Disasters and Resilient City

E Potapova¹, E Kruchina², O Barkhatova¹, A Makarov¹

¹Department of Hydrology and Environmental Management, Irkutsk State University, ul. Karl Marx, 1, Irkutsk, 664003, Russia
²Department of measurements of background chemical pollution of continental natural systems, Yu. A. Izrael Institute of Global Climate and Ecology, Moscow, 107258, Russia

E-mail: e.v.potapova.isu@mail.ru, kruchinael@mail.ru

Abstract. About 200 million people suffer annually from natural disasters. The economic damage of these events amounts to billions of dollars. In circumstances where more than 50% of the world's population lives in cities, naturally arises challenge related to implementation of new methods and means aimed at enhancing the capacity of authorities to ensure the safety of human capital, economic values and natural resources. Resilience of cities, regarded as the ability to keep effective functioning during and after natural disasters, is determined by the many criteria. The most important of it is the correct organizational and planning structure of the settlement that meets the Sustainable Development Goals. The presence of a completed scientifically grounded and rational greening of the settlement system will allow for the main range of ecosystem services - from global, sanitary and hygienic and medico-social to scientific, educational, cultural and aesthetic. There are 6 main associated with the objects of greening and plantings subgroups of city resilience criteria. 8 main directions of work of the governing bodies are proposed to achieve the goals of the development of settlements in accordance with the principles of enhancing the viability. 8 main directions of governing bodies work are proposed to achieve the goals of the development of settlements in accordance with the principles of enhancing the city resilience.

1. Introduction
Disasters, as considerable adverse events that entail various consequences, are occur in many regions of the Earth. Disasters caused by natural hazards such as earthquakes, floods, landslides, droughts, fires, tropical cyclones, storm surges, tsunamis, volcanic eruptions, entail significant human losses and destruction, adversely impact natural ecosystems. Number and frequency of disasters, its scale and intensity has increased significantly since 1960. This trend is seriously threatening sustainable development. In this regard the international community needs to take appropriate measures in this regard [1]. Climatic and geophysical disasters during the period from 1998 to 2017 cause 1.3 million human losses. Also 4.4 billion have suffered from Injures, were left homeless, needed help and were forced to leave their homes as a result of those disasters. The majority of human losses were caused by earthquakes and tsunamis. 91% of all disasters were caused by floods, storms, droughts, and other extreme weather events. Countries affected by natural disasters incurred direct economic losses of US $ 2.908 billion. Overall, reported losses from extreme weather events increased by 151% between
1978 and 1997 and from 1998 to 2017 [2]. Due to the fact that more than 50% of the population lives in cities, most of the damage is related to those large settlements.

2. Theoretical part

Every year natural disasters cause death, damage and event social upheaval and economic turmoil primarily at the local level. Therefore, national and local disaster risk reduction strategies need to be multisectoral, linking approaches in areas such as land use, water use, building codes, healthcare, education, agriculture, environmental protection, power industry, social. Modern approach and planning are based on methods for assessing urban risk and security and planning and implementation of mitigation remediation. Risk as a combination of hazard, exposure and vulnerability must be assessed and calculated from several positions.

Resolution 44/236 of 22 December 1989, the General Assembly decided to declare the second Wednesday of October as International Day for Natural Disaster Reduction. On December 21, 2009, the UN General Assembly, in resolution 64/200, decided to proclaim on October 13, 2009 the title of the International Day for Disaster Reduction [3]. The Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters, and its successor, the Sendai Framework for Disaster Risk Reduction 2015–2030, it, purposeful, promising, focused on practical actions in the event of catastrophic phenomena of origin, contributing to the dynamic restoration of the human environment.

Willingness to accept a disaster of any origin, withstand the blow of the elements and ensure the effective functioning and safety of residents in the current conditions, will provide evidence-based profiling of urban resilience.

3. Materials and methods

Materials of UN-Habitat programs, in particular - “City Resilience Profiling”, WHO - “Healthy cities” and the author's data on field studies of settlements and green areas were applied. More than 100 Master plans for the Russian Federation cities development, modern structural features of settlements in Russia, France, Germany, the Netherlands, the USA, Brazil, Cote d'Ivoire, the United Arab Emirates, China, Mongolia have been studied. The criteria and vectors that determine the development of modern settlements are identified by means of system analysis.

4. Results and discussion

Earthquakes, droughts, floods, hurricanes, etc., are natural hazards, while loss of life and damage are disasters, each of which is unique, but it always reveals actions / omissions of individuals or authorities of different levels, which, if they turned out to be different, they could reduce the number of human casualties and the amount of damage. The ability to prevent both disasters and consequences usually exists, and the question remains how to implement it with minimal cost. Solutions, in accordance with the Sustainable Development Goals, must be three-fold - economic, environmental and social, based on a strong institutional framework. In the context of the author's research, the article examines the area of solutions associated with green areas and plantings.

Greenings are the structural elements of any settlement, they consist of an infrastructure object in the form of a building, structure and plantings that ensure its sustainable functioning, placed in accordance with the rules and regulations.

