

## SUSTAINABLE DEVELOPMENT IN URBAN AREAS IN CORRELATION WITH OVERPOPULATION

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### **Abstract:**

*The contemporary economy paradigm is globalization. This paper contains the interdisciplinary expertise on the innovative solutions of sustainable development of urban areas and cleaner environment. Due to inequality between the developed and undeveloped parts on the regions and countries, big migrations are happening. The result is recognized in overcrowded cities. Concentration of people on small areas produces serious negative consequences on the environment and the quality of the life. This paper aims to point out innovative models of cities from the perspective of sustainable development. New population migrations, relating to their elementary and civilization needs require better solutions. Holistic concept of blue green cities is the latest and the most advanced stage in sustainable development for urban areas. Different renewable energy implementation models and principals of circular economy up to zero waste are researched in this manuscript, representing support of the main idea of blue green cities.*

**Keywords:** *environment, sustainable development, urban resources management, cities, energy efficiency, green areas, innovative sustainable models.*

**JEL Classification:** *O15, O18, O44*

### **1. Introduction**

Cities as a form of organization of human life and work attract an increasing number of inhabitants. The availability of diverse contents which represent the basis of human freedoms and interests, as well as their presence in a relatively small area have always been attractive to the human community. Cultural, educational and other contents important for the spiritual personality development in the cities are much easily accessible both due to the greater concentration of such contents and their availability with less energy and time costs.

The possibility of economic development is also one of the important characteristics of cities, which results in easier access to other civilizational contents. In short, it can be concluded that civilizational needs of people are met more efficiently and meaningfully in cities than in some other forms of organization of human life and work. Easier satisfaction of civilizational needs, greater opportunities for personal development and greater opportunities for the achievement of

human freedoms could be probably considered the basic elements that make cities an increasingly attractive form of human community organization.

However, concentration of population in a small and built-up area has certain negative consequences on fundamental human needs (He et al., 2018). Fundamental human needs entail the need for air, water, food, hygiene, maximum radiation level, maximum noise level and the absence of other negative effects that threaten human health and life. The level of quality of fundamental human needs is measured by the degree of absence of certain negative effects such as air and water pollution, unhygienic conditions, radiation above the natural background level, noise above the maximum values for normal human life and the like.

The other negative effects on human life and health can comprise effects that are not permanently present but can occur in cities (Adrian-Cosmin et al., 2023). The occurrence of heat waves, for example, may have a significant negative effect on the health of vulnerable groups of urban population.

The presence of a large number of residents in a small and built-up area also requires a large consumption of energy for both heating and air conditioning, which, along with significant absorption of solar radiation, results in thermal effects that often exceed the optimal temperature intervals for human life. In combination with heat waves and side effects such as increased ozone concentration, they can cause a significant deterioration of human health and increase the mortality of vulnerable parts of the population, especially the elderly (Wedler et al., 2023).

High traffic density causes increased noise and many cities make efforts to maintain the noise level within acceptable limits for human life and work in cities (Flanagan et al., 2023). Earthquakes represent a particular danger in cities, and as such they are the subject of study from the perspective of hazard (Qadri et al., 2023) and urban planning.

Regardless of all the negative effects of urban areas on basic living conditions, cities represent a very attractive environment for living and as such will continue to expand in the future. The advantages of living in cities definitely outweigh the disadvantages, which led to intellectual efforts in the direction of exploring methods of designing new cities and exploring possibilities for reducing the negative effects of the existing cities.

In view of the commonly used definition of sustainable development according to which the present generation has the right to development provided that it does not compromise that very right of future generations, then this principle applied to cities means that the existing infrastructure in cities must be planned and carried out in a way so as to enable functionality of cities in the distant future.

If the definition of sustainable development according to which the future is a better and healthier place compared to the present is applied (Stevovic et al., 2017), the development of cities has to be planned and implemented in such a way to enable their function to improve continuously in terms of reducing negative effects and besides upcoming energy crisis, as it is presented in the literature (Gabriel, 2023).

A holistic approach to the issue of urban sustainability includes a large number of impacts that must be taken into account while finding adequate solutions (Stevovic et al., 2014).

## **2. Materials and methods**

Life in urban areas is attractive to people because their wishes and needs based on educational, cultural and health contents are more easily fulfilled. The high level of freedom is encouraged by the high concentration of various contents in a relatively small area and the high efficiency (that is, the low consumption of time and energy) of their availability. The economic dimension of life in the city is also of great importance because there is a great variety of economic goals, economic goals are easier to achieve and the economic effects are significantly greater with regard to rural areas.

