KYIV NATIONAL UNIVERSITY OF CONSTRUCTION AND ARCHITECTURE

Urban and Spatial Development Faculty

Urban Economy Department

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GRADUATION THESIS FOR A MASTERS'S DEGREE

On the topic:

Planning from the perspective of ecological civilization construction

By student of the group 192 UPE

Ge Yuxin

Specialty: 192 Construction and Civil Engineering

Educational program: Urban planning and economy

Supervisor **Liubov Apostolova-Sossa**

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A S S I G N M E N T

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Chapter 3. Environmental planning methods and tools
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Introduction	
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Contents

INTRODUCTION

Relevance of the topic

The modern world is facing large-scale environmental problems: climate change, loss of biodiversity, pollution of the atmosphere and water bodies, as well as land degradation. Rapid urbanization and industrialization have led to the depletion of natural resources and disturbance of the ecological balance. In the context of the global ecological crisis, the concept **of ecological civilization** is not only a theoretical basis, but also a practical tool for ensuring sustainable development.

Planning of territories taking into account the principles of ecological civilization provides for a harmonious combination of economic growth, social well-being and preservation of the natural environment. This issue is especially relevant for countries that are on the way to environmentally oriented development.

Thus, the study of planning from the standpoint of building an ecological civilization is extremely important for the formation of long-term strategies for sustainable development.

Purpose and objectives of the study

The purpose of the study is to develop theoretical and practical approaches to the planning of territories, taking into account the principles of ecological civilization.

Research objectives:

1. To analyze the theoretical foundations of the concept of ecological civilization.
2. Explore modern methods and tools of environmental planning.
3. To assess the state of territorial planning in the context of ecological civilization on the example of specific regions.
4. Propose strategies and practical recommendations for integrating the principles of ecological civilization into planning processes.

Object and subject of research

- **The object of research is the** process of planning territories from an ecological point of view.
- **The subject of research** is approaches, methods and planning tools for building an ecological civilization.

Research methods

To achieve this goal, the following methods were used in the work:

- **Analysis of literature and regulatory framework** – to study the theoretical foundations of the topic.
- **The comparative method** is for the analysis of the world's best practices of environmental planning.
- **The method of the system approach** is to consider the object of study as a complex system.
- **Cartographic analysis and GIS technologies** – for the study of territorial aspects of planning.
- **Expert method** – to evaluate the proposed measures and their effectiveness.

Scientific novelty and practical significance

The scientific novelty of the study lies in:

- Formation of an integrated approach to planning from the standpoint of ecological civilization.
- Identification of key methods for assessing the effectiveness of sustainable development measures.

The practical significance of the work lies in the development of recommendations for the integration of the principles of ecological civilization into the processes of territorial planning. The results of the study can be used by local governments, architects and urbanists in the development of plans for the sustainable development of cities and regions.

CHAPTER 1. THEORETICAL FOUNDATIONS OF ENVIRONMENTAL PLANNING

The concept of "ecological civilization" is a response to the challenges faced by humanity due to **industrialization and technogenic development**. Ecological civilization is based on the principles of harmonious coexistence of man with nature, where economic growth is not put in the first place at the expense of environmental destruction. In many countries of the world, this concept has become widespread, especially in China, where programs and strategies for ecological civilization are developed at the state level.

Ecological civilization has several key principles: **rational use of resources, preservation of biodiversity, minimization of impact on ecosystems,** and transition to a green economy. For example, in Singapore, urban planning takes place taking into account biophilic design – buildings are integrated into the natural environment, which allows you to create cities with clean air and comfortable living conditions.

Theories and approaches to environmental planning

Environmental planning as a scientific discipline relies on several theoretical approaches, including **the ecosystem approach, landscape-ecological analysis and the concept of sustainable development**.

Each of these approaches allows us to consider the territory as **a complex system** where natural and anthropogenic factors interact with each other.

The ecosystem approach involves the development of strategies that take into account **the integrity of the ecosystem**. For example, the creation of green corridors in cities ensures the migration of animals and the maintenance of the balance of biodiversity. The landscape-ecological approach uses data on natural relief, climatic conditions and landscape features for planning cities and regions.

Regulatory framework

Regulatory support is the basis of environmental planning at all levels of government. International documents such as the **Paris Climate Agreement, the Rio Declaration and the UN Sustainable Development Goals** define global priorities in the fight against climate change and environmental pollution.

The national legislation of each country details these principles and ensures their implementation in regional strategies. For example, Europe has **the EU Green Deal**, which aims to achieve climate neutrality by 2050.

1.1. The concept of ecological civilization

Ecological civilization is a new model of social development based on harmony between society and nature. Its main goal is to ensure **sustainable development** through the integration of environmental, economic and social goals.

One of the key features of the concept of ecological civilization is its **systematic and integrated approach** to planning the development of society. In contrast to traditional models of economic growth, which focus mainly on industrial production and consumption of resources, ecological civilization is based on **a long-term balance between the natural environment, social needs and economic development**. The main task is to provide conditions for **sustainable existence** of humanity by changing approaches to consumption, production and organization of space.

Ideological and philosophical foundations of the concept

The idea of ecological civilization has not only practical, but also **deep philosophical content**, since it calls for **a rethinking of the role of man** in the natural environment.

1. **Rejection of anthropocentrismTraditional industrial civilization is based on the principle of anthropocentrism**, where man is considered the dominant species, and nature is considered a resource subordinate to human needs. Within the concept of ecological civilization, this approach is replaced by **ecocentrism**, where nature is considered as an integral system, and man is only a part of it.
2. **Philosophy of harmony with natureIn many cultures, there are long traditions of harmonious coexistence with nature. In particular, the philosophy of Taoism** refers to the idea of "Tao" - the natural path that a person must follow to achieve harmony with the world.
3. **Principles of social justiceThe concept of ecological civilization is closely related to social equality** and equitable distribution of resources. Environmental pollution, climate change and depletion of natural resources

hit the poorest segments of the population hardest. Therefore, it is important to create conditions under which every region and every social group will have **equal access to clean water, air and natural goods**.

Ecological civilization in a global context

Global trends in recent decades indicate that the concept of ecological civilization is becoming **a global necessity**. The challenges associated with climate change, environmental pollution and resource depletion require concerted action at the international level.

1. **Global challenges and the reaction of the world community**
    - **Climate change**: An increase in the Earth's average temperature is leading to melting glaciers, rising sea levels, and extreme weather events.
    - **Land degradation**: Irrational use of soils and deforestation reduce their productivity and accelerate desertification processes.
    - **Plastic pollution**: Millions of tons of plastic enter the oceans every year, threatening marine ecosystems.

    The response at the global level includes initiatives such as **the Paris Climate Agreement**, the UN Sustainable Development Goals, the European Green Deal and other programs that promote the transition to **low-carbon technologies**, renewable energy sources and the rational use of natural resources.

2. **China's role in the implementation of ecological civilizationChina was one of the first countries to announce its intention to build an ecological civilization** at the national level. Within the framework of this strategy, large-scale programs are being implemented to:
    - Landscaping of deserts and reforestation.
    - Transition to **renewable energy sources**: solar, wind and hydropower.
    - Creation of "green cities" with a developed public transport system and minimization of car emissions.

    Example: The city of **Shenzhen** has completely switched to electric buses, which has reduced CO_2 emissions by several hundred thousand tons per year.

The place of ecological civilization in modern planning

At the present stage, the concept of ecological civilization is implemented through **innovative approaches to spatial planning** and resource management. The key tools are:

- **Creation of green corridors and conservation areas**: Connecting natural landscapes into a single network ensures the conservation of biodiversity.
- **Implementation of eco-urbanism**: Development of cities where infrastructure is harmoniously combined with the natural environment.
- **Development of the circular economy**: Transition from a linear consumption model to **closed cycles**, where waste is converted into resources.

Example: In Sweden, landfills are practically not used – 99% of waste is recycled or incinerated for energy production.

The concept of ecological civilization is not only a theoretical basis, but also a practical necessity for the modern world. It proposes a new model of development based on **harmony between man and nature**, ensuring a long-term balance between economic growth and environmental conservation. Global initiatives, national strategies and innovative approaches to planning create the basis for the implementation of this concept in all spheres of life.

History and evolution of the concept

1. **The beginning of the ideaThe concept of ecological civilization arose as a response to the negative consequences of industrial civilization**, which led to global environmental crises. This idea was first formulated in China in the 20th century as a strategy for long-term development.
2. **Idea development**
    - **1987** – the UN report "Our Common Future" implements the concept **of sustainable development**, which became the basis for ecological civilization.
    - **2007** – China officially declared ecological civilization a national strategy.
    - **2015** – adoption of the **UN Sustainable Development Goals (SDGs),** which are closely related to the principles of ecological civilization.
3. **Comparison with other development models**

Setting	Industrial civilization	Ecological civilization
Orientation	Economic growth	Harmony of nature and man
Resource Usage	Exhausting, irrational	Rational, cyclical
Technology	Polluting, non-ecological	Clean, green technology
Development strategy	Short-term	Long term

Basic principles of ecological civilization

1. **Harmony between man and nature**
   - The human being is part of the natural system, so development must take into account environmental sustainability.
2. **Green economy**
   - Transition from a traditional economy to **a green** one based on renewable resources and low-carbon technologies.
3. **Rational use of resources**
   - 3R principles: Reduce, Reuse, Recycle.
4. **Innovative technologies**
   - Use **of green technologies** to reduce the negative impact on the environment.
5. **Social consciousness**
   - Formation of a culture **of ecological thinking** among the population.

Ecological civilization in a global context

1. **International initiatives**
   - **The 2015 Paris Agreement**: limiting global warming to **1.5°C**.
   - **United Nations Sustainable Development Goals**: 17 goals encompassing the environment, economy and social well-being.
2. **Examples of ecological civilization**
   - **China**: green urbanization, reforestation, development of renewable energy.
   - **Scandinavia**: use of clean energies (wind, solar power plants), environmentally friendly cities like **Copenhagen**.

3. **Challenges of globalizationDespite positive initiatives, the problem of global coordination of actions remains relevant. It is important to overcome economic interests** in favor of environmental priorities.

1.2. Theories and approaches to environmental planning

Environmental planning is an interdisciplinary approach to managing the spatial development of territories, taking into account environmental, economic and social factors.

Main theoretical approaches to environmental planning

1. **Ecosystem approach**
   - **The essence of the approach**: Consideration of territories as **integral ecosystems**, where all elements (water, air, soil, biota) are interconnected.
   - **Principles**:
     - Taking into account natural ecosystems when planning cities and regions.
     - Supporting biodiversity and natural cycles.
   - **Example**: Planning of green corridors connecting city parks with forest areas.
2. **Landscape and ecological approach**
   - **The essence of the approach**: Taking into account **the landscape features of the** territory when designing. This allows you to reduce the negative impact of construction on nature.
   - **Methods**:
     - Analysis of the landscape structure of the territory.
     - Creation of ecological frameworks (network of protected areas).
   - **Example**: Design of residential areas taking into account natural relief and water resources.
3. **Sustainable development as the basis of planning**
   - **The essence of the approach**: Planning of territories based on the concept **of sustainable development** – ensuring a balance between economic, social and environmental needs.
   - **Principles**:
     - Rational use of natural resources.

