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## **AN ASSESSMENT OF THE POTENTIAL OF PROCESSED AGRICULTURAL PRODUCTS IN POLAND COMPARED TO BIOEAST COUNTRIES**

Key words: bioeconomy, agriculture, bio-based product, BIOEAST, PRODCOM

**ABSTRACT.** In the face of many global challenges, including ongoing climate change, policymakers are seeking viable solutions. The bioeconomy and its development are one of them. Partnerships, such as BIOEAST, are established to support the development of the bioeconomy in CEE countries. The conversion of biological biomass into new bio-products with high added value can contribute to a reduced environmental impact. One of the three economic sectors producing biomass for manufacturing is agriculture. Within the framework of this study, using the PRODCOM statistical list, which provides statistics on the production value of manufactured products, an assessment of manufacturing involving biomass processing utilizing biomass from the agricultural sector in countries of the BIOEAST initiative was performed. In BIOEAST Initiative countries, biomass from agriculture is predominantly used by the food production sector, followed by economic sectors, such as beverages, textiles, leather and wearing apparel. In several BIOEAST initiative countries, the percentage of the production value utilizing biomass from the agricultural sector is remarkable. Poland is one of those countries for which the value of manufacturing production utilizing agricultural biomass represents almost 30% of the total manufacturing value. The results obtained from the analysis, along with detailed information on specific product groups, can provide valuable information for decision makers planning the development of the bioeconomy in reviewed BIOEAST countries, including Poland.

## **INTRODUCTION**

At a time when economic growth and development at all costs is not the most important, and the negative effects of climate change are increasing year by year, solutions are being sought to enable sustainable development, along with reducing its impact on the environment. Within European Union country members, the term “bioeconomy” is well

known. According to strategies, it is defined as “the production of renewable biological resources and the conversion of these resources and waste streams into value-added products, such as food, feed, bio-based products as well as bio-energy” [EC 2012, 2018]. There are many scientific publications and studies that describe particular aspects of the bioeconomy and explain the meaning of this term [Bugge et al. 2016]. One of them is the sectoral analysis of the economy, with the inclusion of bioproducts and bio-based share [Ronzon et al. 2017]. The European Union’s research and development facilities, the Joint Research Centre in Sevilla, together with other research facilities located in Western Europe, monitor and conduct research on the growth and employment potential in bioeconomy sectors and the analysis of socio-economic indicators for monitoring the bioeconomy [Robert et al. 2020, Ronzon et al. 2020, Ronzon, M’Barek 2018]. It is observed that there is a difference between the productivity of bioeconomy sectors and their diversification, between CEE and Western European countries [Ronzon et al. 2020]. As a result, initiatives and partnerships are being established to reduce disparities in bioeconomy development between European Union member states. One of these partnerships is the BIOEAST initiative, which aims to help Central and Eastern European countries develop the bioeconomy by increasing its importance, adding value and creating new employment opportunities [BIOEAST 2018]. At the same time, given the diversity of bioeconomy and sectors in EU Member States, discussions are ongoing on how to determine the bioeconomy’s contribution to the sustainability of the circular economy [Kuosmanen et al. 2020]. One of the indicators analyzed in the sectoral assessment of the bioeconomy is production, including its value and sustainability [Kardung et al. 2021]. One of the key bioeconomy sectors providing biomass for manufacturing sectors is agriculture. The agricultural production sector is linked to many manufacturing sectors and creates opportunities for the further use of biomass in the creation of bioproducts. Increased knowledge of bioproducts and their use can contribute to the greater use of renewable resources to provide sufficient food, fuel and materials for the earth’s constantly growing population [EC 2017].