According to economic research, the importance of cities is reflected in the production and utilization of information opportunities through knowledge spill-over and the fact that job density significantly affects the increase in the number of patents. Innovations and patents are certainly the basis of development and their concentration in cities surely represents one of the prerequisites for the civilization development. In this regard, it can be concluded that cities certainly represent a form of human community organization that will become increasingly important in the future.

The disadvantages of urban areas stem primarily from the fact that a large amount of materials (built into buildings, roads and other facilities) that were not present in a concerned area are now concentrated in a small area, that those materials absorb a large amount of solar radiation and that the geometry of cities (layout, height and shape) causes certain negative effects in the natural environment, threatening the optimal conditions for human life.

These negative effects are manifested through the occurrence of heat islands and the canyon effect. Heat islands and the canyon effect result in an increase in temperature in certain parts of the city areas and can significantly threaten the health and life of the residents. In combination with heat waves, these effects can have tragic consequences and result in an increased level of mortality. The heat wave that affected Europe during the summer of 2003 caused 70,000 more deaths compared to the reference period (1998–2002).

The main risk factor for increased mortality of population was the temperature around the buildings, characteristics of the buildings that lacked proper insulation and their residents who slept directly under the roofs. In the same paper it is recommended that building insulation and urban planning represent protection against possible heat waves in the long term. Indicating this fact, however, implies that the planning of cities and construction of residential buildings were not carried out in a way to protect residents from possible extreme temperature and other negative effects. The impact of noise, air and water pollution as a result of traffic and the burning of fossil fuels further threaten the quality of fundamental human needs, and the search for a solution to these problems is a permanent activity in various scientific fields and professional practice.

### 3. Results and discussion

#### 3.1. Global and urban areas population prediction

The number of people on Earth grew in the period from 1400 to 1970 at a rate greater than exponential, and according to the United Nations, the exponential trend will continue until 2050. Figure 1 shows the projection of total population growth by the United Nations.

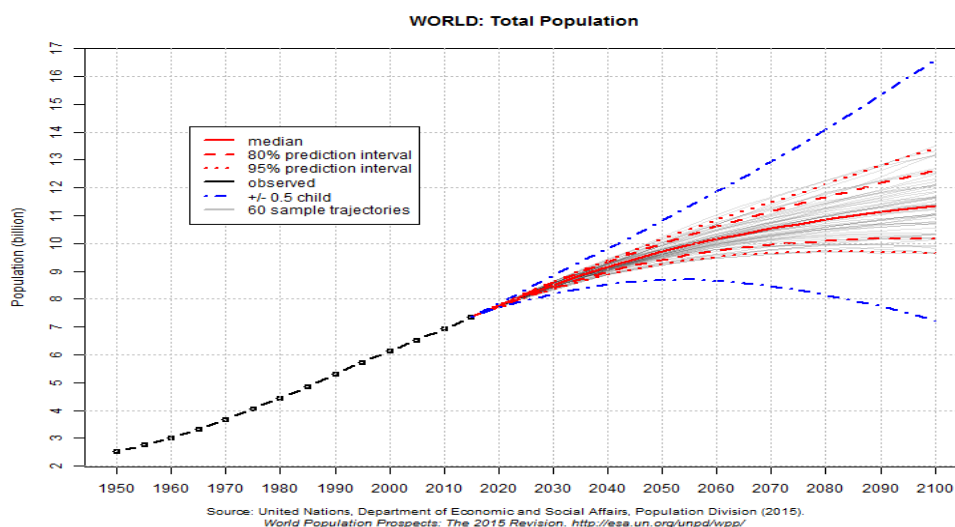


Figure 1: Projection of population growth (Stevović et al.)

Two scenarios can be expected in the period from 2050 until 2100:

- According to the first scenario, the population will be reduced to the level of 2015 and
- According to the second scenario, the population will more than double.

The estimated median of all variants is about 11.5 billion people in the year 2100. According to the forecast of the United Nations, 6.4 billion people will live in urban areas by 2050, which is an increase in the city population of 3.1 billion compared to 2007. Figure 2 shows the forecast of the size and distribution of the urban population in 2050.

