POLISH AGRICULTURAL SECTOR IN THE CONTEXT OF FARM TO FORK STRATEGY

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Abstract

The article includes the research results in the field of food systems in Poland in the context of the F2F Strategy objectives. The aim of this study is to determine the impact of the objectives of the F2F Strategy on the food systems in Poland. The research method applied in the study is the critical analysis of the source literature, statistical methods and scenario method. Attention was paid to such elements of food systems as yields, soil fertility, biodiversity, water resources and land use. According to the research conducted, an increase in the yields of the main crop plants in Poland (ranging from 30% for potatoes to 66% for cereals) was the result of a growth in the consumption of mineral fertilizers by 51.2% and plant protection products by 266.7%, which, under the F2F Strategy objectives, should be reduced. In Poland, it is necessary to use mineral fertilizers in order to supplement the shortage of phosphorus, potassium and magnesium. The resources of freshwater are at a level of 60.6 billion m^3, which classifies Poland in the group of EU countries mostly exposed to water shortage. One of the main objectives of the F2F Strategy is to achieve at least 25% of the EU's agricultural land under organic farming by 2030. With reference to Poland, this objective is particularly difficult to fulfil, because the share of organic farmland in the area of agricultural land from the record 4.6% in 2013 decreased to 3.5% in 2020.

Key words[3]: F2F strategy, agriculture, yields, biodiversity, land use.

JEL: O13, P28, Q15

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Food price shocks, income inequalities (Obayelu, 2010), and lack of purchasing power have been identified among others, as the critical drivers of food demand influencing food insecurity among households in developing countries, particularly Nigeria (Olagunju et al., 2012). Also, the insecurity situation of the country is a contributory factor to food supply and food demand gap particularly farmers-herders clash, insurgency, and militancy in the northern and south-eastern part of the country. However, less effort has been put to investigating the demand side of food security challenges, especially for the vulnerable groups of population, particularly the rural, subsistence, small-scale, and poor agricultural producers. As Adejobi and Babatunde, (2010) rightly posited, over 70% of farm households in Nigeria are poor, while food demand accounted for 60-80% out of their earnings (Fregene, Bolorunduro, 2009; Obayelu, 2010).

Okoruwa and Adebayo (2006) and Tsegai and Kormawa (2002), examined state, regional and/or zonal households' food demand in Nigeria, finding that there has been a shortfall in the food analysis at the national level. This study is different from Akinleye (2007), by estimating households' food demand based on aggregated food groups. However, many studies (Akinleye, 2007; Abdulai et al., 1999; Blanciforti et al., 1986) used Almost Ideal Demand System (AIDS) model in the food demand analysis. Though Obayelu et al. (2009a) have used Quadratic Almost Ideal Demand System (QUAIDS) to analysed households' food demand based on regional (north central) data obtained from the primary data. Akinbode (2014), was focused on disaggregate food products. The study uses the QUAIDS model to determine food consumption patterns nationally in the Nigerian farm households' context. This study is different from these studies by analysing households' food demand using aggregated national panel data across geopolitical zones in Nigeria.

Given that this study used three waves' panel data of Nigerian General Households' Survey, it is therefore important for robust estimates to explore the panel nature of the data. It could not be explored by the "Poi's QUAIDS" function in Stata. Therefore, this study is based on the fixed effect framework by incorporating a dummy variable to control for seasonal variation in the food consumption expenditure patterns across lean and surplus seasons, and the demographic variables for household-specific effects in the estimated QUAIDS. However, structural changes in consumer preferences over time were reflected by introducing a time dynamics into the model as used by Dybczak et al. (2014). This study therefore examined food demand analysis of farm households with the aimed at revealing zonal differences of food demand in Nigeria.

Introduction

The European Union (EU) put an emphasis on an ambitious development plan for climate and the environment. Its main idea and principles are described in the document: The European Green Deal (European Commission, 2019). The key idea is to transform the most urgent contemporary problems into unique opportunities. An essential part of the "new green deal", besides such areas as climate, energy, circular economy and biodiversity, is agriculture and the perspective of its development. The assumptions within this scope are specified in the Farm to Fork Strategy (F2F Strategy), (European Commission, 2020). It is commonly known that the goals here are as ambitious as in the entire European Green Deal package. The basic ones include: a reduction of plant protection products and veterinary drugs consumption by 50% until 2030, mineral fertilizers consumption at least 20% as well as an increase up to 25% of agricultural land (AL) under organic farming.

