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Professional Paper

THE NECESSITY OF KNOWLEDGE, SERVING THE NEEDS OF THE BIO-ECONOMY IN BULGARIA

Angel Sarov*, Daniela Tsvyatkova

Agricultural Academy, Institute of Agricultural Economy, Sofia, Bulgaria,
angelsarov@abv.bg (*corresponding author)

ABSTRACT
The main challenge of the bioeconomy is to achieve economic growth, increase the competitiveness of the economy, balanced production and consumption of products, conservation of natural resources, improve the marketing of farms. The aims of this article is to analyze the knowledge needs for the bioeconomy in Bulgaria. We first present the socio-economic benefits of the bioeconomy, with a focus on agriculture as a leading sector, and then identify the basic needs. A three-step approach is applied to cover all stakeholders directly involved in bioeconomic knowledge acquisition: Education and awareness; Dialogue and consult; Co-creation of new knowledge based on cooperation and training. The results imply: identifying the knowledge and technological knowledge needs required for regional specialized bioeconomies; clarification of the knowledge delivery mechanism; knowledge transfer networks; assessment of knowledge in the bioeconomics. The need for bioeconomic knowledge would support a economic growth to more resource efficient use. Increasing the knowledge base and understanding of specific areas of the bio-economy will be based on obtaining more data, generating better information and systematic analysis.

Key words: Bio-economy, knowledge, Bulgaria.

INTRODUCTION
The bio-economy covers all sectors and systems that rely on biological resources (biomass from animals, plants, microorganisms, including organic waste), their functions and principles. It includes and interconnects: terrestrial and marine ecosystems and the services they provide; all primary production sectors using and producing biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors using biological resources and processes for the production of food, feed, organic products, energy and services (SWD, 2017).

The challenges of food security, the biodiversity conservation, the climate change and the need to adapt to them, the preservation of local food systems and the strong dependency between rural and urban areas create new opportunities for the science and the need for innovation. The bio-economy offers the opportunity to increase the potential of agricultural production to generate added value and stimulate economic development while guaranteeing relationships throughout the food chain (European Commission 2015; 2016). A number of European countries have already identified new business models and technologies related to resource efficiency, improved solutions and services to reduce environmental impact, and to improve the life cycle and the sustainable development of innovation processes.

The need a knowledge of bioeconomy would support an institutional approach to resource efficiency. This includes achieving a common understanding of the sustainable use of biomass and promoting practices for the discovery of new technological solutions, production diversification and solving long-term food security issues. The circular economy, as an element of bio-economy in agriculture, leads to preservation of genetic potential,

reduction of biodiversity loss and other factors beneficial for the preservation of the productive capacity of agricultural systems. The experience in Bulgaria presents how essential is the need for knowledge transfer and communication and how it helps to develop the bioeconomy.

The bio-economy is becoming part of the new information revolution that will dominate the economic life of the world in the forth coming decades. In recent years, the research and the innovation related to the bioeconomy has been a priority for most European organizations and researchers in the field (FAO, 2018; EC 2012a, 2012b, 2015, 2016; UN 2018; Adamowicz, M., 2017; Elevitch, C., Mazaroli, N., Ragone, D., 2018; Ronzon, T., Barek, R., 2018; Schmid1, O., Padel, S. Levidow, S., 2012, etc.).

The European Commission presented the first European Bioeconomy Strategy (European Commission 2012). This paper is based on the definition of bio-economy published by the European Commission (2012) as follows: "The bio-economy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries. Its sectors have a strong innovation potential due to their use of a wide range of sciences (life sciences, agronomy, ecology, food science and social sciences), enabling and industrial technologies (biotechnology, nanotechnology, information and communication technologies (ICT), and engineering), and local and tacit knowledge".

We have identified the needs of the bio-economy in Bulgaria as follows:

- Need for strategic planning;
- Awareness, knowledge transfer and communication;
- Needs for education, training and skills.

MATERIAL AND METHODS

In this article, we apply a three-tiered approach to cover all stakeholders directly involved in bioeconomic knowledge accumulation:

1. Education and awareness, where experts and others share information on the economy standing on bio-based production;
2. Dialogue in which interested parties consult and seek the opinions of other persons and organizations;
3. Joint creation of new knowledge based on cooperation and training between experts from universities and scientific institutes, citizens and interest groups (functional participation).

