BIOHARMONISATION OF AGRI-FOOD ANTHROPOSYSTEMS WITH THE NATURAL ECOSYSTEMS

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Abstract. *A major concern for the EU at the moment is to increase systemic effectiveness (i.e. the returns of various flows and economic efficiency) in terms of finding concrete models and actions to be taken to ensure resilience and achieve the green and digital transition. In this context, the paper aims at problem posing, as a basis for understanding the envisaged transition, through a conceptual analysis on the inter-systemic harmonization between anthroposystems and ecosystems, with the objective of initiating a process of transitional development of agri-food ecosystems to be more resilient, sustainable and digital. It highlights the process by which the anthroposystem is found to be closely linked including the ecological and economic systems of the agri-food domain. A comparative analysis between ecosystems and anthroposystems is carried out, with an applied study in the agri-food domain, highlighting a comparison of flows of physical and biological environments. A number of linking pathways between economic and ecological food systems are highlighted regarding their evolution towards the bioharmonisation of complex biological-informational systems in the"green and digital" transition.*

Keywords: agri-food system, anthroposystem, bioharmonism, ecosystem, resilience

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1. Introduction

At a time of post-pandemic, unprecedented climate change and armed conflict at its borders, Europe is looking for solutions and strategies to evolve as effectively and adaptively as possible to all these issues. The danger of food crises requires solutions that are integrated into the EU's overall concerns [3, 6, 7, 15, 25, 30, 38]. For these reasons, the issue is becoming highly topical, with solutions being addressed through system-level analyses and, above all, with solutions resulting from conceptual comparisons between anthroposystems and ecosystems, which can lead to pragmatic actions directly linked to avoiding disharmonies in feeding the population [1, 2, 9, 10, 31, 32, 35].

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This issue is based on the concerns of the European Commission, which has set out to create a partnership with industry, public authorities, social partners and other stakeholders, process of developing a transition pathway for the agri-food ecosystem. Therefore, a number of models for a transition pathway towards a more resilient, sustainable and digital agrifood ecosystem are being explored [31].

In this context, the paper aims to find solutions through integrated systemic analysis in dual and concurrent ecological and digital dynamics. It starts from the idea that the agri-food system must also transform its business models and value chains to become the foundation of a green, digital and resilient European economy. Therefore the paper has as its overall objective a problem posing, as a basis for understanding the envisaged transition, through conceptual analysis on the inter-systemic harmonisation between anthroposystems and ecosystems. As a targeted objective the paper aims to initiate a process of transitional development of agro-food ecosystems to be more resilient, sustainable and digital, highlighting the idea that the anthroposystem is closely linked, especially to the economic and ecological systems of the agro-food domain.

2. Materials and Methods

A comparative analysis between ecosystems and anthroposystems is carried out, with an applied study in the field of agri-food activity, highlighting a comparison of flows of physical and biological environments. It compares block diagram stuctures, statistical aspects, principles, flows and defining and conceptual elements, as well as methods of eco-energetic analysis.

3. Results and Discussions

We start from the premise that agri-food systems need to transform their business models and value chains to become the foundation of a green, digital and resilient European economy.

RESILIENCE (societal, industrial, etc.) is the ability of a system to continue operating during unforeseen crises or despite disruptions in value chains, which is essential to ensure sustainability.

An accelerated green transition is becoming more than timely to ensure, among other things, energy efficiency and self-sufficiency, as well as greater control over strategic value chains in the European agri-food system and, of course, at the level of individual countries. The transition requires concrete and actionable plans (pathways) developed for each of the agri-food ecosystems.

The emerging systemic bio-harmonisation action plan on the evolution of agri-food systems is the pragmatic aspect supporting the green and digital transition, elements of which include:

- infrastructure
- investment and financing
- regulation and public governance
- research and innovation, technology techniques and solutions
- skills
- social dimension
- sustainable competitiveness.

In convergence with the European and Romanian Food Ecosystem Programme, thematic analyses of the measures included in the recovery and resilience plans need to be adapted to illustrate progress under the six policy framework pillars:

(1) Green Transition
(2) Digital transformation
(3) Smart, sustainable and inclusive growth, including economic cohesion, jobs, productivity, competitiveness, research, development and innovation, and a functioning internal market with strong SMEs.
(4) Social and territorial cohesion
(5) Economic, social and institutional health and resilience, including with a view to enhancing crisis resilience and preparedness
(6) Policies for the next generation, children and youth, including education and skills.

