



Kingdom of the Netherlands

AGRICULTURE IN POLAND

SOIL CHARACTERISTICS AND QUALITY



THE EMBASSY OF THE KINGDOM OF THE NETHERLANDS

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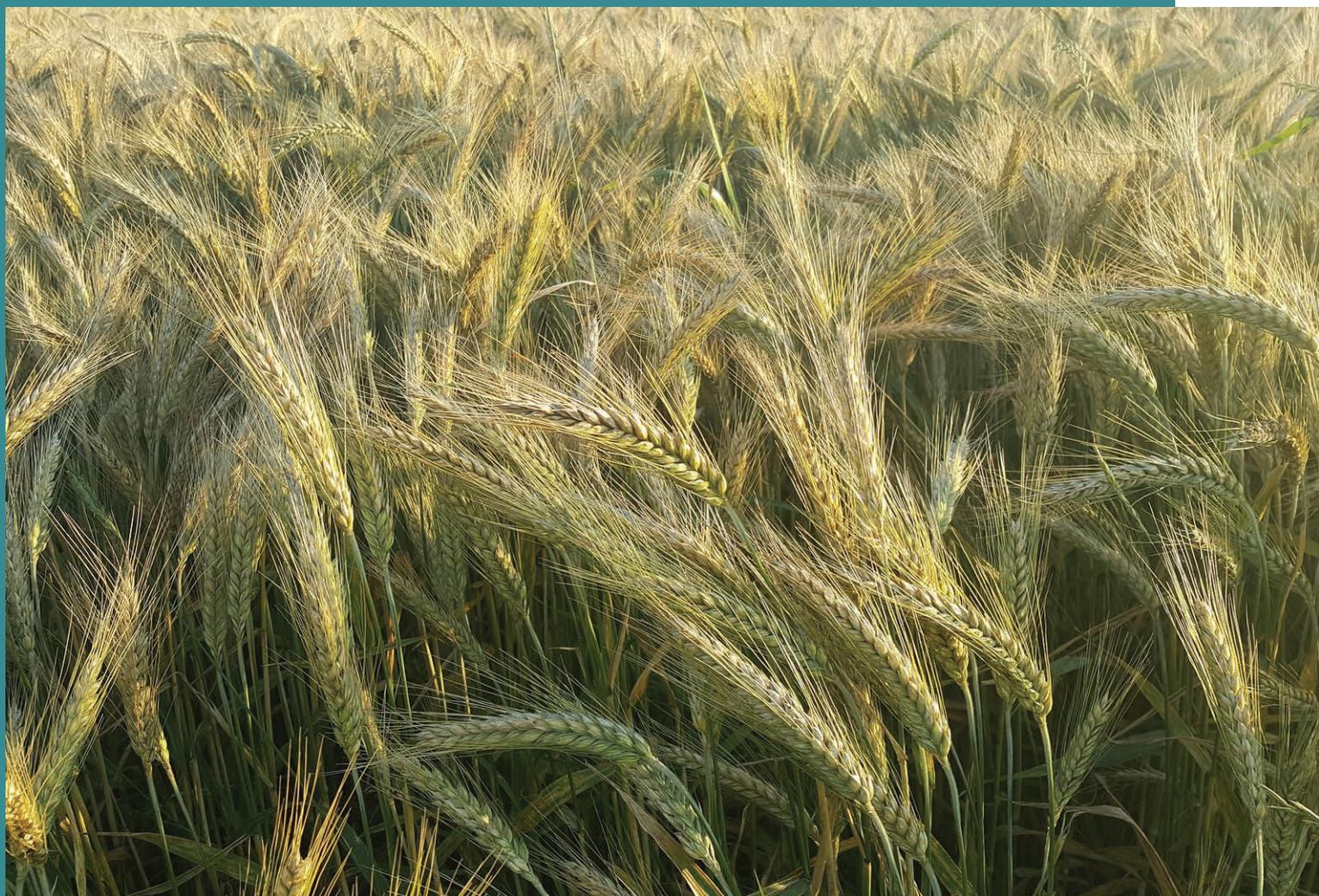
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THE IMPORTANCE OF AGRICULTURE FOR POLAND



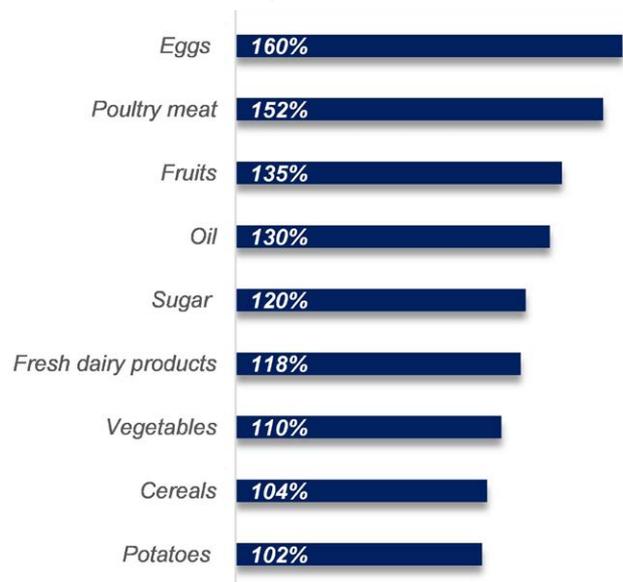
Polish agriculture has undergone enormous changes over the last nearly thirty years. The transformation that Poland underwent after 1989 involved, among other things, opening up the market to foreign products, changes in the forms of land ownership and a reduction in the number of people employed in the agricultural sector. After the initial crisis (a sharp rise in input prices, a fall in the number of farms), the situation gradually began to improve. The turning point was Poland's accession to the European Union in 2004 and the adoption of the Common Agricultural Policy. In 2005 financial support for agriculture increased four times compared to 2003, and in 2010 - 15 times. Before joining the EU, farmers had been the most sceptical group. They are currently the biggest beneficiaries of Poland's membership.

Consumers expect farmers not only to deliver the right quantities and types of agri-food products, but also to ensure that they are of the highest quality and produced in harmony with the environment. Polish agriculture benefits from modern technologies.

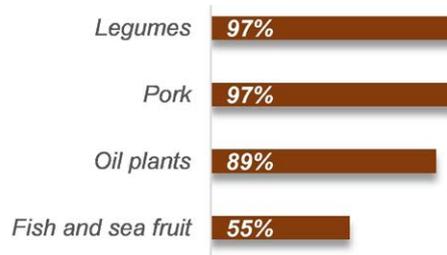


IS POLAND SELF-SUFFICIENT IN FOOD PRODUCTION? IMPORTS AND EXPORTS OF AGRI-FOOD PRODUCTS

Ensuring food security is one of the most important tasks for agriculture. The Global Food Security Index is a useful indicator for determining it. This index takes into account



Sufficiency of selected products in Poland in 2019



Sufficiency of selected products in Poland in 2019

the issues of food affordability, availability, quality and safety, and assesses natural resources and the agricultural sector's resilience to changes in these resources. In terms of GFSI value, Poland ranks 22nd out of 113 countries in the world and 14th among EU countries. Most importantly, Poland's food security has seen the second highest growth rate of all EU countries over the last 10 years, after Romania.

Theoretically, one Polish farmer can feed 129 people. In practice this depends on the type of product. In 2019, the value of agri-food exports was approximately 27% higher than the value of imports, with the growth rate of exports being significantly higher. In the difficult market year of 2020, Poland achieved a record export value of €34 billion

Oil seeds and oleaginous fruit, miscellaneous grains, seeds and fruit, industrial

Products of milling industry, malt, starches

Cereals

Coffee, tea and spices

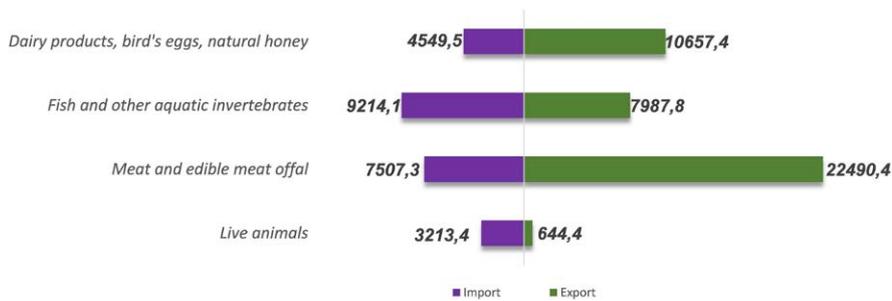
Edible fruits and nuts

Vegetables

Trees and other plants, bulbs, roots, cut flowers, ornamental foliage



Imports and exports of plant-based products in 2019



Imports and exports of livestock and animal products in 2019

- €2 billion more than in the previous year. Poland ranks second worldwide in rye exports, and third in apple exports. It is also an important exporter of eggs and poultry, beef, oats, potatoes, strawberries and currants, as well as tobacco and tobacco products. The vast majority of agri-food exports goes to other EU countries, mainly to Germany and the Netherlands. Interestingly, Poland, as one of the few EU countries, is developing its exports to countries outside the Community (countries of the Commonwealth of Independent States, the United Kingdom, Saudi Arabia) very dynamically.

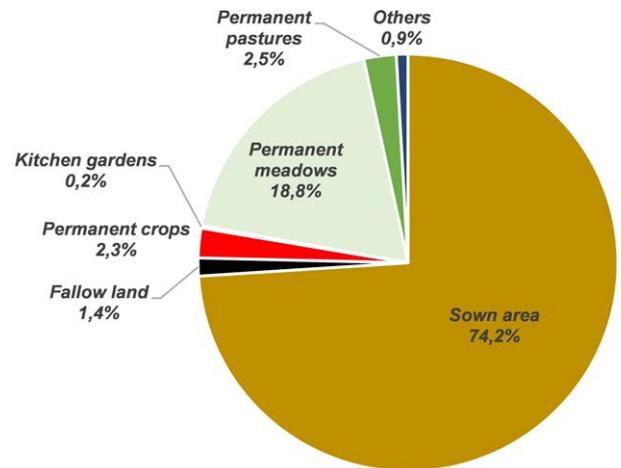
The competitiveness of agri-food products in the European market is determined by, among other things, long tradition, high quality, a well-developed network of suppliers, relatively low production and labour costs, qualified staff, R&D potential and a solid educational base. Sustainability, however, depends mainly on technological development rather than low labour costs.

More than 2/3 of agri-food goods come to Poland from the EU (mainly from Germany and the Netherlands). The import structure is dominated by fresh fish and fish fillets (mainly salmon) from Norway and Sweden, and soybean cake from Argentina and Brazil.

