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The role of science in sustainable development policy

Abstract

Sound sustainability policies are based on the classic Brundtland definition of sustainable development, i.e. "to meet the needs of the present without compromising the ability of future generations to meet their own needs". On the other hand, there are ambiguities with respect to what development patterns do "compromise the ability of future generations". As a result, a number of academic studies and sustainability assessments carried out seem to be inconclusive. In many countries a typical study demonstrates the environmental friendliness of a given project without addressing the question of whether the project is sustainable if continued and/or replicated by others.

The paper draws examples from academic assessments in Poland in order to identify areas where scientific expertise is strong and abundant, and those where studies suffer from omissions or inadequate methodologies. In particular, domestically funded assessments, typically focused on technical and engineering aspects, are contrasted with EU-commissioned ones covering social and political contexts. The author concludes by calling at wider co-operation between domestic and international academic institutes so as to address all salient issues relevant for sustainability.

1. Introduction

The popularity of the sustainable development concept does not come along with the commonness of its understanding. For some it is simply the successor of the idea of environmental protection at a time when it has become clear that the traditional "pure" protection is no longer politically appealing. Others see it as a way to improve the weakened reputation of the industry which strives to maintain a leading role in the forming of economic policy. Natural scientists, for their part, stress the ecological aspect of sustainable development thus creating a tendency to substitute the English term "sustainable development" with the Polish "eco-development". Only sporadically does the original concept laid down in the Brundtland Report (WCED 1987) appear, the concept which was the starting point for the *Agenda 21* accepted in Rio di Janeiro in 1992. The classic Brundtland definition identified sustainable development with "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Pezzey 1998).

The classic definition of sustainable development consists of few words, being at the same time very significant and substantial. It may be criticised for excessive generality but that is precisely what makes the definition non-controversial and hard to challenge. In other words, nearly everyone should agree with it. Yet many practical corrollaries may be derived from it. All chapters of the *Agenda 21* are, in a way, an extension of the classic definition, trying to find a solution for overcoming poverty and other contemporary problems without making the future generations pay the debt.

There exist two completely different concepts of securing a sustainable base for future development, described as "strong sustainability" and "weak sustainability". The first concept calls for keeping natural resources as well as, additionally, any other resources related with human activities. According to the second concept, it is necessary to maintain an unchanged total amount of resources. That is to say that using up environmental capital may be in accordance with the concept of weak sustainability as long as it is compensated by the accumulation of other resources, that is human capital (i.e. knowledge, technology, institutions and behavioural norms) as well as man-made capital (work tools and other accessories).

Many researches have shown that particular kinds of resources may not always be freely substituted one by another. Of course within some limits the loss of one resource may be compensated by the growth of another. For example, the insufficiency of human or man-made capital may not be strongly felt if accompanied by an abundance of natural capital. The functioning of the economy and society, however, requires all three capital components and even ordinary people will find it obvious that it is impossible to go on substituting for example natural capital with other capital types forever (Daly 1990).

The limitations to substituting particular basic kinds of capital are an argument against the weak sustainability concept. Leaving the future generations with an unchanged total capital amount can reduce the chance to meet their own needs if the total lacks any of the key components. The economic theory can solve this problem only by creating a new one. Namely, if one of the capital components turned out to be crucial for meeting the needs, its value should resemble it. But then since it was substituted by another, "defective" one, obviously their summed value diminished, which contradicts the initial assumption. Looking realistically at the case though, it would be hard to expect anyone to have at their disposal a fully adequate assessment of biological diversity, natural landscape or even clean water. Furthermore, this hypothetical assessment would have to be made according to the preferences of the future generation and not the present who are responsible for current economic decisions. The possibility of practical operationalisation of the notion of weak sustainable development is therefore highly controversial.

Yet the notion of strong sustainability is just as controversial. Natural capital comprises both renewable resources which may constantly be exploited and resources that are depletable. The latter - by definition - cannot be passed on to the next generation undiminished unless the present generation gives up using them at all. As it is impossible to imagine a world of today without crude oil and other raw materials, it is also impossible to leave the strong sustainability principle in its strict form. A somewhat milder version of the principle has been formulated, one that permits using depletable resources at the paste of creating their renewable substitutes (Daly 1990). This principle refers to the so-called John Hartwick rule (1977) in the economic growth theory which calls for the investment of scarcity rents obtained from the exploitation of depletable resources. The Hartwick rule does not specify the destination of these capital expenditures, though; they may build up any of the capital types. If the rents are consumed and not invested, economic growth will not be sustained.

