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THE IMPACT OF THE EUROPEAN GREEN DEAL STRATEGY ON SECURITY IN THE SUPPLY OF NATIVE PLANT PROTEIN FOR ANIMAL FEED IN POLAND

Key words: plant protein, native production, food security, cost of mineral fertilization, European Green Deal

ABSTRACT. This article aims to indicate the potential impact of the European Green Deal strategy's solutions on the production of native protein crops for animal feed and its role in achieving sovereignty in the supply of this raw material in Poland. Self-sufficiency in the supply of plant protein is a concern that has been recognized and widely discussed in the national and European scientific community among practitioners involved in the production of livestock feed and, above all, among politicians of the European Commission, which decides the final shape of the EU Common Agricultural Policy. The strategy adopted by the European Commission, referred to as the European Green Deal, proposes restrictions on the use of plant protection products and mineral fertilizers. This will not take place without having an impact on production and the economic situation in agriculture. The research was conducted based on Statistics Poland data and the results of scientific studies. It was concluded that the implementation of the proposed strategy could be a factor that activates the production of native leguminous plants due to their nitrogen-fixing properties. Consequently, this may contribute to an increase in the production of native plant protein for animal feed, and thus to a greater sovereignty in the supply of this raw material for feed purposes.

INTRODUCTION

The COVID-19 pandemic revealed weaknesses in the provision of basic medical supplies and components in many countries, including Poland. It is widely recognized that the main explanation was the relocation of their production, for economic reasons, mostly to Asian countries. In light of this situation, analogies come to mind in relation to the sphere of production concerning the supply of plant protein for animal feed that is crucial for maintaining domestic food security. The dependence of Poland, and many

EU countries, on imports of this raw material from the American continent may be very dangerous in the event of a natural disaster or global financial crisis in America. This is because such situations can significantly reduce the availability of plant protein for animal feed, which directly affects the amount of domestic meat production. Consequently, food security is compromised when „all people, at all times, have physical and economic access to food that meets their dietary needs for an active and healthy life" [FAO 1996, Pieters et al. 2012]. This definition features the considerable complexity of the issues involved; however, the basic ones include three conditions [Michalczyk 2019, p. 18]:

– physical availability of food, which means the guarantee that the national economy will meet at least the minimum physiological needs of its population. In this case, imports provide food above that minimum demand;
– economic availability of food means that food is attainable for even the most economically vulnerable households, including access to food aid programs;
– suitability of food, which means that food is suitable for consumption in terms of health (absence of contaminants) and diet (necessary calorific value and appropriate nutritional value) [Małysz 2008].

The general nature of the definition of food security also makes the methods of measuring this phenomenon ambiguous, which raises problems in terms of its assessment [Coates 2013]. In Poland, it can be assumed that economic food security is currently ensured. However, due to the economy's dependence on plant protein imports, the condition of physical food security is not met. When considering this problem in general from the country's perspective, it is governance that provides the policy framework for this phenomenon. This is because the existing political conditions in Poland and worldwide, as well as the related possibility of creating both law that regulates the phenomenon of food security and mechanisms of food market functioning, directly influence the level of „food sovereignty of states" [Leśkiewicz 2012].

A key element of this sovereignty is self-sufficiency in plant protein supply. This problem has been recognized and widely discussed in the national and European scientific community, both among practitioners involved in the production of livestock feed and, above all, among politicians of the European Commission, which decides the final shape of the EU Common Agricultural Policy. The 2023-2027 CAP reform targets farm profitability and income, as well as a more effective implementation of policies concerning the environment, climate and sustainable rural development. Nine specific objectives have also been proposed. The first objective concerns „supporting viable farm income and resilience across the Union to enhance food security". The specific objectives also included, among others, issues concerning „fostering sustainable development and the efficient management of natural resources such as water, soil and air" as well as „contributing to the protection of biodiversity, enhancing ecosystem services and preserving habitats and

