BENEFITTING FROM THE DEVELOPMENT OF THE BIOECONOMY: THE CASE OF BULGARIA

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ABSTRACT
The bioeconomy is a concept predominantly addressing industries producing and processing biological products with the aim of making them contribute to the transformation of modern economies into more sustainable, green, circular and climate-neutral economies. The aim of the article is to study the benefits of the development of the bioeconomy in Bulgaria, seen as economic, security and climate change impacts. All of these require a balanced management of biomass application, especially for non-food purposes, in order to obtain positive impacts and avoid the degradation of the ecosystem. For these reasons, different approaches to the governance of the bioeconomy are adopted worldwide. Bioeconomic industries in Bulgaria are vulnerable to climate change, and need investment to adapt to it. The main bioindustries are agriculture and food processing with respect to value added and employment, as they are of low efficiency in comparison with EU results. These sectors show resilience in the case of health risks and need technological modernisation and efficiency improvement through new supply chains and approaches to waste management. Renewable energy generation was stable during Covid-19 lockdowns, and impacted positively the decrease in greenhouse emmissions. Along with the ecological benefits, RES increases energy diversification and contributes to national security.
KEY WORDS: *bioeconomy, green development, climate change*.

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Introduction

The bioeconomy is a concept addressing predominantly industries producing and processing biological products with the aim of making them contribute to the transformation of modern economies into more sustainable, green, circular and climate-neutral economies. The new approach towards biomass-producing industries examines how technologies and networks could improve their resource productivity.

At present, a lot of countries are developing strategic plans to manage bioeconomy activities, in order to stimulate their development and modernisation, and gain economic, social and ecological benefits. In each national bioeconomy document, there is a variety of approaches to explain bioeconomy: from a broad definition of processes and industries to narrowing the scope of activities; from strategies to different legislative documents; from government to regional approaches. The European Union (EU) has a strategy for the development of the bioeconomy, and most member states have issued documents to govern the transformation of their bioeconomy. Germany and the United Kingdom have defined their bioeconomies precisely, paying attention to risks and conflict avoidance. Most East European countries, including Bulgaria, have no explicit documents. In Bulgaria, there are few initiatives aiming at the modernisation of agriculture and the increase of its efficiency.

The European Commission defines in its strategy the industries that are considered part of the bioeconomy concept, and observes their contribution to turnover and employment. The main European bioeconomic

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sectors are agriculture and food processing, and they are important industries in Bulgaria. In Bulgaria the over-concentration of employment and the low level of efficiency in agriculture are a stimulus for improvement, for diversification, and for the better usage of new technologies for production and waste management.

The aim of the article is to study the benefits of the development of the bioeconomy in Bulgaria. They are grouped in three main fields: economic motives, security provision and climate change impact. These three dimensions are studied through an analysis of the main economic and climate indicators, and a comparison with average EU results until 2019. The main ratios used to evaluate the climate impact is greenhouse emmission changes and a comparison with the basis of the year 1990. The economic benefits are studied through the contribution of the main bioeconomic industries to value added and employment. The analysis is enriched with the results of an enquiry conducted in Bulgaria among 80 farmers in order to identify the level of knowledge and the application of the main bioeconomic approaches. The security dimension is viewed through the impact of hazardous events on the economic performance of some bioeconomy industries. The basic bioindustries show a resilience to shocks, and provide opportunities for bioeconomic diversification and improvements in efficiency.

1. The bioeconomy concept

Initially, the bioeconomy arose as a field for the development of biotechnologies and integration in different industries in order to contribute to sustainable development (EC 2012; OECD 2009). Later, it was defined and foreseen as an instrument for the production and use of biological resources and innovation to provide sustainable goods and services in all economic sectors (Global Bioeconomy Summit 2015; German Bioeconomy Council 2015). The European Commission (2012) also defines the concept as a key element of intelligent and green growth, and later upgraded it (2018). It is seen as an overall approach towards the environment, energy and food supply, and decreasing natural resources. Meyer (2017) finds two main approaches towards the bioeconomy. The narrower definition is based on modern biotechnologies and natural sciences with high economic impact. The broader approach is focused on biomass and the economic transition from brown towards the bioeconomy.

