachable by sticking to the economic development trajectory chosen initially. But if society applies the same sustainability preferences

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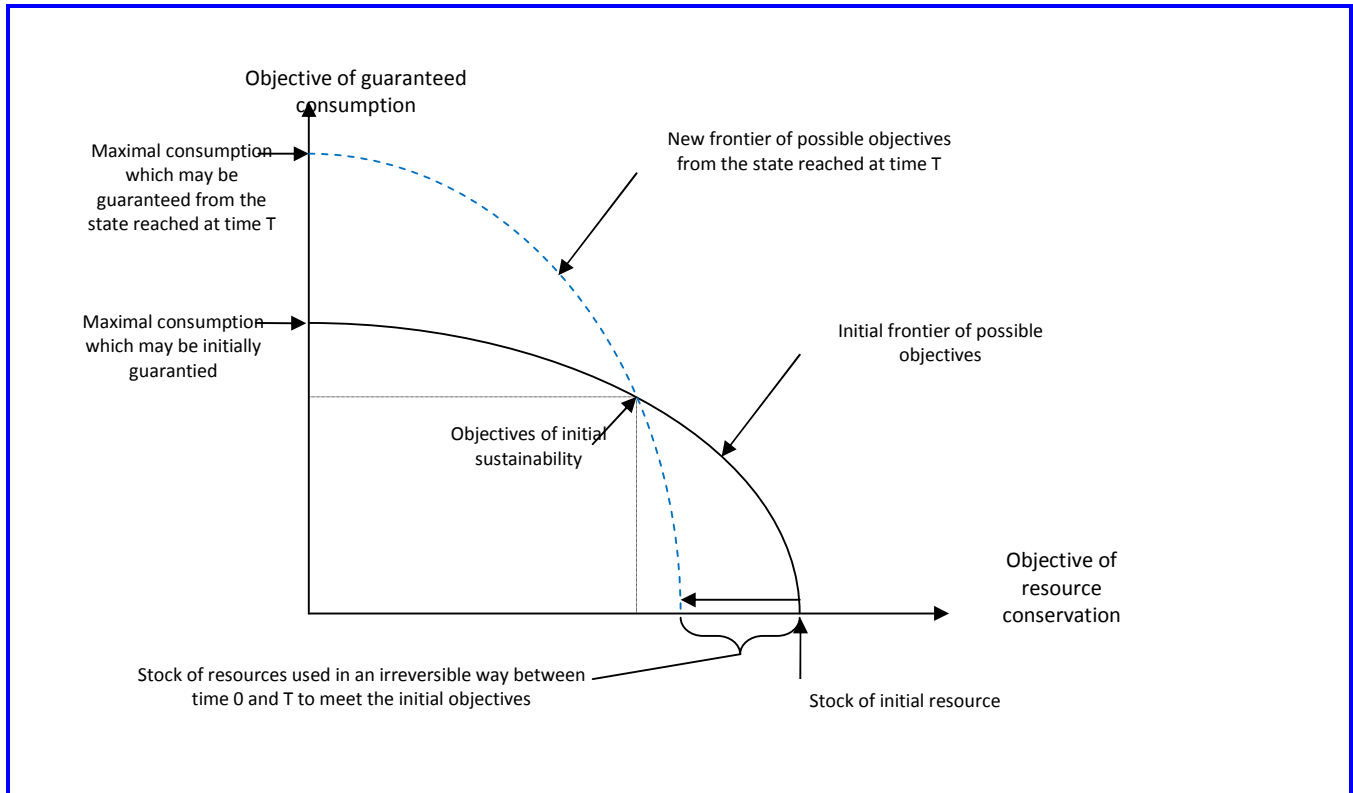
<sup>4</sup>We can think of the case where the consumption of an fossil energy resource generates greenhouse gas emissions

<sup>5</sup>We mean a set of objectives for which it is not possible to increase one objective without having to reduce another.

to the new situation, the sustainability objectives may change. There is, therefore, a temporal inconsistency. However, the inconsistent trajectory which would consist in modifying the objectives repeatedly according to the new economic context and new opportunities that it

offers, is not necessarily untenable in this model. The utility along this trajectory can be maintained, and it is even possible to have some growth if the relative resource conservation preferences are stronger than the utility derived from the stock of resources (Martinet, 2011).

**Figure 2:** Arbitration between guaranteed consumption and conservation of a non-renewable resource



Source: inspired from Martinet (2011)

## Conclusion

What conclusions can we draw from these theoretical outcomes? How can they help us in defining sustainable agriculture and how to reach it?

From a general point of view, we can say that, although more concrete in its terms, the practice which consists in using indicators and thresholds to define the objectives of sustainable development has some points in common from a theoretical point of view with a "value" approach. First of all, scientists can provide decision-makers with a description of the necessary trade-offs between conflicting issues, for example by presenting production possibility frontiers (see

figures 1 and 2). Second, although based on quantities, the definition of sustainability thresholds has to take account of the conflicts between objectives, and therefore reveal social preferences relating to the various issues. As a consequence, there is a notion of value which appears ex post (relative importance given to issues). It is necessary to note that this relative value may evolve over time and that such sustainability thresholds will certainly be modified in time. In the end, once the overall objectives have been set, incentive policies must be implemented to reach them. Again, economists can define the tools to achieve these objectives.

What are the attributes of sustainable agriculture? The answer to this question will depend on the social trade-offs made between contradictory issues. INRA economists can provide decision-making assistance, either by highlighting conflicts between issues of different kinds, or by helping to reveal the value given by the society to the various natural assets. Once the objectives of sustainable agriculture have been defined, the question is what

to do to reach them. Should we allow the market to do it by allowing more or less informed consumers express their preferences? Or should we influence private decisions by public policies? In the latter case, this can be done either by strict standards (regulation) or by attributing a value to the various services or natural assets and creating monetary incentives to protect these services.

**Vincent Martinet**, INRA, UMR210 Economie Publique, F-78850, Thiverval-Grignon, France.  
[Vincent.Martinet@grignon.inra.fr](mailto:Vincent.Martinet@grignon.inra.fr)

#### For further information

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