Research Article

Modeling the Interface Between the Social Geosystem and the Environment

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Abstract. This article deals with the context of a new rationality in modeling due to the climate agenda and the introduction of ESG-type principles. We studied a geosystem with homogeneous ecosystems that have a similar geological basement, relief mesoforms, and industrial-territorial complexes. They function in a unified institutional climate. In this case, the focus was on the mesoscale of the systems. The institutional order was based on the relationship between private and general institutions, and organizational features of regions. The Dixit-Stiglitz monopolistic competition model was used to account for financial performance and utility in an equilibrium industry with high nature intensity. What was new was the introduction of the concept of social brands associated with ecosystem services and used simultaneously to account for the utility and customization of the new economic order, as well as the introduction of a social discount rate (a discount factor). Social brands create a certain 'green' meaningful context in relation to natural capital and acting brands through social platforms. Thus, the society, through the mechanism of social brands, is offered a new format of interactions in which the structure of social brands becomes a priority in relation to the productive structure of the economy.

Keywords: climate agenda, natural and social geosystems, utility, social discount, social brand

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1. Introduction

The dilemma of expanding economic activity while stabilizing the rate of resource use and at the same time reducing environmental impacts presents a significant challenge for society [1]. However, the challenge has not been sufficiently explored. Moreover, it is insufficiently researched both in terms of understanding the true economic value of natural capital and establishing appropriate financial incentives [2], and in terms of promoting this knowledge to the level of an institutional mechanism and to the level of local territories [3]. It is now understood that the above discussion highlights the need for a methodological framework for sustainable development and economic growth in

the present context. In particular, society needs a better statistical “compass” for measurement, to shift the focus of measuring economic phenomena towards sustainable development [4, 5].

It is necessary to take into account the social context in the relationship between social and natural geosystems. However, an accurate valuation of the capital is difficult to achieve when market prices are highly volatile. The question of sustainability assessment is complementary to the question of current well-being or cost-effectiveness. It should be considered separately. If current well-being and sustainability are combined into one indicator, there is confusion (cognitive dissonance) [6].

By joining forces, economists and environmentalists have defined ecosystem services as a way of articulating imperatives of preserving and maintaining environmental quality [7]. Economic and natural capital is currently measured in the System of National Accounts. This is done using an environmental-economic accounting system. It was developed jointly by UN agencies, the World Bank and the OECD [8]. However, there are problems with the formation of an effective model. This model describes features of the territorial mode of production in interaction with natural systems. This research is meant to address this problem.

2. Methodology

Modeling the interface between social and natural geosystems relies on the mechanical coupling of an ecosystem and a social system within traditional (industrial) rationality. At the same time, a compromise is being made to simultaneously use the approaches: descriptive (for land) and normative (for the economy). The compromise is that the representation of ecological relationships reflects a specific ecosystem. And economic relations are based on an abstract model that ignores the specifics of territories. The functioning of production sectors tends to be under pressure from a lack of financial resources (it depends on the distribution of financial outcomes of economic activities among beneficiaries). At the same time, current pricing is not conducive to the sustainable use of natural resources. This happens because it is exclusively focused on short liquidity. So no matter how much we prioritize the natural resource sector, it will always be at a disadvantage compared to the financial sector. The approach to the assessment of ecosystem services within the framework of an economic model, where transaction costs are zero, economic agents are completely rational and institutions do not matter, has a very conditional applicability.

There is a debate about how to adequately identify and consider the value of services and costs. The debate revolves around which variables to include and how to include them in regression equations. In [9-11], economic, institutional and demographic indicators, topography, precipitation, wind, climatic conditions, temperature, soil, biophysical indicators, sustainability of land use practices and other indicators that are relevant for determining the extent and intensity of land degradation and accounting for ecosystem services were included in equations.

At the same time, the equations are calculated under the hypothesis of a Gaussian random process. This process requires ergodicity of the considered system of indicators. However, it is not possible to build a reliable (with a predictive quality) regression model in the case of heterogeneous space, in our case economic space. Since such a system (as an ergodic system) is built on a platform of mechanical rationalism, a statistically significant relationship of elements of the system does not yet explain its unity. It is only possible to distinguish homogeneous sub-areas of space (in other words, cells of the space) and build separate models for them (individual tasks).

