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SERICICULTURE INDUSTRY IN ROMANIA - ANALYSIS ON CURRENT SITUATION AND PROSPECTS OF DEVELOPMENT

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Abstract

Sericulture is an industry with a long tradition in Romania, with a good development throughout the XIX-XXth century, and, despite facing adversities, it still presents a great economic and technological potential for revival. The main objective of this article is to analyze the potential of the sericulture industry trough added value chain analysis, including sectorial analysis, constrain factor analysis and development directions. The research will use both quantitative and qualitative methods for data analysis, which is represented by statistical data from International Trade Center (ITC), EUROSTAT (Statistical Office of the European Union) and INS (International Institute of Statistics), obtained through and published scientific literature. The analysis concluded that, form an added value chain point of view, sericulture industry is facing constrains in most of its sector, from mulberry cultivation and silkworm egg production, to cocoon production and reeling.

Key words*: sericulture, silk, cocoons, potential, import, export.*

INTRODUCTION

Sericulture is an old industry, connected to agriculture and rural development, cultural part of the Asian regions that has extended, as industry, to a worldwide level, with over 40 countries involved in the sector.

Silk processing is the main objective of sericulture, but due to technological advancements, silk became wildly used in areas like biotechnology, nanotechnology, medicine, optical sciences and so forth. Research breakthroughs in silkworm research and industry have played and will play a major role in production and academic fields as well (Mărghitaș et al., 2013).

Concerning Romania, the sericulture, from a successful industry, due to a succession of downfalls, it has become fragmented, silk production becoming depended on imports.

As the potential of sericulture industry remains, strategies should be developed for its revival, taking into account the potential for rural economy diversification and possibility of workplaces generation (Pașca et al., 2008, Akram, 2015).

The analysis of the Global Value Chain (GVC), a series of activities, from imputes and production to marketing, is a tool used to help map the operations from an industry, to illustrate and analyze involved actors, involved interactions and the distribution of the benefits along the chain. It is also wildly used in the development of policies and intervention in different economic or industrial sectors (Kaplinski et al., 2002; Gerefky et al., 2006).

By using the value chain approach, the current review will attempt to show the current situation of the sericulture industry in Romania, in a global and local context, with its structure, involved actors and constrains the industry faces.

MATERIALS AND METHODS

The research strategy used was desk and literature review on the Romanian sericulture industry.

Primary and secondary data reviewed were given by specialty literature treating the

development of the sericulture industry and statistical data on the 2000-2016 time frames.
The Analysis of the Value chain followed the methodology recommended by Gerefky et al. (2006) and Kaplinski et al. (2002).
The main sectors analyzed are: market analysis with a focus on production, import and export aspects, current sericulture status analysis, from a value chain perspective, with a focus on production phases: moriculture (mulberry cultivation), silkworm egg production, silkworm rearing, cocoon reeling, silk and silk derived products processing, marketing and distribution.
The main focus is to highlight the current structure of the value chain, constrains present at sector level and proposed directions for development.

RESULTS AND DISCUSSIONS

World silk market overview

At a worldwide level, it can be stated that approximatively 30-40 countries, majority located in Asia, are involved in silkworm rearing and silk production. As a highly labor intensive industry, sericulture creates millions of workplaces world-wide (Pașca et al., 2008; Mărghitaș et al., 2013).

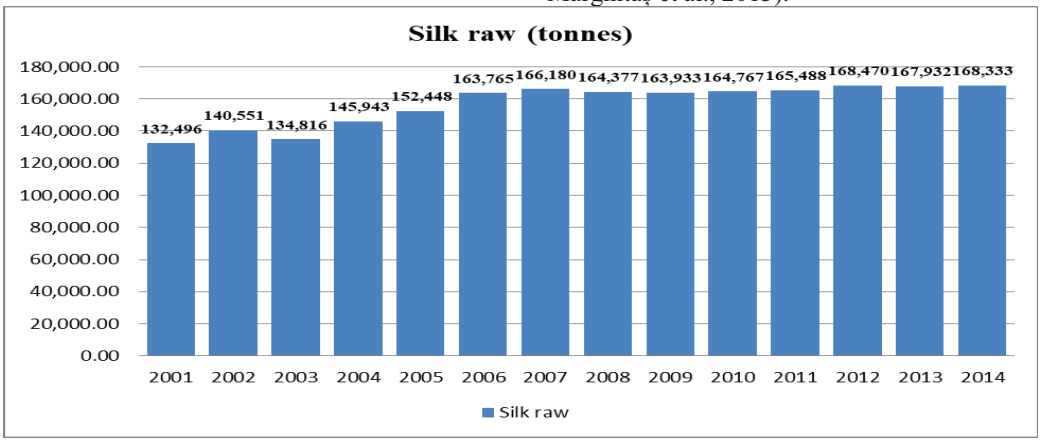

Figure 1. Global Production of raw silk(Source: FAOSTAT, 2017, data available until 2014)

