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BIOSPHERE AND HUMANKIND IN THE XX CENTURY

БИОСФЕРА И ЧОВЕЧАНСТВО У XX ВЕКУ

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Сажетак

У последњих 100 година на Земљи су се десиле велике промене. Број људи повећао се за четири пута, у исто време потрошња енергије је порасла за 10 пута, док је укупна производња већа за 17,6, а минерална производња већа је за 29 пута. Од досадашње минералне производње, око 85% је произведено у XX веку. Укупна количина енергије коришћене у XX веку је 3-4 пута мања од енергије сунца која доспе у горњи део атмосфере.

Данас је око 1/4 земљишта под агроценозама и травама, а 3/4 земљишта се не обрађује или је пусто или под ледом. Светски рибљи фонд такође је ограничен. Климатске промене на Земљи, поспешују природне катастрофе, повећавају штете и доводе до нестајања бројних врста. Даљи убрзани пораст броја људи на Земљи, често неконтролисани раст привредне производње, коју прате бројне негативности, уз досадашњи углавном неодговоран однос човека према околини, проузроковаће бројне негативности у биосфери.

Кључне речи: *Човек - биосефера у XX веку*

Summary

For the last 100 years humankind has increased in numbers in 4 times, energy consumption – in 10 times, total product – in 17,6 times, mineral resources – in 29 times. About 85% of all mineral resources that humans used throughout their history was extracted during XXth century. The total amount of used energy at the end of a century is only 3-4 orders of magnitude lower than solar energy entering the upper atmosphere. At present, ¼ of all land is occupied with agrocoenoses and pastures and ¾ of the land not covered by ice turns out to be directly utilized. The world catch of fish has reached its theoretical limits. Changes in global climate of the Earth, intensifying the natural disas-

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ters, increasing damages and leading to extinction of many species, are clearly visible. The humans will double in size in XXIth century. Will biosphere withstand such load?
Key words: *humankind - biosphere in the XX century*

For the last 100 years humans in general have improved their life conditions. Scientific and technological advances have improved the work performance in many times and facilitated the lives of many millions of people. Mechanization, electrification, advances in chemical science and information breakthroughs became part of life of every human being in rich countries.

The World Community has started to help countries, that suffered from natural disasters – droughts, floods, earthquakes, fires. But even at ordinary periods, the World Community has provided significant food and medical help to poor countries. Such help decreased infant mortality and increased life expectancy in developing countries. Potent medications, aimed against inflammatory diseases (sulfamid medications, antibiotics) and a new vaccines aimed against infectious diseases were developed in the first half of this century. The natural spreading places of plague, malaria and other diseases, transferred by animals, were eliminated in many areas.

With improving conditions, the birthrate, that was traditionally high in agricultural areas and particular countries, has not started to immediately decrease. The experience of many generations that practiced farming has maintained that large families are more stronger than those with few people. The success of simple farming labor mostly depends on the amount of workers. Even children were working starting the early age. The severe life conditions and epidemics were the cause for ubiquitous high mortality – common for primitive life style. The improvement of life conditions during XIX-XXth centuries, decreased the mortality, but could not immediately change the established attitudes.

Only decrease in the proportion of rural population with growing urbanization leads to changes in family composition. The amount of people in a family is not that important while living n urban conditions, comparing to life in a rural areas. At the same time, the unit cost of having a child in an urban family is increasing. The abolition of patriarchal society, a decrease in family size, increased individuality and mobility become an inevitable consequences of urban life style. A "demographic transition" from many-child large family, involved in a family business, to few-child family, with all members being relatively independent from each other, is occurring. A decrease in the birth-rate is the expected consequence of urbanization and changes in life style of country's population. In large cities, population growth is mainly occurring due to immigration from other areas.

Since the decrease in birth rate lags behind decrease in mortality, the Earth's population has experienced a real "demographic explosion" which, predictably started in XVIII century, should come to an end during XXI century.

With world population increasing, rich countries getting richer and modest, but ubiquitous increase in the income of poor people, the consumption rate has increased in dozens times. With Earth's population increasing in size less than 4 times for the last 100 years, the total product produced by humans has increased in 17,6 times, and the total use of mineral resources during for the 95 years (from 1900) has increased even more – in 29 times. The overall usage of energy of all kinds (with oil equivalent) has increased in 10 times during XX century.