We accepted as a basis the following documents related to the bio-economy in Bulgaria: *"National Forest Biomass Energy Action Plan 2018-2027"; "National long-term program to promote the use of biomass for the period 2008-2020"*. Currently in Bulgaria the data on the state of the bio-economy are limited to the official documents of the Ministry of Agriculture, Food and Forestry (MAFF), and National Statistical Institute.

In addition, we reviewed the National Strategy for the Development of Research in the Republic of Bulgaria 2017-2030 (Council of Ministers Decision No 282 of 19.05.2017). The strategy envisages 11 scientific programs, including: *"National Science Program on Healthy Foods for a Strong Bio-economy and Quality of Life"* and *"National Scientific Program on Reproductive Biotechnology in Animal Breeding in Bulgaria"*.

One of the main problems in carrying out this analysis is the gap of information and a big database in Bulgaria, which allow analysis of the bio-economy and its impact on other economic activities. In order to overcome this problem, data are used by the European

Commission per sectors on the biological basis of the 28 Member States of the European Union.

SOCIO-ECONOMIC IMPORTANCE OF BIO-ECONOMICS

In the period 2008-2015, the employment dynamics in the bio-economy sectors presents a decrease. While in 2008 there were 20.64 million people employed, in 2015 they decreased by 2.56 million (about 13%) and reached 18.08 million. Employment data (Figure 1) shows a priority for the agriculture sector, which exceeds 51% of the total employment by sectors in the bioeconomy. Employment is also declining in this sector, or if in 2008 it was 10.7 million, then in 2015 it was already 9.2 million, which is in practice a decrease of over 1.5 million (over 14%). Another priority sector is food, beverages and tobacco, with ¼ share of total employment. Here, the employment also declines over the period considered, from 4.73 million in 2008 to 4.45 million in 2015. Employment in the agriculture, food, drink and tobacco sectors decreased by 1.8 million souls, which is over 70% of the total decline during the period. Data show a decline in employment in other sectors as well, with the largest share being "bio-based textiles" of over 24%, followed by the "furniture industry" with nearly 19%. Fisheries, aquaculture and the paper industry - a 9% reduction; the forestry sector has sustainable employment. The highest growth is reported in the "bio-based electricity" sector with over 120% increase in employment, but measured in absolute value it contributes by only 13.8 thousand people to the EU-28 in 2015, which in practice is less than 0.1% of total.

