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DIFFERENTIATION OF THE SUBJECTS OF PACIFIC RUSSIA IN TERMS OF ENVIRONMENTAL FRIENDLINESS OF INDUSTRIAL AND NATURAL RELATIONS

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Abstract. The purpose of this work is to assess the existing and possible nature management in the future and, as a result, the ecological state of the territory of Pacific Russia in order to adjust the prospects for further development. The result is the zoning of the territory according to the indicator of environmental friendliness of industrial and natural relations, which are essentially nature management. The paper analyzes the existing main types of economic activities in the context of the regions of Pacific Russia that determine the specifics of the region, systematizes the directions of their impact on the environment, as well as the consequences of these impacts. This study also takes into account the results of earlier calculations of the index of economic sufficiency of environmental protection activities and its dynamics. The analysis of the main investment projects

in the regions of Pacific Russia and the resulting differentiation of regions allows us to conclude that in three of the six regions, when implementing major projects that focus on extractive and manufacturing industries, technogenic impact and its consequences can significantly worsen the existing ecological and economic imbalance and the socio-economic situation in the regions (population outflow, pollution and environmental destruction, accumulation of solid waste, etc.). Since the main task of the formation, development and functioning of various territorial natural and economic systems is the balance of conflicting interests of the components of these systems, in which the equivalence of economic, environmental and social interests should be recognized, taking into account territorial features, the main problem is the coordination of conflicting requirements of different subsystems that make up them. The goals of an economic nature will probably remain leading for a long time, and the tasks of rational nature management will be subordinate, although important. Therefore, it becomes important and relevant to determine the existing ecological situation in order to choose the most balanced scenario for the further development of territories. The existing programs of socio-economic development of the regions of Pacific Russia should be adjusted in terms of economic feasibility and environmental conditionality.
Keywords: Pacific Russia, industrial and natural relations, environmental friendliness, economic sufficiency index, zoning

Introduction. In recent years, there has been a greater interest in the Far Eastern regions – part of the Pacific Russia. Mining is the main industry in the structure of industrial production in most regions of the Russian Far East (RFE), while manufacturing plays the key role only in the Primorsky and Khabarovsk Territories. Other important factors are the transport network, availability of communication systems and settlement types, which differ from region to region. Having analyzed the main statistical environmental and economic data, we

concluded that despite a visible increase in many economic indicators (the index of industrial production, including mining, manufacturing, investments in environmental protection, and the rational use of natural resources) in most regions, the indicators of the negative impact of economic activities on the environment are decreasing.

Obviously, the regions in the Russian Far East differ from each other. However, in general, all regions, except for the Primorsky Territory, demonstrated ecological and economic improvements. In the Primorsky Territory, there was an increase in the indicators of air pollution, discharge of polluted wastewater and forest fires, along with declining economic indices, which implies the remaining disproportion in the relationship between production and nature and inefficienct environmental protection in the region.

However, the ecological situation in the regions is not favorable, and this is due to the current economic structure, its impacts and consequences accumulated over the previous years.

To determine the most acceptable, economically and environmentally sound scenario, one should clearly examine both the current and possible environmental and economic situation during the implementation of the planned production. For this purpose, we zoned the territory of Pacific Russia.

Materials and Methods. In the course of the study, official statistical materials of Rosstat, literary scientific sources were used, and methods of statistical analysis and mapping were used to analyze the current situation. To obtain data for zoning the territory, the method of determining the coordinate (indicator) in the n-dimensional Euclidean space was used, which makes it possible to obtain an integral indicator (coordinate) from the n-th number of indicators measured in different units. It allows you to further track changes in the object under study as a whole, as well as its individual components, thus tracking which parameter influenced the change in the state of the object.

Research progress. The existing territorial and production structure and environmental protection activities underlie the effectiveness of the relationship between production and nature (which actually condition nature management). Production-natural relations (which essentially determine nature management), their rationality and efficiency are formed by the existing territorial-production structure and environmental activities. The territorial binding of these structures, which is the basis for human life, is complex, multilayered, multicomponent and differentiated both in terms of individual components and various intercomponent links [1]. These two components are the basis of the efficiency and rational use of natural resources and measures aimed at prevention and elimination of the negative industrial impact on the environment [2-4 end ett.]. In the Pacific Russia regions, the pollution of air and water resources is the main technogenic factor that determines the ecological situation and affects the living conditions of the people. The indicator of total pollution per person per year is one of the limitations on the operation of the enterprise with the largest impact or the entire economic structure of the territory, since it has negative environmental and social effects and badly affects people's health.