POLISH AGRICULTURE AND LANDSCAPE PROTECTION

Farmland has always been an integral part of Poland's landscape, developed and nurtured by farmers. Currently, 60% of the country's area is arable land (74% sown area, 19% permanent meadows, meadows and pastures, and 30% is forested. As in other European countries, although less intensively, pressure on agricultural areas caused by the

need for living space (mainly settlement and industrial areas) is increasing, resulting in land use being changed. On the other hand, fragmentation of agricultural land and changes in agricultural structure, lead



Land use in farms in 2019

to land abandonment. This problem is particularly relevant for the Podlaskie and Lubelskie provinces.

The desired agricultural landscape should be characterised by high agrocentotic diversity, a symbiosis of natural and man-made elements, and the use of native plant and animal species. Preserving regional characteristics and traditions is also a task for agriculture. Balks are a unique feature of the Polish agricultural landscape - traditional green strips which are crucial as habitats for flora and fauna, including pollinators, ecological corridors or physical protection for crops. The importance of this landscape element for the environment has been highlighted by compelling large farmers to introduce green areas.

Currently, almost 13% of Poland's energy is produced by re-



POLISH AGRICULTURE AND RENEWABLE ENERGY SOURCES



renewable sources, mainly sun and wind. By 2030, the share of renewable sources in the final consumption of energy is to be no less than 23%, which means a very dynamic growth of investment in this sector. The combustion of solid biofuels and biogas accounts for 8% of green energy capacity in Poland. For nearly two years, biomass imports (from Russia, Ukraine, Hungary, Bulgaria and Latvia) for energy purposes have been blocked in Poland, which has revitalised the Polish market. The main sources of biomass for energy purposes include: willow, miscanthus, poplar, Virginia fanpetals, field crops (cereals, beet, maize), or by-products (straw, maize stalk seed husks) and waste (manure from pig and cattle farms).

Theoretically, the cultivation of plants for biomass in Poland has a great potential. In practice, however, the legislation up to now and the scant financial support for this activity have resulted in these opportunities being missed. There were 316 biogas plants in Poland in 2020, 116 of which were agricultural. This is 6 times less than planned by 2023. The main raw materials for biogas production are vegeta-

ble and fruit residues as well as slurry. In the face of rising prices for coal and CO₂ emission rights, as well as heating derogations, the emphasis on the use of biomass in the energy sector is increasing. Poland is ranked 22nd in the world in terms of attractiveness for investment and technological development in the renewable energy sector.

Recommended information sources:

Energy from renewable sources in 2019, Statistical analyses, Warsaw 2020. Publication available on website stat.gov.pl

Report Biogas in Poland 2020. Poznań 2020. Publication available on website www.magazynbiomasa.pl

Polish Development Fund Group, pfr.pl
www.magazynbiomasa.pl

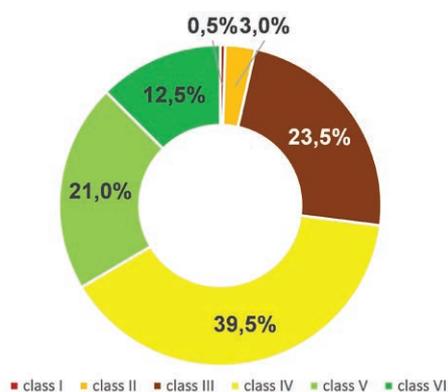
POLISH AGRICULTURE – PRESENT AND FUTURE



The picture of agricultural areas is quite different from the one that prevailed a few decades ago. Today, half as many people are employed in agriculture compared to 20 years ago, the number of farms has decreased but the average farm size has increased. They are more specialised and use modern technology. Support for Polish farmers is the highest among all EU countries. On the other hand, this transformation is still taking place at too slow a pace to maximise profits and fully exploit the potential of agriculture.

NATURAL CONDITIONS - SOILS

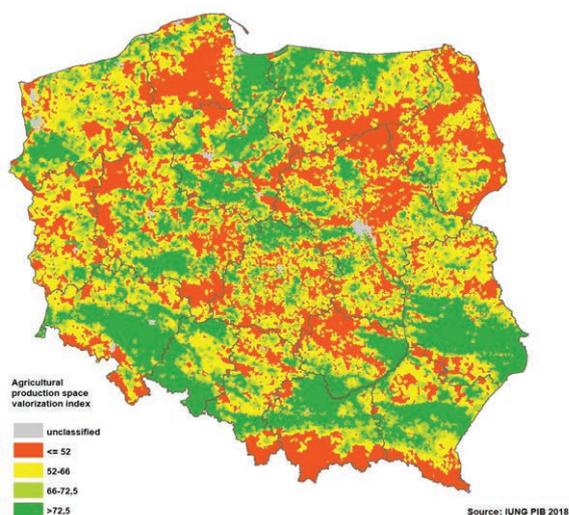
Poland is a lowland country (75% of the area). Over half of the area is covered by proper clay-illuvial soils and brown earth soils, and about 26% of the area is covered by sandy soils, rusty soils, podsollic soils and podsoles. Smaller areas are occupied by alluvial soils (5%) and raw mountain soils (6%). The most fertile chernozem constitute only 1% of the area. Poland's soils are distinguished in Europe by their grain size - they are predominantly light (61%); medium soils occupy 38% of the area, and heavy soils 1%.



Soil valuation structure in Poland

The best quality soils (classes I – IIIa) occupy almost 14% of the arable land. Poland is dominated by soils classified as medium (classes IIIb and IV) and poor (V and VI). The best soils are found in the following provinces: Opolskie, Dolnośląskie, Świętokrzyskie, Lubelskie and Małopolskie.

The indicator which most comprehensively describes the production potential (taking into account the quality and hydrographic conditions of soils, agroclimate and relief) is the indicator of valuation of agricultural production space taking values from 19.5 to 120.



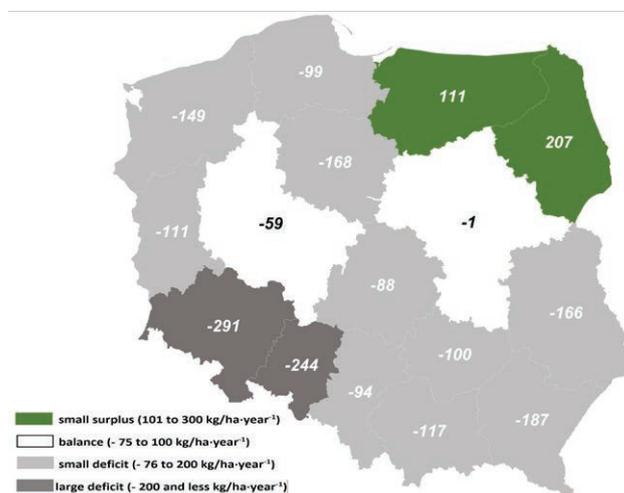
Agricultural production space valorization index (APSVI) in Poland

Provinces	APSVI value
dolnośląskie	74,9
kujawsko-pomorskie	71,0
lubelskie	74,1
lubuskie	62,3
łódzkie	61,9
małopolskie	69,3
mazowieckie	59,9
opolskie	81,6
podkarpackie	70,4
podlaskie	55,0
pomorskie	66,2
śląskie	64,2
świętokrzyskie	69,3
warmińsko-mazurskie	66,0
wielkopolskie	71,0
zachodniopomorskie	67,5

The average value for Poland is 66.6.

Soil quality is among the lowest in Europe. The production potential of an average hectare of arable land in Poland is equivalent to 0.6 hectare in European Union countries.

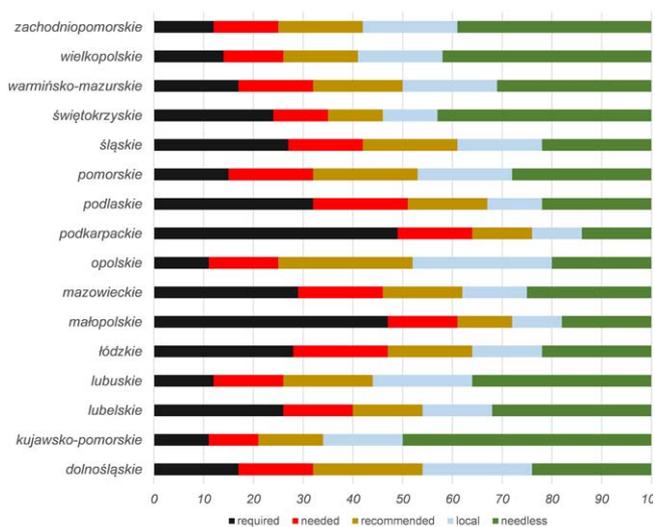
The average **humus** content in Polish soils is 1.94%. According to the European Soil Bureau Network (ESBN) criteria, approximately 89% of the area of soils used for agricultural purposes in Poland should be classified as soils with a low content of organic matter, showing desertification



Balance of soil organic matter in Polish soils

features. The estimated carbon resources in Polish soils are as follows: 616 million tonnes for arable land, 297 million tonnes for grassland on mineral soils, and 279 million tonnes for organic soils. However, based on the monitoring studies, its content is systematically decreasing. The problem, in terms of organic matter management, is a balance of -200 kg per hectare per year.

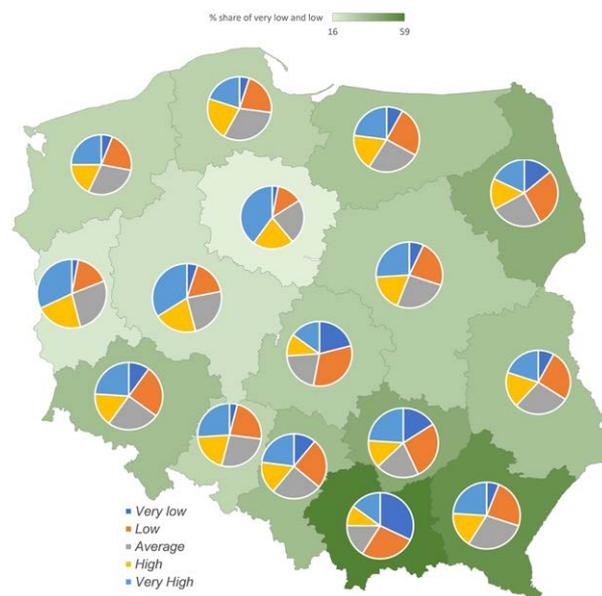
Acidification is important for soil fertility. In Poland, 35% of soils are very acidic and acidic; 37% are slightly acidic, and 28% are neutral and alkaline. Soil with impaired productivity due to acidification (liming needed) accounts for 1/5 of the area, while the situation is worst in the Małopolskie and Podkarpackie provinces. The problem of acidification of Polish soils is multifaceted, mainly due to natural conditions. Since calcium fertilisers do not provide an immediate boost to yields, farmers often only turn to them in crisis. However, this mainly concerns smaller farms with low productivity. In order to improve soil fertility in the long term, it is necessary to support farmers, for example by means of subsidies.



