Formation of indicators of sustainable development for the resource region: the Amur ecoregion

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Abstract. The article discusses the formation and practical use of indicators for assessing the sustainability of development at the regional level. Using the example of the Amur ecoregion, we study the dynamics of some economic, social and environmental indicators in 2013–2019, their compliance with the objectives of the state policy for the accelerated development of the Far Eastern Federal District. It is shown that the result of the action of preferential regimes was the growth of resource industries in the structure of the economy of the Amur ecoregion. A certain decrease in the parameters of sustainability according to social indicators was revealed with positive dynamics of economic and relative stability of environmental indicators in the Amur ecoregion. The relevance and scientific significance of the development of methodological and methodological support for assessing socio-ecological-economic sustainability and the formation of its indicators for the regional level was confirmed.

1. Introduction

The concept of sustainable development presupposes a harmonious combination of its three fundamental elements, namely, economic, social and environmental. An important direction in the development of this concept is the theoretical and applied issues of assessing sustainable development at the regional level.

In current studies, the approaches are presented to the construction of integral indicators of sustainable development for different hierarchical levels including regions [1, 2] and cities [3] based on their adaptation to national specific natural and socio-economic conditions. The influence of factors on the state of the environment is investigated depending on the structure and level of economic development [4]. An important aspect of the interconnection of economic, social and environmental spheres of regional development is the transition from assessments based on standard indicators to comprehensive assessments based on specific indicators (indicator of “true savings” [5], environmentally adjusted human development index [6]) and assessing the dynamics of environmental economic development of territories, taking into account the direction and "color" of economic growth [7].

In this article, the research object is the Amur ecoregion, which is geographically located in the Amur River basin and includes five constituent entities of the Russian Federation, which are as follows: the Trans-Baikal Territory, the Primorye Territory and the Khabarovsk Territory, the Amur Region and the Jewish Autonomous Region [8]. The choice of such a research object is based on the identification of the WWF-Russia ecoregion network, which, in turn, is based on the classification of global environmental priorities [9]. In addition, all of the above regions are part of the Far Eastern Federal
District, where a special policy of accelerated regional development has been implemented since 2014. These regions are characterized by the raw material orientation of the economy and the border position.

The purpose of this article is to obtain some quantitative estimates of the dynamics of stability of the Amur ecoregion (in economic, social and environmental aspects) in the context of implementation of the state policy of accelerated development. The period from 2013 to 2019 has been studied, which reflects the first results of the implementation of a “new model” of the development of the Far Eastern Federal District by the federal center.

2. Materials and methods
To study individual parameters of the sustainable development of the Amur ecoregion (in economic, social and environmental aspects), an array of standard statistical information (gross regional product (GRP), growth of investments and their returns, and incomes and employment) was used. In addition, the calculation of individual socio-economic and environmental indicators was carried out, allowing the formation of an idea of the sustainability dynamics of the Amur ecoregion.

To assess the relationship between the economic and environmental components of sustainable development of the region, the scientific literature uses the “decoupling effect” approach which examines the mismatch between the rate of economic growth and the rate of resource consumption and negative impact on the environment [10].

Accordingly, resource decoupling and impact decoupling are distinguished. Resource decoupling implies a reduction in the use of natural resources per unit of economic result. Impact decoupling implies an increase in the volume of output while reducing the environmental burden on the environment [11]. When the rate of economic growth outstrips the rate of growth in resource consumption or environmental pollution, a decoupling effect is observed. There are the two key aspects of decoupling as applied to sustainable development, namely resource decoupling and impact decoupling. Resource decoupling means reducing the rate of use of primary resources per unit of economic activity. Impact decoupling requires increasing economic output while reducing negative environmental impacts [11]. Decoupling means using less resources per unit of economic output and reducing the environmental impact of any resources that are used or economic activities that are undertaken.

We have implemented this approach to assess the environmental sustainability of the economy of the Amur ecoregion based on the calculation of the impact decoupling coefficient. It is defined as a change in the unit of environmental pressure in comparison with a change in the economic result estimated at the time period and compared with the base period [12].

\[
D_t = 1 - \frac{E_t}{E_0} / \frac{Y_t}{Y_0}
\]  
(1)

where \(D_t\) is the impact decoupling coefficient, \(E_t\) and \(E_0\) denote environmental pressure at the time period \(t\) and the base period 0, \(Y_t\) and \(Y_0\) show the economic result at the time period \(t\) and the base period 0. In the absence of the decoupling effect, the \(D_t\) coefficient is zero. Positive values of \(D_t\) mean that the pressure on the environment (E) decreases with a simultaneous increase in the economic result (Y) at time \(t\) compared to the base period. Negative \(D_t\) values suggest the increased pressure on the environment.

Official statistical data (Rosstat), regulatory documents of the federal and regional levels, and analytical and expert assessments were used as an information base.

