

CLIMATE CHANGE IN BULGARIA AND PRESUMPTION FOR THE FORMATION OF "NEW - ECO" SETTLEMENTS

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ABSTRACT

Climate change is a fact of planet Earth. Whether the change is based on natural-cyclical causes or as a result of increased anthropogenic activity (socio-economic) is the next "big controversy" in the scientific community. The collection of statistical information related to climate change enables the creation of models that can be useful in predicting climate change in the future. For Bulgaria, tracking the dynamics of the processes is essential, since the country is located in the transition zone between two climatic zones (subtropical and moderately continental). At this stage in the development of human civilization, regardless of the advancement of technology, the influence and change of climate processes is still sustained by the natural flora and fauna at the local and global level. The formation and maintenance of green areas and, in particular, "new green eco-villages" is essential for society in the modern way of life. On the territory of the country, there are opportunities to expand and create green areas, both in urbanized areas and outside them.

KEYWORDS: Climate, climate change, green settlements and green spaces.

ABSTRAKT

Der Klimawandel ist eine Tatsache auf dem Planeten Erde. Die Frage, ob der Wandel auf natürliche, zyklische Ursachen oder auf verstärkte anthropogene (sozioökonomische) Aktivitäten zurückzuführen ist, ist die nächste "große Kontroverse" in der wissenschaftlichen Gemeinschaft. Die Sammlung statistischer Informationen über den Klimawandel ermöglicht die Erstellung von Modellen, die bei der Vorhersage des künftigen Klimawandels hilfreich sein können. Für Bulgarien ist die Verfolgung der Dynamik der Prozesse von wesentlicher Bedeutung, da das Land in der Übergangszone zwischen zwei Klimazonen (subtropisch und gemäßigt kontinental) liegt. In diesem Stadium der Entwicklung der menschlichen Zivilisation wird der Einfluss und die Veränderung der Klimaprozesse ungeachtet des technischen Fortschritts immer noch von der natürlichen Flora und Fauna auf lokaler und globaler Ebene getragen. Die Schaffung und Erhaltung von Grünflächen und insbesondere von "neuen grünen Ökodörfern" ist für die Gesellschaft in der modernen Lebensweise unerlässlich. Auf dem Territorium des Landes gibt es Möglichkeiten zur Erweiterung und Schaffung von Grünflächen, sowohl in urbanisierten Gebieten als auch außerhalb davon.

STICHWORTE: Klima, Klimawandel, grüne Siedlungen und Grünflächen.

RÉSUMÉ

Le changement climatique est une réalité de la planète Terre. La question de savoir si ce changement est basé sur des causes naturelles-cycliques ou s'il résulte d'une activité anthropogénique accrue (socio-économique) est la prochaine "grande controverse" de la communauté scientifique. La collecte d'informations statistiques relatives au changement climatique permet de créer des modèles qui

peuvent être utiles pour prévoir le changement climatique à l'avenir. Pour la Bulgarie, le suivi de la dynamique des processus est essentiel, car le pays est situé dans la zone de transition entre deux zones climatiques (subtropicale et modérément continentale). À ce stade du développement de la civilisation humaine, indépendamment des progrès de la technologie, l'influence et le changement des processus climatiques sont toujours soutenus par la flore et la faune naturelles au niveau local et mondial. La formation et l'entretien des espaces verts et, en particulier, des "nouveaux éco-villages verts" sont essentiels pour la société dans le mode de vie moderne. Sur le territoire du pays, il existe des possibilités d'étendre et de créer des espaces verts, tant dans les zones urbanisées qu'en dehors de celles-ci.

MOTS CLÉS: Climat, changement climatique, établissements verts et espaces verts.

INTRODUCTION

The climate of planet Earth has always been and will always be in a process of cyclical change. The formation, development and change of this atmospheric process began parallel to planetary existence. Currently, according to the geochronological table, the planet is in the Phanerozoic Eon, Neozoic Era, under the Quaternary Era, Neogene Period, Holocene Epoch, or Quaternary Ice Age, which began 2,58 million years ago. The earth goes through different cycles of temporal climatic changes, alternating ice ages with warm periods in between, known as - interglacial ages. Twenty-two centuries ago, the ancient Greeks established the dependence of climatic conditions on the inclination of the sun's rays relative to the horizon, since then the term "climate", introduced by Hipparchus (190-120 BC), has been preserved, which means "inclination". From the time of the ancient Greeks to the present day, approximately 60-70 definitions of this process have been formulated (Aleksandrov, 2010). The shortest definition reads: "Climate is the perennial weather regime characteristic of a given place", however, climate-forming factors are not represented here. The definition has been expanded and takes the following form: "Climate of a given place is called the weather regime determined by the solar radiation, the nature of the covering surface and the associated atmospheric circulation" (<https://sites.google.com/site/metshumen/Home/klim>)