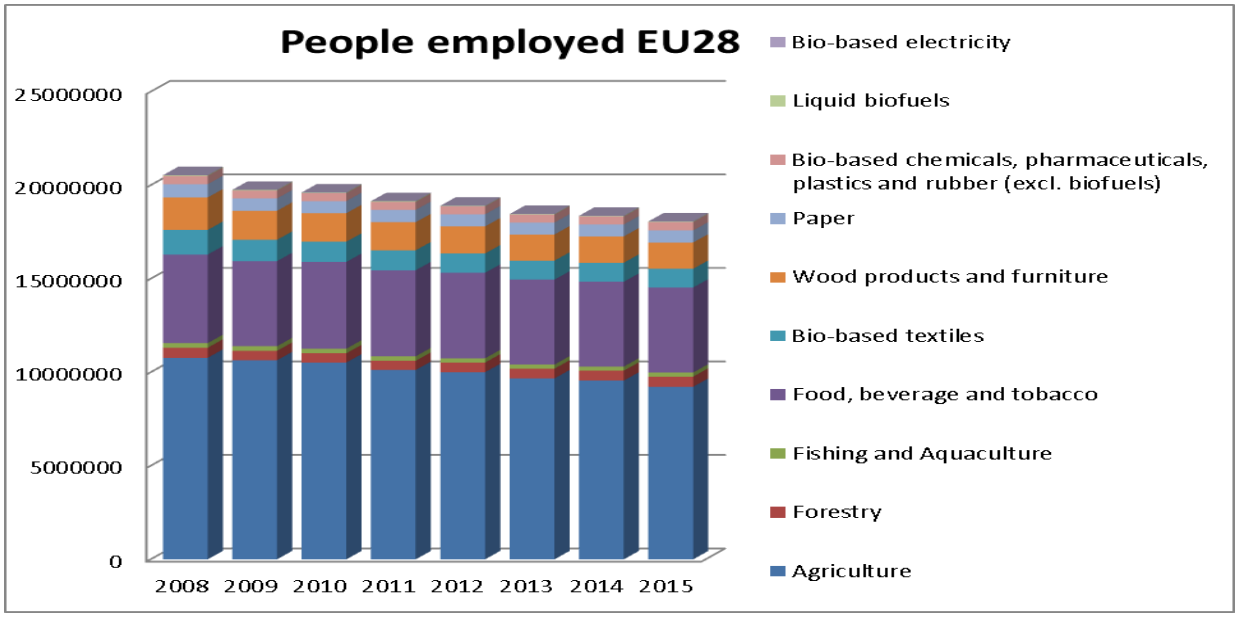

Figure 1. Development of the number People employed by sectors of the bio economy between 2008 and 2015 in EU-28

Source: European Commission, Jobs and Wealth in the European Union Bio-economy (2019)

According to the data, the agriculture sector plays an important role, both in creating economic growth and in formulating effective responses to global challenges.

In 2015, the number of people employed in bio-economy in agriculture of Bulgaria is 177.3 thousand, which makes up 2% share versus EU28 and ranks the country as 11th in the EU. The results (Figure 2) show that the employment growth in the agricultural sector of the bio-economy between 2008 and 2015 is a 21.6% decrease. According to EC data, EU28 employment growth also declines by 14.36%, but it is smaller compared to Bulgaria.

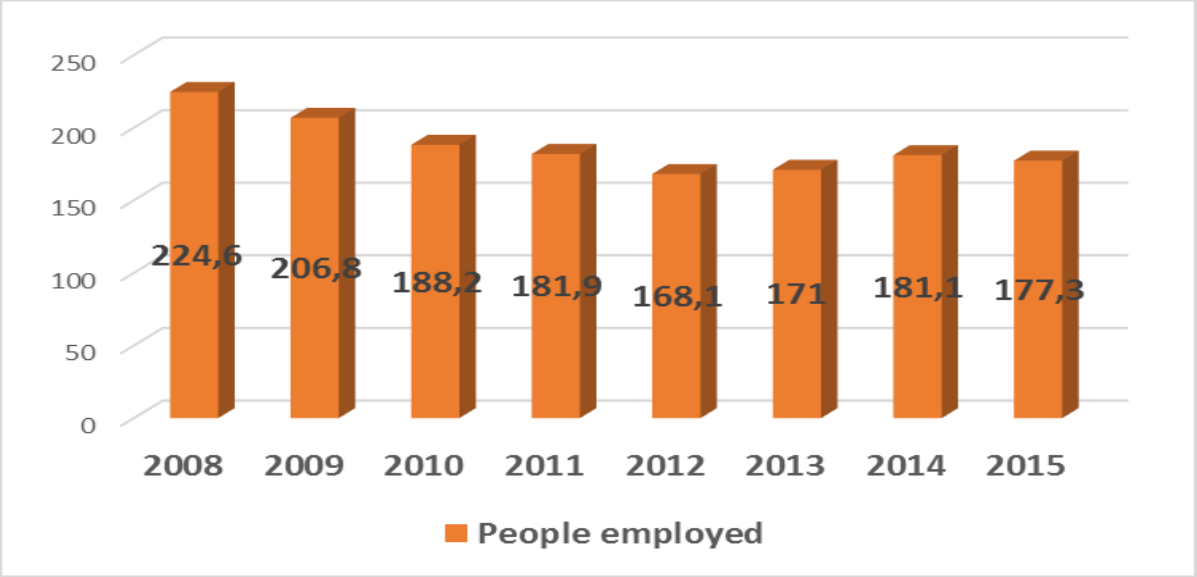

Figure 2. Development of the number of people employed by the agricultural sector in the bio-economics in Bulgaria (EUR, thousands)
Source: European Commission, Jobs and Wealth in the European Union Bioeconomy (2019)

In Bulgaria (2015) the value added is EUR 1.64 billion (Figure 2), i.e. 1% of the EU-28 share, (EUR 173.6 billion). Between 2008 and 2015 there value added a decrease of 18.68% was reported According to the data, the largest decline is in 2009 and 2010. For the same period in EU28, the value added is only decreasing (-3.23%).