Soil liming needs by provinces in 2016—2019

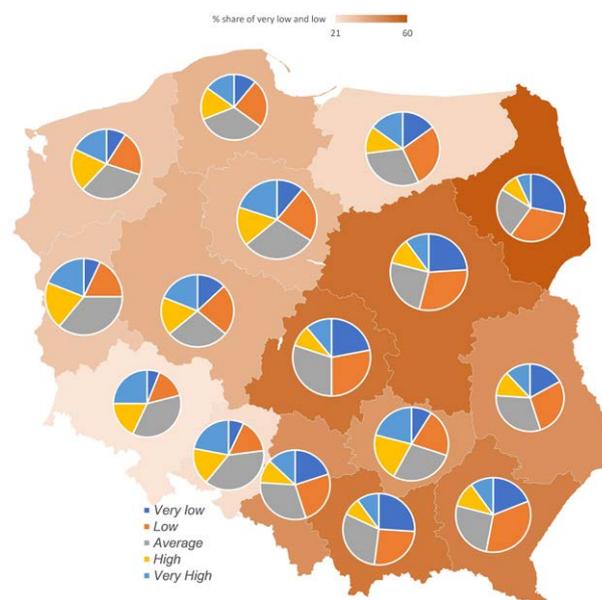
The content of available **phosphorus** in Polish soils varies greatly. The average share of soils with a very low and low content of this component is 25%, with a range from 16% in the Kujawsko-Pomorskie province to almost 60% in the Małopolskie province. The availability of this element is closely linked to soil pH. Provinces where the problem of acidification is smaller, which is often the result of soils

being kept in a better culture, tend to have a higher content of bioavailable phosphorus. Soils with a very high and high content of available phosphorus constitute on average 44% of the soil area in Poland. The best situation in this respect is in the Wielkopolskie and Kujawsko-Pomorskie provinces (more than half of soils with a high or very high content of bioavailable phosphorus).



Soil resources of absorbable phosphorus by provinces in 2016 - 2019

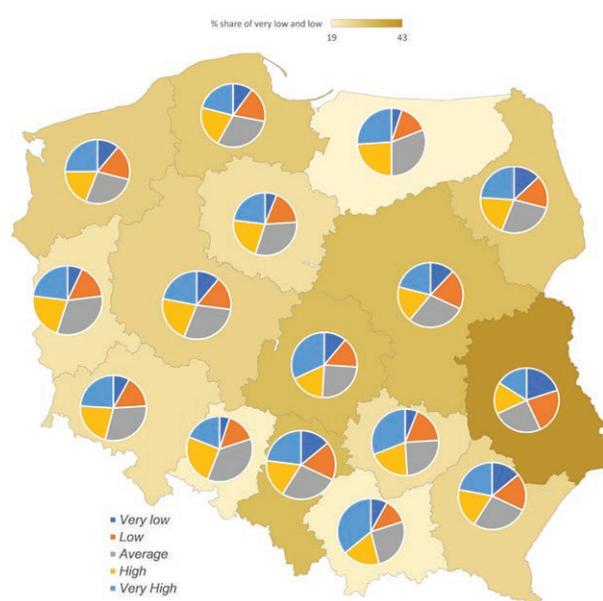
Polish soils are slightly less rich in **potassium** than in phosphorus. Nearly 40% of soils have a very low or low content of this component, with a range from 21% in the Dolnośląskie province to 60% in the Podlaskie province.



Soil resources of absorbable potassium by provinces in 2016 - 2019

The same provinces also have the least (16%) and the most (43%) soils with a very high and high potassium content, respectively. On average in the country, 31% of soils have a high or very high content of bioavailable potassium.

Soils with a high and very high content of bioavailable **magnesium** (44%) predominate over soils with a low and very low content of magnesium (27%). Only in the Lubelskie province is the situation reversed. More than half of the soils in the Warmińsko-Mazurskie, Świętokrzyskie and Małopolskie provinces have at least a high magnesium content.



Soil resources of absorbable magnesium by provinces in 2016 - 2019

Sulphur is another element that is in short supply. As many as 94% of soils in Poland have a low content of bioavailable sulphur. In view of the significant reduction in the inflow of this element to the atmosphere, there is a real risk of a deficit of this component in Polish crops. Maize (due to its large biomass) and oilseed rape (due to the specific nature of its seeds - fat and protein production) are particularly at risk.

In recent years, the analytical methodology (in line with that used in the EU) for determining the content of available forms of nutrients and the limit values for the abundance classes have changed. Comprehensive studies using the new methodology for individual provinces are not yet available. The new assessment criteria are less restrictive

than the previous ones, where, for example, 80% of soils were classified as low in boron.

The content of **micronutrients** in Polish soils varies. Based on the information provided so far, the highest percentage of soils in the low element content class concerns boron, copper and iron. The Małopolskie and Dolnośląskie provinces share relatively the smallest percentage of boron deficient soils. Copper is present in the largest proportion in the soils of the Dolnośląskie and Śląskie provinces. On the other hand, the soils of the Lubelskie province are characterised by a low content of boron and copper. Poland's soils are still rich in zinc and manganese.

Soil resources of absorbable microelements by provinces in 2016—2019

Provinces	B	Cu	Mn	Fe	Zn
dolnośląskie	Yellow	Green	Yellow	Yellow	Red
kujawsko-pomorskie	Red	Red	Yellow	Red	Green
lubelskie	Red	Red	Yellow	Red	Yellow
lubuskie	Red	Red	Yellow	Red	Green
łódzkie	Red	Yellow	Green	Yellow	Green
małopolskie	Yellow	Yellow	Yellow	Yellow	Yellow
mazowieckie	Red	Red	Yellow	Red	Yellow
opolskie	Red	Red	Yellow	Yellow	Green
podkarpackie	Red	Yellow	Yellow	Yellow	Yellow
podlaskie	Red	Yellow	Yellow	Red	Green
pomorskie	Red	Red	Red	Yellow	Green
śląskie	Red	Green	Yellow	Yellow	Green
świętokrzyskie	Red	Red	Yellow	Red	Green
warmińsko-mazurskie	Red	Red	Yellow	Yellow	Yellow
wielkopolskie	Red	Red	Yellow	Red	Green
zachodniopomorskie	Red	Yellow	Yellow	Yellow	Green

The phenomenon of **heavy metal** contamination spares Polish soils – the level of these elements in as many as 97% of the soils is natural and does not limit the possibility of them being used for agriculture production whatsoever. This problem is of marginal importance and relates to regions neighbouring industrial plants in the Śląskie (con-

tamination with cadmium, zinc and lead), Dolnośląskie (contamination with copper) and Małopolskie (contamination with nickel) provinces.

83% of the soils in Poland are not contaminated **with PAHs** (polycyclic aromatic hydrocarbons), and 10% show a low level of contamination. The other share consists of contaminated samples, and we do not see a high level of soil contamination with these compounds. Soils exhibiting higher contamination are located next to roads, industrial plants or mines.

Stones are commonly found in Polish arable soils. Approximately 10-15% of arable land soils should be subjected to mechanical removal of stones. The amount of stones in the arable layer per 1ha ranges from 5 to as much as 500 t. The problem of stony soil is particularly important in the cultivation of potatoes and sugar beets. More and more farmers are investing in machines for removing stones from fields (also made in Poland) or are interested in buying such a service.

NATURAL CONDITIONS – CLIMATE

Poland lies in the zone of a warm temperate transitional climate. The higher parts of the Sudeten and Carpathian Mountains have a mountain climate. The growing season lasts an average of 226 days. The shortest is in the north-east (180-190 days), the longest in the south-west and west of the country (up to 235 days). Over the last decade, the growing season has lengthened by 8 days and will lengthen by another 14 days over the next decade. Climate change is manifested primarily through the increased frequency of extreme weather events such as drought. Peri-

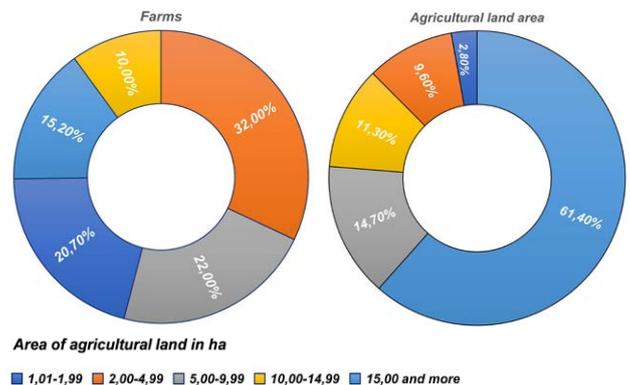


odically, flooding caused by heavy rainfall and occurring freezes are also a problem.

Prolonged periods of agricultural drought combined with high temperatures have become increasingly frequent in Poland in recent years. The crops most vulnerable to drought are those located in the following provinces: Zachodniopomorskie, Pomorskie, Wielkopolskie and Łódzkie. Poland is classified as a country with poor water resources. This is influenced by unfavourable climatic and hydrological conditions. Poland is increasingly affected by water scarcity, and this threat is growing every year.

CHARACTERISTICS OF POLISH FARMS

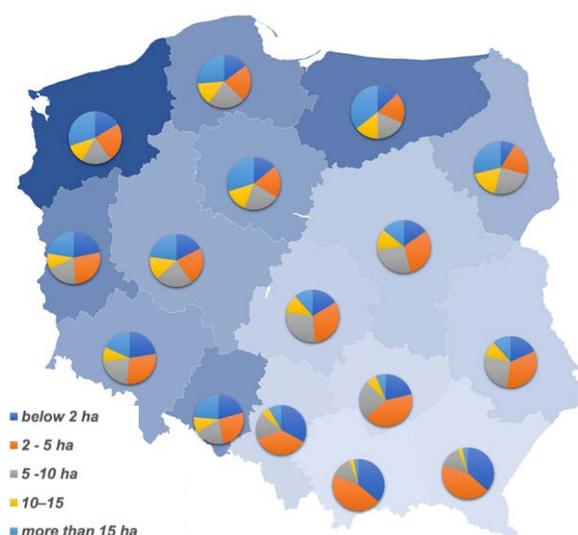
Polish agriculture is characterised by a dominant share of farms with an area of less than 5 ha. The increase in the area of farms is one of the factors allowing a larger scale of production to be achieved. It is mainly large farms that



Structure of private farms exceeding 1 ha of agricultural land and agricultural land areas by area groups in 2019

invest in land purchase, as well as implement innovations and purchase modern machinery. Currently, the tendency to increase the area of farms is not as dynamic as in 2000-2010. The current trend can be summarised as 'big get bigger'. Although the largest farms are not the most numerous group, they own more than 60% of the agricultural area. So-called 'informal leases' by larger farms from small and medium-sized farms are also common practice.