Thus, a new rational platform for describing the behavior of studied objects (territories as a complex of industrial areas and landscapes) is required. It is necessary to talk about a single socio-natural system as a territorial object, or a geosystem, considering new foundations (ESG-type principles) within the new rationality. We understand it in the same sense as in [12]. Therefore, the focus is on the meso-level of economic systems. The meso-level category is understood as occupying a special place in the methodological discussion of individualism and holism [13-20].

In this context, we consider that individual elements of the economic system form a unity. However, the type of relationship differs from macro and microeconomic laws. It is determined by the co-evolution of elements of meso-economic structures [19]. It also corresponds to the structure of geosystem relations. Despite the diversity of approaches, serious shortcomings of previous models (that describe the behavior of ecological-economic systems) are that they do not take into account the relationship between states of the environment. Transactions occur in this environment as an indicator of the effectiveness of management decisions in different geo-economic contexts. The latter ones greatly determine territorial disparities. It is necessary to take into account geo-economic features of different parts of the spatially structured territory of the country in order to eliminate them. Researchers assess spatial differences in the sense that economic actions are contextual rather than determined by the calculus of income maximization [21]. There is a greater focus on organizational procedures. The focus is both on the local process itself [21] and on the changing institutional order of

interactions between agents in localizing the relationship between private and general institutions [16, 18, 20]. Therefore, researchers have begun to pay more attention to the role of institutions in the development of territories [20, 21]. At the same time, researchers pay attention to "meso-phenomena", positioned on the basis of distinction from micro- and macro-levels [20, 21]. So the focus is on "meso-institutions" in explaining the cooperation and coordination of agents within the adopted logic of the "meso-approach" in terms of the interaction of general and private rules. Meso-institutions are a new research category that performs an important function as a mediator between "general" and "private rules" [15, 20]. The concept of institutions allows us to study spatial objects as meso-economic systems, focusing on their organizational features.

The climate agenda establishes a new rationality as an imperative. However, effective tools are needed to set up the new economic order. In particular, these include *online* and *social* media platforms. They have a major impact on the social climate. Nowadays, social platforms are being introduced into economic solutions, marketing and branding. Through their active use, competing *social brands* create a certain semantic context ("green", "carbon", etc.) in relation to the natural capital and other operating brands.

The social brand is a complex of different semantic, visual and other constructs of a social communication. They are able to create a certain recognizable context in the society and influence the social climate. In turn, the category of social climate is the most important mechanism of the social brand. The social climate is subject to regulation. It is the result of systematic work of institutions and organizations, public policies. It is based on existing institutions, institutional and social embeddedness. A new format of interaction is imposed on the society through the social branding mechanism in accordance with the climate agenda and low-carbon economy (ESG investment) formats. The structure of social brands becomes a priority in relation to the productive structure of the economy according to this format of interactions.

The offer of social brands as public goods is different from the offer of commercial brands (as private goods). This necessitates consideration of informal regulators that fill niches. These niches are not covered by formal rules (the same identity) or they act as a socio-cultural corrective to the formal regulation of market economic turnover. Therefore, a balance or synthesis of formal and informal institutions is important.

The difference between the demand for public and private goods is that, firstly, the market demand for private goods is driven by the mechanism of competition between them, based on formal market institutions, whereas for social goods the mechanism of synthesis of formal and informal institutions operates. Secondly, the price of commercial brands enables accurate and mobile tracking and recording of consumer preferences

and tastes, but the lack of market demand for public goods makes it objectively difficult to identify preferences of consumers of these goods.

On the one hand, the marginal utility of a public good can be seen as the willingness of people to pay for an additional unit of a public good together. The equilibrium volume of public goods will be at the intersection of the marginal utility of public goods and the marginal cost of public goods.

