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Sustainable Development in a Regional System

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1 Regional Ecologically Sustainable Economic Development

1.1 Introduction

The notion of **'Sustainable Development'** (SD) has in recent years extensively been discussed (see WCED 1987; Archibugi and Nijkamp 1989). However, these discussions were often taking place on a global scale, whilst to a large extent they were focussing on conceptual issues. And consequently, it is not surprising that the lack of empirical applicability has been a major source of criticism. A more operational treatment of this - appealing but highly abstract - concept of SD seems the only way to let it survive in the current debate on our common future. Thus the practical applicability of this concept has to be emphasized.

An SD analysis should offer operational guidelines for the contents and the steps to be taken in order to meet the objective of SD. The inherent logic of a regional sustainable development (RSD) analysis stems from the belief that this analysis may make functional interdependences at the regional level more manageable in view of a given development objective. Clearly, from a management and policy point of view, a regional system is more suitable for control and transformation than the global system. And hence it is evident that the objective of SD may be achieved more easily, if the processes of socio-economic development and environmental change at a regional scale are clearly understood and properly managed (cf. Kairiukstis, 1989). The interdependences may be either one-dimensional (or single faceted) (e.g., in case of transport, commuting, industrial, infrastructural, communication, or recreation activities) or multidimensional (e.g., broader social, economic, or economic-ecological phenomena). Clearly, regional development objectives may vary from analytical-theoretical to descriptive-empirical or prescriptive. In case of concrete regional management issues, the goal may be a rationalization of policy behavior (ex-ante or ex-post) with respect to one or more facets; in case of a uni-dimensional objective this may be operationalized by means of conventional optimization strategies, while with a multi-dimensional policy analysis a 'satisficing' strategy may be more appropriate (see Simon, 1967, Nijkamp,1981).

In this paper, first a discussion of **sustainable development at a regional level** (RSD) will be presented. In this context a methodological question which is relevant to real-world problems and policy questions is: can a meaningful and operational concept of RSD - and rules for policies to obtain RSD - be postulated on the basis of the global concept of SD? An other question concerns the openness of a spatial system of regions. Given an internal (i.e., intra-regional) policy of sustainable development, an important question is: what are the restrictions in economically and ecologically 'open regions' to render an internal RSD policy effective in a broader spatial system?

Next in section 3 we will give a short discussion of the notion of a 'region' in this context. The main question is: which are - in the context of sustainable development - the specific dimensions of this RSD notion? It will be argued that the **relative openness** of a region, the **specific regional circumstances** (precluding on the one hand a regional leveling out of global developments and leading on the other hand to global impacts of regional problems), and the **level of authority on the common environmental goods or resources** of a region are of critical importance here.

Usually the interdependences in the case of RSD are clearly multidimensional; this will be further discussed in section 4. The emphasis in this section will be on some descriptive-theoretical thoughts with regard to the objective of SD at a regional level.

In our approach, we will link the notion of RSD to a welfare-theoretical approach, in which RSD will be related to often mentioned aspects of welfare in this respect: **intergenerational trade-off, interregional trade-off, multiple use of environmental resources and sustainable use of resources** (cf. Nijkamp and Soeteman, 1989).
In this paper the emphasis will in particular be on one of the key factors for successful implementation of regional sustainable policies: the **institutional structure of RSD management and policy**. Therefore in section 5 some prescriptive-analytical guidelines regarding an institutional structure are developed and proposed. It is evident that - in contrast to the notion of 'regional economic growth' - the multidimensional feature of RSD calls for a satisficing policy analysis, based on compromise optimization strategies. Consequently, in section 6 a set of possible feasible policy strategies is discussed.

2 Towards a Definition of Regional Sustainable Development

In the framework of RSD an integrated economic and environmental approach to policy-making is a necessity in order to minimize conflicts between resource using activities, to enhance socio-economic opportunities (like optimizing productivity) and to bequeath an environmental estate for the benefit of future generations (cf. Cloke, 1985)[1]. Quite often a RSD-oriented strategy is carried out by evaluating the implications of environmental standards set or by putting constraints on industrial, agricultural or transport developments. However, a particular project (proposed or implemented) may increase or decrease welfare levels of society at different (intergenerational) points in time and (interregional) points in space, while the aggregated welfare measured over all these points may still be positive in all cases (depending inter alia on the social rate of discount used). Thus there are distributive implications for income, employment and environmental amenities over space and time.
If for some (new) regional activities no acceptable environmental solution can be found, a solution may be to search for compensating measures. Compensatory measures can be applied to both spatial scales and time scales. The idea of compensation is appealing in as far as it gives space for alternative policy choices. However, in various practical situations still many questions have to be answered to make this option really operational, for instance the question of how compensation has to be utilized (e.g., which are the environmental and socio-economic consequences of the compensating project), of the existence of possible time lags between destruction of environmental amenities and their re-construction, or of the costs to be born by various groups. Recently, various interesting proposals have been made in this respect. One example is to replant forests in Central America as a compensation for the carbon dioxide produced by a new power station in New England. The idea of compensation is of course easier to apply to large individual projects with a single or few decision-makers. For numerous small daily decisions by individual persons (like painting a house, driving a car, smoking a cigarette) direct compensating measures are hard to carry out due to the so-called large number case (cf. Baumol and Oates, 1988).

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1 Until now partial solutions (i.e., without explicitly stated sustainability considerations) for environmental problems are often proposed. Due to incomplete knowledge or limited availability of instruments, it is by no means certain that such a step-by-step treatment of the complicated socio-economic environmental relationship is the best way to attain a higher degree of sustainability in our society. The proposition is sometimes even put forward that such an approach 'automatically' will lead to sustainability (cf. Pezzey, 1989).

An alternative way of looking at RSD in an open spatial system is to conceive of RSD as a balance in terms of flows of regional imports and exports in the long run, both for ecological - physical flows, and trade - monetary flows. The physical flows are not only determined by cross-boundary flows of groundwater, surface water or air (i.e., the physical means of transport), but also by socio-economic activities like trade, capital flows and migration.
The latter view on RSD is appealing, but is still to much region- oriented. RSD refers essentially to more than just balanced flows for a given area. From a welfare viewpoint on SD, it makes more sense to define RSD as: **a development which ensures that the regional population can attain an acceptable level of welfare - both at present and in the future - and that this regional development is compatible with ecological circumstances in the long run while at the same time it tries to accomplish a globally sustainable development** (cf. Nijkamp and Soeteman, 1989). Consequently RSD has to fulfil two goals:
(1) it should ensure for the regional population an acceptable level of welfare, which can be sustained in the future; (2) it should not be in contrast with SD at a supra-regional level.

The latter definition implies that RSD for a single region is compatible with global SD. Consequently, if all regions of a global system have a RSD, then the development in the global system will be sustainable as well. Clearly, the RSD paths of specific regions may have different characteristics because of specific regional circumstances (e.g., availability and use of natural resources and socio-economic capital, environmental vulnerability and resilience, and socio-economic distribution of income and employment), so that it is not easy to typify RSD in general.