Apart from the generally positive response to these plans, doubts remain in two areas at least. Firstly, how will the implementation of the tasks within the F2F Strategy affect the food security in the EU member states and, secondly, how will it affect the other countries and regions of the world? When it comes to the first area, as it is known, the application of agricultural chemistry and veterinary drugs has a direct impact on the specific productivity of plants and animals (it is illustrated by for example the so-called fertilizer curve), and the F2F Strategy assumes, in such reality, yet an increase in the food production. Thus, the question of how this is to be achieved becomes reasonable (Entine, 2020).

According to the approach of the European Commission (EC), the relationship between the food security level and the F2F Strategy is positive. It is to be ensured by the increased coordination of the common agricultural policy (CAP) within the scope of reaction to crises involving food security, development of an emergency plan of food supplies and creation of production potential reserves of the EU agriculture. In the long term, making agriculture sustainable is to lead to its increased resilience (Questions and Answers, 2020). This does not sound credible and rather seems like actions activated in case there occurs a probable disaster regarding the food security level in the EU member states.

As it is known, the EU is a significant importer of agricultural crops. It imports large quantities of soya, corn, meat, etc., from countries and regions where totally different production and environmental rules, as well as production regimes, apply. Usually, they are completely incompatible with the assumptions of the European Green Deal or the F2F Strategy. Therefore, this means consent for double production and environmental regulations and standards. For such reasons an opinion is being formed that the EU proposes rescue of its own environment to the detriment of other regions of the world or even supposition as to the “exportation” of that environmental degradation to other countries, mainly the Global South (Israel, 2020), and in other words, the exportation of environmental external effects. This is a typical Eurocentric point of view. A synthesis of such views is a statement that: *Green Deals is bad deal* (…) *for the planet* (Fuchs et al., 2021).

The F2F Strategy, according to some approaches, is far away from the basic problems of the EU agriculture and food market. It was targeted above all on changes within plant production, whereas the main issue is excessive production and consumption of animal products, especially meat and processed meat. Meanwhile, it is animal production that contributes to the destruction of the environment to the largest extent, being responsible for approximately 15% of the total greenhouse gas (GHG) emissions (Hedberg, 2020). According to extreme opinions, the F2F Strategy is even claimed to be a political utopia (Wirtz, 2020). In this case, a natural question arises about the future of the F2F Strategy, its real impact on the future of agriculture, agribusiness and the environment, as well as possible negative consequences.

Further remarks included herein refer to the conditions in Poland, Polish agriculture and the environment. The aim of this study is to determine the impact of the objectives of the F2F Strategy on the food systems in Poland.

Material and methods

The basic empirical material used in the study is the public statistics data from the Statistics Poland / Central Statistical Office (CSO), as well as international data from the databases of Eurostat and FAOSTAT. The analysis covered such elements of food systems as yields, soil fertility, biodiversity, water resources and land use. The research period accepted in the study encompasses the years 2000-2020, and in certain cases even earlier years.

The research method applied in the study is the critical analysis of the source literature, statistical methods and scenario method.

The context and structure of the research are harmonized with the used data of the Statistics Poland and The Institute of Soil Science and Plant Cultivation (IUNG) and the appropriate scientific literature. The research is based on secondary data.

Scenarios generally concern phenomena, the future course of which cannot be unequivocally predicted. The complexity of the phenomenon and its environment means that it can be predicted in various ways, even when using complex prediction tools (Kahn, 2010).

The literature clearly differentiates between the definition of a qualitative scenario (description of activities, sequence of future events, vision) and a quantitative one (a set of market forecasts, the effect of mathematical modelling), (Johnson et. al, 2005).

Such a qualitative approach to predicting the future shape of Polish agriculture and rural areas is also the main research assumption of this study. It is not about mathematical modelling, for example, of the future structure of farms, but an attempt to create a vision of possible future agricultural models and their regional distribution.

Research and Results

Yields

The level of yielding of crop plants, and, consequently, the amount of production of particular crops, are determined by numerous environmental (quality of soil, precipitation and sun exposure) and technical/technological factors, such as plants' yield potential or the level of chemical agents applied (fertilizers, plant protection products). In industrial, capital-intensive farming, it is the technological factors that are crucial for the level of the yields obtained. Meanwhile, the F2F Strategy involves declarations related to the reduction of using the basic yield factors, i.e., pesticides (by 50%) and fertilizers (by 20%). The fulfilment of these commitments will therefore directly translate into the amount of yields.