## MATERIAL AND METHODS

The aim of the study is (1) to determine the existence of product groups utilizing agricultural biomass in manufacturing and (2) to assess the potential of these product groups in manufacturing in Poland against BIOEAST initiative countries. For this purpose, the Prodcom list was used, which provides statistical data on manufactured goods in the territory of countries reporting such data, including those belonging to the European Union [EUROSTAT 2020]. In this analysis, all industrial processing sectors for BIOEAST countries were considered according to the Statistical Classification of

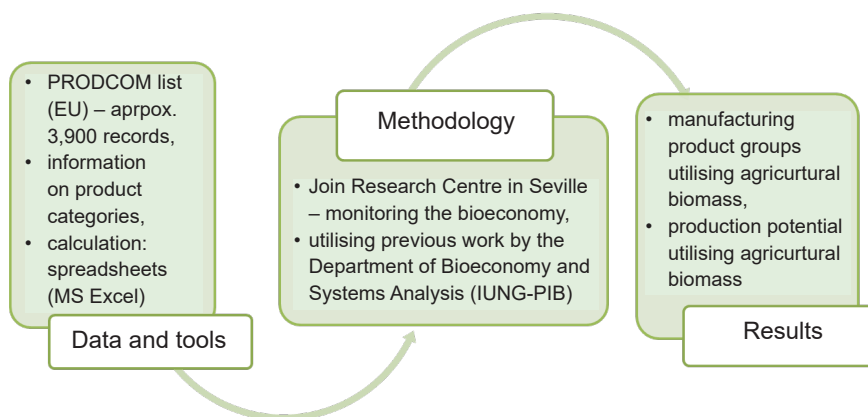


Figure 1. A diagram presenting the data and tools used, the method and type of results obtained

Source: own study

Economic Activity in the European Union (NACE 2). The use of PRODCOM statistics enables a comparable assessment to determine whether products, or intermediate products, from the agricultural sector are used in a particular manufacturing sector and what the percentage of such production is among the group of countries analyzed. The data used for this study contains information on approximately 3,900 diverse types of manufactured products within 24 manufacturing sectors. The study analyzed the existence and value of sold production utilizing agricultural biomass for 11 BIOEAST countries: Bulgaria, the Czech Republic, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia. The PRODCOM list has been used in many studies and analyses to estimate and monitor the bioeconomy by sector [Ronzon et al. 2017, Ronzon, M'Barek 2018, Loizou et al. 2019, Jurga et al. 2021].

At the outset, it was determined whether the product group of a given processing sector contained products which utilized agricultural biomass in the manufacturing process.

Then, applying formula 1, the percentage value of production was calculated for: (1) products, in relation to a group of products in a given processing sector (e.g. PKD 20.15 “animal or plant fertilizers” within the “manufacture of fertilizers and nitrogen compounds”); (2) groups of products in relation to a given manufacturing sector (e.g. group “manufacture of fertilizers and nitrogen compounds” within the sector “manufacture of chemicals and chemical products”); (3) processing sectors in relation to all manufacturing in the investigated BIOEAST country (e.g. sector 20 “manufacturing chemicals and chemical products” within section C “Manufacturing”).

Formula 1 shows the percentage of production, using agricultural biomass, for a group of products or the whole processing sector (based on the modified formula of Tévécia Ronzon et al. [2017]):

$$BBS_{i,k,2020} = \frac{\sum_{j=1}^n bbs_j \times \text{production value}_{j,k,2020}}{\sum_{j=1}^n \text{production value}_{j,k,2020}} \quad (1)$$

where:

- $BBS_{i,k,2020}$  is the agriculture bio-based share of sector  $i$  (NACE Rev. 2), in BIOEAST initiative Member State  $k$  in 2020 (or the agriculture bio-based share of a sector group of products within the sector – one level below);
- $bbs_j$  is the agriculture bio-based share of product  $j$ , given that sector  $i$  manufactures  $j = n$  products (or the agriculture bio-based share of product  $j$  within the group of products, given that the group of products  $i$  manufactures  $j = n$  products – one level below).

Agriculture Bio-based shares vary from 0, for products that do not embed biomass (e.g., Prodcom code 20.15.32.00, ammonium sulphate), to 1, for those that are made entirely of biomass (e.g. Prodcom code 10.11.14.00, Fresh or chilled carcasses, half-carcasses and quarters with bone in, of beef and veal).