landscapes" [MRiRW 2020]. To achieve these objectives, the European Commission has adopted a strategy known as the European Green Deal and strategies such as Farm to Fork and Biodiversity, in which it committed that by mid-century the European Union will become a zero-carbon economy. The aim of the Farm to Fork is to create a fair, healthy and environmental-friendly food system. Food produced in Europe should be safe, nutritious and of high quality, and the way it is produced should be environmentally safe and climate neutral [Wrzaszcz, Prandecki 2020, Parlińska et al. 2020]. The European Green Deal aims at transforming the European Union's economy into a modern, climate neutral, sustainable and competitive one. This strategy is not only concerned with the transformation of energy, industry or transport, but focuses on the more efficient use of resources and environmental protection in all sectors of the economy, including agriculture. The Farm to Fork strategy assumes that 25% of agricultural land will be managed under organic farming by 2030. The use of mineral fertilizers will be reduced by 20%, the use of pesticides by 50%, and the sale of antibiotics used in animal husbandry by 50%. These strategies propose specific objectives, however, they are not yet binding and do not impose any obligations on countries, individual industries or farms. Turning these declarations into reality can only take place in the Common Agricultural Policy (CAP), the new version of which will be in force from 2023 [Jakubowska-Lorentz 2020]. However, the implementation of the proposed principles of this new strategy into agricultural practice will have a significant impact on both crop yield and farm profitability.

Therefore, this article aims to indicate the potential impact of the European Green Deal strategy's solutions on the development of native protein crop production and the role in both balancing plant protein for animal feed and achieving sovereignty in the supply of this raw material in Poland.

The research was conducted based on Statistics Poland data and the results of scientific studies. It was preceded by a thorough literature study. The collected data were compiled using descriptive and comparative analyses. An evaluation of the economic benefits of the domestic cultivation of leguminous plants was also prepared. The comparative analysis was used for determining the price of nitrogen. This study solely focused on the economic benefits of obtained plant protein and soil nitrogen in its pure form, ensuring reduced mineral fertilization of succeeding crops. The effect of reducing the use of chemicals to control diseases and pests, which will certainly also reduce crop yield and agricultural income, was not included in this study. The research results presented in the article concern the issue of the influence of the principles of the "European Green Deal" on the country's self-sufficiency in the supply of vegetable protein, which has not yet been discussed in the literature. This issue is part of an ongoing discussion on the effects of introducing these principles for domestic agriculture. This article is, therefore, a voice in this important discussion

THE USE OF HIGH PROTEIN RAW MATERIALS OF PLANT ORIGIN IN POLAND

In recent years, the increase in demand for plant protein raw materials in Poland has mainly been caused by the needs of pig production and increased poultry production. The annual demand for plant protein for animal feed is on a slight upward trend and was approximately 1 million tons in 2007 [Święcicki et al. 2007] and approximately 1.1 million tons in 2020 [Doroszewski 2020]. However, the plant protein deficit, oscillating around 69-70% of overall demand, is eliminated by imported and genetically modified soyabean meal (59.1%) and sunflower meal (10%) (see Figure 1). The overall deficit of plant protein for animal feed is 2,759 tons. The research of the Ministry of Agriculture's Multi-Annual Program has shown that with the present possibilities of production of native protein crops, the best chance of a rapid reduction of the existing plant protein deficit to a level of at least 50% of demand is the development of native leguminous plant production. This will also result in achieving minimum domestic protein security (for more details see [Jerzak et al. 2020a, 2020b]).

High hopes are also placed on the cultivation of native soybeans, however, at present this is still a very small-scale production and of little economic importance. However, the cultivation of native leguminous plants (*Fabiacae* Lindl) belonging to the Dicots class, the *Rosaceae* subclass and the *Fabaceae* order is immediately available. These