In Poland, in the years 2000-2020, the yields of all main crops significantly increased (Table 1.). Those growths ranged from 30% for potatoes, 45-55% for rape, sugar beet, wheat and barley and up to 66% for cereals.

Table 1. Production and yields of main crops in Poland (period 2000-2020.)

Item	Production (in million t)			Yields (per 1 ha/dt)		
	2000	2010	2020	2000	2010	2020
Cereals (total)	22.3	27.2	33.5	25.6	35.8	42.5
Wheat	8.5	9.4	12.0	32.3	44.3	48.6
Rye	4.0	2.8	3.1	18.8	26.9	32.4
Barley	2.8	3.4	3.8	25.4	35.0	39.4
Rape and turnip rape	1.0	2.2	2.7	21.9	23.6	31.7
Potatoes	24.2	8.2	9.0	194.0	219.0	252.4
Sugar beet	13.1	10.0	13.3	394.0	484.0	578.9

Source: Based on data from CSO, 2007; CSO, 2012; Statistics Poland, 2021.

The increases in the yields were related to a considerable increase in the consumption of fertilizers and plant protection products (Table 2.). The use of fertilizers in terms of pure ingredient went up from 85.8 kg to 129.7 kg per 1 ha of AL land, i.e. by 51.2%. The use of plant protection products rose to a yet larger degree, as their sales in the analysed period increased by 210.9% as per the commodity mass and by 174.4% as per the mass of the active substance. The consumption of plant protection products according to the mass of an active substance per 1 ha of arable land and orchards rose from 0.6 kg in 2000 to 2.2 kg in 2019, i.e. by 266.7%. Whereas, the consumption of lime fertilizers went down by 41.2%, which is not a positive phenomenon when taking into consideration the fact that more than 60% of arable soils in Poland are acidic or highly acidic (Tabak, 2019). It is worth adding that the consumption of qualified seed as the effect of biological progress having a direct impact on the level of crop yielding, in the same period increased merely by 0.3% (from 194.3 thousand tonnes in 2000 to 194.8 thousand tonnes in 2019).

Table 2. Consumption of fertilizers in terms of pure ingredient and sales of plant protection products in Poland (period 2000-2019.)

Item	2000[1]	2010[2]	2019[3]	2000 = 100
Consumption of fertilizers (per 1 ha of AL/kg)				
mineral or chemical fertilizers	85.8	119.2	129.7	151.2
lime fertilizers	95.1	39.8	55.9	58.8
Sales of plant protection products (tons)				
commodity mass	22.164	51.613	68.907	310.9
active substance	8.848	19.449	24.281	274.4
active substance (per 1 ha of arable land/kg)	0.6	1.7	2.2	366.7

Source: Based on data from CSO, 2007; Statistics Poland, 2020.

[a] For the consumption of fertilizers: [1] 1999/2000, [2] 2009/10, [3] 2018/19.

The increase in yields in Poland was the result of a significant growth in the consumption of fertilizers and plant protection products, which in accordance with the objectives of the F2F Strategy should be considerably reduced. As, for instance, the research into the relationship between the wheat yielding and the level of nitrogen fertilization shows, the amount of the yield without fertilization was 5.96 t/ha, with a dose of 40 kg/ha – 6.96 t/ha and with a dose of 80 kg/ha – 7.81 t/ha (Chrzanowska Drozdz et al., 2004). Thus, the increase of the dose of the nitrogen fertilizer consumption by 100% was accompanied by the growth of the wheat yield by 31%, not taking into account the variability of weather conditions. In turn, as far as the cultivation of triticale is concerned, the increase in fertilization with nitrogen, phosphorus and potassium by 20% translated into an increase in the yield by 19%

within one year and 25% in the following year (Jaskiewicz, 2015). According to the studies of Jadczyszyn et al. (2010), the increase in fertilization with nitrogen (by 20%), phosphorus (by 25%) and potassium (by 30%) leads to a growth in the wheat yield by 33%[4], and, respectively, the growth of fertilization by 65N/55P/80K[5] – an increase in the rye yield by 50%, increase in fertilization by 25N/10P/15K – an increase in barley yield 15% and a growth of fertilization by 25N/15P/15K – an increase in triticale yield by 15%.

