ISSN 0308-3675

MERLEWOOD RESEARCH AND DEVELOPMENT PAPER

No 94

INTERACTIONS BETWEEN ECOLOGY AND ECONOMICS

by

PROFESSOR BERNHARD BITTIG

Institute of Terrestrial Ecology
Merlewood Research Station
Grange-over-Sands
Cumbria
England
LA11 6JU

February 1983

PREFACE

During the summer of 1982 Bernhard Bittig, Professor of Forest Economics and Forest Policy in Zurich, visited the Lake District and gave a seminar at Merlewood entitled 'Interactions between ecology and economics'. The seminar created considerable interest, particularly because Professor Bittig had a view of ecology that some of us found hard to relate to - many of the words were familiar but their context and the concepts behind them appeared unfamiliar.

Professor Bittig provided a written version of his talk to maintain the stimulus of the discussion. At that time Dr Paul Messerli, Co-Director of the Swiss Man and the Biosphere Programme (MAB), was on sabbatical leave at Merlewood and he provided further comments on Professor Bittig's paper.

Tragically Professor Bittig was killed in a helicopter accident in Switzerland in October 1982. His paper, along with Paul Messerli's comments, are reproduced here, in memory of the stimulus and insight which he provided and in the hope that the debate will continue.

O W Heal
February 1983

INTERACTIONS BETWEEN ECOLOGY AND ECONOMICS

By B. Bittig, CH-3116 Mühledorf, Switzerland
Professor of Forest Economics and Forest Policy
at the
Swiss Federal Institute of Technology, Zurich

SUMMARY

Interactions between economics and ecology are analyzed by means of a deductive approach as well as by means of an iteration model. Additional approaches are briefly touched upon, with the Black box approach being considered as particularly suitable. Finally, the limits of all thought models are defined.

1 INTRODUCTION

In the current process of forming political opinions it is increasingly admitted that some connection exists between economics and ecology. Many political initiatives are taken in favour of conserving our natural environment, and radical methods are applied by certain militant groups in their efforts to stop the so-called progress.

What are now the actual problems in the field of economics? Most national economies are at present characterized by general underemployment. Although substantial progress was made in the last few decades in economic theories, the important economic basic problems such as full employment, fair wages, low rates of inflation, fair taxation, sufficient social welfare and so on are still not yet solved. The target notion of constant economic growth has somewhat lost its former prominent position in view of the many present economic problems. However, we shall be faced with enormous developments in the next decades in connection with the effects of modern computer techniques. The changes which this will bring about in the economic process cannot yet be fully foreseen but they will undoubtedly have in turn social and economic consequences. - To get a better theoretical grasp of adaptation frictions, the concept of externalities has been introduced in economic theory. These are external effects which are characterized by the fact that consumers or

producers cause each other positive or negative effects of a technical, mental, economic, or social nature for which neither he who causes them is charged nor he who suffers from them is compensated.
Experience in **ecology** has also increased rapidly over the last few years. We are generally agreed that our natural balance suffers worldwide from constant deterioration and that a stop must be put to damages done for economic reasons. The various analyses range from pessimistic (Forrester, Meadows, Global 2000) to positivistic ones (Kahn) but negative assessments prevail in practical politics.

2 POSSIBLE APPROACHES TO COPE WITH THE CONFLICTS BETWEEN ECONOMICS AND ECOLOGY

21 Deductive approach

An attempt is first made to identify the above-mentioned complex of questions by a deductive approach. Beginning with the economic goals, these may be outlined briefly as follows:

- Economically optimum use of the production factors labour, capital, and land.
- Fair distribution of income and wealth.
- Maintaining secondary goals as full employment, price stability, etc.

To this end attention must be paid to the following market conditions:

- The economic subjects are expected to behave rationally both with regard to supply and demand (maximalization of profits and utility, respectively).
- Production should be efficient. This means that production should follow rational principles, i.e. a given target should be achieved with a minimum of means, or, when the means are given, the target reached should be the best possible one.
- Perfect competition is essential (a large number of market participants, complete market transparency, free access to the market, no preferential treatment of market participants in personal, spatial, or material respect, homogeneous supply of goods, rapid adaptation).

