Resource Management:
Do we need public policy?

Small study for Directorate B
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1. Introduction

In the course of the preparation of the 6th Environmental Action Programme, Directorate B of the Directorate General Environment of the European Commission organized on 13 July 2000 an expert workshop on resource management. The question was whether it is needed to focus (again) on resources as part of the environmental programme and if yes, what public administration (in particular the European Union) can and should do in order to promote resource efficiency. The participants of the workshop were asked to outline their views on this in a paper that can be used in future Commission work on resource management.

First, this paper tries to argue that the issue is not so much whether we should focus on either resources or other environmental problems such as pollution, since these concepts are so strongly interrelated. Furthermore, the modern definitions of these concepts imply that it effectively boils down to the same thing. Pollution can be interpreted as depleting an environmental resource, and the problem of resources is often meant to be the problem of the pollution resulting from the use of these resources. It is more important to identify the problems and to analyze how the problems can be solved in the best way.

Much has been written on resource management but, unfortunately, the material can be split into two strands of literature that fight each other more than try to learn from each other. This paper will try to reconcile some of the issues.

The paper is written from an economist's point of view. This implies that concepts and policies that were developed in environmental economics will be highlighted. Of course, many other valuable approaches to the problem exist but these are outside the scope of this paper.

Finally, this paper tries to argue that a distinction has to be made between the politics of public policy, on the one hand, and effectiveness and efficiency, on the other hand. Much too often, advice for public policy is not only based on how to reach certain targets but also on which targets should be reached. The last part is often a matter of preferences and not of professional advice.

The paper starts with some history to put the discussion in the right perspective. In the section after that a classification of resources will be given. Then a number of concepts from environmental economics are introduced which are not always part of papers on resource management but are important to understand the issue and to draw conclusions for the role of the public administration, in particular the European Union. A summary concludes the paper.

2. History

Reports for the Club of Rome (Dennis Meadows, The Limits to Growth, 1971, and after that) drew a lot of attention to the finiteness of resources and the danger of exhaustion. Actually, the issue was not really new because classical economists starting with Thomas Malthus had already drawn attention to the limited availability of land that could lead to starvation for a growing population. Fortunately, Malthus proved to be wrong because he had underestimated the rapid technological progress in agriculture. Hunger is still a major problem for many people in the world, but the cause is more a socio-economic one than the availability of land. The parallel is remarkable because three decades after the reports for the Club of Rome, the conclusion is again that the availability of resources is not a major issue anymore. The reason is twofold. On the one hand, reserves prove to be higher than originally estimated. This is partly caused by new discoveries and partly by the way reserves are calculated: it must be technologically feasible and/or economically rational to extract the resource. Due to technological and economical development, reserves that were previously not counted are counted now. On the other hand, the use of resources did not grow as fast as was originally predicted. Resource use is a cost to the economy and technological progress generally lowers the cost by using less or recycling the resource. In a reaction to the Club of Rome reports, economists had also predicted a price effect: when the resource gets scarcer, the price will go up and the demand will go down. For most resources, however, this did not really happen for reasons outlined above.

Economic theory developed much parallel to the observations above. The neo-classical revolution took place when the common understanding was that natural resources were not scarce. As a consequence, the theory was only built on two input factors: capital and labour. Of course, a specialization called “resource economics” developed to analyse the optimal extraction of non-renewable and renewable resources, but it was not until the publication of the Club of Rome reports that natural resources became part of general economic theory again. Some economists incorporated these issues in the neo-classical framework; others rejected neo-classical economics and took a different approach. In a section below some attention will be given to this debate.

The reports for the Club of Rome mainly concentrated on non-renewable resources like oil and minerals. Later the societal concern switched to environmental resources like air, soil and water. Due to pollution, these resources also became scarce and depletion of this type of resources was considered to be a bigger threat to mankind than depletion of some minerals. Therefore, environmental policy also switched to pollution control. However, upon realizing that pollution is a result of a chain of activities, the question rises whether resource management has to be put on the policy agenda again. Before trying to answer this question, the next section first considers the classification of resources.

3. Classification of resources

Traditionally resources are divided into *renewable* and *non-renewable* (or *exhaustible*) resources. Although almost all resources are renewable in the long run, resources that are not renewed on the same time scale as other processes are labeled non-renewable: e.g. oil and minerals. Renewable resources are usually subdivided into resources that renew fast (e.g. fish) and resources that renew slowly (e.g. forests). The field of resource economics is essentially based on these three types of resources. Non-renewable resources will be depleted in the long run (when extracted), but renewable resources may also be depleted if the extraction rate exceeds the renewal rate.