The bioeconomy is mainly defined as being focused on certain industries (Dietz *et al.* 2018), such as agriculture, forestry and food processing. Circular development is an essential part of this policy, focused upon resource efficiency through waste reduction, reuse and recycling (Fricker 2003; Ivanova 2020). The reasons for the adoption of bioeconomy strategies can be explained by price expectations of production factors and opportunities for income and employment (Sahn 2015). The bioeconomy offers a beneficial approach to the dilemma of food or energy. Its industries are highly innovative, using different sciences, technologies and knowledge (Grassauer, Stoeglehner 2020).

Most countries develop bioeconomic strategies which pursue transformations. They do not address risks and conflicts in achieving their goals through the development of the bioeconomy.

European countries are most sensitive to these problems. In 2012, the EC presented a bioeconomic strategy and an action plan, updated in 2018. The strategy is seen as an approach for an increase in efficiency, food security, renewable usage and environmental protection. Germany and the United Kingdom have the most advanced strategies. In East European countries there are no explicit documents aimed at the development of the bioeconomy (Wohlgemuth *et al.*, 2020; Staffas *et al.* 2013). Of the 27 EU member states, only 15 have or are about to accept specific strategies for the bioeconomy, while eastern countries remain behind the west in this process (Voicilas 2020).

In Bulgaria there is no strategy for bioeconomy development (Kotseva-Tikova, *et al.* 2019; Motola, *et al.* 2018; Brizga, *et al.* 2019). Since the end of 2018, the National Scientific Programme has been executed, which aims at finding suitable solutions for healthy food production and sustainable regional development. Other studies are the draft Strategy for the Development of the Bioeconomy in the Stara Zagora district in 2017, funded by the BioSTEP programme, and a strategy for strengthening the role of agriculture in the bioeconomy created by the Agricultural Academy (2020) in 2020. The bioeconomy policy development of

Bulgaria is characterised by sporadic activities aiming to satisfy EU regulations and dependence on primary industries. The benefits from the creation of employment in traditional biomass production and processing industries have been utilised, and at present the emphasis is on technological modernisation, the realisation of circular practices, and the generation of renewable energy.

2. Benefits from the bioeconomy in Bulgaria

2.1. Climate change adaptation

EU efforts to become climate neutral have resulted in a decrease in greenhouse emissions (GHG) of 4% in 2019 compared to the previous year (EEA), and the total level of the decrease is 25.89% compared to 1990 (Fig. 1). The results for Bulgaria are: a 42.22% change since 1990, and a 3% annual decrease in 2019 (Fig. 2). The greatest decreases were observed in 1989 and 2009, at 22% and 17% respectively. Since 2014, there have been three years with an increase and three years with a decrese in GHG in Bulgaria. The country needs to continue reduction from 2018 and 2019, and to realise about a 13% additional decrease by 2030. A further decrease will be difficult but necessary in order to contribute to the climate neutrality of the EU. Bulgaria has results similar to the EU average during the last four years, with a greater decrease since 1990.

The high GHG emissions per GDP in Bulgaria are due to the energy sector, more than twice as high as the EU 27.

