THEORETICAL AND METHODOLOGICAL FOUNDATIONS FOR MODELING THE FUNCTIONING AND DEVELOPMENT PROCESSES OF REGIONAL POTENTIAL

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The most important economic task of the region's development is to develop a model of an effective mechanism for the functioning of the regional aggregate potential based on determining the initial state of the organizational and economic system in terms of opportunities for further development. The solution of this complex task in conditions of limited resources puts in the first place the systemic problem of quantitative and qualitative determination of available resources and management of the state of regional potential at a specific time based on the analysis of two phases: use and production. The theoretical and methodological foundations of modelling the processes of functioning and development of regional potential allow us to develop a mathematical multilevel model that ensures optimal management of the region based on the maximum use of labor, production, technical and investment resources. The logical models of functioning and development of economic potential presented in the article are at the same time its formal scheme fixing cause-and-effect relationships in the system.

Keywords: regional aggregate potential, economic resources, aggregate social product, technological production waste, gross regional product

1 INTRODUCTION

One of the most important tasks in the development of the regional aggregate potential is the correct definition of its initial state in terms of opportunities for further development. The quantitative and qualitative characteristics of available resources, their ability to adequately respond to a rapidly changing market situation determine their potential. Ultimately, it serves as the basis for all strategic decisions made at the regional level and determines the ultimate goal of production policy, the program of action and the ways to implement this program.

The solution of these complex problems in conditions of limited resources puts forward the problem of quantitative and qualitative measurement of available resources and the total territorial production and technical potential. The correctness of such measurements and the accuracy of calculations depend, first of all, on the decision-making strategy that allows, taking into account the dynamics of the market situation, to ensure the gain from the timely reorientation of production capacities, material, labor, and innovative resources. In turn, it entails a change in management policy, economic relations with potential investors, customers, suppliers of materials, equipment and subcontractors.

1.1 Problem Statement and Research Analysis

The functioning of the regional aggregate (industrial, technical, economic and informational) potential is considered as a change in its state at each moment of time and is represented by two phases: use and reproduction [1, 2, 3].

The mechanism of functioning of the aggregate potential is as follows (Fig. 1).