- Minimization of emissions and waste.
- Application of green technologies.

- **Example**: The use **of energy-efficient buildings** and **renewable energy** in urban planning.

4. **Biophilic design**
   - **The essence of the approach**: Integration of natural elements into the urban environment to create **comfortable and healthy living conditions**.
   - **Elements of biophilic design**:
     - Green walls and roofs.
     - Natural reservoirs in urban spaces.
   - **Example**: The concept of "green cities" like Singapore with its many gardens and parks on the rooftops of buildings.

Environmental planning methods

1. **Geographic Information Systems (GIS)**
   - GIS allows you to analyze and visualize the ecological state of territories for making informed decisions.
   - **Example**: Identification of areas of risk of flooding or soil erosion to restrict construction.
2. **Environmental assessment of territories**
   - Implementation of **an Environmental Impact Assessment (EIA)** before the implementation of construction projects.
   - **Task**: Identification of potential negative consequences and ways to minimize them.
3. **Creation of green infrastructures**
   - Planning **of green areas** as the basis of urban infrastructure: parks, forest belts, reservoirs.
   - **Benefits**: Improved air quality, reduced noise and heat effect in cities.
4. **Spatial zoning**
   - Division of territories into **functional zones**: residential, industrial, recreational and environmental protection.
   - **Example**: Implementation of buffer zones around reserves to protect natural ecosystems.

Putting theories into practice

1. **Leading countries in the implementation of environmental planning**
    - **Singapore**: Creation of urban forests, vertical landscaping of buildings.
    - **Germany**: Introduction of green roofs in cities and systematic transition to **renewable energy**.

2. **The role of architects and urbanistsArchitects and urban planners play a key role in the implementation of environmental planning principles. They ensure a balance between the comfort of life** and **the preservation of nature**.
3. **Local layout features**
    - Taking into account climatic conditions, demographic characteristics and natural relief of territories.

1.3. Regulatory framework

Environmental planning as a tool for building an ecological civilization is based on international agreements, regional regulations and national legislation.

1.3.1. International regulations and agreements

1. **Rio de Janeiro Declaration on Environment and Development (1992)**
    - The official beginning of the global struggle for sustainable development.
    - **Basic principles**:
        - Respect for nature as the basis of human life.
        - The right of every country to sustainable development.
        - Responsibility of states for the preservation of the environment.
2. **Kyoto Protocol (1997)**
    - Goal: Reduce greenhouse gas emissions to slow global warming.
    - Implementation of mechanisms: **quota trading**, joint implementation and clean development.
3. **Paris Climate Agreement (2015)**
    - The main document of modern environmental policy.
    - **Objective**: Limit global temperature rise to **1.5–2°C**.
    - Implementation of **Nationally Determined Contributions (NDCs)** for each country.
4. **United Nations Sustainable Development Goals (2015–2030)**
    - **17 global goals**, including:

- Goal 11: **Sustainable development of cities and communities** (environmentally friendly cities).
- Goal 13: **Fight climate change**.
- Goal 15: **Conservation of terrestrial ecosystems**.

1.3.2. Regional and national standards

1. **European Green Deal (2019)**
   - A comprehensive strategy to achieve **EU climate neutrality by 2050**.
   - Main directions:
     - Transition to clean energy.
     - Creation **of a circular economy** (reuse of resources).
     - Development of sustainable agriculture (**Farm to Fork Strategy**).
2. **Environmental legislation of Ukraine**
   - **Law of Ukraine "On Environmental Protection"** (1991)
     - It determines the rights and obligations of citizens and the state in the field of nature protection.
   - **Law of Ukraine "On Environmental Impact Assessment" (EIA)**
     - Procedure for analyzing the impact of projects on the environment before their implementation.
   - **Strategy for Environmental Security and Adaptation to Climate Change until 2030**
     - Main activities:
       - Minimizing air pollution.
       - Increasing the area of protected areas.
3. **Other regulatory documents**
   - **EU Water Framework Directive** (2000): protection of water resources.
   - **Aarhus Convention** (1998): access to environmental information and public participation in decision-making.

1.3.3. Mechanisms for the implementation of the regulatory framework in environmental planning

1. **Environmental audit**

- Verification of compliance with environmental standards at enterprises and urban planning projects.

2. **Environmental Management System (ISO 14001)**
   - Standardization of processes to reduce the negative impact of activities on nature.
3. **Environmental monitoring**
   - Constant monitoring of the state of the environment for prompt response to threats.
4. **Public participation and transparency**
   - Organization of public discussions of environmental projects to involve local communities in decision-making.

Conclusions to the subsection

The regulatory framework is a key tool for the implementation **of environmental planning**. International agreements, regional strategies and national laws create the necessary conditions for the implementation of sustainable development and the construction **of ecological civilization**.

CHAPTER 2. ANALYSIS OF THE CURRENT STATE OF PLANNING IN THE CONTEXT OF ECOLOGICAL CIVILIZATION

At the present stage, most countries of the world are facing environmental challenges, including **climate change, land degradation, air and water pollution**. In this context, the experience of leading countries such as **Scandinavia, Germany, China** and the United States is indicative for other regions.

In Germany, for example, "green roofs" and energy-efficient construction are being introduced as elements of environmental planning. In China, ecological frameworks are being created that combine nature conservation zones into a single network. There is some progress in Ukraine, but there are still problems with financing and implementing strategies at the local level.

Today, the global environmental situation is one of the greatest threats to the existence of mankind, as well as one of the key problems that must be solved at the level **of planning the development of territories**. Large-scale processes of urbanization, industrialization and uncontrolled use of natural resources have led to a number of challenges that require **urgent solution**. The response to these challenges should be based on the integration of environmental principles into the processes of spatial and strategic planning of territories.

1. Environmental pollution

One of the main challenges of modern planning is **environmental pollution**, which includes air, water, soil pollution and waste accumulation.

1.1. **Air pollutionThe main causes: emissions from industrial enterprises, exhaust gases from road transport, burning fossil fuels for energy needs. Air pollution causes global warming**, acid rain, respiratory diseases among the population.

- **Example**: In Delhi (India), air pollution levels are 10-15 times higher than normal due to uncontrolled numbers of vehicles and industrial emissions.
- **Example**: China is actively switching to **electric transport** to reduce pollution levels in major cities such as Beijing and Shanghai.

1.2. **Pollution of water resourcesWaters are polluted by wastewater from industrial enterprises, chemicals of agricultural production and household waste. Water pollution leads to the death of aquatic ecosystems and poses a threat to drinking water supply.**

- **Example**: In Ukraine, the Dnipro River suffers from pollution due to industrial discharges, agricultural fertilizers and waste from large cities.
- **Example**: Sweden has developed a multi-stage wastewater treatment system that allows it to be reused for technical needs.

1.3. **Soil pollution and waste accumulationThe use of chemical fertilizers and pesticides, mining, uncontrolled landfills lead to soil degradation and their unsuitability for agriculture.**

- **Example**: European countries such as Germany and Sweden are actively developing **waste sorting and recycling systems**, which reduces the amount of waste that ends up in landfills.

2. Climate change

Climate change is a global problem that affects all regions of the world and creates new challenges for environmental planning. The main manifestations of climate change are:

- **Increase in global average temperature**: This leads to melting glaciers, rising sea levels and an increase in the frequency of extreme weather events.
    - **Example**: The Maldives, an island nation, is at risk of disappearing from the Earth's surface due to rising sea levels.
    - **Example**: In Italy, an abnormal heat wave in the summer of 2023 caused large-scale forest fires.
- **Desertification and land degradation**: due to climate change, the area of land unsuitable for agriculture is increasing.
    - **Example**: Africa's Great Green Wall project aims to green areas to combat the Sahara desert.

3. Irrational use of natural resources

Excessive consumption of natural resources is one of the causes of the global environmental crisis. Water resources, forests, minerals and minerals are depleted much faster than they can recover.

- **Deforestation**: forests have important functions for the conservation of biodiversity, climate regulation and protection of soils from erosion.
    - **Example**: The Amazon rainforest, known as the "lungs of the planet", disappears at a rate of **10 thousand hectares each year** due to deforestation for agricultural needs.
- **Depletion of water resources**: improper planning of water use leads to a shortage of fresh water in many regions of the world.

4. Urbanization and chaotic urban planning

The rapid growth of cities often occurs without proper **environmental planning**, leading to the loss of natural areas, increased pollution and oversaturation of infrastructure.

- **Example**: In many metropolitan areas, such as Mexico City or Bangkok, the problem of overpopulation and insufficient green spaces leads to a deterioration in air and water quality.
- **Solution**: Implementation of the concept of "green cities", where natural areas are integrated into the urban environment.

5. Biodiversity loss and ecosystem degradation

One of the most serious challenges of modern planning is **the loss of biodiversity** and the destruction of natural ecosystems, which leads to **an imbalance in natural processes** and negatively affects the sustainability of the environment. Intensive deforestation, development of natural areas, pollution of water bodies and climate change destroy **the life habitats of** many species of plants and animals, which in turn threatens food security and quality of life of the population.

- **Decline in wild animal populationsAccording to the World Wide Fund for Nature (WWF), over the past 50 years, the number of wild animal populations has decreased by 68%** due to the loss of natural habitats.
  - **Example**: In the Amazon, deforestation for agricultural purposes leads to the extinction of rare species such as jaguars, sloths and some species of monkeys.
  - **Solution**: Restoration of protected areas and creation **of ecological corridors** that allow animals to migrate between preserved landscapes.
- **Degradation of marine ecosystemsDue to plastic pollution**, overfishing, and rising ocean temperatures, many marine ecosystems are in danger of extinction.
  - **Example**: The Great Barrier Reef in Australia lost more than 50% of its coral due to "bleaching" caused by rising water temperatures.
  - **Solution**: Implementation of marine protection zones and restriction of commercial fishing.

6. Uncontrolled growth in waste

Another challenge for modern planning is the **accumulation of waste** – both solid household and industrial. With the growth of cities and the level of consumption, the problem of waste is becoming more and more acute.

- **Plastic pollutionEvery year, around 400 million tons of plastic are produced in the world**, of which only **9%** is recycled. The rest accumulates in landfills, in nature and in the oceans.

- **Example**: The Great Pacific Garbage Patch covers an area **of more than 1.6 million square kilometers** and consists of billions of plastic waste.

