Sustainability and Uncertainty: Bottom-Up and Top-Down Approaches

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ABSTRACT: The widely used concept of *sustainability* is seldom precisely defined, and its clarification involves making up one's mind about a range of difficult questions. One line of research (*bottom-up*) takes sustaining a system over time as its starting point and then infers prescriptions from this requirement. Another line (*top-down*) takes an economical interpretation of the Brundtland Commission's suggestion that the present generation's need-satisfaction should not compromise the need-satisfaction of future generations as its starting point. It then measures sustainability at the level of society and infers prescriptions from this requirement.
These two approaches may conflict, and in this conflict the top-down approach has the upper hand, ethically speaking. However, the implicit goal in the top-down approach of justice between generations needs to be refined in several dimensions. But even given a clarified ethical goal, disagreements can arise. At present we do not know what substitutions will be possible in the future.
This uncertainty clearly affects the prescriptions that follow from the measure of sustainability. Consequently, decisions about how to make future agriculture sustainable are decisions under uncertainty. There might be different judgments on likelihoods; but even given some set of probabilities, there might be disagreement on the right level of precaution in face of the uncertainty.

Key words: Empirical Uncertainty, Goals and Means, Value Judgements.

INTRODUCTION – 'Sustainability' has become a notorious buzz-word, referring to something undeniable good. No-one defends unsustainable development or unsustainable activities, just like no-one would call their position 'undemocratic'. However, the almost universal accept of the claim that development should be sustainable comes at a cost, namely that the concept has become almost empty.
Different policy makers appear to interpret the concept each in their own way, always keen to reaffirm the sustainability of their policy, regardless of its content. But this means that it is very unclear what exactly the practical implications of sustainability are.
Hence, there is a need for clarifying the concept. However, any clarification will also make the concept more controversial. And of course, more than one clarification is possible. The differences between conflicting interpretations of 'sustainability' will uncover disagreements about value judgements as well as about empirical issues. This paper attempts to map the logic of some of the important disagreements.

MATERIAL AND METHODS – *The Concept of Sustainability*. The first step is to recognise that sustainability is a normative concept. Sustainability is valuable state - a goal we should strive to realise. This means, firstly, that the only way to make the concept more precise is through reflection on what is valuable about sustainability and how this value relates to other important values. And secondly, analysis of the practical implications of sustainability presupposes that the concept has been clarified. It only makes sense to determine the necessary means to achieve a goal when the goal has been specified.
Considerations on the sustainability of activities date back to the late 19th century, where the question rose within forestry how to determine the maximum cut that could be sustained in the long term; later, similar considerations were developed within fishery, and eventually they spread to many other areas. The underlying principle was the constraint that the resource stock in question should be kept constant over time, and the simple prescription was to keep the harvest rate per year within some area smaller than or equal to the natural regener-

ation rate per year for the resource within the area. This is all right as far as it goes, but unfortunately it does not go very far. One line of research views a farm as a system in exchange with its surroundings. If the farm is to sustain its production over time, keeping the resource stock constant over time is not likely to be sufficient. Roughly, the farm also needs to be sustainable in a social sense. Hence, this research takes the form of uncovering the expectations of all stakeholders with an influence on the farm's survival over time (e.g., Kristensen & Halberg, 1997; Gibbon, 1997). This way to enhance the concept of sustainability corresponds roughly to what Paul Thompson has dubbed 'sustainability as functional integrity' (Thompson, 1997).

Another line of research originates in economics. From an economical point of view, the prescription to keep the resource stock constant over time leaves many questions unanswered.

For one thing, many resources are non-renewable. If they are to be used at all, it is by definition impossible to keep the stock constant over time. Economists suggest answers along two lines (e.g. Solow, 1974; Hartwick, 1977). Firstly, a reduced stock of exhaustible resources can be compensated for by an increase in renewable resources. This strategy assumes that substitution between different types of capital is possible. Secondly, through technological development it may become possible to achieve increasing efficiency in the use of resources and hence possible to sustain a constant level of welfare on a reduced stock of exhaustible resources.

The economic analyses move from the simple prescription of keeping a single renewable natural resource stock constant to the more general prescription of keeping the welfare level at least non-decreasing. This is inspired by Brundtland (World Commission, 1987), who defined a sustainable development as a development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". Economists prefer to analyze this in terms of welfare rather than need satisfaction. The important point is, however, that if we are going to take substitution and technological development into account in order to make more general prescriptions, it is necessary to look at the *value* of resources, i.e. their potential to generate welfare or satisfy needs, rather than simply the stock.

