Main concepts of regional development of the agricultural sector in the context of the green economy paradigm

A.I. Pakhomova* and *A.A.* Guryeva

Admiral Ushakov Maritime State University, Russia

Abstract. The relevance of the study is due to the problems of agricultural development and man-made challenges. In this regard, this article aims to identify the need to build an ideal model of urban-type settlements. The leading approach to the study of this problem is the system method, allowing comprehensively considering the study of green economy in the modern city as a whole, identifying a variety of cause-and-effect links and relations taking place within the system under study and in its interaction with the external environment. This paper considers the ecological rating of regions, provides statistics on man-made and natural emergencies. The authors have concluded that an effective adaptation to technogenic challenges is the creation of a new institutional model for the development of modern urban-type settlements. The materials of the article are of practical value for the authorities at the regional level when making managerial decisions on sustainable development of the region.

1 Introduction

Owing to the multi-crisis situation, the problem of development of modern Russian regions is the most prominent. It is currently believed that urban agglomerations are the most important carriers of the "new economy" formed by the development of the complex services and technology sector, as well as the ultrafast growth of the consumer market. Indeed, the density of connections, the quality of life and the peculiarities of the economy of modern cities make possible the transition to a new level of development of socio-economic relations, which will include the interaction along the line: society – ecology – economy, as an obligatory component. The new paradigm of socio-economic development should put the safety of the individual and society as a whole "at the centre of attention" in the environment of serious natural and man-made challenges [1–6].

At present, the traditional methods of development of modern cities are more negative than positive. The development of the "new economy" with its increased requirements for connectivity within the city faces critical challenges. For example, the explosive growth of motorisation of the population and the inability of urban transport systems to cope with car flows create a contradiction between the standards of quality of life and objective characteristics of regional space.

2 Literature review

Recently, the problems of social, economic and ecological character of regional development of the rural sector in modern cities have become sharply aggravated. Over the last forty years, the economic load on natural complexes has sharply increased, so for the last twenty years the issue of environmental protection from excessive anthropogenic pressure has been raised. The UN document on sustainable development "Agenda 21" substantiates the need to develop new concepts of sustainable economic growth and prosperity [7, 8].

The essence of environmental protection is to find a rational balance between the ecological needs of society in a clean, healthy and highly productive natural environment and the economic interests of society related to the satisfaction of material needs of people. There are now three main ecological concepts. The first is based on a return to lower standards of consumption and its maximum restriction. According to this concept, it is necessary to restrain the growth of consumption by establishing a balance between fertility and mortality. This is the concept of "zero growth"; it emerged on the basis of the world development models of D. Forrester and D. Meadows [23].

In the 70s, J. Forrester built a dynamic model of an ordinary American city. Analysing this dynamic model, three main subsystems can be distinguished in the urban system: population, housing stock and enterprises, considered from the point of view of evolution [9].

A distinctive feature of this concept is J. Forrester's assertion that the nature of complex systems is counterintuitive, i.e. many variables interact. Intuitive judgements are reactions to the immediate cause-and-effect relationships characteristic of simpler systems, whereas in complex systems the true causes may be deeply hidden or distant in time. And, more often than not, they are rooted in the structure of the system itself, which is not immediately recognisable. For this reason,

* Corresponding author: alieva052011@mail.ru

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in this situation, it is necessary to use algorithms rather than rely on intuitive judgements when making decisions [10–14].

Therefore, J. Forrester proposed a complex dynamic model with many direct and feedback links between the subsystems, on whose basis it became possible to forecast the development of the city and analyse the impact of various programmes of urban administration. This model can be applied in agriculture.

The disadvantage of this concept is the uneven development of the economies of different regions and their populations, as it is an assumed exponential growth of population in the conditions of sufficient resources and in the absence of birth control.

D. Meadows proposed the "Limits to Growth" model with feedback loops [23]. The main directions of this theory are industrialisation, rapid population growth, increasing hunger, depletion of non-renewable resources, environmental degradation.

According to the concept of zero growth, humanity should stabilise the population, stop industrial growth, invest in and develop only agriculture to increase food production and services, and compensate for the depreciation of funds only in industry [15–18].

Despite a number of shortcomings of D. Meadows' research, in particular, underestimation of the possibilities of scientific and technological progress, progress of knowledge, this work was an attempt to assess the importance of the environmental factor for the world development. The world catastrophe is inevitable, if the trends of natural resource use and environmental degradation are maintained.