- **Recycling Problems in CitiesThe rapid growth of cities is often accompanied by insufficient infrastructure for waste recycling, resulting in uncontrolled accumulation of garbage.**
  - **Solution**: Implement sorting, recycling programs and create **a circular economy** where waste becomes resources.
  - **Example**: In Japan, there is a **concept of "Zero Waste",** where about 80% of waste is recycled or incinerated to produce energy.

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7. Growing energy needs and pollution from fossil fuels

The modern world is facing **an ever-growing demand for energy**, which stimulates the use of fossil fuels – a major source **of greenhouse gases** and climate change. Despite the development of alternative energy, many regions are still dependent on **coal, oil and gas**.

- **Environmental impactThe use of fossil fuels leads to:**
  - Large-scale air pollution.
  - Acid rain that destroys soils and water bodies.
  - Increased CO_2 emissions accelerating global warming.
- **Transition to renewable energiesModern environmental planning involves the transition to "green energy"** that uses **solar, wind, hydro and bioenergy**.
  - **Example**: In Denmark, more than 50% of energy is produced by wind farms, which has allowed the country to significantly reduce CO_2 emissions.
  - **Example**: Germany is actively implementing the **"Energiewende"** program aimed at a complete transition to renewable energies by 2050.

8. Insufficient environmental awareness of the population

Despite significant efforts by governments and international organizations, the problem **of insufficient environmental education** and public awareness remains relevant.

- **Lack of waste sorting culture** in many countries of the world.

- **Lack of understanding of the consequences** of a consumerist lifestyle, which leads to excessive use of resources.

Solution:

1. Conducting **environmental education programs** in schools, universities and public institutions.
2. Encouraging environmentally responsible behavior through **incentives for citizens** (discounts on public transport, bonuses for waste sorting).

- **Example**: In Sweden, they are taught to sort garbage from childhood and environmental awareness is part of the school curriculum.

The environmental situation today requires **urgent measures** at the global, national and local levels. The main challenges, such as environmental pollution, climate change, biodiversity loss and the energy crisis, require a systematic approach and the integration of **environmental principles** into planning processes. Only with the help **of modern technologies, sustainable development and increased environmental awareness** It is possible to overcome these challenges and ensure a future where nature and humanity exist in harmony.

2.1. Ecological situation and challenges of modern planning

Modern territory planning faces many **environmental challenges** that result from global industrialization and urbanization. Major challenges include:

1. **Climate**
    - Increase in average annual temperature and extreme weather conditions.
    - Consequences: rising sea level, drought, flooding of cities.
    - **Example**: Floods in Germany (2021) and an increase in temperatures in India to 50°C are a consequence of global climate change.
2. **Environmental pollution**
    - **Air**: Emissions of CO_2, nitrogen oxides and dust from industry and transport.

- **Water**: Pollution of water bodies due to industrial waste discharges and plastic.
- **Soils**: Accumulation of heavy metals and chemicals due to intensive agriculture.

3. **Degradation of natural resources**
   - Depletion of forests, reduction of the area of green areas.
   - **Example**: Loss of the Amazon rainforest due to uncontrolled logging.
4. **Irrational use of territories**
   - The growth of cities often occurs **chaotically**, without taking into account environmental features.
   - Consequences: reduction of areas of protected areas, violation of biodiversity.

Conclusion: The challenges of modern planning require urgent solutions to harmonize urban development and preserve the natural environment.

2.2. The best world practices in environmental planning

To analyze successful practices in the field of environmental planning, it is important to pay attention to **performance indicators** that demonstrate the real results of measures implemented in different countries of the world. These indicators include:

- **The area of green areas**.
- **Level of CO_2 emission reduction**.
- **Dynamics of waste reduction**.
- **Energy efficiency indicators**.

1. Examples of world practices

Country	Project	Main achievements
Singapore	"Garden City"	Landscaping of more than 47% of the city's territory. Vertical gardening of buildings has been introduced.
Germany	"Energiewende"	Reduction of CO_2 emissions by **25%** from 1990 to 2020, thanks to the transition to RES.

Country	Project	Main achievements
Denmark	Wind energy	50% of energy is generated using wind farms. The plan is 100% by 2050.
Sweden	"Zero Waste"	99% of waste is recycled or incinerated for energy. Landfills are almost never used.
Netherlands	Integrated water management system	A system of canals and polders protects the area from flooding.

1. **China: green urbanization**
   - China is actively implementing the concept **of ecological civilization**.
   - **Examples**:
     - **Linfen City**: Transformation from the "dirtiest city" to the region of clean technology.
     - Projects **of green cities** with a large coverage of parks, artificial forests and reservoirs.
2. **Scandinavian countries: sustainable development**
   - **Denmark**: Copenhagen is a leader in building **cycling infrastructure** and transitioning to renewable energy.
   - **Sweden**: The city of Malmö is an example of an energy-efficient city with "green roofs".
3. **Germany: eco-urbanism**
   - Coal **phase-out projects** by 2038.
   - Use **of green infrastructure** to combat the thermal effect in cities.
4. **Singapore: Biophilic Design**
   - **Roof gardens**, vertical parks and the integration of water bodies into residential areas.
   - Example: **the Marina One building** with an integrated tropical garden.

2.3. The state of environmental planning in Ukraine

1. **Positive developments**
   - Implementation **of the Law on Environmental Impact Assessment (EIA).**
   - Development **of green city** strategies in cooperation with international partners.

- Projects to create **regional protected areas** (for example, Svyatoslav's White Coast).

2. **Environmental planning problems**
   - **Low level of implementation of legislation**: plans often remain only on paper.
   - **Financial instability**: insufficient funding for environmental initiatives.
   - **Outdated infrastructure**: industrial cities have high levels of pollution.
3. **Examples of successful initiatives**
   - **Kyiv**: development of projects to increase the area of green areas (parks, squares).
   - **Lviv**: introduction of waste sorting and construction of a modern waste processing plant.

Conclusions to Chapter 2

The analysis shows that environmental planning is a key tool for building **an ecological civilization**. Despite numerous challenges, successful examples from different countries demonstrate the effectiveness of **green strategies**. Ukraine has the potential to implement these approaches, provided that efforts are intensified at all levels of government.

CHAPTER 3. ENVIRONMENTAL PLANNING METHODS AND TOOLS

Environmental planning today is one of the most relevant and effective tools in the context of building an ecological civilization. In the modern world, the importance of this approach can hardly be overestimated, as it is designed to harmonize the relations between nature, society and economy. Achieving this goal is possible only through the systematic use of methods and tools based on the latest technologies, scientific developments and practical developments of different countries. The key elements are **environmental impact assessment, spatial planning, innovative tools** such as geographic information systems, as well as the strategic development of "green infrastructures" that combine environmental function and socio-economic benefits for the population.

One of the most important methods in the environmental planning system is **environmental impact assessment (EIA),** which involves a preliminary analysis of the potential environmental consequences of any economic activity. This method is mandatory for many types of construction, industrial and transport projects, as it allows not only to identify threats, but also to find alternative ways to minimize the negative impact. For example, in the construction of hydroelectric power plants or wind farms. parks in European countries, a detailed environmental impact assessment is used, which involves studying the impact on river ecosystems, bird migration and local climate change. Thanks to this approach, it becomes possible not only to reduce risks, but also to propose measures to restore the natural environment after the completion of construction.

Another integral method is **geographic information systems (GIS),** which are a modern tool for collecting, processing and analyzing spatial data about territories. GIS technologies allow not only to visualize information in the form of maps, but also to create complex models for predicting the consequences of urbanization and climate change. For example, in the United States and Canada, GIS is actively used to monitor the state of forests, analyze erosion processes and manage water resources are used in urban planning, where they help determine the most optimal places to create green areas, transport infrastructure or residential areas. Thanks to GIS, urbanists can more accurately assess the potential environmental risk associated with new buildings and take into account the peculiarities of the local landscape.

Another key tool is **green infrastructure**, which combines a network of natural and semi-natural areas, such as urban parks, forest belts, reservoirs and other green areas. The concept of green infrastructure is based on the principle that nature is not only an aesthetic element of the environment, but also a functional component for improving the ecological state of cities. Green infrastructures are actively used to combat "hot islands" – a phenomenon when temperatures in cities are much higher than in rural regions due to asphalt surfaces. Parks and trees help lower the temperature of the air, purify it of pollution and create a comfortable environment for residents.

Biophilic design plays **a special role in environmental planning**, which aims to integrate natural elements into spatial planning. This approach is actively used in Asian countries, in particular in Singapore, where modern buildings are designed with green roofs, vertical gardens and natural reservoirs. Biophilic design allows not

only to create aesthetically pleasing objects, but also to improve air quality, reduce noise pollution and promote mental health residents of cities.

In general, environmental planning methods and tools provide an integrated approach to the development of areas where environmental sustainability is a top priority. The use of modern technologies, such as geographic information systems, and the introduction of green infrastructure practices create conditions for the sustainable development of cities and regions. At the same time, environmental impact assessment and biophilic design are important components for minimizing the negative impact of human activities and harmonizing relations between nature and society.

In the context of the modern development of cities and regions, environmental planning is becoming not only an important component, but also a necessity that determines the future existence of humanity on the planet. The rapid development of industry, infrastructure and urbanization creates **a double challenge**: on the one hand, it is necessary to ensure economic development and population growth, and on the other hand, it is necessary to preserve the environment and provide resources for future generations. **modern, integrated and as effective as possible** for achieving harmony between nature and human activity.

One of the important tools in this area is **spatial planning**, which allows the distribution of functional zones of territories in accordance with their ecological, social and economic characteristics. Spatial zoning ensures **optimal use of land resources** and prevents chaotic urban development around industrial facilities to minimize the negative impact on residential areas. In such buffer zones, **forest plantations** or recreational parks are often created, which not only serve as a natural filter, but also serve as places of recreation for residents.

In addition to zoning, an important method is **regional environmental planning**, which takes into account the characteristics of large areas and combines them into a single strategy for sustainable development. In China, where the problem of overpopulation and pollution is particularly acute, **comprehensive regional plans** are being developed that provide for the creation of so-called "ecological frameworks". **conservation of biodiversity** and maintenance of natural ecosystems. In this way, the territories are divided into **sustainable development zones**, where the infrastructure is placed so as not to harm the most vulnerable ecosystems.

Innovative technologies also play a key role in environmental planning. Among them, it is worth noting the **modeling of environmental scenarios**, which allows you to predict the consequences of various projects and choose the best solutions. Thanks to modern software packages, such as **ArcGIS** or **QGIS**, urbanists and ecologists can create interactive models of territories by analyzing various factors: **air pollution, changes in groundwater levels, decline in biodiversity,** etc. For example, in the United States, modeling is used to develop **drought control strategies**, which allows optimizing the distribution of water resources in the most arid regions.