The term weather in meteorology refers to the state of the atmosphere, at any particular moment or time segment, for a given place. The Earth's atmosphere is characterized by a set of meteorological elements: temperature, air humidity, atmospheric pressure, cloudiness, wind, etc., such as phenomena: fog, frost, snow cover, etc.

(<https://sites.google.com/site/metshumen/Home/klim>)

The last and most accurate definition of "Climate" was adopted at the Conference on Physical Basis of Climate and Climate Modeling in Stockholm in 1974 and reads: "Climate is a statistical ensemble of states through which the system atmosphere-hydrosphere-lithosphere- cryosphere-biosphere over time periods of the order of several decades".

On 02/04/1991, the Council of the European Community authorized the Commission to participate on behalf of the Community in the negotiations on the UN Framework Convention on Climate Change, adopted in New York on 05/09/1992. The Convention was ratified by Decision 94/69/EC of 15.12.1993 and entered into force on 21.03.1994. The signed Framework Convention (by 122 countries) sets out basic principles in a global aspect regarding the fight against climate change. It defines in particular the principle of "common but differentiated responsibilities". The Convention does not contain

specific, numerical commitments regarding the reduction of greenhouse gas emissions. There are no specifics for every single country or region for a certain continent. In order to achieve a greater effect, the leaders of the countries that signed the Framework Convention decided to gather at a conference in March 1995 in Berlin. The goal is to renegotiate concrete solutions and steps to reduce CO₂ and greenhouse gas emissions of the highly developed industrialized countries for the period after the year 2000. Prolonged working meetings and consultations between individual leaders of countries and communities began. On 11.12.1997, the so-called "Kyoto Protocol" was signed in Kyoto. The Protocol, which followed the United Nations Framework Convention on Climate Change, is one of the most important international legal documents designed to combat climate change. It contains commitments made by industrialized nations to reduce their emissions of certain greenhouse gases responsible for global warming. In total, the emissions of developed countries must be reduced by at least 5% for the period 2008-2012 compared to the level of 1990. Decision 2002/358/EC of the Council of 25.04.2002 for the approval on behalf of the European Community of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint implementation of the commitments arising from it.

The Paris Climate Conference was attended by 195 countries on 12/12/2015, and the agreed agreement entered into force on 4/11/2016. This act is the first global agreement between countries for specific measures against rising temperatures on Earth. The agreement includes 31 pages of specific quantitative parameters. Which in turn should strengthen the implementation of the United Nations Framework Convention on Climate Change (UNFCCC), launched at the Earth Summit back in 1992 in Rio de Janeiro. The Paris Agreement includes three main objectives:

- 1) Limit global warming to less than 2 °C by 2050 compared to pre-industrial levels. The goal is to limit warming to only 1,5 °C by the end of the 21st century;
- 2) Increase the ability to adapt to the negative effects of climate change and promote climate change resilience and reduce greenhouse gas emissions in a way that will not harm food production;
- 3) Encouraging the flow of funds in the area of greenhouse gas emission reduction and climate change resilience. It is necessary to reduce greenhouse emissions and CO₂ in the atmosphere from 40 to 70% in order to reduce the increase in temperature values from anthropogenic activity. In order to keep the average values of the Earth's temperature to 2 °C at this stage, as a result, continue to reduce the values of harmful emissions until reaching 70-90%.

As the next stage, reaching an average temperature value for the planet Earth within 1,5 °C was set as a parameter of the Paris climate conference in 2015. When signing this agreement, each country must limit harmful emissions in concrete terms, and every five years, each country presents a plan for the implementation.

The natural complex of Bulgaria is formed by three components: natural environment, natural resources and natural conditions. As the main elements entering into their structure are: geographical position, relief, high and low carbon resources, climate, waters, soils, vegetation and animal world. All of them take part in one way or another in the formation and development of economic complexes and territorial units of the country. There is a close relationship between the three components, the development of land forms and the construction of the Earth's crust. The great diversity of high and low carbon natural resources in the country is determined by the long-term and very different geotectonic

development of the Balkan Peninsula and Bulgaria in particular. There are different understandings of natural conditions, which come down to the same interpretation, leading to a minimal distinction with the concept of a natural resource (Mihailova, 2019).

