

Bioeconomic Management of Biodiversity of Sericulture Genetic Resources in the Context of Sustainable Development in Romania

Cristinel Gigi ȘONEA^{1*},
Mirela STOICAN²
Andra Cristina ȘONEA³
Alina Iuliana TĂBÎRCĂ⁴

¹Valahia University of Targoviste,
Targoviste, Romania,
cristinel.sonea@yahoo.com.

²MS-Training Innovate, Brasov,
România, jercalai@yahoo.com.

³Institute for Diagnosis and Animal
Health, Bucharest, Romania,
andracristina.sonea@gmail.com.

⁴"1 Decembrie 1918" University of
Alba Iulia, Alba Iulia, Romania,
alina_tabirca@yahoo.com.

Abstract: Today's society is a reaction to the excesses of a market economy that has not always been properly understood, thus leading to an imbalance of limited natural resources, disturbances in the unraveling of the lives of firms, or even the global economy. However, the eco-economy, under the given conditions, respects the sustainable efficiency of the eco-systems on which it depends. Addressing a fair, balanced attitude can be achieved through a system of implementing methods well-defined strategies, thus using the interdisciplinarity of the concept of development. The present paper aims to argue the need for bioeconomic sericulture management, based on the experience held in the field of sericulture and the untapped potential of this field in Romania. The bioeconomic management of sericulture biodiversity is a new method in the development, growth, and exploitation of silkworms as a pursuit of the sustainable development of agriculture and light industry, the chance of applying sustainable innovation, and relaunching the Romanian agriculture.

Keywords: *Bio-eco-economy, sericulture, rural space, sustainable innovation.*

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1. Introduction

Sustainable economic growth is increasingly linked to the ability of an economy to change and innovate at any level. In the extent to which Romania has its own rich resources, the development of the sericulture sector is able to play a leading role in European countries, but efforts must be made for this goal to create an environment capable of encouraging innovation, research, and development.

For a country or society, sustainable development means an economic activity that can withstand over time while respecting both the individual and the environment. In this acceptance, the concept of sustainable development highlights the existence of two major components of the economy and environmental protection. But at the World Summit on Sustainable Development (2002) in Johannesburg (World Summit on Sustainable Development) the concept of sustainable development was defined based on three components: ambient, economic, and social. The overall objective of sustainable development is to find an optimal interaction between four systems: economic, human, environmental, and technological in a dynamic and flexible process of operation. Their in-depth analysis allows the development of mechanisms, criteria, tools, and models that can be considered in an economic-environmental vision of the development of society, without neglecting the importance of cultural diversity. Given that economic activity, the economy, in general, is influenced by both human behavior and human capital and by elements of the biophysical fund, economic science should now be open to an efficient and balanced correlation with other disciplines, thus fleshing out the characteristic of interdisciplinarity [11].

2. Problem Statement

Discussing bioeconomic management of biodiversity of sericulture genetic resources in the context of sustainable development is one of the chances of relaunching Romanian agriculture. Starting from the sustainable development that arose from the need to limit the disastrous effects of too fierce industrialization and without realizing the need for an acceptable limit on the development of economic, social, cultural life and the viability of ecosystems, it has come to what we call today, eco-economy - the solution to save the future [6].

In the framework of profound transformation processes that take place at the level of society, the formation of eco-bio-economy, conditions

the reform of human activity, which leads to the construction of a new way of life for many people.

If, for a long time, the economy has been shaped by market forces, today, in concentrated form, the essence of these global trends is to increase the socialization and humanization of social-economic relations. The main change of place and role of man, the transformation of intellect into a decisive factor of social progress with direct effects on human behaviors aimed at ensuring innovative sustainable development [7].

Long-term economic development takes on new connotations based on the concept of eco-economy introduced by Lester Russel Brown in the book *Eco-Economy, Building an Economy for the Earth*. Eco-economy is the expression of the existence and recognition of a subsystem resulting from the interaction between two realities the economic reality and ecological one. "It is a sustainable society that shapes its economic and social system so that natural resources and life support systems are maintained" [2].

Eco-economy is based on meeting the needs of the individual, without jeopardizing the prospects of future generations. The fact that both the economy and the environment are valued at the same level can be said that sustainable development is found, in economic life, in different ways. Much more numerous regulations to be respected and lots of demands from entrepreneurs regarding the environmental impact and last but not least the pressure of final consumers, who want to make sense of their consumption [4].