Another important tool is **energy planning**, which is based on the transition to **renewable energy sources**. This is especially true for cities seeking to reduce their dependence on fossil fuels and reduce greenhouse gas emissions. In Nordic countries such as **Denmark and Sweden**, energy planning includes the **integration of solar and wind power plants** into the urban environment. Buildings are designed with energy efficiency in mind, and **"passive houses"** that minimize energy consumption are becoming the new standard in construction.

Green infrastructures as a tool for environmental planning are a key element in creating sustainable and comfortable cities. They connect natural areas with the urban environment, creating **ecologically functional networks** that benefit both nature and people. In New York, the **"Million Trees NYC"** program, within which more than a million trees were planted, became an example of the successful integration of green infrastructure into the metropolis. The trees not only improved air quality, but also helped reduce the temperature in the city by several degrees during the summer heat.

In conclusion, environmental planning methods and tools are the basis for shaping **an environmentally sustainable future**, where the development of cities and regions takes place in harmony with nature. Spatial planning, modern GIS technologies, regional environmental zoning and green infrastructure are tools that allow you to achieve a balance between human activity and environmental safety.

3.1. Principles of environmental planning

1. Conservation approach

This approach is aimed at **preserving and restoring natural resources** and ecosystems. Planning is carried out taking into account the ecological value of the territories, and the main emphasis is placed on **limiting the negative anthropogenic impact**.

Features of the approach:

- Creation **of nature conservation zones** and their integration into spatial planning.
- Implementation of measures for **reforestation**, land reclamation and water purification.

Example: In Canada, the conservation approach is actively used to create national parks where economic activity is limited and primitive ecosystems are preserved.

2. Landscape and ecological approach

This approach takes into account **the landscape features of the territory**, such as topography, climate, soils and water resources, for an optimal distribution of functional areas.

Basic principles:

- Analysis of the natural potential of the territory before development.
- Conservation of key landscapes and their integration into the planning of cities and regions.

Landscape component	**Environmental planning measures**
Forests	Creation of protective forest belts, prohibition of felling
Ponds	Restoration of rivers, creation of buffer zones
Mountainous areas	Construction restrictions, development of ecotourism

Example: In Switzerland, the landscape-ecological approach is used to plan mountainous regions where development occurs with minimal interference with the natural relief.

3. Socially-oriented approach

This methodical approach is aimed at **creating a comfortable environment for the population** by providing access to clean air, water, green areas and environmentally friendly infrastructure.

Main aspects:

- Development **of green infrastructure** in cities (parks, squares, gardens).
- Expansion of areas for **bicycle transport** and pedestrian spaces.
- Involvement of the public in environmental planning processes.

Social component	**Environmental measures**
Air quality	Landscaping of streets, restriction of car traffic
Recreation of the population	Creation of parks, urban forests, public gardens
Environmental education	Education campaigns, environmental festivals

Example: In Copenhagen, a large part of the budget is invested in the development of cycling infrastructure, which not only reduces pollution levels, but also improves the quality of life of the population.

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4. Technological approach

The technological approach involves the use **of modern tools and technologies** to monitor the state of the environment and predict the results of environmental planning.

Approach tools:

- **Geographic information systems (GIS)** for mapping territories.
- **Remote sensing of the Earth** to monitor changes in the landscape.
- **Smart sensors** for monitoring air, water and soil quality in cities.

Example: In the United States, GIS monitors the level of air pollution in megacities, which allows you to take timely measures to reduce it.

Environmental planning is based on several key principles:

1. **Rational use of resources**
   - Territory planning involves minimizing the consumption of natural resources, in particular water, soil and energy.
   - **Example**: Scandinavian cities are actively implementing water reuse systems, and buildings are being built with energy-efficient materials.

2. **Conservation of natural landscapes**
   - All projects must take into account the landscape features of the territory and environmental restrictions.
   - **Example**: In Switzerland, construction in mountainous areas is carried out with minimal interference with the natural terrain.
3. **Reducing environmental impact**
   - Using modern technology to reduce emissions and pollution.
   - **Example**: In Germany, during the reconstruction of cities, "green roofs" are introduced, which reduce the temperature and filter the air.
4. **Spatial balance**
   - Division of territories into functional zones: industrial, residential, recreational, environmental protection.
   - **Example**: In London, green infrastructure connects parks and protected areas into a single network.

3.2. Comparison of methodological approaches

Approach	Target	Features	Example
Conservation	Conservation and restoration of nature	Restrictions on economic activity	Creation of national parks in Canada
Landscape and ecological	Optimal use of territories	Taking into account natural landscape features	Planning in the mountainous regions of Switzerland
Socially oriented	Improving the quality of life of the population	Green infrastructure development	Copenhagen's cycling infrastructure
Technological	Using Innovation for Monitoring	GIS, smart sensors, modeling	Pollution monitoring in the United States

1. **Environmental Impact Assessment (EIA) Method**
    - It consists in identifying possible environmental consequences before starting the project.
    - **EIA process**:
        1. Assessment of potential risks to the environment.
        2. Identification of alternative construction options.
        3. Implementation of measures to reduce negative impact.
    - **Example**: Projects for the construction of hydroelectric power plants on rivers always go through the EIA procedure.

2. **Geographic Information Systems (GIS)**
    - GIS are used to collect, process and visualize spatial data of an area.
    - **GIS application**:
        1. Mapping of natural resources.
        2. Analysis of air, soil and water pollution.
        3. Planning of risk areas (flooding, erosion, landslides).
    - **Example**: In California, GIS technology helps monitor fires and coordinate rescue operations.
3. **Green Building**
    - A method that involves the introduction of energy-efficient technologies and environmentally friendly materials in construction.
    - **Examples**:
        1. Using solar panels for electricity.
        2. Construction of houses with thermal insulation materials to reduce energy consumption.
    - **Leading countries**: Sweden, Denmark, Canada.
4. **Environmental zoning**
    - The method involves the distribution of territories according to their ecological value and functionality.
    - **Example of zoning**:
        1. **Residential areas**: limiting the height of buildings and integrating green areas.
        2. **Industrial zones**: placement at a distance from residential areas.
        3. **Conservation areas**: prohibition of construction to preserve ecosystems.

3.3. Environmental planning tools

Environmental planning in the modern world cannot do without the use of **tools and technologies** that allow for an integrated approach to assessing the state of the environment, predicting the consequences of human activity and implementing effective solutions.

Environmental planning tools cover a wide range of methods and technologies, ranging from simple engineering approaches to state-of-the-art digital monitoring and modeling technologies. It is their integration into planning processes that allows you to create **sustainable, environmentally safe and harmonious areas**.

Information and analytical tools

One of the main tools of modern environmental planning is **information and analytical systems** that provide collection, processing and analysis of data on the state of the natural environment. These tools allow **you to visually reflect environmental problems** and make informed management decisions.

Among such tools, the following are of key importance:

1. **Geographic Information Systems (GIS)** is a modern tool used for mapping territories, analyzing spatial data, and creating models of territorial development. The use of GIS makes it possible to identify ecologically vulnerable areas, identify ways to minimize the negative impact on the environment and ensure **optimal use of resources**.
2. **Earth remote sensing systems (ERS)** are a technology that allows you to obtain data on the state of the environment using satellite images. This data is important for monitoring changes in the landscape, assessing the level of pollution, the state of forests and water resources.
3. **Databases and analytical platforms** are specialized software complexes that systematize large amounts of information about natural resources, climate change and the state of the environment.

Engineering and technical tools

Engineering tools play an important role in the environmental planning process, as they are aimed at **the practical implementation of** environmental conservation and restoration measures. Basic engineering tools include:

1. **Green infrastructure** is a system of natural and semi-natural areas that includes urban parks, forest belts, green roofs, and wetlands. Green infrastructure provides **ecological functions** such as air filtration, temperature regulation, and biodiversity conservation.
2. **Water management technologies** – systems for collecting and purifying rainwater and wastewater, creating artificial reservoirs and implementing water conservation systems.
3. **Energy-efficient technologies** – the use of modern materials and innovative solutions in construction to minimize energy consumption. Examples include "passive houses", green roofs and solar panels.

Monitoring and control of the state of the environment

Effective environmental planning is impossible without **systematic monitoring of the state of the** environment. Monitoring allows timely detection of deviations from the norm, assessment of the effectiveness of implemented measures and response to new challenges.

The main monitoring tools are:

1. **Smart sensors** are modern devices that provide real-time **measurement of air, water and soil quality**. They are widely used in cities to monitor the level of pollution and respond in a timely manner to its increase.
2. **Aviation and satellite monitoring** allows you to obtain global data on the state of territories, forest fires, melting glaciers and other natural phenomena.
3. **Laboratory control** is the study of water, air and soil samples to determine the level of pollution and quality of the environment.

Technological innovations for environmental planning

Modern technological developments open up new opportunities for effective environmental planning. The main innovative solutions include:

1. **Digital twins of cities** are virtual models of the urban environment that allow you to analyze and predict the consequences of planning decisions. They are used to optimize infrastructure, manage resources, and monitor the environment.
2. **Smart Cities is** a concept that involves the introduction of digital technologies for urban environmental management, including environmental monitoring, energy optimization and the development of green infrastructure.
3. **Bioengineering technologies** are methods that use natural processes to purify water, soil, and air. An example is phytoremediation – the cleaning of contaminated areas with the help of plants.
4. Tools and technologies in environmental planning are an integral part of the process of creating **sustainable and environmentally safe territories**. The use of analytical systems, engineering solutions, monitoring technologies and innovative approaches allows to ensure the rational use of natural resources, minimization of negative impact on the environment and harmonious development of territories. Only through **a systematic approach** and the integration of modern technologies, it is possible to achieve effective planning that meets the challenges of today.

Introduction of innovative technologies in cities and regions

In the modern world, **innovative technologies** are becoming the basis for creating effective environmental planning strategies both at the city level and at the scale of entire regions. Thanks to the active development of digital solutions and engineering approaches, it has been possible to achieve significant success in monitoring, forecasting and preventing negative environmental consequences.

Smart energy management systems play an important role in the formation of sustainable areas. For example, automated lighting systems are being implemented in cities, which work on the basis of motion sensors and the level of natural light. Such systems can significantly reduce electricity consumption and reduce carbon emissions. Similar approaches are being actively implemented in Germany, where urban infrastructure is adapting to **energy-saving standards**.

Application of bioengineering solutions for environmental restoration

Bioengineering technologies are a promising direction in the field of environmental planning, as they use **natural processes** to clean and restore contaminated areas.

Phytoremediation is a method of cleaning contaminated lands and water resources with the help of plants. Plant roots absorb toxins from soil and water, accumulating them in their tissues. This approach is not only effective, but also cost-effective, as it allows you to restore large areas of areas without significant financial costs.

- **Example**: In Italy, phytoremediation is actively used to clean agricultural land affected by the excessive use of chemical fertilizers.

Waste management systems and resource reuse

In the environmental planning process, **effective waste management** and the transition to **circular economy** principles play an important role. The main idea is to minimize waste through its **recycling, reuse and disposal** for energy or new materials.