With reference to the studies of Jaskiewicz (2015) and Jadczyszyn et al. (2010)[6], an assumption was accepted that a change of the fertilization level affects the change of a yield solely in 50%, while factors such as temperature, sun exposure, precipitation, crop rotation and adherence to agro-technical terms are responsible for the other 50% of yielding. In these conditions, one may expect that the fulfilment of the F2F Strategy objective will affect the reduction of wheat yield by 15%, rye - by 25%, barley and triticale - by approximately 10%. Referring these figures to the harvest of these crops in 2020 and accepting the same acreage of these crops, the production of the four types of cereals analysed herein will decrease in Poland as follows: wheat – by 1.8 million tonnes, rye - by 0.8 million tonnes and barley - by 0.4 million tonnes. The total drop in cereals production[7] in Poland only on account of a reduction of fertilization by 20% will therefore be approximately 3.5 million tonnes.

The account above does not take into consideration the impact of plant protection products consumption onto the amount and also the quality of the yield of crop plants. The relationship between the consumption of plant protection products and the amount of yield varies according to the type of the crop, varieties of the crop plants applied, weather conditions, crop rotation, etc. As commonly given, the application of plant protection products may prevent the loss of as much as even 70% of the wheat yield attacked by *Apera spica-venti*[8]. According to the study by Podolska and Sulek (2012), the increase in the number of applications of plant protection products

4 Differences in effectiveness of fertilization in the studies quoted derive from the fact that in the first study (Chrzanowska Drozdz et al., 2004) solely the impact of increased doses of nitrogen was analysed, and in the second one – of all the basic ingredients, which means that apart from nitrogen, those were also phosphorus and potassium.

5 N – nitrogen, P – phosphorus (P_2O_5), K – potassium (K_2O).

6 The studies are complex, as they refer to the impact of the changes of the level of fertilization on the yielding of plants with a full set of macro elements (NPK), and not only with N, as in the study by Chrzanowska Drozdz et al. (2004).

7 Not including oat and cereal blends, which in 2020 comprised 17% of cereal production in Poland.

8 www.syngenta.pl/blog/srodki-ochrony-roslin/zaprawy-nasienne/sprawdz-jak-srodki-ochrony-roslin-wplywaja-na-plon, retrieved at: 10th May 2021.

from 3 to 6 (herbicide and fungicide) affects the increase in the yield of winter wheat by 20%. Whereas, according to the study of Jaskiewicz (2018), the application of herbicide to destroy weed led to higher yielding of winter wheat – by 10%, spring wheat – by 13%, spring barley – by 12% and spring triticale – by 9% in relation to yield of crops without the use of the herbicide. Regardless of what level of relationship between the application of plant protection products and yielding is accepted, the fact that such a relationship, and it is a close relationship, exists cannot be omitted. This means a further decline in plant production as a consequence of the fulfilment of this objective of the F2F Strategy. Whereas, a decrease in plant production will be a decrease in animal production, and, as a consequence, deterioration of food security. A factor preventing such a case may be new achievements of biological progress; yet, this is possible solely in the long run.

Soil fertility

Besides the level of the agricultural chemistry consumed and the genetic properties of the seeds of the cultivated plants, the third factor crucial when it comes to the amount of yields is the quality of arable soil. The quality of the soil determines its usefulness for plant cultivation. Limitation of agricultural chemistry consumption foreseen in the F2F Strategy increases the significance of soil quality. In Poland, the soils are not the most fertile ones.

The Polish classification system distinguishes 6 classes of AL: I – best soils, VI – worst soils and 6 classes of grassland: I – best grassland, VI – worst grassland. The best AL (classes I and II) comprises merely 3.3%, whereas the least fertile ones (classes V-VI) as much as 34.1 % (CSO, 2012). Therefore, land of medium quality dominates.

In Poland, there dominate acidic soils (highly acidic, acidic and slightly acidic), which comprise as much as 73% of all AL. Neutral soils comprise 18%, and alkaline soils – 9% (Statistics Poland, 2020). In view of the above, redundant liming refers only to 31% of soils; instead, it is necessary or indicated on the surface of 69% of soils. This is because an incorrect pH causes many negative consequences, such as e.g. deterioration of soil structure, the permeability of soils and, as a result, negative impact on the growth and development of plants, i.e. amount and quality of yield (IUNG, 2017). It should be added here that in the years 2000-2015 the share of highly acidic soils increased from 18.1% to 36.1%. This proves proceeding acidification of the Polish soils. The main cause of this phenomenon is a rapid drop in the consumption of lime fertilizers from 95.1 kg/ha in the years 1999/2000 to 55.9 kg in the years 2018/2019, i.e. by 41.2% (Statistics Poland, 2020).

