The decoupling estimation effect as an indicator of the efficient use of natural capital in the agrifood in the southern geographical area of the Russian Federation

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Abstract. In the process of studying the issues of ecological and economic interaction, the so-called "decoupling" is increasingly becoming one of the defining concepts. Decoupling implies the elimination of the contradiction between the possibilities of ensuring economic growth and reducing the level of environmental impact. The most significant field of economic activity is an agrifood production. In the scope of reducing the consumption of natural resources, achieving the decoupling effect is fundamentally essential. In this regard, the paper based on the author's methodological approach assesses the level of resource decoupling in the agrifood in the southern geographical area. Effectively, the obtained calculations propose to show a direct ratio between the level of resource decoupling and the agrifood efficiency at the regional level. The introduction of innovative nature-like technologies describes as one of the most considerable fields in agrifood development, which determines the accomplishment of the decoupling effect. Such technologies allow within the framework of technical systems and used technologies to reproduce the processes that occur in the natural environment.
Keywords: natural resources, natural capital, decoupling, agrifood production, the Southern Federal District.

1 Introduction

Recently, several ways of analysis of the ecological and economic interaction processes have brought up the attention of representatives` attention of a wide scientific scope. It is understood that the increasingly large-scale use of natural resources in economic activity not only causes irreparable damage to the environment and limits the possibilities for ensuring the effective life for future generations, but it also affects the current development of socio-economic systems. Moreover, it determines the paradigm for approach implementation on the environmental and economic interaction.

Quite naturally recognized by modern economic science as one of the capital forms, the efficient reproduction of natural resources supposes a relevancy to use environmental and

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economic objectives. Economic facility between them is based on the decoupling effect advance, which implies the need to eliminate the direct ratio between the rates of economic growth and consumption of natural resources.

The accomplishment of the decoupling effect is associated with ensuring that the direct ratio between the increase in the parameters of economy growth, and the consumption of natural resources is eliminated[1]. Firstly, in the official document, the concept under consideration was given in the Environmental Strategy in the first decade 21st century, and adopted by the Organization for Economic Cooperation and Development in 2001. There it was defined as a situation where the growth rate of the environmental load lags behind its growth rate, and advance of the economic progress.

One of the most common decoupling definitions belongs to M. Fischer-Kowalski[2], who had considered this concept as a process of reducing the amount of resources used in economic activity and the negative impact of this activity on the environment per unit of production.

A. Wijkman and K. Skanberg reported to the Rome Club in 2015, that it was the necessity for more efficient use of all types of natural resources, defining the decoupling objective as the economic ability to grow without the increase in resource consumption and pressure on the environment [3].

In this case, the authors consider the advance as the relative effects and absolute decoupling. There is a situation where the economic indicators` growth exceeds the parameters of an increase in the consumption of natural resource capital. Then, there is an absolute decrease in consuming the natural resources for economic purposes even in conditions of growth in the production parameters[4].

In addition, based on the fundamental nature considerations that cause the decoupling effect, it is distinguished such forms as the resource decoupling produced by a decrease in the consumption of natural resources in economic activities and decoupling of the impact, which takes on its advance due to a decrease in the negative impact of this activity on the natural environment [5].

Effectively, the most often in studies devoted to the quantitative assessment of the decoupling level, the effect analysis of decoupling has been carried out in relation to the influence of changes in CO_2 emissions on the parameters of economic development. Particularly, L. Freitas and S. Kaneko, assessing the relationship between the volume of carbon dioxide emissions and the parameters of economic growth in Brazil, pointed to a high advance level of the decoupling effect [6]. S. Neves and A. Marquez substantiated the possibility of its provision in the US transportation based on the use of alternative energy sources [7]. Therefore, A. Rokhmawati substantiated a higher competitiveness level of the Indonesian enterprises, which were focused on the measures implementation that allow reducing CO_2 emissions and, thereby, ensuring the accomplishment of the specified effect at the company level [8].

However, assessing the decoupling level in the agrifood production system, it is more significant to study the advances of resource decoupling, basically in the scope of analyzing trends in the use of land and water resources in the production process.