Today's society is a reaction to the excesses of a market economy that has not always been adequately understood, thus leading to an imbalance of limited natural resources, disturbances in the unraveling of the lives of firms, or even the global economy. Eco-however, the economy respects the sustainable yield of the eco-systems on which it depends. The concepts of sustainable development and eco-economy seem to intersect to a certain point, according to the specialists [3]. The ambivalent nature of the delimitation of these two concepts has given rise to a new paradigm that still arouses their interest.

The eco-economy paradigm can be seen as a socio-spatial essence, thus referring to both production and consumption, consisting of a complex network of new viable economic activities. These activities should take into account the use of resources on a differentiated basis, through sustainable methods that do not lead to resource depletion but provide net benefits for the environment. The eco-economy paradigm must lead to understanding and solving problems in the production-consumption relationship at both local and regional levels between rural and urban spaces [5].

40 years ago, the American scholar of Romanian origins, Nicolae Georgescu-Roegen launched the concept of Bio-Economics. He brings into question the role of man in anthropogenic eco-systems, with the statistically proven need on the negative energy balance in the case of excessive consumption of raw materials and the lack of prospects for future generations. Nicolae Georgescu-Roegen integrates economic science with institutions and biophysical reality into his model of the productive process, first presented in 1965 and elaborated in his capital work, *The Entropy Law and the Economic Process* [9]. In its model, new technology is defined as viable if and only if it can maintain its appropriate material structure that supports resource flows and support functions, thus being able to support the human species under current environmental conditions indefinitely. Therefore, viability requires that the funds be unchanged in the production process. Without the supporting functions that maintain the funds, the ability of the economic approach to producing flows cannot be maintained.

Economic theories inspired by the bio-economic approach are much more appropriate to the complexity of the realities facing today's globalized economy. At the same time, the economic programs developed based on this approach are more relevant and consistent with the "joy of living", as Nicolae Georgescu-Roegen, which is the motivational, purely human, engine of the economy, states.

An OECD report states that the bio-economy is capable of making a significant contribution to economic activity. The OECD estimates that by 2030, the use of biotechnology will contribute up to 35% of the production of chemicals and other industrial products that can be manufactured using biotechnology, up to 80% of pharmaceuticals and diagnostic products, and about 50% of agricultural production. Even without new policies or significant advances, biotechnology could contribute up to around 2.7% of GDP to the OECD by 2030. For developing countries, this share may be higher due to the importance given to primary and industrial production in total production obtained. They probably underestimate the potential effects on energy, health, and agriculture, where a wide range of research and development activities are maturing at a rapid pace.

The bio-economic approach can be the foundation on which a more relevant economic theory of innovation can be conceived, as well as the basis for building concrete and realistic innovation programs oriented towards civilizational leap: towards another global, sustainable, knowledge-based civilization [8].

One of Romanian specialists, a member of the Romanian Academy, succeeded to put together the two concepts of Eco-Economics and Bio-Economics, in a new paradigm called "Eco-Bio-Economics". "Eco-Bio-

Economics represents an economy of the future, with a highlight on the service of people's lives through the rational use of environmental resources" [1].

In the authors' view, sustainable development is the result of the intertwining of economic, social, bio-economic, cultural and spiritual elements, which constitute a complex process of transforming the conditions of material and spiritual life. At the same time, the eco-economy is delineated by respecting eco-systems and socio-economic dimensions by pursuing the sustainable yields of resources in a relatively constant balance.

From the depth of the analysis of the components delimiting them, it is found that the two concepts have a common goal, namely that of ensuring the development of society in harmony with eco-systems, based on social responsibility.

How society will manage to achieve a balance in economic and social life depends on the degree of understanding of the current problems regarding the level of use of resources, the degree of deterioration of eco-systems. Addressing a fair, balanced attitude can be achieved through a system of methods of implementing and implementing well-defined strategies, thus using the interdisciplinarity of the concept of development [5].

The Romanian sericulture field has been one of the strengths of the international market for a long time. Extensive research carried out by specialists, based on an ancient tradition dating back to 1906, led to the positioning of Romania in 1977 among the largest producers of silk in Europe, occupying the 6th place in the world.

