NATURAL RESOURCES AVAILABILITY IN A SUSTAINABLE ECONOMY

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Abstract
In the theoretical and practical approach of the economic life, appears more often the idea of sustainable economic development, of reconciliation between man and nature in attracting and using its resources without interfering in its natural movement and evolution.
In this paper we are trying to bring to light the relation between the economic development and the mineral resources, in terms of achieving sustainable development. The place and role of natural factors in the market economy is revealed by bringing to the forefront a number of arguments that demonstrate their vital position in the sustainable growth and development.

Keywords: *mineral resources, natural environment, economic growth, environmental protection, eco-development*

Introduction

When the relations "natural resources – raw materials" and "energy – final products" are considered, we must also take into account the possibility of replacing certain raw materials, because some natural resources become deficient or depleting at some point. Technically speaking, raw materials are interchangeable but, from the economic point of view, the substitution is limited at the level of unitary production costs. Thus, as long as these expenses are under the marginal cost of extraction, preparation and processing of a particular material, its substitution with a new raw material is considered profitable. For these reasons, we consider that in approaching the economic management system of natural resources we have to take into account some peculiarities determined by: the type of resource, the type of ownership on the soil and subsoil, the pricing methods, as well as of the relation between the development of industries consumers of natural resources and the environmental protection policies.

In terms of the degree of depletion of deposits, natural resources can be divided into three categories: renewable, permanent and nonrenewable. Therefore, vegetables, livestock and the biomass resources (generally, riches of the soil) are included in the renewable natural resources category, as they continuously reproduce, so a balance between production and consumption is established. Man can intervene in the processes of production and consumption of renewable resources in order to change their status. In the permanent resources category (solar energy, rain and running waters) are included those whose conversion cycle is the same, man not being able to fundamentally change it. In the specialized literature, permanent resources are mostly included in the renewable category.

Nonrenewable resources are, generally, the minerals, whose formation lasted millions of years. Therefore, geological reserves of natural resources appear as finite, and their exploitation and consumption lead to the depletion of deposits.

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This delimitation of natural resources brings a distinct policy of economic management and financing of the exploitation activities by type of resource. For example, in the case of mineral resources, which are exhaustible, it is implemented an efficiency directed exploitation and usage policy. In fact, exploitation of mineral deposits must be made within certain economic and technical limits, so as to ensure the necessary mineral resources for future generations. In the same time, there are certain renewable resources whose regeneration stretches over 2-3 generations, such as the forest resources. Replanting forests and growing trees up to the economic limit of exploitation lasts between 50 and 100 years, which also requires a rational economic management policy on these resources.

Implementing a system of economic management also depends on the type of ownership on the soil and subsoil richness. In Romania, both mineral deposits (subsoil richness) as well as most of the forests are State's property, which imply appropriate organizational systems and international circuits for the management of these resources in the market economy conditions.

A special element in the economic management system of natural resources is the costs-prices relation, as well as the pricing methods for the products in mining, oil, gas, forest resources etc. In mining, as in forestry, there are major differences between the costs of production of the respective companies, because of the exploited deposits or the existing species of trees, as well as because of the conditions for obtaining the respective raw materials or energy resources. Depending on the market prices of raw materials or energy resources, companies may register profits or losses in relation to the costs incurred. In case of profit, companies may use a part of it for development, using, in this respect, a series of short, medium and long term strategies. In case of loss, according to their volume and the social utility of the respective natural resources, they may decide to close the company or to receive subsidies from the state up to a certain economic limit. The state intervention in the field of mineral resources exploitation is mandatory. The state, through its policies, may control both the mineral resources exploitation and the pollution arising from the exploitation activities.

The analysis of natural resources availability

By closely analyzing the results of specialized research we can assess that the earth curst encompasses, in absolute terms, practically inexhaustible resources of all metals and minerals necessary to human beings, although many of them are distributed evenly in the crust and are to be found in low concentrations. The necessary costs for mining the inferior deposits are surpassing their economic and social value and, therefore, under the current technology, these are not considered exploitable.