The issue of depletion leads to a further classification. Non-renewable resources can be *recyclable* (e.g. minerals and oil used in plastics) or *non-recyclable* (e.g. oil used as fossil

fuel). Renewable resources can have a permanent character (e.g. solar and wind energy) and are then labeled *flow* resources.

When attention shifted from the resource problem in the traditional sense to pollution of the environment, *environmental* resources (e.g. air, water and soil) came into the picture. Pollution can be seen as depleting an environmental resource. Although these resources cannot be destroyed, they can become useless for mankind.

This leads to the following, most common classification:

- non-renewable and non-recyclable resources, such as fossil fuels
- non-renewable but recyclable resources, such as minerals
- fast renewable resources, such as fish
- slowly renewable resources, such as forests
- environmental resources, such as air, water and soil
- flow resources, such as solar and wind energy

4. Concepts of resource management

Resource economics is basically concerned with the question how to optimally extract a resource. In case of a renewable resource, a benchmark is the *maximal sustainable yield*, which is the highest extraction rate that preserves the stock of the resource. Due to costs and benefits of extraction and due to discounting, it can, however, be better to choose a lower (but sustainable) yield. In case of a non-renewable resource, the optimal extraction rate is a type of *Hotelling rule*. These theories, however, are developed under a number of crucial assumptions. The assumptions that are most relevant for the discussion are treated here one by one.

Consider first the issue of *property rights*. If one person or one company owns a resource, optimal management may be expected, but if a resource is common property or if many agents have open access to a resource, the story is very different. Hardin's tragedy of the commons may occur. An example is overfishing, and to the benefit of all involved, public administration has to play a role: fishing quota's are set for certain fish in the North Sea, and governments enter international agreements like the Law of the High Seas.

Second, Hotelling assumed a *backstop technology*, which means that at a certain price the economy will switch to another resource so that demand for the resource will disappear. It is best for the resource owner to extract the whole resource before the switch occurs. This can be recognized in the exploitation of oil as fossil fuel. Big oil companies, such as Shell, already have alternative technologies to provide energy, but as long as the price of oil is low, it is economically rational for them to continue to use oil. The owners of the resource, such as the OPEC, make sure that the price of oil stays below the switch point, because otherwise their oil loses its value. As long as oil does not have an intrinsic value for society, public administration does not have to interfere and can rely on the game that is played.

However, the use of fossil fuel has serious negative *externalities*. CO2 is released into the atmosphere and that may lead to costly or even life threatening changes in the climate. In their primary responsibility, big oil companies and OPEC are less concerned, so that here a major role has to be played by public administration. One can also say that clean air, an environmental resource, is depleted and public administration, as the representative of the society as a whole, has to set a price. This also explains the shift in public concern from the issue of depletion of fossil fuels to the issue of climate change. If oil is depleted but substituted by alternative sources of energy, there is not much to worry, but if as an effect of that process high costs occur due to climate change, there is a lot to worry. However, this does not mean that public policy should not focus on the depletion of fossil fuels. It is better to try to control the carbon as an output of the production process, but if that is not feasible or very costly, it is also possible to control the carbon as an input. By taxing the use of fossil fuels, it may look like public policy is concerned about the depletion of the resources but in fact public policy tries to control the use and thus the release of carbon. Another example is the release of nitrogen and phosphorus, through the manure of pigs, leading to soil and water pollution. It is best to tax or constrain the release of nitrogen and phosphorus directly but it is almost not possible or very costly to monitor this. Based on the material balance principle, an alternative policy is to tax or constrain the nitrogen and phosphorus contents of the food of pigs.

Negative externalities are also at the heart of the well-known *prisoner's dilemma*. To give an example, if countries do not coordinate their policies, they do not take into account the

costs to other countries of their own release of CO2 or SO2, and this results in too much pollution. By the same token, if countries coordinate their policies, each country has an incentive to deviate and release more, relying on the other countries to stick to common policy. In case of transboundary pollution like acid rain or global pollution like climate change, a federal government such as the European Commission has a role to coordinate policy in order to achieve efficient use of environmental resources, and also has to find ways to suppress incentives to deviate.

Another important assumption in the basics of resource economics is that *stocks* have no value. This may be true for stocks of oil but forest stocks definitely have a value in terms of enjoyment and habitat of species. Modern resource economics takes account of that.

These are just a few issues that are important for the discussion. A vast literature already exists that treats these topics and much more, and this literature is rapidly expanding. In the last few years many textbooks appeared that provide a good introduction.