The use of the regional potential of the territory (RPT) is carried out in the process of production of material goods and services to meet the social and economic needs of the population of the territory (in the Fig., the process of production of a social product is indicated by P) [4, 5]. The production of the product is carried out by enterprises of the branches of regional economy (O_1, O_2, ..., O_n). The implementation of the production process by industries involves the use of resources that are elements of the regional potential: labor (LR), production (PR), natural (NR), investment (IR). The latter are represented by tangible working capital, fixed assets and information in the form of intangible resources.
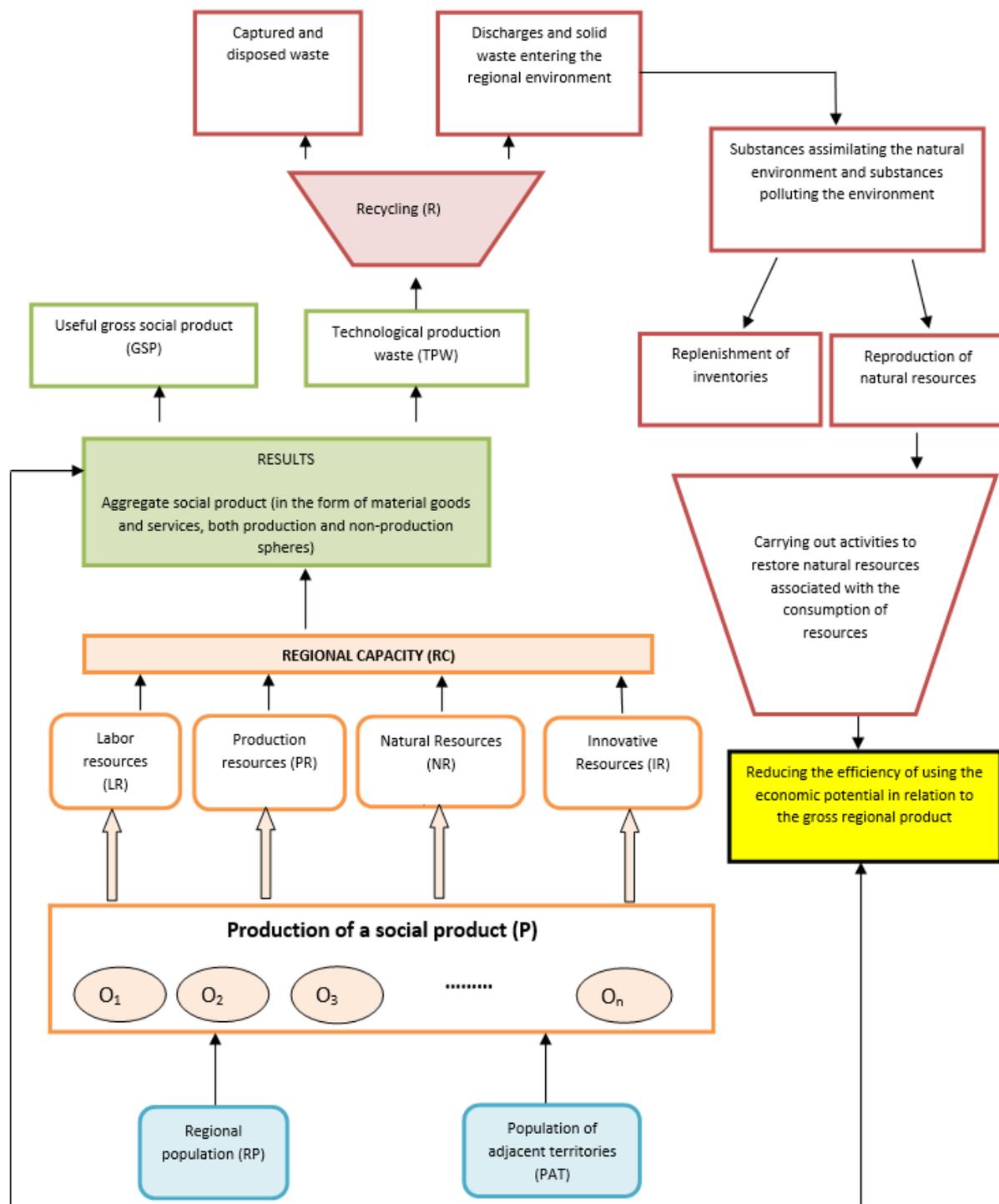
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Natalia Vladimirovna Bredikhin et al. - Theoretical and methodological foundations for modeling the functioning and development processes of regional potential

Fig.1. The mechanism of regional potential functioning

The sources of economic resources are [6]:

    a)   labor - economically active regional population (RP) and positive migration of the population from adjacent territories (PAT);

    b)   production (PR):

        • intra- and intersectoral distribution of material resources;

        • import of means of production from outside;

        • secondary use of material resources.

    c)   natural resources of adjacent territories entering the natural system of the region (for example, the flow of water from the river runoff of adjacent territories).

The primary result of using the potential of the region is the aggregate social product (in the form of material goods, works and services of both production and non-production sectors of the economy) [7, 8], represented by two streams-useful gross social product (GSP) and technological production waste (TWP). In the diagram, the process of waste processing is represented by a software block, in which part of the waste is captured and disposed, and the

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Natalia Vladimirovna Bredikhin et al. - Theoretical and methodological foundations for modeling the functioning and development processes of regional potential

other part in the form of emissions, discharges and solid waste enters the environment of the region. The flow of substances entering the environment consists of substances that are assimilated by the natural environment, and substances that pollute the environment. In turn, the polluted environment affects the population of the region and its active part, thereby lowering the labor potential of the territory. Similarly, pollution affects natural productive resources (water, land, forest, flora and fauna), removing them from circulation or lowering their productivity, which negatively affects the value of the natural resource potential. Polluted environment affects the state and production possibilities of investment resources. As a result, inventories become unusable, premature wear of fixed assets sets in, the operational characteristics of their active part decrease, and an effective fund of time is lost. Accordingly, the production potential of the region decreases, the consumption of resources per unit of the created product increases [9].