In fact, some of these farms do not exist. Farms with the largest area are found in the northern and north-western part of



Differentiation of private farms exceeding 1 ha of agricultural land by area groups and provinces in 2016

the country, while the smallest farms are in southern Poland. Practically all arable land is in good cultivation. The structure of use is dominated by land under sown crops (3/4). The number of organic farms in Poland has not changed significantly in the last few years, but their area has been increasing. The largest organic farm areas are in the Warmińsko-Mazurskie and Zachodnio-Pomorskie provinces. In Poland, there are not many certified farms using integrated farming methods. They are concentrated in the region of central Poland (provinces: Łódzkie, Mazowieckie, Świętokrzyskie).

In Poland, 2 out of 3 farms have at least one tractor. The percentage of machine owners is particularly high in the Świętokrzyskie and Kujawsko-Pomorskie provinces, while the lowest percentage is in the western and south-western regions of the country. The smallest number of tractors (0.59) per 1 farm falls in the group of up to 5 ha. Depending on the size of the farm, there are different preferences for the purchase of heavy agricultural equipment. The largest farms often buy or lease new equipment. Some farms rent machinery and equipment, others (especially smaller farmers) decide to buy second-hand machinery. Polish farmers often import second-hand agricultural heavy equipment from Germany, France and Great Britain. The most frequently purchased brands of new tractors in recent years include: Zetor, New Holland, Kubota, John Deere and Deutz-Fahr. In contrast to the rest of the EU countries, Poland has seen a continued growth in the agricultural equipment trade sector. Harvesting and threshing machinery as well as machinery for cultivation and soil preparation and agricultural trailers are produced in Poland. The main customer for this equipment is Germany, and in recent years exports to Russia and the Ukraine have revived.

In 2005-2019, the amount of direct support to agricultural land amounted to 194.6 billion PLN. The largest amounts of subsidies were received by farmers from the following provinces: Mazowieckie, Wielkopolskie and Lubelskie. However, individual beneficiaries from northern Poland gained the most.

number of farms in Poland in 2020: **1 317 000**
(decrease by 13% compared to 2010)

average size of a farm: **11.1 ha**
(decline by 13% compared to 2010)

185 000 organic farms,
i.e. 3.4% of the agricultural area

3 325 certified farms applying integrated
farming methods with a total area of **18 710 ha**

99.1 % of the agricultural area
in good condition

75% of the agricultural area is under sowing,
almost 20% **is permanent grassland**

single area payment: **107.35 EUR/ha**

payment for agricultural practices beneficial
for the climate and the environment: 72.05 EUR/ha

payment for young farmers: 41.06 EUR/ha

CHARACTERISTICS OF POLISH FARMERS



The youngest in Europe

Replacement rate 1.27

Every tenth Pole works in agriculture

Secondary education

Satisfied with the level of subsidies

Every third person makes a living only from farming

3819 PLN net average monthly income from work
on an individual farm

200 EUR subsidies per hectare

Just over 20% of Polish farmers are under 40 years of age, making them, along with Austrians, the youngest in Europe. Thus the replacement rate is very high, more than 8 times higher than the EU average. Polish farmers are increasingly better educated compared to 10 years ago. The percentage of farmers with a university education is significantly higher in the case of owners of larger farms (> 50 ha). Young farmers usually manage an area of 20-50 ha, have good agricultural qualifications, often take part in further training courses. Polish farmers rate the Common Agricultural Policy higher than the average EU farmer. For one third of farmers in Poland the main source of income is agricultural activity. This applies above all to farms of 21 ha or more, with a large share of industrial crops in the sowing structure. A Polish farmer receives on average about 200 EUR in subsidies per hectare - 60 less than the average for the EU countries.

Agricultural education in Poland has a long tradition. There are 59 agricultural secondary schools teaching in 27 professions. They attract considerable attention. In 2020, over 2 thousand students graduated from them. There are 6 higher education institutions of agriculture in Poland: Wrocław University of Environmental and Life Sciences, Warsaw University of Life Sciences, Poznań University of Life Sciences, Kraków University of Agriculture, Lublin University of Life Sciences, Siedlce University of Natural Sciences and Humanities. Moreover, agricultural faculties can be studied at other universities with agricultural faculties. In 2020, the total number of students studying at agricultural faculties was 22.8 thousand, of which 60% at first degree engineering studies.

CONSUMPTION OF MINERAL, NATURAL AND ORGANIC FERTILISERS

The consumption of mineral fertilisers in Poland is about 130 kg of pure components per hectare. Poland is one of the EU countries with higher consumption of mineral fertilisers. After years of systematic growth of fertiliser consumption, currently a stabilisation trend may be observed. Nitrogen fertilisers dominate in the structure (about 50% of the NPK dose used). The average consumption of nitrogen and phosphorus fertilisers per hectare has not changed much over the last decade, but the consumption of potassium fertilisers has increased (from 25 in 2009/10 to 38 kg K_2O /ha in 2018/19) as has the consumption of calcium fertilisers (from 34 to 52 kg CaO). Regional differentiation of fertiliser use is very high: from 83 kg NPK/ha in the Podkarpackie Province to almost 190 kg NPK/ha in the Opolskie Province. The most commonly used nitrogen fertilisers are: ammonium nitrate urea and urea-ammonium nitrate solution (UAN). Among phosphorus fertilisers, 40% enriched superphosphate and simple superphosphates are most frequently applied.

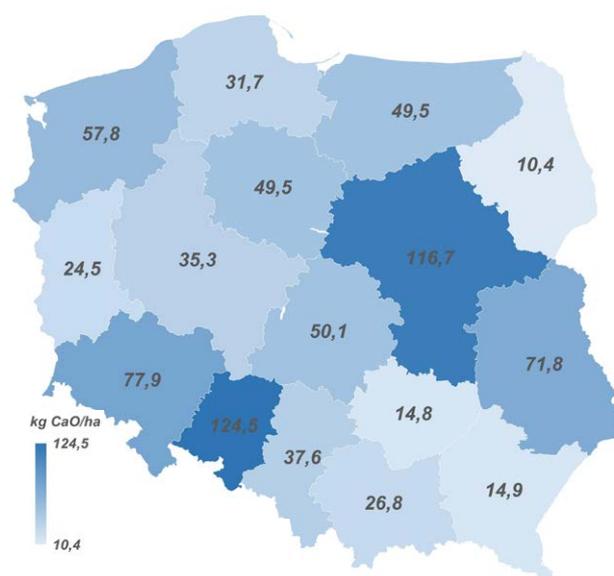
Potassium fertilisers are mainly potassium salt and potassium sulphate, however, this element is usually introduced in the form of compound fertilisers. On the European market,



Consumption of mineral or chemical fertilisers in terms of pure ingredient by provinces in 2018/19

the Polish mineral fertiliser producer 'Grupa Azoty' holds the second place in the production of compound fertilisers and the third place in the group of nitrogen fertilisers and liquid fertilisers. Poland exports fertilisers to Germany, the UK, the Czech Republic, and Ukraine.

The consumption of calcium fertilisers in the country varies widely from almost 15 to nearly 125 kg CaO/ha. The consumption of these fertilisers is closely related to subsidy programmes for this goal. However, a tendency to increase the consumption of this group of fertilisers can be observed.

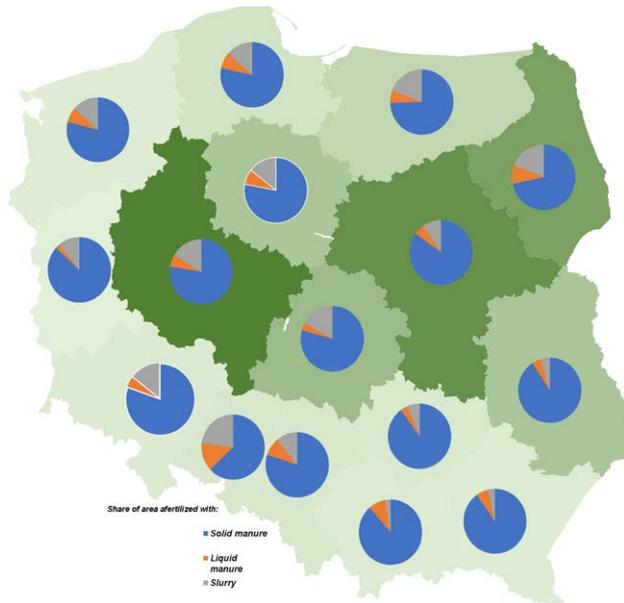


Consumption of calcium fertilisers in terms of pure ingredient by provinces in 2018/19

The consumption of calcium fertilisers changes in direct proportion to the size of farms. In large-scale farms, larger than 1000 ha of agricultural land, an average of 189.7 kg CaO/ha was used in 2017/18. The doses used diverge from the real needs of soil liming in Poland. In the 2018/19 marketing year, 44 million tonnes of manure, 6.8 million m³ of slurry and 13.7 million m³ of manure were applied in Poland. This is less than in 2016/17 by 15%, 25% and 12%, respectively. The largest amount of natural fertilisers is applied in the Podlaskie, Mazowieckie and Wielkopolskie provinces.

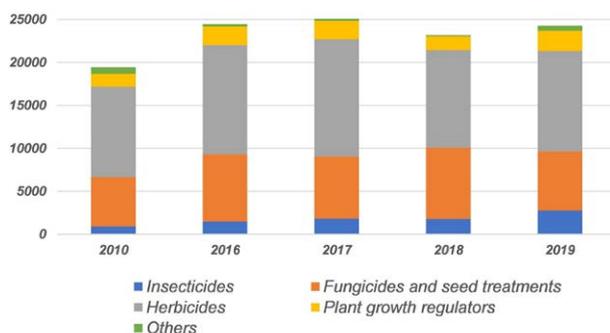
The directions of development of innovative fertiliser technologies are: microbiologically enriched fertilisers, fertilisers enriched with functional additives (smart fertilisers), encapsulated fertiliser slow-release fertilisers, and organic and organic-mineral fertilisers for soil improvement.