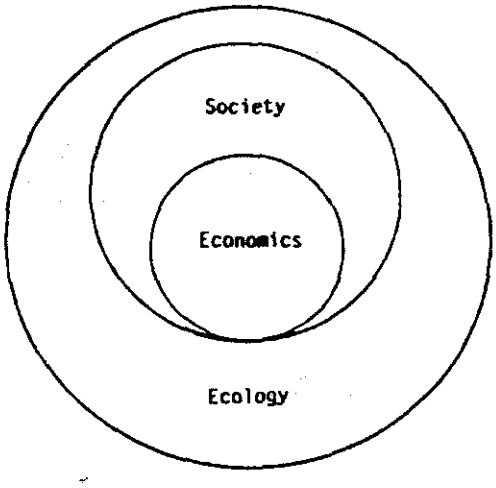
As soon as one of these conditions is not met, we do no longer have the best possible allocation of market resources (the Pareto optimum is not reached).

It is not possible to formulate ecological objectives. Only the following theories can be drawn from ecology:

- Man must take its place in the natural cycle; he cannot dominate nature.
- The ecological laws of nature should be strictly observed, particularly in the points of contact between man and nature.
- The amount of energy used for production and consumption of goods and services should be reduced.
- Any disruptions of the material cycle through biocides and inorganic pollution should be avoided.
- Attention should be paid to threshold values from negative to positive feedbacks of ecosystems. The destruction of local ecosystems also affects other systems.
- Man does not live from nature only but also from immaterial values. These should be taken care of too.

What do these interactions look like in the deductive process? **Figure 1** shows ecology as life-encircling sector of first priority, followed by society in which economics is yet given a serving function. This thought model is found in the field of political ecology.

Figure 1: Model of political ecology



The following **figure** 2 shows political economics including ecology in the sense of Marxism.

