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Rational Use of Atmospheric Air as a Natural Resource

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Abstract: The basic requirements for use of atmospheric air have been formulated, as well as its main peculiarities and functions; a structure of use of atmospheric air has been proposed; the role of atmospheric air in biological and technological processes has been described.

Key words: atmospheric air, natural resource, rational management of natural resources

1. Introduction

Humans can impact nature by means of targeted and conscious utilization of components and forces of nature, in which natural substances are converted into the desired product. Thus, productive activity of people is targeted transformation of nature into the forms acceptable for human use. But indirect, random impact of humans on the natural systems is possible as well that cause enormous harm often. These include numerous human caused disasters, depletion of ozone layer etc.

Therefore under management of natural resource in the broad meaning both direct and indirect impact of humans on the environment that may be both conscious and spontaneous, targeted and random is meant.

This understanding about use of nature was formed by the late 1950-s. Initially, it was equated with use of resources, i.e., use of resources for economic ends. Further development of natural resources management proceeded historically from utilization of needed features on the natural resources towards their protection, and then to reproduction, and further, towards improvement and sophistication [1].

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Under management of natural resources in the broad meaning, use of natural environment for meeting ecological, economic, and cultural and recreational needs of the society [2]. Management of natural resources is normally divided into rational and not rational one.

At rational management of natural resources, the needs for material goods are met maximally while environmental balance and possibilities of restoration of natural resources potential. Search for such optimum of economic activities for the individual territories or sites is an important applied task for the science of management of natural resources. Achievement of such optimums is termed as sustainable development [3].

The purpose of the paper is covering the basic rules related to the rational use of various features and functions of atmospheric air (AA) as a natural resource.

2. Requirements for Management of AA Use

The management of AA use, in our opinion, must be based on the following premises. First, it is preservation of environmental security, i.e., preservation of human habitat and protection of natural diversity. Second, social and economic evaluation of a natural resource (NR), assuming, on the one hand, economic reasons of AA use for economic ends, on the other hand it is prevention of conflicts between

population and the user of natural resource. Third, legal framework, i.e., respect for all laws and other legal acts on AA, water and other natural media. Fourth, it is permanent monitoring of AA and its components' condition.

3. Main Peculiarities and Functions of AA

In the paper [4], the main peculiarities of the atmospheric air as a natural and environmental resource have been discussed: these are its complexity, multifunctionality, and variability of composition and features. Based on the sepeculiarities, classification of the atmospheric air functions dividing all the functions into two groups: raw material and not raw material, has been proposed. Within these groups, five classes of functions are isolated: landscape forming, (climatic) bioecological, social, chemical and technological, and energy. In turn, within these classes, functions have been detailed into 13 sub-classes.

4. Structure of AA Use

Let us consider the structure of rational use of AA as NR. In general, management of natural resources is utilization of the natural media resources for social spheres functioning, i.e., it acts as a channel of communication between these two mega systems (nature-society). Thus, management of natural resources envisages not only exploitation and transformation of natural resources for meeting material and spiritual needs of the society, but protection of the natural conditions of habitat. It should be born in mind, that the structural peculiarity of management of natural resources takes various forms depending on feature of the natural resource.

With regard of the atmospheric air given its peculiarities the functional structure of its rational use seems to us as the following hierarchical form. Under zero level, the resource itself should be understood, i.e., atmospheric air. The next level supposes control of rational use, which is systematic exercise of targeted impact of the society on AA taking into account its functional possibilities and securing its protection as a natural resource. Control is implemented through complex of legislative acts and directives, instructions etc. The next three levels are connected with use o primary functions of AA: the social, bioecological, raw material, and landscape forming ones.

As the atmosphere is lower order system in relation to nature (along with biosphere, hydrosphere, pedosphere, and lythosphere), on the second level, function that are not connected with society must manifest themselves. These include protective and productive functions, as well as functions securing vital activities of organisms. Those functions that condition some kinds of human economic, biologic, and social activities are related to the next, third level. And here, and it is the most important, human activities do not pollute the atmosphere that allows sustain quite certain quality of life. The quality of life may be characterized with number of criteria, in particular including bioclimatic indices, parameters or air cleanness etc.

And finally, the fourth level is formed of those types of human activities and services that directly connected with using AA as a raw material. These are, first to fall, processes connected with burning various types of fuel in transport, as well as in the thermal power plants. Just on this level, negative impact on atmosphere takes place by means of is pollution.

Control of the rational use of atmospheric air consists of development of a complex of air protection measures aimed at elimination of this impact of the higher levels of use. And the set of air protection measures that are part of nature protection problems must be multiscaled: from global to regional and even to microscale one, i.e., on the level of individual source.

5. Role of AA in Biological and Technological Processes

Life on the Earth is possible to the extent the Earth atmosphere exists, the gas shell protecting living