A last issue concerns the position of the future generations. They cannot defend their own interests and current generations tend to *discount* the future in their trade-offs. The report of the Commission chaired by Gro Harlem Brundtland (Our Common Future, 1987) calls for *sustainable development*, meaning that all development should meet the needs of the present generation without compromising the ability of future generations to meet their own needs. Emphasis was also given to the needs of the poor. However, the concept of sustainability was since then heavily discussed and many definitions and interpretations were introduced. One debate was whether the target should be to maintain welfare or to maintain natural capital (resources). Another distinction was between *weak* and *strong* sustainability reflecting differences in view on the substitutability between natural and other forms of capital.

It is clear that no debate arises when the stocks of resources can be kept intact. Regarding renewable resources, if development can be based on catch of fish or harvest of forests up to the degree of regeneration of these resources, development is sustainable. Similarly for environmental resources, if development can be based on pollution up to the degree of natural assimilation, development is sustainable. Regarding non-renewable resources, if development can be based on 100% recycling, development is sustainable. However, not

all resources are recyclable and for the ones that are, the laws of *thermodynamics* learn that 100% recycling is not possible. Strong sustainability would therefore imply that all production had to stop which is not really realistic. This also shows that everything is a matter of trade-offs. Not many people will claim that it is always bad to cut trees in order to develop agriculture or build houses, or to develop polders to relieve densely populated areas. However, trade-offs are not easy to make. By law, the government of the U.S.A. is obliged to make cost-benefit analyses but given the uncertainty and the problems how to value environmental goods, this is an extremely difficult task.

If one accepts the concept of weak sustainability, the question remains whether in some sense limits have to be set to the degree of substitutability between natural capital and other forms of capital. Basically, this is a matter of preferences. People who prefer that humanity lives in harmony with nature reach another conclusion than people who prefer that humanity lives in control over nature. People attach different values to the intrinsic value of nature. Given the high degree of uncertainty (e.g. about climate change or future values of biodiversity), also differences occur because some people are more risk averse than others. However, people will agree that mankind must survive and since ecosystems are also life-support systems, this implies that a limit to the possible depletion of natural capital exists. This has led to concepts like *environmental space*, *carrying capacity* and *critical loads* (e.g. GUA, 2000). Although these concepts are appealing, it is very difficult to precisely position the constraints. This also left room, when applying these concepts, to mix the idea of life constraints with preferences for natural capital, which confuses the discussion.

Neo-classical economic theory has been strongly criticized by environmentalists. It is true that neo-classical economics has neglected environmental issues for a long time, but this is changing now. Essentially, neo-classical theory is more technique than content. It uses optimization under constraints to model behaviour of the firm (profit maximization), the consumer (utility maximization) and the government (welfare maximization). The theory is simplistic in many respects, such as modeling the production process by a production function, but at least it provides analytical tools to get insight in the efficient allocation of

resources. The techniques can also handle hard constraints, following from the concepts of environmental space and carrying capacity, so that no a priori reasons exist not to use neo-classical economics to tackle environmental and resource problems. In fact, a large number of interesting contributions appeared both in general economics journals and in field journals over the last decade. Moreover, the development of game theory provides a framework to analyse issues like common property, incomplete markets, externalities and the prisoner's dilemma. Of course, the models are usually simplistic and do not cover all the aspects of the problem and other, more holistic, approaches are also needed to reach a full understanding. A trade-off occurs between simple models with analytical depth and more complicated models with less analytical depth. Both types of study are needed.

5. Public policy

What can we learn from all this for public policy and especially for a federal government like the European Union? It is by now generally accepted that a government should not try to manage everything. If by protecting institutions like property rights and markets, society can solve the problems by itself, public administration should not intervene. An example is the provision of energy. Fossil fuels are non-renewable resources, but the oil companies want to stay in business and have developed alternative sources of energy that will be supplied whenever it is economically rational to do so. Because stocks of oil have no other value to society, the government does not have to tax extraction of oil in order to slow down depletion. There may be other reasons for taxing oil but we will come back to these later. Public administration, however, must intervene in cases of common property or open access, externalities and prisoner's dilemmas. By means of examples, these cases will be treated here one by one.

A resource like fish in open sea is a typical example of public property with open access. Each fisherman has an incentive to catch as much as possible, because he has no control over the resource anyway. Although the resource is renewable, overfishing will result and the resource will be depleted, which is not in the interest of anyone. Public administration must intervene in the interest of all involved.

Examples of externalities are numerous. In the line of this paper it is interesting to present three of them. Forests are cut in order to sell the timber or to develop land for agriculture. However, by cutting the trees, negative external effects to others result. Forests are sinks for CO2 and thus mitigate the risk of climate change. Forests are also a habitat for species and a high level of biodiversity may be important to sustain life one earth. Finally, forests are an amenity: people enjoy the view and like to hike in forests. All these values have to be taken into account and public administration has to play a role.