The second part of the waste, captured and disposed, replenishes the material resources of the region, which positively affects the potential of the region. The software block also provides for the technical production of natural resources previously involved in the production system (for example, land reclamation, afforestation, etc.). These actions increase the natural resource potential of the territory [10,11]. At the same time, the implementation of environmental protection and nature restoration processes in the software block is associated with the expenditure of resources. If environmental protection and restoration measures are considered as socially necessary activities, then the diversion of economic resources for their implementation does not reduce the potential of the region, but reduces the efficiency of its use in relation to the production of the gross regional product.

The well-known concept of a closed-loop economy, which goes beyond the scope of our research, offers an approach to production, consumption and economic activity based on renewable solutions and business models. The so-called "butterfly diagram" proposed by the Ellen MacArthur Foundation can be seen as an illustration of the continuous flow of technical and biological materials through the "circle of values".

The formation of the gross social product (GSP) completes the phase of using the potential of the territory. Further processes in the region's system are associated with the consumption of the newly created social product, as well as with simple and expanded reproduction of the region's potential (Fig. 2).
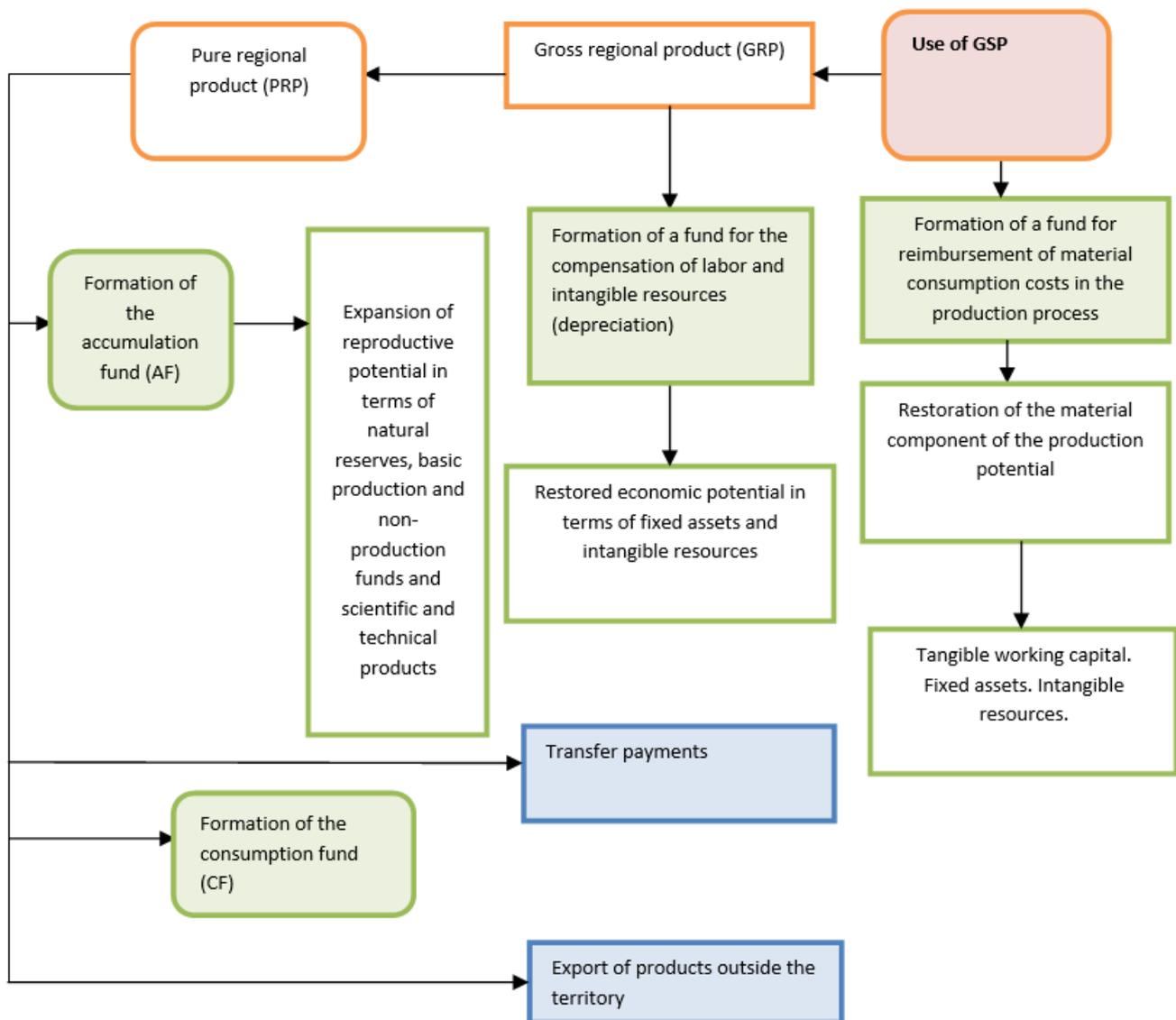