Anticipating future conditions is clearly arbitrary and subjective and therefore, the mineral richness of a certain region may vary widely from one evaluator to another. Therefore, it can be said that the mineral richness of an area or region cannot be expressed in absolute terms, but only in connection with a certain economic and technological situation, but it may be that in these circumstances there is plenty of room for error.

A country's mineral reserves include both the reserves known and declared by the companies and the estimates based on the best information available. The information obtained is related to the ore regions that, if not already exploited, at least have been prospected.

The concept of reserves is dynamic in essence. Therefore, the terms used to define mineral reserves, namely the quantity, type, concentration etc., must be regarded as variables that can change in time, together with technology and economic conditions.

There are few materials found in nature in a form man can use as such. In order to become materials, in most cases, natural resources have to undergo a certain physical or chemical processing, which requires an increase in prices.

This price rise shall be particularly due to the additional energy necessary for extraction and treatment of poor ores, as well as to the efforts to maintain satisfying ecological and geographic levels (envinronmental changes). These rises shall be partially balanced by a decrease in exploration expenditures, the practice of economies of scale, the technological improvement and the development of procedures for the recovery of all elements of real value from a certain resource. An important problem is the market imbalance which may come from the complex recovery of useful substances (POSTOLACHE T.,1987).

As national economies develop, their profile and structure does not longer depend exclusively on the endowment with natural production factors. The economy structure remains closely linked to its own energy basis and raw materials only as far as the national economy is at a relatively low level of development. The influence of technical progress on the economic structure, in particular on the industry, had led to weakening its ties with the energy basis and raw materials because:

a) the creation of new industries and diversification of production which encourages an increasing demand for high skilled labor and research had resulted in the reduction of natural resources consumption per unit of national income;

b) the development of foreign trade relations has triggered the payment in different currencies for the import of natural resources and the expansion of international cooperation through direct investments in production, as well as in energy and raw material research;

c) some raw materials and energy resources have been replaced by new ones (synthetic and artificial) or alternative resources have been used.

In the economic literature it was said that natural resources depletion is caused by the economic and demographic development. But the technical, economic and social progress leads to a wider nomenclature with new natural and artificial resources which may substitute the weak and exhausted ones. In fact, the technical progress simultaneously acts on the economic structure and on the specific consumption of resources, especially on those which are poor and expensive, making it possible to obtain increasing amounts of goods and services by improving the product performance and reducing the consumption per product unit or performance (W. Malenbaum, 1975).

In theory, the evaluation of natural assets is based on the development of an integrated model, essentially focused on extending the capital theory, and a social welfare theory in dynamic and uncertain conditions. From this perspective, *natural assets are known as capital goods, not produced by the economic system, but directly and indirectly influenced by the production and consumption conditions of economic goods within this system* (Amigues J.P., 1997). We are, therefore, talking about an explicit temporal approach and the introduction of uncertainty in the system, which gives it a double nature. On the one hand, uncertainty comes from not knowing if the potential ecosystems could maintain a certain amount of services to society, as well as their impact on the human activities. On the other hand, uncertainty depends on the dynamics of economy and society, the role of technological progress, the demographic evolution, the dynamics of production and consumption patterns, as well as on the special distribution of agricultural, industrial and population assets.

In purely economic language, the uncertainty is caused, primarily, by the "efficiency" and "dynamic" of accumulation and dispersion of natural assets, which revives the problem of "sustainability" of the economic development trajectories in interaction with the environment dynamics. Secondly, uncertainty also ponders on the criteria which have to be adapted in order to make sure the optimal decisions are taken when talking about the evolution of the relation economy-environment, which have to take into account the future generations.

In terms of applicability, the evaluation of natural assets encounters difficulties because of the studies regarding the physical impacts, certifications or social and political analysis, as well as the social perceptions and implications on the environment when talking about the behavior (actual or

simulated) of the economic agents. The physical impact tends to be confused with individual welfare, in general, measured in biological or physical constants in relation to the environment quality characteristics and with welfare in economic terms, which reflects the characteristics, life options and social situations of individuals, as well as the technical and economic rationales of industrial or agricultural production. As a matter of fact, it is again discussed the performance of surveys to guide the public choice in terms of environment. If the need for a scientific expertise is unquestionable, a minimum democratic requirement must take into account the public option with regard to the financial efforts to be made in order to improve environmental quality. Otherwise, countries will only measure social perception without acknowledging neither the actual behavior of individuals nor their attitude when making a choice, in sacrificing money or improving environmental quality.

