

COORDINATION BETWEEN ECOLOGY AND ECONOMY FOR A BETTER TOMORROW

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Abstract. *The paper tries to create such confrontation of ecology and economy that may result in a better tomorrow. All the developments in the human environment are related to human existence. That is why the contemporary economic theory is trying to figure out the cost of ecological optimization. Of special interest are teachings of ecological economy, spatial economy, resource economy, economics of environmental protection, and the like. The model of ecological optimization is an ecological approach to the modern technological development.*

Key Words: *Economy, Ecology, Environment, Ecological Optimization, Economic Theories*

1. ENVIRONMENT

Every living being on the earth is the carrier of at least one natural process of substance exchange or metabolism and the process of transforming of one type of energy into another. In such a way nutrition chains are formed whose constituents could be divided into: producers, consumers and dissolvent organic substances. Within this context there emerges the question of not only a small number of plants or animals but of the entire population or all the species which take part in the chains of nutrition, which create our living community, cover the greatest part of land and sea on the earth and inhabit it.

Ecosystem, accordingly, has two components.

The first is a biological one which covers all living participants and organic processes happening within it; the other component is abiological one and it takes into account all organic and inorganic materials and substances and processes which exist outside the living organisms as well as phenomena such as temperature, light and pressure.

Energy represents the most needed precondition for the existence of ecosystem. Two basic groups of natural ecosystems are differentiated:

a) Natural ecosystems with small or low energy usage (underground lakes, ocean depths, forests on great heights, polar areas), and,

b) Natural ecosystems with high energy usage (consumption) such as savannas, tropical forests or some others which cover or contain the greatest number of existing plants and animals (flora and fauna) species and which could transfer the part of organic substances they themselves produce to the ecosystems with low energy usage. The creation of the first primeval ecosystems on the earth has not been clarified yet but the principles and limitations of their development could still be understood by the analysis of already existing ones.

1.1. Quality of Environment

First of all, the quality of environment is determined by social relations, degree of production forces development (regarding interaction between man and environment) and the aims which society realizes. The degree of responsibility for environmental quality is as much differentiated as the world itself is divided in the social, economic, political and cultural sense.

The Relation of Scientific and Technological Development and Quality of Environment has to be based on the following:

General interest should dominate personal or single interest.

Environment and its treasure should be managed in such a way to ensure or provide long-term rational usage and reproduction - so called theory of sustainable development.

Maximal inclusion of all items and instances in decision making about development and part of responsibility.

Human needs, social targets and capacity of environment should be mutually coordinated.

Decrease of differences in development.

Questions which need to be answered in the process of overcoming of conflicts of scientific and technological development and quality of environment referring to the following:

Influence of growth and distribution of population on environment, especially the mutual influence of population, resources, capacity of environment and development.

Influence of present economic development on environment if present devastating trends continue (implication of mismanaging and reduction of natural resources in the process of determined development).

How to decrease differences in development, how to provide healthy food and enough clean water for all, how to decrease all types of environmental pollution and how to promote and improve natural resources management, especially forest and the like.

2. HUMAN BEING

Beside natural production and decomposition of different materials or substances in one ecosystem, the production of substances is also taking place; it is initiated by human beings. The human-induced or anthropogenous production processes could be determined as the changes of place, shape or content of natural materials (raw materials) which man moves, maintains and controls with the aim of producing things for wider usage, or for

their turnover value. Human beings or, better to say, man has started many such processes. It is usual that economics only deals with movers or carriers of anthropogenous production processes while biology or ecology deals with the carriers of natural production processes.

Anthropogenous production processes could be divided into, at least, five groups such as:

a) Gathering dispersing (spraying), clearing (purification) and mixing of natural, mainly, inorganic substances. Such productive processes mostly happen in the field of mining, oil production and construction materials production.

b) Urging, slowing down or increasing of the volume of different various natural production processes. Such kind of production we meet, of course, in agriculture forestry and in molecular and atomic changes which in nature do not happen and whose final products could be made by natural causes (such processes start and are maintained in the greatest part of chemical industry and partially in black and non-ferrous metal forming).

c) Transforming semi-products into ready-made ones leaving only waste (such processes are initiated in all industrial branches of higher production and processing phases).

d) Transfer or transportation of human beings, things and information, different services moved in order to make easier and better production, or to make consumption easier and more comfortable (so-called productive services).