Fig.2. The mechanism of using the gross social product

Journal of Applied Engineering Science

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Natalia Vladimirovna Bredikhin et al. - Theoretical and methodological foundations for modeling the functioning and development processes of regional potential

In the process of using the GSP, a fund is formed to compensate for material costs consumed in the production process, and at the expense of it, the material component of the production and technical potential is restored. The remaining part of the GSP forms the gross regional product (GRP), from which the fund is formed to compensate for the consumed labor and non-material resources (depreciation of fixed assets). This restores the potential of the region in terms of fixed assets and intangible resources. The remaining part of the GSP forms a net regional product (NRP), which is distributed to the Accumulation Fund (FN), the Consumption Fund (CF) and the export of products outside the region in the form of means of production and consumer goods [12].

At the expense of the accumulation fund, the expanded reproduction of the production and technical potential is carried out in terms of the increase in stocks of inventory items, which is one of the main goals of the management system, production and non-production assets and scientific and technical products intended for use in the economy of the region [13, 14]. The Consumption Fund (CF) is used directly by the population of the territory and the management system in the region.

Due to the latter flow, the functioning of the local government system is ensured, in addition, part of the Consumption Fund is redistributed by the management system to the needs of the population of the territory in the form of transfer payments. The management system forms the conditions that ensure the most complete and efficient use of the potential of the region. Part of the Consumption Fund, which is directed to meet the needs of the population, ensures the restoration of the labor force consumed in the course of production (P), as well as its expanded reproduction. Thus, the labor potential of the economically active population is restored and its development is ensured.

Each of the blocks of the presented scheme involves a certain group of mathematical dependencies, with the help of which it is possible to determine the quantitative characteristics of the processes occurring in them. The inputs of the blocks determine the information flows external to them, which are used to obtain the necessary quantitative estimates at the output. The totality of these estimates is formed into output streams, reflecting the intermediate or final results of calculations. So, with the help of the dependencies of the production block (P), the following are determined:

- composition and volumes of products produced in the region based on available resources;
- amount of production waste generated, captured and released into the environment.

The initial information for obtaining final estimates are the coefficients of total and direct costs of intersectoral material and financial balances that characterize the interaction of enterprises and organizations of the territory with each other and with the external environment; tax standards and proportions of the formation of funds of the enterprise, the population and the region, determined by the regional and external management systems [15, 16].

The level of pollution of its components (water, air, soil), changes in the state of recipients (population, natural productive resources, material objects) under the influence of pollution, the transfer of pollution outside the region are determined with the help of dependencies of the "natural environment in the region" block. The main output characteristic of this block is the reserves of natural resources of the appropriate quantity and quality, which together determine the natural resource potential of the region. The initial information for the "natural environment" block is data on the flow of waste into the environment from the enterprises of the region, the population and adjacent territories, quantitative dependencies characterizing the assimilation potential of the natural environment [9, 17].

Dependencies of the block "population of the region" allow you to determine the population of the territory, taking into account the factors of birth, death, migration; qualitative characteristics of the population (morbidity, duration of the active period, educational level, etc.) depending on living conditions, the state of the natural environment and the provision of material goods and services. The main output characteristic of this block is the number of economically active population and its qualitative parameters, which together determine the labor potential of the region. The initial information that determines the state of the population of the region is data on living standards, the quality of the environment, and migration.

The resource blocks LR, NR and IR allow you to determine the maximum amount of labor, natural and production resources that can be involved in social production (P) at a given point in time. With the help of the output data of these blocks at a given level of technologies, determined by the block, taking into account the conditions specified by the territory management system and the external management system, the maximum possible volume of NRP production is determined, which characterizes the total potential of the territory at a particular point in time.

