

REGIONAL REPORT ON EXISTING REGIONAL INDUSTRIAL EXCELLENCE NODES IN PRECISION

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Poland

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1. Poland¹

1.1. Overview of regional PA status

Poland is in third place in Europe due to the share of agricultural area in the total area of the country. The countries ahead of Poland are France and Spain. This area is 18 608 thousand hectares, i.e. 56% of the entire country. Such a large surface area allows the land to be used less intensively as well as the use of environmentally friendly production methods. In 2018, farms in Poland produced production whose global value (in current prices) places Polish agriculture in 7th place in the European Union, behind France, Germany, Italy, Spain, Great Britain and the Netherlands. Its value (over PLN 110 billion) constituted 2.8% of the value of global production in the national economy. In turn, the gross value added generated in the agriculture, hunting and forestry department reached almost PLN 45 billion, and in agriculture alone it amounted to over PLN 38 billion, which constituted, respectively: 2.7 and 2.3% of the country's global production value. The development of agricultural commodity production did not, however, increase its share in the raw materials resources of food processors. Currently, it is estimated at about 60-65%, while the value of this indicator shows

¹ Provided from KIRG: Pawel Materka et.al. (2020)

a decreasing tendency. In the middle of the last decade, Polish agriculture still supplied approx. 75% of raw materials for the production of food preparations, but the high dynamics of the development of imports of agricultural products and semi-finished products reduced the importance of agriculture in the supply of raw materials to food companies¹. The structure of the commodity value of agricultural production was dominated by animal products, which in the years 2006-2016 constituted 56-58%. The best PA companies operate in the Zachodniopomorskie voivodship, e.g. DIS /

On the one hand, in the total number of farms (of which there are 1 405 700 - data from 2017), small farms with an area of 1-10 hectares dominate. According to data from the Central Statistical Office of 2017, they constitute about 75% of the total number of farms, but their use is only about 28% of arable land¹². On the other hand, we have larger farms (with an area of over 10 hectares), whose total share in the total number of farms is about 25% (including the largest farms, over 50 ha - 2.5%) and they use about 72% of agricultural land

Territorial diversity of the agrarian structure is also characteristic of Polish agriculture. For example, while the average farm area in the Lesser Poland Voivodship is only about 4 hectares, in the Warmian-Masurian and Lubuskie Voivodships it is over 20 hectares, and in the West Pomeranian Voivodship it exceeds 30 hectares¹

According to Eurostat, Poland is the second largest in the percentage of farms (13.2%), slightly ahead of Italy (9.3%) and Spain (8.9%) and is one of the largest agricultural producers in the European Union. In 2016, it held a high sixth position among the 27 member countries. According to data from 2018, Poland achieved the value of agricultural production (25 billion or 6 percent) Output of agricultural industry and its components in Poland. Poland is overtaken by countries such as France, Italy, Germany, Spain and the United Kingdom

In Poland, most farms are small. Average size of farm amounts to 8.4 ha UAA. The cereals are main crops with more than 70% share. Low production inputs cause the level of yields to be low.

Therefore, the value of agricultural production is low. Only 0.7% of farms have > 50 ha UAA in Poland. However, they use about 1/4 of total cultivated land. For such farms, more advanced PA systems are needed, which involves higher costs. This reduce these costs, the rational utilization of equipment is necessary. A multi-farm machinery use system can help to diminish fixed costs thanks to higher annual use.

Fragmentation of farms and low value of agricultural production makes the adoption of PA difficult in Poland. However, under such conditions, more simple forms of PA can be adopted. There are opportunities to start it without purchasing an expensive yield monitor. The assessment of variability field to field can be applied, especially as the fields are small and relatively uniform. Each field is assessed as a uniform area and receives a uniform application of fertiliser, lime, and pesticides. Crop yields for each field can be determined by weighing loads. Records are maintained by field and contain average yield, size or area, soil types, lime and fertility data, and pesticide applied. Costs for adopting this system are minimal. They include the time for record keeping and weighing of each load. This is a practice that crop producers should be using to insure each field is treated properly based on average fertility and pest data. Adoption of this system would be a first step to more complete data registration on farms according to EU standards.