In the present market, according to the International Sericultural Commission the main producers are China, with a silk production of 158,400 metric tons, followed by India with a silk production of 30,340 metric tons, Uzbekistan with a silk production of 1,256 metric tons, Thailand with silk production of 712 metric tons and Brazil with a silk production of 650 metric tons.
Silk production is affected, even in present day, by the production, at low cost, of synthetic fibers and low cost-low quality silk imports from China.
Another factor is the fact that affects the silk market, is the price that China sets, as lead producer and exporter, especially as it has taken measures to increase the silk price by reducing their mulberry plantations.
Sericulture is an industry that involves high level of labour force, and people being attracted by other, more profitable sectors, did affect the industry, as the figure above shows fluctuations in silk quantity produced. (Pașca et al., 2008; Mărghitaș et al., 2013). India is able to maintain its second place in the silk industry due to its efforts focused on silk reeling facilities modernization process and research focused on obtaining productive silkworm hybrids (Dezmirean et al., 2008; (Daltaet et al., 2005; Pasca et al., 2009; Dezmirean et al., 2008).
At a European level, the silk demand is mainly covered by imports from countries like China, India or Brazil. Up until 2008, the European sericulture industry was somehow protected by the World Trade Organization imposed measures and the import quotas implemented by the European Union to Non-EU countries, but once the restrictions were lifted, the whole textile sector felt the impact, not only the silk

industry. The high value-high cost input (fiber production at a farm level) production sector couldn't compete with the low cost imports from developing Asian countries like China and India. As a consequence, Europe remained specialized on producing high quality textile (including silk) with raw materials such as threads imported from Non-European Union countries. Other non-European countries that follow this trend are als Japan and Koreea (Daltaet et al., 2005; Dezmirean et al., 2008; Kipriotes, 2008; Pasca et al., 2009).

To be noted is the fact that the demand for natural fibers is still on the rise, at such a level that the European production sector cannot satisfy it, opening opportunities for European developing countries like Romania or Bulgaria, or developed countries like Italy to further explore the possibility of revitalizations and development of the textile sector, with a focus on sericulture (Kipriotes, 2008; Popescu, 2013).

Overview Sericulture Industry in Romania Silk, historically, first originated in China, more than 3000 years ago, and as cultures started to enter more into contact, the silk, as a fabric started to spread globally. Slowly, the occupation of silkworm rearing spread towards Korea and India, and during 500-552 e.n silkworms rearing entered the territory of Europe as well. Silk production, as an occupation, was first historically dated around 1496 in Transylvania area and 1797 in Romanian Country (Pașca et al., 2008; (Akram, 2015).

The sericulture develops throughout the decades, encouraged by implemented actions like organization of training schools (1904 - Saint Helen Church, Bucharest), establishment of reeling Institutions (1904- Lugoj Reeling Facility) and research and management institutions (1906 - Sericultural Station, Cotroceni 1916 - it gains a new location at Baneasa and is named SERICAROM BANEASA) (Pașca et al., 2008).

Before the year 1990, Romanian sericulture was a profitable industry with peak productions of 1,300 tons of silk cocoon in year of 1944, 1,300 tons in 1963 and 200 tons in 1989. Silkworm eggs production was also well established, with a high production of 2,469 kg in1989 (Pasca et al., 2009).

After the year 2000, the production continues to decline, due to continuous reduction of the mulberry plantations and the closure of the only silk cocoon reeling plant in 1995 (Pașca et al., 2008). The major decline of the industry started after the shift in political regime from social to democratic political regime. Other aspects that contributed to the decline of the sericulture industry are the lack of support legislation and the lack of reeling facilities (Mărghitaș et al., 2013).

One incentive initiative to encourage farmers to get involved in the production of silk and silk cocoons, was financial support from the European Union, under the form of subvention (136 euro per box of silkworm eggs), but as of late, starting with 2017, this form of financial support is no longer available, according to Agency for Payments and Intervention for Agriculture (APIA).

Sericulture market overview

The production of silk cocoons and raw silk has stopped completely, last crop of silk cocoons being obtained in the year of 2009 (National Institute for Statistics of Romania; Pasca et al., 2009).