METHODOLOGY

The presented mathematical model for creating a new type of eco-village is based on the number of inhabitants of the urban area, as each of them must have a minimum area of 20 m² (Radovanova, 2021), public forest plantations, or 40% of the administered territory should be green spaces (Dobrev, 2012). We will call such a settlement good for living. The purpose of the mathematical approach is to create a model applied in scientific research - the ratio between the population, depending on the area of the village (Dokuzova, ets, 2014), and the available urban forest resources, could be defined as:

S km² - area of the settlement;

40% - from the territory of the settlement with green area;

N - number of inhabitants of the settlement in thousands of people;

K - coefficient for a good settlement

Where:

There is 40% of S km² or $4 \times 10^{-1} \times S \text{ km}^2$, green area in the village

On the other hand, this area is: $20 \times 10^{-6} \times N$

Therefore: $20 \times 10^{-1} \times N = 4 \times 10^{-1} \times S \text{ km}^2$

$$N = 20\,000 \times S \text{ km}^2$$

Presentation: Let in the eco-village which has green areas 40% of its territory and live N number of inhabitants - we could give the following equation as a solution:

K = (2000 / N), hence the relation is:

A) Good settlement **K = 1** B) In a better settlement **0 > K < 1**

C) In a worse settlement **K > 1** D) In the worst settlement **K ≈ 0**

In the development of the scientific material, the definitions: "New City", "Garden City" and the "New" Eco-settlements should be considered as synonymous terms. A historical approach and a comparative analysis have been applied in the research.

RESULTS AND DISCUSSION

Climate as an atmospheric process combines factors that are basic, compile different types of elements and their manifestation during the annual cycle of time. For the territory of Bulgaria, the geographical position, the water basins, the relief, the radiation balance and last but not least the anthropogenic factor are outlined as such.

Geographical location is a basic factor of the above. According to him, Bulgaria is astronomically located between 41°14' / 44°12' N and 22°21' / 28°36' E. It occupies the southwestern part of Europe and the northeastern part of the Balkan Peninsula. In terms of climate, the country is located between two climatic zones - the northern border of the subtropical and the southern border of the temperate. Southern Bulgaria is in the transitional climate zone, and there are also outlined on the territory: Black Sea and Mountain. Based on this factor, the others are formed.

Water basins for the country are important to the extent that they determine the influence of the air masses formed above them. The Atlantic Ocean influences the climate of the country, through the

invasion of cyclones in the west-east direction. The influence of the Mediterranean Sea is felt in the southern parts of the country and in the invasion of air masses along the river valleys in these areas. The Black Sea influences the climate up to 40 km. in the interior of the country. The Dunav River, regardless of its size (2852 km), its influence is 2-3 km., to the interior of the country. Inland water basins have local importance and form a micro climate.

The topography of Bulgaria is mainly flat and hilly, with plains in the northern and southeastern part of the country and a relatively low average altitude of up to 470 m. It forms altitudinal zoning of the climatic elements and forms altitudinal climatic zones. The Old Mountain is part of the Alpo-Himalayan Mountain system and is an orographic barrier for southern Bulgaria. Viewed from north to south, the country is divided into four geomorphological regions: the Dunav, the Old Mountain, the Thracian Plain and the Rilo-Rhodope Massif. A characteristic feature is the local climate, which is formed on the basis of the landscape profile.

The radiation balance is related to the insolation and is related to the geographical position. The duration of sunshine in the country has a theoretical duration of about 4460 hours within a calendar year. In reality, the duration of sunshine in Bulgaria is between 2100 and 2400 hours. In mountainous areas it is approximately 1900 hours, depending on the climatic elements - cloudiness and fog. It is highest in the region of the Upper Thracian Plain and the valley of the Struma River. The shortest duration of sunshine is in the month of December, and the sunniest days are recorded in the summer months.