Productive assets (mineral resources, forestry, arable land) are evaluated by rules similar to those of productive physical capitals, which allow the conversion of the service flow value generated by the value of available inventories. These flows may be spread over finite periods (the case of a mine, or all exhaustible resources) or infinite periods (for example, a forest continuously replanted, a cultivated and maintained soil etc.). When adopting general rules of evaluation the specific characteristics of each type of natural asset are taken into account. But, sometimes, these rules are not applicable if not verified the following hypothesis: the existence of a balanced capital market rationally anticipated by the economic agents. However, the evaluation of these assets is a very delicate operation, depending on the period of time considered, therefore also on the uncertainties affecting their use and value (for example, the long-term evolution of demand for raw materials, the exploration and discovery of new reserves, the evolution of production technologies and use) (Răducanu V., 2000).

The evaluation of the subsoil mineral assets was subject to many theoretical arguments for extending or restricting the introduction of mineral resources in the national wealth. Taking into account that the availability of mineral resources is dynamic (on the one hand, following the extension of geological research activities and the influence of technical progress on the level of demand for raw materials and energy and, on the other hand, due to the size of the exploitable reserves due to consumption) the problem regarding their introduction in the national wealth became more complicated. In general, economists interested in this area, converge towards two interpretations:

The first group considers it is necessary to make a distinction between the quantifiable elements, well known, of the national wealth and those that cannot be evaluated in a satisfying manner. This idea was promoted by A. Vincent and R. Neline (1965), who believed that national wealth is a theoretical concept and as such, it is necessary to distinguish between its quantifiable elements (such as the industrial exploitable reserves) and those that cannot be rigorously quantified (such as potential reserves).

The second group, supported by N. N. Constantinescu (1976), gives to the term national wealth both a theoretical and a practical meaning. Thus, are included in the national wealth, in addition to the exploitable reserves (which can be determined with certainty), also those reserves which have a low level of useful elements but which can be drawn in the economic circuit in the future. Therefore, it is considered that in the national wealth should be included both the exploitable reserves of mineral resources (known and rigorously determined) and the potential reserves which cannot be drawn into use and efficiently exploited with the existing technologies. The authors also emphasize the necessity of a periodical evaluation of national mineral resource potential because there are indissoluble links between the evolution of the production process and the volume of goods offered by nature.

The problem of introducing the mineral resources in the national wealth was subject to many studies in our country. Most authors have considered that the evaluation of mineral heritage has a practical importance for the measurement of the potential exploitable subsoil, in order to avoid waste in production and consumption, for their efficient exploitation etc. In order to introduce the mineral resources in the national wealth it was required to group the mineral resources, according to the possibility to attract them in the economic cycle, in three categories (Răducanu V., 2000):

1. useful mineral substances found in deposits;
2. useful mineral substances recoverable from deposits;
3. useful mineral substances capitalized as raw materials.

Such a classification of raw materials is particularly useful as it can highlight the share of national exploitable potential from the total mineral asset of the subsoil. In fact, knowing and evaluating the mineral potential offers the possibility to quantify the share of internal production to cover the necessary of energy and mineral resources.

Developing a methodology and a unitary statistical system of classification and quantitative and qualitative assessment of the mineral resources potential represented a complex issue that has been examined repeatedly by the UN Economic and Social Council. In developing this methodology, the recommendations made by F. Blondell and S. C. Lascky were taken into account (they were valued and supported even since 1956 by the International Committee of the Society of Economic Geologists). These recommendations underline the need to distinguish between the term "reserves" and the term "resources"[1], as well as the classifications made by other specialized bodies. Therefore, in terms of opportunities for exploitation, the European Commission classifies the resources in: exploitable, marginal, submarginal and latent (qualitative aspects). From the point of view of the degree of knowledge (quantitative aspects) there are: not estimated (unknown), presupposed, identified and measured. This classification takes into account that, when evaluating and defining reserves and resources, two factors have to be considered: the degree of geological safety regarding the industry's existence and extent (discovered and potential reserves) and the possibilities to recover the useful substances with the economic and technological conditions existing at a certain moment. These two factors are directly influenced by the technological level existent at a certain moment in the mining industry.