The work is "folded" on the concept of BIOARMONY, which is the scientific-philosophical approach that brings to the foreground the ideal of matching the elements of a systemic whole (ecosystem or anthroposystem) and especially of a complex societal system (biological-technical, economic-social and info-cultural, politically expressed), a theory based on the study of living organisms, animal and plant, complementary to the human species (as an individual or as a society), respectively with the thinking, behavior and relationships between people and collectivities, to avoid systemic inharmony. In this sense, based on the *Theory of bioharmonism* [20], we consider that the process of transition from one state to another is based on the process of systemic bioharmonization.

BIOARMONISM is therefore the process that translates the ideal of bioharmony into objectives, strategies and tactics that pursue an alternative ideological and pragmatic (including technological) way of transforming reality with anarchic tendencies into one with optimised efficiency.

Pragmatically, bioharmonism is a benchmark for the policy transition towards a different economy (green economy, blue economy, circular economy, etc.) capable of ensuring environmentally friendly anthroposystemic models with the potential for a dynamic on a beneficial trajectory for the whole planet, towards the Knowledge Society and, in the longer term, towards the Consciousness Society [11, 20, 21, 42, 43, 44].

Making this trend concrete for the agri-food system, we consider it appropriate to understand the notions and aspects of the bioharmonization process between anthroposystems and agri-food ecosystems along the lines of resilience and sustainability [31].

The ANTHROPOSYSTEM is the human analogue of the ecosystem, which serves to compare material flows through human systems with those in natural systems.
The ECOSYSTEM is the whole of the biotope and biocenosis, in which close relationships are established both between organisms and between organisms and abiotic factors.

The anthroposystem model is used to compare the flow of materials through human systems with that in natural systems. As Santos defines it, an anthroposystem is "the ordered combination or arrangement of physical and biological environments for the purpose of maintaining human civilization... built by man to sustain his species." [31].

It is principally worth noting that the ecosystem is sustainable being a closed loop in which almost everything is recycled, while the anthroposystem is not sustainable being an open loop in which very little is recycled.
The comparative analysis shows that both the anthroposystem and the ecosystem can be divided into three component groups: producers, consumers and recyclers (Table 1).

Table 1. Comparative analysis of the structure of anthroposystems versus ecosystems (including agri-food

Group	*Anthroposystem*	*Ecosystem*
Producers	Consist of fossil fuel energy production, non-fuel mineral production and food cultivation;	Consist of plants and some bacteria capable of producing their own food through photosynthesis or chemical synthesis;
Consumers	Consist of humans and domestic animals on the energy-nutritious and health-giving consumption of agri-food products;	Consist of animals that obtain their energy by grazing and/or feeding other animals;
Recyclers	Consist of decomposition or recycling activities (e.g., waste water treatment, recycling of scrap metal and solid waste) / see circular economy.	Consist of decomposers such as fungi and bacteria.

An analysis of the items in Table 1 shows that unlike the ecosystem, producers and consumers in the anthroposystem are much more spatially dispersed than those in the ecosystem and therefore more energy is required to transfer the material to a producer or recycler. It is well known that much of this energy currently comes from non-renewable fossil fuels.

Recycling is a natural component of the ecosystem and is responsible for a large part of the resources used by the system. In the anthroposystem model, recycling does NOT occur naturally, so external input (externalities) is used to supply materials and energy, in practice existing recycling systems are artificially created. This is a critical point, as yields are relatively low and the lack of recycling leads mainly to pollution and biodiversity imbalances [19, 39, 40, 41]. This calls for structural and functional rethinking of anthroposystems, including agro-food systems, where the matrix system is applicable. Thus a matrix can be used to describe the anthropological network of producers, consumers and recyclers and the movement of materials between each of them. An eloquent example is natural ecosystems in relation to anthroposystems with responsible tourism activity, i.e. nature protection by minimising impacts in tourist destination areas [5, 8, 12, 22, 24, 26, 33, 34, 36, 37].

The ecosystem model shows the existence of bioharmonization processes as structural and functional units generated by the integrity of biocenoses and biotopes and are in fact the seat of actions and feedbacks of the living world [16,19]. In essence, they represent the basic unit of order in the environment, a balance ensured by its basic functions, namely the energy function, the matter circulation function (biotic cycle: circuit of water, organic substances, carbon, nitrogen, phosphorus, etc.) and the self-regulating function [29].