3. DISHARMONY AND POLLUTION

The natural production processes whose global number and volume are slowly changing in the evolutionary sense of the word, on the one hand, and the anthropogenous production processes whose number and volume have been rapidly increasing in the last two hundred years, share many common elements. The most important are special processes since they happen together with the previous two ones, because either of them use elements and connections that undergo global structural changes but without their own increasing or decreasing. What they all share are elements and energy.

The history of the anthropogenous production processes shows that their initiators are never pre-defined or led by the preservation of ecosystem. Moreover, for centuries no one has been in any special danger for this because the overall range of these anthropogenous processes has been neglected. But from the Industrial Revolution on, the range has increased at a high rate so that, today, the simultaneous and interactive happening of both the anthropogenous and the natural production processes cannot be found anywhere. Waste or damage which ecosystems suffer become visible only when the anthropogenous processes achieve a great range. Such measures and scales increase further on so the anthropogenous processes begin to disturb each other and they all together disturb ecosystems to such an extent that in some industrialized and urbanized parts of the Earth and space today the basic human physiological processes are endangered.

Numerous clashes and disturbances created in such a way could be divided into two basic groups. The first group consists of clashes and conflicts of anthropogenous productive processes and ecosystems. By killing or by deforestation, some species could be destroyed indirectly and could be also terminated directly - by being chased or by clearing away or destroying their natural environment. This process is usually called degradation of human environment.

The second group of conflicts consists of overlapping of anthropogenous, productive, non-productive and consumption processes. Such overlapping happens at places where human productive, infrastructural and consumptive lines of business get together.

Health, and most often life itself, are endangered today also by activities such as taking breakfast, lunch or breathing.

4. ECONOMIC THEORY

The economic aspect of the disharmony of anthropogenous and natural processes is not hard to see and figure out. Polluters are always producers or consumers which, being restricted and limited by economic balance, mutually and simultaneously produce, consume and earn. It is somewhat harder to see how the economic type of disharmony, due to multiplication and spreading of pollution, becomes more and more important. The question whether this disharmony can be somehow solved, it is possible to give a positive answer from all aspects except from the economic one. Modern technology redefined most of pollution products and consumption processes and found their alternatives; medicine, biology, hydrology, meteorology and other important sciences are developed enough to give to such redefinitions the needed ecological categories and parameters. Regarding the question why, regarding the global scale, pollution still happens as well as concerning the possibility of its elimination, it is obvious that these cannot be answered before investigating of economic motives and economic relations of starters or initiators of anthropogenous processes.

The anthropogenous production processes are launched because of direct or indirect gains such as income from the sale of the created products, or thanks to their satisfying different needs or fulfilling some public interest and cause. In this way, nobody produces in order to delight others; neither has anyone such intentions during consumption.

So the most unavoidable is the question: how does economics relate to the very destruction of the natural base of the economic processes induced by the very carriers of such processes?

This is a very complicated and compound question because it also relates to the theory and practice and it is good to place it at the microeconomic and microeconomic level. The theorists must ask themselves if the new phenomena can, after all, be covered by the theories otherwise formulated at the time when waste and garbage were too small in amount to endanger anybody. Or, they should decide if it is necessary to formulate a new ecological-economic theory. Likewise, the methodologists must decide if they will go on offering the same development methods or they will think up some new ones. And the like.

Also unavoidable is the question of economic policy. Its carriers and supporters must realize and study the existing instruments, think about new ones and determine and state what "has to be done – yesterday" in order to submit productive and consumptive motives and relations to the self – and this is, after all, an understandable request for the human environment in which humans can breathe, eat and drink freely.