Mc. Kelvey made another distinction between reserves and resources, applied to fossil fuels (Mc. Kelvey V.F., 1978). Thus, the reserves are economically identified deposits and resources include other than reserves also the sub-economic or undiscovered deposits. According to Mc. Kelvey, a high degree of geological certainty leads to the identification of new geological reserves and a known economic feasibility degree leads to the growth of industrial exploitable reserves.

It should be noted that in the picture made by Mc. Kelvey resources are listed in columns according to the degree of knowledge, and in rows according to costs. Even though this classification differs according to the geological and mining peculiarities of minerals, we could make a simplified diagram in order to notice the distinction between the different types of resources (Fig. 1), whose evolution is determined by:

[1] The term "reserves" is limited to the mineral substances estimated and considered exploitable from the teorethical and economic point of view and the term "resources" are the "reserves" plus all the substances that may become exploitable (See: F. Blondell, S. C. Lasky, Mineral reserves and Mineral Resources, Economic Geology 51 (7), 1956; D. Gabor, V. Colombo, A. King, R. Galli. "Sa iesim din epoca risipei, Ed. Politica, 1983).

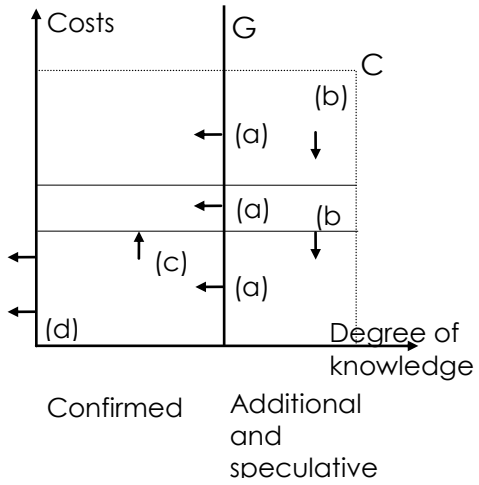

Fig.1: The simplified diagram for the classification of mineral resources according to Mc. Kelvey.

- the growth in volume of confirmed resources following activities of attraction in the economic circuit (arrow "a") of certain deposits;

- shift of some resources from the "high cost" category to "low cost" category following the introduction of new methods of extraction (arrow "b");

- the shift of some deposits from the "reserve" category in the "resources" category due to lower efficiency and higher costs of extraction (arrow "c");

- increase in resource consumption (arrow "d").

It should be noted that the dynamics marked by arrows a, b and c modify only the distribution of resources among the different categories, their total volume remains constant, while those marked by arrow d reduce their volume.

Theoretically, the horizontal lines according to cost may be succeeded infinitely. Practically, these stop at a certain level (line of points c) from where exploitation, even in a distant future, is not profitable. Therefore, the vertical line "G", which marks the evolution according to the degree of knowledge, may have the "O" value, but practically, the process of mineral resources evaluation does not reach this point.

The distinction between "reserves" and "resources" according to the level of production depend also on the mineral resources market, which determines the limit fixing the boundary between these two concepts. As rich deposits deplete, this limit will rise due to increasing level of marginal costs influencing the resources trading prices. Such a movement of the cost limit is stopped by the appearance of certain factors that reduce marginal costs (especially those related to technical progress) (Răducanu V., Bulearca M, and others, 1997).

This methodology was implemented also by the US Bureau of Mines which sorted the mineral resources both in terms of knowledge development (identified and undiscovered) and that of development of profitability level (economic and sub-economic).

Regarding the classification of geological reserves into deposit groups and categories, the specialized literature considers that certain criteria of classification have to be taken into account, among the most important are: knowledge of reserves from the quantitative, qualitative and deposits conditions point of view; the technical and economic exploitation possibilities of the respective deposits; the medium or minimum content of useful substances in the extractible mining gross mass; the existence of natural energy in the case of hydrocarbon deposits etc.