CONSUMPTION OF PLANT PROTECTION PRODUCTS



Consumption of natural fertilisers and area fertilised with natural fertilisers by province in farming year 2018/2019

According to the “EU Biodiversity Strategy”, it is planned to halve the use of plant protection products used in agriculture by 2030. A total of 24,300 tonnes of plant protection products (expressed as pure product) were sold in Poland in 2019. Just over ¼ came from domestic production. In Poland, mainly herbicides (67%) and fungicides (25%) are produced. The structure of imports is dominated by herbicides (just over half of the products imported). Fun-



Sales of plant protection in 2019 (in terms of active substance)



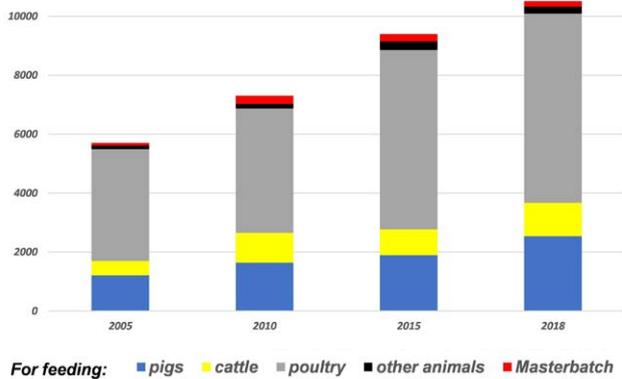
gicides (32.3%) rank second in terms of quantity imported, followed by insecticides (9.5%) and growth regulators (4.1%). Pesticide imports have shown a slight downward trend in recent years.

In EU countries, an average of 3.50 kg of active substance per hectare is used, in Poland - 2.2 kg (13th place in the EU). As a matter of fact, this is 3.5 times less than in the Netherlands. The doses of plant protection products vary greatly and depend on the specific needs of each crop. The lowest doses of plant protection products are used in cereal cultivation (from 0.54 kg/ha for oats to 1.32 kg/ha for winter wheat) and winter rape (1.74 kg/ha). Definitely more plant protection products are used in orchard crops (almost 10.5 kg/ha for apples) and vegetable crops (7.24 kg/ha for tomato). Biological agents are currently not very popular or widely used. They account for 2% of all registered plant protection products, which is twice as low as in the global market. In Poland, biological plant protection products are generally used in greenhouse crops, where regulation of the prevailing conditions is easy. Their more extensive use is limited primarily by their price – they are up to 5 times more expensive than chemicals

SALES OF FEED USED IN FEEDING LIVESTOCK

In Poland, cereal feed production increased to about 24.1 million tonnes in 2020 (a 22% increase compared to 2019), while protein-rich feed production increased to about 2.1 million tonnes (a 16% increase). Domestic market demand for concentrate feed in 2020/21 is estimated at around 22.2 million tonnes. Slight reductions in demand for feed in poultry production are compensated by an increase in this demand in pig farming.

Imports of the main feed materials in 2020/21 are slightly down compared to last season. Poland imports the most protein-rich raw materials (3.1 million tonnes), including



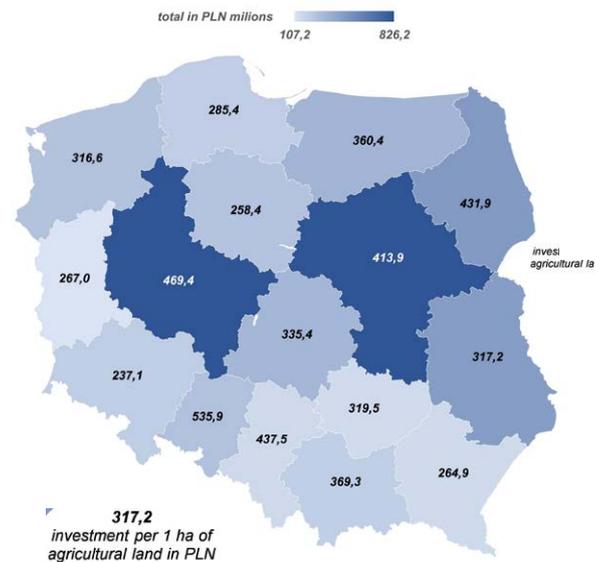
Sales of feeds used in feeding livestock in thousand tonnes

2.6 million tonnes of soya meal (70% from Argentina) and 0.4 million tonnes of sunflower meal (mainly from Ukraine). Cereal feed materials are the main focus of Poland's exports (around 2.6 million tonnes in the 2020/21 season).

INVESTMENT IN AGRICULTURAL AREAS

Since 2004, there has been a clear increase in budget expenditure on agriculture. This is, among other things, a result of national funds being boosted by EU money. In 2019, the total investment in agriculture amounted to 5,283 million PLN. Investments up to 1 ha of agricultural land are highly differentiated between the provinces. Young farmers invest the most. Investment loans with subsidies from the Agency for Restructuring and Modernisation of Agriculture are often used for these investments.

The share of agricultural expenditure in the Polish budget decreased in the 2014-2020 period to around 11%, i.e. 5.5% less than in the 2004-2014 period. Over the past 20 years, farms have increased their investments nearly twofold, from 181 PLN per ha to over 350 PLN per ha of arable land. The value of fixed assets on farms also doubled. The increase in investment in agriculture is stable and this can be considered a long-term trend. Since 1999, national R&D expenditures in the area of agricultural and veterinary sciences have increased 2.4 times, but their share in total R&D expenditures has decreased. Funding in the area of agricultural sciences grew more



Investment outlays in agriculture and hunting by voivodships in 2019

slowly than in the other areas. Poland is a country with a low level of patenting modern solutions in the ICT, food chemistry and environmental protection sectors. From the point of view of specialists, broadband infrastructure and cloud technologies are mentioned as very important investment fronts for rural areas and agriculture, as well as the use of drones (possibility to analyse large areas), autonomous cars or digitalisation in general.

What do Polish farmers invest in?

Land

Agricultural machinery and equipment:

1. tractors;
2. combined cultivators and seed drills;
3. sprayers;
4. combine harvesters

Renovation of livestock buildings

Irrigation systems

Animal welfare

Renewable energy sources

Purchase of breeding stock

COOPERATION BETWEEN SCIENCE AND AGRICULTURE

Economic issues in Poland have improved significantly since joining the EU. However, it turned out that the knowledge transfer system was not efficient enough under the conditions of marketisation of the economy. Over the last dozen years or so, the situation has improved considerably: a stable framework for the functioning of existing structures has been established, while on the other hand new institutions, often non-governmental, have been set up to provide effective support for agriculture, e.g. in terms of obtaining EU funds. In the area of research on agriculture, rural development, agricultural markets and fishery, there are 12 research institutes (under the supervision of the Ministry of Agriculture and Rural Development), 10 public universities (supervised by the Ministry of Education and Science), 10 institutes of the Polish Academy of Sciences and other research institutes under other ministries that partly conduct research for agriculture. In total, almost 20 000 people work for agricultural development in these facilities.

The agricultural advisory centres have the best assessment of their cooperation within the Agricultural Knowledge and Information System (AKIS) with agricultural research institutes and provincial and marshal offices. They have an equally positive perception of cooperation with agricultural and natural science universities, with 68% of the centres rating it as very close or close. On the other hand, companies supplying agricultural inputs and collecting agricultural crops hardly cooperate with agricultural advisory centres. Currently, in order to activate and facilitate contact, a Network for Innovation in Agriculture and Rural Areas has been established based on the Agricultural Advisory Centre in Brwinów and a network of 16 Provincial Agricultural Advisory Centres where innovation brokers work.



Recommended information sources:

Agricultural Advisory Center in Brwinów <https://en.cdr.gov.pl/>
 Institute of Agrophysics, Polish Academy of Sciences in Lublin <https://www.ipan.lublin.pl/>
 Institute Of Plant Protection – National Research Institute <https://www.iior.poznan.pl/lang,2>
 Institute of Technology and Life Sciences in Falenty, <http://www.itep.edu.pl/>
 Ministry of Agriculture and Rural Development <https://www.gov.pl/web/agriculture>
 National Council Of Agricultural Chamber (Farmers organization) <http://www.krir.pl/>
 National Support Centre for Agriculture <https://www.kowr.gov.pl/>
 Polish Rural Network <https://ksow.pl/>
 Soil Science and Plant Cultivation – State Research Institute <https://en.iung.pl/>
 The Agency for Restructuring and Modernisation of Agriculture (ARMA) <https://www.gov.pl/web/arimr-en>
 Statistics Poland <https://stat.gov.pl/en/>

WHAT DO FARMERS PRODUCE?

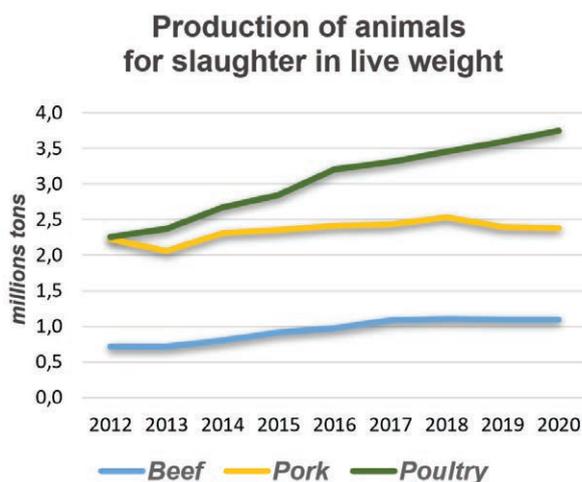


The agricultural sector is an important element of the Polish economy. In the last 20 years, the value of exports of Polish agri-food products has increased 12 times, to the level of 37.5 billion USD. A particular increase in production was recorded after Poland joined the EU. In the years 2004-2020, the productivity of farms doubled. At the same time, the number of people working in agriculture dropped to 10% of total employment, which is still 3 times higher than in the EU. The income situation of farms depends on their size and type of production. For some, direct payments and other financial support are the main sources of income. For others, it is only a minor addition. The financial result depends on the efficiency and direction of production. A gradual trend of concentration and intensification of production can be observed. According to the FADN (Farm Accountancy Data Network), the income of an average family farm in Poland amounts to nearly 45 thousand PLN and increases every year.