In antithesis, anthroposystems show to a large extent the unfortunate situation when the management of a subsystem can be inharmonious or even harmful to the whole system. Principally, resilient functionality is directly related to the anthropogenic gad of an ecosystem [4, 17, 18]. Therefore it is advisable to consider in each type of anthroposystem its organizational elements, hierarchies, laws and principles, its invariants, production, vitality and continuity through enhanced resilience. All this in relation to human activity and the role of the system in the economy [29]. Flows, food chains and energy-information transformations of living and non-living matter in ecosystems must become benchmarks in anthroposystems for their substitution in its specific networks, from externalities to processing and valorisation through population consumption (Fig.1).

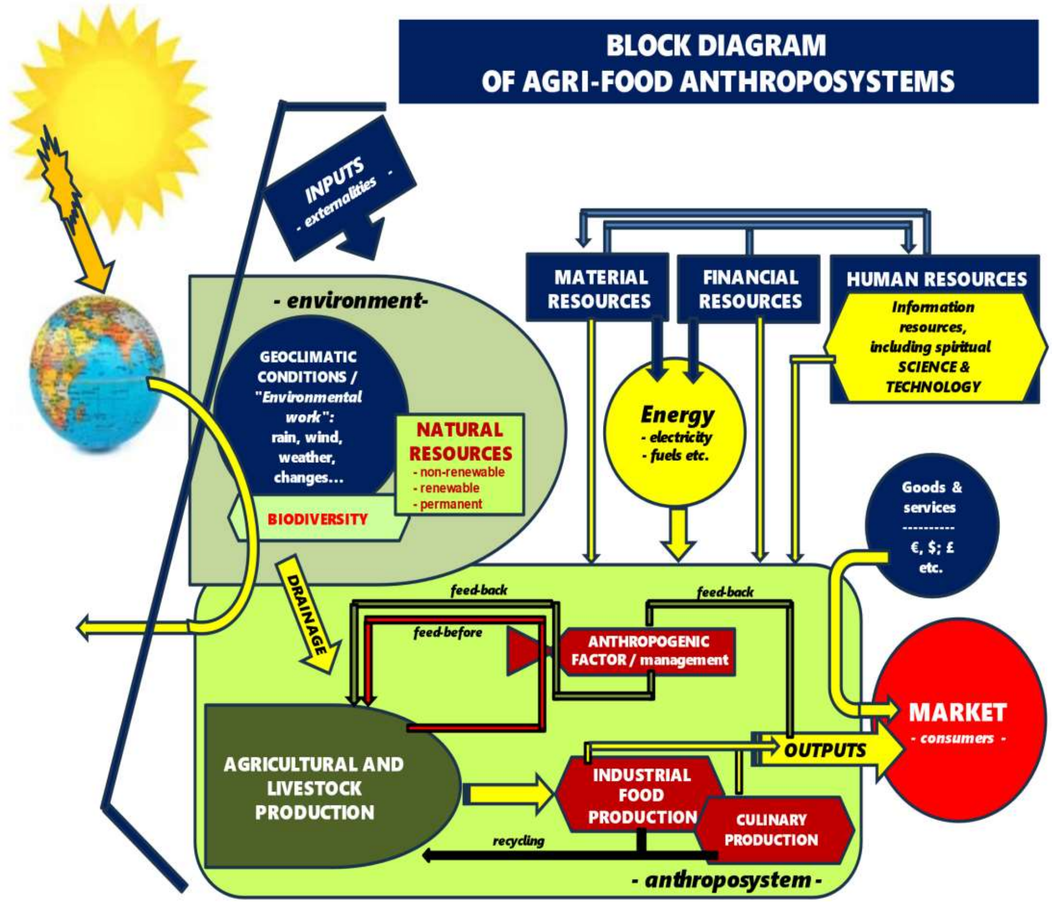

Fig. 1. Anthroposystem: through bioharmonisation between Environmental elements and factors and the the Economy increases the potential for development in terms of systemic efficiency and effectiveness

To date, although based on an ecosystem model, the matrix model of the anthroposystem fails to recognize the physical redistribution of mobilized matter and hence low yield, with deviations from the entropy law and increased potential for pollution [13, 14, 19, 23, 27]. In developing the FOOD ANTHROPOSYSTEM model, there is a trade-off between simplicity and completeness. A simple representative model involving only producers, consumers and recyclers can be created, but this is an open and incomplete system. Therefore a complex matrix (including producers, consumers and recyclers) can be imagined and added to the system to make a more complete model, but the model loses its simplicity in the process.