Polish agriculture is still not able to sufficiently use PA when it comes to its practical implementation. The main reason for this lies in the nature of the fragmented Polish agricultural sector composed of many small farms that lack the potential to adopt PA practices.

1.2. High-performing OEMs (HW & Equipment), by technology

1.2.1. Steering Systems

Farmers most often use office software, followed by specialized applications created for agriculture. Programs for completing applications, supporting plant protection, reminding of deadlines for field work, product price bases, fertilizers, etc. are the most popular among farmers.

Farmers prefer free software or at a very low price. The main goal of another group of projects was to develop innovative applications and open ICT platforms that aim to advise, inform and support farmers, as well as to encourage users to cooperate actively. This type of open platform, using the power of modern smartphones and the economy of applications, was implemented as part of the AGROIT project. Meanwhile, the FOODIE project has created a cloud platform that is designed to store spatial and non-spatial agricultural data, while the AUDITOR project created a GNSS ground-based support system through which farmers can benefit from highly efficient and cost-effective services and applications.

Among the enterprises available on the Polish market that offer a range of ICT services also include:

Bitkomp company

- Bitfarma application - for farmers and agricultural advisors - recording economic events on farms - supporting the planning process and making decisions in the field of current plant production management - GIS functionality and a module cooperating with maps

Agropower company

- AgroAsystem - for farmers conducting any sown crops, regardless of their area - supports farm management in crop production - GIS functionality • Map module
- AgroPomiarGPS application - agriculture, forestry, land management - designed for portable Pocket PCs (PDAs) with GPS receiver - GIS functionality, measurement using GPS, graphic presentation of measurements in the form of a map, adding SHP sleepers with record plots
- The RolnikON company - has developed an online farm management system - effective management of crops, stored materials, breeding - GIS functionality • presentation of fields on a Google map

Agroboss company

- eLMID-AgrarGIS, introduces GIS functionality, loading and editing various types of maps, description and vector development of cadastral maps of the entire farm and single arable fields, development of aerial photographs, topographic maps and other soil maps. The program databases contain data of surface registers and usage methods, taking into account cadastral data and the possibility of making manual divisions on the farm schedule and aerial photography base, as well as creating application maps of fertilization taking into account soil tests

Agrar-Office

- produces agriculture applications for full farm management - works with machines from many manufacturers - 4 modules, Field Journal - field card is a tool for accounting - saving field work on the farm, GIS - for area management, Field Book - for management plots for registration and for creating maps of precise fertilization, spraying and sowing - GIS functionality, GIS Smart Rural module.

Agro Innovations Center

- Introduced the application "Virtual Virtual Zootechnik" - WirtualZootechnik.pl. It is a web application that works in a web browser. Basic program for detailed herd management - WirtualZootechnik Farm Manager. The application works on Android phones and is used for daily work directly in the barn. Thanks to the proximity technology, it allows identification of the animal after placing the phone close to the animal's earring.

1.2.2. Tillage/Soil Cultivation and Seeding Equipment

In Poland, there are not many manufacturers of machinery and equipment, the main role in providing equipment for farmers is played by distributors who, in cooperation with Polish and, above all, international producers, e.g. CYKOMET. Distributors mediate in the trading of machinery, equipment and control programs.