The F2F Strategy provides for the reduction in the use of fertilizers, however, without reduction of soil nutrients. It is a very important requirement and at the same time one quite difficult to fulfil as far as Poland is concerned, for even nowadays every second hectare (51%) is characterized by a very low, low or medium level of phosphorus content, and 69% of the AL – very low, low or medium level of potassium content. As for magnesium, the percentage of such soils is 56% (Statistics Poland, 2020). This means the necessity of using mineral fertilizers in order to supplement the deficiency of these ingredients. Furthermore, the differences in the content of macro elements in soil are very high (Table 3.).

Table 3. The total content of the main macro elements in arable soils in Poland (period 1995-2015, in %)

Macro elements	Value	1995.	2000.	2005.	2010.	2015.
Nitrogen	minimum maximum	0.02 0.32	0.04 0.91	0.04 0.34	0.04 0.41	0.04 0.36
Phosphorus	minimum maximum	0.011 0.166	0.013 0.570	0.017 0.204	0.022 0.144	0.021 0.135
Potassium	minimum maximum	0.03 1.00	0.02 1.19	0.02 0.98	0.02 0.52	0.00 0.53
Calcium	minimum maximum	0.02 20.8	0.02 25.9	0.02 26.8	0.02 21.29	0.01 21.0
Magnesium	minimum maximum	0.03 1.57	0.02 1.54	0.02 1.56	0.02 0.91	0.01 0.78
Sodium	minimum maximum	0.002 0.111	0.003 0.098	0.001 0.099	0.001 0.023	0.002 0.015
Iron	minimum maximum	0.20 3.78	0.18 3.47	0.18 3.56	0.19 3.13	0.21 3.16
Sulphur	minimum maximum	0.005 0.069	0.005 0.058	0.008 0.079	0.006 0.079	0.008 0.063

Source: Based on data from IUNG, 2017.

The minimum and maximum content of particular elements in the territorial (spatial) arrangement is several hundred-fold, and it even exceeds a thousand-fold. This refers to, for instance, the content of calcium. When it comes to such basic macro elements as nitrogen, the difference between the minimum and maximum level is a 10-fold, for phosphorus 7-fold, and for potassium 25-fold. The highest content of nitrogen in soil can be found in such voivodships of Poland as: Opolskie, Lubelskie Lodzkie and Podlaskie, and lowest one – in the voivodships: Zachodniopomorskie, Pomorskie and Wielkopolskie. As regards the content of phosphorus, the highest level of this macro element can be found in the voivodships: Opolskie, Lubelskie, Pomorskie and Zachodniopomorskie, and definitely the lowest in the Swietokrzyskie voivodship. This is important, as phosphorus is responsible for significant functions in the life processes of plants, including regulation of cell division, root development, as well as it influences the processes of flowering and seed setting (IUNG, 2017).

Potassium also plays a significant role in plant cultivation, above all being responsible for their water management and the photosynthesis process. The highest content of potassium can be found in the soils in voivodships Warminsko - Mazurskie and Opolskie, and the lowest content of this ingredient in such voivodships as: Wielkopolskie, Kujawsko - Pomorskie, Lodzkie, Mazowieckie and Podlaskie (IUNG, 2017).

The content of trace elements in the soil is influenced by both natural and anthropogenic factors. The latter ones include such basic factors as industrial emissions (mining and metallurgical industries) as well as incorrect industrial waste management. Excess of trace elements in the soil is toxic for plants, affecting the quality and amount of yields. At the same time, soil contamination with metals reduces their agricultural usefulness. The situation in Poland in terms of soil contamination with metals varies. For instance, the level of cadmium content is below the standards accepted by law (Journal of Laws of 2016, item 1395), except Slaskie voivodship and to a small extent in a part of Malopolskie voivodship. On the other hand, an increased level of copper content can be found solely in Dolnoslaskie voivodship, in the vicinity of the places where this metal is extracted and processed. Also, there are not found cases of exceedance of the acceptable levels of lead and zinc in soil, except for a small area in Slaskie voivodship. On the area of the entire country there are not found cases of exceedance of the acceptable levels of chrome and nickel contents (IUNG, 2017). Therefore, generally speaking, the soils in Poland are free from metal contamination.