3. Results and discussion
As for the economic aspects of assessing the dynamic characteristics of sustainability of the development of the Amur ecoregion, the traditionally used indicators of economic activity (investment) and its results (GRP) show growth both in comparison with the average Russian level and in the intraregional dynamics of all five constituent entities of the Russian Federation (Table 1). At the same time, a more detailed examination of the structure of investments from the standpoint of attractiveness of the resource and non-resource sectors of economy [13] shows that not only the concentration of investments in economic...
activity (EA) "Mining" takes place at an accelerated rate, but also an increase in the share of resource industries in the structure of industrial activity in the Amur ecoregion.

Table 1. Indicators of socio-economic results of implementing a "new model" of development of the Far Eastern Federal District in the Amur ecoregion

| Trans-Baikal Territory | Primorye Territory | Khabarovsk Territory | Amur Region | Jewish Autonomous Region |
|------------------------|--------------------|----------------------|-------------|--------------------------|
| Investment in fixed assets per person employed in the economy, thousand rubles / person | 181.9 | 190.3 | 239.6 | 881.8 | 213.4 |
| 119.9 | 123.9 | 212.9 | 259.4 | 177.1 |
| GRP per capita, thousand rubles / person | 327.5 | 533.8 | 575.3 | 481.2 | 334.1 |
| 209.8 | 297.2 | 371.4 | 258.8 | 224.1 |
| The share of EA "Mining" in the industrial sector, % (2018 to 2013) | 63.8 | 6.8 | 21.6 | 44.1 | 47.6 |
| 47.8 | 5.4 | 20.7 | 50.1 | 5.5 |
| Social indicators | | | | | |
| Employed, thousand people | 476.2 | 942.7 | 673.9 | 385.5 | 72.6 |
| 479.4 | 993.0 | 704.6 | 393.3 | 80.9 |
| Poverty rate, % | 21.5 | 13.5 | 12.2 | 15.7 | 23.9 |
| 16.9 | 16.3 | 12.5 | 16.2 | 20.9 |
| Average resident population per year, thousand people | 1062.7 | 1899.3 | 1318.6 | 791.6 | 159.1 |
| 1092.8 | 1942.9 | 1340.9 | 814.1 | 171.5 |

Note: in the numerator – the data for 2019, in the denominator – the data for 2013.
Source: calculated according to data of Federal State Statistics Service. Available at: https://rosstat.gov.ru.

However, in assessing the sustainability of development, it is not only the accelerated rates of attracting investment and economic growth that are important. Thus, one of the officially assessed indicators of a "new model" of the development of the Far Eastern Federal District is the creation of new jobs. The growth in the number of people employed in the regional economy can be considered a definite measure of this process. The actual dynamics of this indicator in 2013–2019 (see Table 1) demonstrates its decrease both in the Amur ecoregion as a whole and in each of the five considered subjects of the Russian Federation.

An important measure of success for economic and social policy is considered to be the indicator of poverty level of the population, determined by official statistics on the share of the population with incomes below subsistence level in its total population (in percent). In the Amur ecoregion, despite a fairly high GRP per capita and a decrease in the poverty level in most of its regions in 2019 relative to 2013, this indicator still exceeds the average Russian level (12.3 % in 2019). At the same time, in the regions where in the period under review there is a significant increase in the share of mining in the structure of industry (Trans-Baikal Territory and the Jewish Autonomous Region), there is also a high level of poverty and a tendency for its growth.

The final result of the formation of economic and social living conditions that satisfy the population is reflected in the dynamics of its numbers. The positive movement of this indicator is one of the key goals of active state policy in the Far Eastern Federal District. However, during the period under review, it was not possible to overcome negative trends: both in the Amur ecoregion as a whole, and in most of its regions, a decrease in the population was noted. So, in 2019 relative to 2013, it amounted to 2.4 % in
general, the population in the Jewish Autonomous Region decreased more significantly (more than 7%).

In the context of an ever-increasing understanding of the “primacy” of the environment at all levels for ensuring sustainable development, it becomes important to assess the environmental aspects of the regional economy. In the scientific literature, there are enough studies devoted to it. In this article, attention is focused on how the state economic policy pursued has affected the state of the environment and the ecological living conditions of the population. Table 2 shows a change in specific indicators of atmospheric emissions and wastewater discharges per capita in 2013 and 2019, reflecting the socio-ecological well-being of the territories.

| Table 2. Indicators of social and ecological well-being in the Amur ecoregion |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                         | Trans-Baikal Territory   | Primorye Territory       | Khabarovsk Territory     | Amur Region              | Jewish Autonomous Region |
| Air emissions per capita, t / person | 0.10                    | 0.09                    | 0.08                    | 0.16                    | 0.10                    |
| Wastewater discharges per capita, m³ / person | 70.57                   | 136.37                  | 138.03                  | 82.11                   | 81.71                   |

Note: in the numerator - the data for 2019, in the denominator - the data for 2013.
Source: calculated according to data of Federal State Statistics Service. Available at: https://rosstat.gov.ru.