Among Polish producers, as well as international ones, who decided to produce in Poland (among others) due to low employment costs we distinguish the following. The latest and award-winning products were also presented:

- Przedsiębiorstwo Usługowo-Produkcyjne AGROMIX Sp. z o.o., manufacturer Manitou Group - Manitou MLT 420 telescopic loader
- USARYA POLSKA Sp. z o.o. - Husarya SCS-100 stone collection machine
- UNIA Sp. z o.o. - UNIA HERON 50 27 - Trailed sprayer
- MZURI-AGRO Sp. z o.o. Sp.k. - Mzuri Pro-Til - belt cultivation technology
- Przedsiębiorstwo Produkcyjno-Handlowo-Ustugowe A-LIMA-BIS Sp. z o.o. - ALIMAMIX EVOLUTION PRO forage wagon
- NAMYSLO Damian Namysło - Seedbed combination with pneumatic seed drill Namyslo FLYY
- Agroma S.A. - The company provides advanced agricultural tools, blocking monitors, cameras, customer relationship management, data management software, flow meters, GPS receivers, planter clamping force, precision application systems, precision planting unit row, speed controllers, RTK signal providers, UAVs.

1.2.3. Plant Breeding & Research

The main crop systems in Poland are:

DIRECT SEEDING

direct (no-tillage) is an extreme method of simplification and consists in sowing seeds into uncultivated soil. This sowing technique has recently attracted increasing interest, but in Poland it is carried out on about 1% of the area sown

BELT CULTIVATION / BELT SEEDING (strip till)

Belt sowing is a cultivation system consisting of loosening only a narrow several-centimeter strip of soil in a row, where seeds are sown and fertilizer is fed at the same time, and lateral soil stripes (inter-rows) remain uncultivated. The cultivating chisel loosens the soil to a depth of about 20-25 cm and at the same time compound fertilizer is applied at one or two depths (depending on the design solutions of the seeder)

To a large extent, success in strip-till depends on how we crush and scatter plant residues across the field. Soil cultivated in belt technology is mulched with plant residues, which allows better management and saving of water.

SINGING CEREAL SEEDS

The seeds are fed from the central tank to the distribution head and are then transported pneumatically to the seeding coulters - as in seeders from other manufacturers. Before they are placed in the soil, they go to a patented dispenser located above the sowing coulters, which separates the seeds delivered by pneumatic lines

Precision fertilization is one of the elements of precision farming. It is the use of fertilizers in doses exactly suited to the needs of fertilization, i.e.

- variable dosing depending on the soil's abundance and plant development phase,
- calculation of actual yields and precise guidance of machines in connection with satellite navigation.
- The benefits of precise fertilization that we can get are:
 - saving fertilization and increasing its efficiency (dose adjustment),
 - crop uniformity,
 - reducing fuel costs.

Production is based on performing fertilization treatments in a timely manner and using the right amount of fertilizer. It is justified to use different fertilization and liming on individual parts of the field. We need to adjust the amount of fertilization

to the potential plant demand to the knowledge we have about variable soil richness and its efficiency.

The limiting factor for precision fertilization methods are the high costs of introducing this technology, especially on small and medium-sized farms.

The main enterprises providing solutions to the Polish market in this area include:

IUNG company - which has introduced several solutions

- NawSald - for agricultural producers and agricultural advisors - preparation of fertilization plans on farms for arable land in accordance with the principles of sustainable mineral management
- MacroBil - balancing nutrients on the farm on the surface of the field
- Plano RSN - creating fertilizer plans with component balance control
- InfoPlant - a comprehensive assessment of the current nutritional status of a crop based on the results of chemical analysis of a plant sample taken during the growing season

Agroboss company

- Poultry application - supports management of laying poultry and meat poultry - the possibility of operating a farm consisting of many buildings (poultry houses) and many warehouses (packaging, feed, eggs and chicks) - the possibility of operating an egg sorting plant

1.2.4. Animal Monitoring

EU funds are an opportunity to develop precision farming technology also in this area. An example is the SYMPHONY project, which resulted in the creation of an early warning system that quickly detects the presence of toxins in milk, so it can become a huge support for milk producers.

An important element for this area is measuring available feed and adapting it to the needs of cows. Controlled access to pastures improves their use.

The grass should be allowed to grow to the right height, because if it is bitten too low, the cows will not eat as much as they should.