There is actually no obvious logical justification for Herman Daly's principle. It assumes the possibility to substitute the two components of natural capital - renewable and depletable resources - although the relation between them may in reality be more complicated. It is nevertheless quite eagerly acknowledged as a principle that allows moderating the strong sustainability principle without resorting to the weak principle which "sacrifices" natural capital for other kinds of capital too easily.

Irrespective of the doubts that accompany the attempts to operationalise the notion of sustainable development, it is something that may be subject to empirical testing. What turns out to cause much more trouble is the rational justification of the principle of equal opportunities - the very fundament of the sustainability concept.

The principle of fair division of welfare between generations is derived usually from Kant's categorical imperative, especially the way John Rawls expresses it (1971). The core of such deliberations is the idea of a hypothetical convention where representatives of different generations meet to decide upon the division of welfare between them. It is of great importance that the representatives not know which generation they belong to, in other words they should act "behind the veil of ignorance".

Needless to say it is impossible to make people act as if they did not know who they were; in some circumstances, however, negotiating an agreement "behind the veil of ignorance" is possible

indeed. One example is the arrangement and approval of the convention on preventing climatic changes caused by burning fossil fuels before the parties had unquestionable knowledge as to how much each one would lose due to these changes. (The convention was accepted in Rio in 1992.) Usually, however, parties are aware of their own position and interests so it is unlikely that sustainable development instruments, e.g. taxing energy sources or subsidising clean technologies, should be introduced on a scale that is indeed economically justified.

2. Key Research Areas

The scientific dilemmas outlined above show the breadth of the area of research that is crucial for the implementation of the sustainable development concept. It includes mainly traditional environmental protection that comprises both natural science and technical disciplines. There is no sustainability without guaranteeing the environment elementary protection from attacks by human activity. Scientific research should therefore encourage people to recognise the natural components of the enviromnent as well as the relations between them. It should also help natural scientists and engineers design equipment that reduces the negative influence of the economy on the environment and find ways to repair damages once these have occurred. Lastly, scientific research ought to indicate the relations between public health and the state of the environment thus increasing the effectiveness of medical care.

Traditional environmental protection is merely a small part of the sustainable development mechanism. As the above review shows, sustainability requires solving a number of problems that have to do with the economy itself as well as the relation between man and the environment and man and the products of man's activity.

Within the frames of economic sciences there are controversial and unsolved dilemmas, among which the most important one is the substitution and complementarity of different kinds of capital, namely human, natural and man-made capital. In Poland, the theoretical aspect of the problem has so far attracted very few researchers while no empirical work whatsoever has been done. Meanwhile determining to what extent the loss of capital may be compensated by investing in other capital types is substantial for the sustainable development policy. The case is similar when regarding the possibility of substituting depletable resources with their renewable substitutes. It is impossible to conduct an efficient and effective state policy without such deepened analyses.

Another research area that allows to understand sustainable development is natural resource valuation including the damages caused by the degradation of the environment. Although some scientific research in this field is being done in Poland, it is rather occasional and has little to do with international science. It is worth adding that nature valuation methodology has improved considerably in the world during the last two decades, allowing more and more precise estimations of the economic value of some resources. The results of such analyses are of great importance when planning the environmental protection strategy as they explain the nature of the benefits that may be expected after keeping or restoring particular elements of natural environment (Zylicz 2000).

Apart from economics, other humanities are also essential for the implementation of sustainable development. Since intergenerational equity is one of the important and at the same time controversial elements of the concept, as it was pointed out earlier, not only sociology but also philosophy should be applied in policy design. Intergenerational equity is the subject of economic inquiry although its practical meaning seems to be rather insignificant (Zylicz 2001). What appears to be more important is subjecting the notion to sociological and philosophical analysis. Thanks to philosophy it would be possible to deliberate on the subject of values in man's life and their role in economic and social development, whereas sociology is the appropriate discipline on the basis of which to compare theoretical concepts with the actual social and political life organisation.