organisms from hazardous impact of cosmic radiation and sharp serge of temperature. All aerobic microbes breeze the atmosphere air. When importance needs to be emphasized the saying reads “needed as air”. While a man can live several weeks without food, several days without water, death of asphyxia follows in 4-5 minutes. The relatively stable composition of the atmospheric air is the most important for the living organisms. It contains nitrogen (N_2) 78.3%, oxygen (O_2)–20.95%, carbondioxide (CO_2)–0.03%, argon (Ar)–0.93% of the volume of dry air, some amount of other noble gases. Water vapour makes 3-4% of the total volume of air. The air composition is sustained through permanent processes: utilization of gases by living organisms and their discharge into atmosphere. During the recent years, certain change in nitrogen balance in the atmosphere takes place due to human economic activity. Nitrogen fixation and inclusion of nitrogen in complex chemical compounds in production of nitrogen fertilizers has increased. Its inflow into atmosphere decreases due to breach of soil generation processes in the large territories, for instance, in the Western Siberia. But due to enormous amount on nitrogen in atmosphere the problem of its balance is not as serious as that of oxygen and carbon dioxide. It is known that about 3.5-4 million years ago oxygen content in atmosphere was by thousand times lower than at present because there was no main producer of oxygen — green vegetation at that time. Life of living organisms is supported by the modern ration of oxygen and carbon dioxide in the atmosphere [5]. The natural processes of consumption of carbon dioxide and oxygen and their inflow into atmosphere are balanced. With development of industry and transportation, oxygen is used for the burning processes. Thus, 10 to 25% of the oxygen produced by the green vegetation is consumed now for burning of various kinds of fuel. Inflow of oxygen into atmosphere decreases due to reduction of the forest, savannah, and steppe areas and increasing of the desert territories. Number of the oxygen produces reduces in the water ecosystems as well due to pollution of the rivers, lakes, seas, and oceans. Researches think that in the nearest 150-180 year the amount of oxygen in atmosphere may shrink by 1/3 as compared to it modern content. Some increase of CO_2 in the atmosphere impacts positively on plans productivity. For instance, saturation of the green houses air with carbon dioxide increases yield of vegetables due to intensification of the photosynthesis processes. But the total increase of CO_2 content the atmosphere leads to the complex global phenomena. Carbondioxide passes easily short wave solar radiation but retains thermal rays outgoing from heated Earth surface. This effect was called green house effect. It is deemed that due to the green house effect the Earth temperature will increase by 1.5-4°C by 2050. Burning of fuel results in additional heating of the lower layers of atmosphere. It is especially remarkable in the territory of large cities, where the temperature of the central areas is by 2-4°C higher than annual average temperature for the area. Increase of annual average temperature of the lower layer of atmosphere is capable of causing melting of glaciers of Antarctica and Greenland, which will cause raise of the world ocean level, inundation of lower areas of continents, intensification of the tectonic processes, climate change. Dust and smoke pollution of the atmosphere yields opposite effect. The mechanical particles reflect the solar rays, increase the reflective capability (albedo) of the Earth and decrease its heating. Prevalence of these processes is capable of expansion of ice sheets on the poles, sharp cooling, and upcoming of ice-age. At present, the thermal balance of the Earth is under study in order to find the ways to control it. The atmosphere pollution may be natural and artificial (or man caused). Natural pollution of the atmosphere happens at eruption of volcanoes, wind erosion of rocks, dust storms, wild fire, and ejection of the salt crystals into atmosphere [6]. In normal conditions, the natural sources do not cause significant pollution of the atmosphere. Industrial, transportation, and household exhausts are the artificial sources of

pollution. The industrial enterprises act as the main suppliers of pollutions. They discharge unburned particles of fuel, dust, channel black, and ash into atmosphere. In the industrial areas, 1 ton of dust particles precipitate on 1 km^2 a day. The cement plants are the powerful suppliers of the finest dust into atmosphere. For a long time, the local pollutions of atmosphere used to be dissolved by clean air relatively fast. Dust, smoke, and gases used to be dissipated by the air flow and precipitate on earth with rain and snow, neutralized entering into reaction with natural compounds. Now, the volumes and speed of exhausts exceed capacity of nature for their dissolution and neutralization. Therefore, special measures needed for elimination of dangerous pollution of atmosphere. At present, the main efforts are aimed at prevention of pollutants exhaust into atmosphere. Operating and new enterprises are equipped dust collecting and gas cleaning equipment. About 3/4 of all exhausts are arrested this way. At present, the search for more sophisticated ways of their refining goes on. Another important direction: it is development and implementation of non-waste technologies, building of such industrial complexes that use all incoming raw material and any waste of enterprises. Zero waste technologies are valuable because of their similar to the processes going on in the biosphere, where there is no waste there as all the biological discharges are utilized by various sections of ecosystems. Closed cycles of air and water that exclude exhaust into environment may be examples of such technological processes. Due to up-to-date research, techniques have been developed and are being introduced into practice that diminish and prevent pollution from exhaust gases of vehicles. Partially, pollutions is decreased by installation of the filters and after-burning devices in the vehicle engines, excluding lead containing additives, organizing traffic in the streets without frequent change of engine operation mood. Replacement of internal combustion engines with different ones is radical solution of the problem of atmosphere pollution by motorcars. Models of gas turbine, rotor, solar, and other engines have been developed. Electro mobiles are the most promising type of vehicles. Today's models of that are not perfect yet: their speed is relatively low and running distance between charges is short that does not allow them to compete with the modern motorcars. In order to bring down the content of toxic substances in the exhaust gases of motorcars, some counties switch to new types of fuel instead of gasoline, for instance methane and alcohol. Planting of greenery in the cities and industrial centers is important for controlling the atmosphere pollution. The plants enrich the air with oxygen. Up to 72% of dust particles suspended in air and up to 60% of sulfur dioxide precipitate on trees and bushes. Therefore, there are by dozens times less dust in the city parks and gardens as compared to that in open streets and squares. Many species of trees emanate phytoncides — biologically active substances that kill bacteria. The green plants control the cities microclimate, absorb and lower the city noise [7].

6. Conclusion

Let us in conclusion to give a number of ideas on the results provided in the paper. They may be used to addressing the following problems:

- zoning of various manifestations of the AA as natural and ecological resource (bioclimate, recreation, wind power generation etc.) by physical and geographical and territorial and production indicia;
- development of economic mechanism of the AA evaluation as a whole and by components;
- development of automated system for complex evaluation of the AA condition with consideration of human-caused impact on the atmosphere.

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