The contribution of greening, especially arboreal and shrub planting, in determining the vitality of cities is primary due to the fact that it performs the whole range of ecosystem services such as environment-forming, global (climate regulation; oxygen production; substances and water cycles; produce of primary products; soil formation); resource (food; fuel; genetic; seed bank; resource of mineral substances); ecological (influence on the thermal and radiation regime; air ionization change; air humidity; windproof; wind formation; change in air composition (release of specific substances); sanitary and hygienic (filtering; gas, noise, water and soil protection); medical and social (effect on the central nervous system, on eyesight and on the respiratory system; antibacterial; spiritual, mentally
and aesthetic; recreational); decorative and planning (landscape-forming; structural and planning; decorative and artistic); scientific and cognitive (communication with nature; object of study; knowledge system; bioindicator) [4, 5]. During catastrophic situations, greening supports containment forces of nature and is usually the place of rescue and accommodation of people.

As a consequence, condition criteria are needed to ensure the functioning of greening. Condition criteria form the predominant mechanism for resilience assurance of the entire settlement. There can be many such criteria: from funds allocated for these issues to special programs that provide various social elements of life (everyday and special - for low-income and low-mobility groups of the population) and are used to achieve the Sustainable Development Goals. The consolidated criteria of city resilience associated with the objects of greening and plantings are representing an aggregate group with urban planning indicators and with the quality of the environment of the settlement.

Criteria subgroup A includes the presence of plantings on the territory of public greening in the amount of 50–70 m² for each settlement inhabitant.

Criteria subgroup B includes a complete list of greenings for all categories of these areas.

Criteria subgroup C includes the reasonable existence, structural conditions and content (accordance the Sustainable Development Goals and the population safety) of planting in each type of greening.

Criteria subgroup D includes special forms of greening which provides ecosystem services to the population.

Criteria subgroup E includes the presence of a city protective green belt.

Criteria subgroup F includes the existence and performance of programs for the creation, development, and restoration of greening in case of the presence of innovations after changes in the Master Plan and reactions to catastrophic events.

Development of the Viability Profiling program formal criteria has not been finalized. Scientists are encouraged to participate in defining, classification, and implementation those criteria. Achieving the Sustainable Development Goals by 2030 is also impossible without taking into account the increase of natural disasters and the risks associated with it. A significant role in adjusting development in accordance with this situation is assigned to the governing bodies. Its work coordinates the actions of all services and elements of the urban structure. The main directions of work of city authorities, in field of the greening, can be considered as:

1. Screening of the settlement greenings.
2. Certification of greening.
3. Assessment of the plantings state.
4. Planning the development of a greening system, including a protective green belt.
5. Development of recommendations for owners of greening and plantings.
6. Formation of the development of the settlement structural and planning organization, to provide safe living space for people.
7. Land use regulation and planning.
8. Planning for disaster risk reduction investments to resilience capacity building.

At all levels, greater action is needed to reduce exposure to risk and reduce vulnerability to help prevent new disaster risks and establish responsibility for creating such risks. Therefore, the main argument to support the City Viability Profiling Program is an integrated method for long-term planning development based on the criteria of viability. This approach contributes to the protection of population and property, as well as recovery after the elimination of catastrophe's consequences.

Disaster risk requires a broader and more humanitarian-oriented preventive approach.

5. Conclusion

Life can change beyond recognition, both due to natural disasters and due to war, epidemics and similar factors. Any disasters impedes economic development, increases the level of poverty and is the cause of many social upheavals. Natural disasters happen without warning and result in huge numbers of casualties, destruction and losses. Most of them occur in large settlements, the main places of
concentration of people and material values. Nevertheless, the use of the correct preventive means of assessment, forecasting, etc., increases the chances of overcoming difficulties and strengthening the resilient of settlements. Disaster risk reduction is a cost effective investment in preventing future losses.

The resilient of cities, as the ability to continue to effective functioning even during and after natural disasters, is determined by many criteria. The most important of them is the correct organizational and planning structure of the settlement, mainly green areas, in line with the Sustainable Development Goals.

6. References
[1] International Strategy for Disaster Reduction (ISDR) 2001 UN 25 p
[2] Wallemacq, Pascaline; House, Rowena Economic losses, poverty & disasters: 1998-2017 URL: https://www.undrr.org/publication/economic-losses-poverty-disasters-1998-2017 (06.06.2021)
[3] International Day for Disaster Risk Reduction URL: https://www.un.org/ru/observances/disaster-reduction-day (06.06.2021)
[4] Sokolova O E and Potapova E V 2019 Structural features of green areas of settlements 1 Proceedings of Voronezh state university Series: Geography. Geoecology рр 19–24
[5] Healthy Cities Vision URL: https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/who-european-healthy-cities-network/healthy-cities-vision (06.06.2021)

Acknowledgments
The reported study was funded by RFBR, project number: 20-45-380032. This study was carried out in the framework of the Research Project AAAA-A20-120020490070-3 «Development and improvement of methods and technologies for integrated background monitoring and comprehensive assessment of the environmental state and pollution in the Russian Federation including their dynamics (based on the joint results of RosHydroMet’s monitoring networks)». 