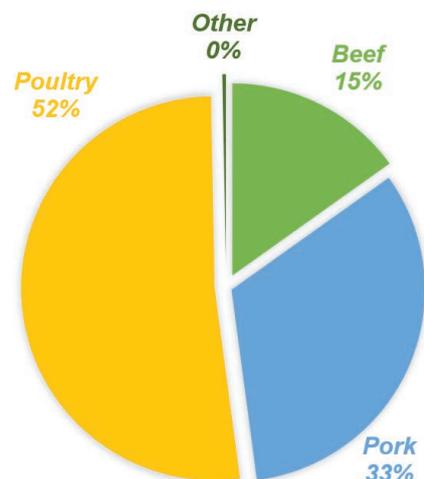


ANIMAL PRODUCTION

Animal production is an important branch of Polish agriculture. The most important species are pigs, dairy cattle, beef cattle and poultry. Sheep, goats, horses and fur animals are farmed on a smaller scale. The way of keeping animals, the size of herds, and intensification of production is highly diversified and depends on the region of the country, species and size of the farm. Poultry production is carried out on highly specialized farms. The production of pigs and dairy cattle is carried out both extensively and intensively, in small (several pigs) and large herds (several thousand pigs). Poland's animal production is undergoing concentration of production. Smaller farms, due to the drop in profitability, stop keeping animals. Farms with larger herds at the same time increase the livestock population. As a result, total livestock production increases or is on the same level while the number of farms with animal production decreases significantly.



SLAUGHTER LIVESTOCK IN POLAND- STRUCTURE

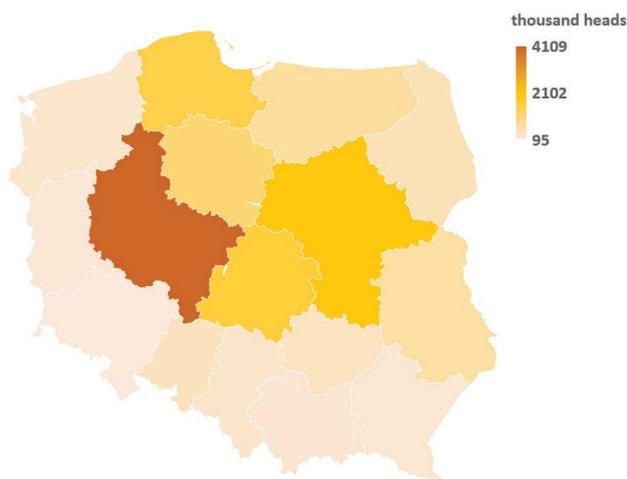


PIGS

Poland is one of the largest pork producers in the EU. The dominant pig farms are those with small herds, producing in a closed system, from the birth of piglets to the sale of fattening pigs. This strongly distinguishes Polish farms from others in the EU, especially from Mid-Eastern Europe. Currently, this characteristic is changing very quickly. In Poland, at the beginning of 2021, the average herd had 109 animals. Over the last 20 years, this number has increased 4 times but still almost 38 thousand livestock farms had less than 10 pigs in 2020. Such small herds are most often found in south-eastern Poland. In contrast, in western Poland, if farms run animal production, pigs are kept in large herds.

Small producers, keeping several dozen pigs, abandon their production due to low profitability and veterinary requirements related to African Swine Fever. At the same time, the share of medium and large herds is growing, enabling the reduction of production costs.

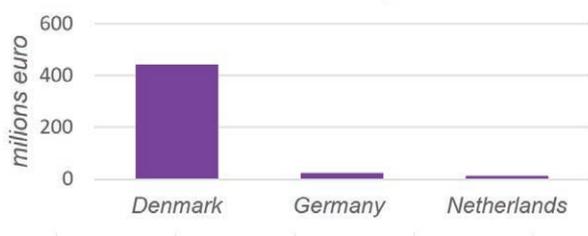
Production of pigs, by region



The production model is also changing. More and more pigs are kept in an open system, where piglets are purchased for further rearing. Very often those piglets are imported, mostly from Denmark. The domestic production of piglets is run on small/medium-scale farms and is losing competition to importers.

The method of financing fattening is also changing. The transition is from the farmer financing the production to the contract fattening model. In this model, farmer signs a contract with the slaughterhouse that pays for the fat-

Value of imported pigs in 2019



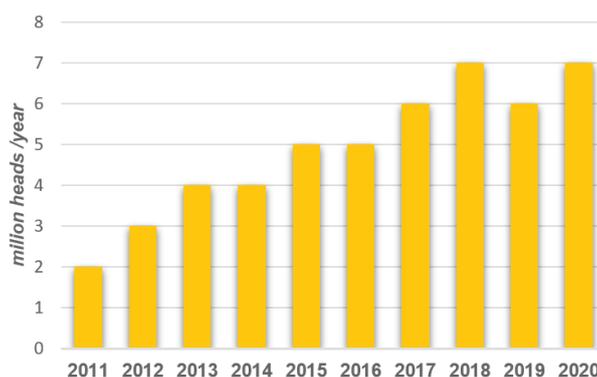
tening of each head and provides feed and animals. This makes the farmer profit independent from market price fluctuations but reduces the market position. Pig production is concentrated in several provinces, with Greater Poland province as leader.

Professionalisation of production requires investments in livestock buildings, improving animal welfare and management systems.

■ **DAIRY COWS**

Poland is the 3rd largest milk producer in the EU. The country's dairy cow herd is 2.1 million heads, which produce 14 billion litres of milk. As with pigs, there is the process of concentrating production and increasing productivity. Small producers are discontinuing milk production but production in medium and large farms is increasing. In smaller herds the cows are usually tethered. Larger barns, or newly built ones, allow cows to stand freely.

Import of young pigs up to 50 kg



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www.wetgiw.gov.pl

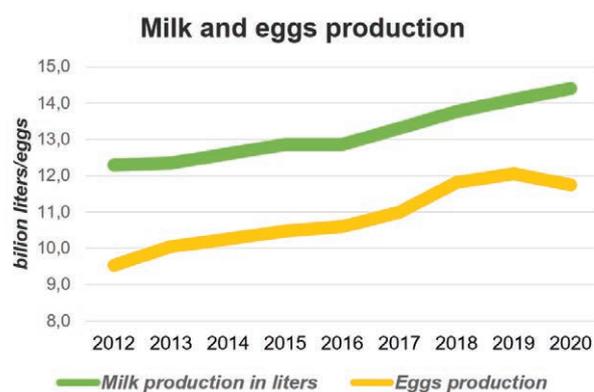


Due to natural conditions and traditions, milk production is concentrated in the central and eastern regions of the country. More than half of the cows are concentrated in three regions: Mazowieckie, Podlaskie and Greater Poland. An important factor in the development of the dairy industry is the growing export of dairy products, mainly to EU countries, but also to third countries, especially China.

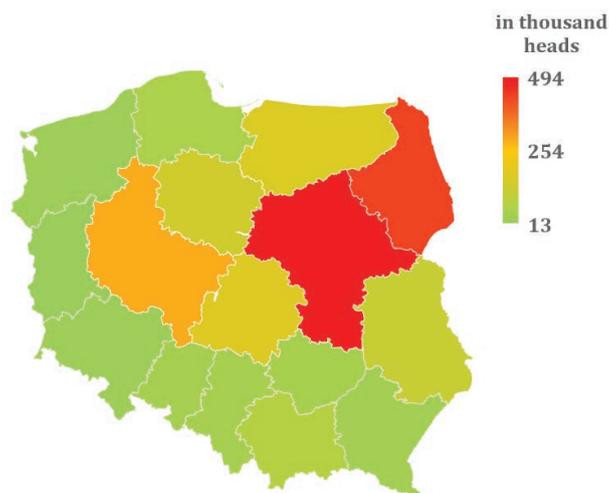
The production of milk without the use of genetically modified feeds is gaining importance, and those standards are set by dairy companies. This provides demand for domestic sources of protein, other than imported soybean. Increasing animal welfare and reducing greenhouse gas emissions from production may play a major role in the future.

■ BEEF PRODUCTION

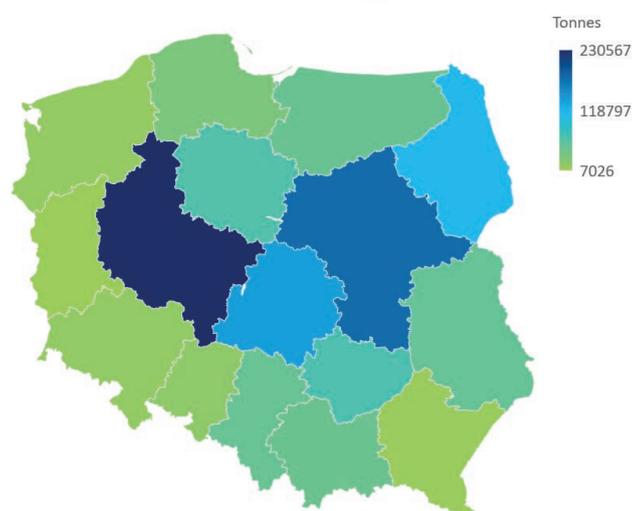
Poland is one of the leaders in beef exports in Europe. 80% of the production is sold abroad. The meat is valued for its great taste and good price. Beef production in Poland is increasing, but this does not translate into internal consumption, which is only 2-3 kg per year per person. Beef production is carried out on farms of various sizes. Most often, the animals are kept in buildings, in a free-standing or tethered system, on deep litter. They are fed with maize silage or hay. Often, fattening is carried out on farms that do not have dairy cows or suckler cows. In this case, the farms rely on purchased calves. High demand for them increases their price. The calves are bought from domestic dairy farms and often even imported: from Lithuania, the Netherlands or Slovakia. For many farms, the reduction in profitability of pig production changed the direction and encouraged beef production.



Average number of dairy cows



Production of cattle for slaughter in live weight



■ POULTRY

For several years, Poland has been a leader in poultry and egg production in the EU. Production significantly exceeds the domestic demand and Polish poultry meat is exported mainly to the EU markets. African and Asian markets show great promise for further development of the industry.

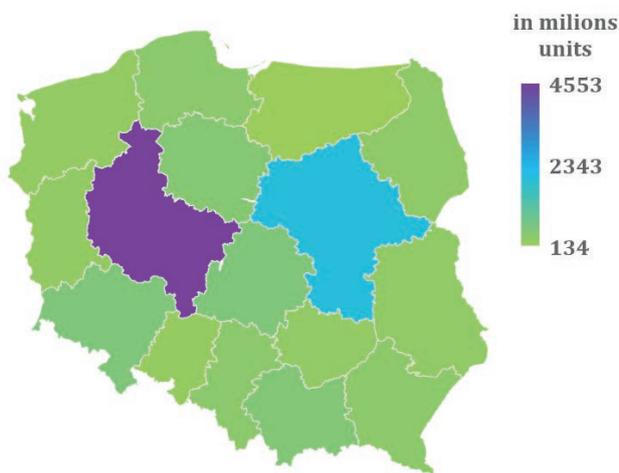
Production is carried out mainly on farms run by farmers or agricultural companies, in an intense manner, in modern livestock buildings. It is concentrated in several regions, but the largest number of poultry houses is located in Wielkopolska. The poultry industry is threatened by rising feed and electricity prices, the withdrawal of veterinary medicate and the threat of bird flu. Hens are also very often kept by farmers and non-farmer villagers for self-supply in eggs and meat.