In this scientific field, it is necessary to note the significant contribution of the Chinese researchers. Yu Zhang and Yang Qishan analyzed the decoupling level of the agrifood of the PRC on the basis of comparing the parameters of water consumption with the volume of commercial grain production and indicators of the negative impact of the agrifood production on the environment and indicated the existence of the a sufficiently strong dependence in the first case and sufficient weak in the second case [9]. Another group of the Chinese researchers led by Zhao Rongqin investigated the connection between the water indicators and land resources by using the agrifood and CO_2 emissions into the atmosphere, noting the existence of the a closer connection between the value of the latter parameter and the consumption level in the agrifood production process of the water resources [10].

At the same time, as a rule, the authors concentrate on studying the manifestation of the decoupling effect at the level of the national economy, paying less attention to the regional aspects of this problem [11].

2 Materials and Methods

The research was carried out on the basis of a theoretical analysis of the scientific literature and a descriptive method that allows outlining the specific peculiarities of the decoupling concept used and the methodology for determining the decoupling parameters based on the author's proposals and improve the methodology for calculating its adjusted index.

For assessing the advance degree of the decoupling effect, as a rule, such an indicator as the decoupling index is used, and it allows correlating the dynamics of the economic development, expressed on the basis of a special creating indicators with the parameters of the natural resources in economic activity and the negative impact of its activity on the environment. For calculating the value of this indicator, the following formula is used:

$$DI = \frac{T_R}{T_Y} = \frac{(T_{R1} - T_{R0}) / T_{R0}}{(T_{Y1} - T_{Y0}) / T_{Y0}}, \quad (1)$$

where $T_R$is the relative change in resource consumption or pollution level over a certain period; T_Y is the relative change in the resulting indicator of economic activity for the same period; T_{R0} and T_{R1} are the consumption amount of a certain resource or environmental pollution in the initial and final years, respectively; T_{Y0} and $T_{Y1}$are the consumption amount of a certain resource or environmental pollution in the initial and final years, respectively.

For analyzing decoupling indices, it is used the methodological approach and terminology proposed by the Finnish researcher P. Tapio [12]. According to this approach, the decoupling situation can be divided into several basic types. In each of the basic cases, the values of the decoupling index are the main criterion for assigning a particular case to a specific situation [13].

It shows the existence of a sufficiently thought-out approach to identifying the forms of decoupling advance within the framework of using this methodology, effectively, it should be highlighted that it does not allow arranging the researched objects in accordance with the advance level of the decoupling effect. There is a situation that the same numerical values of the calculated index can characterize different types of decoupling and must be correlated with certain conditions that describe it.

In this scope, it seems appropriate to use the model for calculating the adjusted decoupling index, determined in accordance with the following formula:

$$DI = \frac{T_R}{T_Y} = \frac{T_{R1} / T_{R0}}{T_{Y1} / T_{Y0}}. \quad (2)$$

The final value of the index, which is in the range from 0 to 1, indicates the existence of a decoupling effect within the assessment object, while a value exceeding 1 indicates its absence. Effectively, the closer the index value is to the zero mark, the more this effect advances itself. Effectively, the use of such an approach makes it possible to arrange the objects under study in accordance with the advance degree of the decoupling effect.

3 Results

The most significant area of economic activity, where the accomplishment of the decoupling effect is essential from both economic and environmental points, can be called agriculture.

Moreover, it is the resource decoupling that is of particular importance, since the agrifood process is inseparable from the large-scale use of natural resources, and the key place, of course, is occupied by land and water.

In this scope, the assessment of the resource decoupling level in connection to these two types of natural resources is carried out using the example of the geographical areas in the southern geographical area as one of the key agrifood producers in the Russian Federation. It should be proposed that to data comparison, the analysis is carried out in relation to the territories that are a part of the southern geographical area throughout the entire period under consideration in 2014 - 2019. This area includes the Republic of Adygea, Astrakhan Region, Volgograd Region, Republic of Kalmykia, Krasnodar Territory and Rostov Region.