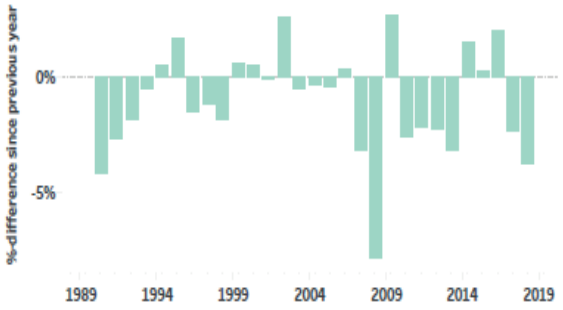

Figure 1. Annual percentage change emissions in EU

Source: EEA, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

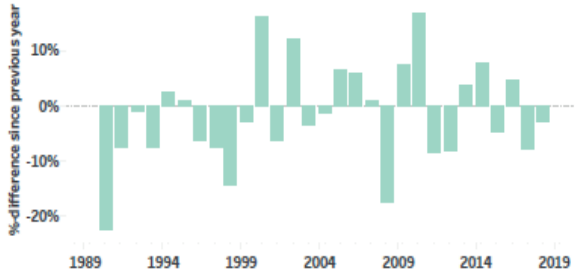

Figure 2. Annual percentage change in emissions in Bulgaria

Source: EEA, https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer.

The energy intensity of the Bulgarian economy continues to be the main problem, as well as its high dependence on local coal. The share of coal in eletricity production is 40%, as most of the coal is mined in the country, which means that the coal sector also contributes to national employment and GDP more than in countries that rely exclusively on imported coal. The Bulgarian coal sector is under economic pressure from increased CO_2 prices (Zachmann *et al.* 2022). This sector needs new technologies to become more carbon neutral, accompanied by measures for the improvement of energy efficiency.

Increased GHG emissions contribute to climate change, and in Bulgaria they are expected to influence negatively all sectors of the economy. According to the National Strategy for Climate Change Adaptation and Action Plan (2019), by 2050 the implications will be:

- A negative shock to productivity in the agricultural sector.
- A decline in the production of the energy sector as a result of the economic slowdown.
- The transport sector will experience a negative outcome as national economic activity shrinks.
- High energy-intensive industries, including the production of chemicals, steel, aluminium, cement and ceramics, will have a positive effect from trade changes that will help boost exports and thus mitigate the decline in domestic demand.
- There will be an increase in domestic real prices for the whole economy.
- Income from skilled and unskilled labour will decrease in all scenarios.

Agriculture, the main bioeconomic industry, is highly vulnerable to climate change, which requires the application of appropriate measures of adaptation (Mochurova *et al.* 2014). The benefits of adaptation are higher especially in the case of more intensive climate change. The government can use national financial sources as well as EU financing to develop green and carbon-neutral solutions in the most vulnerable industries. The benefits of measures for adaptation are high in forestry and in biodiversity and ecosystems in respect to NPV and cost/benefit results. Biodiversity and ecosystems impact significantly all major climate-related industries and activities: transport, energy, forestry, etc. The strong negative net effect on economic development requires a transformation towards more green solutions and activities, as well as measures for adaptation to the inevitable changes. The most important are the creation of a stable and reliable green energy sector, which uses solar, water and biomass energy for heating, electricity production and transport. The bioeconomy is seen as an important link for the circular use of waste from agriculture and forestry in Bulgaria. The high electricity and energy source prices stimulate the application of alternative renewable sources. Additionally, the bioeconomy contributes to carbon processing through long-term storage as wood and wood products (Georgiev *et al.* 2020). It will decrease GHG, but needs investment in infrastructure. Biomass usage requires balanced management in order to avoid the degradation of ecosystems, as a result of strong competition between food and non-food applications.

2.2. Bioeconomy results

The bioeconomy sectors are considered to bring significant economic and ecologigal benefits in the EU, as they are engaged in biomass production and conversion (agriculture, forestry, fishing, food processing, bio-based textiles, chemicals, biofuels and electricity, and wood processing), and contribute to employment and income creation (Fig. 3). The added value of all bioeconomic industries increased by 28% for the period 2008 to 2019 in the EU, while in Bulgaria the growth was lower, at 18%. For the same period, employment decreased in the EU by 14%, and in Bulgaria by 20%.