Given the existence of trade, transport, dispersion of species, or other socio-economic and ecological linkages between regions, it may of course be possible to attain SD at a global level without having a RSD path at the regional level. In extreme cases it might even be possible that global SD demands regional 'sacrifices' to the detriment of regional development (or environmental sustainability). Such a development may be acceptable from a supra-regional or global human need perspective. By 'sacrifice' we mean here a reduction in welfare for the regional population, which will be in contrast to the first above mentioned goal of RSD. This may happen, for instance, when certain regions are used for specific environmental or economic purposes (such as conservation of natural areas, concentration of industrial activity, or dump of waste). According to the Brundtland-report (WCED, 1987, p 45) it is even not realistic to suppose that every ecosystem (which may encompass more than one region) can be preserved intact everywhere. In these cases we have to look for regional implications of SD, which may ask for solutions to the already mentioned difficult problems of regional compensation.

In the next section the specific regional dimensions of SD will be discussed in order to understand where to place the emphasis in case of a proper management of RSD.

3. Aspects of a Regional Analysis Regarding Sustainable Development

Sustainable development of a region runs of course the danger of transferring the 'global rhetoric' (Pezzey, 1989) of sustainability towards a micro or meso level of application. Clearly,

a regional treatment of sustainable development falls in between a macro (or global) systems level and a micro (or project) level approach, as an analysis of RSD is spatially a meso level analysis. It should be added however, that practical, efficiency or analytical reasons may necessitate a flexible use of different spatial scales. Also management reasons may necessitate a differentiated level of treatment of RSD, for both legislative tasks and control (or executive) tasks. Thus, RSD presupposes a meso level of analysis, but not an a priori fixed spatial scale of a region.

Regions are however not uniquely defined spatial entities. Demarcation of a region may depend on the purpose of analysis but may also be the result of an analysis. If the resulting demarcation is searched for, the following rather abstract and analytical definition of a region which is often used in the regional economic literature may be applied: "a set of spatial points that are either homogeneous with respect to some characterization (criterion of homogeneity) or are more intensively interrelated among each other than with other spatial points (criterion of functional dependence)" (Siebert, 1985, p.126). A region is in this definition seen as a subset of a global system. Consequently, it would be straightforward to define the concept of RSD as a translation of the global concept of sustainable development applied to the regional level. For instance, if for a given region RSD is possible and independent of the rest of the world, then it is self-sufficient. However, it follows from the above definition that regions are open systems with respect to many characteristics, so that they are to a large extent dependent on other regions for their development. Interactions and trade-offs between regions are in this context especially relevant. It is noteworthy that in the context of RSD a closed regional system seems a rather unrealistic abstraction of the real world. First, for a global system all processes are in principle internally determined, but for a region many factors are outside determined (e.g., scarcity and prices of resources, imported pollution, and even climatic conditions). Secondly, global developments do not uniformly and smoothly impact on all regions. Global warming of the atmosphere, for example, may have positive effects on the total of organic production in the world, but will certainly result in socio-economic and ecological disasters in parts (regions) of the world[2]. Also the consequences of the finity of natural resources on a global scale may have important different consequences at a regional scale. For instance, the depletion of resources primarily originating from one region may be compensated by surpluses of other regions. However, such compensations will only be possible if there exist a wide diversity among regions and if the resources are mobile. In the case of land (an immobile resource), the interrelation of regions may also ease the mobility of human activities when the pressure on this resource becomes too high (see Arntzen, 1989). Thus, on a regional level of analysis and policy there is much scope for various trade-offs: interregional, global-regional and intertemporal. Consequently it is necessary to consider RSD in relation to interactions with other regions and their respective developments. The resulting kind of RSD depends then on the type and amount of goods and services the region can sustainable offer and on the sustainable import of goods and services of the rest of the world.

If however the purpose of demarcation is taken as a central aim, a less abstract definition may

2 How different the policy perspective may be between SD and RSD shows the next example. The Russian climatologist Michail Budyko was one of the first scientists in the middle of the sixties who warned for the glass-house effect. Now after some 25 years his ideas are generally accepted among policy makers and scientists, he advocates the idea of promoting the warming effect of the atmosphere in view of global rationality.

be used. In this case the demarcation is starting point in stead of result in the analysis. For example, if institutional considerations are taken as a focal point, a region may be defined as: "an area within which there is enough community to support an authority that represents and serves the common good" (Daly, 1989, p.2). Clearly, a government that wishes to serve the regional common good needs a program consisting of goals, objectives, and finally measures or projects. Similar to the global concept of SD, it is not easy to arrive at a sustainable development path by coordination of individual projects impacting on these common goods. Complicating issues are inter alia multiple use of natural resources, multiple and often conflicting or competitive objectives of social groups, dynamic interdependences within and between social acting and environmental evolution, etc.. In this definition interregionally complicating factors are not yet taken into consideration. If there are any relevant interregional connections, the region simply would have to be enlarged in order to encompass these spatial connections. Clearly, in a policy context, this may not always be possible.

Consequently, RSD differs from SD in three essential aspects: the openness (or interrelatedness) of a region, the aspects which are - in contrast to a global treatment - not levelled out on a regional scale, and the regionalized authority of common goods. These aspects should be considered explicitly to make SD operational on the basis of (supra-)local, regional or supra-regional - but regionally differentiated - decisions. These three dimensions justify separate attention for Regional SD.

To render this discussion on regional aspects more transparent, in the next section RSD will first be related to various relevant aspects of welfare. In section 5 this will be elaborated with special reference to one of the characteristics of a regional system - and in our opinion a key factor for successful implementation of sustainable policies -, viz. the level of authority that serves and represents the common good, or more specifically, the institutional structure.

4 Welfare Considerations with respect to Regional Sustainable Development

4.1 Introduction

In a recent publications (see e.g. van den Bergh et al., 1989) it has been indicated that key factors considered to be relevant in an RSD approach are notably:
- intergenerational trade-offs
- interregional trade-offs
- multiple use of environmental resources
- sustainable use of renewable resources
- risk and uncertainty

These key factors will, in this section, be discussed in relation to the following socio-economic issues which are of crucial importance for regional development:
- population pattern
- production structure
- regional income
- regional investment

The overall structure and coherence of this section is shown in the next table (see table 1).

Table 1 Structure of the next sections.

aspects/attributes of regional sustai--nable development	income	popula-tion struct.	product-ion struct.	invest-ment
intergenerational trade-off		4.2.2	4.2.1	4.2.3
interregional trade-off	4.3.3	4.3.1	4.3.2	4.3.4
multiple use of environmental resources			4.4.1	
sustainable use of renewable resources			4.5.1	4.5.2
risk & uncertainty				4.6.1

It is clear from the above table, that not all potential issues of sustainable regional development planning will be discussed to a full extent. We will only concentrate on those socio-economic issues, which are regarded as most important in a regional setting.

In the following sections the meaning of the above mentioned issues for analyzing the institutional regional policy structure will be discussed in greater detail: intergenerational trade-off (section 4.2), interregional trade-off (section 4.3), multiple use of environmental resources (section 4.4), sustainable use of renewable resources (section 4.5), and risk and uncertainty (section 4.6). After an elaboration of this framework - on the basis of both economic and ecological criteria - an attempt will be made (section 5 and 6) to design and discuss a feasible institutional structure which is appropriate from the viewpoint of regional sustainable environmental policy.

4.2 Intergenerational trade-off

4.2.1 Regional population structure and intergenerational trade-offs

There exists a mutual relationship between population and the environment. On the one hand, the rate of population growth influences the speed of extraction of environmental resources. On the other hand, the environment provides the population with necessary resources for existence, survival and growth (cf. UNEP, 1987).