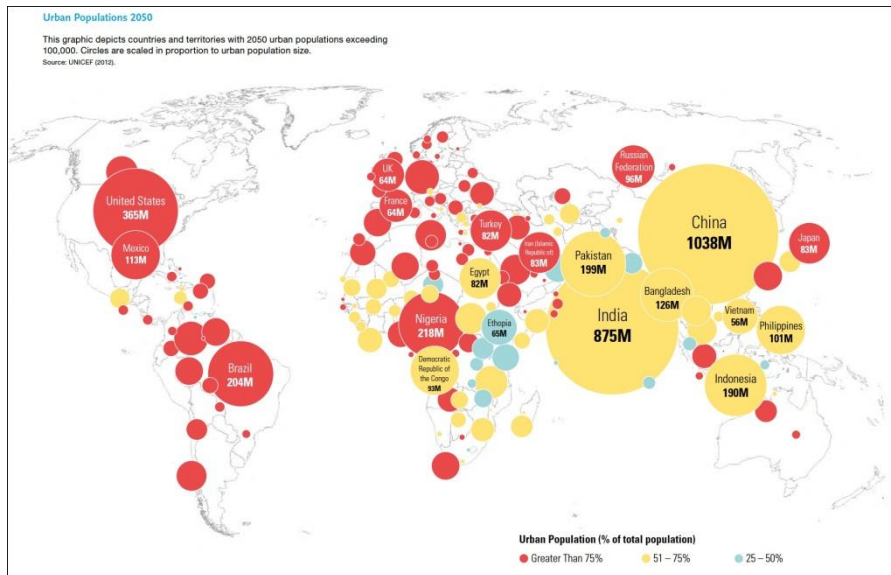


Figure 2: Forecast of the size and distribution of urban population in 2050.

Forecasts and trends in the development of urban areas with no doubt indicate that the number of inhabitants in cities will increase. Figure 3 shows the ratio and forecast of the ratio of urban to rural population in the period up to 2100.

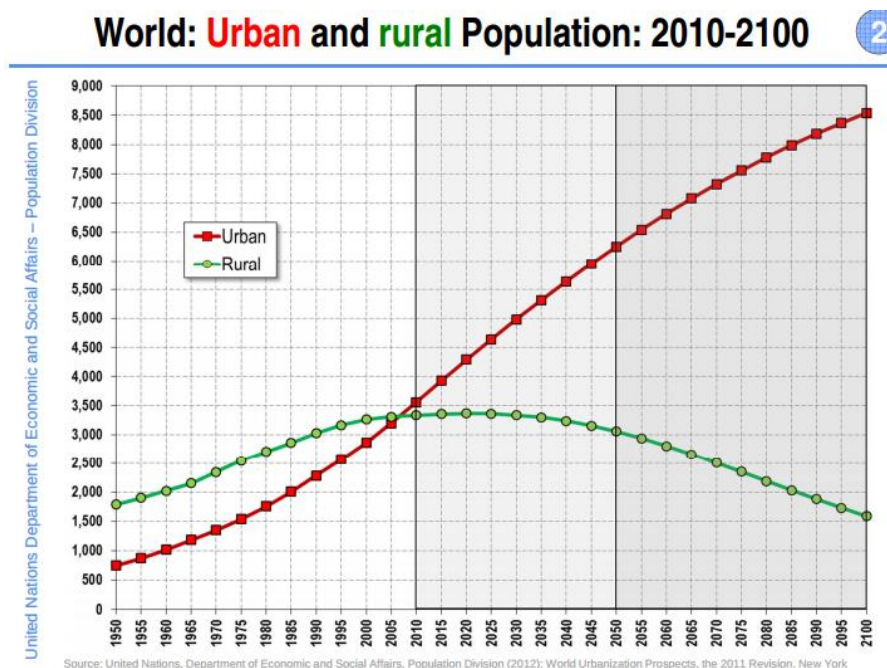


Figure 3: Ratio and forecast of the ratio of urban to rural population until 2100

This trend will inevitably lead to economic development and better satisfaction of civilizational needs while threatening at the same time the satisfaction of fundamental human needs if appropriate measures are not taken. Since this problem was observed and studied to a great extent, solutions were found to improve the satisfaction of the civilizational needs of city residents whilst maintaining the level of quality of fundamental human needs.

The entire concept that simultaneously solves the problems of satisfying civilizational and fundamental human needs is known as the „concept of blue green cities“, besides the concept of higher use of renewable energy depending on availability (Stevović et al., 2021). In addition to these concepts, there are also different models for solving the problem of heat islands and canyon effects by expanding park areas, increasing the albedo of built-up areas (painting facades in light colours) and installing green roofs and green facades. Some of these measures are mandatory in some cities and voluntary in others. One of the possibilities of reducing the negative impact of built-up areas on fundamental human needs can be found in incentives through various forms of value added tax exemption for materials and works to be used and carried out for this purpose.

### **3.2. Resulting innovative sustainable models for urban development**

Back in the 19th century, it was observed that built-up areas were warmer than unbuilt and forests areas, although the forest’s wood volume is highly exploited, as it is presented in the literature (Hadrovic et al., 2022). A reason for this is due to the fact that structural materials absorb and retain significantly more solar energy than natural materials. There are two main reasons mentioned in the literature that explain this phenomenon. The first reason is opacity and water-tightness, causing a lack of moisture for absorbing solar energy. The second reason is that dark materials and canyon-like configurations collect and retain more solar energy. Temperatures of dry and dark surfaces directly exposed to sunlight may reach up to 88°C during the day, while surfaces with vegetation under the same conditions reach only 18°C. Heats caused by human activities, lower wind speeds and air pollution in cities also contribute to the increase in temperature.