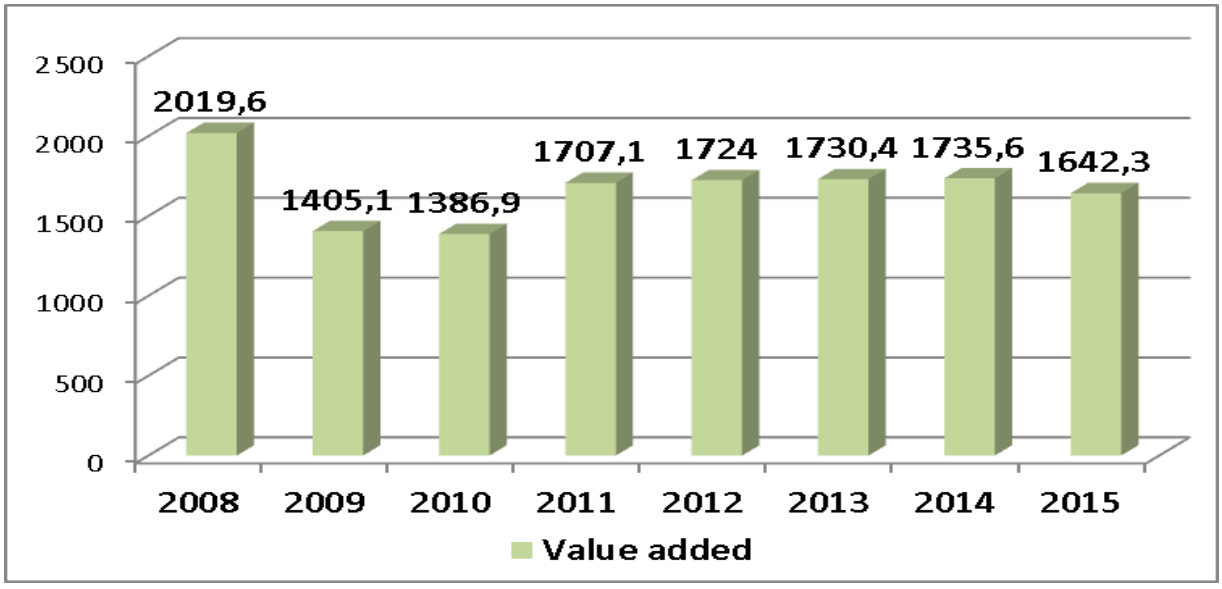

Figure 3. Development of the agricultural sector's value added in the bio-economics of Bulgaria
Source: European Commission, Jobs and Wealth in the European Union Bio-economy (2019)

The results show that the bio-economy has not yet reached its full potential in bio-based production and job creation. Thus, the multipliers of production and employment show that many sectors related to the bioeconomy have more opportunities, especially those with higher added value.

The bio-economy in the agricultural sector is a policy towards the fuller use of solid waste - straw, maize, animal waste such as manure, whey, and more. For example, one option is to utilize biogas waste from farms that can be used for fertilization, but they often pollute the environment and increase the carbon content in the atmosphere. Alternatively, the development of wastewater technologies such as biogas and soil improvers can be developed. The production and the waste in agriculture refer to the category of biomass. According to Eurostat data, the relative share of biomass related to the total waste per capita is about 9.1%. As biomass is the main source of agriculture and forestry, it can be assumed that they account for less than 8% of the generated waste.

Agriculture provides a biomass from the production of feed and bio-based products. The biomass includes the production of crops (economic biomass) and residues (waste). So far, the farmer's attention has been focused on the production and processing of economic biomass, but policymakers have been increasingly payed attention to the use of waste products. The benefits are mainly directed towards a more efficient use of resources, environmental protection and economic growth.