The statistical data, presented in the table 1, presented below, containing data retrieved from Eurostat, office where the Romanian National Institute of Statists also reports, and the National Institute of Statistics, revealed, that, production wise, Romania focuses on production of silk textiles and silk fashion apparel, as only the silk yarn and derived products remains active in the silk value chain. From the table below, the demand for silk garments, allows for this sector to develop, as production in almost doubled in 2016, compared to 2001.

The industry can further develop into obtaining finished products like accessories (shoals or ties) or silk garments, as the economical returns proves to be quite high.

Table 1. Silk cocoon production (source: http://www.insse.ro/cms/)

Silk and silk products	Measure units	Years								
		2001	2003	2005	2007	2009	2011	2013	2015	2016
Silk cocoons, reelable	(Tons)	1.59	2.20	3.00	1.00	5.00				
Silk Fabric	(Thousand sqm)	31,831	34,732	22,916	19,773	10,472	9,443	12,085	8,379	8,267
Silk Knitted fabric	(Thousand units)	16,568	18,089	17,352	12,390	8,724	8,733	6,725	7,432	6,200

Imports and Export of silk and silk products on the Romanian market (table 2)

As production has decreased, to almost a non-existent sector, Romania relies heavily on importing silk and silk textiles, as reflected in data presented. According to United Nations Statistical data base, Romania imports silk and silk textiles mainly from Italy, China and Germany. As export markets, Romania had higher trade values with Italy, China, Bulgaria (especially silk yearn commodity), Germany and Greece.

Table 2. Import and export in silk and silk products (http://www.insse.ro/cms/)

Silk and silk products. Import.	Romania's Imports from the world								
	2001	2003	2005	2007	2009	2011	2013	2015	2016
	Thousands EURO								
Silkworm cocoons relabel	1	:	1	:	:	:	1	:	7
Raw silk (not twisted)	2,786	6,776	19,212	30,038	13,216	42,692	64,777	59,398	76,984
Silk waste	:	:	4	54	188	249	49	161	125
Silk yarn (other than silk waste yarn), not put up for retail sale	37	810	5,670	10,224	3,938	5,101	5,876	6,302	5,785
Yarn of silk waste, not put up for retail sale	:	1	12	108	60	288	494	1,382	971
Silk yarn or silk waste, put up for retail sale; hair of Messina (hair of Florence) Silk fabrics or silk waste	17	34	57	75	46	30	86	24	49
Silk or silk waste fabrics	3,105	5,757	12,842	17,363	13,938	19,229	20,069	17,202	19,925
Silk and silk products. Export	Romania's Exports to the world								
Raw silk (not thawn).	26	3,141	9,384	3,879	2,205	5,557	5,760	7,591	6,507
Silk waste	:	:	3	:	8	47	:	:	6
Silk yarn (other than silk waste yarn), not put up for retail sale	2,826	6,088	9,524	29,876	22,795	37,935	52,657	60,191	58,439
Yarn of silk waste, not put up for retail sale	:	:	2	:	3	22	39	856	420
Silk yarn or silk waste, put up for retail sale; hair of Messina (hair of Florence) Silk fabrics or silk waste	:	:	:	:	:	9	3	4	:
Silk or silk waste fabrics	231	1,422	7,856	12,940	5,743	7,487	11,417	11,957	12,207

Sericulture and biodiversity

The sericultural genetic patrimony concerning the silkworms is composed of 69 breeds and hybrids of mulberry silkworm (*Bombyx mori* L.) and of 4 breeds of ricin silkworm (*Salmya ricini*). The countries of origin are represented by Japan, China, Rusia, Bulgaria and India.

In terms of mulberry species diversity, Romania has about 10 local breeds and 49 foreign breeds and hybrids, originating from Japan, China, Russia, Bulgaria and India (Pau et al., 2008).

Sericulture and rural traditions

Sericulture in Romania originated as a rural based industry; proving to be a lucrative occupation for rural population, involving women in the production process through

activities like silkworm rearing, cocoon reeling and fabric weaving using manual handlooms. The thread obtained is known as "borangic" - silk, a thin filament obtained from rearing 5 to 10 cocoons at a time. Most known obtained products proved to be decorative objects and popular costumes rich in embroidery. Evidence of the silk handicraft industry can be located country wide, in museums dedicated to conservation of the crafts (Tzenov et al., 2006; Pau et al., 2006).