Environmental protection in these regions is extremely poor. Both the financing of the activities aimed at the reduction of the negative industrial impact on the environment and the costs of environmental protection (EP) or the rational use of natural resources remain stably low and insufficient. The real investment in environmental protection is disproportionately small compared to the economic optimum. This is also evidenced by the index of economic sufficiency of environmental protection (IES) [5].

Considering the prospects for the economic development of the Far East as part of the Pacific Russia, one can note the key role of the extractive industries, since the main projects are connected with the development of natural resources (the coastal zone and shelf). In addition to the current territorial and economic structures in the Pacific Russia regions, in the future, the government plans to

develop such economic activities as coal mining, power industry, mining and processing (MPPs and MMCs), metallurgy, ship repairing, tourism, gas production and processing (LNG), reconstruction of ports, building of new port stations and transshipment terminals, as well as tourism. Undoubtedly, such development can stimulate the economic recovery in the regions. At the same time, given the current environmental situation and the fact that there are almost no effective measures for environmental protection, rational use of natural resources, or preventive measures (for example, modern methods of cleaning, disposal, and reclamation), the ecological situation and the imbalance in the environmental and economic relations will worsen [2,3,6].

Table

Impacts and consequences of major economic activities in the Pacific Russia regions

Economic activities	Environmental impact	Consequences of the impact
Power lines	Deforestation; electrical pollution (due to an emerging electromagnetic field).	Disturbance of the terrain, changes in the habitat conditions and the well-being of wild animals and birds; deterioration of human health (cardiovascular and nervous disorders).
Oil and gas processing plants (factories, oil and gas pipelines, pumping stations, oil depots, oil loading terminals, etc.)	*Pipelines*: air pollution due to gas leakage through leaky connections or in case of gas pipeline ruptures, due to oil and oil products combustion, emergency situations or fires; mechanical and thermal destruction, soil pollution; reduction and destruction of forage resources, pollution, mechanical destruction of banks and river beds; oil and oil products leakage from tanks during accidents at underwater pipelines, during the construction of onshore and bottom trenches; deforestation; soil cutting. *Oil and gas processing plants*: soil pollution with oil and oil products; air pollution with hydrocarbons, carbon, sulfur, nitrogen, and benzopyrene; pollution of surface and ground waters with oil and oil products, chlorides, sulfites, phenols, suspended solids, salts of heavy metals, and nitrogen compounds.	Advancing erosion, ravines, thermokarst, deformation of river beds; decreasing biological productivity of soils and plants, destruction of cultivated crops, emergence of woodless landscapes; reduction and destruction of forage resources, limited migration of wild animals; deteriorating water quality and living conditions of aquatic organisms and plants, accelerated river bed evolution; destruction of soil and vegetation; increasing emergency risks; higher morbidity rate.
Ore mining	Soil disturbance (during the development and creation of tailing dumps); pollution of soils, surface water bodies and groundwater at the development site and in the area of tailing dumps with heavy metals, arsenic, zinc, lead, cadmium, copper, products of chemicals used, and operating equipment; air pollution with nitrogen oxides, soot, benzopyrene, and kerosene; noise impact on ecosystems; storage of hazardous waste of any type.	Formation of cavities due to natural agents oxidation, release of rock pressure inside the high-stress massif, formation of ground sinkholes on the day surface; more active soil erosion, destruction or disturbance of soil and vegetation, misbalance of primary natural conditions of the environment; increasing concentration of heavy metals and arsenic that exceeds hygienic standards in crop and livestock products; increased dusting of the atmosphere with stored waste (tailings); higher morbidity rate; the formation of technogenic landscapes over large territories (dumps and tailings); flooding or drainage of the area, changing plant aggregations; changes in animal migration routes; changes in snow accumulation conditions; decreasing agricultural lands; reduction in hunting, fishing, fish resources, and wild plants.
Mining and metallurgical, mining and chemical, mining and processing plants	Contamination of soils, water in open reservoirs, and groundwater with heavy metals, arsenic, zinc, lead, cadmium, copper, products of the used reagents, and operating equipment; air pollution with nitrogen oxides, soot, benzopyrene, and kerosene; noise impact on biosystems; storage of hazardous waste of all classes.	Formation of cavities due to natural agents oxidation, release of rock pressure inside the high-stress massif, the formation of ground sinkholes on the day surface; more active soil erosion, destruction or disturbance of soil and vegetation, misbalance of primary natural conditions of the environment; increasing concentration of heavy metals and arsenic that exceeds hygienic