According Agrostatistics date, MAFF, (2017) in Bulgaria, in 2017, 15.1 million t. of the biomass was produced in agriculture, which is almost three times more than in 2007. The largest volume is of the cereal biomass, which reaches 63% of the total production. When using raw materials in agriculture - Bulgarian agriculture continues to be characterized by a relatively low rate of utilization of raw materials and waste from agriculture.

The European Commission actively supports and promotes all types of innovation and practices for sustainable food and agriculture systems, forestry and biotechnology, applying a systematic and cross-sectoral approach that links actors, territories and value chains, for sustainable economic growth. This is necessary for the development of the bio-economy in a way that mitigates environmental pressures, prices and conserves biodiversity and supports the full range of ecosystem services.

RESULTS AND DISCUSSION

The effective engagement of stakeholders and the public in bioeconomics knowledge requires application of communication tools that respond to the needs of different target audiences and provide the necessary information and knowledge.

The results for Bulgaria present that a broad three-step approach requires wide involvement of all stakeholders from an early stage:

Education and awareness

Firstly, there is a need for an integrated knowledge dissemination policy for the bio-economy sectors. This means access to biotechnology knowledge designed to contribute to the development of environmentally sustainable technologies.

In order to make the transition to a more integrated and sustainable production and processing system faster and more efficient, the level of funding for R&D in the bio-economy should be increased through multidisciplinary research programs. Networking between industry and academia could also help to overcome the barriers and the knowledge gaps that currently exist between these two stakeholders.

Higher education, research institutes, technology parks, and regional innovation agencies are the conduits of knowledge transfer and technological expertise in the field of bioeconomy. The main task is to present the benefits of the circular economy and to deliver a package of knowledge to the Bulgarian producer. Bulgaria needs high-quality research infrastructures to generate new knowledge that helps to cope with the environmental and social challenges facing our society.

Consistency with research and innovation priorities and more specific programs to support knowledge in the field of bioeconomics is needed. All this is in line with public awareness programs and engagement with the bio-based and circular economy: understanding and sharing the benefits of the bio-economy, including reducing the risks of the circular economy. At the level of educational institutions, efforts should be directed to economic disciplines to orient future employees or business owners to targeted management decisions on farms and their accurate implementation as well as Innovative bachelor's and master's programs for young people, incorporating a knowledge base and understanding of specific areas of bio-economy.

There is a need for a long-term strategic framework (e.g. a common understanding of the bio-economy and better awareness), a clear allocation of roles (e.g. which ministry / public authority is responsible for the bio-economy). These requirements are linked to public bioeconomic policy not only at national, but also at regional / local level. In particular, when it comes to important infrastructure investment decisions or to support clusters, government and sectoral ministries, as well as ancillary agencies, should give priority to thematic areas and chains for the creation of new knowledge and added value. This is especially important in regions that are still detached from the approaches to the implementation of bioeconomic principles.

The experience in Bulgaria presents a how essential the need for knowledge transfer and communication is and how it helps to develop the bio-economy. Raising awareness of new opportunities in organic products, creating demand for organic products. This could be supported by encouraging the establishment of business incubators in which different sectors of the value chain can meet and exchange ideas, demonstrations and mutually absorb and share news. Therefore, there is a need for qualified experts with specific ideas and proposals for education and training. This is sometimes not a specific need for bioeconomics, but rather a general problem related to the capacity for transfer of knowledge and innovation in research and scientific institutions. Better trained staff would make optimal use of natural resources and be aware of the specifics offered to them by the region in which they operate. The accumulation of knowledge about the bio-economy supports a regional approach to more resource efficient use. This includes achieving a common understanding of the sustainable use of biomass and promoting practices for the discovery of new technological solutions, diversification of production and addressing long-term food security issues. The circular economy, as an element of bio-economy in agriculture, leads to the conservation of genetic potential, reduction of biodiversity loss and other factors favoring the preservation of the productive capacity of agricultural systems.

Dialogue and consultation

A common strategy for communication, dialogue and active involvement of stakeholders is needed. This will not only help the raise of awareness of bio-technology, but also will ensure that long-term goals will be achieved reflecting the society needs.