Land resources are undoubtedly the basic factor in agrifood production. Effectively, the established methodology for determining the value of decoupling parameters, starting from changes in quantitative parameters reflecting the state of this factor, has not been developed yet. Indeed, the use of such a parameter as the total area of the agrifood land does not seem appropriate due to its rather weak volatility.

In this scope, the most acceptable approach would be used with such a parameter as the cultivated land for obtaining crop production. The ratio of changes in these two parameters for the geographical locations in the southern geographical area is presented in Table 1.

Table 1. Dynamics of changes on the cultivated land for agrifood crops in the southern geographical area (thousand hectares).

Geographical location	**2014**	**2019**
Republic of Adygea	232.28	232.99
Astrakhan region	69.78	82.59
Volgograd region	2918.31	3146.12
Republic of Kalmykia	239.25	317.18
Krasnodar region	3618.49	3708.52
Rostov region	4361.68	4695.04

Source: Data from the Federal State Statistics Service of the Russian Federation.

The second key natural resource used in agrifood production is water. In this regard, due to the study of the decoupling effect in this aspect, the concept of "water footprint" is often used, introduced into scientific circulation in 2002 by the Dutch researchers under A. Hoekstra leadership [14]. He proposes the water resource volume using in the production of certain products.

In this research, the author will consider the existence of the a decoupling effect for such a parameter as the use of fresh water for irrigation and agrifood water supply in geographical locations in the southern geographical area. As in the first case, it is compared with the change in the value of this indicator in period 2014-19 in Table 2.

Table 2. Dynamics of fresh water use for irrigation and agrifood water supply in the southern geographical area (million m^3).

Geographical location	2014	2019
Republic of Adygea	72.57	135.53
Astrakhan region	487.85	375.71
Volgograd region	124.33	153.73
Republic of Kalmykia	140.29	153.10
Krasnodar region	3248.90	2600.26
Rostov region	790.60	749.97

Source: Data from the Federal State Statistics Service of the Russian Federation.

As a parameter reflecting the level of economic efficiency of the agrifood activity, it is most expedient to use the indicator of the agrifood production volume at the regional level, where the

parameters at the end of 2014 and 2019 are presented in Table 3. Effectively, following the assessment objective principle, it seems appropriate to use the values of the considered parameters reduced to comparable prices.

Table 3. Dynamics of changes in the agrifood production volume in the southern geographical area (million rubles).

Geographical location	2014	2019 (actual prices)	2019 (comparable prices)
Republic of Adygea	15262	26290	17857
Astrakhan region	29070	50490	36361
Volgograd region	100673	149118	116011
Republic of Kalmykia	21479	27871	20331
Krasnodar region	266663	417201	308191
Rostov region	172459	285455	213407

Source: Data from the Federal State Statistics Service of the Russian Federation.

The parameters of the adjusted index of resource decoupling when comparing the change in the values of the cultivated area and the volume of agrifood products obtained in each area are shown in Figure 1.