		standards in crop and livestock products; increased dusting of the atmosphere with stored waste (tailings); higher morbidity rate; the formation of technogenic landscapes over large territories (dumps and tailings); flooding or drainage of the area, changing plant aggregations; changes in animal migration routes; changes in snow accumulation conditions; decreasing agricultural lands; reduction in hunting, fishing, fish resources, and wild plants.
Construction of highways and railways	*Construction:* landtake, disturbance of landscapes, deforestation, pollution of air, water, and soil with various types of wastes (dust, exhaust gases of operating equipment, carbon monoxide, nitrogen dioxide, sulfur dioxide, soot, lead, benzopyrene, and saturated hydrocarbons); soil dumps; consumption of a large amount of stone, crushed stone, sand, and other fossil raw materials extracted by surface mining. *Operation:* consumption of a large amount of air (for ventilation of premises, during fuel combustion in production) and water (for drinking, household, and production needs); pollution of the atmosphere, water bodies, and groundwater with nitrogen and sulfur compounds, as well as fuel combustion products: solid fuel – oxides of sulfur, carbon, nitrogen, fly ash, and soot; fuel oils – sulfur oxides, nitrogen dioxide, and solid products of incomplete combustion of vanadium. *Maintenance*: emitted vapors contain acetone, benzene, xylene, butyl alcohol, toluene, white spirit, and formaldehyde; work trains, diesel locomotives emitting oxides of sulfur, carbon, nitrogen, and aldehydes as exhaust gases when burning fuel. Wastewater mainly contains suspended particles, oil products, bacterial contamination, acids, alkalis, and surfactants. The most common pollutants of the territories of railway enterprises are metals, plastics, glass, textiles, waste paper, oil products, fuel oil, or fuel; noise pollution.	Dismemberment and destruction of the terrain, landslides, talus, floods, other types of soil movements, and land erosion; changes in surface runoff conditions, and groundwater flow; soil drainage or waterlogging; destruction of the conditions for plants growth, animal habitats, marine and river bioorganisms.
Development of oil and gas deposits	Contamination of soil with oil and oil products; air pollution with hydrocarbons, carbon, sulfur, nitrogen, and benzopyrene; pollution of surface and ground waters with oil and oil products, chlorides, sulfites, phenols, suspended solids, heavy metal salts, and nitrogen compounds; the risk of emergencies and fires; mechanical and thermal destruction, pollution of soils and plant aggregations; reduction and destruction of forage resources; pollution, mechanical destruction of territories, banks, and river beds; deforestation.	Deterioration of water quality and living conditions of aquatic bioorganisms and plants, accelerated river bed evolution; destruction of soil and vegetation; increased emergency risk; destruction of recreational and health-improving facilities, higher morbidity rate; developing erosion, ravines, thermokarst, deformation of river beds; decreasing biological productivity of soils and plants, destruction of cultivated crops, development of woodless landscapes; reduction and destruction of forage resources, limited migration of wild animals; changes in the oxygen regimen of the reservoir, increasing likelihood of water bloom, more frequent occurrence of heat stress in aquatic organisms; accidents with consequences fatal for all living things.