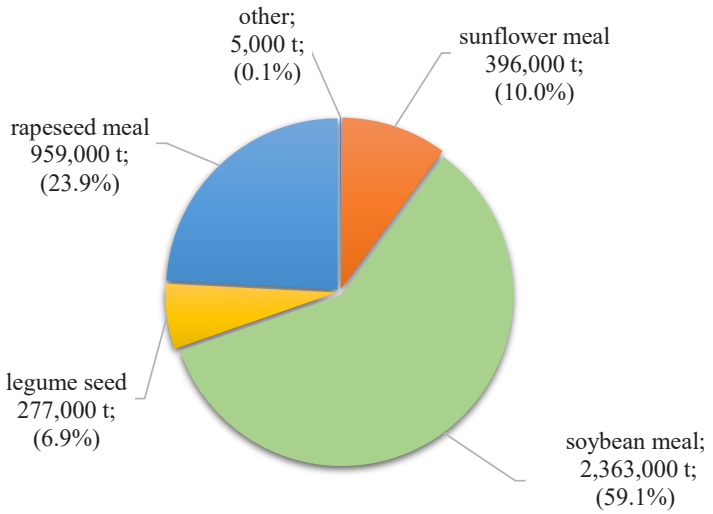

Figure 1. Plant protein sources in domestic feed production

Source: own study based on Statistics Poland data and IERiGŻ-PIB (National Research Institute of Agricultural and Food Economics) [GUS 2019, Dzwonkowski 2020]

plants have high protein content rich in essential amino acids in seeds and vegetative organs, and thus they are used as food for humans and feed for livestock. The average protein content in leguminous seeds can be 24-44 g/kg and the green fodder of these plants can contain 15-20 g/kg of protein [Podleśna 2018]. Climatic conditions provide the cultivation of these plants throughout Poland. These plants are grown for seeds that are used for industrial (oil production), consumption and fodder purposes, as well as serving as raw material to produce concentrated feed. Moreover, the biological value of the protein content of leguminous plants is higher than that of cereals. These plants can also be used for high protein concentrate feed [Jasińska, Kotecki 2003]. At present, the production of leguminous seeds in Poland is 277 thousand tons, which is only 6.9% of national demand. The current economic importance of leguminous plants is primarily limited to direct consumption and the food industry. The small use of this raw material for feed production is due to strong competition in the market of imported soybean meal as an alternative protein for animal feed.

THE IMPACT OF RESTRICTIONS CONCERNING MINERAL FERTILISATION, RESULTING FROM THE FARM TO FORK STRATEGY, ON DOMESTIC SECURITY IN TERMS OF NATIVE PLANT PROTEIN SUPPLY

Arable soils often lack adequate nitrogen, which may result in reducing crop yield and lowering production profitability. Therefore, farms use mineral fertilizers containing nitrogen, which become its main source for most crops. Mineral fertilizers cover 60-70% of a plant's demand for nitrogen; the remaining part is taken by plants from natural fertilizers, organic soil reserves and atmospheric precipitation [Podleśna 2018]. In Poland, the average consumption of NPK fertilizers in 2016/2019 was 2,010.6 thousand tons in terms of pure form (Table 1).

The share of nitrogen fertilizers is 55.1%, potassium fertilizers is 27.1% and phosphorus fertilizers – 16.9%. In 2019, farmers in Poland used a total of 129.7 kg/ha of NPK fertilizers in terms of pure form (Table 1). However, as emphasized in the literature, there is a great differentiation in terms of the level of mineral fertilizer consumption between voivodships [Matyka 2018, Zalewski, Piwowar 2018]. In 2018/2019, the highest mineral fertilizer consumption was observed in the Opole Voivodship (189 kg/ha of NPK fertilizers in terms of pure form), while the lowest mineral fertilizer consumption was reported in the Subcarpathia Voivodship (only 84.5 kg/ha). It is assumed that, after the implementation of the Farm to Fork strategy, the consumption of mineral fertilizers will decrease by 20%, i.e., by 402.2 thousand tons, and will constitute approximately 1,608.4 thousand tons. According to Mariusz Matyka [2021], this may result in yield stagnation at existing levels.