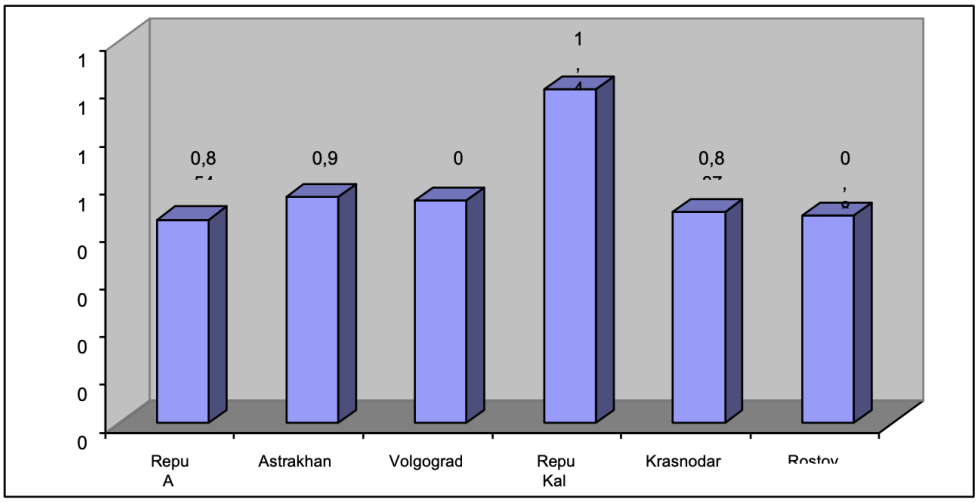

Fig. 1. Values of the adjusted decoupling index for the parameters "cultivated land for agrifood crops" and "volume of agrifood production" by geographical location in the southern part in 2014-2019. *Source:* author's calculations.

The leading position among the areas in the southern geographical area in the scope of assessing the quantitative values of the decoupling index for the parameter "cultivated land for agrifood crops" is the Republic of Adygea (0.854). The existence of the the decoupling effect in accordance with the values of the adjusted index in descending order is also inherent in the Rostov region, Krasnodar region, Volgograd, and Astrakhan regions. Effectively, the Republic of Kalmykia is describedby the absence of the decoupling effect in the scope of the parameter under consideration.

Particularly, the value of the adjusted resource decoupling index, which characterizes the use of fresh water in agrifood production in the geographical locations are illustrated in Figure 2.

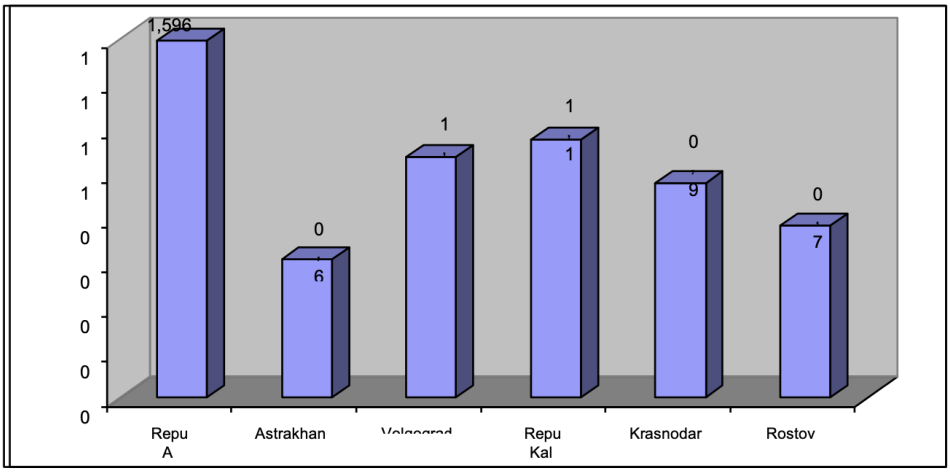

Fig. 2. Values of the adjusted decoupling index for the parameters "use of fresh water for irrigation and agrifood water supply" and "volume of agrifood production" by thegeographical locations in the southern part in 2014-2019. *Source:* author's calculations.

In accordance with the decoupling level, according to the parameter "use of fresh water for irrigation and agrifood water supply" allows stating the leading positions of the Astrakhan and Rostov regions. The Krasnodar region, as an area with a weak decoupling level, gets the third place in the list with a value that is almost on the verge of being classified as a region described by the existence of the the decoupling effect (0.958). Obviously, the other three areas are distinguished by the absence of decoupling effect for second of the parameters analyzed in this paper.

4 Discussion

The results of the analysis allow us to conclude that two largest agrifood areas are the Krasnodar Territory and the Rostov Region quite effectively and rationally use land and water resources in the agrifood. Moreover, the decoupling situation for both considered parameters is typical for the Astrakhan region. Therefore, it is the highest growth rate of agrifood production in comparable prices among all observed areas in the southern geographical part, at the end of 2014-19, it is 125.1%. Therefore, the Rostov and Krasnodar regions occupy the second and third positions in this parameter, respectively. The dynamics of changes in the indices of agrifood production in the three indicated areas in relation to the analyzed period is shown in Figure 3.