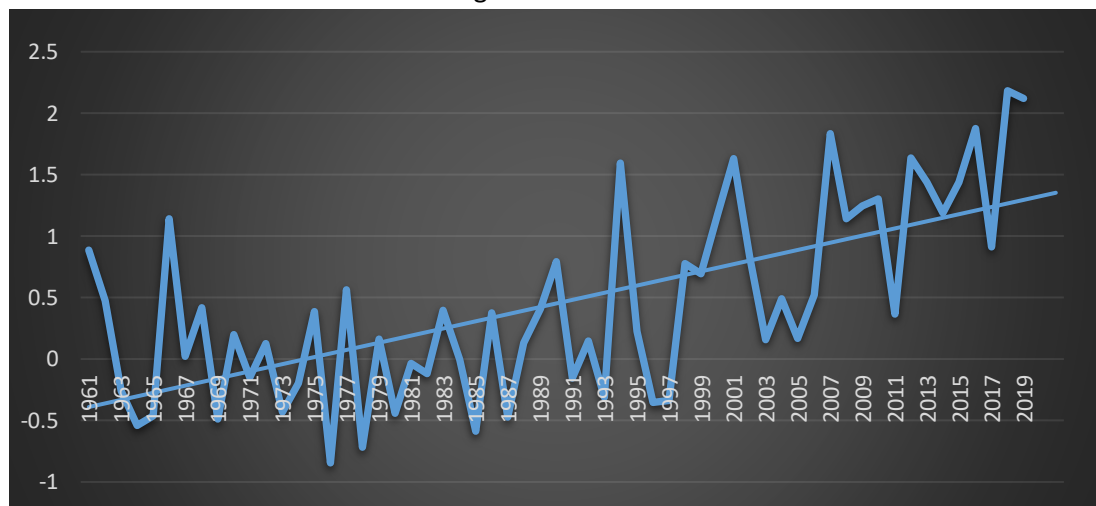
Anthropogenic influence is determined by different types of economic activities, including those related to agriculture. Transport in the country's agglomerations is defined as a local pollutant, as well as the high population density, again concentrated in these areas. The mental attitude towards the environment is emerging as a future problem, the change of the human paradigm is the key to the sustainable development of climate elements. Climate change is happening and no one has any reason to dispute the ongoing processes. And yet there remains a doubt - whether the transformation of the climatic elements is due to a certain climatic cyclicity of the planet or to the increased anthropogenic activity. The accumulation of information about climatic processes and phenomena, as well as their scientific study, began at the beginning of the 20th century.

From a modern point of view, we find the warmest - the first twenty years of the XXI century, then the previous decades. According to (IPCC, 2013), the estimated global mean temperature increase trends for the periods 1880 - 2012, 1901 - 2012 and 1951 - 2012 are 0,064, 0,08 and 0,118 °C per decade. Average global temperatures for the periods 1986 - 2005 and 2003 - 2012 were respectively 0,61 °C and 0,78 °C higher than the average for the period 1850-1900. Obviously, the increase in average global temperatures continues and at an increasingly rapid pace. Again, according to (IPCC, 2013), the largest increase in average temperatures is observed over the continents, where for the periods 1880–2012, 1979–2012 the trends are 0,092 °C and 0,262 °C per decade, respectively. For the period 1850–2012, the average temperature over land has risen by about 1,5 °C. Temperature changes for Bulgaria are not isolated from those of the rest of Europe. Most of the continent has a warming trend in the 20th century (Mihailova, *ets.*, 2021). The average annual air temperature has increased by 0,8 to 1,0 °C. In the second half of the 20th century, the average surface air temperature over the Balkan Peninsula tended to decrease until the end of the 1970s, and then to warm. According to the recommendation of the WMO, the average temperature values for the period 1961-1990 are used to describe the modern climate. Therefore, the

monthly and annual temperatures are compared with this period and refer only to the flat part of the country.

Fig. 1 shows the temperature values for a period of 58 years, with a clear rising curve. In fig. 1 shows the changes in climatic indicators for Bulgaria within 58 years. The trend is clearly expressed - an increase in the values from the first year of research to the last. When analyzing the curve outlining climate change, it is noticeable that in the early 1970s, per century to the mid-1980s, the change in temperature was minimal. After the 90s of the same centuries, the amplitude began to rise significantly, compared to the previous years, with the trend constantly growing upwards. During this period of the development of human civilization, there is an increase in the economic development of countries in the world, which in turn requires greater amounts of energy and natural raw materials. The accumulation of high emissions of carbon dioxide in the atmosphere increases the surface temperature. Again, in the same period at the beginning of the 21st century, there is an increase in the population in a global aspect and the pressure on the environment increases and in particular a rise in temperature values as a result of the consumption by the human population. For the entire study period, the average temperature values for the country have increased by approximately +1,1 °C, corresponding to global climate changes.

