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SYSTEM FOR CONVERSION OF NATURAL RESOURCES, WHICH PROVIDES HUMAN NEEDS AND ECOSYSTEM FUNCTIONS – THE DEVELOPMENT OF MATHEMATICAL MODEL

Introduction. The necessity for the accurate quantitative planning of natural resource management, probably, will arise relatively soon. This management will include the conversion of the primary natural abiotic resources (PNARs) into the ecosystem functions (ESFs) as well as the set of the products for the human needs. In this work «conversion» is considered to be the phenomenon of the rise of one value(s) by means of the depletion (and thus the loss) of the other value(s).

Scope. We develop the methodology for the modeling of computation. It can contribute to the underpinning for the solving of the above-described problem. The presented methodology consists of a) the model of the system of the conversion of resources (MSCR), including the conceptual framework and mathematical apparatus; b) the mathematical definition of the problem, based on this model; c) the prediction of the drawbacks for the formal mathematical calculations.

Model of system for conversion of resources. MSCR is treated to be the series of the sets of variables: input (P & A); output (N, E & G); internal for the core of the system (R, O & L). The input variables enable the system to function; the internal ones arise during its working; the output ones represent the results of this functioning. P means PNARs; N – needs in products for the human population; E – ESFs; G – greenhouse gases emission; R – natural recourses, which are produced during the mentioned functioning; O – agents, which convert one forms of the recourses into the others (converting agents – CAs); L – links of such types as p-o, r-o, o-r, o-e, o-g, o-n. «A» expresses the series of the sets: natural conditions; human-dependent conditions and recourses.

To give the mathematical interpretation for MSCR we employ the terms, used by W.R.Eshby (1957). According to his terminology P, R, E, N, and partially A play the roles of vectors in MSCR and the role of operators-converters belongs to O. Each operator-converter serves for the definition of the several groups of the mathematical relations: the quantitative ratios between the vectors a) output for the CA; b) input for it (the ideal ratio); c) important input to output vectors; d) the mathematic functions «how does the departure from the ideal input ratio result in the ratio of output vectors». Vector in MSCR is the variable, which comprises the system (≥1) of values. MSCR allows for the hierarchy of the levels of resources: from simple (nutritive substances and compounds, energy) to compound (e.g., the separate items and groups of products and the other materials). Therefore, to describe the resource of compound level it is necessary to use vector, whereas to depict the simple level's resource it is sufficient to employ the separate variable within a vector.

Research objective. According to above mentioned notations, the solution of the problem has to satisfy the following system:

$$\begin{cases} N = \text{const} \\ P = \text{const} \\ E/P \to \max \\ G/N \to \min \end{cases}$$

Thus the solving of the problem consist in the finding the optimal sets of R, O & L.

Among the **drawbacks of the computational solving of the problem** we outline: a) likelihood of the inconsistency between certain resources and CAs; b) absence of the accepted methodological background for the quantification of ESFs (Вітер, 2017); c) existence of some unexamined questions within the fundamental science. In our opinion, the fundamental investigations should be undertaken to shed light on such questions: 1) non-linear dependence of human and animals on nutrient entering; 2) which of the plant communities and factors of their maintenance the most efficiently contribute to ESFs; 3) which of the CAs provide the highest yields of deficient nutrients (DNs) and ESFs as the function of the input ratio «proteins : arenes : non-protein non-aromatic organic substances»; 4) effect of DNs on the functionally significant animal communities; 5) control of the biosynthesis of deficient amino acids in rumen; 6) overproducers of the precursors for soil organic matter; 6) immobilized nitrogenase for the fertilizer production; 8) opportunities for the substitution of animal source foods for prokaryotic and fungal source foods.

Perspective of MSCR development. The process of revealing of those chains and network of the chains for the resource conversion, which are the most relevant to the statements of the mathematical problem, can be solved by means of computer, particularly applying the method of search trees.