Traffic noise and noise from other sources create health problems for people in urban environment, the total costs of which are estimated from 0.2% to 2% of the gross national product in the European Union. In Sweden, a noise limit of 55 dB(A) outdoors and 30 dB(A) indoors was set as a long-term goal as early as 1996.

In the literature, there is a division into personal and general (public) benefits achieved by applying blue and green resources.

The personal benefits of blue-green deployment are the following:

- Reduced energy consumption and temperature control (energy savings of up to 25% for air conditioning during the summer on higher floors with 100 mm green roof media, while the impact of „living walls“ on the thermal performance, although not visible at first glance, are still significant);
- Noise reduction (green roofs with a 12 cm substrate layer can reduce noise up to 40 decibels and a 20 cm thick substrate layer can reduce noise from 45 to 50 decibels);
- Increasing air quality inside the building (vegetation absorbs pollutants and filters organic compounds from carpets and furniture. Certain studies show that half of benzene and toluene and up to 90% of formaldehyde are being removed in this way);
- Cost reduction when green roofs are integrated into the building system;
- Expanded open space and comfort for human life and
- Protection of the building structure from harmful ultra-violet rays which can damage various materials and
- Direct action in the field of sustainability.

The general benefits are:



- Reduction of the effects of urban heat islands (with 50% coverage of green roofs, the temperature in the city can be reduced by 2°C);
- Reduction of air pollution;
- Water management during storms;
- Improvement of human health and well-being;
- A chance for the development of urban agriculture;
- Reclamation of urban land;
- Adaptation to climate change and
- Contribution to the aesthetics of urban design.

The concept of blue green cities is based on attempts to make maximum use of the resources available within the boundaries of the urban environment and to obtain only the resources that are lacking from the broader environment. This approach represents a significant approximation of the philosophy of development and adaptation of cities to the postulates of sustainable development and as such represents an imperative for planning and designing cities in the future. An example of a blue green wave (Breuste, 2023) in Paris is shown in Figure 4.



**Figure 4: Blue Green Wave “École des Ponts ParisTech” (ENPC)**

The Blue Green Dream (BGD) is a concept according to which natural resources are used to provide ideal conditions for human life. Figure 5 shows the concept of the Blue Green Dream (BGD) (Battisti, 2022).



**Figure 5: Blue Green Dream (BGD)**

Supply of electricity from renewable resources, especially from solar energy (Stevovic et al., 2021) and improvement of the aesthetics of cities simultaneously has been designed in „solar trees“ (Eltayeb et al., 2023). Solar trees represent supports for solar cells in the form of a tree, shaped to convert solar energy into electricity, without disrupting the urban environment. Unlike natural trees, however, these trees cannot perform other functions such as air purification, and have no noise reduction properties. Figure 6 shows the shape of the solar tree presented throughout Europe (Bal et al., 2023).



**Figure 6: Solar tree**

Source <http://www.core77.com/posts/10997/Solar-Tree-to-Debut-in-Venice>

The effects of that concept are in the education on the same time in the direction of the cognition of all the benefits of solar energy implementation, as it is explained in the literature (Stevović, 2017).

#### 4. Conclusion

Providing optimal living conditions for city residents is a very complex process often associated with considerable problems. On the one hand, cities represent the most desirable form of organization of human community because they enable efficient satisfaction of civilizational needs. On the other hand, the concentration of materials, traffic and facilities in a small area threatens the quality of fundamental human needs. The negative effects of a built-up area are manifested in the conditions of extreme heat waves that threaten human health and increased mortality within vulnerable groups. This problem can be solved by planning the development of future cities and adaptation of the existing cities.

Adaptation of the existing cities is based on expanding green areas by using roofs and facades („green roofs“, „living walls“) and increasing albedo. Planning and construction of new cities is based on the maximum utilization of the existing resources and the application of the concept of blue green cities („Blue Green Dream“).

The economic dimension of cities and the forecasts of population growth in urban areas indicate that, regardless of the shortcomings of urban environment, they will grow significantly in the future. This fact creates an imperative to strive for the sustainability of cities and the application of principles that enable the sustainable development of cities. The sustainability of cities is only possible if resources are used rationally and if optimal living conditions are provided and/or if the quality of fundamental human needs for clean air, water and optimal temperature conditions is provided at a satisfactory quality level. In doing so, the consumption of resources must be harmonized with their availability in the future.

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