Another phenomenon that affects the level of yields, and which in the event that fertilization and use of plant protection products are reduced will influence the yield significantly, is soil erosion. In the world, according to the estimation by FAO, degradation refers only to 33% of the soil area, and by 2050 it may cover as much as 90% (FAO, 2021). Additionally, environmental and climate changes influence the escalation of erosion risk, which only in Europe may mean an increase in the intensity of this phenomenon by 13.0-22.5% until 2050 (Kawalko Marczuk, 2021).

In Poland also wind and water types of erosion are of key importance. According to the research conducted as early as in mid-‘90s of the 20th century, there is a risk of wind erosion for approximately 28% of the AL in Poland, where 17.3% is slight erosion and 10.3% medium and strong. Whereas water erosion is a risk for above

20% of arable soils, including partially slight erosion and partially medium and strong (Jozefaciuk, Jozefaciuk, 1995; Wawer, Nowocien, 2007).

Thus, in Polish conditions, water erosion has higher importance for the amount of yield, as it occurs in a medium and strong form much more often than wind erosion. As it is known, erosion may lead to yield reduction even by half (FAO, 2021). This means a significant loss in plant production, which, after the implementation of the F2F Strategy, will not be compensated by means of increased application of mineral fertilizers. A positive phenomenon is a relative suppression of the wind and water erosion processes.

Biodiversity

Healthy soils are of key importance not only for food production, but also for biodiversity (FAO, 2020). Biodiversity is of key importance for many fields of human activity. The maintenance of natural assets is a crucial issue for ecological and economic reasons, both at the domestic and international levels. The loss of biodiversity of ecosystems is a threat for the correct functioning of our planet, and as a consequence – for the economy and population (CSO, 2021a).

Establishing areas of special natural value which are protected by law is a form of protection of ecosystems against the effects of uncontrolled anthropo-pression. In Poland, in 2019, such areas comprised 10.1 million ha, i.e. 32.3% of the general area of the country. Per capita, there was 2,633 m^2 of areas protected by law. The largest share in their structure were the protected landscape areas (69.5%) and landscape parks (25.8%), (CSO, 2021a).

According to the data of the World Bank (2021), in 2018, the area of land and marine protected areas in 28 EU member states was 23.4% of the total area of the EU. Poland was among the countries with the highest percentage of protected areas, 38.1%.

Water resources

Water is one of the most important resources on Earth, and it is of crucial importance for all forms of life. Agriculture, industrial infrastructure, urbanization and individual needs of the growing population contribute to the increase in demand for freshwater; thus, it is important to monitor the level of its resources and its quality, as well as effective management.

In Poland, the resources of freshwater are at a level of 60.6 billion m^3. This means that on average 1,600 m^3 of water per annum falls per capita, which classifies Poland in the group of EU countries mostly exposed to water shortage (CSO, 2021a).

The most frequently applied measure to assess the amount of the water resources owned is the water availability index, which defines the average annual outflow of surface water (from the territory of Poland, including inflow from abroad) per capita. In 2019, this index was at a level of 1,100 dm^3, i.e. the lowest in the period from 2000. Surface water is the main source of water provided for the national economy. Its consumption in 2019 (without irrigation in agriculture and forestry) was 7,437.2 hm^3, comprising 80.4% of the total consumption. Surface water obtained from rivers and lakes are used most of all for production purposes, in 2019 in 80.9% (CSO, 2021a).

Groundwater, as water of much better quality, is used mainly to provide the population with drinking water. The reserves of groundwater for the end of 2019 were 18,252.2 hm^3, i.e. more than in 2018 and 2000, respectively by 0.7% and 13.7%. Their consumption was at a level of 1,772.1 hm^3 (19.2% of the total consumption), which means that it did not change in comparison to the previous year, but it rose by 1.4% with respect to 2000 (CSO, 2021a).

In order to depict the country's total demand for water in comparison with the amount of the water resources owned, the Water Exploitation Index (WEI)[9] applied by Eurostat is used. In 2018, for Poland, that index was 17.1%, and as of 2000, the value of 20.2% was achieved in 2006[10].

Land use

One of the main objectives of the F2F Strategy is to achieve at least 25% of AL in the EU for organic crops by 2030. With reference to Poland, this objective is particularly difficult to fulfil, if realistic at all.