Table 1. National consumption of mineral fertilizers (NPK in terms of pure form) – current status and status after implemented restrictions resulting from the European Green Deal strategy

Fertilizer	2016-2017		2017-2018		2018-2019		Average consumption 2016-2019		Consumption after implemented restrictions (20%)	
	thou. tons	kg/ha	thou. tons	kg/ha	thou. tons	kg/ha	thou. tons	kg/ha	thou. tons	kg/ha
Total including:	2,049.8	130.3	2,076.6	141.6	1,905.4	129.7	2,010.6	133.8	1,608.4	107.0
– nitrogen	1,150.6	71.7	1,178.8	80.4	994.1	67.7	1,107.8	73.2	886.2	58.5
– phosphorus	343.4	22.4	338.7	23.1	343.5	23.4	341.8	22.9	273.4	18.3
– potassium	555.8	36.2	559.1	38.1	567.8	38.7	560.7	37.6	448.5	30.0

Source: own elaboration based on Statistics Poland data

However, for a scenario that assumes a continuation of the current upward trend in mineral fertilization, yield can be lower by 18% for the sugar beet crop and by 10% for oats. A wider use of large-seeded leguminous plants is an alternative for a simultaneous increase in the production of native plant protein and can partially compensate for the effects of reduced mineral fertilization. Increased production of these plants will, on the one hand, increase domestic protein security and, on the other hand, reduce the decline in yields of succeeding crops, and thus in farm income. These plants are of great importance for the feed industry and play a significant role in organic farming. When grown for seeds, these plants contribute to nitrogen fixation through symbiotic bacteria that exist in nodules on their root systems and produce nitrogen compounds. Nitrogen is the main component of protein and an essential component for plant growth, hence the inclusion of leguminous plants in crop rotation results in a lower demand for mineral and organic nitrogen compounds that account for 24% of total direct greenhouse gas emissions of EU agriculture [Domínguez et al. 2016]. According to Jerzy Księżak [2015], the cultivation of leguminous plants is also beneficial for improving agrotechnical conditions, which is expressed by:

1. Achieving a positive balance of soil organic matter with an appropriate crop rotation system. After-cultivated and ploughed (green matter) leguminous plants contribute approximately 6 tons of dry matter to the soil, which is equal to a dose of manure and mineral fertilization of 150 kg N/ha.

2. Leguminous plants are an excellent forecrop for cereals, industrial crops and root crops. The yield of cereals grown after leguminous plants, compared to the yield after oats, increases from 50 kg to 1.5 tons per hectare. The profitability index of cultivation of winter wheat sown after peas was 40% higher than in monoculture and 28% higher than in crop rotation without peas.
3. Leguminous plants leave 40-95 kg of nitrogen per hectare in post-harvest residue, as well as approximately 40 kg of phosphorus and 45 kg of potassium.

Depending on the species, post-harvest residues of leguminous plants can reduce the cost of nitrogen fertilization of succeeding crops from PLN 52.4 per ha for pea to PLN 124.4 per ha for lupin. When analyzing the effects of restrictions on the use of mineral nitrogen fertilizers in Poland, a calculation of the economic benefits of cultivating leguminous plants was performed for plant protein production and the amount of soil nitrogen. The average nitrogen content in the post-harvest residue of field beans, peas and lupins was considered in the calculation shown in Table 3, based on Table 2. The price of nitrogen was determined by comparative analysis, using the market price of ammonium nitrate in 2021 – PLN 1,300 per ton. Nitrogen content in ammonium nitrate was assumed at a level of 34.4% (344 kg per 1 ton). On this basis, the value of nitrogen contained in 1 ton of ammonium nitrate fertilizer was calculated (34% × PLN 1,300 per ton /100 = PLN 447.2).

Table 2. Nitrogen content in post-harvest residues of leguminous plants

Species	Nitrogen content	
	kg/ha	PLN/ha
Field bean	60-80	78.6-104.8
Pea	40-60	52.4-78.6
Lupin	65-95	85.1-124.4

Source: own study based on [Baranowska et al. 2016]

Table 3. Economic benefits of cultivating leguminous plants in Poland

Agricultural area [ha]	Nitrogen in post-harvest residues		Seed protein production		Total benefits
	total tons	PLN value	total tons	PLN value	
250,000	16,875	22,106,250	143,750	158,125,000	180,231,250
500,000	33,750	44,212,500	487,500	536,250,000	540,462,500
750,000	50,625	66,318,750	731,250	804,375,000	870,693,750