Figure 2: Model of political economics

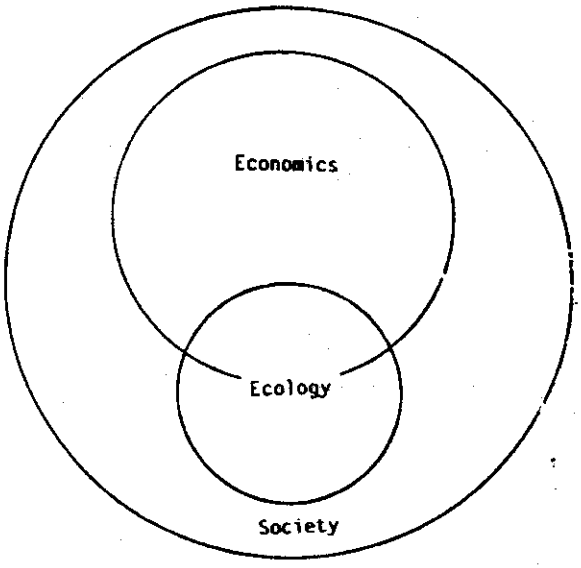


Figure 3: Market-oriented model

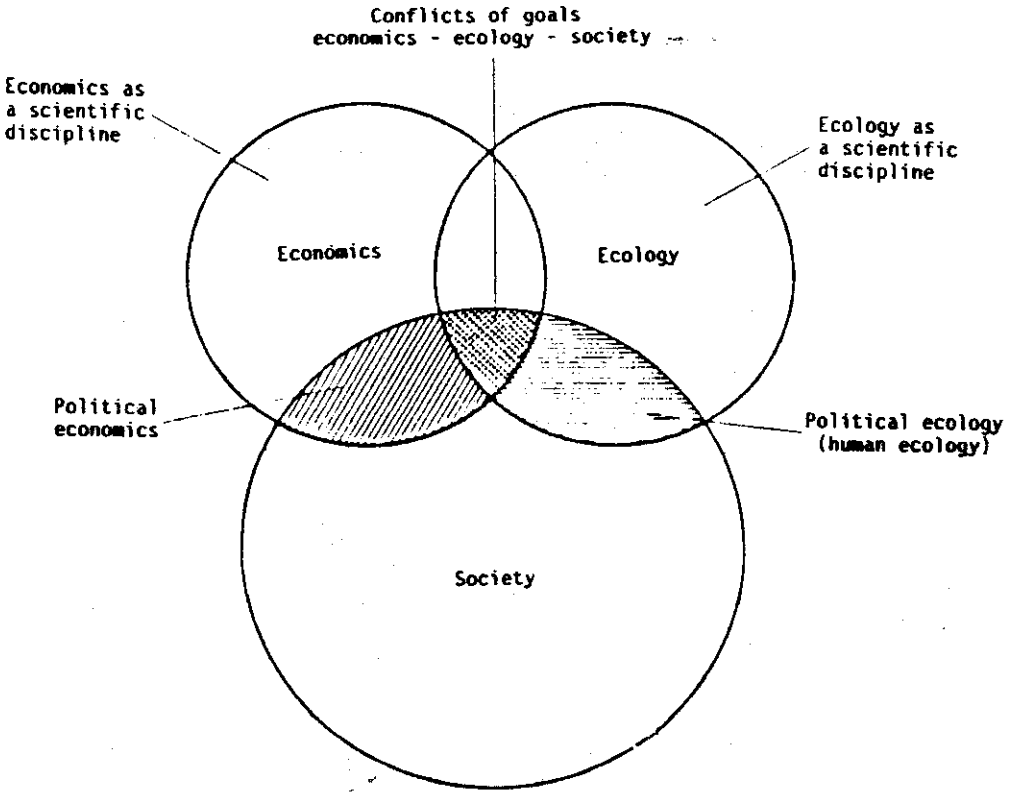


Figure 3 shows a thought model illustrating the tension between the three sectors mentioned in a market-oriented society. The intersections of the three circles are particularly interesting.

Political economics, which is concerned normatively with all relevant economic questions, is to be found in the left-hand intersection. On the right-hand side we find political ecology, indirectly also human ecology, which attempts to deal with the intersection between ecology and society. In the field of political ecology the organizing principles of nature are in this connection frequently applied to society (cf., for example, Ehrlich/Ehrlich and Goldsmith/Aellen). Such an approach is in my opinion inadmissable since society as heterogeneous human creation defies the comparatively simple organizing principles of nature in many respects.

The middle sector is of particular interest since it shows the area in which there are the actuel conflicts of goals between economics, ecology, and society. This sector is particularly influenced by the following factors:

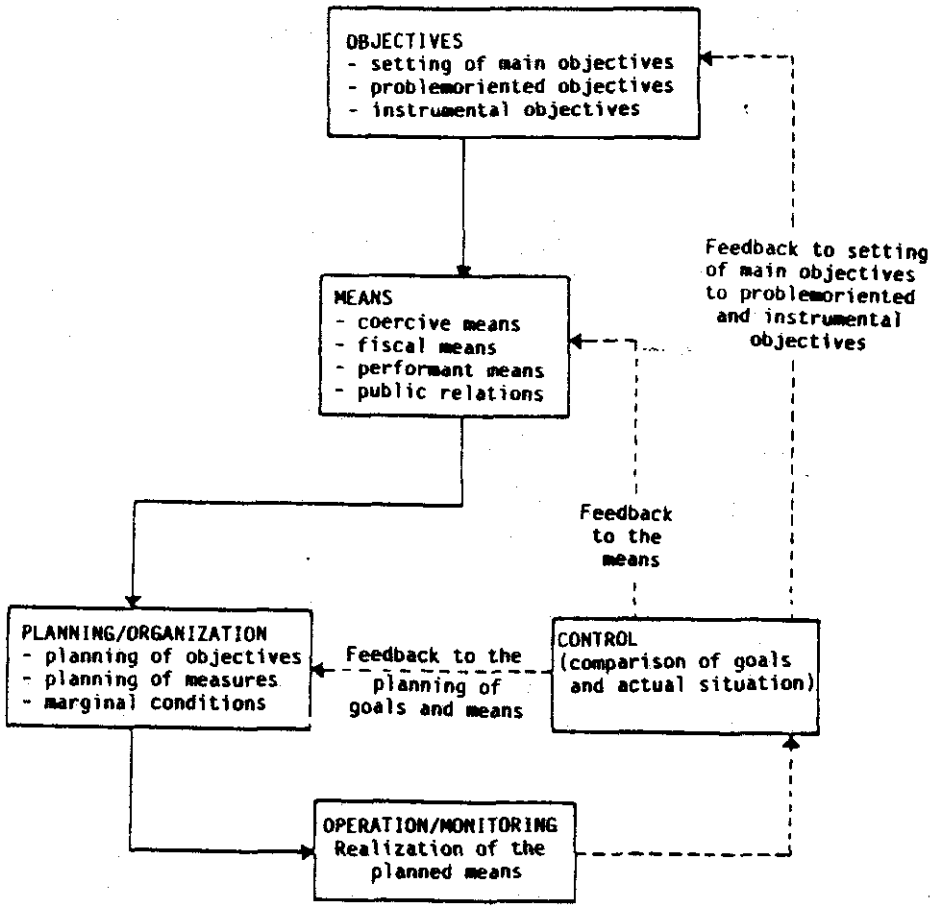
- **Time factor**: This factor has a highly restrictive effect in economy since all economic decisions are in the long run decisions taken under uncertainty. Economics is not yet able to supply data which provides binding information for decisions over a period of more than 20 years. Weak points are, for example, calculation of compound interests where exponential functions are used, or price formation which only takes into account the cost of exploitation in the utilization of non-renewable resources but disregards any signs of scarcity in the future (shadow prices).
- **Spatial factor**: Whereas economics requires production to be as efficient as possible thus leading to pronounced division of labour, ecology and society are based on balanced spatial development.
- **Assessability factor, appraisal**: Economics have produced some interesting models in the sense of global appraisals including also ecology (input-output calculation, total analysis, etc.), though these models are not fully operational because of their lack of assessability. Ecology cannot be completely measured due to the lack of an efficiency criterion whereas economics can show human preferences for marketable goods only. But it is a fact of experience that mankind acts irrationally thus preventing any comparison of non-marketable goods such as utility, intertemporal or interpersonal, and making such assessment illusory.

This shows that there appear to be so many methodical problems in coping with conflicts of goals by means of deductive instruments that we cannot expect more than to be moderately successful in this respect.

22 Iteration approach

A further possibility would be an iteration process in order to improve the decision-making process. This iteration process is briefly outlined in a basic model in figure 4.

Figure 4: Iteration model for decision-making



The objectives may be formulated on the basis of existing materials for a certain problem.

On the level of means, coercive means are applied in a prohibitive sense whereas the fiscal means may act either as inducement, adaptation, or discouragement, and the performant means are in particular directly induced means (for instance, infrastructure). After planning and

operation, control is of particular interest although the main problem here is the great difficulty to define the set goals.

This approach is particularly useful in areas where substantial parts of the problem may be assessed and defined quantitatively. I have achieved positive results here in particular in connection with forest policy in Switzerland. The possibility of feedbacks is also interesting, thus making possible permanent adaptation to changing circumstances.

As regards economics and ecology attention must be paid to the fact that the corresponding objectives should be formulated in such a way as to take into consideration both economic and ecological aspects. On the level of instrumental objectives both sectors should then be on the same level.

23 Other approaches

In connection with the synthesis of complex states of affairs in the field of economics/ecology it appeared that there existed additional theoretical approaches. These experiences were gained through the MAB (Man and Biosphere) project in Switzerland. Mention should first be made of the growth models which use both econometric methods and linear programming. Such models are particularly interesting in a didactic respect but are not very suitable to gain substantial new findings due to their determinacy.

Scenarios are used to investigate possible future situations for their effects on the entire complex of problems. These, too, are thought models which are valuable from a didactic point of view but lead to clear findings in their turning points only (analogous to the sensitivity analysis). Since economic developments usually occur over long periods of time and (indistinctly) in small steps only, such scenarios are usually a failure.