The rate of population growth is, amongst others, a function of the structure of population (see Nijkamp and Vollering, 1989). A fast rate of population growth has often been regarded as one of the most important factors accelerating environmental degradation (see for example, Hardin, 1972; Ehrlich en Holdren, 1971). There are however other people who disagree with the viewpoint that there exists a causal relation between population and environmental degradation. For example, Commoner (1971) considers the technological factor in production as the main cause of environmental degradation. A representative of a more synthetic view is Wilkinson (1974), who considers both factors, population and technology, as causes of environmental degradation. In his view ecological imbalance will force people to look for new resources and new exploitation methods that require increasingly complicated technologies. These new technologies may induce new problems, and so a spiral effect may come into operation of ever changing technologies that result in an increasing interference with the environment.

Clearly, the rate of population growth is closely related to the structure of the population while the use of environmental resources is also related to the rate of per capita consumption.
The relation between population structure and the welfare position of future generations may manifest itself by way of different consumption patterns and engagements in the production process of different aged people. For example, the activity level of older people may decrease with age. This in turn may mean relatively less environmental externalities and less use of environmental resources. The need for infrastructure is also a function of population structure (e.g., commuting). For a regional sustainable development, it will be clear that the fulfillment of present needs may preclude the realization of new needs in the future. Another example is the aging of the rural population which may be one of the factors which cause lack of successors in the agricultural sector. This may lead to a more concentrated form of cultivation of farm land by less farmers. The resulting agricultural production processes will show more mechanization and an increase in monocultures (i.e., 'industrial farming'). The final result may be a loss of environmental amenity for future generations.

Although population structure plays evidently a clear role in questions of intergenerational trade-offs, hard facts are difficult to obtain. Macro figures about issues such as population growth, consumption and production are relatively more easily available. For example, in the Netherlands, between 1960 and 1985, the amount of waste per capita increased with 83%, whereas population only grew by 26%. Thus, only less than one third of the increase can be attributed to population growth (C.B.S., 1987).

Whatever the main cause of regional environmental degradation, the population structure also plays an important part in it. Therefore, in order to ensure a regional sustainable development, a balance has to be kept between population structure on the one hand and the use of environmental potentials (like natural resources) on the other hand, not only for today, but also for the future. Intergenerational trade-offs have to be made, that is to say, society has to choose (implicitly or explicitly) between the use of natural resources for economic development by the present generation and their conservation for later use by future generations.

Such a sustainable development, however, is unlikely to come about automatically. A major reason for this is the following (see e.g. Krutilla and Fisher, 1975; Kula, 1988; Kirsch et al., 1986, Nijkamp and Rouwendal, 1988). Individuals make decisions on the basis of the value they attach to the environment. To obtain this value at any moment in time, the net benefits derived from the environment are weighted by a discount factor. The discounted value is a decreasing function of time, which implies that the benefits of the environment that accrue to the individuals in the near future are valued higher than the benefits in the distant future. The value of the discount rate partly depends on the time preference (or the consumption rate of interest) which may differ with age. For example, older people will probably have a relatively high time preference rate (i.e., they value present consumption relatively high), as they know their remaining life time is likely to be short. Consequently, an allocation of resources meant to support the next generations is probably not very highly appreciated by them. Young people on the other hand may value the future benefits much higher, because the probability that they will also enjoy (a part of) these benefits is higher. Thus age (or population structure) is one of the factors that explains the difference in time preferences - and thus discount rates - of different generations. Another factor which also explains differences in discount rates is the welfare level of the population: people living near a subsistence level, tend to have a very high time preference.

It is not always true however, that the time horizon of people is limited to their life span. They may also be concerned about the future of their children or grandchildren. But their is a general consensus among economists that concern about the future consequences of our decisions quickly decreases with time; empirical evidence shows that people seldom look further than one or two generations (Hilhorst, 1987). This feature may lead to the discrimination of future generations, as they are the ones who will to a large extent bear the consequences of decisions taken by the present generation, although they do not have any say in this decision-making process.

To overcome this dilemma it will be necessary to influence current decisions of individuals and institutions by means of a proper environmental policy. Sustainability requires - at least implicitly - that the discount rate be a derivative of desired future welfare positions and not the

other way round, i.e. the future welfare positions are a derivate of the present discount rate (cf. Rawls' ideas of social justice; see Kula, 1988). Such a policy would have to decide how much environmental capital should be preserved and what its composition should be (cf. Opschoor, 1987; James et al., 1989). Clearly, this proposition is necessarily fraught with many uncertainties, because various assumptions have to be made about:

- future population, both in terms of size and structure (e.g., interregional migration which may change the pressure on the regional environmental resources)
- the future demands (e.g., regional changes in preferences)
- technological developments through which the natural potential limits may be shifted, for instance new substitution possibilities or recycling methods, new extraction methods etc. (although the regional dimension is less evident in the later case).
- the future assimilative capacity of the environment; various environmental effects of activities in the past or present may only come about in the future and it is hard to determine at forehand the temporal and spatial impacts as well as the intensity of these delayed effects. Here the regional aspects appear more clearly.

It will be clear from the above observations, that the relationship between intergenerational trade-offs and population structure is multi-dimensional. No easy and straightforward answers can be generated for a particular region. In a system of interrelated regions, robust answers related to this issue of the time perspective are even harder to provide.

4.2.2 Regional income and intergenerational trade-off

An equal distribution of income within and between regions is often regarded as an essential factor in a policy oriented towards a sustainable development (see e.g. WCED, 1987; World Bank, 1987). Although the link between income and environmental degradation is somewhat obscure, it is generally accepted that severe poverty has a negative impact on the environment. An unequal income distribution - which implies the concentration of means and power in the hands of a few people, whereas what is left has to be distributed among the large majority - is a characteristic phenomenon in many less developed countries. The same imbalance appears between countries in the world as a whole. The fast growth rate of population and consequently the growing need for food and other basic requirements on the one hand, and the limited access to resources on the other, drive the mass of poor people to an unsustainable use of environmental resources. Although they are often aware of the potential dangers of their decisions, they have in many areas no alternatives in their struggle to survive (their time preference is necessarily very high).

From an opposite point of view, however, one may also claim that high income levels may lead to an unsustainable use of the environment. A high - material - standard of living implies more needs and wants and therefore a greater stress on environmental resources. For example, the per capita consumption of cereals in the United States is 4.5 times as high as in India and the

energy consumption even 60 times as high (Opschoor, 1989).

The two above mentioned issues show, that there is a close relation between the intergenerational distribution of income generating capacity of the environment (and consequently of welfare) and the intragenerational distribution of income. A more equal distribution within one country may on the one hand lead to an alleviation of poverty and therefore enable people to take more consideration of the limited capacity of the environment. On the other hand, a decrease in income of the very wealthy people may reduce their "overconsumption" which also may work out positive on the environment, not only now, but also in the long run.

In an international setting however, there is some evidence that the higher developed countries have the ability to take more care of their environmental resource base. From an environmental viewpoint it is not clear whether international redistribution of welfare will have positive environmental effects. Clearly, there is severe lack of research in this respect.