In 1992, a new work by D. Meadows "Beyond Growth" emerges. The main theme of this work is formulated as follows: "there are limits to growth, but no limits to development" [24]. According to the researcher, the limits of growth are the limits of the intensity of flows, i.e. the limits of the sources' ability to provide the flow of resources and the limits of effluents' ability to absorb waste.

Going beyond the limits is understood as a violation of the stability of this ratio due to exceeding the potential capacity of the environment. The reason for the limits is that the population and capital in the world system are growing exponentially, and in such situation a quantitatively growing economy destroys its resource base, after which collapse should occur [19].

The second concept assumes the development of the economy without taking into account environmental constraints. In a very short time, such policy will inevitably lead to the degradation of nature, the decline of agricultural production and the death of humankind. The third way is a combination of ecological and economic needs. Besides, if we approach the solution of environmental problems from a more rational and utilitarian point of view, a complete rejection of the achievements and conquests of the modern scientific and technological revolution is not required. It is necessary to direct the results of scientific activity to meet human needs in compliance with the principles of sustainable development [10].

Currently, there is an active development of indicators that take into account the impact of the economy on the natural environment and consequently on the agricultural sector. For example, the system of environmental-economic accounting aims to take into account the environmental factor in national statistics. This system describes the relationship between the state of the natural environment and the economy of a country. In the system of "green accounts", the account of forest resources is kept in natural terms, the concept of ecological debt and the concept of "natural capitalism" [16].

3 Methodology of the study

Attempts to assess the "natural potential" allow specifying the volumes of environmental damage only partially, without taking into account the humanitarian component and the size of the overall destruction of production factors. Meanwhile, according to the forecasts of the Organisation for Economic Co-operation and Development (OECD), the current methods of production and consumption can destroy about 70% of flora and fauna by 2050 [2], which will adversely affect the agricultural industry. In our opinion, it is advisable to talk about the assessment of the complex natural and human potential of the agricultural sector.

The ecological rating of cities of LLC "Green Patrol" [5] allows a comprehensive comparative assessment of positive and negative factors and trends in environmental, social and economic activities based on the criteria of environmental safety and balanced sustainable development of the agricultural industry in the regions.

The environmental rating of cities includes 15 indicators that cover three basic areas of monitoring in the regions of the Russian Federation:

- ecosphere – environmental protection;
- sociosphere – protection and improvement of the human and social environment;
- technosphere – state and development of industry taking into account the requirements of environmental safety.

Table 1 presents the scope of the assessment and the estimated components in the environmental ranking.

The environmental rating is formed on-line as information materials are received from various sources, including mass media, authorities, business entities and citizens' initiative groups.

The rating is calculated on the basis of a single mathematical model and software for all constituent entities of the Russian Federation.

Table 1. Evaluation area and estimated project components

<table>
<tr><th colspan="2">Assessment area</th><th colspan="2" rowspan="2">Calculation indices</th><th rowspan="2">Final rating regions</th></tr>
<tr><th>Sphere</th><th>Indicators</th></tr>
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<tr><td rowspan="5">Sociosphere</td><td>Power and the law</td><td rowspan="5">Socio-environmental index</td></tr>
<tr><td>Civil society</td></tr>
<tr><td>Education and culture</td></tr>
<tr><td>Human habitat</td></tr>
<tr><td>Informative – psychological climate</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="5">Technosphere</td><td>Industrial environment</td><td rowspan="5">Industrial and environmental index</td></tr>
<tr><td>Science and technology</td></tr>
<tr><td>Business Responsibility</td></tr>
<tr><td>MSW and industrial waste</td></tr>
<tr><td>Products and services</td></tr>
</table>

4 Results and discussion

The rating compares the number of man-made accidents in the regions, natural fires, floods, deterioration of the sanitary and epidemiological situation, indicators of the quality of the regional environment, the number of innovations, the participation of business in solving environmental problems, etc.

The Krasnodar Region's ranking in the environmental rating of cities is shown in Table 2.

Table 2. Ecological rating of Krasnodar Krai for 2019-2023 [compiled by the authors on the basis of data from http://greenpatrol.ru/ru/regiony/]

Year	Nature Conservation Index	Industry-ecologically rating	Socio-environmental rating	Composite index	Place in the rating
2019	+ 47/–53	+ 69/–31	+ 48/–52	+ 58/–42	16
2020	+ 52/–48	+ 71/–29	+ 53/–47	+ 61/–39	21
2021	+ 53/–47	+ 74/–26	+ 56/–44	+ 64/–36	31
2022	+56/–44	+ 75/–25	+ 59/–41	+66/–34	32
For the first 9 months of 2023	+58/–42	+ 82/–18	+ 65/–35	+72/–28	31

Table 2 above allows concluding that in 2019, the Krasnodar Region has slightly improved its position in the environmental ranking and now it ranks 16th. This indicates that the Krasnodar Region pays enough attention to environmental problems and to addressing issues to improve the environmental situation.