2 RESULTS AND ITS DISCUSSION

At the same time, the presented logical models of the functioning and development of the economic potential are its formal scheme, fixing cause-and-effect relationships in the system.

It is known [18-20] that the value of the regional potential is quantitatively determined by the maximum possible output of the gross regional product for a given amount of economic resources and conditions that determine their maximum use. In this case, the total regional potential (Q) can be represented by a multifactorial function of the form:

$$Q = F (L, K, P, I, M) \tag{1}$$

where L is the labor potential of the active population of the territory; K - production and technical potential, i.e. the potential of the main and material components of revolving funds concentrated in the given territory; P - natural

Journal of Applied Engineering Science

Vol. 20, No. 4, 2022

www.engineeringscience.rs

iipp
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Natalia Vladimirovna Bredikhin et al. - Theoretical and methodological foundations for modeling the functioning and development processes of regional potential

resource potential of the territory; I - innovation potential or potential of scientific and technological progress; M - intra-production turnover, characterizing the work of the production system for itself (consumption of raw materials, materials, fuel, energy, etc.).

In turn, the labor potential (L) of the active population can be expressed by the function:

$$L = f(R, L_e, L_h, L_l) \tag{2}$$

where R is the active population; L_e- average educational level of the active population; L_h- an indicator of the health of the population of the territory, taking into account the quality of the environment; L_l, the standard of living of the population of the territory.

Production and technical potential K in the general case can be reflected by the dependence [21]:

$$K = f(\Phi_r, \Upsilon_a, \Phi_a, Y_p) \tag{3}$$

where Φ_r is the residual value of the region's fixed assets; Υ_a is the share of the active part of fixed assets; Φ_a - average annual balance of the material component of fixed assets; Y_p is an indicator of scientific and technological progress that affects the return on assets.

The natural resource potential depends on the amount of relevant natural resources, their productivity, and the qualitative impact of the environment state [9].

The natural resource potential (P) is generally defined as:

$$P = f(B, \rho, Y_{eq}) \tag{4}$$

where B is the amount of one or another type of natural resource; ρ is the specific productivity of the resource, taking into account the influence of the quality of the environment; Y_{eq} is an indicator that takes into account the impact of environmental quality on the productivity of a natural resource.

The innovative potential can be ignored separately, since this indicator indirectly affects the labor and innovative potentials.

The amount of generated waste (Z) in the general case is a function of the volume of production of the final product (Q) and intermediate product (t), i.e.

$$Z = f(Q) + f(m) \tag{5}$$

As a result of environmental protection measures, a certain amount of waste is captured and neutralized, then:

$$Z = Z_w - \Delta Z \tag{6}$$

where Z_w is the amount of waste entering the environment; ΔZ is the amount of captured and neutralized waste.

In turn:

$$\Delta Z = f(R_z) \tag{7}$$

where R_z is the expenditure of labor, capital and natural resources for the disposal of production waste.

The level of pollution of environmental components (L_{ec}) is described by the following expression:

$$L_{ec} = f(\Delta Z, S, I) \tag{8}$$

where ΔZ is the amount of captured and neutralized waste; S is an indicator that takes into account the assimilation potential of the environment; I is an indicator that takes into account the conditions for the spread of harmful substances in the environment.

3 CONCLUSION

The considered theoretical and methodological foundations for modeling the processes of functioning and development of the regional potential for the developing economies of the world make it possible to develop a mathematical multilevel model of this process, which allows solving the following problems:

- analysis of the effectiveness of the use of resources of the territory and assessment of the role of each of them in the production of the gross regional product;
- analysis of resource replacement possibilities;
- assessment of the impact of the proportions of distribution of the internal regional product, the pace of development of scientific and technological progress and the quality of the environment on the reproduction of regional potential;
- obtaining short-term and long-term forecasts of the territory development on the basis of a dynamized model of the regional potential;

Natalia Vladimirovna Bredikhin et al. - Theoretical and methodological foundations for modeling the functioning and development processes of regional potential

— ensuring optimal management of the region based on the maximum use of labor, production, technical and investment resources.

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