On the other hand, the question of combining the formal and the informal is ultimately a question of whether self-organization and bureaucracy can be effectively partnered. The role of institutions is to reduce uncertainty by establishing a stable (and not necessarily effective) framework of interaction. In other words, there is a continuum of actions that rely on different trust support mechanisms and patterns of enforcement.

An informal regulation can be directly based on formal norms. In other words, it can exist in tandem with them. This symbiosis is achieved by using formal procedures as a tool to implement informal arrangements. There are many examples in market relations where formal and informal law coexists without coming into contact. For example, most contracts involve a wide range of issues in addition to prescribed agreements. These issues are regulated on an informal basis, as there is no formal way to handle them.

Therefore, if rational principles such as “current well-being” and “sustainability” are combined into one indicator, there is a significant amount of uncertainty. In other words, the new “rationality” (which is based on social brands) creates a cognitive dissonance. This dissonance is caused by the fact that a methodological harmonization of simultaneously used abstract models of the microeconomic equilibrium and the value (it has a financial short-cycle dimension), and the macroeconomic equilibrium and the value in use (it has a social dimension and is expressed in social brands), as well as the harmonization of systems for accounting for the value and the value in use of ecosystem services at non-zero transaction costs (social brand communications within social marketing are not free) is required.

Therefore, we will use recommendations for dilution of valuation approaches proposed by Stiglitz-Sen-Fitoussi [6]. These recommendations suggest a separation of tasks and a subsequent harmonization of social and natural geosystem models. We will also divide the task according to the method of spatio-temporal measurement and description of the spatial structure of the object that is being studied. The chronological differentiation of each component is retained in a continuous form and the spatial differentiation is retained in a discrete form.

We obtain either the biosphere as a whole or parts thereof, or a locally situated object if we apply the operation of averaging by spatial coordinates. Next, we use the

concept of a geosystem in relation to the geographical dimension (as a territorially unified set of natural components that interact directly with each other and with the external environment as a whole) [12].

Three scales of geosystems are distinguished: planetary (biosphere), regional (landscapes, zones, etc.) and local (ecosystems, etc.). It is about the evolutionary alignment and modeling of social and natural geosystems, as we consider the regional level (autonomous institutional actor). In other words, objects are regions and functional areas (including landscapes, ecosystems, etc.). This level provides a different methodological basis for describing these objects and solving predictive tasks. They differ from macro and micro approaches that are used to describe national economies and individual enterprises.

In our case, the control objects are localities (territories, functional areas, landscapes, nature parks, territorial and industrial complexes). Therefore, taking the above into account, we propose a monopolistic brand competition model. We propose it in order to establish effective mechanisms and the correct monetization of ecosystem services (in terms of selected facilities). This model is based on the analogy of the monopolistic competition model of Dixit-Stiglitz-Krugman (DSK) [23-25]. This approach has a wide application to a variety of economic phenomena. In particular, it allows us to focus on socially-oriented marketing communications and other factors that influence not only the structure of economic (and social in general) relations, but also determine attitudes towards natural systems as a whole, and not just as a utilitarian resource (production factors). It is important to consider market expectations. Another important consideration is that economics is also an art and a decision-making technique in the context of long-lasting contradictions and resource constraints. Therefore, the ability to negotiate, coordinate and regulate property and non-property relations is of great importance.

Thus, a different research methodology appears. It differs from the traditional one. The reason for this is the fact that it is not individual objects and projects that are investigated, but *situations* determined by the specific position of the subject (a simple observer or an active subject). In this case, the concept of utility and value in use is raised above the level of a simple tautology through other economic theories (meso-economics). They do not just use the concept, but also provide opportunities for comparison with data from experiences. The fundamental difficulties associated with the concept of utility, and in particular with attempts to represent it numerically, are not the purpose of this work.