Table 2 demonstrates that during the analysed period, the environmental index is quite low compared to other indices. The Krai occupies very high positions in terms of the socio-ecological index.

The rapid development of complex technological systems introduced into the economic turnover has conditioned both the development of modern urban settlements and the growth of the risk of various man-made accidents and disasters [20].

United Nations (UN) data show that man-made disasters rank third among all types of disasters in terms of the number of deaths. The first place is occupied by hydrometeorological disasters, floods and tsunamis, and the second by geological disasters (earthquakes, mudflows, volcanic eruptions, etc.).

One of the vivid examples of a man-made environmental disaster is the accident at the Fukushima-1 nuclear power plant in Japan. It was caused by natural cataclysms and currently threatens the scale of an environmental catastrophe of a global nature. The irrational placement of NPP units, as well as the use of buildings constructed before the 1980s in the nuclear power industry, despite Japan's innovative technological equipment, calls into question further development of nuclear power worldwide. It reorients humanity's attention to safe energy sources created by wind farms and solar panels [21].

As a result of the "Fukushima effect", many states began to devote more time to organising human and social safety. One example is the preparation of the FRG leadership for a possible disaster at the Belgian nuclear power plant "Tiange" after experts warned about the possibility of an emergency at the plant. This shows that the country's leadership is taking measures to ensure the safety of its citizens.

"The Fukushima effect has thus confirmed that the survival and development of humankind require a transition to a green economy. That is, a system of economic activities related to the production, distribution, exchange and consumption of goods and services leads to increased human well-being in the long term, without exposing future generations to significant environmental risks or ecological scarcity".

Therefore, we can conclude that despite the contrast between man-made and natural disasters, we can see a consistent pattern of increasing man-made disasters against the background of growing natural disasters. One of the reasons is the rapid technical development of society and the human factor manifested in errors of workers, engineering calculations, ineffective assistance of rescue services.

Figure 1 shows the dynamics of natural and man-made disasters in Russia for 2005–2023.

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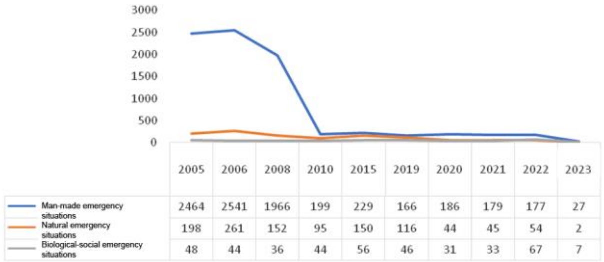

Fig. 1. Dynamics of emergencies that occurred on the territory of Russia in 2005-2023 [compiled by the authors on the basis of data from the Ministry of Emergency Situations of Russia http://www.mchs.gov.ru/activities/stats/CHrezvichajnie_situacii]

The above figure shows that by 2023, there is a significant decrease in man-made and natural emergencies. The graph demonstrates that the level of man-made disasters significantly exceeded natural and biological and social emergencies in 2005–2008.

Hence, we can conclude that an effective adaptation to technogenic challenges is the creation of a new institutional model for the development of the modern city.

According to Polish urbanist T. Tolwiński, in the middle of the XX century, there was an urban crisis [1], which forced a new look at the future ecological and economic model of urban and regional economy.

A new field of research is emerging in modern economics, dealing with the relationship between natural ecosystems and socio-economic systems in the broadest sense. Green economics addresses current human problems, as well as the problems of building an "eco-city".

In our opinion, the regional development of the agricultural sector should be understood as a natural-adapted model of the region, which has an economically productive and socially effective functioning environment based on the ecologisation of life [22].