Sericulture and population's interest

In terms of future development, in the context of increased demand for silk products, there was a study conducted in 2012-2013, with its main focus on identifying interest level for sericulture and its development. Its conclusion revealed that sericulture as industry it is important for the Romanian farmer. Only 27% (out of 480 specialist and farmers interviewed) were interest in participation. Major reasons of concerns in terms of practicing sericulture were focused on interviewees being involved in other productive activities or being unable to invest at that moment (Matei et al., 2012).

Sectorial analysis of Romanian Sericulture Value Chain

Mulberry cultivation**,** also known as moriculture, is the first subsector of the input sector of the value chain, is a vital process as it provides food for silkworm rearing for sericulture farmers, but also provide samplings for establishing a new farms (Akram, 2015). The most wildly used breeds and hybrids of white mulberry (*Morus alba)* were Calafat, Galicea and Basarabi, with leafs with high protein content of up 24%. Most common plantation types were low bushes or plantations with trees with medium or high trunks (Pau et al., 2008).

Mulberry plantations have declined, not only in surface cultivated, from 3,550 ha in 1991, to 2,300 ha in 1995, to 321 ha in 2010, but the leaf quality has also declined (Pau et al., 2006) (Figure 2).

The last data concerning the number of farms that owned mulberry plantations was presented on the General Romanian Agricultural Census, 2010 and it was a total of 107, according to International Sericulture Commission.

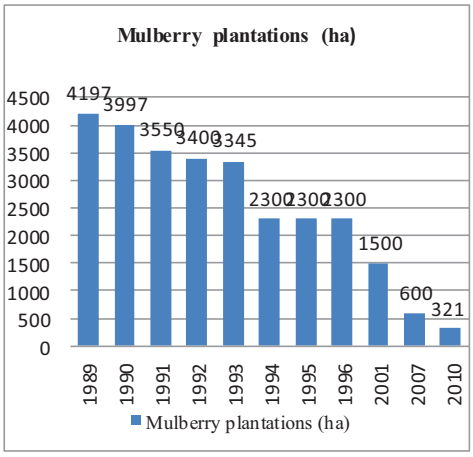

Figure 2. Evolution of mulberry plantations (Pasca et al. 2008)

Silkworm seed Production, the second subsector of the input sector of the value chain is responsible for providing disease free silkworm eggs from silkworm's productive breeds and hybrids (Akram, 2015).

Currently, no institution is involved in the commercialization of the silkworm egg production as the number of farmers involved in sericulture declined.

Romanian silkworm breeds and hybrids genetic stock is of upmost importance for the revival of the sericulture. According to conducted research, it can be stated that, overall, silkworm breeds and hybrids from the Romanian Sericultural Patrimony, proved to be quite productive: number of eggs/laying, cocoon weight and raw silk weight (and ratio), and last, but not least, fiber technological parameters (Matei et al., 2008).

Silkworm rearing is performed mostly at the University of Agricultural Sciences and Medicine Veterinary of Cluj-Napoca, with the purpose of conservation of the local genetic fund**.**

Silkworm rearing is usually done in the Sericulture Family Farm module type of exploittation, on mobile overlapped beds, and is system focused on providing rearing technologies for the small farmer. The technology was research and developed through the following project: „Organization and exploitation Model of Silkworm Rearing Family Farm in the Area of Transylvania", supported by the World Bank. This model is used to set a rearing

technology framework for future involved farmers (Mărghitaș et al., 2005; Dezmirean et al., 2008).

At a national level there are few to non reares left, but they conduct their activity independently, from procurement of inputs, to implementing the rearing of silkworm's technology, to traditionally rearing the silk cocoons and further processing them into fabrics and traditional garments for direct marketing (Mărghitaș et al., 2013; Ichim, 2013; Pau et al., 2006).

Silk production involves yarn and textile production from the silk cocoon. Raw silk is imported and textiles are fabricated.

There is no existing reeling factory for silkworm rearing. In this sector, Romania relies heavily on importing the raw material (Pașca et al., 2008).

Only traditional aspect of silk cocoon rearing left, and it is done manually using handlooms or using reeling facilities for processing high quality cocoons and pierced cocoons (waste from the production of biological Materials. Such a unit functions in the farm of one of the last silk farmers, Niculescu Family, from the village of Stoinesti, County of Valcea (Slădescu et al., 2012).

Marketing and Distribution

The sector is focused mostly on activities of import and export as cocoon and raw silk production has declined.

Support Institutions and Services

Sericulture value chain, like any other analyzed sector is influenced by different institutions through legislation, regulations, technological breakthrough, educational programs so forth (Kaplinski et al., 2002; Gerefky et al., 2006).

For Romania, there are 2 dimensions to consider when it comes to the support and research and development sector connected to the sericulture Value Chain, national and international institutions and organizations which can cooperate or support the Romanian sericulture industry revival process.