The majority of Earth's population, located in China, India and other developing countries is reasonably claiming the rights for benefits of modern civilization. These people want to live in modern houses, have a better meals, cars and better health care. Economics globalization leads to creation of more works, construction of factories in any country with sufficiently qualified and unassuming workers. This means, that the use of natural resources and accompanying energy use will continue their increase even

faster, than the increase in Earth's population. With population size doubling in size during 1990 – 2050, the income per capita will increase in 2,4 times based on estimations of UNO's experts, energy use – in 2,6 times, water use – in 1,5 times. The total product of the world should increase in 4,5 times during this period.

The complex impact of humankind onto the biosphere increases much faster than world's population. Because of that, with subsequent doubling of Earth's population the biosphere load will increase immensely.

Almost all XX century can be described by the dynamics of extensive development: the increase in energy production, production of steel, aluminum, fertilizers, pesticides, cars, transport highways etc.

The revolutionary changes in the strategy of economic development have occurred only in the last quarter of XXth century. The increase in oil prices by OPEC countries, forced major consumers – USA, Japan and western European countries to urgently develop new technologies for energy savings.

During almost ten years the world community continued its development without the accompanying energy costs. This example shook up seemingly unchangeable dogma on faster required rate of energy production to supply the stable economy. Since that time, the future development of humankind is related to the rate of scientific and technological advances, aimed at final product obtained with less and less resources.

However, when the price for oil in the world market began to fall during 80-s, the increase in energy use by humankind became obvious again, with hi-tech energy saving methods becoming unprofitable. Possibly, in conditions of market economy the increase in prices for raw materials facilitates the technological advances and rational economy with limited resources. The poor countries, not having their own valuable mineral resources, do suffer because of that, however.

On the negative side of the extensive development lies the environmental pollution. Humans never previously pondered about the fate of its wastes and thus, never planned the closed cycle technologies. The nature itself disposed the straw, wood, animal corpses. Everything, that withstood the chemical changes, was just buried in soil or mud. Comparing to substance circling in the biosphere, the human wastes remained insignificant in quantities for a long time. However, multifold increase in industrial and agricultural manufactures during XXth century, led to pollution of water, air and soil at greater scales. With limited size of our planet, that is currently almost completely populated, the people should utilize their wastes for themselves, and do it in such a way, not to inflict a biosphere damage.

The XXth century has started with ambitious plans to conquer the nature, which resources were mainly seen as unlimited, but not always within the easy reach. During life of several generations it turned out, that the ranges of "Oikumena" are not only reached, but all best areas are populated, the resources are not that plentiful as was previously thought and reconstruction of nature itself is often threatens with severe consequences.

The economy improvement during the after-war years (1950–1960) became the cause for fast deterioration of the environment, forcing people to ponder about imminent future of civilization, about depletion of mineral resources and about disastrous consequences of biosphere pollution. Due to great joint investigations of life on Earth during International Biological Program (1964-1974) by scientists from more than 100 countries, the fundamental data were obtained. These data forced people to seriously think about the stable limits not for particular ecosystems, but for biosphere in general.

Based on strictly utilitarian points of view, it can be considered, that humans depend on state of the biosphere just by several parameters and first of all, by : 1) availability of food, 2) availability of energy and mineral resources, 3) stability of global climate.

The food supply still depends on productivity of ecosystems. In theory, the total annual production of biosphere (dry weight) is about $14x10^{10}$ tons, and the production of all fields and pastures is about

$2{,}8 \times 10^{10}$ tons. All humans at present consume directly and indirectly about 2×10^{9} tons of grain per year (wet weight).