The bioeconomic results in Bulgaria are lower than the EU average, which shows the opportunities for the application of measures to increase efficiency. In 2019, around 36% of the value added in European biomass-processing industries was the result of the food, beverage and tobacco sectors, and 29% from agriculture. In Bulgaria, the results were the opposite: the most important industry was agriculture (41% of value added), while food, beverages and tobacco had a 31% share. The structure of employment was again dominated by agri-employment with a share of 51% in the EU, and much higher in Bulgaria (74%), and food, beverages

and tobacco, with 27% of employment in the EU, and 12% in Bulgaria. There is an over-concentration of jobs in the bioeconomy compared with the EU average, which is combined with low productivity (Koceva-Tikova, Mochurova 2021). This confirms that the role of agriculture in rural areas as an economic and social buffer should not be underestimated.

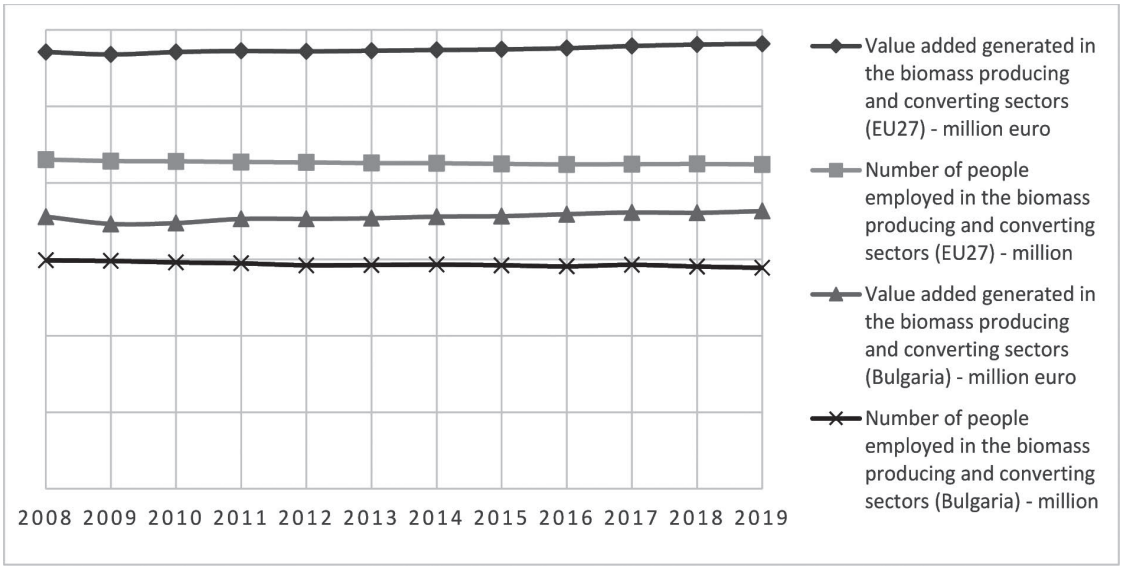

Figure 3. Employment and Value added in the biomass producing and converting sectors in EU and Bulgaria (lg scale)

Source: EC (2017), Data-Modelling Platform of Agro-Economics Research, https://datam. jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html

A lot of people work in different agricultural sectors in Bulgaria, over 571,000, and for some of them this is a complimentary business activity. In 2020, a survey was conducted among 80 agricultural producers from the Plovdiv district in order to reveal the level of knowledge of the basic principles of the bioeconomy.[2] Kotseva-Tikova (2022) calculates that for 64% of the participating farmers, agri-production is the source of the sole or a basic income. The survey also confirms some negative agri-results: the ageing of employees, a lack of specialised higher education (around 50% of participants had a secondary education not connected with agriculture), and the average period of experience (80% of participants have been engaged in agri-production for a period of up to ten years). The bioeconomy is associated with new technologies and production, the realisation of which depends mainly on the availability of financial incentives, with less influence from competitors and their activities. The market stimulates less than 50% of respondents to take new technological decisions. The state is accepted as a tool for stimulating innovation activity through bioeconomic principles of work. It is expected to support new technologies and innovations.