3. The involvement of science

There are many scientific programmes whose aim is to help implement sustainable development. The *Global Change* scientific network is probably the oldest one of them. It originated as a response to the challenges resulting from the disturbing changes in global ecological systems caused by human activity. Due to its spatial and time extent, the network is in fact devoted to sustainable development issues. The network's main interest area are intergenerational issues. Human capital management and institutions whose goal is to maintain social order in the process of global changes are beyond its interests, though.

The social aspect of sustainability lies in the heart of another scientific network's interests, namely the *International Human Dimensions Programme.* The projects carried out within this network deal exactly with the social perception of global ecological concerns as well as the way the economy and political institutions respond to those.

State and regional governments try to steer scientific research so as to find support for sustainable development policy. We shall illustrate the outcome of these efforts with the example of projects financed by the European Union (EU) funds included in the *Fifth Framework Programme* and also - during the last decade - by the Polish Committee for Scientific Research.

In the EU, sustainable development has become a nearly constitutional principle. However, the same standing has been given to free trade with which it is, at times, incompatible. As practice shows, in conflict situations priority is given to free trade or other "non-ecological" principles. Sustainable development has nevertheless been ratified in many official documents and was also given priority treatment in the competition for scientific research budgets. As a result, the notion frequently appears in EU-financed research.

And so in the *Community Research and Development Information Service* (CORDIS) data base there are as many as 1153 records that contain the key word "sustainability". It appears that there are 8 long-term programmes dealing exactly with sustainability. Out of the programmes that are financed by the EU, in 71 the word "sustainability" appears in the title. In the next 274 programmes, "sustainability" is listed among the key words characterising the contents of the project. All this proves the great consideration of the notion in the EU. Scientists are, in a sense, "programmed" to associate the subject of their research with sustainability.

Among the projects that declare a direct relation to the notion of sustainability there is, of course, ecological research, e.g.:

- Phosphorus cycling and sustainability in agroforestry systems in the humid tropics
- Biological criteria for sustained development in natural degenerate forests of Mediterranean Europe
- The impact of forests and silvicultural practices upon the extreme flows of rivers
- Low-input agriculture and soil sustainability in Eastern Europe

Other projects are limited to technical sciences, as indicated by the following titles:

- Technological paradigms and transition paths: the case of energy technologies
- Durable binders from renewable sources for paints and coatings in the building industry
- Demonstration plant for steam gasification of PVC rich plastic waste
- Sonar technology for monitoring and assessment of benthic communities
- Product development and innovation in shipbuilding
- Improvement of the storage process of electricity in remote photovoltaic installations

A different category comprises a number of projects which involve social disciplines, especially economics:

- Application of non-monetary procedures of economic valuation for managing a sustainable development
- Tourism eco-labelling
- Economic and social implications of moving towards environmental sustainability through fiscal reform
- Resource-based growth of new, technology-based firms - new theory and its empirical application
- New elements for the assessment of external costs from energy technologies

Clearly interdisciplinary projects that bring together specialists in diverse disciplines such as economics, ecology, political sciences, engineering etc., should also be listed:

- Land, culture and crisis. From productionist success to fiscal and environmental impasse on European farms (1940-1990)
- Sustainable new housing in Ireland
- European network for management of arthropod resistance to insecticides and acaricides
- Strategies towards the sustainable household
- Climate, hydrochemistry and economics of surface water systems
- Baltic basin case study
- Achieving sustainability in transport and land use

Lastly, some projects intend to determine or assess sustainability indicators, e.g.:

- Operational indicators for progress towards sustainability
- Urban lifestyles, sustainability and integrated environmental assessment
- Development and application of soil productivity indexes for central America
- Implementation of EMAS (Eco Management and Audit Scheme) in Turkey
- Promoting action for sustainability through indicators at the local level in Europe

The review of Polish research related to sustainable development has been prepared on the basis of the reports done by the Polish Committee for Scientific Research. It turns out that of all projects carried out since the beginning of the Committee's work, only 8 - i.e. less than one per year on average - contain the word "eco-development" (which, in Polish, typically stands for sustainable development) in the title, namely:

- Analysing characteristics of red soils from the perspective of eco-development of rural areas
- An eco-development strategy for Zakopane and its impact zones including its recreational and sport functions
- Revitalising degraded settlement structures in the context of sustainable development (eco-development)
- Foundations of eco-development programming in local government units
- Environmental management in eco-development with particular emphasis on agriculture and forestry
- Natural science foundations of an urban eco-development theory and their practical implementation in spatial planning
- Conditions for the existence of organogenic soils in an agricultural landscape managed according to eco-development principles
- Environmental protection considerations in regional assessments for siting and modernisation of transport infrastructure according to eco-development principles. A methodology - a model design for the Cracow area

These projects are mostly rather small, with an average budget only slightly exceeding PLN 80,000 in current prices. Since all but two projects started in the latter part of the nineties, the budget may approximately be treated as if expressed in the 2000 prices. With such a budget it is possible to hire a team of several people for only a few months (in terms of full-time jobs). This proves that eco-development has not become a popular research topic in Poland.

A more detailed review of the 907 projects that deal with economics and various environmental protection domains, where the sustainability issue is likely to appear, does not alter this view significantly. Among those where this issue does appear, the majority are small projects limited to one single discipline. Large projects, especially ones that assemble teams from various disciplines, are very rare. Here are some examples of the latter category:

- Costs and benefits of public and private transport in cities
- Euroregions as a factor of economic development and environmental protection in border regions in Poland
- Sustainable development in indicators and statistical reporting systems
- Studies of recreational centres ("filters") clustering mass tourist flows in national parks of the Tatry region (Tatry, Babia Gora, Pieniny and Gorce National Parks)

Other projects that may be of interest are those connected with financial institutions as they combine advanced economic issues with sustainable development. Even though these projects are usually small, they are - potentially - very important given the role of money in the economy and in steering social processes.

- Banks and investment funds *versus* the environmental protection problem. Ecological criteria in financial transactions
- Pro-ecological reorientation of Polish banks in view of the UN declaration "Banking and environment"
- Using security market instruments in financing environmental investments

The majority, however, are narrowly outlined topics. It is very likely that the authors would not want their work to fall into the sustainable development research category; the Polish Committee for Scientific Research is far from encouraging such classification, anyway. As a result, Polish scientific research is nowhere near the model promoted in the EU.

Cases of partnership of Polish research teams in sustainability-related programmes financed by the EU are rare. "Baltic Drainage Basin Project" carried out in 1994-95 may serve as an example. Thanks to this study, Polish scientists were able to gain experience in environmental valuation in association with the leading centres in Sweden and England. It is nevertheless all too common for Polish sustainable development research teams to have very loose ties with international science.

4. Recommendations for the future

Sustainability research comprises many disciplines. It requires the involvement of economists, ecologists, engineers and representatives of other sciences. In part 2 above, significant (as far as working out and promoting sustainability principles is concerned) research areas have been identified. These include: social sciences, especially economics, environmental sciences, especially ecology, and technical sciences, especially environmental engineering.

With so broadly outlined a research area, some key issues of particular meaning ought to be identified. This group should contain natural capital valuation research as it is irreplaceable at integrating different science disciplines. Such research is a good opportunity to develop the uncommon in Poland modern economic analysis techniques. Other than that, natural capital valuation research allows for a detailed recognition of the current role of particular natural capital elements, including the possibilities of its substitution. Last but not least, it forces people to

seriously consider the future role of natural capital: the anticipated social preferences, technical abilities and ecosystem resilience. A truly responsible attempt to valuate a small part of natural capital requires the cooperation of economists, ecologists, engineers and sociologists.

Research on social aspirations and preferences as well as society's functioning mechanisms is also essential given its role in implementing sustainable development. This kind of a development path may not be decreed; it must result from a choice made on the basis of economic and political conditions but also from the awareness of natural capital inherited by the society and from the sense of intergenerational unity. Research projects in this field should assemble - alongside natural scientists - other humanities' representatives, including philosophy and pedagogy. It is the only way to competently analyse decision processes which encourage sustainability.

Looking at projects financed by the Polish Committee for Scientific Research from this perspective, it is clearly visible that they already include many of the above mentioned issues. What the projects lack is thorough economic research on sustainability fundamentals. Moreover, one may observe the dominance of narrow topics, limited usually to a small geographic region. The projects are mainly small and assemble teams of few scientists representing related disciplines.