## RESULTS

### PERCENTAGE SHARE OF THE PRODUCTION VALUE OF PRODUCTS UTILISING BIOMASS FROM THE AGRICULTURAL SECTOR BY SELECTED ECONOMIC SECTORS OF BIOEAST COUNTRIES

Of all the manufacturing sectors, nine were identified to utilize agricultural biomass in their production processes. These sectors are the manufacture of: food products, beverages, tobacco products, textiles, wearing apparel, leather and related products, wood and of products of wood and cork, chemicals and chemical products and pharmaceuticals (Table 1). In all BIOEAST countries, the highest percentage of production utilizing intermediate products from the agricultural sector, as expected, is linked to the food production sector (between 63-91%). Thereafter, the highest percentages of production value are associated with sectors such as beverages, textiles and wearing apparel. Apart from these, the only exceptions are Hungary and Slovakia, where the leather sector, in percentage shares, is one of the three most productive sectors utilizing agricultural products. The manufacturing of wood and wood products and cork is mainly linked to another primary sector, forestry. Sectors, such as the production of chemicals or pharmaceuticals, are based, to a limited extent, on natural intermediate products, including those from agriculture. The results

Table 1. The percentage of the manufacturing production value containing intermediate products from the agricultural sector

| No. | Manufacture of:   | Bulgaria | Czech Rep. | Estonia | Croatia | Latvia | Lithuania | Hungary | Poland | Romania | Slovenia | Slovakia |
|-----|---|----------|------------|---------|---------|--------|-----------|---------|--------|---------|----------|----------|
|     |   | 79.22    | 79.66      | 77.77   | 77.03   | 85.65  | 79.25     | 84.80   | 86.34  | 62.96   | 90.98    | 73.84    |
| 10  | food products   | 5.99     | 11.36      | 6.20    | 8.30    | 4.34   | 7.29      | 7.42    | 5.49   | 10.65   | 4.43     | 9.93     |
| 11  | beverages   | 0.14     | 0.00       | 0.00    | 0.88    | 0.00   | 0.00      | 0.00    | 2.85   | 3.93    | 0.00     | 0.00     |
| 12  | tobacco products  | 4.42     | 6.78       | 8.99    | 2.41    | 1.53   | 6.72      | 1.64    | 3.15   | 4.99    | 2.99     | 3.82     |
| 13  | textiles  | 9.80     | 1.29       | 6.22    | 6.50    | 8.43   | 6.33      | 1.93    | 1.54   | 12.23   | 1.42     | 2.31     |
| 14  | wearing apparel   | 0.38     | 0.36       | 0.80    | 4.88    | 0.06   | 0.23      | 3.70    | 0.54   | 5.22    | 0.17     | 10.11    |
| 15  | leather and related products  | 0.00     | 0.00       | 0.02    | 0.00    | 0.00   | 0.01      | 0.00    | 0.05   | 0.00    | 0.00     | 0.00     |
| 16  | wood and of products of wood and cork   | 0.02     | 0.55       | 0.00    | 0.00    | 0.00   | 0.12      | 0.00    | 0.27   | 0.04    | 0.00     | 0.00     |
| 20  | chemicals and chemical products   | 0.04     | 0.25       | 0.00    | 0.00    | 0.00   | 0.00      | 0.51    | 0.01   | 0.00    | 0.00     | 0.00     |
| 21  | pharmaceuticals   |          |            |         |         |        |           |         |        |         |          |          |
|     | The percentage of the manufacturing production value containing intermediate products from the agriculture sector | 36.34    | 12.13      | 18.88   | 34.02   | 28.81  | 27.13     | 14.04   | 27.70  | 26.97   | 17.01    | 7.83     |

Sectors with the highest percentage of the manufacturing production value containing intermediate products from the agricultural sector: 1 (highest value – grey color), 2 (orange), 3 (blue)