3. Results

The geosystem can be conceptualized and modeled in two ways: 1) holistically, with the system seen as an object (the aforementioned “bottom-up” approach) and 2) mechanistic, with the system seen as a coherent set of subsystems, each of which is viewed and modeled holistically [26]. For the reasons mentioned above we will focus on the second method taking into account social brands. Next, we present a social utility modeling approach. We assume that in unstable conditions, the role of the state of reality in which interactions take place, rather than the state of the object (the subject or agent of interactions), increases dramatically. In other words, we are talking about the economic space. This space is characterized by a certain value of the economic potential (rents) and institutional properties (they enable cost-effective transactions through which economic rents are generated and extracted by beneficiaries). They are responsible for the synchronization and efficient coupling of elements of the economic rent generation and distribution process.

The control system is based on the PF effect (increasing public goods) in the case of changes in the environmental and land use regime when implementing ESG-type principles at time t (ecosystem chronology stages). This effect can arise from both the implementation of land-use changes, the choice of the farming method, and the availability (or absence) of product labeling. These products are produced in the region with a carbon footprint to determine the carbon tax or compensation.

Thus, the effect includes the expected present value of all costs (transformational and transactional). Consideration of global trade standards as well as the realities of the market structure is included. In this sense, the value of an ecosystem service is not a deterministic value, but a ‘most likely’ estimated value.

In general, the effect in practice is determined by the following formula:

$$PF\,(t) = \; E\left(\int_{Th}^{TH} W\,dt\right), PF\,(t) = \; E\left(\sum_{Th}^{TH} W\right), (1)$$

where E is the expected value, W is the utility function, T_h is the moment of fixation or change of the land use regime, which corresponds to a particular chronological stage (h), T_H is the accounting period. At the same time, we define the utility function as a composite of individual utilities w_i(associated with ecosystem services): $W = \{w_i\}$.

In addition, we define w_i as being in conjunction with competencies and standards to be set. In particular, the climate agenda introduces standards of the called “carbon economy” to the global economy. In accordance with these standards, the way of doing

business is verified against standards of the carbon economy. At the same time, one or another territory gets either loss or profit (depending on the established institutions).

The effect of optimization under the ESG investment principle according to the split-task method (recommendations according to [7]) is defined as follows:

$$PF\left(T_h(h),\ C,\ R\right) \rightarrow min_C max_R (2)$$

where *C* is costs, *R* is the rent arising from the economic potential of the territory (natural capital is included).

The solution of the optimization problem can be interpreted as the establishment of equilibrium under the conditions $C > 0$ and $R > 0$. At the same time, the social system "knows" the principles by which the natural system chooses the optimal solution for any strategies of the social system.

We apply the DSK approach according to the above circumstances [23-25]. Then, the aggregate utility (e.g. estimated using ESG-investment criteria) is as follows:

$$w\ \left(x_0, x_1, \ldots,\ x_n\right) =\ W(x_0,\ V\ \left(x_1, \ldots,\ x_n\right))(3)$$

where x_i is the consumed brands (associated with ecosystem functions), *V* is the sub-utility function arising from the elasticity of demand for different social brands (in the simplest case, a single elasticity is assumed); x_0 is the financial capital service (*PF* liquidity assessment) which determines the budgetary constraints on marginal utility.

We assume that the utility function has the following properties: the function is homothetic in all its arguments; first, the optimum sub-utility V is found and then, within the budget constraint, the scale of utilization of the utilities is determined.

We consider a structure of relations corresponding to the Chamberlain type of market. On the one hand, liquidity is not exclusively a priority variable, due to assumptions of the Dixit-Stiglitz model [23], in particular with regard to a consumer who has the right to choose under a single elasticity. On the other hand, it is nevertheless a performance measure.

We must take into account realities of the geosystem if the scale of the model object changes (in our case, the region, the landscape, the land cover, the zone). This geosystem is detailed in the meso-economic science complex, which is made up of approaches from new geography, spatial economics, sectoral market theory, etc.

At the same time, we will compare the liquidity of social brands with budget constraints and systemic risks. On the one hand, it is necessary to talk not about sustainable development with a serious systemic risk, but about survival. On the other hand, this situation imposes increased requirements on the management system.