Figure. 1 Temperature changes in Bulgaria in the period 1961-2019. Source: Information from FAO's work on Climate Change and author's calculations



Many authors believe that the formation of new eco-villages can be based on already existing ones (Harvey, 2005), and not by creating new ones in separate areas. The development is based (as a philosophy) on the "New Urbanism" movement created in the USA in the early eighties of the XX century. Creation and operation of buildings with zero carbon emissions; ensuring 30% of housing in a city to be owned and formed on green areas (green infrastructure spaces), making up 40% of the urbanized territory. The idea of creating such eco-villages dates back to the 19th century, and this type of utopia was first conceived in 1817 by the industrialist Robert Owen (1771-1858), who built New Lanark, near Glasgow, for poor workers, Scotland. Subsequently, other similar ideas were developed, the built industrial city of Saltaire, by Sir Titus Saul (1803-1876) for 1500 workers can be used as a model. The modern idea over the

decades was developed mostly by wealthy industrialists who understood that better living conditions accumulate high and quality production activity.

The concept of the New Town, which is based on the idea of improving the quality of life through sustainable development of the urban environment, has its roots in early 1898, with the formation of the Garden City Association in England. The idea for its creation was based on Ebenezer Howard's (1850-1928) book "To-morrow a "Peaceful Path to Real Reform" (1898). Four years later, the book was published under the title "Garden Cities of Tomorrow" (1902), this popularized the author himself and his ideas.

In 2020, the world's population is over 7,7 billion people, of which 56.2% live in urban areas. Global population growth, climate change, disruption of the functioning of the biosphere, continued use of conventional natural resources, and last but not least, the concentration of the human population in urbanized areas, require the creation of a new paradigm, principles and factors to develop a new philosophy for the formation of the "New" Eco-settlements.

When forming and developing the idea of the "New" Eco-settlements, the need for a mandatory cultural change in the formation of mentality should also be considered. The change is necessary to the extent that the principles and factors on which the new face of human society will be built can be understood. This is important and necessary from the point of view that the old model of functioning in urbanized areas does not work and will lead to the destruction of human civilization. Therefore, a new paradigm shift "clothed" in new principles and factors will integrate human society into biosphere processes with new understandings and approaches.

The experience gained in preparing the strategy for forests in England (Forestry Commission, 1998) is based on four main principles: quality, integration, partnership and community support. The presentation of this kind of "policy" can be applied as a basis for the development of the next "New" Eco-settlements.

The creation and development of a new type of ecological settlement must be based on factors, principles and mathematical models. On the other hand, they must be tied to the philosophy, existence and functioning of this type of settlement (Mutafov, 2021). Any change in these requirements will lead to compromises, change and failure of the entire concept. The application of various factors, (without claims of exhaustiveness on the subject under consideration), will support the development of the eco-village, in a vertical and horizontal direction:

➤ Social - basic on which the philosophy for functioning of the "New" Eco-settlements or the conceptual doctrine is built. This type of factors should be aimed at the environmentally friendly way of life in the settlement.

➤ Economic - directly related to the functioning of the settlement (Tsvyatкова, 2021). They are the economic drivers associated with the investment policy aimed at creating a new generation of technologies serving social activities.

➤ The ecological factor will be indicative of the "New" Eco-settlements. Maintaining an ecological environment will be the primary duty of every resident on a vertical and horizontal level. Recycling of all types of waste products, domestic or industrial, will be mandatory. Production facilities and transport will meet certain requirements and standards, subject only to the ecological way of life.

➤ The climatic factor is the subconscious reason for the creation of this type of city. Changes in the climate as a result of the excessive use of the natural resource potential of the planet Earth, led to

the introduction of new paradigms in the socio-economic way of life. Climate change in a global aspect has happened many times on the planet, but in the last 30-40 years, very sharp changes and a large number of anomalous climatic phenomena have been reported. The change in the microclimate of certain regions of the Earth has a direct impact on the global synoptic picture. The construction of the "New" Eco-settlements and their functioning based on a natural-idiosyncratic way of life will perhaps slow down the apocalyptic pictures of an ecological catastrophe on the planet.

➤ Infrastructural factors are key to the functioning of the "New" Eco-settlements, in the construction of the green infrastructure. They will have a base meaning. In turn, they can be grouped as follows: underground and above-ground.