In Romania, there is still a solid basis for the sustainable development of silkworm rearing activity, both genetically and in terms of feed base.

The return of agricultural land and support to Romania through European financing programs can lead to the creation of new mulberry plantations and the construction of new suitable spaces or the modernization of existing ones for the growth of silkworms, leading to the development of rural areas [10].

Since the requirements of the Member States are directed to the consumption of quality yarns obtained through the primary processing of silkworms rather than from the growth of silkworms, it is of interest that there will not be strong competition between the Member States. Still, an interest in support for this activity to be relaunched in Europe and developed sustainably to counterbalance the large productions obtained by other countries around the world such as China, North Korea, South Korea, Indonesia, Brazil, and other countries in Southeast Asia or South America

and even Africa. Adopting an “open sustainable development” approach in the sericulture sector could be a strategic advantage in achieving both industrial and sustainability objectives.

3. Aims of the research

This paper wishes to argue the need to apply sustainable bioeconomic management of the Sericulture genetic fund in Romania, in the context of the innovative application of the principles of rural development.

The Romanian countryside is in a continuous process of identifying the best solutions for its development. Starting from the premise that sericulture can represent the way to achieve these significant objectives of the Romanian rural area. We discuss the major implications at a socio-economic level and will conduct a discussion on the need to ensure the management of the sericulture genetic fund.

The current legislation draws up lines of directions on the development of this area. Still, at the implementation level, it has been shown that during 30 years, none of the objectives set by the various normative acts developed by the competent institutions have been achieved. Our scientific effort wants to help identify viable solutions for the development of this field in rural space, thus drawing attention to the many benefits from harnessing the genetic potential held by the only research institute in Romania.

4. Research Methods

The research undertaken includes a study carried out based on expert indicators on the production of silkworms and the analysis of the activity of preserving the unique genetic background in the country and in Europe by Sericarom S.A.

The methodological basis of research knowledge is the dialectical method, device and philosophical categorical general systems theory, comparative analysis method.

5. Findings

5.1. Evolution of the silk industry in Romania

Research on the history of Romanian sericulture has revealed activities since the 14th century. Our investigation revealed that the first sericulture entity was established in 1840, and in 1852 - a nursery of dupes in Pantelimon. Between 1852 and 1864, the expansion of sericulture activity led to a famous export of sericulture products. In 1858, the Sericicola Company

of Damaroiaia was founded, which was also the first association to operate in the field of silk thread processing (silk doughnut shears).

In 1894, Agriculture Minister - P.P. Carp developed a plan to relaunch sericulture based on a program of measures and appointed specialized persons to implement it. The program contained chapters on mulberry culture, training of people in the field of silkworm rearing, and the monopoly of the state's production of silkworm eggs. In 1904, the establishment of the Sericulture and Nursery Resort of Cotroceni, was approved, and from 1 April 1916, the resort moved to Kiseleff Road, called the Baneasa Sericulture Resort.

The period from 1 April 1906 to 1 April 1916 can be said to have represented the beginning of the current stage in the history of Romanian sericulture. Since 1906, the organizational evolution of Romanian Sericulture is as follows (Table 1):

Table 1. The organizational evolution of sericulture in Romania

Year	Description
1906	Sericultural Resort and Mulberry Tree Nursery from Cotroceni (Ministry of Agriculture, Industry, Trade and Domain of Mulberry Tree)
1916	Sericultural Resort from Băneasa (Kiseleff Street)
1937	Sericultural Resort from Băneasa by I.C.A.R. (Romanian Institute of Agronomic Research).
1941	Mulberry Tree Nursery from Cazaci was subordinated to Sericultural Resort of Băneasa by I.C.A.R.
1944	Sericultural Centre from Orsova and Sericultural Centre of Cislau were subordinated to Sericultural Resort of Băneasa by I.C.A.R.
1949	Sericultural Experimental Resort by I.C.A.R develops near Bucharest
1957	Central Resort of Researches for Beekeeping and Sericulture Baneasa, with 3 territorial centers
1974	Sericulture Researches Resort with 15 centers
1977	Central Production and Research Resort for Sericulture with 3 complexes, 15 centers and 32

	independent farms.
1990	Sericulture Culture Trust
1991	The Sericulture Culture Trust is transformed into a commercial company Sericarom SA with 11 working points
1993	The land areas of Sericarom SA were diminished by restitution and the abolition of farms
	Source: author's research

Since 1992 the sericulture activity in Romania has been coordinated by the Baneasa Research Branch, which produced silkworm eggs, distributed them, collected silk doughnuts, and processed them in various forms (artisan yarn, medicinal products and cosmetics). Currently, SC Sericarom SA holds the area just over 11,000 square meters.