One possible way that may contribute to a more sustainable use of environmental resources is an increase in resource prices to a level where the true cost of depletion and pollution are being reflected (cf. Daly, 1986). For non-renewable resources the increasing relative scarcity instead of absolute scarcity in the market at a certain time should be reflected in their price. For renewable resources, the market price should at least reflect all costs of sustainable production. Such price rises may bring about a change in production processes towards a more environmentally sound direction (i.e., more efficiency). The income effects of such changes may work out in different ways depending amongst others on the time period under consideration. For example, higher resource prices for industries in a certain region may have a negative effect on employment and income when these price increases can not be passed on to consumers. It may also be possible that some regions are harder affected than other regions. The same can be said for environmental regulations by the Government. The result may be that the more heavily affected regions lag behind in their development, thereby decreasing the production and income opportunities for future generations.
It should be added at this stage that an environmental investment will either imply a reduction in consumption or a decrease in non-environmental investments. When the environmental investment is unproductive and squeezes profits, it may induce a negative impact on new investments and thus on the income generating capacity of future generations (cf. Meissner, 1986).

4.2.3 Investment and intergenerational trade-off

Industrial investment in specialized plants and equipment often represents an irreversible commitment of capital. If the investment has been misjudged, there will be a loss of capital value. However, when information necessary to meet future demands for capital goods has been lost (e.g. because of a misjudged investment), the options available for future generations will be reduced, which will imply a welfare loss for society as a whole (Krutilla and Fisher, 1975).

In the case of land, the option value of an investment in land development implies gains from

being able to learn about the future benefits - benefits otherwise forgone by a development of this land - if one does not develop it immediately (Fisher and Hanemann, 1985).

However, not all investment implies a technological irreversibility. Sometimes restruction or compensation is possible, but here again some difficulties arise, because:
-restruction/compensation may take time and there might be
considerable time lags before the desired effects will manifest
themselves
-perfect restruction is very hard to realize and leaves us with the problem of the absence of authenticity in a reproduction or a restoration (Fisher, 1985).

Another issue related to investment and intergenerational trade- off concerns the discount rate. Individuals try to maximize the present value of their investment. In their decision they will consider both the time preference regarding consumption and the productivity of the investment (see also Kula, 1988). Regional differences in discount rate may therefore lead to regional differences in investment and therefore influence the production capacity of future generations.

4.3 Interregional trade-off

4.3.1 Population structure and interregional trade-offs

Interregional trade-offs between population structure and the environment is an important issue in the light of an integrated environmental economic policy. In the case of land (an immobile resource), for example, the interrelation of regions may ease the mobility of people. If the pressure on land increases, e.g. due to a fast population growth, migration to less populated regions may alleviate the pressure on land. There are also examples of increasing pressure on land due to outward migration of people with an agricultural occupation, thereby leaving the land fallow and prone to erosion (see Manning, 1988; Brouwer, 1988). So, on a regional level there is much scope for trade-offs between economic-environmental decisions (see also Siebert, 1985; Frey, 1986).
In order to achieve a regional sustainable development, the regional population, given their activity level, would have to be balanced with respect to the environmental potentials. The population size may be larger, if more resources are allocated to technologies that serve to minimize environmental degradation or if interregional sustainable resource exchange is possible. A problem in this context is, that no one can exactly determine an optimal size of a regional population from this perspective, ignoring historical circumstances or public preferences (in contrast to a more isolated issue like the determination of an optimal fish population in fishery management).

However, it will be clear that free fluctuations in population may have severe ecological consequences in ecosystems under stress. Therefore a policy may be needed to control the regional population structure. Meissner (1986) has suggested two policies, viz.:
-control of the number of jobs
By controlling the number of jobs, the region might become more or less attractive because of the changes in job opportunities and also because of the effect a change in job opportunities will have on the wage level.

-control of the number of dwellings
By controlling the number of houses, the region may become more or less attractive for workers and this may result in an increase or decrease of the supply of labour. Then, the wage level will be affected (due to for example labour shortage) and the region will become more or less attractive for firms. Furthermore, a change in the supply of houses will affect the price of houses, which will even further increase or decrease the attractiveness of the region concerned.

Besides, regional environmental policy itself may influence the growth of regional population. Stringent environmental measures and high environmental taxes, for example, may induce people to move to regions where a less stringent environmental policy is implemented.
A common feature of all above mentioned policy measures is that their effects are socially and spatially discriminating: only affluent people can afford to stay in the region and to pay the higher costs (e.g., for transportation, housing, taxes) that are associated with the above mentioned policies. Here interregional welfare effects come to fore. We may conclude that institutional regulations or incentives may influence the way these interregional trade-offs will work out in this respect. The level of institutional assignment of responsibilities is of primary importance here.

4.3.2 Production structure and interregional trade-off

Economic growth - or increase in GNP - and environmental quality are both components of human welfare. However, evidence from the past has shown us an antagonistic relation between these two components. Particularly in regions with a high concentration of human activities (e.g., agriculture, industry), the environmental burden has been heavy.

A policy to alleviate this problem may try to spread these activities over a larger area. This will surely result in a reduction of the environmental pollution in the most heavily concentrated regions. But the other side of the coin is an extension of the number of regions that will endure environmental damages, although to a less intensive degree (cf.Bresso, 1989).

Therefore, another policy option may be based on the spatial separation of polluting activities in (parts of) regions that will be given up ('black spots') in order to safeguard other (parts of) regions against environmental damages resulting from these activities (see also Siebert, 1987). An example of this spatial functionalization is the concentration of industrial activities in specially designated industrial zones in order to maintain the recreational or natural function of other regions.

Such policies oriented to alleviate environmental degradation may lead to a rise in production costs; the additional efforts (i.e. costs) that have to be made will often not be compensated by extra output. In the case of free trade and mobility of production factors (including capital), regional differences in environmental policies may induce the relocation of certain polluting activities from regions where a stringent policy is implemented to regions with a more flexible environmental policy (e.g., the industrial free zones in developing countries have replaced the most polluting hot spots of the OECD-countries (cf. Jernelöv, 1988)). It is noteworthy here that in the case of free mobility of production factors, activities will relocate according to the principles of absolute advantages. Only in the case of immobility of production factors

relocation will take place on the basis of comparative cost advantages (Daly, 1989). The environment (including environmental policy) may become (or already is ?) the most important immobile production factor and consequently this factor the future production structure for a large extent. In the context of mobility of production processes one more aspect has to be mentioned. If because of stringent environmental legislation for instance, production moves to more easily accessible spots in the world, it becomes increasingly important that the consumption process will be controlled (e.g., no import of cars from countries where the pollution in production exceeds already environmental standards, no imports of tropical wood from countries with no sufficient reforestation programs).

Although practical evidence regarding to the relationship between structural change and environmental effects are as yet rare, the study by Jänicke et al. (1988) for 31 countries has shown, that a clear relationship exists between the level of production (GNP), the growth rate of GNP and the change in resource use. The four input factors used in his study (steel, cement, energy and freight transport) show a de-linking from GNP in the highly developed countries: the rate of growth in use of these inputs has been smaller than (or is sometimes even negative related to) the growth rate of GNP.

4.3.3 Income and interregional trade-off

When regional environmental investments are less productive than non-environmental investments, an opportunity cost will arise which implies a decrease in potential regional revenues. Less revenues may in turn imply less investments and less regional employment opportunities. So, next to the temporal dimension, the effect on regional income should also be considered from a spatial perspective.

The spatial dimension implies that, for example, the closing down of polluting industries due to stringent environmental policy regulations may bring about a relocation of these industries to other regions, thereby also relocating income and employment opportunities (see also Siebert, 1985).