The application of principles (without claims of exhaustiveness on the subject under consideration) is essential for the functioning and development of the eco-village in combination with the above-mentioned factors. Every single system or subsystem must develop and work only in the direction of an environmentally friendly way of life:

➤ The educational system should be aimed at forming a new type of thinking and consciousness. New knowledge must ask questions and seek answers directed at the eco-village. It should be seen as a living organism - a symbiosis between man and nature. Education should be a priority area aimed at all age groups.

➤ The ratio between the number of the population and the green spaces presented in the form of forest resource potential in the new eco-villages appears as one of the most important principles on which the entire philosophy is built.

➤ Geodemography includes - birth rate, death rate, natural and mechanical growth and migration mobility. For the new type of eco-village, it will be necessary to maintain approximately the same number of populations. In the event of an increase (which is inevitable), it should be smooth and meet the other two factors mentioned above (the methodology is based on population to corresponding green areas). With the mechanical growth of the population, "corrective" measures must be introduced in order to ease the way of life in the settlement. An important element in the Green City will be the even distribution of the population throughout the territory, thus avoiding a number of inconveniences in socio-economic life.

➤ The green city should be an administratively independent unit, as a way of management within the boundaries of the land. If centralized government is imposed in the country, the settlement must be excluded from such a scheme; self-management is important in decision-making. The administered management of the settlement must be electronic. In this case, all administrative services (systems) will be connected in one common scheme.

➤ The application of new technologies and technological solutions must be tailored and directed to the ecological way of life of the people. They must solve the problems of the citizens related to their way of life. Their application should be in the spheres of transport, recycling of any type of waste product and last but not least in industrial activities.

Giving an exact definition of the "New" Eco-settlements at this stage is quite difficult and will most likely be inaccurate, for the practical reason that currently, nowhere in the world, there is no such settlement that fully satisfies its needs and wants through alternative energy or to process more than 95% of waste products from household, industrial activity, transport or other activities. The synergy between

the mathematical models applied in the creation of the new ecological settlements, the urban forest resources, the principles and the factors are an essential connection between them. From its creation and functioning in future periods of time, depends on the socio-economic prosperity of the human population inhabiting the "New" Eco-settlements. The residential forest has an impact on people's health, their physical and mental recovery, as well as preservation of the overall forest resource potential (Petrov, 2021). For this reason, urban forest resources should be integrated into sustainable development strategies and habitat management and considered as part of a non-renewable natural resource. In general, the process of urbanization should be tied to urban forest resources.

CONCLUSION

Rising temperatures are a fact that cannot be ignored in the coming decades. The increase in temperature is largely due to anthropogenic activity related to satisfying the mercantile behavior of human civilization, but the possibility that the planet Earth is entering (or has entered) a cycle of global warming preceding a new Ice Age should not be excluded.

As temperatures rise, traditional crops reduce their yields as a result of the change. In this case, they should be replaced by varieties of the same species suitable for the respective latitude. The geographical position of Bulgaria and especially the radiation balance allow the cultivation of crops that are not typical for the country. The entry of new crops into agriculture and their availability to consumers will not disrupt traditionalism in nutrition, but will even increase the number of useful foods used. The repetition of change is a fact, and we as a sane human population must take into account and take advantage of the ongoing processes in the most intelligent way possible.

In the first decades of the XXI century, there were large-scale discussions (on a global scale) related to improving the quality of life in urban areas (Yarkova and Mutafov, 2017). In this regard, the elaborated study, without claiming to be exhaustive, gives a point of view (minimum) on solving environmental problems in general in the settlements and a new look at the creation of "new" and modern settlements. They stepped on a new paradigm based on a mathematical model, principles and factors, defending the existing and future development of human society as a whole. The settlement forest in the urban zone or in the areas of the settlement is essentially important for regulating the local climate - reduces the strength of winds, controls water flows in horizontal and vertical directions, filters air and sunlight. It prevents the effect of the city's "heat island", which automatically reduces the amount of electricity in residential buildings. To maintain the standard of clean air in the settlements, the city's forest resources appear as "protective filters". The forest-resource potential is the basis for the creation of a new type of settlements. Observance of the principles and factors for the formation and functioning of the new eco-settlements is essential for the population inhabiting these areas.

The "New" Eco-settlements will completely change the "old" way of life of the people living in these new spaces. The real task of these new settlements will not consist only in the construction, functioning and use of new socio-economic-environmental needs, but the creation of a modern paradigm related to new cultural ecological thinking.

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