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Consumers also show an increasing demand for free-range eggs, preferably from a friendly supplier. In the coming years, changes in consumer behaviour and EU regulations will force a change in egg production, which will be a challenge for the industry

Hen eggs production in 2020



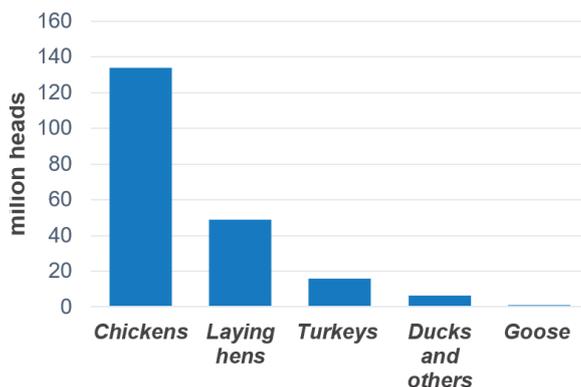
OTHER ANIMALS

Other animals play a less important role. In the past, sheep and goats played a significant role. They are not very common these days. The keeping of horses is carried out for recreational and sports purposes. Equestrianism is also growing rapidly in popularity, especially close to larger ur-

ban centres. Horses are not a common sight away from cities - it is rare for farmers to keep them.

Poland is also a recognized producer of fur animals such as rabbits, foxes, minks, ferrets and other. Production is carried out in specialized farms and is export-oriented. The future of the fur industry is uncertain due to social pressure.

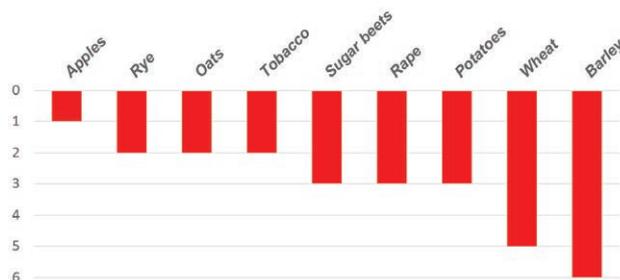
Annual production of poultry by the number of heads



CROP PRODUCTION

Poland has 14.5 million ha of UAA, which is 9% of the EU. Currently, there are very strong changes, both in terms of organization and production. The existing ideas about Polish agriculture from a few years ago may differ from reality.

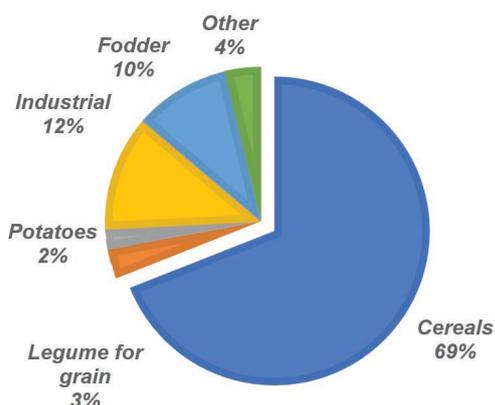
Place of Poland in production of some agricultural products in EU



CEREALS

Cereal production is one of the main directions of agricultural production in Poland. Cereals account for nearly 3/4 of the total area of sown crops. Such a large share results from the climatic and soil conditions and the relative ease of production. The production of cereals satisfies the domes-

THE STRUCTURE OF SOWING AREA IN 2020

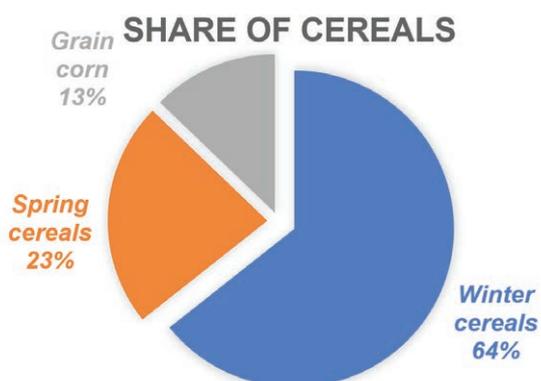


tic demand for feed for pigs and poultry and is exported mainly by road to Germany and by sea to the rest of the world. Among the cultivated cereals, wheat and triticale are dominant. The area of maize and winter barley cultivation is increasing yearly.

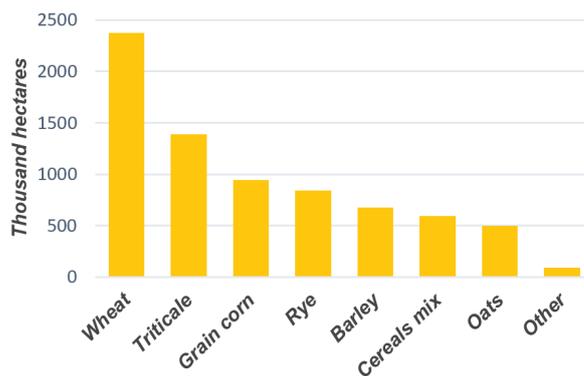
Due to the higher yield potential and drought tolerance, winter crops occupy more and more land at the expense of spring crops. The large acreage of winter cereals is also a result of the increasingly milder winters and the reduction of the risk of the plants freezing out.

One of the distinguishable plants is maize cultivated for grain. Its acreage is growing, and the reason for this is the low time-consumption for its cultivation, the developed market of agricultural services, drying and purchasing. Relatively good yields on poorer soils are also important, provided that the total rainfall is sufficient.

Cereal yields in Poland are subject to substantial fluctuations over many years due to the variable amount of rainfall. However, an upward trend is observed, resulting from an increase in expenditure.



Cereals area in 2020



■ **POTATO**

For many years, Poland was a potentate in the production of potatoes. However, recent years have seen a decline in the cultivation area. This happened as a result of a reduction in the feed use of potatoes and a change in the feeding system of pigs. The cultivation area has dropped from 1.25 million ha in 2000 to the level of 0.3 million. The decrease in the cultivation area was compensated by the increase in productivity. Potato harvest in Poland in 2019 amounted to 6.6 million tonnes, with an average yield of 21 t/ha.

Potato yield obtained in a given year is strongly dependent on the soil conditions on a given farm, weather conditions and the professionalization of production (e.g. having irrigation systems).

In Poland, potatoes are grown in various systems, with the use of various technologies and with a different degree of intensity. In terms of the number of farms cultivating potatoes, the dominant farms are those with low input cultivation, often on a small area. However, in terms of area, intensive cultivation covers a larger part of the area, although it is carried out by a smaller number of farms. There are few plantations that are irrigated, although farms systematically invest in this area. Irrigation allows doubling the yields. An interesting fact is that the inhabitants of eastern Poland, including Warsaw, prefer white and cream-coloured potatoes, while the inhabitants of western Poland prefer yellow ones. Professionalization of production causes an increasing demand for irrigation systems, planting, harvesting and sorting machines, storage systems. Stone harvesting machines are also important.

■ BEET

Sugar beet is one of the most important industrial crops grown in Poland. The beet cultivation acreage in 2020 was 250 thousand ha, and the average root yield was 60 t/ha. The average plantation area in Poland is over 8 ha, and 30,000 farmers are involved in the cultivation of beet. The cultivation is based on a contract and the roots are sold to 1 of 17 sugar factories throughout the country. The beet-root campaign usually lasts from the beginning of September to January, during which more than 2 million tonnes of sugar are produced. This amount exceeds the domestic demand which fluctuates within limits. The distribution of rainfall affects beet yield. The beet technology is professionalised. Beets are most often sown with a private seeder or using a service provider. There is a market demand for beet sowing in the ploughless technology. Harvesting



is usually based on a service company cooperating with a sugar factory. Due to mechanisation of harvesting, beet cultivation has become less labour-intensive, although its profitability is lower than a few years ago. The profit for the farmer is increased by the subsidy for cultivation and beet pulp. The purchase price of beets depends on the sugar factory to which the beets are transported. The challenges

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for producers are the limited number of pesticides due to EU regulations, the threat of weeds and pests. The price of fertilisers is also important in calculating profitability.

■ RAPE

The most important oilseed plant cultivated in Poland is rape, mostly winter form. The cultivation area in 2020 was 900 thousand ha. Rapeseed crops are at risk of freezing out during winter. This can happen every few years. In addition, rapeseed plants are attacked by pests that are difficult to deal with. Likewise, they can be damaged by wild animals. However, the high price of rapeseed encourages farmers to continue the cultivation, especially in good soil conditions.



■ LEGUMES

Legumes are characterised by a high protein content, the ability to fix atmospheric nitrogen, and they have a positive effect on the soil. Despite many advantages, their cultivation in Poland is low. It is influenced by economic and natural factors. As spring plants, they are sensitive to spring droughts. They show high variability in yield. A species whose importance is slowly growing is soybean. The best



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conditions for its cultivation occur in the south of Poland. In the north, field bean is cultivated with success due to its high water requirements. Peas and lupins are also cultivated throughout Poland. Of the fodder crops, alfalfa is the most important.