Some remarks are in order here. First, it is possible that the increased production costs will be passed on to the consumers, so that ultimately revenues may remain the same. Employment in such an environmentally controlled sector may increase (see below). Also, pollution control may lead to a decrease in other costs (e.g., due to energy saving or recycling). Therefore, it is very hard to predict a priori what in the long run the final result will be of environmental policy with respect to income. In an interregional setting one would expect that comparative disadvantages due to environmental policy will lead to some regional income redirection and consequently of regional employment.

However, empirical studies show, that in most cases the net effect (i.e. the positive effect of investment on the short run and the negative price and income effect on the long run) of regional environmental policies on employment is positive. For example, between 1970-1975 the net employment effect in the United States was an increase of 524,000 jobs (man/years). For Germany, the increase was about 300,000 jobs (man/year) (Meissner,1986). This may be in accordance with the viewpoint of Potier (1986, see 4.3.4), that interregional trade-offs of

environmental policies are of less importance.

These studies have however been carried out for developed economies. For less developed countries, it is likely that price and income effects offset the investment effects because of less value added in production structure (capital investments caused by environmental legislation may necessitate import of new technologies or capital goods).

4.3.4 Investment and interregional trade-off

Besides the temporal implications of investments, as discussed in section 4.2.3, investments also have a spatial dimension. Investments may differ among regions due to:

- economic factors

Differences in (the speed of) development (and consequently in means, knowledge and power) may enable some regions to invest more and more successfully than other regions. Also regional differences in income may imply that people in poor regions - who are close to subsistence - will have a high time preference. This means that present consumption, in relation to future consumption, is valued very high and therefore the rate of investment will be relatively low. Regional differences in property rights may also influence investments; when environmental property rights are weak, both marginal user costs and marginal external costs may be ignored. This will result in a private rate of return that will exceed the social rate of return and thus may lead to an unsustainable use of environmental resources (Pezzy, 1989).

- political factors

Regional difference in investment may also result from the goal to strive for maximization of national welfare. To that end, some regions may be selected where pollution-intensive investments will be concentrated ('black spots') in order to save other regions from being polluted (Siebert, 1985). An example of this is the concentration of industrial activities in a certain region to maintain the recreational function of other ones. It might be clear that here also the location of a certain new activity may be influenced by the bargaining power of the region.

R&D and investments in pollution control and prevention may be stimulated by the Government by way of subsidies, tax exemptions etc. For example, a study carried out by the OECD among its member states in 1977, indicated that the financial assistance for pollution control and prevention - measured as a percentage of total environmental investment - varied between 0.004 and 26.9% for different countries (Potier, 1986). Not only financial differences, but also more stringent environmental regulations may induce industries to search for and implement new technologies. In the United States, for example, the investments in favor of the environment are much higher than e.g. in Italy, where the environmental regulations are much less intensive.

- infrastructural factors

Lack of infrastructure due to e.g. a low population density, may hinder research and development, but also the pressure on natural resource base may be less, simply because the means and knowledge are not available to exploit and transport the natural resources (cf.

Boserup, 1981)

- natural factors
With respect to natural production factor the production potentials of regions differ (see also Munn, 1989). This may be due to differences in soil composition, vegetation, climate, geographical location etc. The confrontation to natural threats may induce the search for and implementation of new technologies that will increase the resilience of the region. Also, lack of potentials may induce investments (e.g., green-houses in regions with a shortage of sun-hours respectively low temperatures).

4.4 Multiple use of environmental resources

4.4.1 Multiple use of environmental resources and investments

From an economic viewpoint, resources are to be allocated in their most productive direction. Often, this may imply regionally a single use of a specific resource. However, sustainable resource use (e.g., with respect to risk management) gives some scope for the idea to diversify uses as much as possible. In cases where one use would exclude the use of a resource in other directions, less profitable uses would be stimulated either by subsidies or regulations. In cases when more uses of one resource would not conflict with each other, it would also from a welfare viewpoint reasonable to promote all these uses in such combinations of intensity that total welfare (including environmental amenities) is maximized.

Thus, for a specific region, the investments (which make up part of regional resources) should from a SD perspective be directed in not just one profitable use and one use should certainly not preclude other uses in the future.

4.5 Sustainable use of renewable resources

4.5.1 Production structure and sustainable use of renewable resources

In many regions all over the world a sustainable use of renewable resources has become problematic. On the one hand, the increasing population and intensification of economic activities have resulted in a great stress on the natural resource base, whereas on the other hand cross-boundary environmental effects (e.g., acid rain, ozonization) have made the control over the natural resource base much more difficult (see also Archibugi et al., 1989).

In order to find a balance between economic development and ecological sustainability, conventional economic policy - based on maximization of income, production, profits etc. - would have to be oriented towards an ecologically sound policy, based on increasing efficiency (i.e. increasing throughput, not output (Daly, 1973)), while maintaining an acceptable standard of living (Simonis, 1989).

Regional differences in efforts to change the production structure to the benefit of the environmental production potentials may be caused by differences in physical circumstances

(e.g., regional assimilative capacities) and regional preferences (e.g. with regard to the environmental stress). For example, hot and dry climates may reduce the impact of certain effluents from production processes or high rainfall levels may reduce the impact on air quality of some types of emissions (Walter, 1975).

From all sectors, the agricultural sector makes most intensely use of renewable resources. The idea that this sector benefits from a sustainable use is certainly not reflected in the production structure. At least in the well developed countries this structure may be identified as highly diversified and specialized. External effects of one level influences the production results of other levels. Specialization may exhaust specific organic growth potentials, while the environment becomes polluted with chemicals and pesticides. An integrated long term viewpoint on renewable production still has to be developed. In a regional perspective a material balance in the production structure seems a reasonable condition to enhance sustainability. Consequently, the stratification of production - which has resulted in very high yields in the past decades - should now carefully be reconsidered in view of the stratification of material uses. The interrelation between production sectors is also increasingly attaining importance in a regional context. A coherence between, for instance, waste treatment and agriculture seems (economically) almost impossible. In this respect a source-oriented policy may imply a change in production processes and products, so that they become less polluting (cf. Bresso, 1989). Technological innovations in the field of pollution control equipment, recycling processes, conservation and recovery techniques may all attribute to the reduction of environmental pollution.

To ensure such changes in production, a strict planning system would be necessary, as one may not expect such changes to be implemented voluntarily. One way is stimulating the implementation of pollution control technology, but this policy has its shortcomings. Stimulating effective pollution control technology with regard to one given environmental pollutant, may lead to a neglect of pollution control of other environmental pollutants, thereby only shifting the problem and not solving it (cf.Voelzkow, 1986). A spatially oriented policy is a second option to implement a change in the production structure in order to find an optimal sustainable combination of different uses. Key issues in this policy are regulations of activities, land use zoning and assimilation of plans. Thus a coherent spatial-economic, sectoral-economic and source-oriented policy is necessary from a sustainable viewpoint.

4.6 Risk and uncertainty

4.6.1 Investment and risk & uncertainty

Since World War II, technological innovations have led to an enormous increase in investment and economic growth. However, these innovations have also often coincided with the exploitation of natural resources, the decrease (or elimination) of ecological habitats and environmental pollution. A reason for the one-sided economic approach toward technological innovations may be the fact that the economic benefits of an investment up to a certain point often increase as a proportion of the scale of its application, while many of its social and environmental effects evolve in a highly non-linear way. The result might be that " technological activities become strongly established with influential vested interest long before the disbenefits

begin to manifest themselves " (Brooks, 1986).