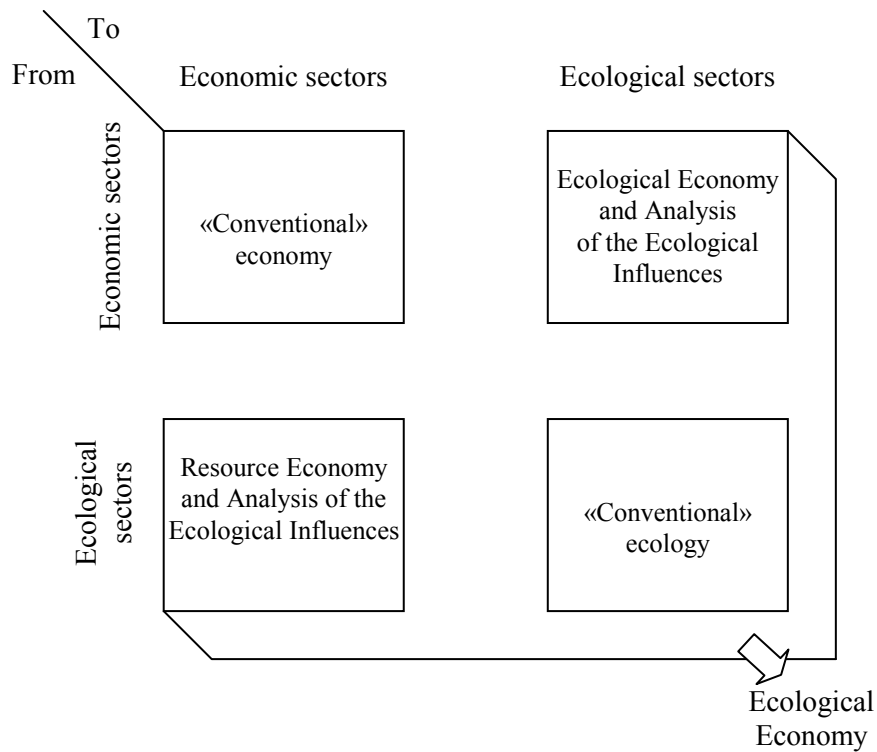


Fig. 1 Different Areas of Economy and Ecology

4.1 General Economic Theory

Whatever the name (earth, space, ecosystem, resources, environment) and whatever the importance, the natural base of an economic process is the subject of economic theory from its earliest days till now. Yet, it remains to be seen if these beginnings are taken to date from the first written documents in which economic processes are partly analyzed but not described or they are related to Richard Cantillon and his "General Discussion about the Very Nature of Trade" from 1755.

Very long is the list of all those who have tried to realize the relation of ecology and economy but some of them are worth mentioned such as: Keynes, Schumpeter, Adam Smith, David Ricardo, Maltuss, Marx, Marshal, Larette.

4.2. Spatial Economy

The spatial aspects of economic processes have always been left aside of the trends, from the very beginning of the economic theory, since they present analytical difficulties.

Yet, the spatial aspect of the economic process is obvious and interesting; that is why, almost independently of the development of the general economic theory, some economists deal with it.

Some attempts have been made to get to the answer where the *homo economicus* places his production plant, transports all he needs and drives away what he sells with the least cost and expenses.

Between the two Great Wars (First and Second World Wars) the distribution and allocation of production units began as well as their dislocation. That is how the movement was launched and gave rise to some excellently elaborated spatial-economic models. In addition, out of all this arises a new discipline called regional economy. But, even though space thus entered the economic theory, it has remained two-dimensional and static (Weber and Tinnen).

4.3 Theory of Growth

The lack of the category of time in the neoclassical economic theory was, for a while, complemented by the so-called comparative static analysis. Only in the period between the two Great Wars did the theoreticians begin to deal with the time as the continuous variable which resulted in a set of models and even theories of growth. Almost all scientists who dealt with this topic agreed with the starting assumption that growth means to produce more than it is produced in the previous period, so that models must solve the relations of saving, investment, used capital and work and final product and place them in such a way that all capital invested becomes used or spent and turned into product and sold. In such a way the theory of growth, up to now, has failed to come closer to the solution of ecologic aspect of economic process.

4.4. Economics of Resources

The urgent problem of the exhaustion of resources also got quite late to the cabinets and study rooms of the neoclassical theorists, even as late as on the eve of the Second World War. The first written papers and items of this kind appeared in the 1930's but the economics of natural resources grew into an economic discipline only after the Great War.