In Romania, it is recommended to create a DIGITAL PLATFORM that can then be integrated into the European Platform. Thus, in the interest of local and specific actors of agri-food ecosystems, a support platform is needed, a "one-stop-shop" to find the necessary resources and to collaborate in finding solutions for the implementation of the different transition paths. Connecting to the Platform is necessary in order to access a range of content tailored to the needs of stakeholders, including learning opportunities and resources, funding opportunities, best practices, and various relevant platforms and communities of practice.

Without going into details we mention some pragmatic objectives, drawn from eco-biotechnology models envisaged over time [19, 28], directions that the Agri-Food Anthroposystem Platform can generate (Table 2).

Table 2. Transition directions towards green and digital agri-food systems

Crt. No.	*Action lines*	*Specification*
1.	**Systemic analysis**	(1) Holistic and objectivised analysis of bio-harmonisation processes of anthroposystems on the green line, i.e., in relation to ecosystems, based on the insights of environmental engineering, bio-economics, environmental technologies (with the preparation of eco-technical, eco-energetic, eco-pathological surveys, etc.); (2) Computerised analysis of the relationships between systemic components: producers, consumers and recyclers; (3) Analysis of regulatory mechanisms, estimation of tolerance and adaptability, system resilience; (4) Analysis of the human impact specific to the anthroposystem, on the environment (externally/relationship with the "landscape") and on cost-benefit efficiency and yield (within the system).
2.	**Eco-biotechnology control**	(1) Assessment of relationships between hierarchical levels (individual, population, ecosystem biocenosis), between applied technology, consumption and yields, economic efficiency and effectiveness at the anthroposystem level; (2) Sanogenic assessment of agri-food system products and counteracting the negative effects of new technologies applied in the given anthroposystem; (3) Application and control of innovative alternative methods: harmonising production with the long-lasting laws of nature; building agri-food as a living system on ecosystemic principles; use of ecological and biological methods with maintenance of production potential, etc.
3.	**Environmental protection and agro-ecological conversion**	(1) Protecting biodiverse genetic resources and ecological conversion of land; (2) Inventorying and cataloguing microorganisms useful or harmful to production; (3) Studying risk factors and developing specific technical measures to avoid pathogenic actions in order to increase the resilience of the agri-food anthroposystem; (4) Elimination of forms of environmental pollution and ecological reconstruction, where appropriate.

The digital platform will become a framework programme for the managerial piloting of agri-food anthroposystems, which will aim to maximise the degree of effectiveness of human nutrition in the context of the input resources to the system, concomitant with the elements of sanogenesis specific to humans and the environment. Principally these bioharmonisation processes are concerned with the idea of how much an organism can be influenced by food, bearing in mind that food interaction with the environment is a *sine qua non* of open systems (anthroposystems) in which loops do not recycle and yields are relatively low. Only the adaptation of networks of agri-food anthroposystem actors, through management methods and programmes based on models influenced by ecosystem dynamics, will lead to increased resilience and reduced environmental impact.

Basically, we mean the use of the One-Stop-Shop databases (Platform) for the optimisation and bioharmonisation of agri-technical, zootechnical, economic, ecological and genetic measures, in the sense of maximising the use of solar energy and the use of substances found and used in the air, in the soil or in the controlled environment and space of anthroposystems. It will take into account the elements of the Action Plan established concretely for each type of agri-food anthroposystem, from investments and technological solutions to public governance. An example of this is the model provided by the "CLIC methodology" of some European projects [45]. In short, the FOODCLIC type of project will create strong interfaces between science, policy and practice in different European city-regions, and the backbone of these interfaces will be provided by food policy networks, which will be trained in living labs to build a complementary database to the European Platform. The method is policy-relevant through learning-in-action through real-life interventions, using an innovative conceptual framework (CLIC) that focuses on four desired outcomes of agri-food anthroposystem integration (Sustainability **C**o-benefits, Spatial **L**inkages, Social **I**nclusion and Sectoral **C**onnectivities).

An innovative model of a green transition and digitization pathway, of economic, social and territorial cohesion to increase resilience to crises, which can strengthen the resilience of the national (here, Romanian) and European agro-ecosystem can be achieved.