From the above it becomes clear that investments in new technology are surrounded by much environmental risk and uncertainty. For a specific region, this risk and uncertainty is related to the following (cf. Siebert, 1987):

- accumulation, interaction and spatial transportation of pollutants. An investment in a certain region may cause environmental effects in other regions by way of interregional diffusion of pollutants (externalities). Also, environmental effects may only appear after a considerable time period has passed. Thus, the investment decision will necessarily be based on incomplete information, in which no full account may be taken of externalities. This will result in a non-optimal investment decision.
- damages of a given quantity of pollutants. Besides uncertainty about the environmental decay caused by an investment in a certain region, the damages of a given quantity of pollutants, both in time and magnitude, will also be surrounded by uncertainty.
- the irreversibility of the environmental use. A new investment may imply such a modification of the regional environment that the changes become irreversible. Then the possibility to learn about future benefits by retaining the option to preserve or invest in the future is excluded.
- the costs of abatement. It is not always easy to identify which investment has caused the environmental damage in a certain region. Therefore it is difficult to identify the responsible actor for the abatement, or the compensation of the damages incurred by society.

From a regional environmental policy viewpoint, risk and uncertainty relate to the impact of the new investment on the regional environmental quality. The more uncertain the environmental impact, the higher the environmental quality targets may be set. Higher environmental quality can be interpreted as an insurance of environmental degradation or, in other words, as a risk premium. Also, investment in technological diversity may imply a form of insurance against risk and uncertainty, as a greater diversity implies a greater survival potential in an environment subject to surprises from causes that accumulate over long periods of time. "The existence of and the considerable depth of technological options is a potential source of systematic self-renewal and adjustment to new circumstances" (Brooks, 1986). Here, there is a striking similarity with genetic diversity: a variety of genetic processes maintains the values of parameters that define the ecosystem. If, however the natural variability is being constrained, it will lead to self-simplification and to fragility of the ecosystem (cf. Holling, 1986).

Which risk level for certain investments is acceptable however, is often a matter of political choices, based on estimates about the tolerance of society. Although such a numerical approach of risk levels may encounter several societal, ethical and scientific problems, it may be a useful means to help preventing an unsustainable use of environmental resources. Risk levels should however be incorporated in a broader system that also considers source - related elements. Such an integrated system may encompass the following criteria (Wams, 1989):

1) Justification
2) ALARA-principle
3) Environmental standards

ad1) The risk level of a development, an activity or product should be weighted against that of

all its alternatives. In the case of serious (potential) environmental dangers, also the zero-option should be considered.
ad2) When the development, activity or product is justified, then, one should try to prevent risks as far as is technological feasible. The ALARA-principle, which stands for "As Low As Reasonably Achievable", thus implies the prevention of avoidable environmental degradation and the application of the most suitable available means.
ad3) When criteria one and two are met, environmental standards can be enforced in order to resist the strive for socio-economic aims at the cost of the environment. In order words, environmental standards should get a kind of control function.

5 Institutional Assignment

5.1 Introduction

In Section 2 of this paper RSD was defined as a regional development of economic and environmental conditions so as to accomplish a globally sustainable development, while at the same time ensuring that the regional population can attain an acceptable level of welfare, both at present and in the future and that this regional development is compatible with ecological circumstances in the long run. It was also argued that in the framework of RSD an integrated economic and environmental approach to policy-making is a necessity. However, its implementation will face a variety of difficulties. One of these difficulties is related to the institutional structure of regional planning (cf. Zimmermann, 1982).
In this context, the institutional structure refers to the whole system of rules and regulations by which competencies, tasks and responsibilities are divided among actors.
When production factors are relatively immobile or no free trade is allowed between regions, a regionally differentiated RSD is always considered desirable (see e.g., Frey, 1980, Ewringmann and Hansmeyer, 1980). Clearly, these issues are time-related (as in the very long run everything is mobile). Also with a limited mobility and free trade, however, there is still sufficient environmental evidence to warrant regional policy. But does this also give a satisfactory scope for regional authority? An integrated regional policy can be centrally planned or delegated to lower levels (regional, local) or can be organized from this viewpoint of functionalization. This assignment problem of competencies and operational tasks, is a matter of concern in this section. The aim is not to give a clear cut answer (if ever possible) to this question, but to make a first step in designing a framework for integrated regional policy organization oriented towards the achievement of a sustainable development.

In the implementation, the institutional assignment issue can be related to the problems considering coordination of tasks and responsibilities in the current practice of specialization in facets of planning (section 5.2) and the coordination problem as a consequence of the hierarchical structuring of planning (section 5.3).

5.2 Facet planning

Present planning structures have evolved over a long period of time. Problems show up in due course. In general, new governmental tasks and responsibilities may evolve as a result of a perceived imperfect working of the market economy (e.g., external economies, economies of

scale, equity considerations, imperfect supply of social utilities). Consequently - rooted in a specific historical background - separated planning cultures have evolved (e.g., housing programs as a result of bad hygienic circumstances at the end of the last century, employment planning in the period before World War II).
Physical planning became popular in the twenties as a result of imbalanced development between industrialization, housing and transport. Environmental and social planning are the most recent developments in this respect.
A historical characteristic of many of these planning efforts is that in early phases of planning the emphasis was mainly laid on prohibitions and regulations, while in later phases more emphasis has been laid on development. This is certainly true for environmental planning. It started with measures coping with the negative environmental externalities of production and consumption processes (e.g., end-of pipe technologies). Nowadays there is a tendency towards a more source-oriented policy. An inevitable development for the near future will be an integrated development policy in which environmental policy will be a key factor for welfare development (e.g. integrated spatially oriented policy).

It will be clear that such a development is impossible without a simultaneous design of coordination channels between the several functional areas. Main coordination problems may be the result of the above mentioned historical roots of separate planning fields. Consequently, significant differences in planning culture can be identified; in more recent planning fields the fireman's approach of problem solving is practiced while established fields may be characterized as development-oriented. The coordination problems may also be the result of a different educational background of specialists, separate planning languages, separate planning horizons, use of different data bases, lack of integrated formal and evaluation models and use of different performance indicators.

5.3 Hierarchical design

Hierarchical structuring is a second issue in the context of coordinated and integrated planning. A hierarchical design can be regarded from the viewpoint of responsibilities and tasks delegated to various levels or from the viewpoint of a hierarchical division of goals. The first viewpoint is related to a problem-oriented policy; in other words, a specific issue is emphasized from several functional viewpoints (e.g., economic, social, spatial, environmental) and these viewpoints determine the level of assigned responsibilities and tasks. In the next section some examples of this viewpoint will be given. In section 5.3.2 the goal-oriented approach will be elaborated.

An advocate of a more economic approach is Zimmermann (1982), who formulated some guidelines with respect to the choice of the level on which an environmental policy should be carried out.

a) Regional preference with regard to certain environmental and socio-economic goods and services (especially with regard to equity aspects).
b) Economies of scale with regard to the supply and provision of environmental goods (especially with regard to efficiency aspects).
c) Spillover effects (both equity and efficiency aspects are relevant here).

ad a) When interregional preferences with regard to environmental good are rather

homogeneous, a national policy may be most appropriate, for example, in the case of minimum health standards. However, the more the impact of certain activities on specific environmental goods differ among regions, the more heterogeneous interregional preferences may work out (e.g., in the case of noise nuisance). In this case a more decentralized policy may be recommended.

ad b) The marginal cost of supplying the region with specific environmental goods or services may decrease by growing quantity (e.g., waste treatment). Therefore, efficiency -in the sense of economies of scale - might serve as a criterion for the implementation of regional environmental policy, in case of changes in the marginal cost of supply.

ad c) By internalizing the costs and benefits of an environmental good or service within a region, its provision may become more efficient and equitable, because in this case, those who benefit from the provision of the environmental good or service will also pay for it. This criterion for the assignment of a regional environmental policy can, however, only be used in a limited way, since - by striving for an internalization of all costs and benefits of environmental goods and services - the region should have the size of the whole system. Therefore the cost of not internali all environmental effects should be balanced with respect to the positive welfare effect of regionalized planning organization.