Table 3. Goals of creating an eco-city [compiled by the authors from a study based on the UN Conference on Human Settlements (Habitat II)]

Goals of creating an environmentally friendly city	
For the population of the city	For the environment
1. Improving the quality of life of the population	1. Restoration of the biosphere
2. Formation of ecological outlook of the population	2. Increasing the area of green spaces in the city
3. Ensuring the health and safety of residents	3. Reduction of nature pollution from the city
4. Achievement of energy savings, generally economical housing	4. Utilisation of renewable energy and reduction of non-renewable energy consumption, non-renewable materials
5. Enhancement of aesthetic qualities of the city. Perception of the city as a natural component of the natural environment, its inclusion in the ecosystem	5. Maintaining ecological balance between developed and natural areas

For many years, the idea of eco-cities in the context of regional development was only proclaimed and not implemented. At the "Global Forum-94", a real project of an eco-city in Sweden, which is the first in the world practice, created in accordance with the provisions of the sustainable development strategy, was presented. At the beginning of the XXI century, the global forum "Habitat-II" adopted the concept of creating an eco-city [2]. Table 3 presents the main objectives of creating an ecologically clean city.

The main task to be solved when creating an eco-city should be its organic inclusion in the course of natural processes of the given territory. The conditions for normal fulfilment of the most important social functions should be created here. And, finally, the eco-city should become a generator of cultural processes taking place in the system of regional economy

The modern practice of creating ecocities has been developing since the early 1960s. In general, it is widespread in Europe, North America, and Australia. However, the most active countries in the field of ecological construction are European, especially Sweden and Denmark. Germany, Belgium and Norway are also involved in this process. In general, almost all European countries have joined the process of greening their cities. Currently, there are 6 eco-cities in the European Union: Malmo (Sweden), Dublin (Ireland), Tallinn (Estonia), Hillerød (Denmark), Hamburg (Germany), Augustenborg (Denmark) [3].

The city of Malmo is an example of a holistic eco-city in which the principles of social and architectural ecology are fully realised. One of the main objectives of reconstructing the city of Malmo into an eco-city was to reduce emissions of pollutants into the atmospheric air from stationary sources. The goal is achieved by applying new construction technologies, developing public transport, switching car owners to hybrid and electric cars, promoting alternative energy and energy-saving technologies [23].

Malmo is currently the third industrial city in Sweden. The city government has therefore decided to use only renewable energy (solar panels, wind turbines, heat pumps, biogas to produce electricity, heat and fuel for cars).

In the Russian Federation, the process has not yet gone beyond the design and construction of individual eco-houses. Experience in this area is being developed, and organisational and financial resources are being accumulated. However, in Russia, the development of urban ecologisation is still mainly carried out through the efforts of scientists.

In Russia and CIS countries, which have quite a significant reserve of ecological, natural and territorial resources, the process has not yet found support of state structure. It is being developed by the efforts of individuals and organisations. Theoretical issues of ecologisation and methods of its implementation on a large urban planning level are quite actively discussed in the scientific press and at various conferences. But practical activities in this area have not yet reached the urban planning level.

5 Conclusion

"The green economy is now at the centre of attention of nations around the world. Investments in energy-efficient technologies and natural infrastructure are becoming increasingly attractive and profitable. In the crisis year of 2009, it was no coincidence that the June Ministerial Council meeting of the OECD adopted a Declaration on Green Growth. It recognises that stimulating environmentally oriented investments can help to both boost and create the necessary infrastructure for a new model of urban development. This will help to ensure sustainable economic growth, social well-being of the population and environmental health [2].

The above allows concluding that the creation of environmentally favourable conditions in urban-type settlements is a complex process. In the modern world, the paradigm of "green economy" of regional development of the agricultural sector should help to solve the problems of social ecology of cities and urban-type settlements. This means that the formation of the process of designing the model of cities and urban-type settlements as a stable functioning socio-economic system is associated with the need to develop and solve a number of complex problems.