The adoption of these principles led to the development in various countries, including Romania, of similar classifications, which facilitated data comparisons. However, in terms of terminology and parameters used in setting up the categories or classes of reserves these classifications still differ.

Taking into account all recommendations and classifications used, since with the sixth session of the Committee on Natural Resources, held in Ankara in 1979 under the aegis of ECOSOC, was adopted an international classification of mineral resources which attempted to unify all methods of quantitative evaluation of potential mineral resources (in compliance with the essential condition that these principles are compatible with those of the national classifications).

Recently, it has been tried to develop a new methodology to allow the equalization in exploitable reserves of those resources belonging to different categories and groups in order to obtain a full picture of the entire national heritage. Such an activity is extremely important because the evaluation of mineral resources in natural-conventional units (equivalent) allows a better understanding of the potential of different mineral substances by using an equivalent unit (for example: tcc, Kcal or joule for energy).

Problems concerning the environment and the mineral resources

In the context of economic growth, sustainable development, economic and environmental progress, natural resources and environmental protection are having a strong impact on redefining and determining their real content. In the economic literature there are new terms like: ecotechnics, eco-development, ecological progress, ecological growth etc., which express the evolution of economic phenomena and processes due to the human impact on the environment and the restrictions in the natural resources field (FROGER G.1997).

Intense exploitations of natural resources of raw materials and energy have maintained an unsustainable economic growth, leading to an increasing economic gap between the developed and the developing economies. The human impact on nature increased, nature being the main source of natural resources (mineral and organic) and in the same time the main industrial and household waste receptor. The limited absorption capacity of these residues and the low capacity of the natural factors to self-healing were shaken for long periods of time.

In the relations between man and nature the social-economic system proved to be very important. Thus, the desire for profit and the tendency to avoid external costs by not considering the total effect of the economic activity gave the impression of movement in an infinite space, with "free and unlimited" natural assets. The market mechanisms had proved to be unable to prevent this exploitation and degradation of natural environment, causing serious ecological imbalances. This type of economic growth, especially in the developed countries does no longer meet the current conditions, a new vision on the growth model is required, which must take into account a series of restrictions regarding the natural resources and the environmental quality.

Today, the problems on natural environment and natural resources have become increasingly complex. It is therefore necessary: (a) a thorough knowledge of the natural environment and the interactions between the social-economic system and the natural systems; (b) a rational and economical use of natural resources, avoiding waste and disorder in their management; (c) preventing and combating serious environmental degradation caused both my man and nature; (d) harmonize the immediate interests with the long term and permanent interests of the human society in the use of natural environmental factors: air, water, soil, subsoil, flora, fauna, nature reserves, monuments of nature, landscapes. By discussing these issues we can discover a series of consequences regarding the efficiency criteria of modern economic growth and sustainable development.

Modern concepts, that support sustainable development, start reconsidering the human role not only in the economic system of market economy, but also in the social, spiritual, moral space. It can be noted the international and national institutions concern for maintaining a natural environment capable of efficiently capitalize the human physical and intellectual capacity. For Romania, which goes through profound changes towards a market economy, a problem of vital importance is the protection of natural environment. It is also important to learn and promote new conceptions on the relation man-nature, meaning that man is part of nature and cannot live but in harmony with it, for his own good and for the whole community.

The rational and economical use of natural resources leads to obtaining from the same amount of raw material and energy a larger amount of utilities or added value due to the amplification of work in their processing. The process of rationalizing and saving resources is complex and requires knowledge of all factors influencing it. This leads to less pressure on the natural environment, the

rational conservation and use of nature. In this respect, it is necessary to reduce the energy intensity of certain products, to attract and seize all relevant components of deposits, to set aside the way too selective character of processing technologies (by creating integrative technologies), to recover and recycle materials after they are no longer used, to recycle waste and industrial waste.

The problem of economic growth under the environmental protection conditions has at least two aspects. First is the incompatibility of economic growth with natural environment disorder and second the efficiency criteria of economic growth in contemporary conditions.