Source: own study

obtained are comparable to those of other conducted studies [Loizou et al. 2019, Jurga et al. 2021]. In Poland, the highest percentage of the production value related to the agriculture sector was observed in the food sector (86.34%), followed by beverages (5.49%), textiles (3.15%), tobacco (2.85%) and the wearing apparel (1.54%) manufacturing sector. The percentage of the value of manufacturing production containing intermediate products from the agricultural sector is the highest for countries, such as Bulgaria (36.34%), Croatia (34.02%), Latvia (28.81%), Poland (27.70%) and Lithuania (27.13%). The lowest percentage of manufacturing production values containing intermediate products from the agricultural sector was observed for the following countries: Slovakia (7.83%), the Czech Republic (12.13%), Hungary (14.04%), Slovenia (17.01%) and Estonia (18.88%).

#### THE PRODUCTION OF FERTILIZERS AND NITROGEN COMPOUNDS FOR POLAND AS AN EXAMPLE OF A GROUP OF PRODUCTS (PKD 20.15) WITHIN THE SECTOR OF “THE MANUFACTURE OF CHEMICALS AND CHEMICAL PRODUCTS – THE MANUFACTURE OF FERTILISERS AND NITROGEN COMPOUNDS”

Economic activities in the Prodcom classification are linked with The Statistical Classification of Economic Activities (NACE). This study also identifies the percentage of products using intermediates from the agricultural sector for sub-groups within each sector. As an illustrative example, Figure 2 presents the distribution of a product group belonging to the manufacture of fertilizers and nitrogen compounds (20.1.5) for Poland. This subgroup belongs to the manufacture of chemicals and chemical products sector – subgroup: the manufacture of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary form (20.1) as well as subgroups:

- the manufacture of industrial gases (20.1.1),
- the manufacture of dyes and pigments (20.1.2),
- the manufacture of other inorganic basic chemicals (20.1.3),
- the manufacture of other organic basic chemicals (20.1.4),
- the manufacture of plastics in primary forms (20.1.6),
- the manufacture of synthetic rubber in primary forms (20.1.7).

The percentage of the production value of Polish economic activity – the manufacture of fertilizers and nitrogen compounds, which utilize agricultural intermediate products is extremely low and equal to 1.58%. That value determines animal and plant fertilizers. Other products in this group do not utilize intermediate products from the agricultural sector or any other primary bio-based economic sector.

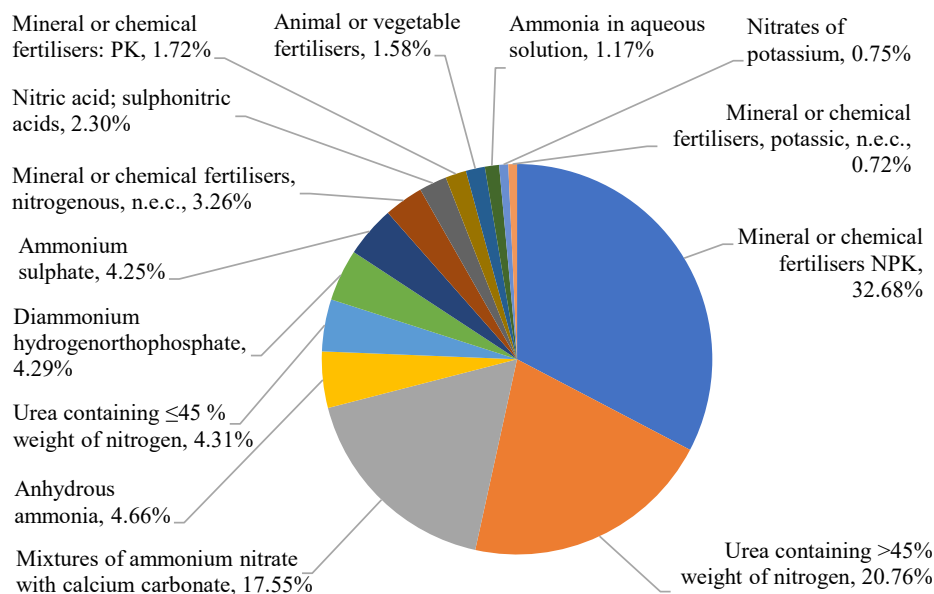


Figure 2. Percentage of production of fertilizers and nitrogen compounds for Poland (PKD 20.15)