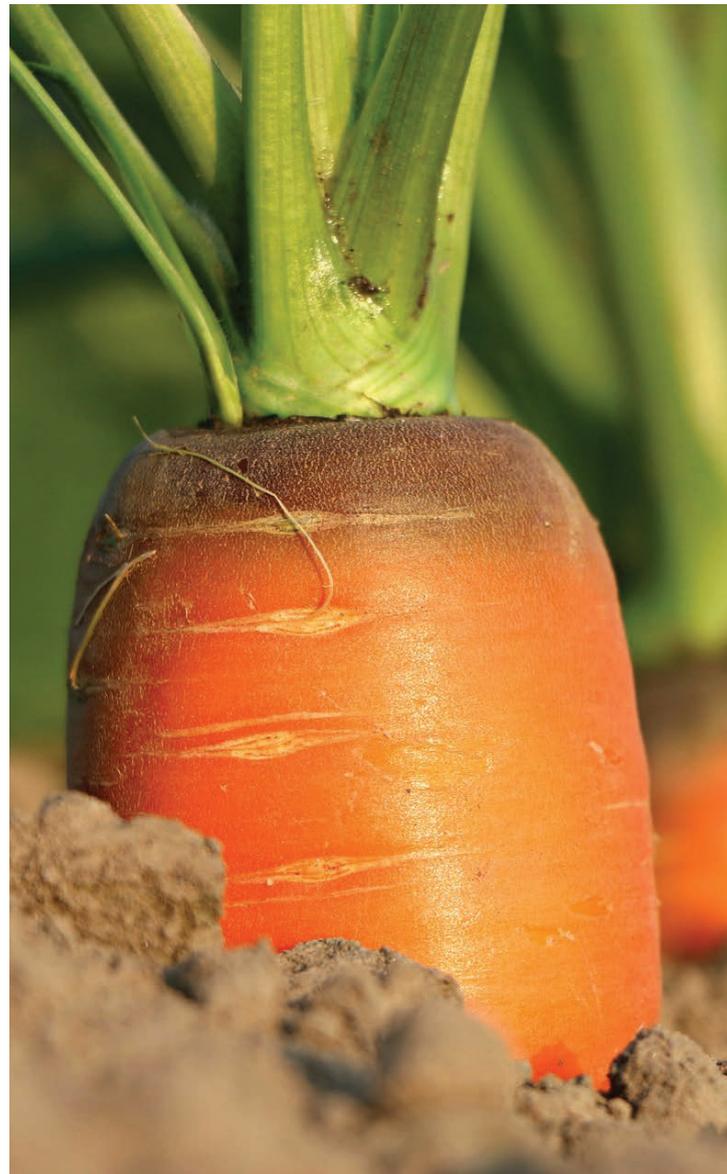
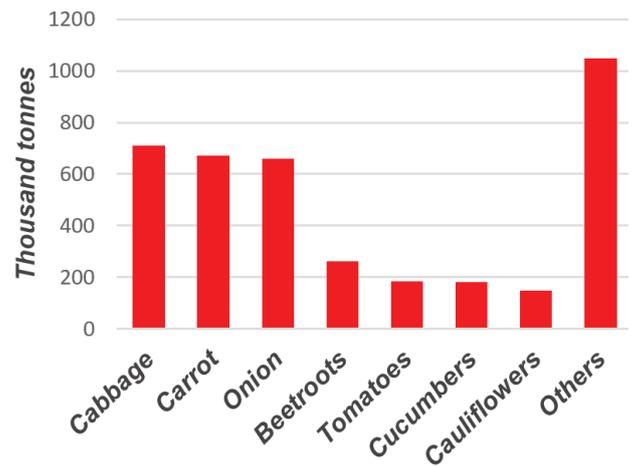


■ VEGETABLES

Poland is the leader in the production of vegetables. The largest share in EU production belongs to cabbage, carrots and onions, which are also the main exports. The production of vegetables is developing dynamically. Mechanisation, crop areas and yields are increasing. More and more often, production on medium and large farms is highly mechanised. It requires farmers to have irrigation systems, and is carried out more and more by highly specialized farms, producing one or several types of vegetables similar to each other in terms of technology. At the same time, there are still farms, smaller producers, cultivating crops that require more human labour. In selected regions - and

even localities in Poland, under cover production is also carried out. Diseases and pests are a challenge in regions with a high concentration of production. Vegetable farms invest in irrigation systems and storage systems.

Field vegetables production in 2020



DEVELOPMENT DIRECTIONS



Agriculture is a difficult sector of the economy. Production depends on many factors, including those that are difficult to predict, such as drought, diseases, flooding, the occurrence of pests, and frost. Each year brings new challenges that the farmer has to face. Knowledge and experience help to overcome all adversities. Technology and access to modern tools are also increasingly important. The use of innovation in production increases profitability, allows you to increase competitiveness. The challenge is to take care of and increase soil fertility. Another goal for the coming years is to reduce greenhouse gas emissions from agriculture. In addition to conventional agricultural production, in line with the assumptions of the European Union, ecological production is also planned to develop in the coming years.



NEW CULTIVATION TECHNOLOGIES

The main method of soil cultivation in Poland is ploughing. At the same time, an increasing number of farms, especially larger ones, are starting to use no-tillage systems. In this technology, a cultivator is used instead of a plough. The second option is strip tillage. Zero tillage cultivation does not work in Polish climatic and soil conditions. It causes a decrease in the yield of plants.

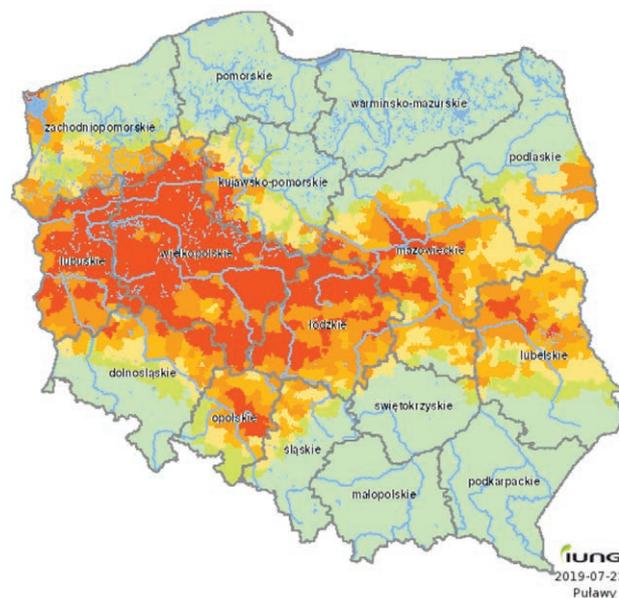


Strip cultivation and cultivation with a cultivator does not cause a decrease in yield compared to ploughing, and very often even increases the yield of plants. This is due to improved plant emergence and soil water conservation. Cultivation without ploughing is often chosen on large farms for economic reasons, as it saves time and effort. It requires a high demand for tractor power, which is easier

to find on large farms. Thanks to the rapidly growing market of agricultural services, ploughless technologies are becoming commonplace for small producers. Every year more and more farmers decide to establish rape, sugar beet and maize plantations in the strip-till system. This market segment will surely grow in the coming years. There will also be special green subsidies for conservation tillage.

IRRIGATION

Research shows that droughts in Poland will occur more and more often, will last longer and damage plant production more severely. The greatest risk of droughts occurring is in the central strip of Poland, along the A2 motorway. What makes them difficult to study and prevent them from happening is their occurrence at different times of the year and in different areas. In addition to soil quality, lack of wa-



ter is another major factor limiting plant yield. The occurrence of drought in the periods of emergence hinders this process, during flowering the number of seeds is reduced, and their weight decreases during maturation. Increasing water collection is an important process in improving water management. Water shortage manifests itself in the plants selected by farmers. Winter crops dominate. Farms producing vegetables and potatoes more and more often decide to implement irrigation systems.

Drought in Poland can be monitored using the website: susza.iung.pulawy.pl/kbw

PRECISION AGRICULTURE

Precision farming is a concept of agricultural production based on data collected from the field. After analysis and processing, the collected information is used to make the best possible production decision adapted to the changing field conditions. The aim of precision agriculture is to increase the profits achieved through the effective use of means of production, selected for environmental factors and changing soil conditions in the field. Precision farming includes variable dosing of seeds and fertilisers, and precise machine control.

The interest of farmers and the availability of equipment are growing strongly. Technologies related to tractor auto-steering are chosen, as well as variable dosing of seeds or fertilisers. Farmers, especially large ones, more and more often use services related to the assessment of soil quality, its physical properties and nutrient content. They provide maps which are then used in the application of fertilisers.



Mobile applications for farm management are becoming popular, especially among younger farmers. Large-scale farms or those providing services often equip their equipment with GPS locators that allow tracking the operation of the machine park (e.g. position, time) on the farm. The purchase of this type of technology is supported from EU funds, the granting of which depends on innovation.

Many farmers may not have sufficient knowledge about the profitability and usefulness of precision technologies on the farm, but they are open to learning about modern precision farming methods. The National Center for Agricultural Support plans to develop a long-term project on the use of satellite teledetection in agriculture to support farmers' decisions during the growing season and in emergency situations. It is planned to build a system that combines satellite, meteorological and soil data in the territory of the country. The system is to provide information on the yield and agricultural production and is to be constantly improved. It will be used for drought monitoring and estimating losses in agriculture.

ORGANIC PRODUCTION

Organic production is one of the rapidly growing branches of agriculture in the European Union. In 2020, the area of ecological agricultural land was over 0.5 million ha. The dominant regions in terms of area are Warmińsko-Mazurskie and Zachodniopomorskie. These are also provinces with the highest average farm area.



Organic production is carried out in Poland, both on small and large farms, which are focused on exporting the production. The dominant crops grown in the ecological system are rye, buckwheat, oats, and lupins. In organic farming, no synthetic fertilisers, plant protection products or GM plants are used. Production is based on rational crop rotation and maximisation of the circulation of elements. The average area of an organic farm was 27.41 ha, and in some provinces it exceeds 40 ha. This shows that organic production is carried out on farms larger than the national average.

GREEN DEAL AND ECOSCHEMES

Starting from 2023, farmers will apply a new common agricultural policy of the EU, known as the Green Deal. A novelty for producers are eco-schemes - one-year payments granted for activities supporting the environment and climate. Farmers will be able to choose from several measures. This will include, for example, a fertilisation plan, no-till cultivation or animal welfare. Ecoschemes and rates specified in the national strategic plan (at stage December 2021) are provided in the table:

Ecoscheme	Payment rate	Planned amount
Areas with honey plants	1 198 PLN/ha	3 000 ha
Extensive use of permanent grassland with livestock	838 PLN/ha	582 000 ha
Winter catch crops	786 PLN/ha	240 000 ha
Developing and following a nitrogen fertilisation plan	129 PLN/ha 649 PLN/ha (for liming)	2 989 400 ha
Plant diversification	339 PLN/ha	500 000 ha
Mixing the manure on arable land within 12 hours after application	428 PLN/ha	1 248 000 ha
Direct soil application of liquid natural fertilisers	291 PLN/ha	40 000 ha
No-till cultivation systems	601 PLN/ha	775 000 ha
Maintaining field trees	2 494 PLN/ha	1 648 ha
Maintaining agroforestry systems	300 PLN/ha	3 900 ha
Water retention on permanent grassland	280 PLN/ha	360 000 ha
Fallowing of 7% farm's arable land	85 PLN/ha	300 000 ha
Integrated Production System	1 300 PLN/ha	28 260 ha
Biological Pesticide Use	400 PLN/ha	5 000 ha
Ecological farming	Varied	512 649 ha
Increased animal welfare	Varied	3 461 797 LSU

* The data contained in the table are part of the draft National CAP Strategic Plan and may still be changed. The final version will be known in 2022. For more information, see: <https://www.gov.pl/web/agriculture>