Source: own elaboration based on Statistics Poland data and [Baranowska et al. 2016]

To calculate the price of 1 kg of nitrogen, the amount of PLN 447.2 was divided by the amount of nitrogen contained in 1 ton of fertilizer, that is 340.4 kg. In this way, the price of 1 kg of nitrogen was obtained at PLN 1.31. For further calculations shown in Table 3, the price of 1 ton of nitrogen was assumed to be PLN 1,310. To calculate the value of used protein of leguminous plants, it was assumed that the average protein content in these plants is 32% and the average yield is 3 t/ha. The value of plant protein was calculated based on the average price of lupin, pea and field bean in 2020 and a price of PLN 1,100 per ton was assumed.

The obtained results indicate that with the current sown area in Poland (250,000 ha), leguminous plants can reduce mineral fertilization with nitrogen in its pure form for areas for succeeding crops by approximately 16,875 tons. It represents total savings at a level of PLN 22,106,250 (Table 3). The increased size of sown area to 500,000 ha, i.e., the size which guarantees domestic security in terms of the supply of plant protein, can reduce mineral fertilization with nitrogen in its pure form by 33,750 tons, which is PLN 44,212,500 (Table 3).

CONCLUSIONS

1. The implementation of the „European Green Deal" strategy and the „Farm to Fork" strategy is associated with limitations in agricultural production technologies, which may consequently affect its profitability. On the other hand, these strategies may constitute a factor that activates the production of native leguminous plants as they can partially compensate for restrictions on mineral fertilization thanks to nitrogen found in leguminous plants.
2. The potential increase in the production volume of leguminous plants, triggered by restrictions on fertilizers, will contribute to an increased production of seeds of this plant and, to a large extent, balance the demand for plant protein for animal feed with native raw material.
3. The increase in production and use of native leguminous plants for feed purposes will ensure a reduction of imports of genetically modified soybean meal for feed purposes. This will increase domestic security in terms of the supply of plant protein for animal feed, and consequently, the country's food security.

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WPŁYW STRATEGII „EUROPEJSKI ZIELONY ŁAD" NA BEZPIECZEŃSTWO W ZAKRESIE DOSTAW RODZIMEGO PASZOWEGO BIAŁKA ROŚLINNEGO W POLSCE

Słowa kluczowe: białko roślinne, rodzima produkcja, bezpieczeństwo żywnościowe, koszty nawożenia mineralnego, „Europejski zielony ład"

ABSTRAKT

Celem artykułu jest wskazanie potencjalnego wpływu rozwiązań strategii „Europejskiego zielonego ładu" na produkcję rodzimych paszowych roślin białkowych, a także przedstawienie jej roli w osiągnięciu suwerenności w zakresie dostaw tego surowca w Polsce. Samowystarczalność kraju w zakresie dostaw białka roślinnego jest problemem dostrzeganym i szeroko dyskutowanym w krajowym i europejskim środowisku naukowym, wśród praktyków zajmujących się produkcją pasz dla zwierząt gospodarskich, a przede wszystkim wśród polityków Komisji Europejskiej, która ostatecznie decyduje o kształcie Wspólnej Polityki Rolnej UE. W przyjętej przez KE strategii, określanej jako „Europejski zielony ład", proponuje się ograniczenia w stosowaniu środków ochrony roślin i nawozów mineralnych. Nie pozostanie to bez wpływu na sytuację produkcyjną i ekonomiczną w rolnictwie. Badania przeprowadzono na podstawie danych GUS, a także wyników dostępnych opracowań naukowych. Stwierdzono, że wprowadzenie proponowanej strategii może stanowić czynnik aktywizujący produkcję rodzimych roślin bobowatych, ze względu na ich właściwości dotyczące wiązania azotu. W konsekwencji przyczynić się to może do zwiększenia produkcji rodzimego paszowego białka roślinnego, a przez to uzyskania większej suwerenności kraju zakresie dostaw tego surowca na cele paszowe.

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