The area of AL in Poland declined from 19,102 thousand ha in 1980 to 18,760 thousand ha in 2020, i.e. by 342 thousand ha (by 1.8%). However, at the same time, the area of the land used for agricultural purposes decreased from 18,947 thousand ha to 14,637 thousand ha, which means by 4,310 thousand ha (by 22.7%). If one takes into consideration the fact that the average area of an agricultural holding in 2020 was 11 ha (CSO, 2021b), then during the 40 years analysed, almost 390 thousand holdings 'disappeared' from the Polish agriculture, without transferring their productive potential to other holdings. This is due to the fact that the land is no longer used for agricultural purposes. Therefore, the natural production potential of Polish agriculture decreased.

9 The WEI represents the share of the average annual consumption of freshwater in long-term average amounts of freshwater resources. The value of the WEI exceeding 20% means occurrence of water stress phenomenon, i.e. stress caused by water shortage.

10 https://ec.europa.eu/eurostat/databrowser/view/t2020_rd220/default/table?lang=en, retrieved at: 25th April 2021.

There are a few reasons for this phenomenon. The first one is the marginalization of the significance of agriculture in the period before the EU accession. Lack of perspectives for the development in comparison with the non-agricultural activity led to the resignation from maintaining agricultural holdings and sometimes even abandonment of agricultural holdings and migration to urban centres. It is in that period that the loss of land in agricultural use was the highest. From the general area of the loss of AL in the analysed 40 years, 61% falls for the years 1980-2004, and 39% for the years 2004-2020. After the accession of Poland to the EU, part of the land returned to agricultural use (in the years 2005-2009 – approximately 210 thousand ha of AL), however, for a relatively short period. The land began to 'disappear' from agricultural use as soon as after 2010. The basic reason for that was the resignation from using land in small agricultural holdings, including those which did not qualify for aid from EU funds (the requirement of a minimum area of a holding and a plot entitling for application for direct payments). Another reason was the resignation from maintaining a holding due to its small area, the advanced age of the owners, lack of successors, etc.

For some time, a new phenomenon having an impact on the reduction of land used for agricultural purposes has been noticed, i.e. purchase of plots with an area exceeding 1 ha of AL by people living in cities. Such an area gives the plot a status of an agricultural holding, which helps obtaining e.g. building permits for houses. If in such units any agricultural production is maintained, it is mainly for self-supply, and after some time, it is usually abandoned. A loss of AL for non-agricultural purposes, including urbanization, transport, etc., is also of importance. With the decreased interest of agricultural holdings in maintaining agricultural production, the question remains on how the interest in organic farming is presented.

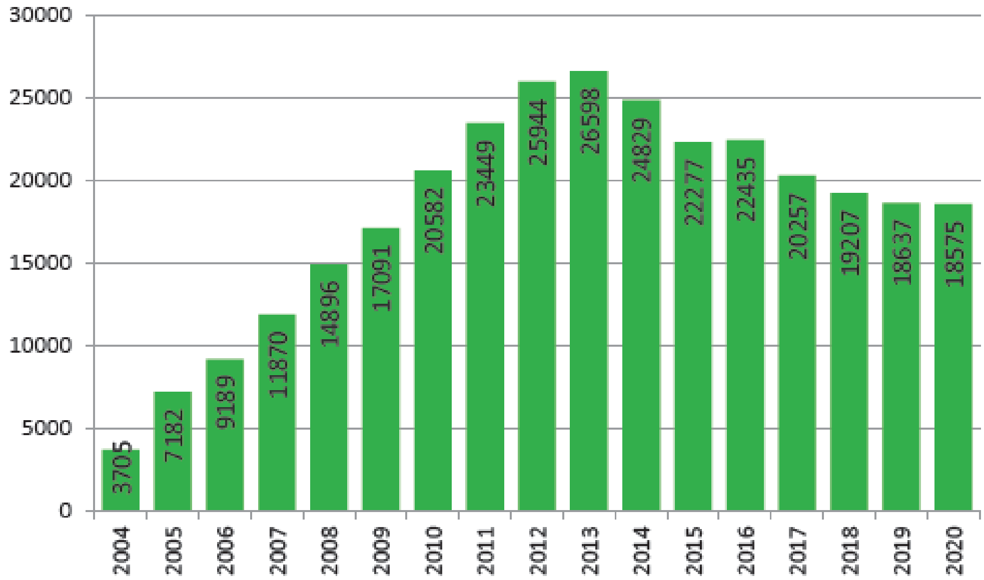
From this perspective, the years 1990-2020 should be divided into three periods:

- 1990-2004 – beginning of interest in organic farming in Poland. In 1990 in Poland there were 27 organic farms, and already in 1999, around 555 farms (GIJHARS, 2007);
- 2005-2013 – rapidly growing interest in organic farming;
- 2014 until today – drop in interest in organic farming.