1. The increase of national income and gross domestic product per capita implies attracting in the economic circuit both the natural resources of raw materials and energy and their superior capitalization. Their selective use requires more energy and causes waste of raw materials. Basically, the relation between the mass of natural resource extracted and the finite product decreases in direct proportion with the increase in processing steps. Contrary to this trend, recovery and recycling reduces this waste, but differently from one economy to another, depending on the existing industrial structure, their degree of technicality and economy.

The economic growth was realized so far as a "polluting" growth based on the idea of obtaining maximum profit and ignoring the external costs of development. Some economists consider that the economic growth cannot avoid pollution, their removal meaning an arrest in the economic growth, solution mirrored in "Limits of Growth" with the famous theory "zero growth." Economic growth and sustainable development should not be opposed to environment, but adapted to the laws of nature, of natural ecosystems. Therefore, ensuring an ecological balance requires particular attention from society, effective actions to protect the environment, to prevent and combat environmental degradations, of rationally using natural resources.

2. The economic growth in the modern market economy is efficient when the optimum economic-social-ecological relation is fulfilled. This includes: maximizing the efficient use of key resources for the society; allocating these resources based on the market mechanisms; maximizing material and spiritual welfare by making consumption more diversified and efficient; maintaining ecological balance. These criteria of the optimum economic-social-ecologic must be completed by new criteria which come from the necessity for economic growth in the context of environmental protection. Such criteria may be: a) minimizing the natural resources incorporated into products or per unit of national product and national income; b) appropriate conservation of natural resources; c) full capitalization of material substance and energy by designing and introducing technologies in steps; d) production and products energy intensity criterion (energy intensity – essential condition of economic efficiency); e) recycling and recovering after consumption; f) the biodegradation and integration in the natural circuits of goods entered in the natural environment; g) minimizing costs imposed by using non-polluting technologies; h) rational consumption of goods and services per inhabitant; i) environmental responsibility in all productive and non-productive areas.

a) *The criterion of minimizing the amount of natural resources per product* favors growth by maintaining the average annual growth rate, in terms of restructuring, modernization and improvement of technology by stimulating activities which bring about technical progress. The difficulties in accessing the raw materials and energy make this criterion a very important one. Along with this criterion we can find the qualitative and quantitative restrictions, the economic efficiency of attracting and using natural resources. Generally, attracting resources occurs in the decreasing order of their effectiveness and therefore the same amount of utilities is obtained by using a bigger volume of production factors.

b) *The criterion of appropriate conservation of natural resources* starts from the fact that social production takes place in a finite environment with renewable and non-renewable resources, which must satisfy not only the immediate requirements of the present generation, but also the needs of future generations. From this point of view, it is necessary to reduce material consumption and reallocation of natural resources used for military purposes by orientating them towards peaceful activities. Maintaining economic growth, without worsening working conditions, involves

rebalancing the relation between the amount extracted from nature and the amount included in the goods produced at various stages of processing.

c) *The criterion on the full capitalization of material substance and energy* starts from the principle of conservation of matter and energy. Based on this criterion it is made the transition from linear production processes to active loop system production processes.

d) *The criterion on the energy efficiency national production* expressed by the indicator "energy consumption/social product or national income" which measures how many energy units are used to obtain a unit of national product or national income. For physical products it is necessary to specify the energy efficiency by degrees of intensity. In the economic literature in our country, it was expressed the need to determine the cumulative energy consumption in value and physical units (t.c.c.).

e) *The criterion of post consumption recycling and recovering* aims to anticipate the recovery of useful material from the physical body of material goods after their removal from production, both as inputs and consumer goods. This involves maintaining the quality of economic goods with low and very low value – likely to be attracted in a given time horizon – and after expressing the duration of use to be considered as "stocks of raw materials in the recycling process."

f) In order to maintain the quality of the natural environment, by avoiding the risk of pollution, *the biodegradation criterion* takes into account the decomposition of materials without any harmful effects to nature. "Biodegradation is the decomposition process of certain elements, objects or organic bodies in nature under the action of living organisms and especially of "microorganisms." By the action of biodegradation the decomposing microorganisms help reintegrate into nature all organic compounds. Therefore, the capitalization in steps of natural resources, ensuring the return and reintegration of waste in nature, justifies the promotion of eco-technics and economic eco-growth.

g) *The criterion of minimizing the anti-pollution costs* is verified by the curve of total savings resulting from the anti-pollution activity. This curve has a rapid growth up to a certain point where growth is slowed (Fig.2.).