Conclusions

(1) Producers and consumers in the anthroposystem are much more spatially dislocated than those in the ecosystem, and therefore more energy is required to transfer material to a producer or recycler, so a structural and functional rethinking of agri-food anthroposystems is required, through the application of the matrix system needed to describe the anthropological network of producers, consumers and recyclers and the movement of materials between each of them.

(2) Anthroposystems show to a large extent the unfortunate situation when the management of a subsystem can be inharmonious or even harmful to the whole system, indicating that functionality is directly related to an ecosystem's anthropogenicity, organisational elements, hierarchies, specific laws and principles, its invariants, production, vitality and continuity, all bioharmonised (balanced and optimised) leading to increased resilience.

(3)Transition directions towards green and digital agri-food anthroposystems involve actions on systemic analysis, eco-biotechnologies control and environmental protection and agroecological conversion necessary for the optimisation and bioharmonisation of agrotechnical, zootechnical, economic, ecological and genetic measures, in the sense of maximised use of solar energy and purchased materials where a series of substances exist and are used from the air, soil or controlled environment and space of anthroposystems.

(4) Bioharmonisation of agri-food anthroposystems in relation to natural ecosystems will enable an innovative model of a green and digitised transition pathway, economic, social and territorial cohesion to increase resilience to crises, which can strengthen the resilience of agri-food anthroposystems, integrated into the European Support Platform with national connections, through which to find the necessary resources, opportunities for collaboration, implementation of different transition pathways and the possibility to access and apply a range of content tailored to local needs, including learning opportunities and resources, funding opportunities, best practices, as well as various relevant platforms and communities of practice, such as on agri-food systems.

R E F E R E N C E S

[1] Ayres, R. U. "Industrial Metabolism." In: J. Ausubel and H. Sladovic, eds., Technology and Environment. Washington, D.C.: National Academy Press (1989).

[2] Ayres, R. U. Industrial metabolism: restructuring for sustainable development (in Romanian). Tokyo: United Nations University Press. (1994).

[3] Bell, D., The end of the ideology in the Occident (Sfârşitul ideologiei în occident), in Political Ideas in the Filties, London, 400-410 (1967)

[4] Bell, S. et al. Outdoor recreation and nature tourism: AN European perspective, Living Reviews in Landscape Research (2007)

[5] Bjork, P., Ecotourism from a Conceptual Perspective, an Extended Definition of an Unique Tourism Form, International Journal of Tourism Res. 2. (2000).

[6] Brown, L. R., et al. State of the World. A Worldwatch Institute Report on Progress toward a Sustainable Society. Washington, D.C.: W.W. Norton & Co. (1985).

[7] Commoner, B., The clossing circle. Nature, Man and Technologhy, Alfred A. Knopf Inc., New York. (1971).

[8] Cosmescu, I., Economia turismului: serviciileturistice, EdituraUniversităţii "Lucian Blaga", Sibiu, (1998).

[9] Daly, H. E. Toward Some Operational Principles of Sustainable Development. *Ecological Economics 2*. (1990).

[10] Daly, H. E., and J. Cobb. *Towards the Common Good: Redirecting the Economy towards Community, the Environment and a Sustainable Future. Boston*, Mass. Beacon Press. (1989).

[11] Drăgănescu, M., Society of Consciousness (Societatea conştiinței), Research Institute for Artificial Intelligence of the Romanian Academy. https://www.scribd.com/ (2007).

[12] Epler Wood Megan, Ecotourism: principles, practices and policies for sustainability, UNEP, First edition, United Nation Publication (2002).

[13] Georgescu-Roegen, N., Entropy Law (Legea entropiei), Politica Publishing House, Bucureşti (1979).

[14] Georgescu-Roegen, N. Energy, Matter and Economic Valuation: Where Do We Stand? In: Daly and Umana, eds., *Energy, Economics and the Environment*. AAAS Selected Symposium 64 (1980).

[15] Goodland, R. The Case that the World Has Reached Limits. In: R. Goodland, H. Daly, and S. El Serafy, eds., *Environmentally Sustainable Economic Development*: Building on Brundtland. Washington, D.C.: World Bank. (1991).

[16] Gruia, R., Eco-farms management (Managementul eco-fermelor), Ceres Publishing House, București, 36-50 (1998).

[17] Gruia, R., Management fundamentals and future evolution directions (Bazele managementului și direcțiile viitoare de evoluție), Lux Libris Publishing House, Brașov, 163-179 (2013).