The outlined diagnosis suggests the need for stronger ties between Polish and EU research programmes. This postulate is fortunately in agreement with the Polish government's political decision to allocate part of the science budget to international project selection procedures by participating in the Fifth and later in the Sixth Framework Programme. Independently of that, there are other, substantive reasons to encourage Polish research teams to cooperate with European centres more closely.

First of all, some scientific disciplines in Poland are still at initial development stages, which is why cooperating with leading foreign partners is highly desirable. Secondly, the fragmentary research conducted in Poland is valuable and often deserves wider popularisation, most easily acchieved by preparing a synthesis in cooperation with a renowned research centre. Lastly, carrying out interdisciplinary research - i.e. the kind of research that is most desired in the field of sustainability - requires the involvement of large teams and, consequently, large budgets. Since the Polish science budget is very limited, and will certainly remain such for some time, there is no better strategy than taking advantage of international funds.

There is an additional reason why taking part in EU programmes can be attractive. While the selection of projects by the Polish Committee for Scientific Research is carried out by narrowly specialised internal commisions, the projects submitted to the European Commission have much higher chances of interdisciplinary assessment. And so, since sustainability research by its very nature requires an interdisciplinary approach, the authors of the best projects will receive kinder assessment by the Commission than by the Polish Committee for Scientific Research.

The research offer presented by the European Commission in the VI Framework Programme for the years 2002-2006 is very interesting from this point of view. The topics related to sustainable development may appear in different chapters of the Euro 12.5 billion budget undertaking; the most appropriate one, however, is the priority area entitled "Sustainable development and global change". The anticipated budget for this field is Euro 1.7 billion, i.e. nearly 14% of the total sum. Unlike Polish science administrators, the European Commission supplies its offer with rather detailed indications as to preffered research projects. Assuming that energy and transport are in the greatest conflict with sustainability, priority has been given to these areas.

The "Sustainable development and global change" area has been divided into two parts: *Technologies for sustainable development* and *Global change.* Five research priorities have been singled out in each of them, namely:

- Renewable energy sources, more efficient and clean use of energy, especially in urban areas, new concepts of energy efficient and cleaner transport
- Sustainable transport
- Fuel cells
- Hydrogen
- Solar photovoltaic technologies and biomass

and

- Impact and mechanisms of greenhouse gas emissions on climate and carbon sinks (oceans, forests and soil)
- Water cycle
- Biodiversity, protection of genetic resources, functioning of terrestrial and marine ecosystems and interactions between human activities and the latter
- Mechanism of desertification and natural disasters connected with climate change
- Global climate change observing systems

The priority topics above may at first seem narrow and technical. A closer analysis shows, however, that the proposed projects are expected to be complex and interdisciplinary. The introduction to the first part of the " Sustainable development and global change" area contains an indication that "proposed technological solutions [... should address] technical but also organisational, institutional, financial and social issues". Each topic is additionally described in a few sentences and supplemented by an indication as to what project authors should pay particular attention to. Here is an example of such indications concerning biodiversity: "research will focus on: assessing and forecasting changes in biodiversity, structure, function and dynamics of ecosystems and their services; relationships between society, economy, biodiversity and habitats; integrated assessments of drivers affecting biodiversity and mitigation of biodiversity loss; risk assessment, management, conservation and rehabilitation options.

Independently of research projects focused on fundamental sustainability issues, there is demand for scientific analysis of minor issues with which particular economic sectors or local governments have to deal. Such cases ought also to be seriously treated though few of them will succeed in securing funds from a science budget, be it Polish or European. In Poland, there are a number of institutions that can provide financial support for research projects of this type. The most important one of these institutions is the National Environmental Protection and Water Management Fund.

The basic requirement for the success of sustainability-devoted research is ensuring cooperation of specialists in different fields who represent the highest scientific level. The need for an interdisciplinary approach is hard to challenge. The quality of such interdisciplinary cooperation, however, is sometimes problematic. In a team of, for example, an economist, ecologist and engineer we have interdisciplinarity but the team members may not be equally competent. If the results of their work are discussed by a group consisting of representatives of one single discipline, e.g. ecology, the quality of the results cannot possibly be properly assessed; in this case the economist's and engineer's role may be assessed very superficially while the rank of the results will remain unclear. Therefore, providing competent support for sustainability research requires great intelectual and organisational effort related to project assessment.

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Information available at the following internet sites has also been used:

www.kbn.gov.pl

and

www.cordis/lu