Thus economics provides at least some meaningful guidelines for a demarcation of planning responsibilities. But also ecological considerations should be taken into account.

Administrative and legal boundaries seldom coincide with those of the environmental problem region concerned. This has resulted in the fact that environmental problems are often being carried out on the basis of assigned responsibilities without special emphasis on the spatial dimensions of the environmental problem. In order to carry out a proper policy - oriented towards sustainability - the assignment should also be based on spatial ecological characteristics of the problem (Klijn, 1988).

In order to clarify the latter observation, in table 2 an illustration is given of some environmental problems and the spatial range of their impact. For example, climatic change is a process that seizes in the atmosphere and works through the whole ecosystem. Therefore, an efficient policy to influence this process necessitates a global planning approach.

Table 2 Environmental problems and the spatial range of their impact

	Climatic change	Acidification	Pollution	Nutrification	Drying up	Destruction	Dispersion	Disturbance
Atmosphere	o	o	o					
Geomorfological structure	|	|	o			o		
Relief	|	|	|			o		
Groundwater	|	|	o	o	o	|		
Surface water	|	|	o	o	o	o		
Soil	|	o	o	o	|	o		
Vegetation	|	|	|	|	|	o	o	
Animal life	↓	↓	↓	↓	↓	o	↓	o

Source: Klijn, Milieubeheergebieden, CML-mededelingen 37, 1988
(o)= intervention point (↔)= impact of environmental problems on ecosystem

Thus, a plausible conclusion is here, that from an ecological point of view, the institutional assignment should be derived from the spatial impact of the environmental problem (see also Clark
and Munn, 1986).

Both above mentioned considerations for institutional assignment offer each reasonable clues to design an appropriate framework for an institutional structure of balanced planning for regional sustainable development. However, when combining these two approaches the problem arises that the economic efficiency and equity aspects, do not often coincide with the ecological problem intervention points. Moreover, an optimal response assignment may vary wildly for all above mentioned aspects.

Table 3 Facet planning and institutional level

Facet / Level	Economic	Social	Environmental
National			
Regional			
Local			

In table 3 the above mentioned approaches are visualized by means of vertical lines. The above mentioned approach starts from one discipline. From this, side-conditions are derived for the treatment of the next disciplines and so on. This is how actual planning is often carried out. For RSD such an approach does not suffice; a more integrated approach is necessary.

5.4 Integrated RSD policy: a goal-oriented approach

Between regions there are many economic and ecological exchange relations (Ewringmann et al., 1980). These relations may exist because (Siebert, 1978):
- emissions in one region may affect other regions by way ofinterregional diffusion
- regional differences in environmental policy induce migration of production factors, people and goods
- environmental policy in one region may be pursued taking into account the environmental quality of other regions, thereby raising the question of the compensation problem related to the functional specialization and differentiation between regions.

A proper environmental policy should take account of these interdependencies between regions. According to Odum (1981) the main goal of environmental policy makers should be to minimize the impact of human activities on the environment through a perspective of the ecosystem. In our opinion such an ecocentric viewpoint has no direct policy meaning, because it implicitly abandons the trade-offs between socio-economic development and a sustainable environment. The National Physical Planning Agency in the Netherlands (RPD) defines environmental policy as:
" The stimulation of certain spatial and ecological conditions in such a way that:
- the real aspirations of individuals and groups in society can be realized to full advantage
- the diversity, coherence and sustainability of the physical environment can be guaranteed as much as possible".

Clearly, because environmental and socio-economic variables influence each other mutually in an interrelated system, an integrated policy is necessary in order to find a balance between these variables. Moreover, integration may also be desirable from the perspective of compensation. From this viewpoint, the level of regional welfare is considered to be determined by the total sum of separate welfare components. Equalization of regional welfare may thus be achieved, without the necessity of a strict interregional equality of the separate welfare components.

An integrated policy does not mean, however, that it should automatically be implemented on one centralized level. This would result in a top level with a too heavy burden and charged with issues that could be more efficiently dealt with on a lower level. When decentralizing national policy, however, there may also arise some difficulties:
- regional or local agencies may strive for maximization of welfare of their own region, thereby neglecting the interregional effects of some of their activities/measures (spillover problems) (Siebert,1985)
- environmental media may differ as far as their spatial extent is concerned. This implies, that the planning regions will overlap, which in turn will create coordination problems (Ewringmann et al., 1980).

Decentralization of environmental policy may, however, be justified, because regional authorities are suited best to discover regional preferences and to implement regional targets, and they will be better informed than the national authorities with respect to the implementation of environmental policy instruments (Siebert, 1985).

In this context it might be useful to distinguish between:
- institutional policy aspects
- executive policy aspects

Institutional policy aspects are related to the distribution of responsibilities over various policy levels (constitutional power). Executive policy aspects are related to decisions taken during the policy period to ensure that the policy goals are being achieved (executive power).

An integrated policy with regard to the above mentioned policy issues means:
1) **An integrated institutional policy:** vertical coordination between different policy level, i.e. "lower level authorities should be well informed about decisions to be taken by higher level authorities, since the latter decisions function as macro-constraints to the former". On the other hand," higher level authorities should be informed about the decisions to be taken by lower level authorities since the latter are micro-constraints to the former" (Klaassen and Paelinck, 1974).

2) **Integrated executive policy:** horizontal coordination between authorities at the same level of different policy departments and of the same policy department, but of different regions. This will especially be important in the case of externalities.

In the latter case horizontal coordination between economic authorities and environmental policy may also lead to more efficiency. Economic authorities could provide the environmental authorities with essential information. However, economic policy often has a short term planning horizon, whereas environmental policy necessarily has to have a long term planning horizon. If we take an investment as an example, economists are concerned with the income and employment effects of the investment. Environmentalists may be concerned with the long term effects of such a new investment, for its effect may become manifest over long periods of time or the investment might imply an irreversibility, in the sense that it precludes other developments in the future.
Taking into account both equity and efficiency aspects of an integrated policy, in the following part it is tried - whenever possible - to identify an optimal assignment of the institutional structure.

6 Attributes of Sustainability: a Guideline for Institutional Assignment

A goal-oriented approach - as discussed in the previous section - is another way of arriving at an integrated planning system. This approach is in line with the sustainability framework developed in the first sections of this paper. To make this welfare-theoretic approach operational, in the following sub-sections the attributes of welfare as discussed in section 4 will serve as guidelines for the hierarchical policy assignment.

6.1 Intergenerational trade-off and institutional assignment

As we have seen in section 4.2.1 (the relation between population structure and intergenerational trade-offs), this relation cannot be neglected when discussing the subject of institutional assignment in the context of sustainable development.