References

1. E.G. Animitsa, *The Median region* (Urgeu, Ekaterinburg, 2007)
2. R.V. Chernyaeva, A.I. Pakhomova, Mixed economy from “Brown” to “Green”, In the World of Sci. Discov. **4.2(40)**, 92–103 (2013)
3. D.H. Meadows, D.L. Meadows, J. Randers. W.W. Behrens III, *The Limits to Growth* (Univers Books, New York, 1972), 203 p.
4. N.V. Dulina, *Social and spatial modification of the modern Russian large city* (Doct. dissertation thesis) (Volgograd, 2007), 27 p.
5. V.A. Grigoriev, Basic principles of development of ecovillages, in *Intellectual potential of Siberia. Modern problems of humanitarian and socio-economic sciences*, Proc. mater. interuniv. sci.-stud. conf. (Novosibirsk, 2000), p. 35
6. I. Gruza, *The Theory of city* (Moscow: Stroyizdat, 1972), 247 p.
7. *Indicators for sustainable development: theory, method, applications.* A report to the balaton group (Int. inst. for sustainable development, Bossel Manitoba, 1999), 124 p.
8. D.N. Kavtaradze, *Ecology of the small city, Environment* (USSR Acad. of Sci.; Moscow state Univ. M.V. Lomonosov, Pushchino, 1987), p. 15
9. Ch. Landry, *The creative city: a toolkit for urban innovators* (Earthscan, Great Britain, 2000), 350 p.
10. I.A. Ogorodnikov, V.A. Ogorodnikov, *On the road to sustainable development: eco (materials)* (Socio-ecological union, Moscow, 1998), 84 p.
11. A.I. Pakhomova, Modern eco-city: experience and prospects of development, Vest. of Irkutsk state techn. univ. **5(45)**, 312–317 (2010)
12. A.Y. Rubinstein, *The Theory of Patronized Goods and the Paternalism in Economic Theories: General and Special* (RAS Inst. of Econ., Moscow, 2015), 52 p.
13. A.A. Korshak, V.V. Pshenin, Calculation of phase transitions in condensation units for recovery of oil and oil products vapors, Oil Industry **2021(6)**, 98–101 (2021), DOI: 10.24887/0028-2448-2021-6-98-101
14. M.Z. Yamilev, V.V. Pshenin, D.S. Matveev, D.S. Podlesniy, T.I. Bezimyannikov, The use of compact inspection devices for monitoring the technical condition of pipelines in protective cases, Oil Industry **2022(2)**, 106–110 (2022), DOI: 10.24887/0028-2448-2022-2-106-110
15. G.Y. Korobov, A.A. Vorontsov, G.Y. Korobov, D.V. Parfenov, T.N. Van, Mechanisms of the formation of asphalt-resin and paraffin deposits and factors influencing their intensity, Bull. of the Tomsk Polytech. Univ. Geo Assets Eng. **334(4)**, 103–116 (2023), Retrieved from: https://doi.org/10.18799/24131830/2023/4/3940
16. I.B. Ardashkin, A.N. Yakovlev, N.V. Martyushev, Evaluation of the resource efficiency of foundry technologies: Methodological aspect, Adv. Mater. Res. **1040**, 912–916 (2014), DOI: 10.4028/www.scientific.net/AMR.1040.912
17. A.M. Shagiakhmetov, D.V. Lvova, B.I. Seregin, A.V. Vasiliev, Facilities Construction Engineering for the Avaldsnes Section of the Johan Sverdrup Field in the North Sea, Energies **15**, 1–18 (2022), Retrieved from: https://doi.org/10.3390/en15124388
18. V.L. Tatarintsev, M.M. Shostak, L.M. Tatarintsev, Organizing Sustainable Agricultural Land Management in Altai Krai: a Geo-Ecological Prospect, Siber. J. of Life Sci. and Agricult. **14(2)**, 356–372 (2022), DOI: 10.12731/2658-6649-2022-14-2-356-372
19. A.A. Korshak, V.V. Pshenin, Determination of parameters of non-pump ejector gasoline vapor recovery unit, Sci. and Technol.: Oil and Oil Prod. Pipeline Transport. **13(1)**, 25–31 (2023), DOI: 10.28999/2541-9595-2023-13-1-25-31
20. V.V. Kondrat’ev, A.S. Govorkov, M.V. Lavrent’eva, I.A. Sysoev, Description of the heat exchanger unit construction, created in IRNITU, Int. J. of Appl. Eng. Res. **11(19)**, 9979–9983 (2016)
21. Shutaleva, N. Martyushev, Z. Nikonova, I. Savchenko, V. Kukartsev, V. Tynchenko, Y. Tynchenko, Sustainability of Inclusive Education in Schools and Higher Education: Teachers and Students with Special Educational Needs, Sustain. **15**, 3011 (2023), DOI: 10.3390/su15043011
22. N.V. Martyushev, V.N. Kozlov, M. Qi, V.S. Tynchenko, R.V. Kononenko, V.Y. Konyukhov, D.V. Valuev, Production of Workpieces from

Martensitic Stainless Steel Using Electron-Beam Surfacing and Investigation of Cutting Forces When Milling Workpieces, Mater. **16**, 4529 (2023), DOI: 10.3390/ma16134529

23. O.A. Filina, N.V. Martyushev, B.V. Malozyomov, V.S. Tynchenko, V.A. Kukartsev, K.A. Bashmur, P.P. Pavlov, T.A. Panfilova, Increasing the Efficiency of Diagnostics in the Brush-Commutator Assembly of a Direct Current Electric Motor, Energies **17**, 17 (2024), DOI: 10.3390/en17010017