[18] Gruia, R., Management and development in tourism industry (Management și dezvoltare în industria turismului), Lux Libris Publishing House, Brașov, (2017).

[19] Gruia, R., Genetic resources in the agro-tourist farms (Resurse genetice în fermele agroturistice), Clarion Publishing House, Brașov, (2017).

[20] Gruia, R., Theory of Bio-Harmonism, Journal of Eco Agri Tourism, Asociația publ.jeat-rosita.ro/jeat, Vol.14 no.2(37), 5-21(2018).

[21] Gruia, R., Bio-Harmonism from theory to a future ideology (Bioarmonismul, de la teorie la o ideologie de viitor), Clarion Publsihing House, Brașov (2019).

[22] Ikonnen, Hanna, Perceptions of tourism in Finland, Degree Program in Tourism, Thesis. (2012).

[23] Meadows, D. H., D. L. Meadows, and J. Randers. *Beyond the Limits*. Post Mills, Vt.: Chelsea Green Publishing (1992)

[24] Megan, E.W., Ecotourism: principles, practices and policies for sustainability, UNEP, First edition, United Nation Publication. (2002).

[25] Mikesell, R. F. Project Evaluation and Sustainable Development. In: Goodland, Daly, and El Serafy, eds., *Environmentally Sustainable Economic Development: Building on Brundtland*. Washington, D.C.: World Bank. (1991).

[26] Nistoreanu, P., coord., Ecotourism and rural tourism (Ecoturism și turism rural), ASE Publishing, Bucureşti (2003).

[27] Onete, M., Pop O.G., Gruia. R., Plants as indicators of environmental conditions of urban spaces from central parks of Bucharest, Environmental Engineering and Management Journal, Gheorghe Asachi Technical University Iasi, Vol.9, no.12, 1637-1646. (2010).

[28] Pauli, G., Blue Economy, Report to the Rome Club (Economia albastră, Raport către clubul de la Roma), Paideia Publishing House, 346 p. (2010).

[29] Pillet, G., Odum H.T., E^3 – Energie, Ecologie, Economie, Georg Editeur SA, Geneve, 149-218 (1987).

[30] Pop O.G., Marculescu, A., Gruia, R. Environmental Engineering and Management Journal, Gheorghe Asachi Technical University Iasi, Vol.9, no.12, 1671-1680. (2010).

[31] Santos, M.A. Filho, Walter Leal "An analysis of the relationship between sustainable development and the anthroposystem concept" (PDF). International Journal of Environment and Sustainable Development. Inderscience Publishers. 4 (1): 78. doi:10.1504/ijesd.2005.006775. Archived from the original (PDF) on 2006-10-24. (2005).

[32] Vezeanu, C., Pop, O.G., Gruia, R., Mărculescu, A. Environmental Engineering and Management Journal, Gheorghe Asachi Technical University Iasi, Vol. 9, no. 12, 1611-1628. (2010).

[33] Tapaninen M., Sustenability spurring the development of finish travel destinations associated with national parks, Metsähallitus, Natural Heritage Services, Kajaani, Finland.

[34] Tuohino Anja, Hynonen, Anne, Ecotourism – imagery and reality. Reflections on Concepts and Practises in Finnish Rural Tourism, Department of Geography, University of Oulu (2001).

[35] Vitousek, P. M., et al. Human Appropriation of the Products of Photosynthesis, BioScience 34, no. 6. (1986).

[36] Williams Lake Forest District Tourism Opportunities Study, after Eagles and Higgins, (1998).

[37] xxx: Concepts and Practises in Finnish Rural Tourism, Department of Geography, University of Oulu.

[38] xxx: Finlands Regional Development Strategy 2020, (2010).

e-Bibliografie

[39] http://www.nature.org/greenliving/what-is-ecotourism.xml
[40] http://biodiversitate.mmediu.ro/romanian-biodiversity/
[41] http://www.eco-romania.ro
[42] x x x: Doctrine politice în http://www.politicaromaneasca.ro/
[43] x x x: Green economy, from Wikipedia, the free encyclopedia.
[44] x x x: The_Blue_Economy in: http://en.wikipedia.org/wiki
[45] https://bv.prefectura.mai.gov.ro/foodclic-un-proiect-dedicat-politicilor-alimentare-sanatoase-si-sustenabile/ (director proiect Gaceu, L. 2022-2026).