Source: own study

## CONCLUSIONS

The countries belonging to the BIOEAST initiative are those located in Central and Eastern Europe. Most of them have no strategy for bioeconomic development and no monitoring system for the bioeconomy, taking bio-based products into account. For many of the countries under analysis, the percentage of the production value using biomass from the agricultural sector is considerable. These countries are: Bulgaria, Croatia, Latvia, Lithuania, Romania and Poland. The product groups utilizing biomass from agriculture have been identified in nine manufacturing sectors. Across the BIOEAST Initiative countries, biomass from agriculture is used most extensively by the food production sector. Thereafter, the highest percentages of the production value are associated with sectors such as beverages, textiles, leather and wearing apparel. Manufacturing sectors, such as chemicals and pharmaceuticals, use limited quantities of biomass from agriculture. The analysis of individual product groups within a specific manufacturing sector enables to determine to what extent the group utilizes biomass from agriculture. In addition, it can be determined in percentage terms whether a product group is relevant to a particular manufacturing sector or the country's bioeconomy or not. Poland, for instance, which is one

of the leaders in the European Union in terms of fertilizer production, only manufactures a limited percentage of natural fertilizers [Piwowar 2021]. The information obtained for this product group, as well as many others, may be useful for policy-making authorities for the development of the bioeconomy [UMWL 2014]. Depending on the relevance and importance of a specific bioeconomic sector or product group, it is possible to design support programs for the creation of innovative solutions and, thus, of new bio-products. An indication for further research and analysis may be an assessment on whether biomass from the agricultural sector (products and intermediate products) is produced in a particular country or not and to what extent this production is sustainable.

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## OCENA POTENCJAŁU PRZETWORZONYCH PRODUKTÓW ROLNYCH W POLSCE NA TLE KRAJÓW NALEŻĄCYCH DO INICJATYWY BIOEAST

Słowa kluczowe: biogospodarka, rolnictwo, bioprodukt, BIOEAST, PRODCOM

### ABSTRAKT

W obliczu wielu globalnych wyzwań, w tym postępujących zmian klimatycznych i ich skutków, decydenci poszukują możliwych rozwiązań, w celu ich zapobiegania i łagodzenia. Za jedno z nich uważa się biogospodarkę i jej możliwości rozwoju. Partnerstwa, takie jak BIOEAST, są tworzone w celu wspierania rozwoju biogospodarki w krajach Europy Środkowo-Wschodniej. Przekształcanie biomasy w nowe bioprodukty o wysokiej wartości dodanej, może przyczynić się do ograniczenia wpływu na środowisko. Jednym z trzech sektorów gospodarki, dostarczających biomasę do celów produkcyjnych jest rolnictwo. W artykule dokonano oceny produkcji, obejmującej przetwarzanie z wykorzystaniem biomasy z sektora rolniczego, w krajach inicjatywy BIOEAST. Wykorzystano dane statystyczne PRODCOM, m.in. dotyczące wartości produkcji sektorów przetwórstwa przemysłowego. W tych państwach biomasa z rolnictwa jest wykorzystywana głównie przez sektor produkcji żywności, a następnie przez sektory gospodarki, takie jak produkcja napojów, tekstyliów, skór i odzieży. W kilku krajach grupy BIOEAST odsetek wartości produkcji wykorzystującej biomasę z sektora rolnego jest znaczący. Polska jest jednym z tych krajów, dla których wartość produkcji przemysłowej wykorzystującej biomasę rolniczą stanowi prawie 30% całkowitej wartości produkcji. Wyniki uzyskane z przeprowadzonej analizy, wraz ze szczegółowymi informacjami na temat poszczególnych grup produktów, mogą stanowić cenną informację dla decydentów planujących rozwój biogospodarki w analizowanych krajach BIOEAST, w tym w Polsce.

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