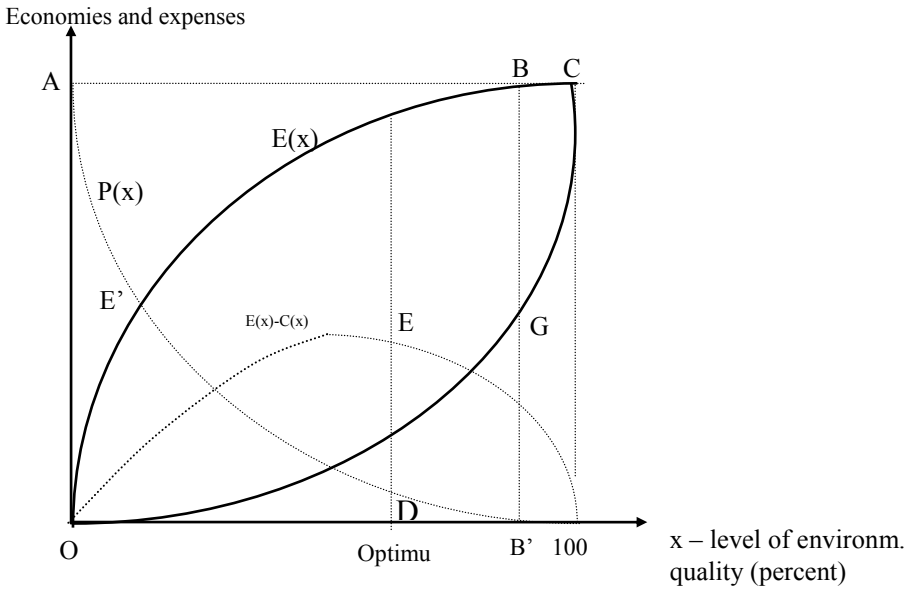

Fig. 2. The evolution of costs for anti-pollution actions C(x), the total savings resulting from the anti-pollution activity E(x) and the damage produced by pollution P(x) according to the level of environment quality (x)

The inside region bounded by curves C(x) and E(x) represents an area of environmental quality where saving are greater than anti-pollution costs. In practice, removing pollutants and waste should be made up to the point B, because this marks the disappearance of economic and social damage caused by pollution. The optimal level, minimal level, where these expenses have maximum effects is achieved on top of the graph representing the differences between E(x)-C(x). In other words, in point D on the Ox axis it is achieved the optimal level of environmental quality; in point E the minimum level, optimal level, of anti-pollution costs; and in point F the maximum level of savings and benefits as a result of the implementation of anti-pollution measures.

The problem of optimizing the anti-pollution costs arises especially since they appear as production costs, included in the company's costs.

Starting from the fact that these expenses are necessary, the company must determine their optimal level compared with the saving and benefits achieved by each pollutant unit.

From the figure result the main functions that define the actions taken in combating environmental damage and the effects obtained. Here is their meaning:

C(x) - expenses for anti-pollution actions, depending on parameter X, which represents the level of environmental quality;

E(x) - total savings resulting from the anti-pollution actions, according to the same parameter x;

P(x)- economic and social damages caused by pollution, according to the same parameter x.