The networks are an appropriate tool for building trust and strong links between research centers, innovation agents and companies through innovative clusters or knowledge dissemination centers. Stakeholders and public engagement are important tools for networking and for developing a bio-based economy. Support for small and medium-sized enterprises in setting up new networks for the development of dialogue should be stepped up.

Due to the poor development of the bio-economy in Bulgaria, the country is in a good position to exploit and transform its economy into environmentally sustainable and socially inclusive development and green growth. This will be possible in the study and dissemination of good practices after a thorough analysis of the bio-economy in the regional environment and the creation of new matrices that respond to the needs of agriculture and agricultural

areas, which will be implemented in the primary production processes and in the activities of farmers in individual areas. In this way, the priority features of the sectors in the regional specialized bio-economies will be highlighted. This means that, on the one hand, the synergy between university, industry and government organizations must be strengthened, and on the other, the involvement of civil society organizations. In addition, the provision of financial resources to enhance cooperation with non-governmental organizations on bioeconomics and the circular economy.

Construction, development and training of labor resources - Increasing innovative capacity. Programs in the field of technical and organizational modernization of farms; Investments in new technologies should be included in the set of impact measures. The so-called integrated production, which involves the use of uniform technical and biological progress, which will affect the adaptation of production to the requirements of the consumer; Focusing on innovation and deploying innovation as a prerequisite for maintaining and enhancing market opportunities. In crop production, forestry, animal husbandry, aquaculture - improvement of technologies for plant and animal production, utilization of waste production, bioenergy production; More active use in the management arsenal of long-term planning and strategizing of the activity and enhancement of management knowledge and skills for the bio-economy; Introduction of innovative solutions for environmental protection from the negative factors (harmful gas emissions, industrial waste, etc.) in the production of energy from fossil resources in the mineral energy complexes, the utilization of waste from various agro-industrial production; Planning the transfer of the business to the next generations and ensuring their preparation and motivation for succession.

Next, designing and implementing effective tools to broaden stakeholders' dialogue and increase public engagement. In order to reach all stakeholders to address their needs, a combination of tools covering the fields of education and information, dialogue and co-production of knowledge is needed.

Interdisciplinary and collaborative research would lead to new and valuable business activities. Enhancing cooperation between the private and public sectors should be a focus for further improvement.

Collaboration and training (functional participation)

One of the major challenges remaining in the industry is the transformation of research into products, including the development of new bio-based products. Public-private partnerships would lead to pooling of resources, thus achieving more ambitious goals and reducing time to market. This would also allow the industry to adopt longer-term bioeconomic investment plans, taking into account the market outlook.

Therefore, more demonstrations and training from public-private organizations should be encouraged. At this stage, they are the important measures that can be taken in the development of the bio-economy, as they are able to bridge the critical gap between scientific knowledge and industrial application. At the level of agro industry, non-governmental organizations and educational institutes should foster agrobusiness support for the bio-economic sector through the adoption, implementation and control of many European directives, norms and standards. First of all, they need to improve their interaction, establish the necessary priorities in their activity, and search for mechanisms for transfer of know-how and good practices. Agricultural industry and non-governmental organizations should take the responsibility to serve as an intermediate connection between universities, international research and support programs, business and government in order to organize projects to form and transfer good practices and dissemination.

In the economic world, business organizations are confronted with a number of challenges posed by the increasing dynamics and uncertainty of the external environment,

increased competition, technological development and, last but not least, the multifaceted effects of the ongoing crisis for several years. These conditions require creativity, active pursuit of new opportunities and their decisive exploitation. The lack of targeted and comprehensive research in the field of bio-economics and the circular economy in Bulgaria necessitates working on the following main directions: The first, promoting research and policies supporting knowledge transfer should go hand in hand with integrating research findings into processes and applications in the industry. Second, finding a connection between politics, business, science and stakeholders, as well as developing strategic solutions in the various fields affecting the bio-economy.

At the level of business, entrepreneurs and managers in agriculture must focus their efforts on multiple courses and training such as circular economics, sustainability, bio-economy. Improving skills is a key to increasing productivity and employment and thus improving living standards. Increased supply of skilled labor is likely to attract investment in more productive higher value-added industries, thereby boosting overall economic growth and fostering income convergence. The active involvement in the activities of business support organizations in order to overcome the challenges of the bio-economy requires a knowledge-based approach to various policy areas and interests, as well as work of farmers with universities and scientific institutes.