The Animal Sericulture Genetic Fund is composed of 85 breeds of silkworms of different provenances, and 59 varieties of mulberry. This genetic heritage is currently safe and reproduced appropriately annually due to the sustained work of the research branch's team of specialists, which has survived under particularly tricky conditions since 2009.

Since 2009, sericulture activity has been in total decline and only the conservation of the genetic background currently taking place. Silkworm breeders are few, and the collection and payment of silk doughnuts is complicated due to the lack of financial resources.

5.2. Actual Context

Sericarom SA was designed as the only unit in Romania to produce and distribute silkworm eggs, to carry out scientific research in the field of sericulture and of course, to develop new technologies in the field of silkworm growth. Sericulture, as a distinct branch of Romanian Agriculture, is one of the sources of raw materials for the textile industry, the agricultural industry, the medical industry, but also an activity designed to bring additional income to the rural population. Especially knowing that, before 1989, the rural community was involved in gathering mulberry leaves for the growth of worms.

On the other hand, it is not without interest that silk vines are involved in biotechnology research, mentioning in this respect the production of substances for food and pharmaceutical use. Sericarom SA it's the only entity in the country that owns the sericulture genetic fund of Romania. It has managed, with all the hardships, to be subject to

tremendous pressures that have made it challenging to research, to preserve 72 breeds of silkworms, and to preserve with great financial efforts 60 varieties of mulberry.

Today, the offer of silkworms that Sericarom holds is one of the most diverse in entire Europe. It will allow, in a short time, to achieve essential productions and maybe to compete with countries that have staked on this branch and managed to develop integrated businesses through well-defined financing programs. Moreover, Romania was among the major silk producing countries in the 1980s, with an internationally appreciated textile industry. The medical sector should not be neglected, where modern medicine requires more and more natural silk, very often used in surgical operations, knowing that the thread produced by silkworms is a resorbable one [6].

In the artisanal industry, Romania is a country with massive potential in the field, still having famous craftsmen who produce artisanal costumes sewn with “borangic” thread. Sericulture is an occupation of all ages but especially for women, older people and children from Romanian villages. Thus, offering an opportunity to develop the Romanian villages by implementing coherent measures in a public-private partnership. Due to its economic, social dimensions, and ecological functions, the silkworm growth sector is traditionally a national wealth.

6. Discussions

At the European level, solutions were found to develop and preserve the sericulture, as an essential branch. In this context, more and more, there is talk of sustained agriculture, integrated into the grand chapter of the Bioeconomy, Romania has lost its start and still fails to enter a straight line. The organizational structure of sericulture entities and their production have had undergone significant changes consisting of liquidation of many entities and the lack of heritage preservation (mulberry plantations). The result was a decrease in the production of silk doughnuts. In addition to the decapitalization of companies with sericulture profile, other factors have contributed to the decline of sericulture entities, such as the closure of the Lugoj Filature and the three-natural silk fabrics in Bucharest.

At the Romanian level, the areas of sericulture tradition were the counties of Dolj, Olt, Mehedinti, Teleorman, Dâmbovita, Calarasi, Prahova, Buzau, Vrancea, Vaslui. In all the above counties, were mulberries trees on both the alignments of the road and on former communal ponds, in some places, even mulberry plantations that currently are not being maintained.

This branch of the economy is seen as a reasonably profitable field in the community space, and that's because, in the Western economy, there is a need to maintain and develop the branch that produces natural fibers, as a form of protection against synthetic fibers. The financial funds, thus made available to natural silk producers through E.U. research programs, are considerable. However, some countries have gradually neglected this industrial branch, such as France, Italy and Romania.

Sericarom S.A. receives from the Romanian state two types of subsidies. The first type of subvention is granted for its activity in the sericulture sector, mainly targeting over 3,250 families of silkworms. The annual subventions granted by the state for this activity are 1.3 billion lei. The second form of subsidy directly targets silkworm breeders and is transmitted through the county agricultural directorates as a form of annual financial support. The amount awarded to them is 30,000 lei per kilogram of silk doughnuts. The condition imposed on the particular silkworm breeder is that he has made at least 2 kilograms of silk doughnuts per gram of eggs and of course, to be a member of a specialized association.