Modern waste management tools include:

- **Automated sorting lines** using artificial intelligence to identify and distribute different types of waste.
- **Systems for collecting biogas** from landfills, which is used to generate electricity.
- **Plastic recycling programs** that allow you to obtain new products from recycled materials.
- **Example**: In Sweden, about 50% of household waste is incinerated in specialized plants for the production of heat and electricity, which makes it possible to provide heating for entire cities.

Green technologies in construction

The construction sector is one of the largest sources **of greenhouse gas emissions** and consumption of natural resources. That is why environmental planning actively implements **green technologies in construction**, which minimize the negative impact on the environment.

Among the main solutions are:

- **Green roofs and walls**: Vegetation on the roofs of buildings improves air quality, regulates temperature, and reduces noise pollution.
- **Energy-efficient materials**: The use of insulation materials reduces the need for space heating and air conditioning.
- **Solar panels**: Producing energy from renewable sources to power buildings.
- **Example**: In Singapore, modern buildings are designed according to **the principles of biophilic design**, which includes the integration of green areas, water bodies and natural light into the urban environment.

Innovations in transport infrastructure

Environmental planning of the transport system is critical to reducing air pollution and reducing carbon emissions.

Key tools include:

- **Development of public electric transport**: Trams, electric buses and metros are the backbone of the transport system of many modern cities.
- **Implementation of bicycle infrastructure**: The creation of bicycle paths and rental stations reduces the traffic load on cities.
- **Integration of "smart" transport systems**: The use of sensors to optimize traffic and reduce congestion.
- **Example**: In the Netherlands, more than 30% of the population uses bicycles as their main mode of transport, which minimizes transport emissions and improves air quality in cities.
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1. **Environmental monitoring**
    - This is a system for monitoring the state of the environment and detecting negative changes.
    - **Tools**:
        - Sensors to measure air and water quality.
        - Satellite monitoring to control deforestation.
    - **Example**: Air quality monitoring systems in Beijing have reduced smog levels by 30% over the past 5 years.
2. **Green infrastructures**
    - It is a network of natural and semi-natural territories that provide ecological functions in the urban environment.

- **Components of green** infrastructures:
  - Parks, squares, green roofs.
  - Bioparks and wetlands for water filtration.
- **Example**: New York implemented the "Million Trees NYC" program, thanks to which more than a million trees were planted.

3. **Biophilic design**
   - This is the introduction of natural elements into the layout of buildings and urban spaces.
   - **Benefits**: Improved quality of life, reduced heat stress.
   - **Example**: In Singapore, buildings with biophilic design have become the standard for new projects.

CHAPTER 4. PROPOSALS AND PLANS FOR THE IMPLEMENTATION OF ECOLOGICAL CIVILIZATION

4.1. Development of an ecologically oriented planning model

The development of an ecologically oriented planning model is an important step towards the implementation of the concept of ecological civilization. It involves the integration of environmental principles into spatial planning processes, which allows to ensure harmony between the natural environment and the infrastructural development of territories. Such a model should be systematic, comprehensive, and include various aspects – from the preservation of ecosystems to the efficient use of resources.

The main idea of ecologically oriented planning is to create a balanced environment where natural ecosystems and human activities exist in harmony, mutually complementing each other. An important task is to ensure the **sustainability of territories**, which involves minimizing the negative impact on the environment and implementing effective measures to protect it.

Components of the Ecologically Oriented Planning Model

1. **Spatial zoning with an ecological emphasisSpatial zoning is the foundation for the environmental planning model. It provides for the**

division of territories into functional zones, each of which will have a clearly defined purpose and restrictions:

- **Residential areas** – construction must be carried out in compliance with the principles of energy efficiency and the use of environmentally friendly materials.
- **Industrial zones** – the location of facilities should take into account environmental restrictions, and enterprises should use modern technologies to reduce emissions and waste.
- **Recreational and nature conservation zones** are the preservation of green areas, forests, reservoirs and other natural objects for recreation of the population and the maintenance of biodiversity.

Example: In Sweden, spatial planning involves the presence of "buffer zones" between industrial facilities and residential areas, which minimizes the impact of harmful emissions on public health.

2. **Integration of green infrastructureGreen infrastructure is a key element of environmentally oriented planning. It involves the creation of a network of natural and semi-natural areas** that perform important environmental functions.
   - Parks, gardens, forest plantations and green corridors.
   - Green buildings - roofs and walls of buildings covered with plants.
   - Urbanized reservoirs that serve as natural reservoirs for rainwater.

   Example: In Singapore, green infrastructure is part of the overall strategy of the city, where more than 47% of the territory is made up of parks, gardens and vertical landscaping of buildings.

3. **Introduction of modern technologies and innovationsTechnological progress is an important tool for the development and implementation of environmentally oriented planning. The use of such innovations allows to increase the efficiency of territory management:**
   - **Geographic Information Systems (GIS)** for modeling and forecasting the ecological state of territories.
   - **Energy efficiency systems** for buildings and infrastructure that minimize energy consumption.
   - **Smart technologies** for real-time monitoring of air, water and soil conditions.

Example: In the United States, GIS technologies are actively used to map areas at risk of flooding and soil erosion, which avoids construction in dangerous regions.

4. **Taking into account local natural featuresThe ecologically oriented planning model should take into account regional features** such as climatic conditions, landscape relief, availability of natural resources and demographic indicators.

   Example: In the Netherlands, the threat of flooding is taken into account, so regional planning involves the creation of **a system of polders** - areas protected by dams and canals to control the water level.

Advantages of the Ecologically Oriented Planning Model

The implementation of such a model has a number of important advantages:

- **Environmental sustainability** is the conservation of natural resources and biodiversity.
- **Social comfort** is the creation of a healthy and safe environment for the life of the population.
- **Economic benefit** is a reduction in the cost of eliminating the consequences of environmental disasters and optimizing the use of resources.

The development of an ecologically oriented planning model is a strategically important task for modern cities and regions. The combination **of spatial zoning, green infrastructure, modern technologies** and taking into account local natural features will create **a harmonious environment** where the development of territories takes place without harming nature. Such a model is a key tool for building an ecological civilization that will ensure **a sustainable future** for the next generations.

4.2. Strategies for the integration of ecological civilization at the regional level

The integration of the principles of ecological civilization at the regional level is one of the key tasks for the sustainable development of territories. Since each region has

its own **natural, socio-economic and infrastructural features**, strategic planning should be adaptive and based on local conditions. In this context, it is important to take into account not only global challenges, such as climate change or resource degradation, but also **the specific needs of the population** a certain territory.

Environmental strategies should be based on **a systematic approach**, where natural ecosystems, economic development and the interests of local communities are combined into a single planning model.

1. Development of regional sustainable development programs

Regional sustainable development programs are strategic documents that determine **priority areas of environmental planning** and specific measures for their implementation. They cover several important components:

- **Conservation of natural resources and biodiversity**: Regional strategies should include measures for the protection of forests, water bodies, fertile soils and other natural resources. For example, in the Carpathian region of Ukraine there is a program for the conservation of primeval forests, which provides for the restriction of logging and the development of ecotourism.

- **Restoration of degraded areas**: Particular attention should be paid to areas that have been destroyed by industrial activities or climate change. In such regions, measures are being implemented for land reclamation, soil restoration and landscaping.
  Example: In Germany, after the closure of coal mines, large-scale landscaping and the creation of parks are being carried out on the site of former industrial zones.
- **Creation of regional nature conservation zones**: The strategy should include the creation **of reserves and reserves** that will protect natural ecosystems. At the same time, it is important to ensure access for the local population for recreation and educational purposes.

2. Development of environmentally friendly transport and infrastructure

At the regional level, the **optimization of the transport system**, which is one of the main sources of environmental pollution, plays an important role. The strategies include the following measures:

- **Public transport development**: Promoting the use of electric vehicles, trams, trolleybuses and electric buses reduces CO_2 emissions. For example, in Warsaw (Poland), 40% of city buses run on electric traction, which significantly reduces air pollution.
- **Creation of cycling infrastructure**:The construction of cycle paths and bicycle parking encourages residents to use environmentally friendly modes of transport. In Copenhagen, the bicycle network covers more than 400 km, and 70% of residents cycle every day.
- **Ban on the use of cars in central areas**:The introduction of "pedestrian centers" in cities reduces car traffic and improves air quality. For example, in Barcelona there is a strategy of "super neighborhoods", where cars are limited and space is given to pedestrians and green areas.

3. Development of the green economy and renewable energy

At the regional level, the implementation **of the green economy** allows you to simultaneously achieve economic development and reduce the negative impact on the environment. The main areas include:

- **Transition to renewable energy sources**: The use of solar, wind, hydropower allows regions to reduce dependence on fossil fuels. In Denmark, more than 50% of energy is provided by wind farms, and the Netherlands is actively developing offshore wind farms.
- **Promoting green business**: Supporting enterprises engaged in waste recycling, production of environmentally friendly products and the development of eco-innovation.
- **Energy modernization of buildings**: Insulation of buildings, implementation of energy efficiency systems and the use of "passive houses" contribute to reducing energy consumption.

4. Education and public engagement

Any strategy will not be effective without the active participation of local communities. It is important to ensure **environmental education** of the population through:

- Educational programs in schools and universities.
- Conducting seminars and public discussions of environmental initiatives.
- Organization of eco-festivals, fairs and actions, such as Earth Day.

Example: In Sweden, children learn how to sort waste from an early age, and sustainable lifestyle trainings are regularly held in local communities.

Strategies for the integration of ecological civilization at the regional level are multidimensional and include the **development of sustainable development programs, the development of clean transport, the introduction of a green economy** and the active education of the population. Local strategies should be based on the real needs of the regions, taking into account the natural, economic and social characteristics of the territories.

It is thanks to this approach that it is possible to achieve **environmental sustainability** and provide conditions for harmonious coexistence of nature and man.

One of the important steps in the implementation of the strategy is **the formation of ecological corridors** that connect individual nature conservation areas and ensure their ecological interaction. natural circulation of species and ecological balance.

In parallel with ecological corridors**, a water management strategy is important**, which includes measures for the rational use of water, the restoration of natural reservoirs and the creation of rainwater harvesting systems in cities and regions. In many European countries, such as the Netherlands and Denmark, "blue infrastructure" systems are actively being implemented – canals, artificial reservoirs and green areas that serve as water reservoirs during rains and floods. These solutions help to avoid flooding and at the same time improve local ecosystems.

Another area is **energy efficiency planning** at the regional level. In many countries, programs are being implemented that provide for the modernization of old infrastructure in order to increase its energy efficiency. This applies to both public buildings and industrial enterprises that switch to the use **of alternative energy**

sources. For example, in Finland, most municipal institutions are already equipped with solar panels and heat recovery systems, which can significantly reduce energy costs and reduce CO_2 emissions.