Economists are mainly interested in such items as, for instance, how fast an exhaustible resource is to be spent in order to maximize gain and realize dynamic balance. In such a way, the economics of resources, implicitly deals with such issues, in fact, by chance.

4.5 Economics of Environment

Economics of environment (environmental economics) which has, as a separate discipline, developed fast in the last twenty years, has become thoroughly comparable to economic resources and with the economic resources. It is not satisfactory either concerning results or its approach. The basic question or issue with which this discipline deals with is the social expense of endangerment of human environment, but, since the analytical apparatus is also here neoclassical, the existing theory was first called to help. Air, water, sea and all other things which belong to nobody and everybody, are taken as the concepts of public wealth and public goods, but, on the contrary, the concept of pollution was taken as external. Environmental economists in such a way look upon time preferences, social rate of profitability and reliability; find models which force the polluter to calculate external gain into their global calculation of balance; they also reexamine and reestimate the concept by which Cost-benefit analysis tried to be based as the theory. Such an approach, inevitably, leads to the request-environment, so this request is placed among the first on the agenda of this discipline.

Beside various additional presumptions, economists of environmental theory came to the mathematically valid models but not to the usable methodological procedure and steps of procedure. The reason for that is not hard to notice: the question refers to what appears on the market and whose consumption could not be exclusively determined and paid for.

4.6 Ecological Economy

In the last ten years there has been an increase in the number of works and papers concerning economics of environment which are not based on the neoclassical microeconomic apparatus. They are characterized by interdisciplinary approach or the return to the general theory, the repeated and repaired interest in the classics, critics of the existing models of growth and attempts to find the new ones in order to get some ideas about resources and space in which economic processes happen. Space is here determined as a dynamic multidimensional category, that is, as the category which is liable to change by labor or impact of economic subjects. It is the discipline, as many other things concerning the environmental protection and safety, a brand new discipline and it promises a lot. The name of this discipline is given recently and it quite suits it.

4.6.1 Problems of "Ecologization"

Problems of Introducing Ecology into Technology

However, regarding the previous scientific-technical development and quality of environment, it could be concluded that.

1. Scientific-technological progress in the basic technological process does not have any truly important influence on the emission of waste materials in processing industry. Improvements and changes have an influence on the usage of energy and raw materials and on the improvement of working conditions. There is a significant number of exceptions and the most known and important is the technology of chloral production, in which, for ecological reasons, the electrolytic procedure with mercury cell is replaced by the process of membrane cell.

2. Scientific-technological progress was, in its largest part, directed toward solving of waste material drainage out of basic technological processes, meaning that waste materials are the products of the basic technological process. All these actions are targeted toward:

Transformation of waste into non-detrimental materials, which, without influence on environment and living surrounding, can be thrown into human environment (for example, the waste water purification).

Returning of waste materials back to production processes (recycling).

Solution of usage of waste materials in other production processes (revalorization).

Useful usage of waste materials outside production processes (for example, usage of slag or dross from melting furnaces in road construction).

3. Treating of waste material outflow is based, in its essence, on the usage of mechanical chemical and biotechnological procedures. The basic knowledge for these procedures is existing; yet, the must be created for each separate case concerning that it is the

matter of specific material systems and specific conditions in which each problem must be solved.

Beside industry and mining, other important factors of environmental pollution are also agriculture and traffic.

There is no need to put a special emphasis on the need to solve some situations pre-conditioned and caused by development of science and technology in relation to quality of environment. The traditional, short-term aims of development of science and technology must be in correlation with long-term effects on the living environment quality. If such interdependence is not done optimally, there is the risk that the problems of environment can be transferred to economic stability, national safety and political manipulations. But, some problems of environment are already seen on global plan:

Change of climate, caused by greater concentration of carbon monoxide, could have great economic and social effects and consequences.

Enormous and over-limited air pollution by acid rains already endangers almost all continents.

Effects and consequences of inadequate usage of chemical substances, inadequate management of dangerous waste materials exceed the scope of national competence.