When regarding the relation between population structure and intergenerational trade-off, we mainly have to deal with equity aspects. Because regions differ in terms of both the environmental resource base, production structure and regional preferences, the future effects of current institutional decisions will not have a homogeneous character among regions. Clearly, population structures affecting policies (e.g., densities of population) with the aim of RSD may be hard to implement. Because of the open character of this kind of socio-economic and environmental instruments, such policies should necessarily be carried out on a inter-regional or national level. Moreover, interregional and intertemporal equity issues necessitate an environmental policy at a more comprehensive level, as regional agencies may only be concerned with the welfare of the people in their own region.

As far as income is concerned, environmental policies are mainly directed to equity issues. It is hard, however, to assess in general the relationship between the institutional assignment of environmental policy and income effects. The abatement of pollution, for example, may lead to increasing production costs or consumption prices, which will have a negative effect on real income and income distribution. This in turn may reduce investments which will also have effects on future income. However, pollution control techniques may also lead to a more efficient use of environmental resources and the production costs will decrease - instead of increase -, while at the same time environmental resources will be saved. The kind of environmental pollution and the range of its impact may be decisive for the institutional assignment in this case.

6.2 Interregional trade-off and institutional assignment

When considering interregional trade-off and population with regard to institutional assignment, it is noteworthy that both equity and efficiency aspects have to be considered. As far as equity is concerned, the institutional level should comply with the spatial range of environmental effects and measures regarding population. So, if there are any spillover effects, a policy that exceeds the regional level will be necessary. From an efficiency point of view, a national policy may be appropriate when this implies economies of scale. This will mainly depend on the way

measures affecting population levels can be handled and on their foreseeable impacts. In general, the planning and legislative tasks should whenever possible be in the hands of a central government within the boundaries of this planning framework. Thus, it will be clear from the above that it is not possible in general to identify the most suitable institutional assignment.

In order to let changes in either production processes or products have a significant effect, these changes have to materialize on a national (or even international) level. If for example a polluting production process is forbidden in one region only, while at the same time the demand for its output remains, profit-seeking entrepreneurs will simply relocate their production to other regions. The same applies to products. If the sale of a polluting product is prohibited in a certain region, people may import them from other regions. Therefore, a national policy will be necessary, both in the context of interregional trade-off and use of renewable resources.

With regard to efficiency, regional specialization may lead to a more efficient production. Consequently, this may result in a more economic use of resources and therefore - in the context of sustainability - have a positive impact on the environment. However, specialization of production may also imply concentration of pollution and environmental degradation in certain regions, to such an extent that the limits to ensure a sustainable regional development will be exceeded. Therefore, a national policy may be required to take decisions of such interregional trade-offs.

It will be clear from the openness of the spatial system and the benefits of physical or economic specialization, that the institutional assignment of environmental policy will necessarily be on an supra-regional level (e.g., multi-regional or international). At this level well-thought decisions may be taken that encompass the whole regional system.

According to an empirical study by Zimmermann and Ullmann (1981), however, it seems that intraregional changes have been more important than interregional changes in production structure. Also other studies, although not directed to the spatial dimension of changes in the production structure, point at this direction. For example, in the Netherlands 66% of the equipment industries are located in the Western part of the country. Environmental policy may come into play in the sense that subsidies given to control environmental damage may stimulate industries to develop and implement less detrimental production processes (cf. Potier, 1986). This evidence may weaken the need for the above mentioned regional institutional structure of environmental planning.

In the case of polluting industries, a closing down or no new investments would mean a decrease in income and employment. Because these effects are mainly regional in nature, a policy focussing exclusively on a regional level has the danger that a self-interested policy-maker is only concerned with his own region. Therefore it is not likely that such stringent measures will easily be implemented, especially when other regions do not follow these measures. Thus, here a supra-regional assignment of regional environmental policy would be a proper strategy. This certainly will be true for the legislative tasks of authorities , but possibly also for executive tasks of local or regional officials.

6.3 Multiple use of environmental resources and institutional assignment

Environmental resources can often be used for different purposes (e.g., water can be used either for drinking purposes or waste disposal). Multiple use of resources also exists (e.g., use of water for fishing and transportation) However, quite often different uses are conflicting with each other. See for instance table 4 in which the degree of compatibility is given for multiple land uses is illustrated.

Table 4 Compatibility and multiple land use

Primary land use	Compatibility with secondary land use								
	U	R	A	F	G	T	WR	W	M
(U)rban		0	0	0	0	1	0	1	1
(R)ecreation	0		1	2-4	0-1	1	2	5	1
(A)griculture	0	1		0	0	0	1	2-4	2
(F)orestry	0	6	0		0-5	0	0	6	2-4
(G)razing	0	6	0	1		0	2-6	6	2-6
(T)ransport	0	0	0	0	0		0	0	0
(W)ater (R)esources	0	2-6	1	1	2-4	0		2-6	1
(W)ildlife	0	6	1	4	4	0	2		1
(M)ineral production	0	2	2	3	3-4	3	2	2-3	

Legend of physical compatibility: 0=none, 1=very poor, 2=poor, 3=fair, 4=moderate, 5=fairly high, 6=high

Source: M.Clawson et al, 1985

It is clear from the table, that not all different land uses are compatible. Here the task of the regional planner is to find an optimal sustainable combination of different uses. In this case of land use there are several management approaches. Key elements of these approaches are (cf. Leeflang, 1989; Cloke and Park, 1986):

1 - regulation of activities
2 - land use zoning
3 - assimilation of plans

ad1) The degree of compatibility of land use determines the scope of manoeuvre in allocating land to compatible uses in the planning process. However, when different land uses are incompatible, they can be regulated by a system of permits.

ad2) Land use zoning (physical separation of land uses within a given tract) is an option when different land uses are incompatible. Land use zoning is in particular practiced in order to allocate available land use resources as equitable as possible among competing resource users and for different purposes. Land use zoning policies tend to be more effective when applied to the planning of new developments, particularly for public land.

ad3) The spatial impact of environmental problems related to different land uses are often regional in nature. Therefore, policy makers should incorporate physical planning in their environmental policy, which would contribute to priority setting in the case of multiple use of land.

6.4 Sustainable use of environmental resources and institutional assignment

The answer to the question about the institutional level of environmental policy regarding the use of renewable resources and production structure, may point at a more centralized level, since there may be a danger that the closer the relation between the decision maker and the polluter, the more sensitive the decision maker may be for social and economic arguments (e.g., employment) and the less inclined he will be to take measures to the benefit of the environment (de Rijk, 1989).

6.5 Risk and institutional assignment

The institutional setting in which such an integrated risk approach - as discussed in section 4.6.1 - should be carried out depends on the related elements at hand. The ALARA-principle should be pursued by the central authority and implemented by the responsible organization of the activity or development. Environmental standards ask for a central legislation, although they may regionally be specified. Implementation and control may be regionally or locally. Justification handling, depends on the activity or development under consideration. For developments with extra-regional consequences, the level of authority should be supra-regional.

6.6 Concluding remarks

By way of illustration of a welfare approach to RSD we discussed in the above sections the question of institutional assignment. From this discussion we may conclude that the hierarchical assignment of responsibilities often ask for a central authority. When intertemporal and interregional aspects has to be considered, lower level authority may bring about sub-optimal results. Considering risk and the use of renewable resources the same arguments hold. However, as soon as the executive character of policy gains importance - as we discussed with respect to multiple use - lower level of authority come to fore as a reasonable option.
In the above sections we only briefly mentioned some aspects of executive responsibilities. In the context of RSD, horizontal and vertical assignment, coordination and integration of executive responsibilities still need to be worked out.

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