According to E.U. Regulation 866/1990, the support our country was to receive for sericulture work, starting with European integration, was EUR 13.32 per gram of silkworm eggs. An amount 15 times higher than the current subsidy granted by the Romanian state. If we take into account that following the development of silkworm breeding programs, the production of silk doughnuts per box has increased by 25%, the weight raised by 15%, the content in the silky coating by 10.5% and the length of the fiber by 20%. In this context, it appears necessary to establish a strategy for the development of sericulture, the tradition and usefulness of which is unanimously recognized, with significant implications at the national, regional, and local levels.

To develop an effective strategy to achieve the strategic objectives of sustainable development, applying the bio-eco-economy principles, we will consider the main strengths and weaknesses, the current and prospective opportunities and threats of the field.

Strengths

- tradition and experience in the production and reproduction of silkworms;
- the holding of a controlled genetic heritage;
- the existence of a body of valuable researchers' sources of genetic material for the establishment of elite farms;
- accredited and nationally certified research units;
- good ability to ensure the multiplication of genetic material

Weaknesses

- lack of mulberry plantations to feed silkworms;
- lack of sericulture farms; insufficient promotion of this activity;
- poor attraction of young graduates with adequate specialization for the researches sector in the sericulture field;
- poor involvement of the authorities in the relaunch of this sector;
- inadequate, unfavorable and non-stimulating policies to achieve and preserve biological material.

Threats and risks

- migration phenomenon of “brain migration” from Romanian researchers;
- lack of research programs in the field of sericulture and a lack of interest of MADR in this field.
- depopulation and abandonment of areas suitable for this type of activity in certain regions of Romania;
- lack of transparent medium-and long-term strategies for sericulture in Romania.

Opportunities

- for the growing demand for quality natural silk in the textile and medical industries both at home and abroad;
- capacity for innovation and increased development of the private sector;
- the possibility of disseminating the results of researchers in the personal environment and rural areas;
- very advantageous prices for products on the E.U. market much higher, depending on quality, than in other markets;
- Romanian tradition in the growth of silkworms the orientation of young people for investments in the field of silkworm growth and exploitation;
- reorientation of farmers to fast-growing businesses in a relatively short time;
- the development of an integrated system in agricultural holdings as an additional form of income; development of technologies for the processing of sericulture products.

The establishment of a development strategy will consider ensuring sustainable management of serum genetic resources as well as diversifying horticultural raw materials with superior nutritional properties to obtain healthy foods. These objectives can be achieved in the light of programs for the genetic improvement of worm populations and the fruit and leaf mulberry crop, which will include:

- research on breeds and populations of native silkworms owned by the genetic background of Romania; research on the effectiveness of the application of different methods of selection and hybridization; optimization of programs to improve diverse silkworm populations, development, and accreditation of breeding methods;
- research on obtaining new biological creations. conservation and preservation of populations of vulnerable and endangered silkworms;
- improving worm breeding indicators using specific biotechnology;
- re-establishment and preservation of mulberry varieties;
- the recovery of the products obtained;
- the recovery of the fruit obtained in various forms;
- production of local and high-quality agri-food products.

7. Conclusions

The development of bioeconomic management of sericulture biodiversity in Romania is a new method that mainly focuses on the growth, and exploitation of silkworms as a pursuit of sustainable development of agriculture and industry. The effects generated by this integrated system of management of the activity of growing silkworms in the private network, by attracting private breeders could contribute to the development of farms with beneficial effects for both the rural space population and the light industry. Artisanal processing would also contribute to the efficient exploitation of the Romanian countryside and the preservation of Romanian cultural identity.

The implementation of this management would create jobs in rural areas, harnessing the workforce with reduced physical capacities (women, children, the elderly, disabled locomotors) and could generate the development in the education network of professional qualifications. Also, the growth of silkworms in these schools could ensure their self-financing.

The fact that the mulberry trees do not raise significant problems of adaptability, we state that programs for the intensive development of plantations in disadvantaged areas can be implemented. Thus, would have a substantial impact on local communities through the practice of sericulture.

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