CONCLUSIONS

The bio-economy is a good opportunity to achieve a sustainable and competitive economy, balanced production and consumption of products, conservation of natural resources and maintaining a high standard of living for the population. The bio-economy offers the opportunity to combine economic growth with environmentally responsible business activities and the transformation of society into a bio-based knowledge economy. In this context, the need to redefine key priorities in agriculture of Bulgaria becomes even more apparent, including the integration of individual sectors, the identification of consumers as a key driver for bio-technological change, the increase of private investment and the evolution of information and communication technologies. These factors, combined with the increasing importance of bio-economic knowledge, outline how to examine the impact of agricultural activity and policies on behavior innovative and practices in the agricultural sector.

In conclusion, the integration of the bio-economy sectors should be supported by research that should cover the entire value chain - from raw materials to the end product - as this will help innovation stimulate. One of the main challenges is adapting research to the needs of the bio-based market. This would allow the sector to adopt longer-term investment plans in the field of bioeconomy, taking into account the market dynamics.

In the long term, the expectation is for closer integration of the different sectors of bio-based products, as well as between different research areas in food and non-food commercial applications.

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REFERENCES

Adamowicz, M. (2017). Bioeconomy-Concept, Application and Perspectives. *Problems of Agricultural Economics, 1* (350).

Bonaccorso, M. (2014). The European Path to Bioeconomy Runs through Clusters. In "Renewable Matter. International Magazine on the Bioeconomy and the Circular Economy" (1/2014). Available at: www.renewablematter.eu/art/22/The_European_Path_to_ Bioeconomy_Runs_through_Clusters.

Elevitch, C., Mazaroli, N., Ragone, D. (2018). Agroforestry Standards for Regenerative Agriculture Sustainability 2018, 10, 3337.

European Commission (2012a). Communication from the commission on EU Bioeconomy Strategy & Action Plan "Innovating for Sustainable Growth: A Bioeconomy for Europe". COM (2012) 60.

European Commission (2012b). Commission Staff Working Document. "Innovating for Sustainable Growth: A Bioeconomy for Europe".

European Commission (2015). Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe. SCAR 4th foresight exercise. DG Research and Innovation. Directorate F – Bioeconomy. Edited by Barna Kovacs.

European Commission (2016). A strategic approach to EU agricultural research & innovation. Final paper. Outcome of the European Conference: 'Designing the path' - 26-28 January 2016. Brussels: DG Agriculture and Rural Development.

European Commission (2019). Jobs and Wealth in the European Union Bioeconomy.

FAO (2018). Assessing the contribution of bioeconomy to countries' economy. A brief review of national frameworks.

Ministry of Agriculture, Food and Forestry (MAFF), Agrostatistics.

National Forest Biomass Energy Action Plan 2018-2027.

National long-term program to promote the use of biomass for the period 2008-2020.

National Science Program on Healthy Foods for a Strong Bio-economy and Quality of Life

National Scientific Program on Reproductive Biotechnology in Animal Breeding in Bulgaria.

National Strategy for the Development of Research in the Republic of Bulgaria 2017-2030 (Council of Ministers Decision No 282 of 19.05.2017).

Ronzon, T., Barek, R. (2018). Socioeconomic Indicators to Monitor the EU's Bioeconomy in Transition, Sustainability 2018, 10(6), 1745.

Ronzon, T., Santini, F. & M'Barek, R. (2015). The Bioeconomy in the European Union in numbers. Facts and figures on biomass, turnover and employment. European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Spain, 4p.

Schmidt, O., Padel, S. & Levidow, S. (2012). The Bio-Economy Concept and Knowledge Base in a Public Goods and Farmer Perspective. *Bio-based and Applied Economics, 1*(1): 47-63, 2012.

SWD (2017). Review of the 2012 European Bioeconomy Strategy, 13.11.2017.

UN (2018). Progress towards the Sustainable Development Goals. Report of the Secretary-General.