One the main bodies, at the national level, that overviews the development of agriculture and the rural industry, is the Minister of Agriculture and Rural Development. The possibility of sericulture industry revival could begin through a targeted plan designed to sustain the missing links from the silk value chain, starting from cocoon production to silk reeling and processing.

The reference Center for Advanced research in Sericulture and Silk Production, functioning within the University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca, center accredited and recognized by International Sericulture Commission, focuses its activities on germplasm conservation and its genetic characterization, managing the current bio-base it owns and is collaborating with students and didactic personnel in research activities (Mărghitaș et al., 2013; Dezmirean et al., 2008).

The Institute for Bioengineering, Biotechnology and Environmental Protection, a private research institute that was implicated in research projects concerning silkworm rearing waste, in collaboration with organizations from China and Bulgaria. (http://www.bioing.ro/en/; Ichim, 2013)

Universities are also implicated in the process of support and governance of the sericulture industry sector.

Most notably, The University of Agricultural Sciences and Veterinary Medicine, localized in the city of Cluj-Napoca, is involved in research activities and teaching activities (focused on aspects of silkworm biology, rearing technology, reproduction techniques, moriculture, and sericulture management and marketing) within the discipline of sericulture, which is managed by the Apiculture and Sericulture department. The institution was also involved in important research projects with focus on the following areas: Conservation of the sericultural germplasm, both in silkworm rearing and moriculture base; Research of technological and biological parameters of silkworm and silkworm cocoon breeds and hybrids under the influence of environmental conditions (Pașca et al., 2008) and under different diet additives (Dezmirean et al., 2008; Bojan et al., 2008; Bojan et al., 2008; Grigut et al., 2002).

The National Research and Development Institute for Textiles and Leather, located in Bucharest, also played an important role in silk industry, as it was a main partner in developing cocoon reeling technology suited for smaller farms. (http://www.certex.ro)

At an international level, Romania is part of the Organization with name Black, Caspian Seas and Central Asia Silk Association (BACSA, localized in Bulgaria) with main objectives focused on preservation of the sericultural fun of its member countries and production of biological material for cocoon production and cocoon processing and silk products marketing (Tzenov et al., 2006).
It is also a member of International Sericultural Commission, since 1959. Main objectives of the Commission focus on assistance in sericulture industry implementation and development, training programs and research with a focus on productivity of the silkworms. (http://www.inserco.org).

Development strategies

The main directions a development policy should focus on establishing an infrastructure for silkworm cocoons production and reeling, under associations as recommended form (Paşca et al., 2008) as this sector has been identified as the missing link the sericulture value chain in Romania.
In terms input sector development (mulberry plantations and silkworm egg production), it is imperative that some measures are taken:
Creation of a genetic fund in order to preserve the local mulberry breeds and hybrids and the local silkworm breeds and hybrids.
Implementation of advanced research in order to obtain high quality and highly productive silkworm eggs.
Mulberry plantations should be created for production of high quality samplings (Mărghitaş et al., 2013).
Research in this sector has led to the development of a Sericultural Family Farm Module designed for silk production for small size farms, as they represent a majority in the rural area of Romania (Mărghitaş et al., 2013).
Further actions in light of sericulture revival, at production level, should focus on modernization of silkworm rearing technology and silk processing at farm level; focus on silkworm rearing under the formation of a value chain with specialized sectors, from silkworm egg production, to young larvae rearing (instar 1 and 2), to adult larvae rearing and cocoon production and silk processing; on strategies developed to sustain and develop the silk handicraft cottage industry as traditional processed products are on demand. (Pau et al., 2008; Pau et al., 2006).
When referring to possibilities for the diversification of the sericultural farm activity with the purpose of increasing the profit, some recommended solutions focused on production through processing of secondary sericulture outcomes like pierced cocoons and remained pupas (Tzevnov et al., 2008).

CONCLUSIONS

Sericulture is an old and rural industry with high possibilities for revival. Although was a developed industry, the changes that came after 1989, including the reduction of mulberry plantations and downfall of the reeling plant have set back the industry.
In this context, Romania has turned from a producer of silk to importer of silk.
Active research is vastly conducted to preserve the genetic fund and to develop revival strategies that could relaunch the sericulture industry in Romania, an activity that will take quite a few years.
Currently Romania should focus on establishing a production infrastructure set to connect the silk cocoon production with the existing silk industry sectors.

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TECHNOLOGIES OF THE AGRO FOOD PRODUCTS PROCESSING