Another important component of the strategy is **the transition to a circular economy**, which focuses on minimizing waste and reusing resources. Under this model, waste from one enterprise can become resources for another, creating **closed production cycles**. For example, in Sweden, 99% of waste is recycled or used for energy production, and the rest is disposed of in accordance with the highest environmental standards. got rid of landfills, which are the main source of environmental pollution in many regions of the world.

An important component of the strategy is **the development of agriculture with an ecological focus**. In regions where the agricultural sector is the main economic activity, it is necessary to introduce **organic farming** and agroforestry methods. It has a positive effect on the quality of agricultural products and reduces soil and water pollution.

In many naturally rich regions where there are forests, mountains or unique bodies of water, ecotourism can become a powerful tool for stimulating the local economy without harming the environment. Projects are being implemented to create **eco-estates** and hiking trails that contribute to the development of regional tourism and nature conservation.

Thus, the strategies for the integration of ecological civilization at the regional level are multifaceted and cover **environmental planning, resource management, transition to a green economy** and raising environmental awareness of the population. The integrated combination of these approaches allows for the creation of sustainable regions where development occurs in harmony with nature, ensuring a sustainable future for future generations.

4.3. Assessment of the effectiveness of the proposed measures

Assessing the effectiveness of measures aimed at integrating ecological civilization is an important component of the process of planning and implementing sustainable development strategies. Without a clear system of monitoring, analysis and control,

it is impossible to assess how well the implemented measures have achieved their goal or what adjustments need to be made to increase their effectiveness.

The effectiveness of the proposed measures can be evaluated through **environmental, socio-economic and infrastructure indicators** that allow measuring results in specific areas.

1. Environmental indicators

Environmental indicators are the main indicator of the effectiveness of measures, since they reflect the state of the natural environment and the extent of its improvement or degradation after the implementation of strategies. The main indicators include:

- **Reducing air pollutionMonitoring the concentration of greenhouse gas emissions, dust (PM2.5, PM10) and harmful substances allows you to assess the positive impact of measures such as the development of electric transport or landscaping.**
    - **Example**: In Beijing, after implementing an emissions reduction program, the level of fine dust (PM2.5) has decreased by 40% in the last 10 years.
- **Improving the quality of water resourcesThe introduction of wastewater treatment systems, the restoration of natural reservoirs and the creation of "blue infrastructure" contribute to improving the quality of water in rivers and lakes.**
    - **Example**: In the Netherlands, the water in the canals of Amsterdam has undergone a biological treatment process and today is one of the cleanest among the metropolises in the world.
- **Expanding the area of green areasIncreasing the area of parks, forest belts, squares and green roofs is a key indicator of environmental planning.**
    - **Example**: In Singapore, 47% of the city's territory is green spaces, which allows you to maintain clean air and reduce the average daily temperature.
- **Conservation of biodiversityAssessment of the state of protected areas and restoration of populations of rare species is an important indicator of the effectiveness of conservation measures.**

2. Socio-economic indicators

Socio-economic indicators help to assess how the measures have had a positive impact on the well-being of the population and the local economy. Key indicators include:

- **Improving the quality of life of the populationThe quality of air, water and access to green areas directly affect the health and well-being of residents of the regions. Measuring the incidence of respiratory diseases or allergies is one of the indicators of the positive impact of environmental measures.**
    - **Example**: In Copenhagen, thanks to the development of cycling infrastructure and reduced car emissions, the rate of cardiovascular disease has decreased by 15%.
- **Creating jobs in the green sector of the economyThe transition to renewable energy sources, the introduction of waste recycling systems and the development of ecotourism create new jobs and contribute to economic growth.**
    - **Example**: In Germany, the transition to renewable energy has created more than 300 thousand jobs in a new sector of the economy.
- **Level of energy efficiency of regionsReducing energy consumption in buildings and infrastructure allows you to reduce the cost of maintaining territories and increase resource savings.**

3. Infrastructure indicators

Infrastructure indicators allow you to assess changes in urban planning and regional policy as a result of environmental planning. Key aspects include:

- **Development of transport infrastructureThe number of kilometers** of bicycle paths, pedestrian zones, the introduction of electric transport and a decrease in the share of car traffic.
    - **Example**: In Barcelona, the introduction of "superquarters" has reduced the number of cars in the central areas of the city by 30%.

- **Scale of implementation of green buildingsThe number of buildings with green roofs, walls and energy-efficient systems that have a positive effect on the local microclimate.**
- **Creation of nature conservation zones and eco-corridors** Assessment of the area of restored areas, their ecological functionality and impact on the natural environment.

4. Monitoring and adjusting strategies

To effectively evaluate the results of the implemented measures, it is necessary to establish **a monitoring system** that will include regular data collection, processing and analysis. Regional authorities should cooperate with scientific institutions in order to have an objective picture of the effectiveness of strategies.

Based on the data collected, **corrective measures are developed** to improve the effectiveness of programs. For example, if the development of public transport did not provide the expected reduction in emissions, the plan to stimulate the use of electric transport could be revised.

The effectiveness of the proposed measures can only be assessed through an integrated approach that includes **environmental, socio-economic and infrastructural indicators**. Regular monitoring, analysis of results and adjustment of strategies are the key to achieving sustainable development goals and building ecological civilization at the regional level.

4. Development of long-term monitoring indicators

To ensure sustainable development and effectively evaluate environmental planning measures, it is necessary to implement **long-term monitoring indicators** that allow the results of strategies to be tracked over time. This is especially important because some changes, such as ecosystem restoration or reduced pollution levels, take **many years** to obtain visible results.

Long-term indicators include:

1. **The state of forests and green areas**
    - Dynamics of the area of forests, squares and other green spaces in the regions.

- Estimation of the number of trees planted within the framework of landscaping programs and their survival.
- **Example**: In New York's Million Trees program, more than a million trees were planted over 10 years, which made it possible to reduce the temperature in the city by several degrees during the summer heat.

2. **Quality of water resources**
   - Assessment of the purity of rivers, lakes and reservoirs according to the indicators of chemical, biological and bacteriological analysis.
   - Implementation of systems for **water reuse** in cities and regions.
   - **Example**: In Singapore, the "NEWater" program allows wastewater to be treated to a level of drinking quality, providing about 40% of the city's water supply.
3. **Reducing greenhouse gas emissions**
   - Measurement of the dynamics of reducing emissions of CO_2, methane and other harmful gases in territories.
   - Taking into account the share of alternative energy sources in the overall energy balance of the region.
   - **Example**: Denmark has set a goal to achieve **climate neutrality** by 2050 through the phasing out of fossil fuels and the massive use of wind energy.
4. **Socio-economic well-being of the population**
   - Dynamics of the standard of living of the population due to the implementation of environmental programs.
   - Reducing the incidence of chronic diseases associated with environmental pollution.
   - Increasing the number of jobs in the "green economy" and new industries.
   - **Example**: In Sweden, the implementation of energy efficiency programs has created more than **100 thousand** jobs in the construction and energy sectors.

5. Use of innovative technologies for monitoring

Modern innovative technologies can significantly increase the accuracy and efficiency of the process of evaluating the effectiveness of the proposed measures. This is especially important at the regional level, where it is necessary to analyze **large amounts of data** and ensure their visualization for effective management decisions.

These technologies include:

1. **Geographic Information Systems (GIS)**
   GIS technologies help to create detailed maps of air, water and soil pollution, as well as predict potential risks. For example, thanks to GIS, it is possible to quickly identify areas with a high level of emissions and plan measures to reduce them.
2. **Remote sensing of the Earth (ERS)**
   The use of satellite data allows you to receive information about the state of the environment in real time.
   - **Example**: In the United States, NASA satellites are used to monitor deforestation, air pollution levels, and climate change dynamics.
3. **Smart sensors and IoT systems**
   Sensor systems that measure air quality, noise pollution and water resources are being actively implemented in cities. The collected data is transmitted to analytical platforms for further analysis.
   - **Example**: In London, a network of sensors monitors the level of air pollution, which allows you to instantly respond to exceeding the norms.
4. **Analytical platforms with artificial intelligenceThe use of artificial intelligence algorithms allows you to analyze large amounts of data and predict the effectiveness of the implemented measures.**

6. The importance of feedback and adjusting strategies

The effectiveness of any measures largely depends on the availability **of feedback** between stakeholders, in particular authorities, scientists, the public and enterprises. Regular public discussions and public reports on the achieved results make it possible to identify weaknesses in the implementation of programs and make the necessary adjustments.

- **Example**: In Germany, the National Environmental Report **is published every 5 years**, where the results of the implemented measures are analyzed and the strategic goals are updated.

Evaluation of the effectiveness of the proposed measures is an integral part of environmental planning, which allows monitoring their implementation, measuring results and making the necessary adjustments in time. The use **of environmental,**

socio-economic and infrastructural indicators in combination with modern monitoring technologies provides a systematic approach to the evaluation of results. Monitoring can achieve the goals of ecological civilization and ensure **the sustainable development** of regions for many years to come.

CHAPTER 5. OCCUPATIONAL HEALTH AND SAFETY

5.1. General requirements for labor protection in environmental planning

Occupational health and safety is an integral part of any type of activity, including **environmental planning and project implementation processes**. General occupational health and safety requirements include:

- Ensuring the safety of work at all stages of research and practical activities.
- Compliance with **safety precautions** when performing measurements, monitoring the ecological state of territories and during work in the field.
- Use **of personal protective equipment** (PPE): helmets, overalls, respirators, gloves, etc.
- Conducting **briefings** for employees on labor protection and fire safety.

Compliance with these requirements ensures the preservation of the health of employees and minimization of risks in the process of performing environmental planning tasks.

5.2. Labor protection during work on the creation of green infrastructure

The creation of green infrastructure is an important element of environmental planning, as it performs both **environmental** and **socio-economic** functions. Green infrastructure includes parks, squares, green corridors, public gardens, vertical landscaping of buildings and other green areas. Compliance with **labor protection** rules is mandatory to ensure the safety of workers and minimize the risks of industrial injuries.

Organizational measures for labor protection

To ensure the safe performance of work during the creation of green infrastructure, it is necessary:

1. **Briefings**:

- **Introductory briefing** for new employees on general safety rules.
- **Initial briefing** at the workplace on the rules for handling equipment, tools and materials.
- **Periodic briefings** on labor protection for all employees involved in work.

2. **Organization of** workplaces:
   - Clear definition of **work areas** and places for work.
   - Providing adequate **lighting** and **coverage of areas** to minimize the risks of falls or injury.
3. **Medical examination of employees**:
   - Conducting a preliminary and periodic **medical examination** to identify contraindications to physical activity.
   - Monitoring the health status of employees, especially in hot or cold weather.

Personal protective equipment (PPE)

Employees involved in the creation of green infrastructure must be provided with personal protective equipment to prevent possible injuries or exposure to harmful factors.