4.6.2. Ecological Approach to Technological Development

Ecological overload in the developed countries mainly does not allow importing and processing of raw materials on their territory but, on the contrary, it requests the import of more and more purified materials or substances (for example metals, cellulose and polymerized substances), by which some pollution technological processes of processing of mineral raw materials are avoided. The developed countries try to reject old fashioned technologies which, because of more and more strict requirements for environmental safety and protection, become less profitable and less economical. It may seem, at a glance, in terms of absolute index, that the economy development of one country is increased and accelerated. But, the final result is such that the developing countries accepting the pollution technologies, enable and help the developed countries become increasingly wealthy just because of this fact.

The developing countries can not keep pace with the developed ones and the gap between them increases. They, in fact, under the seemingly good conditions of technology transfer, often transfer the problems of environment to its own territory. Such phenomena already have their names: neocolonialism or ecocolonialism. Special part of ecocolonialism is the pollution of international rivers, seas and oceans and also we can not underestimate the phenomena of polluted air transmission to very large distances, up to industrially undeveloped countries.

Today it can be said that ecology, from the initial branch of biology, has become a great issue of interest of knowledge and facts in the center of which man has found himself and, together with himself, the whole organization procedure of creating the life on earth. Ecology has stopped to be studied by biologists and now the scientist of different professions and vocations deal with it.

4.6.3. *Ecological Markers*

In the relation of a man or a human being toward nature there are two ways of endangerment and decrease of its values:

Direct attitude or behavior by which natural resources are directly devastated and used and by which the centuries old ecosystem is disturbed or made to disappear or plants and animals have become increasingly less numerous.

Indirect attitude in the case of which, on the basis of natural resources processing and processing of other substances, the environment has become contaminated or polluted and it is the case mainly with soil, water and air.

Ecological engineering tries, by the use of scientific methods and new additional technological processes, to solve the problems and contradiction of environment and rational usage of natural resources energy and raw materials. The branch or area of interest of ecological engineering is a very vast one characterized by an interdisciplinary and multi-disciplinary approach because it covers the entire phenomenon of living in one environment. It must be understood from the basis and aspect of science, technology, economy and social policy.

Area of interest called ecological engineering which covers equipment and procedures for prevention of environmental pollution is marked with the notion ecotechnics. Technological solutions of ecological engineering could be found, first of all, in the usage of such technologies which do not pollute the environment (pure, clear or ecogene technology).

Non-pollution or pure technology, as already accepted subject, means practical usage of scientific discoveries, methods and technical means elaborated to ensure and provide the most rational usage of all natural resources as well as the ability to solve the problems of general process of human society but, at the same time, to protect environment (living and working environment).

Although there are, in all the countries, the parties which oppose the notion of technology without waste materials, because they think that it endangers or even destroys national economies, the greatest number of scientists have come to the conclusion that economical could be only those processes which return to nature all things which they took from it in the process of production.

Basic elements of non-pollution technology are:

Practical usage of modern methods of exploitation and concentration of mineral raw materials.

Improvement and development of new technological processes in which, to the greatest extent, outlet, drainage or release of polluters into the atmosphere are solved in the best way.

Development and usage of efficient technological procedures of waste water and waste gases purification.

Usage of all kinds of waste materials in a particular area or in the domain of usage of some other industry.

Introduction of non-pollution technology covers:

Gathering information concerning creation of waste materials, their separation and possibilities of their usage for other purpose.

Storage and analytical control of waste materials.

Special scientific and expert activity in this domain.

Coordination and coupling of social activities with the special emphasis on laws and regulations.

At the moment when the choice of some determined technology is in question it is possible to choose between two solutions.

1. Add some parts of technological processes to the already introduced technological processes by which waste materials detrimental for environment are eliminated.

2. Introduce pure technology so as to have minimal negative impact on environment.

The method of cost-benefit determination still gives best results concerning investment decision-making or choosing of solutions, because it based on comparing of more or less different measuring influences and consequences on environment.