Another important externality is the release of CO2 when burning fossil fuel with the risk of climate change. It was argued earlier that the depletion of fossil fuels as such does not have to be a concern of public administration, but climate change is a public bad and that may be a reason to tax oil after all.

The most important externality is the effect of what we do now on future generations. We are back at the issue of sustainable development. Assuming that people care about future generations, public administration must intervene.

Prisoner's dilemmas occur, for example, when pollution is global (like climate change) or transboundary (like acid rain). In the cost-benefit analysis, each country will not take the damage to other countries into account and therefore emit more than in case the countries cooperate. Federal governments like the European Union can solve this by coordinating the policies if the problem is confined to the federation (e.g. acid rain is predominantly a regional problem). Otherwise, international agreements are needed.

After we have identified in which situations public administration has to intervene, two important questions remain: to what extent and in which way? It is easy to say that the policy should be based on a cost-benefit analysis and that all values should be taken into account, but the problem is how to determine some of these values. What is the value of biodiversity or the amenities of a forest? What are the expected costs of climate change? Under the name of *valuation* a lot of research is performed on valuation techniques and applications, but one cannot say that methods and results are generally accepted. Much more research is needed, but in the meantime it is clear that public administration has to act now to control certain resources. Another problem is, as was mentioned earlier, that people attach very different values to, for example, environmental resources. Except for

situations that threaten life, a wide variety of preferences exist in society. This is not a new phenomenon and public administration is used to handle differences in view through political processes. However, one cannot say that right now serious political discussions on resource management take place. There is a clear need to challenge the institutions to express their views.

After it has been determined what the targets are, the final question is how to reach these targets. The choice of instruments is important here but also the timing. It is beyond the scope of this paper to discuss all possible instruments of resource policy and the reader is referred to textbooks for an introduction. In general, *economic instruments* like taxes and tradeable permits are preferred because of the efficiency properties and the pressure to improve performance over time. Firms strongly oppose to economic instruments because of the costs introduced by taxes and the price for permits. However, often a remedy can be found by compensating firms through other channels: the purpose of the instrument is to regulate behaviour and not to raise revenues. Timing is important as well: adjustment takes time and trying to force the society to adjust too quickly may not have the desired effect. It is best when the adjustment comes from *technological change* but research and development take time. If policy triggers technological change but does not overask, the interests are probably served in the best way. Estimates on technological possibilities are also the basis for the concepts *factor 4* and *factor 10* (e.g. GUA, 2000).

The final issue is how to implement, for example, a tax. If the problem is that emissions (like carbon, sulphur, nitrogen and phosphates) are too high, it is best to directly tax the emissions. However, in order to be able to implement the tax, it is necessary to monitor the emissions and that can be very difficult or costly to do. Since the substances enter the production chain somewhere, it is also possible to tax the input instead of the output. It is in principle better to tax the substances later in the chain in order to take advantage of all reduction possibilities but the trade-off between monitoring costs, on the one hand, and costs of loosing reduction possibilities, on the other hand, may lead to taxing earlier in the chain. Examples are taxing fossil fuels instead of CO2 emissions, and taxing food of pigs instead of the manure.

6. Conclusion

The question asked in this paper was whether it is needed to focus (again) on resources as part of the environmental programme and if yes, what public administration (in particular the European Union) can and should do in order to promote resource efficiency. It is, of course, not possible to cover everything in a short paper and therefore some topics have to be chosen. It was first argued that environmental problems can be viewed as depletion of environmental resources and in that sense environmental policy is resource policy. The question then becomes whether it is needed to focus policy again on raw materials instead of pollution. Contrary to the prediction in the reports for the Club of Rome, raw materials have not become scarce yet and firms seem to be able to find substitutes in time. As far as extraction of raw materials does not yield external effects to current or future generations, public policy is not needed but if external effects occur, governments have to intervene. A second reason why resource management in the traditional sense is needed appears if it is the only or the best way to tackle the environmental problems resulting from the use of resources.

The second topic of the paper was to summarize the relevant concepts that are developed in the field of environmental economics in order to complete the report, written by GUA for the workshop in July 2000, which is more based on the concepts that are developed in the field of ecological economics. It was also tried to link the two.

Finally, it was argued that a distinction has to be made between the role of governments in preventing public bads or providing public goods and correcting externalities, on the one hand, and the political process within governments to weigh and channel the wide variety of preferences for environmental goods, on the other hand.

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