We will define the regional liquidity as the region's guarantee fund, which is measured through the sum of funds used and the increase in total capital. For simplicity, we define it in terms of GRP:

$$x_0 = \xi R(4)$$

where R is the GRP and ξ is a structural parameter.

The result of optimizing the sub-utility function is a social brand structure that acquires a concrete financial dimension through the monetization mechanism of ecosystem services. In other words, this occurs when social brands are inelastic:

$$\pi = \beta \sum_{i=1}^{n} \pi_i, \quad \pi_i = p_i x_i, (5)$$

where π is a social brand (monetization) assessment (or a budget), β is a parameter to account for social brand substitution, x_i is the amount of the social brand, p_i is the social brand's value defined in the simplest case by the investment or by *NPV* ecological project. The brand is purchased in quantity x_i proportional to the amount of p_i.

If it is a specific project (e.g. reclamation) within a region (excluding transaction costs), the calculation of the measure is usually based on a specific set of indicators. This is the Discounted Profitability Index (*DPI*), the internal rate of return (*IRR*), the payback period (*PP*), the integral present value (*GPV*), etc. At the same time, rental income is most often calculated. It is estimated (e.g. as in the case of an investment project) through the net present value (*NPV*). NPV is the difference between all cash inflows and outflows in a certain time interval as an interest income (by using the formula 6):

$$NPV = \sum_{t=1}^{T} \left[R(1+r)^{-t}\right] (6)$$

where R is the rental income from the use of the land, which is received over a period of T years, r is the discount rate.

If the revenue stream is expected over a long period of time, it can be calculated as a marginal value (by using the formula 7):

$$\lim_{t \to \tau} NPV = R\, r^{-1}, \tau \gg 0 (7)$$

In general, such investment analysis is designed to evaluate a portfolio of related assets as means of comparing investments with an alternative (such as playing the stock market). At the same time, transaction costs are nullified. That is why such analysis is not sufficient to assess the impact of ESG investment.

In particular, a methodological disadvantage of this approach is a short forecasting and, consequently, planning horizon. Errors in economic measurements are accumulated in the uncertainty of the long-term discount factor. Even the interest rate for a

deposit and a loan is frequently changed by banks (not to mention the volatility of the market, stocks and currencies). Thus, a complex problem with a long planning horizon (as the exploitation of natural resources is a long-term process) should be solved on the basis of fundamental trends. It should be taken into account that the institutional matrix is largely responsible for the regulation of long waves.

Indirect methods are also used by constructing demand curves for a natural resource in addition to direct costs. At the same time, the value should be defined precisely to a certain number according to a certain scale and a certain logic, which are institutionally defined. Moreover, they are defined on the basis of a balance of extractive and inclusive institutions. The question is how to influence institutional decisions. Most importantly, the question is how to strengthen the role of decentralization in governance. The answer lies in the intensification of demoralization in the synthesis of formal and informal institutions. That is why the role of social brands is increasing.

So the DSK approach allowed us to describe decentralized solutions in terms of the ESG environment. This has been done with variable efficiency and variability of the method of monetization of natural services and with a particular value choice of the society. As suggested by experts from the group called "the *Working Group of the Millennium Ecosystem Assessment*" [27], the set of values that are placed on ecosystems can be defined as socio-cultural identity. These values are expressed through the designation of sacred views or places, the development of social rules. These rules are concerning the use of ecosystems.

For many people, socio-cultural identity can to some extent be determined by the ecosystems in which they live and on which they depend, to the extent that ecosystems are linked to community identity itself. That is why the socio-cultural value of ecosystems trumps the satisfaction of utilitarian preferences. [27] And social brands influence the culture of attitude towards the environment. The identity itself can be redefined through institutional and social embeddedness as a first approximation. Then, these categories explain differences in the production process and particularities of the mode of production in different countries according to the new geography. It is correct to apply the microeconomic approach to these countries. We apply the approach to mesoscale territorial modeling objects for the same reasons in our case.