Agriculture contributes to a 4% share of the Bulgarian gross added value, and promises opportunities to increase through the better usage of biomass and waste, which would boost other sectors such as biofuels and electricity generation. In the context of the necessity of energy diversification and the establishment of local sources, this could leverage value added and contribute to the better use of the waste generated in the agriculture, wood and food industries. Decarbonisation is a process covering different industries, and while electricity is seen as the easiest sector, it is harder for transposrt, heating, industry and agriculture (Tol, 2021). According to Tol, satisfying the targets of the Paris Agreement would cost between 0.5% and 10.5% of GDP in 2050, with a model average of about 3%. The new financial mechanisms of the EC, national plans for recovery and resilience, are important for the financing of projects contributing to climate neutrality.

[2] The survey was conducted with the support of the National Research Programme 'Healthy Foods for a Strong Bioeconomy and Quality of Life' of the Ministry of Education and Science.

2.3. Security

The advantage of the bioeconomy is that most of its sectors are based mainly on local resources and are relatively little dependent on supplies from foreign markets. This is particularly important at a time when globalisation policies are being rethought, and the focus is on local resources, supply chains, and domestic energy supply (Koceva-Tikova, Mochurova 2021).

During the Covid-19 pandemic in 2020, agriculture and the food industry were less affected and showed a resilience to this shock (Kotseva-Tikova, Dvorak 2021). The food and tobacco industries were least affected, and they recovered quickly from the initial slowdown. Renewable electricity generation was not influenced by the pandemic. The consumption of biofuels declined as a result of the decline in transport.

After the outbreak of Covid-19, some countries created strategies or action plans for the bioeconomy as instruments for recovery (Costa Rica, Italy and Japan) (Woźniak, Tyczewska 2021). The strategies pay special attention to the impact of the pandemic. In the Italian plan, the bioeconomy is seen as an area for accelerating after Covid-19, while the updated strategy of Japan emphasises the role of the bioeconomy in the post-Covid-19 period in developing measures against future crises in public health and in building an effective chain of deliveries (Global Bioeconomy Policy Report 2020).

The crisis provides an opportunity for reorientation towards sustainable and environmental initiatives, as these are connected with local production, which in addition ensures independence and the diversification of the energy mix. The initial lockdown had a negative effect on bioeconomy branches, but some of them succeeded in recovering, and changed their production and sales channels and adapted to the new conditions. As a whole, these sectors show resilience to the health risk, as food and green energy production demonstrated growth.

The delivery of basic energy sources from unstable regions is seen as the main driver for the diversification of the energy mix through the inclusion of renewables. The increase in electricity prices stimulates the realisation of local solutions for the satisfaction of energy needs. The RES are an instrument for the diversification of the energy mix and insurance against fluctuations in oil prices. Awerbuch (2006) calculates that when the price of oil rises, economic activity decreases. Increasing the share of renewables in the energy portfolio will have the effect of reducing GDP losses.

Conclusions

The bioeconomy emphasises the necessity to modernise primary industries and at the same time to develop new ones devoted to renewable energy generation and technology modernisation. It is a greener approach to future development. Its strong implications are an increase in resource efficiency and a decrease in greenhouse gas emissions, which would work for adaptation to climate change.

Climate change is expected to influence negatively most industries in Bulgaria, which requires appropriate measures and investment in green technologies. The energy sector depends strongly on local coal, creating a high GHG impact and employment vulnerability. The bioeconomy contributes to the circular usage of waste from agriculture and forestry in Bulgaria for energy and non-energy purposes, as well as to carbon processing through long-term storage as wood and wood products. The use of biomass is influenced by intense competition between food and non-food applications, which requires appropriate strategic approaches.