Balance models make it possible to show changes in situations in the economic and ecological sector. But they are meaningful only if flux vastly exceeds the capital. However, the opposite applies to ecology so that this approach, too, is useful for a few partial questions only.

The blackbox approach in synthesis discussions appears to me to be particularly promising. The effects of sub-systems are taken into consideration only when there are substantial external changes. Systems with negative feedback and without important changes in the course of time do not have to be looked at more closely, and their relevance to overall systems is simply restricted to external parameters. Should there be positive feedback in a blackbox, further division into smaller blackboxes and a more detailed analysis of the sub-system in question are, of course, essential. The blackbox approach makes it possible, in particular, to combine different sub-systems which were dealt with with different intensity, methods, or time horizons.

3 CONCLUSIONS

The purpose of the present paper was to outline some basic questions of interactions between economics and egology by means of a summary account. In this connection, attention must be paid to the fact that all scientific efforts are merely thought models working through abstraction (omission) and isolation (variables becoming constants). Such models cannot reflect reality. One must further be aware of the fact that results may be better than input data. Moreover, the quality of the results does not depend on the number of equation or the size of the computer or the type of presentation. The parameters are frequently chosen in a way that the model is "right". The equations, too, are formed in a way that the results appear to be reasonable which, of course, again prevents a priori substantial new pieces of knowledge to be gained. Finally, models assist merely in the decision-making process; they cannot be considered as actual decisions because of their structural weaknesses.

It is essential to continue permanently to examine methodically these questions. It is unlikely that there will ever be a complete break-through in a methodical respect. It is rather an iteration process in which, figuratively speaking, various methods are circled round a non-attainable target. If the new methodical pieces of knowledge are circling towards the centre point, this would already be a great success. Whether the contents of the present paper are also circling towards the centre point or running in the opposite direction is left to the reader to decide.

LITERATURE

Bittig, Bernhard: Zielkonflikte zwischen Oekologie und Oekonomie. DISP Nr. 59/60, p. 13-22, Zurich 1980

Ehrlich, P.R./**Ehrlich**, H.A.: Population - Resources - Environment. Sec.Ed., San Francisco 1972

Goldsmith, E./**Aellen**, R.: A Blueprint for survival, London 1972

SOME COMMENTS ON PROFESSOR BITTIG'S SEMINAR PAPER

BY DR P MESSERLI

With these few coments I do not expect to provide greater insight into the problems identified by Bittig in his paper. However, I do hope to widen the context within which Bittig's analysis can be seen. I have tried to do this mainly in two directions:

- Towards a historical analysis of the development of ecological and social systems, as done by Lieth (1981). He outlines some very persuasive arguments as to why the links between ecology and economics are so tenuous and why the human value-systems incorporate only few ecologically-based components.
- Towards a practical suggestion on how to overcome the problem of integrating ecological objectives into the decision process, otherwise dominated by the rationale of economics.

In addition I think there are points of misunderstanding between ecologist and economist because of their different points of view. This difference arises from the fact that the ecologist is mainly concerned with the improvement of our understanding of ecological processes, whereas the economists' viewpoint, represented by Bittig, is that of a political adviser, personally involved in the decision-process where he has to defend nature against increasing impingement of man. However, to advocate nature within a rationale defined by economic rules needs a clear analysis of the main points of divergence between ecological and economical principles.

HISTORICAL ANALYSIS OF THE DEVELOPMENT OF ECOLOGICAL AND SOCIAL SYSTEMS

In his historical analysis of the development of human and natural systems and the interactions and inter-dependencies between these systems, Lieth makes the following points:

1 As a result of man's intelligence and ability to cope with constraints, human beings have been able to reach a sovereign position within the material- and energy- flows of an ecosystem.

This position is characterized a) by the fact that the percentage of human activity devoted to obtaining material needs decreases in the course of time and b) by his increasing resistance against attacks from the next trophic level in the ecosystem (microbes), by development of hygiene and medical treatment.

Therefore, man's eminent position within the ecosystem depends mainly on his ability to produce food and on the protection of the population from being consumed.