The main PPE includes:

- **Overalls**: work suits that provide protection against dirt, cuts and mechanical damage.
- **Safety shoes**: boots or boots with reinforced soles to prevent injury to the feet.
- **Gloves**: To protect your hands when handling tools, plants, or chemicals.
- **Safety goggles**: when using lawn mowers, chainsaws or work related to cutting branches.
- **Helmets**: to protect the head when working at height or in places where objects may fall.
- **Respirators or masks**: to protect the respiratory system when working with fertilizers, chemicals or in dusty conditions.

Safety when using technical equipment

Work to create green infrastructure often requires the use of a variety of **technical equipment** and tools, such as lawn mowers, chainsaws, electric trimmers, garden shears, tractors, etc.

Safety requirements when working with equipment:

1. Before starting work, you should **check the serviceability of tools and equipment**.
2. Only trained workers **are allowed to use the equipment**.
3. It is forbidden to work with tools in a state of fatigue, under the influence of alcohol or drugs.
4. When using the equipment, **a safe distance** between workers must be maintained to avoid accidents.
5. The workplace must be **cleared of foreign objects** before using the equipment.

Safety when performing work at height

Creating vertical gardening or caring for trees involves performing work at height. To minimize risks, it is necessary:

- Use **safety systems** and safety belts.
- Use **stable structures**: ladders, towers or lifts.
- Work in a team where one person controls the safety of another.
- Perform work in **favorable weather conditions** (it is forbidden to work in rain, strong wind or ice).

Protection against harmful substances

When planting or caring for plants**, fertilizers, pesticides and other chemicals** are used that can adversely affect the health of workers.

Protection measures:

1. The use **of specialized sprayers** that minimize contact with chemicals.

2. Providing employees **with respirators and protective suits**.
3. Compliance with **the norm of dosage** of chemicals.
4. Carrying out work at **a clearly defined time**, when there are no unauthorized persons (morning, evening).
5. Organization **of places to wash hands and face** after contact with chemicals.

5.3. Fire safety at objects of environmental importance

Fire safety at objects of environmental importance is one of the **most important components of labor protection and environmental protection**. Protected areas, such as national parks, reserves, forests, wetlands and recreational areas, play **a key role** in biodiversity conservation, climate regulation and environmental balance.

However, these areas are vulnerable to fires, especially in **hot climates, increased dryness and anthropogenic load**. Forest and steppe fires lead to **large-scale destruction of ecosystems**, loss of rare species of plants and animals, air pollution and significant economic losses. Therefore, ensuring fire safety is **a priority** task for the preservation of environmental protection facilities.

Causes of fires in protected areas

1. **Anthropogenic factors**:
    - Uncontrolled burning of vegetation or dry grass.
    - Careless handling of fire: making fires, smoking in unspecified places.
    - Use **of fire-hazardous equipment** (chainsaws, equipment without spark arresters).
    - The presence of debris, especially **glass bottles**, that can focus the sun's rays.
2. **Natural factors**:
    - Prolonged lack of precipitation and **high** air temperatures.
    - **Lightning**, which is the cause of spontaneous combustion of vegetation.
    - Rapid spread of fire due to **windy weather** or dense vegetation.
3. **Low level of control**:
    - Insufficient number of fire safety equipment.
    - Lack of monitoring and early detection systems for fires.

Basic fire safety measures

To ensure fire safety at environmental protection facilities, it is necessary to implement a **set of measures** including **fire prevention, monitoring, response and extinguishing**.

1. Prevention of fires

- **Organization of fire seasons**: restriction of visits to territories during periods of increased fire danger (spring-summer period).
- **Arrangement of fire barriers**: creation of mineralized strips that prevent the spread of fire.
- **Installation of information stands and signs** prohibiting making fires, smoking and the use of open fires.
- **Providing patrolling of territories** by specialized teams to identify potential threats.

2. Technical support of fire safety

- Equipping territories **with fire-fighting equipment**:
  - Fire extinguishers, shovels, knapsack fire extinguishers, motor pumps for extinguishing fire.
  - Water reserves in special containers or natural reservoirs for prompt response.
- **Implementation of early fire detection systems**:
  - Using **thermal sensors** and surveillance cameras to monitor the situation in real time.
  - Remote sensing of territories using **drones** and satellite images.

3. Extinguishing fires

- Development **of fire extinguishing plans** that determine the procedure for actions in case of fire.
- Organization **of exercises and trainings** for employees of protected areas.
- Involvement **of specialized fire brigades** and equipment for quick extinguishing of fires.

Organization of personnel actions

Personnel working in protected areas must be **clearly instructed** and ready to act in the event of a fire. Key responsibilities include:

1. **Immediate notification of responsible persons** about the detected fire.
2. **Organization of evacuation of visitors** from dangerous areas.
3. **Use of primary fire extinguishing means** before the arrival of fire services.
4. Involvement **of volunteer teams** to localize the fire at the initial stage.

The importance of fire safety for environmental protection facilities

Ensuring fire safety at objects of environmental importance is critically important for:

- **Biodiversity conservation**: Fires lead to the loss of unique plant and animal species.
- **Prevention of economic damage**: The destruction of ecosystems, forests and recreational areas entails significant restoration costs.
- **Maintaining ecological balance**: Forest and steppe fires cause soil degradation, air and water pollution.
- **Ensuring the safety of the population**: Having an effective fire protection system reduces the risk of fire spreading to nearby areas.

5.4. Environmental safety for employees and the population

Environmental safety is an important aspect in the implementation of environmental planning measures, especially in cases where work is carried out in areas with a high level of pollution or vulnerable ecosystems. Ensuring **environmental safety** is aimed at protecting the health of employees and the population from the negative impact of **harmful substances**, dangerous working conditions and man-made factors that may arise in the process of planning work.

This unit focuses on measures and recommendations that allow minimizing risks to human health and the environment when performing tasks for the creation and maintenance **of ecologically oriented areas**.

Main threats to environmental safety

1. **Chemical contaminants**:
    - Exposure **to toxic substances** contained in soils, water or air in areas to be recovered.
    - The use of **fertilizers, pesticides and herbicides** during landscaping can pose a threat to the health of workers.
2. **Physical factors**:
    - Increased noise level from machinery and equipment.
    - Risk of injury during work in difficult conditions (at height, on slopes or in wetlands).
3. **Biological risks**:
    - Contact with potentially dangerous plants (allergens, poisonous plants).
    - Bite of insects, ticks or animals that can carry infectious diseases.
4. **Atmospheric pollution**:
    - Exposure to dust, equipment exhaust gases or other **aerosol pollutants**.
5. **Social risks**:
    - Insufficient awareness of the population about environmental threats during the implementation of planning activities.

Measures to ensure environmental safety

To minimize risks and ensure safety during work, it is necessary to implement a set of measures aimed at protecting both employees and the local population.

1. Personal protective equipment (PPE)

Providing employees with proper personal protective equipment is a priority task:

- **Respirators and masks** to protect the respiratory system from dust, aerosols and chemicals.
- **Protective gloves** for working with soil, plants or chemicals.
- **Overalls and safety shoes** that provide protection against mechanical damage and pollution.
- **Goggles and shields** to protect your eyes from dust and small particles.
- **Anti-allergenic agents** to prevent skin and respiratory irritation.

2. Technical protection measures

- **Monitoring of air, water and soil quality** in the work areas.
- Use **of environmentally friendly technologies** and low-emission equipment.
- Limiting the use **of toxic chemicals** during landscaping and land reclamation.
- Carrying out work in **favorable weather conditions** to minimize the spread of dust and pollutants.

3. Medical and preventive measures

- **Regular medical** examinations of employees to monitor the state of health.
- Providing **resting places** with clean drinking water, especially during the hot season.
- Provision **of individual first-aid kits** to employees and organization of first aid points at work sites.
- Vaccination **against diseases that can be transmitted through contact with vegetation or insects** is mandatory.

4. Informing and raising environmental awareness

- Conducting **briefings** and trainings for employees on risks and safety rules during work.
- **Informing the population** about the work through local media, announcements and public meetings.
- Implementation **of environmental campaigns** that explain the importance of measures to restore territories and rules of safe behavior at such facilities.

Control over compliance with environmental safety

For the effective implementation of environmental safety measures, it is necessary to carry out **systematic control and monitoring**. The main measures include:

1. **Environmental audit** of work areas to identify and eliminate potential threats.
2. **Laboratory control** of water, air and soil quality in work areas.

3. **Regular checks of the condition of equipment** to prevent emergencies.
4. **Control of emissions and waste** in the process of work to minimize environmental pollution.

CONCLUSIONS

In the process of the study, key issues related to environmental planning in the context of building an ecological civilization were analyzed and systematized. Taking into account modern challenges and global trends, the main approaches, methods and tools that ensure the formation of sustainable development of territories and their harmonious interaction with the natural environment have been identified.

1. Relevance of environmental planningEnvironmental planning is an integral part of modern territory management. Due to global environmental challenges, such as **climate change, biodiversity loss, environmental pollution and resource depletion**, the need to transition to environmentally oriented planning becomes extremely important. sustainable development at different levels – from local to global.

2. Basic methodological approaches to environmental planningThe study demonstrated that effective environmental planning is based on the integrated application of methodological approaches. These include:

- **An environmental approach** aimed at preserving ecosystems, creating nature conservation zones and restoring the environment.
- **Landscape and ecological approach**, which takes into account the natural potential of territories for their optimal use.
- **A socially-oriented approach** that focuses on improving the quality of life of the population through the development of green infrastructure and the creation of a comfortable environment.
- **A technological approach** that involves the use of modern innovative solutions to monitor the state of the environment and optimize planning processes.

The integration of these approaches allows to ensure **a balance between the needs of society** and the requirements for the preservation of the natural environment.

3. Challenges of modern planning and their overcomingThe current state of the environment is characterized by global threats that affect the stability of natural ecosystems and the quality of life of the population. The main challenges are:

- Air, water and soil pollution.
- Climate change and its negative impact on territories.
- Loss of biodiversity and degradation of natural resources.
- Rapid urbanization and chaotic urban planning.

The study showed that the effective application of environmental planning tools such as **geographic information systems, monitoring, green technologies and waste management** is key to overcoming these challenges. An important factor is the **combination of international experience** with the local characteristics of the territories to achieve the most optimal solutions.

4. Global practices as a guideline for sustainable developmentAs a result of the study, the best world practices in the field of environmental planning were considered, demonstrating the effectiveness of the application of modern approaches and technologies:

- **Singapore** is implementing the concept of a "garden city", where more than 47% of the territory is occupied by green areas.
- **Germany** is actively implementing energy-efficient technologies and renewable energy within the framework of the "Energiewende" program.
- **Sweden** successfully implements the "Zero Waste" model, where 99% of waste is recycled or used for energy production.
- **The Netherlands** demonstrates the effectiveness of integrated water management to combat flooding.