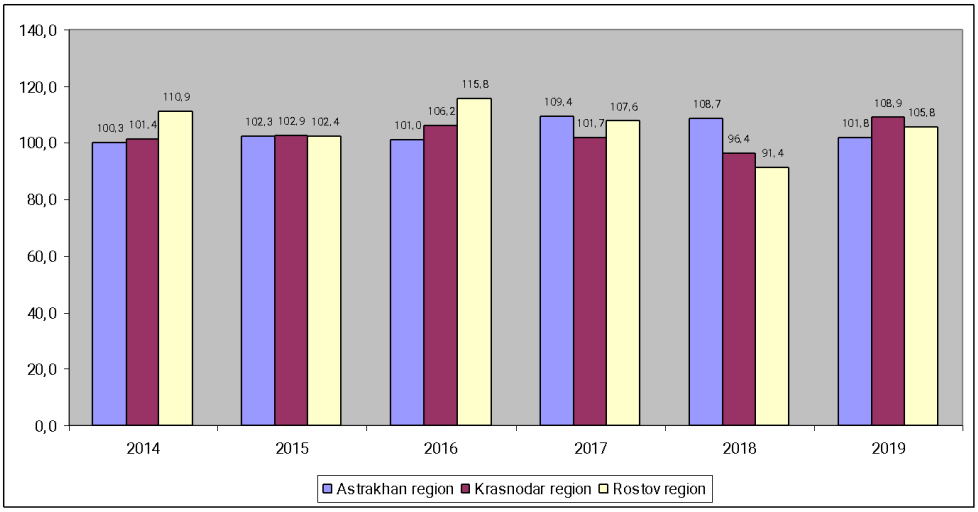

Fig. 3. Dynamics of changes in the value of the agrifood production indices in the Krasnodar region, Rostov and Astrakhan regions in 2014-19. *Source:* author's calculations.

This circumstance indicates the existence of a direct ratio between the level of resource decoupling and the efficiency of agrifood production. Moreover, it should be considered that the resource component of this efficiency is based, firstly, on ensuring a more rational approach to the water resources use. As a result, the calculations made indicate that the cultivated land for agrifood crops in the three regions, where the decoupling effect is observed in both considered parameters, increased during the analyzed period by 9.5%, while the average value for all district areas was 11.2%. Effectively, with a decrease in fresh water consumption in the agrarian sector of the Krasnodar, Rostov and Astrakhan regions by an average of 5.1%, the average regional growth of this parameter in 2014-19 is amounted to 18.1%.

The accomplishment of the decoupling effect in the agrifood of the three researched areas is largely facilitated by the use of innovative technologies, which are actively being introduced due to a more developed scientific and production base. One of the most considerable fields in the use of innovative technologies is to ensure the associated consistent development of the technosphere and biosphere. Therefore, the development concept of nature-like technologies as a qualitatively new system element of ecological and economic interactions is becoming more widespread [15].

According to the conditions of agrifood production that have developed within the southern area, one of the most considerable fields for the introduction of nature-like technologies is the formation of adaptive agrifood landscapes, which are understood as landscapes that have undergone targeted transformation due to the implementation of various forms of ameliorative impact that integrates natural and modified components into a single complex. This complex is described by the existence of certain structures and properties that make it possible to intensify the production of agrifood products with the formation of a natural technological complex with the specific peculiarities of the chosen area, and the increased bio-productivity and environmental stability.

5 Conclusion

The proposed methodological approach for improving the assessment of the advance degree of the decoupling effect enables arranges the researched objects in accordance with the advance level effect. It is based on the analysis of the advance level effect of resource decoupling in the field of agrifood production in the geographical areas that included into the southern part of the

Russian Federation, it can be carried out using two evaluative approaches that the largest agrifood areas of the district use land and water resources most efficiently and rationally in the agrifood. This circumstance indicates the existence of a direct ratio between the level of resource decoupling and the efficiency of agrifood production.

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