At present, all agricultural areas of humankind occupy 37% of all land, with fields and pastures occupying 28 %. This area covers $4{,}1 \times 10^{9}$ hectares. The proportion of woods is nor more than 31 % of all land and the remaining land (about 32%) is mainly of low productivity. Bearing this in mind, the warnings of the ecologists regarding continuing demolition of woods become clear. However, human population should double in size in the next 50 years. Would it be possible to supply everyone with food? This question is not trivial, if one considers that at present at least 1 billion of people are constantly underfed. It can be expected, that more and more poor countries will have the opportunity to modernize their agriculture and approach the productivity of land areas found in developed countries. However, these optimistic expectations will not solve the problem of food supply for population of more than 10 billions. Thus, the gap in food content of rich and poor countries will also be retained in the future. The food is obtained in abundance in rich countries, which partially export it to other regions, donate its small part as a humanitarian aid and sometimes, just destroy the food excess, as happening in Europe due to cattle epidemics. Poor countries are able to feed their people mainly with vegetative food – rice, maize, potato.

The prospects for huge food resources of the World ocean, which were considered to be proportional to area covered, turned out to be false. By expert's estimations, the allowable annual catch of fish in the World ocean, considering its importance in the food chains, should not exceed 90 mln. tons, which is more than 2 times lower than the production of animal proteins in agricultural manufactories on land. By the present time, fish resources of the World ocean are used practically in full. The further increase in catch threatens to destroy stocks of main fishery species.

We see, that humankind has reached the biosphere's capacity to supply people with desirable food ratio. The vast agriculture turns out to be the worst enemy of natural ecosystems. Trying to solve the nutritional problems, humans impose greater impact to nature, decrease areas occupied by natural ecosystems, thus indirectly destroying numerous species and disturbing the natural processes of self-regulation of biosphere stability. Estimating the available area and productivity of agrocoenoses, we should admit, that artificial ecosystems become comparable by scale with natural ones even at present. Thus, the roles of agrocoenoses should be expanded considering not only the production of food, but also the conservation of biosphere regulatory functions.

The economic activity of humans in just one field – ore mining and construction materials – turns out to be only 1-2 order of magnitude lower than such significant natural processes, as export of terrigenous materials with rivers. At the same time, export of various materials from Earth's interior as a result of volcanic activity and seeping from mantle is estimated as 10 mln. tons per year, i.e. 2-3 orders of magnitude lower, than the materials extracted by people.

The comparison of anthropogenic and natural flows of energy provides similar results. At present, humans produce about $8{,}7 \times 10^{16}$ kkal/year by burning all kinds of fossil fuel, which is just 5000 times lower than the total amount of solar energy, entering the upper limit of the atmosphere per year - $4{,}2585 \times 10^{20}$ kkal/year. For the last 1000 years the energy consumption by humans has increased in 10 times. Thus, if the current rate of energy usage persist, it will be a short time before we reach the amount of solar energy, currently obtained by Earth, and which governs the most vital biosphere processes.

A decrease in biological diversity along with increasing domineering role of just one species - *Homo sapience* – will lead to disturbance in fundamental process of self-regulation in the biosphere. The integrity of ecosystems is the result of long-term adaptation of various communities to living with relatively stable (or predictably changing annually) environmental conditions. The ecosystem integrity is expressed most of all not in counteraction with deviating external influences, but in preservation of a dynamic equilibrium (its own structure and pattern of functioning) with stable external conditions.

Non-pronounced self-destruction is the main feature of stability of ecosystems and the biosphere. On of the important mechanisms of such stability is a backup, interchangeability and restriction of domineering role of a particular parts of the whole.

The measures taken yet do not allow to cope with a dangerous trend of nature destruction. The concentration of greenhouse gases still increases in atmosphere, threatening way too fast changes in climate. Areas, occupied by natural ecosystems, including such valuable ones as tropical rain forests, are shrinking, which leads to extinction of numerous rare species. The first evidence of degradation on vast areas of the most productive aquatic ecosystems – coral reefs, has also appeared.

However, one can't deny the obvious thing, that humans went through impressive way of development – from just taking nature resources and senseless destruction of the biosphere to purposeful changes in its stereotypes, admittance of need to preserve the biosphere resources for coming generations, gradual transition to thoughtful self-restriction of its needs, cooperating efforts in generous goal to find a way out of ecological crisis without hurting particular countries and social groups. The fact, that the results often do not match the spent efforts should not embarrass and terrify people. The enormous energy and intellectual potential of the modern humankind is not only the possible cause for hypothesized de-stabilization of biosphere processes, but also is half the battle on the way for finding the solution for energy crisis.

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