The given unit indicators demonstrate the unequal dynamics of the processes. In terms of the unit indicator of emissions into the atmosphere, the situation in the Amur ecoregion as a whole can be called relatively stable, its decrease is noted (except for the Amur region).

The dynamics differ in terms of the unit indicator of wastewater discharge. A noticeable decrease occurred only in the Amur Region and the Primorye Territory, and it was influenced by both a decrease in absolute indicators of discharges and a decrease in the population. A slight increase in the indicator (by 4%) was noted in the Khabarovsk Territory. The most difficult situation is observed in the Trans-Baikal Territory, where there was a more than twofold increase in the unit indicator of discharges, even in spite of a decrease in the population indicator. This is due to an increase in the absolute volume of pollution.

The ecological and economic well-being of the regions can be assessed using the decoupling effect. Table 3 shows the results of calculating the impact decoupling coefficient in the regions of the Amur ecoregion. The gross regional product (GRP) in constant prices was chosen as an indicator reflecting the economic result. The environmental load is measured through "the volume of emissions of pollutants from stationary sources" (air emissions) and "the volume of discharges of contaminated wastewater" (wastewater discharges) indicators, the data on which are published by the Federal State Statistics Service.

| Table 3. Impact decoupling coefficient in the Amur ecoregion in 2013–2019 |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Characteristics          | Trans-Baikal Territory   | Primorye Territory       | Khabarovsk Territory     | Amur Region              | Jewish Autonomous Region |
| Air emissions            | 0.424                   | 0.440                   | 0.355                   | 0.451                   | 0.518                   |
| Wastewater discharges    | -0.412                  | 0.482                   | 0.329                   | 0.533                   | 0.329                   |

Source: calculated according to data of Federal State Statistics Service. Available at: https://rosstat.gov.ru.

The analysis of Table 3 shows that in all the regions of the Amur ecoregion, there is a positive impact decoupling coefficient according to the indicator “emissions of pollutants into the atmosphere”. In most regions, except for the Trans-Baikal Territory, there is a positive coefficient in terms of wastewater...
discharge. As noted above, the negative situation in the Trans-Baikal Territory is confirmed by an increase in absolute volumes. Actual data on the discharge of polluted wastewater into surface water bodies indicate their sharp (2.2 times) increase in 2013–2019 which was associated with the violation of environmental legislation and illegal discharge of untreated wastewater by nature users [10].

Nevertheless, it can be concluded that during the study period, in most of the regions of the Amur ecoregion, a positive process was noted, namely, a decrease in the environmental load with an increase in the GRP volume in 2013–2019.

Correlation of the dynamics of environmental pressure with the dynamics of the population size reflects both the social and environmental aspects of sustainable development of territories. The decoupling effect can be considered one of the integral environmental and economic indicators of the implementation of modern state policy in the region.

In connection with the estimates obtained, a number of controversial questions arise. The growth of investments in the economy and the positive dynamics of parameters of economic growth by themselves do not guarantee sustainable socio-economic development of regions [14, 15, 16]. Our estimates for the regions of the Amur ecoregion confirm these conclusions.

An important scientific area that requires methodological, methodological and informational development is the selection of adequate indicators to assess the relationship between the use of natural resources and the nature of socio-ecological and economic development at the regional level. As for the information aspect, in this study we attempted to calculate some indicators using data in official statistics. To obtain more accurate estimates, a special statistical base is needed at the regional level with a set of indicators reflecting this relationship. Such estimates are found in the scientific literature, but they require further detailing.

The methodological support of assessing socio-ecological and economic development at the regional level requires its development. In our opinion, one of the important issues which have not been sufficiently resolved in the framework of the concepts of sustainable development and a "green" economy is the adaptation of criteria and estimated indicators of the international and national levels at the regional level [17].

As part of further deepening the above-mentioned approaches, the concept of “inclusive development” and a new comprehensive indicator for assessing and cross-country comparisons in terms of growth, equity and sustainability, namely, the Inclusive Development Index (IDI) are being currently discussed. The calculation of the index is based on 12 indicators, which also include the indicators discussed above in our study (GDP growth, poverty level, life expectancy, etc.). Such theoretical and applied problems remain relevant for research in the framework of the new concept of inclusive development.

4. Conclusion
In accordance with the stated goal, an attempt was made to form an idea of the dynamics of sustainable development processes in the regions of the Amur ecoregion during the period of implementation of the policy of the federal center in Eastern Russia. The estimates obtained indicate that there is no unambiguous direct relationship between the growing economic activity and the improvement of social indicators in the Amur ecoregion. With the growth of economic indicators, the population is decreasing and its level of poverty remains high. As for the assessment of the environmental aspects of the regional economy according to the considered range of indicators, the deterioration of the environmental situation in most constituent entities of the Federation (except for the Trans-Baikal Territory) in a sense cannot be attributed to positive aspects because world and domestic practice shows that often stimulation of economic activity leads to technogenic press on the environment.

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