Hydroelectric power station, thermal power station, state district power stations, thermal power stations	*Hydroelectric power stations:* flooding of large territories, changes in the hydrological regimen of rivers. *Thermal power stations*: air pollution with solid dust particles, carbon compounds, oxides of sulfur, nitrogen, fluoride compounds, metal oxides, gaseous products with incomplete combustion, fuel oxidation, as well as with aerosols and carcinogenic substances; pollution from thermal power plants with waste water containing vanadium, nickel, fluorine, phenols, and oil products; thermal pollution of water bodies; long-term storage of ash and slag.	Insurmountable obstacles for the migration of spawning fish going up to breed; local rise in water levels leading to flooding, waterlogging, eutrophication, banks erosion, or landslides; changes in water level, currents, waves, temperatures, and ice formation; changes in the hydrological regimen; the greenhouse effect; deforestation, decreasing agricultural lands; higher concentration of harmful elements in plants and animals (including cultivated ones) that are harmful to human health; melting of glaciers, rising sea levels, and flooding of vast areas.
Floating nuclear power plants	Radioactive contamination of the atmosphere and water with carbon-14, krypton, strontium, iodine-129 and 131, xenon, cesium, and inert gases (depending on the reactor type); thermal pollution of the atmosphere and water; air pollution with solid dust particles, carbon compounds, oxides of sulfur, nitrogen, fluoride compounds, metal oxides, gaseous products of incomplete combustion, fuel oxidation, as well as with aerosols and carcinogenic substances.	Changes in the oxygen regimen of a reservoir, stronger likelihood of water bloom, more frequent occurrences of heat stress in aquatic organisms; accidents with consequences fatal for all living things.
Value-added wood processing	Deforestation; pollution of soil, surface, and underground waters, as well as atmosphere with products of chemical reagents (phenol-formaldehyde, liquid polymer resin, etc.).	Accelerated formation of sediments in natural water bodies, deteriorating hydrological regimen of water bodies, and a decrease or disappearance of the biological resources of a water body.
Tourist and recreational facilities (a set of historical, ethnographic, archaeological, paleontological, cultural, entertainment, sports, and recreation facilities that use unique natural and climatic phenomena: extremely low temperatures and permafrost)	Violation of the geological conditions of the area and mountains; trampling; pollution of surface and ground waters by chemical and biological pollutants; littering; pollution of the water area and the atmosphere with fuel combustion products emitted by vehicles; deforestation; noise impact.	Destruction of natural monuments, degradation of the soil and vegetation; deterioration of the sanitary state of an area, talus, landslides, and soil washout; coastal erosion; changes in the hydrological regimen of water bodies, their physical and chemical composition, eutrophication, decrease (or complete disappearance) of aquatic and forest biological resources; poorer aesthetics of the landscapes.
Gemstones cutting and jewelry making	Air and waste water pollution by diamond dust, shavings, sawdust of precious metals, vapors and residues of gasoline, emulsions, bleaching solutions, chemical reagents (sulfuric, hydrochloric, nitric, hydrofluoric, orthophosphoric, boric acids, caustic soda, caustic potassium, ammonia, potash, borax, copper sulfate, sulfate oxide, silver chloride, chloride gold, cyanide silver, cyanide potassium, sodium	Fully or partial ignorance of the safety rules may lead to the following: electric shock, respiratory poisoning, burns, fires, damage to the mucous membrane of the eyes and respiratory organs, staff injury; air pollution in the common production area with harmful vapors and dust.

	cyanide, silver nitrate, bitumastic enamel, sodium thiosulfate, and carbon disulfide), components of polishing pastes (chromium oxide, stearin, split fat, kerosene, silica gel, oleic acid, chromium oxide, industrial fat, turpentine, oxidized petrolatum, and paraffin).	
Development of seaports infrastructure	Depending on a particular object type	Depending on a particular object type.

Dwelling on the earlier studies and the obtained indicators, we zoned Pacific Russia regarding the sustainability of the relationships between production and nature.

For this, we estimated integral (complex) indicators by determining the coordinate (indicator) in the *n*-dimensional Euclidean space. This method allowed us to select an integral indicator (coordinate) from the *n*-th number of indicators measured in different units and then track changes in the studied object as a whole and in its individual components, thus identifying the parameter that led to a change in the state of the object [6].

At present, the relationship between production and nature (nature management) in the regions of Pacific Russia reflect the existing production structure. The pandemic decreased the technogenic impact, although this mainly occurred in the regions with developed food processing, light industry, social infrastructure (cafes, restaurants, cinemas, and public transport), and partly agriculture.