2 Since, in the course of history, even fewer people were needed for the essential physical functions mentioned above, the satisfaction of spiritual and psychological needs of society have taken priority over agriculture and nursing, in the creation of new social structures.

3 As a result of this development, all human cultures hitherto have exploited their environment until it collapsed, the population was diminished by incurable illness or epidemic, or else was eliminated or absorbed by stronger cultures.

At no time did there exist a real understanding among humans about their relationship to their environment.

What are the conclusions that can be drawn from this analysis, for a better understanding of the existing conflicts between ecology and economics?

1 The highly independent development of natural ecosystems and social systems is seen in the development of decision rules and value systems within which ecological principles have only low priorities.

2 The time of the physical independence of man from the ecosystem is coming to an end because the human species has expanded too much and the impact of man on nature has caused the progressive worsening of environmental conditions, with feedbacks on human health and well-being.

3 The existing cultural and social structures cannot meet this new situation and therefore we have to look for improvements.

CONFLICTS BETWEEN THE STRUCTURE OF SOCIAL AND ECOLOGICAL SYSTEMS

Bittig's analysis is based on Lieth's third conclusion, ie that there exist structural conflicts between ecological and social systems. By means of a deductive approach, he identifies three areas of divergence between ecological and economical principles:

1 Time: Within economics, and related to the decision process, there is an over-emphasis on short-term information and effects, whereas, in ecology, long-term effects and responses are of equal, if not of dominant, importance.

2 Space: Spatial organization according to economic principles (division of labour and selective use of resources) and technical constraints (indivisibility of technology) is in contrast to spatial organization and land use pattern which allows intensive interactions and exchanges between parts of an ecosystem and between different ecosystems. Thus stability is enhanced (all known self-regulations rely on interactions and not on separation!).

3 Efficiency: In Bittig's deduction, the following logical chain can be recognized: Ecology has no objectives comparable with those existing in economics. Without objectives, no efficiency criterion can be developed and therefore there is no immediate possibility of relating ecological findings to the decision process. It is even more difficult to incorporate ecological findings if they are of a purely qualitative nature.

This discrepancy can be illustrated by a simple comparison of the two systems:

- Economic system: Characterized by high flow rates and small stocks. On change, the resilience is therefore high, and misallocations of production factors provoke an immediate response in the actor. There also exists a uniform scale of measurement and a simple information code. Money fulfils the function of a macro-indicator of efficiency.

- Ecological system: Characterized by high flow rates and small stocks. By inertia and buffering capacity the resilience is relatively low. Therefore, time lags in response to impacts and spatially remote effects are typical. The perception of change in relation to human generations is difficult and the responses of the ecological system are expressed by a variety of scales. No macro-indicator exists. Measurements and observations are time intensive and costly.

These differences yet again express the independence in the development of the two systems.

To avoid misunderstanding it should be stressed that efficiency criteria undoubtedly exist in ecology. But again, they can only exist in relation to quantitative data; to flow rates and stocks; to input and output ratios. In respect of qualitative information, a link with efficiency criteria is very difficult because there exists no one-to-one correspondence between the structure and function of an ecosystem.