In 2004 in Poland there were 3705 organic farms (Figure 1.). This number regularly increased until 2013 to reach a level of 26,598 farms (more than a 7-fold increase). Starting from 2014, the number of organic farms in Poland has been regularly declining. At the end of 2020, there were 18,575 such farms, i.e. 30.2% fewer than in 2013. The consequence of the changing number of the farms was the change of the area under organic farming. In 2004 it was 82.3 thousand ha, and in the record 2013, 670 thousand ha. The following years saw a regular drop in the area under organic farming to a level of 484.7 thousand ha in 2018. A slight increase was registered in the years 2019-2020 up to a level of 509.3 thousand ha. In total, in the period 2013-2020, there were lost 160.7 thousand ha of the area of organic farms, i.e. 24%.

The share of organic farmland in the area of AL in Poland from the record 4.6% in 2013 decreased to 3.5% in 2020. In this case, achieving not only the F2F Strategy target level of 25%, but 15% and 10% by 2030 is very little realistic, if possible at all.

Figure 1. Number of organic farmers in Poland (period 2004-2020)



Source: Based on data from GIJHARS, 2021.

Achieving a level of 10% of organic crops in the general area of crops in Poland requires a conversion of an additional area of approximately 950 thousand ha of AL, with the present area of 510 thousand ha. This means that the decision on changing the status of a holding into an organic one, in the period 2023-2030 should be taken by approximately 4,700 farmers per annum (the average area of an organic farm in Poland practically did not change throughout the period of 2004-2020, and it is 25 ha). This is a very risky variant. It is more realistic to achieve a level of 7-8% of organic farmland by 2030. This requires a change of the status of the holdings into organic farms by approximately 2,500-2,700 holdings annually and an additional area of 500-650 thousand ha of AL. However, the implementation of that last variant will depend on several factors, mainly the change of the farmers' opinion about economic/market perspectives of maintaining the farm with organic methods.

Conclusion

The European Union F2F Strategy has set extremely ambitious challenges in terms of climate and environment. To a major degree, they refer to the agriculture and food production systems.

However, the objectives set as regards the reduction of agricultural chemistry application, maintaining biodiversity or greening of food production and consumption, will not remain without economic consequences regarding the costs of manufacturing agricultural raw materials, food products and, as an effect, retail prices of food. Therefore, it is necessary and urgent to perform adequate projections as regards these areas. This is due to the fact that shaping the future cannot strike directly at the existence of contemporary consumers.

The reduction of the use of chemical production agents in the agricultural and food industry is justified and purposeful. Nonetheless, this task cannot overshadow the contemporary challenges, and these include not only the protection of the environment and biodiversity, but also a guarantee of food security and food safety for the consumers of the single market. Nowadays, however, appropriate projections of the possible consequences of the implementation of the F2F Strategy objectives are missing. Yet, the above studies, on the example of Poland, clearly indicate that consistent implementation of the F2F Strategy objectives will have serious consequences, both in terms of food production costs and the level of future food consumption.

The F2F Strategy, according to some approaches, is far away from the basic problems of the EU agriculture and food market. It was targeted above all on changes within plant production, whereas the main issue is excessive production and consumption of animal products, especially meat and processed meat. Meanwhile, it is animal production that contributes to the destruction of the environment to the largest extent, being responsible for approximately 15% of the total greenhouse gas (GHG) emissions (Hedberg, 2020). According to extreme opinions, the F2F Strategy is even claimed to be a political utopia (Wirtz, 2020). In this case, a natural question arises about the future of the F2F Strategy, its real impact on the future of agriculture, agribusiness and the environment, as well as possible negative consequences.

The main source of climate change is human activity, such as fossil fuels combustion and converting ecosystems into agroecosystems and urbanized areas. These actions lead to anthropogenic emissions of GHG, and agriculture is one of its main sources.

Polish agriculture is responsible for approximately 9% of GHG emissions, among which the most important is the emission of nitrous oxide from the soil as a result of nitrogen fertilization and methane emission from animal production. Plant production contributes both to greenhouse gas emission and to sequestration of carbon, and actions taken within its scope involve practices related to land use and cultivation as well as soil and nutrient management (MRiRW, 2021).

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