These examples highlight that **combining environmental strategies** with economic benefits and social benefits is the most effective way to achieve sustainable development.

5. Tools and technologies for environmental planningParticular attention was paid to the tools and technologies that are the basis of environmental planning. In particular:

- **Geographic information systems (GIS)** and remote sensing of the Earth provide monitoring of changes in the environment and provide an opportunity to predict the consequences of planning decisions.
- **Engineering solutions** such as green infrastructure, phytoremediation and energy-efficient technologies contribute to the restoration of territories and minimize the negative impact of humans.
- **Innovative approaches** in transport and construction can achieve significant reductions in emissions and resource consumption.

6. The importance of integrating environmental strategies into spatial planningEnvironmental planning is strategically important for ensuring sustainable development. It contributes to the harmonization of the interests of society, the economy and the environment, ensuring **a long-term balance** between the development and conservation of natural resources.

Thus, the results of the study confirm that **environmental planning** is an effective tool for overcoming modern challenges and building an ecological civilization. to achieve **harmony between nature and society**, ensuring a high level of quality of life for current and future generations.

7. The role of environmental planning in the construction of ecological civilizationThe study confirmed that environmental planning is the basis for the formation of ecologically balanced areas. The creation of ecological civilization is impossible without awareness of the importance of sustainable development and the need to integrate **environmental principles** at all levels of government.

Modern realities require **a revision of traditional development models** that focused on maximizing economic growth at the expense of resource depletion. Today, it is important to find **the optimal balance**, where natural ecosystems will not only be preserved, but also restored to ensure a healthy future.

The role of environmental planning is as follows:

1. **Rational use of natural resources**: The gradual transition to renewable energy sources and closed cycles in production allows you to reduce the consumption of non-renewable resources.
2. **Biodiversity conservation**: The planning of conservation areas and green corridors ensures the preservation of natural habitats for flora and fauna species.

3. **Creating a comfortable urban environment**: Green spaces, clean air, efficient transport infrastructure and water management systems are an integral part of environmentally sustainable cities.

8. Practical recommendations based on the studyAs a result of the analysis of environmental challenges and world practices, a number of practical recommendations were formulated that contribute to increasing the effectiveness of environmental planning:

1. **Implementation of green infrastructure** in cities and regions, including the creation of parks, squares, green roofs and forest belts to reduce the impact of urbanization on the environment.
2. **Development of alternative energy sources**: The use of solar, wind and hydropower as the main source of energy supply will reduce greenhouse gas emissions.
3. **Improving waste management efficiency**: Implementing waste sorting, recycling and reuse systems to minimize the burden on the natural environment.
4. **Environmental monitoring**: Using modern digital technologies such as geographic information systems (GIS), air and water quality sensors to regularly monitor changes in the natural environment.
5. **Raising environmental awareness of the population**: Conducting educational campaigns and awareness-raising activities that contribute to the formation of a culture of environmentally responsible behavior.

9. Prospects for further researchAlthough the study covers a wide range of issues related to environmental planning, there is significant potential for further scientific research and research in this direction.

Main areas for further research include:

- **Development of integrated planning models** that combine social, economic and environmental aspects of territorial development.

- **Study of the impact of climate change on environmental planning processes** and development of strategies for adaptation of territories to global warming.
- **Using artificial intelligence and machine learning** to predict the environmental impacts of planning decisions.
- **Analysis of local and global practices** in order to adapt best practices to the conditions of specific regions.

PRACTICAL RECOMMENDATIONS

On the basis of the research on environmental planning in the context of building an ecological civilization, it is possible to formulate the following **practical recommendations** aimed at achieving sustainable development and increasing the effectiveness of management decisions in this area.

1. Development and integration of green infrastructure

One of the key recommendations is the active development and implementation of **green infrastructure** in urban and regional planning. This approach provides not only the aesthetic appearance of the territories, but also performs important environmental functions: air purification, microclimate regulation, and biodiversity conservation.

Main activities:

- Creation of new parks, squares, public gardens in cities and settlements.
- Landscaping of roofs and facades of buildings to increase the area of green spaces.
- Restoration of natural areas such as forest belts, wetlands and coastal zones.
- Creation **of green corridors** that connect protected areas and allow you to preserve the habitats of animals and plants.

Example: The "green infrastructure" model is actively implemented in **Singapore**, where more than 47% of the territory is occupied by green spaces, and green roofs are an integral part of urban architecture.

2. Optimization of transport infrastructure and development of environmentally friendly transport

In order to reduce air pollution and greenhouse gas emissions, it is necessary to introduce **environmentally friendly modes of transport** and optimize the existing transport infrastructure.

Main activities:

- Development of public electric transport (electric buses, trams, trolleybuses) to reduce car traffic.
- Creation of convenient and extensive **cycling infrastructure** in cities (bike paths, parking lots, rental stations).
- Restriction of the use of private transport in the central areas of cities, creation of pedestrian zones.
- Introduction **of "smart" transport systems** that regulate traffic and reduce congestion.

Example: In **Copenhagen,** more than 60% of the population uses bicycles as their main mode of transport, which reduces CO_2 emissions and improves the quality of life of citizens.

3. Implementation of energy-efficient and renewable technologies

To achieve sustainable development, it is important to implement **energy-efficient solutions** and switch to **renewable energy sources**.

Main activities:

- Use of solar, wind and hydropower as alternatives to fossil fuels.
- Construction **of energy-efficient buildings** that minimize energy consumption thanks to modern materials and technologies.
- Stimulating investors to implement green technologies in industry and construction.
- Development of programs for building insulation and infrastructure modernization to reduce heating and electricity costs.

Example: In **Germany** , the "Energiewende" program stimulates the development of renewable energy, whereby more than 50% of electricity is generated from clean sources.

4. Implementation of waste management systems

It is necessary to develop and implement modern **waste sorting, processing and disposal** systems, which will reduce the burden on the environment and ensure the reuse of resources.

Main activities:

- Implementation of a separate waste collection system at the level of households and enterprises.
- Creation of infrastructure for recycling of secondary raw materials and production of energy from garbage.
- Stimulating business to transition to **a circular economy**, where waste from one production is used as a resource for another.
- Conducting educational campaigns to improve the culture of waste management among the population.

Example: In **Sweden,** 99% of waste is recycled or used for energy production, which allows you to almost completely avoid the use of landfills.

5. Monitoring and control of the state of the environment

The introduction **of systems for constant monitoring of the state of the environment** allows timely detection of deviations from the norm and response to environmental threats.

Main activities:

- Use **of modern sensor systems** to monitor air, water and soil quality in real time.
- Analysis of satellite data to track changes in landscapes and pollution levels of areas.
- Creation of open databases for public access by citizens and scientists.
- Implementation **of an environmental audit** system at enterprises to control their impact on the environment.

6. Increasing environmental awareness of the population

The effectiveness of environmental planning depends to a large extent on **the active participation of the public** and the increase in the level of environmental awareness.

Main activities:

- Implementation of environmental education in schools, higher education institutions and public initiatives.
- Organization of **campaigns to educate the population** about the importance of sustainable development, resource conservation and waste management.

- Involving the public in the discussion of environmental projects at the level of cities and regions.
- Carrying out **eco-actions** such as cleaning areas, planting trees and natural landscape restoration activities.

FURTHER DEVELOPMENT PROSPECTS

In view of the results of the study, environmental planning is the main tool for achieving **sustainable development** and building **an ecological civilization**. However, modern challenges such as climate change, urbanization, biodiversity loss and degradation of natural resources require further improvement of methods and approaches in this area.

Further prospects for the development of environmental planning can be considered from several key areas, covering both technological innovations and social and managerial changes.

1. Integration of innovative technologies

Further development of environmental planning is impossible without the active introduction of **modern technologies** that allow for a more effective assessment of the state of the environment, forecasting changes and implementing optimal solutions.

Main areas of development:

- **Development of "Smart Cities",** where Internet of Things (IoT) technologies, environmental monitoring systems, green buildings and alternative energy are integrated. This will minimize the negative impact of cities on nature.
- **Using artificial intelligence (AI)** and big data to analyze environmental threats, optimize transportation systems, and predict the consequences of planning decisions.
- **Digital twins of cities** are virtual copies of real territories that allow you to simulate various development scenarios and assess their environmental impact.

- **Remote sensing of the Earth** for global monitoring of climate change, deforestation, water pollution and changes in urban landscapes.

Perspective: Technologies will increase the **accuracy of forecasting**, reduce decision-making time and minimize errors in territory planning.

2. Expanding the concept of "green infrastructure"

In the future, special attention will be paid to the development and expansion **of green infrastructure**, which will become the basis for the harmonious development of cities and regions.

Main prospects:

- **Creation of multifunctional green areas** that will perform ecological, social and recreational functions.
- **Vertical landscaping of** buildings as an effective method of increasing the area of green spaces in densely built-up cities.
- **Development of green corridors** to ensure the migration of animals and the preservation of biodiversity.
- **Introduction of urban forests** and public gardens, which will contribute to improving air quality and creating a comfortable microclimate.

Perspective: With the integration of green infrastructure, cities will become more **resilient to climate change**, pollution levels will decrease, and the quality of life of the population will improve significantly.

3. Transition to a circular economy

The further development of environmental planning implies **a complete transition to a circular economy**, where resources are used efficiently and waste becomes new resources.

Main areas of development:

- **Stimulating waste recycling** at all levels: from households to large enterprises.
- **Development of waste minimization programs**: implementation of "Zero Waste" policies in cities and regions.

- **Encouraging businesses** to use closed production cycles, where waste from one industry becomes resources for another.

Outlook: A complete transition to a circular economy will reduce the burden on natural resources, minimize waste and provide **economic benefits** from the introduction of environmentally friendly technologies.

4. Raising environmental awareness of the population

Further development of environmental planning is impossible without the active participation **of the public** and raising the level of environmental culture among the population.

Main activities:

- **Implementation of environmental education** at all levels – from preschool institutions to universities.
- **Organization of education campaigns** that inform citizens about the importance of nature conservation, efficient use of resources and minimization of waste.
- **Intensification of public initiatives**: involvement of the public in the implementation of environmental projects, such as planting trees, cleaning up territories, creating public gardens.

Perspective: A high level of environmental awareness will become the basis for **systematic environmental conservation**, as the population will actively support environmentally oriented measures and policies.

5. Adaptation to global climate change

Global climate change requires the development **of adaptation strategies** that will minimize their negative impact on territories.

Main directions:

- **Construction of infrastructure** resistant to climatic disasters (flooding, heat, landslides).
- **Creation of water management systems**, including rainwater collection tanks and flood protection barriers.
- **Landscaping of territories** to regulate temperature and reduce the thermal effect in cities.

Perspective: Adaptation to climate change will ensure **the resilience of regions** to external threats and minimize economic and social losses.

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