It is implicit in this move that 'sustainability' no longer can be applied on a single activity in isolation, such as a single farm or even farming; rather, we shall judge whether society at large and its development is sustainable. Hence, I find it reasonable to dub this approach a *top-down approach*, because it starts by determining sustainability at the level of society, and then infer prescriptions for a single activity, given some technological stage. On the other hand, the systems approach is a *bottom-up approach*, because it starts out by inferring prescriptions for a single activity, and then reaches prescriptions for society at large by putting together the prescriptions for all relevant activities.

RESULTS AND CONCLUSIONS – If the bottom-up approach is based on the implicit premise, as it often is, that the system in question should be sustained perpetually, or at least as long as the time horizon reaches, it may be in conflict with the top-down approach. The latter has, among other things, the implication that an activity, which at some time can be part of a sustainable society, not necessarily needs to be part of it at a later time; for instance, because technological development may have made it superfluous or just too costly to maintain. From an ethical point of view, it is clearly the top-down approach that has the upper hand: whereas the claim that the level of welfare should not decrease over time has great ethical weight, the claim that some isolated system, e.g. a farming practice, should be sustained over time has no ethical weight (although the farmer's welfare of course should count). If we take a closer look at the ethical value implicit in the top-down approach, it seems clear that the objective is justice, within and between generations. However, this objective needs refinement. One problem is whether the requirement of non-decreasing welfare over time represents a too rigid form of equality between generations. Another, more important problem is concerned with the problem of increasing population. The economic analyses referred to above assume a constant population over time. But if the population grows over time, as it is likely to do, and we understand sustainability as the requirement that the welfare level *per capita* should not decrease over time, this of course results in more stringent requirements of sustainability. As it happens, population ethics is riddled with problems, and no-one has so far been able to state a reasonable concept of justice between generations with variable population sizes (Parfit, 1984). I shall have to leave this problem aside in the present context.

Given some clarified notion of justice, prescriptions for sustainability will depend on the rate of population growth, the rate of increased efficiency in use of resources and the possible substitutions between types of resources. These are empirical questions, but presently we do not know for certain what the answers to them are. The economic discussion has uncovered disagreements about the likelihoods.

We can roughly summarise this debate in the following table, where the strategy derived from the main rival set of assumptions about possible substitutions are listed as acts together with a rough description of the consequences if each of these set of assumptions are true:

Table 1. Strategies in the face of uncertainty about substitution.

States / Acts	Unrestricted substitution	Restricted substitution	Natural resources cannot be substituted
Keep total stock of resources constant	Constant level of welfare	Considerable reduction of welfare	Ecological catastrophe
Keep total constant & preserve critical res.	Reduction of welfare	Constant level of welfare	Ecological catastrophe
Keep stock of natural resources constant	Extreme reduction of welfare	Considerable reduction of welfare	Constant level of welfare

Hence, there is an empirical disagreement about how to judge the likelihood of the different possibilities of substitution. But even given agreement about the likelihoods, there might be disagreement about the right strategy in dealing with this kind of uncertainty about the future. A strongly precautionary approach would choose the act with best worst outcome (i.e. the most stringent). A weaker type of precaution would consider the size of likelihood and the seriousness consequences and then seek to balance the degree of precaution against its costs.
Given the indeterminateness of the top-down approach and the uncertainty of its implications, we might want to turn to the bottom-up approach. It should not just be concerned with the expectation of present stakeholders, but try to determine the implications of the general requirements of justice and sustainability. Hence, it too cannot avoid dealing with uncertainty; but still it might be easier to derive practical implications from it.

REFERENCES – **Gibbon**, A., 1997. Addressing livestock farming systems ecological sustainability at the regional level: an example from the Central Pyrénées. In J.T. Sørensen (ed) Livestock farming systems: More than food production. EAAP Publication No. 89, pp. 30-41. Hartwick J.M., 1977. Intergenerational equity and the investing of rents from exhaustible resources, American Economic Review 66: 972 – 974. **Kristensen**, E.S. & Hallberg, N., 1997. A systems approach for assessing sustainability in livestock farms. In J.T. Sørensen (ed) Livestock farming systems : More than food production. EAAP Publication No. 89, pp. 30-41. **Parfit**, D., 1984. Reasons and Persons. Oxford: Clarendon Press. **Solow**, R.M., 1974. Intergenerational equity and exhaustible resources. Review of Economic Studies, Symposium, pp. 29 – 45. **Thompson**, P., 1997. The varieties of sustainability in livestock farming. In J.T. Sørensen (ed) Livestock farming systems: More than food production. EAAP Publication No. 89, pp. 5-15. **World Commission** on Environment and Development, 1987. Our Common Future. Oxford University Press.