Table 1 Comparison of "Conventional" Economy and Ecology with Ecological Economy

	"Conventional" Economy	"Conventional" Ecology	Ecological Economy
Basic view on the World	Mechanistic, Static, Atomistic	Evolutionary, Atomistic	Dynamic, Systematic, Evolutionary
Time	Short	Wide	Wide
Space	Local to International	Local to Regional	Whole Ecosystem, including Human
Species	Only Human	Everything except Human	Whole Ecosystem including Human
Primary Macro Goals	National Economy Growth	Survival of the Species	Ecologic and Economic System Sustaining
Primary Micro Goals	Maximum (firm) Profit Maximum Usage (Singles)	Maximum Reproductive Success	Has to be adjusted to sustain system goals
Assumptions about Technical Progress	Very Optimistic	Pessimistic or without opinion	Wisely Skeptic
Academic attitude	Disciplined	Disciplined	Transdisciplined

4.7. Development Methodology

At the beginning of 1970's the issue of the existing and potential pollution of environment started to be approved and accepted by the social and economic development of methodology. Attention was not only paid to achievements of the development projects, to those who undertook and realized them and to the economy that was more or less changed by them, but it was also paid to the effects and achievements regarding environment.

The development methodology almost exclusively develops on the civil side of the dichotomy of economic science. The existing methods which look upon social approach also try to conform to the ecological criteria and requirements, but, for many reasons, in practice, it has shown many shortages and defects. Also, there are new methods devel-

oped which are generally new and planned. Their aim is to evaluate proposals for production, distribution, consumption and usage which threaten the pollution of environment.

The methods that are today at our disposal are numerous and could be classified into three groups of methods. They are cash-flow analysis, cost-benefit analysis and a group of procedures most often called Environmental Impact Assessment (EIA).

4.8 Economic Policy

Care taken about polluters and attention paid by project founders, investors and others is of different kind. Most often, however, care is taken about how to avoid attention and concern so, in most cases, the polluters who are responsible for endangerment and real damage of their environment still try to behave as if the air and water are free raw materials. Every twenty last years laws and standards are issued which explicitly determine and often sharply impose sanctions for ecological damage and determine the degree of ecological damage caused by production, distribution and consumption. They also propose what other things the investor or potential polluter must do in order to avoid or prevent pollution of environment.

Direct force and enforcement of law is more often supplemented by different methods of economic especially fiscal policy. Also, funds are raised for financing the cleaning of polluted localities and water flows, waste material and poisons dislocation as well as for scientific research from which directly usable and applicable results are expected.

Environmental safety care, in such a way, has not been only incorporated in institutionalized enforcement of law and regulations but it is also founded on direct interest of all participants who do their business activities and activities of economy.

5. ECOLOGICAL OPTIMIZATION

Ecological optimization of the existing production processes and production plants can give successful results if it is based on broadly organized and planned scientific, research and consultant work which should cover economy, science, consultant and engineering enterprises and companies. Activities organized in such a way should issue the following results:

Optimization of basic technological processes in the aim of improvement of their selectivity and efficiency, better usage of raw material and energy, decrease of pollution creation and emission and waste material creation, also improvement of better working conditions.

Development of technological processes in the aim of fulfillment of conditions for recycling of waste water flows and their repeated usage in production processes.

Development of technological possibilities for usage of waste materials for other useful purposes.

Development of methods and equipment for efficient and permanent control of environmental state, especially in closer and further environment as well as potential sources of pollution.

Development of productive adequate processing equipment for purification of waste materials flows.

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KOORDINACIJA IZMEĐU EKOLOGIJE I EKONOMIJE ZA BOLJE SUTRA

Vidoje Stefanović

U radu je učinjen pokušaj sučeljavanja ekologije i ekonomije čiji bi rezultat bio bolje sutra. Sva dešavanja u životnoj sredini se tiču ljudskog bitisanja. I zato savremena ekonomska teorija nastoji da odgonetne koja je cena ekološke optimizacije. Posebno su interesantna učenja ekološke ekonomije, prostorne ekonomije, ekonomike resursa, ekonomike zaštite životne sredine i dr. Model ekološke optimizacije je ekološki pristup savremenom tehnološkom razvoju.

Ključne reči: *ekonomija, ekologija, životna sredina, ekološka optimizacija, ekonomske teorije*