Thus, the total utility has the following form, according to the DSK-approach:

$$w\ \left(x_0, x_1, \ldots,\ x_n\right) =\ W(x_0,\ V\ \left(x_1, \ldots,\ x_n\right)), W =\ \left\{w_i\right\}, (8)$$

where x_i are consumable brands (they involve ecosystem functions), W is the utility function, w_i are individual utilities (they are associated with ecosystem services, competencies and set standards), V is a sub-utility function arising from the elasticity of demand for different social brands, x_0 – is the service of the financial capital that determines the budgetary constraints on marginal utility.

Let us transform the formula (1) as follows:

$$PF(t) = E\left(\int_{Th}^{TH} W * e^{-\tau t} dt\right) \rightarrow PF(t) = E\left(\sum_{Th}^{TH} W * e^{-\tau t}\right), (9)$$

$$x_0 \stackrel{def}{=} PF = \xi * R,$$

where E is the expected value, τ – is the discount factor, ξ is a structural parameter, Th is the moment of fixation or change of the land-use regime that corresponds to a particular stage of the ecosystem chronology, T_H is the calculation period.

Let us consider a fundamental characteristic, taking into account the long planning horizon as a discount factor. This characteristic describes the institutional design of the area in general. Namely, it characterizes the social discount rate. We introduced it in the same way as the paper [28]. However, we did it for other reasons. The reason is that we considered the challenge in the context of the resilience goal (stress resistance) rather than the overall sustainable development goals. That is why we make sense of the institutional and social specificities of territories (regions) and the need to include transaction costs in this category. This rate is based on the particular structure of social relations that is specific to the territory.

Next, we will consider a utility model for natural assets, taking into account the *social discount rate*. The final utility model of natural assets, which is constructed as a monopolistic competition model of social brands coupled with ecosystem functions, is as follows:

$$w\ (x_0, x_1, \ldots, x_n) = W(x_0, V(x_1, \ldots, x_n)), W = \{w_i\},$$

$$PF(t) = E\left(\int_{Th}^{TH} W * e^{-\varepsilon t} dt\right), PF(t) = E\left(\sum_{Th}^{TH} W * e^{-\varepsilon t}\right), (10)$$

$$x_0 \stackrel{def}{=} PF = \xi * R,$$

where ε is the social discount rate.

The marginal utility curve has the same shape as the brand demand curve. In other words, it represents the set of goods that have the same level of utility for a consumer. At

the same time, the transition from one demand curve to another occurs by “switching” these systems from one state of equilibrium (or stability area) to another with both the concept of resilience [29] and terms of ESG investment.

The optimal choice is the point at which the society maximizes total utility, taking into account fixed income and limitations of social brands and ESG investment. It is reached at the point where the budget line touches the highest indifference curve. It is a rational consumer choice. At the same time, if there is an opportunity and a political willingness, a net gain can be made by moving as follows: $f\left(x_0, \delta C\right) \rightarrow f'\left(x_0, \Delta C\right)$.

Let us define the final outline of the applied approach (which complies with ESG investment requirements) and explain it as follows:

1. Ecosystem functions are differentiable and distinguishable. We assume that they do not interact and are monetized separately from each other. Monetization of individual functions does not affect the monetization of other functions. At the same time, it is carried out in the context of existing social brands.

2. The map of societal indifference curves, which is determined by the number of all ecosystem functions, already contains the desirability of a diversity of social brands. The analysis is based on solving the problem of making the best choice for a consumer (the choice is influenced by the problem statement: in the context of sustainability or resilience).

3. The interface of social and natural systems with many properties of natural systems (ecofunctions) and social systems (formal and informal institutions) is significant. Onn the one hand, it is of equal priority; on the other hand, it is non-additive. Following the recommendation given in [6], we divide the problem into an accounting-environmental problem and an institutional-economic problem within an iterative system of equations.

4. In the case the problem is formulated in the sense of sustainability (ESG investment risks), preferences between social brands (which include some ecosystem services) are described by a symmetric CES-function (constant elasticity of substitution of factors of production, in this case brands).

5. Minimization of the system risk is added to the system of objective functions in the case of formulating the objective in terms of ESG investing and resilience of the region.