In determining the optimal level we have to start from the increasing values of x, which express a growing level of environmental quality. The anti-pollution expenses curve increases slowly at the beginning. These expenses shall influence the gross income (benefit) and hence the national income and price level. On the other hand their optimal determination is necessary because without any of these expenses the absolute growth of the national product and income cannot take place, because of the worsening environmental conditions.

h) *The criterion of material and social wealth*, under the modern economic growth conditions, means increasing the national income per capital and the amount of goods and services to satisfy their needs. However, under the environmental protection conditions, the need to preserve and improve environmental factors has to start with determining the consumption needs, their harmonization with the biological requirements of each individual. Material wealth is achieved in relation to the natural and human resources level and efficiency. When talking about rational consumption of goods and services per capita, economic growth efficiency may be achieved by switching from mono-energetic production to multi-energetic production, from the "dirty" (but still useful) fossil resources, to the clean ones. How do we exploit or preserve the resources available today, how energetic we develop our new technologies, how carefully we reduce their capacity to damage the environment, all these represent opportunities we leave to future generations. To make sure that the current aspirations will be met in the future, we have to limit the range of actions allowed today. Giving up on the tendency to shorten a product's life and to acquire personal goods, over the real needs, are basic requirements for the conservation of natural resources. Economic growth, under the conditions of environmental protection, is marked by the society's efforts to avoid the degradation of nature. Together with the economic growth there is a tendency of increasing external costs to be born, primarily, by those who caused the environment degradation. It is clear that money have to be spent in order to maintain the environment unaltered.

i) The social and economic implications of the exploitation of nature are not sufficiently understood by all participants in the economic life. One or another criteria mentioned above is being generalized, or any change is judged by the immediate pecuniary effects. "Taking into account this insufficient knowledge, anyone taking any action which represents an investment in nature, no matter how minor it would seem at first sight, is bound to make a scientific analysis of all implications that might result from it."

Conclusions

Any decision should be based on ethics, environmental responsibility, which involves compliance with the rules of human coexistence with nature. These rules were formulated by Odum in 1971 and state that man is part of nature and any economic activity bears the seal of this relationship sine-qua-non. "Homo tehnicus" or "Homo economicus" should respect and implement the following rules, a true human-nature Decalogue:

- do not waste potential energy;
- know the exact elements on which our own system's survival depends;
- act so that everyone benefits as efficiently as possible from the energetic circuits of the system;
- highlight in your own work systems those parts to place you on the goods side of events;
- value the other forms of life in the environment, as it were your own life, because that is the only way to survive;
- judge any value by the energy needed to obtain and by the energy capable of accumulate, and the flow of energy do not turn it, any time it is possible, into money;
- do not use large amounts of energy because mistake, destruction, noise and excessive surveillance lead to waste;
- do not take anything from man and nature without offering them back a service of equal value;
- enrich your legacy of information, because by this unique and complex action the system shall justify what is immortal in it;
- have trust in the advantages of stability over growth, of organization over competition, of diversification over uniformity, or system over parts and of general survival process of humankind over personal peace.

We believe that in terms of a sustainable development the criteria of measuring the efficiency of economic growth could be more, but in this paper we referred only to the most important ones.

It should be noted that these criteria converge towards a common goal: the satisfaction of human welfare. This gives a human meaning to growth which cannot take place, whatever the system, without a rational use of natural and human resources, without maintaining a natural environment proper for life on earth.

We consider necessary to mention that, under the economic development conditions, the natural environment becomes environment prepared for the economic activities of protection, defense, preservation and improvement. Environment appears both as premise for development and the materialized effect of our efforts to attract it and transform it in a man-made environment. From this point of view, we consider complete and full of meaning the definition given by academician N. N. Constantinescu to the environment "the environment itself is defined by understanding man as part of nature and purpose for the general development; he represents all natural factors and those created at a certain time and in a certain place, influencing the ecological balance, determining the life and work conditions of man and the social development prospects." From here results a new concept regarding the position of man towards nature, towards its wealth. The demiurgic, almighty, victorious in the "fight" with nature position is excluded. Environment is an economic factor of utmost importance, traditionally considered production factor, along with capital and labor. It is also interesting the definition of environment given by prof. Gonzague Pillet, from the University of Freibourg, Switzerland, who considers that "the environment or environmental resource is any function assigned or obtained from an ecosystem or produced by it." We note, in particular, the point of view according to which the environment becomes economic resource of the ecosystem as it attains certain functions in the benefit of man. But the environment cannot be limited only to the function of provider of resources and recreational services; it provides, first of all, the greatest service to humanity: the maintenance of life on earth, basis for life and economic activities.

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