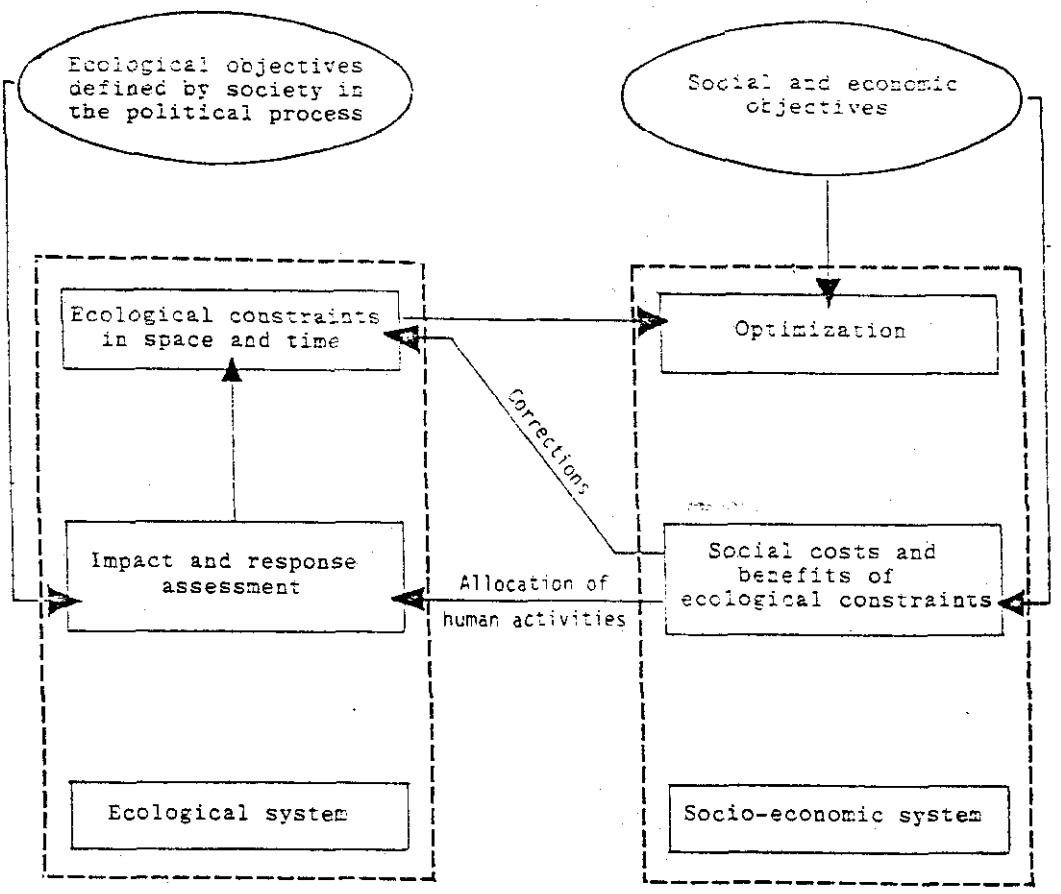
As a result of this argument, we can point out that the evaluation system of economics cannot easily be expanded on ecological grounds, because the evaluation through the market mechanism is restricted to marketable goods (see Bittig). Although economics developed new concepts in order to transfer ecological restrictions and capacity limits through scarcity signals into prices, and several suggestions were made to incorporate ecological principles into the design and management of social systems, we have still to cope with the fact that, in pluralistic society, social policy strives not to achieve remote goals, 'scientifically determined', but rather to maximize man's overall well being in a manner easily understood and perceived by most individuals in the society.

In one point I disagree with Bittig. The formulation of ecological objectives is possible and is a matter of fact. Many ecological targets have been formulated, on all levels of decision making, during recent decades. This can be seen as a result of the increasing concern of man about nature and as a reaction of perceived responses of nature to human activity. The actual problem is, therefore, not a lack of ecological objectives but the incorporation of these objectives into the decision process.

A PRACTICAL APPROACH ON HOW TO INTEGRATE ECOLOGICAL OBJECTIVES INTO THE DECISION PROCESS ON A LOCAL OR REGIONAL LEVEL

Figure 1: Integration of ecological objectives into the decision process.

A main objective of ecological research is to improve the knowledge and assessability of ecological responses to human activity.



This approach takes into account:

1 Both ecological and social objectives are at the same level.

2 General ecological objectives have to be translated into operational criteria and expressed in relation to space and time.

3 Ecological restrictions can be incorporated in optimization models which simulate the economic evaluation process. Therefore ecological objectives can be integrated into the decision process.

4 Social costs and benefits of ecological constraints can be ascertained and corrections can be made.

5 Through impact and response assessment, a re-evaluation of the ecological restrictions is possible.

REFERENCE

Lieth, H. (1981). Ecosystem and social system from the viewpoint of an ecologist. In Interactions between ecological, economical and social systems in regions of intensive agriculture. MAB - Mitteilung 7: 28-36. MAB National Committee of West Germany, Bonn.