6. Consideration of the efficacy of the regulatory capacity of the institutional matrix. This takes into account, firstly, the balance of institutions (extractive and inclusive

[30], formal and informal), secondly, the optimality of social brand selection, and thirdly, public welfare in the context of ESG investment and stress resilience.

7. Consideration of socio-cultural identity, institutional and social embeddedness in the context of ESG investment and resilience is mandatory.

4. Conclusions

The main systemic factor of a geosystem is its function. This function consists not only of the internal logic of preserving the system, maintaining its structure and orderliness. It is objectively conditioned by the external environment and the need for the system to exist within the current social practice. The function indicates what role the geosystem plays in relation to the wider system (on a space-time scale) into which it is embedded and which is its external environment. In this case, we have every reason for the following statement. We assume that the impulse to the development of the geosystem can be generated either by its internal state or by its external environment (be caused by external factors). External and internal factors can cause a change in the function or structure of the system. However, some factors become limiting in certain time periods. Limiting factors can be not only a state of scarcity of a resource, but even a state of surplus, limiting high resource costs or insufficient efficiency. The range between the two states constitutes the limit of geosystem resilience.

As initial assumptions, we assume that the geosystem develops evolutionarily, going through successive stages of development, functioning within an individual and systemic rhythm. The heterogeneity of space leads to the formation of not just separate and somehow connected parts of space (geosystems), but with their own forms and rhythms of evolving internal organization. Different rhythms of processes require coordination and synchronization of economic and natural processes. Their efficacy depends both on the influence of objective economic factors and on institutions. These institutions form a corresponding institutional matrix that realizes the conditions for the emergence and generation of economic rents.

A conceptual model of the coordination of evolutionary rhythms of social and natural geosystems is presented in Figure 1 in the form of a map of the interface between social and natural (soil) systems. It reflects the main factors, status, impact, response to the impact of external factors. Unlike a cascade model [31], a closed management cycle is proposed here (Figure 1). This cycle is supported and enforced by social brands. They create a certain semantic context (“green”, “carbon”, etc.) about the natural capital and active brands through social platforms. A new format of interaction is proposed to the

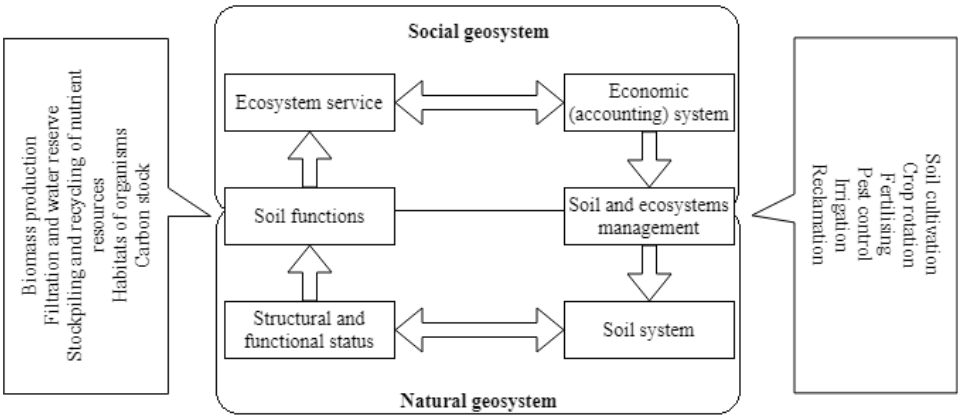

Figure 1: Interface between social and natural geosystems based on legitimization through social brands. Arrows denote the effect of limiting factors.

society in accordance with the climate agenda and ESG principles through the social branding mechanism. In this format, the social brand structure becomes a priority in relation to the productive structure of the economy.

It is necessary to take into account the nature of social brands when modeling the interface between social and natural geosystems. Informal regulators that fill niches not covered by formal rules or act as a socio-cultural corrective to formal regulation of market economic turnover should be taken into account. That is why the balance or synthesis of formal and informal institutions matters.

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Conflict of interest

The authors have no conflicts of interest.

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