We estimated an increase in the technogenic load by analyzing the number and hazard class of the main projects to be implemented (construction of enterprises). The indicators obtained by calculations revealed that most of the considered regions belonged to the zone of a moderate increase in the anthropogenic impact. We can predict a significant increase in the technogenic load in the Primorsky and Khabarovsk Territories. This is due to the construction of new and the development of old shipbuilding and ship repair industries, the processing industries (mining and processing plants and concentrating plants), as well as construction industry enterprises. According to the calculated indicators, the Chukotka Autonomous Okrug demonstrated a slight increase in the anthropogenic impact. However, considering the natural and climatic conditions in the region with its fragile ecosystems, even a slight technogenic impact may cause serious, even irreversible, consequences. Thus, we put Chukotka Autonomous Okrug into the zone of moderate increase in the technogenic impact. Due to the

specifics of the region and the projects planned, the government should consider the expediency and safety of these activities [7] (Fig.).

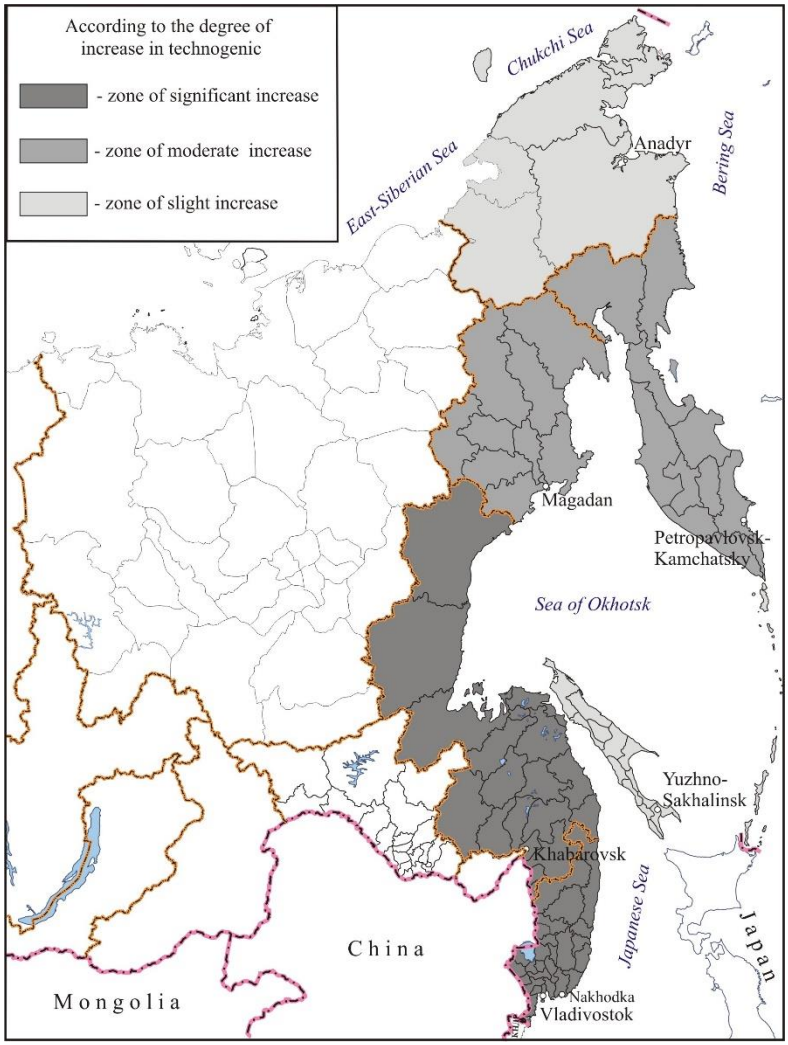

Fig. Differentiation of the territory of Pacific Russia in terms of the degree of increase in technogenic impact

Conclusion. Thus, taking into account the planned development of the Pacific Russia regions, one can note the prospects for economic growth both in a particular region and in the Russian Far East in general. At the same time, due to severe natural conditions in some regions and present environmental and social problems, as well as inadequacy (or absence) of effective and relevant environmental protection measures and programs, further development will increase the man-made impact on the territory. As a result, the ecological situation will worsen significantly [10, 3, 4]. To obtain a more balanced model for further development of the Pacific Russia regions, one should adjust regional development

programs according to the specifics of the area and existing environmental problems. The government should develop not only industrial and agricultural projects, but establish environmental protection and resource-saving enterprises. These activities should be financed and supported at the federal level, so that the regions can maintain and preserve natural resources and create favorable conditions for people living in there.

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