Bioeconomy industries in Bulgaria rely heavily on agriculture and food processing with respect to value added and employment. Their results are lower than the EU average, which indicates opportunities for technological modernisation and efficiency improvement. The problems in this sector are that agriculture is dominated by the ageing of employees, a lack of specialised higher education, and a short average period of experience. The government is seen as the main driver of bioeconomy transformation and the adoption of new technology, which emphasises the need to have a strategic plan, with appropriate financial mechanisms for boosting innovation processes and an increase in efficiency.

The bioeconomy benefits companies producing and processing biological products, as well as positively influencing national security and resilience in cases of health or other external shocks.

Acknowledgments

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BIOEKONOMIKOS PLĖTROS NAUDA: BULGARIJOS ATVEJIS

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Santrauka

Bioekonomikos koncepcija daugiausia skirta biologinius produktus gaminančioms ir perdirbančioms pramonės šakoms, siekiant, kad jos prisidėtų kuriant šiuolaikinę tvaresnę, ekologiškesnę, žiedinę, klimatui neutralesnę ekonomiką. Galima nauda skatina šalis kurti bioekonomikos strategijas, siekiant pokyčių, net jei ne visi jie sprendžia bioekonomikos plėtros problemas. Europos šalys šioms problemoms jautriausios.

Europos bioekonomikos strategijoje ir veiksmų plane ypač akcentuojamas saugus maisto produktų auginimas ir sandėliavimas, atsinaujinančių išteklių naudojimas ir aplinkos apsauga. Vokietija ir Jungtinė Karalystė yra sukūrusios pažangiausias saugaus maisto produktų vartojimo ir aplinkos apsaugos strategijas. Reikia pabrėžti, kad Rytų Europos šalyse aiškių šias veiklas reglamentuojančių dokumentų nėra. Bulgarija bioekonomikos plėtros strategijos neturi, nors yra kelios iniciatyvos dėl bioekonominės veiklos tobulinimo reglamentavimo. Šiuo metu akcentuojamas technologijų modernizavimas, žiedinės praktikos įgyvendinimas ir atsinaujinančios energijos gamyba. Straipsnio tikslas – ištirti Bulgarijos bioekonomikos plėtros naudą. Biolekonomikos plėtra apima tris pagrindines sritis: ekonominiai motyvai, saugumo užtikrinimas ir klimato

kaitos poveikis. Jos tiriamos analizuojant pagrindinius ekonominius ir klimato rodiklius, palyginti su ES vidurkiu iki 2019 m. Klimato poveikis vertinamas pasitelkus šiltnamio efektą sukeliančių išmetamųjų teršalų pokyčių, palyginti su baziniais 1990 m., rodiklius. Ekonominė nauda tiriama atsižvelgiant į pagrindinių bioekonominių pramonės šakų indėlį į pridėtinę vertę ir užimtumą. Analizė papildyta Bulgarijoje atlikto tyrimo, kuriame dalyvavo 80 ūkininkų, rezultatais, siekiant nustatyti jų žinių lygį ir taikomus bioekonomikos metodus. Saugumo aspektas vertinamas atsižvelgiant į pavojingų įvykių poveikį kai kurių bioekonominių pramonės šakų ekonominiams rezultatams. Bulgarijos bioekonominės pramonės šakos pažeidžiamos klimato kaitos, kad jos galėtų prisitaikyti, būtinos investicijos.

Bulgarijos bioekonomikos pagrindas – žemės ūkis ir maisto perdirbimas, tačiau pridėtinė vertė nedidelė, esant didžiuliam darbuotojų užimtumui. Tai atskleidžia gana dideles technologinio modernizavimo didinimo galimybes. Bioekonomika siejama su naujausiomis technologijomis ir produkcija, kurių realizavimas daugiausia priklauso nuo rinkos, finansinių paskatų prieinamumo, dotacijų. Žemės ūkio bendrovės nepajėgios pačios pirkti modernias technologijas, tad būtina vyriausybės parama.

PAGRINDINIAI ŽODŽIAI: *bioekonomika, ekologiška plėtra, klimato kaita.*

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