Timer-operated gates and automated fences can be used to control cow access to pasture, and a combination of all these technologies can help lead cows out of the area where the grass has been bitten to the optimal height.

You can record the sounds that animals make while chewing and analyze the frequency of biting and chewing.

This kind of "bioacoustic" monitoring could be combined with activity sensors for better accuracy and thus determine when to open the gate to the next part of the pasture.

The technology is a source of additional information for consumers about the food they buy, e.g. information about the product they purchased could be written in a bar code on the packaging. The more intensive use of precision technologies can benefit the image of dairy farmers.

The main system suppliers that support plant research and breeding include:

Zeto software

OBORA application - for dairy farmers - supports the management of a breeding farm covered by the performance assessment - fully integrated with the national system for the assessment of the utility and breeding value of cows and bulls (SYMLEK) -

- GIS functionality
- animal selection
- event forecasting (calving, drying, covering, testing)
- analyzes (performance, reproduction, somatosis and observation)

Agroboss company

The "Ferma" application - a computer system for handling a herd of cattle - supports management of a herd of cows - handling databases on cows, bulls and calves

The "Trzoda chlewna" application is a system for managing pig farms - for breeding (breeding) and commercial farms - fast and efficient data processing in the field of animal utilization and the level of production of a given farm - developed by specialists in the field of pig breeding, therefore all operations are adapted to the requirements and habits of pig producers

Hatchery - gathering and processing information on the hatching process - tracking numerical movement of eggs from the egg warehouse (acceptance) to sale from the chick warehouse - the possibility of creating a database of egg suppliers and chick recipients

Veterinary clinic application- supports the practice of a veterinarian in conducting substantive and financial documentation related to the performed activity - the possibility of performing various analyzes of own professional and financial activity

Mroczko company

- MR-A WinPro-Genetica - sow insemination station service

Alima BIS company

- Afimilk - dairy cow herd management - modules: AfiMilk - control of milk production and udder health, AfiLab - milk composition control, AfiAct - heat detection, AfiWeigh - automatic animal weighing, AfiSort - automatic separation of cows, AfiFeed - individual nutrition with concentrated feeds, AfiFarm - software connecting all modules.

Meteoryt company

- Assistant Register of Pigs - for farmers to support pig farming - a register of basic data about animals, e.g. earring number, origin, breed, age, type - gathering data on nutrition and animal weight
- Assistant Cattle Registry - for farmers to support cattle breeding - detailed records of animal data, e.g. earring number, origin, breed, age, type - gathering data on nutrition and animal weight
- Goat Registry Assistant - for breeders to support goat breeding - record of basic data about animals, e.g. earring number, origin, breed, age, type - gathering data on nutrition and animal weight
- Assistant Register of Sheep - for farmers to support sheep farming - record of basic data about animals, e.g. earring number, origin, breed, age, type - collection of data on nutrition and animal weight
- Live Inventory Assistant - for farmers - cattle records on a farm, including, for example, cattle photos, recording milk and weight performance, collecting nutritional data.

Zeto software

- OBORA - for dairy farmers - supports the management of a breeding farm covered by the performance assessment - fully integrated with the national system for the assessment of the utility and breeding value of cows and bulls (SYMLEK) - GIS functionality • animal selection • event forecasting (calving, drying, covering, testing) • analyzes (performance, reproduction, somatosis and observation)

e-stado sp.z o.o. company

- the company's goal is to provide necessary information about the health of cows and their reproductive cycle. It includes features such as animal health monitoring, heat, insemination and calving. It is non-invasive and safe to use, based on maintenance-free biosensors. Based on data from biosensors, the system monitors herd and barn environment for 24 hours. Data on the animal condition and conditions in the barn are then sent to a central server. The user receives access to the www application and SMS notifications about emergencies, where he has access to all data on an ongoing basis. The company's main systems and devices are: Ear biosensors, Environmental sensors, Tail biosensors, Radio transmitters in the barn and on the pasture

1.3. High-performing service providers, by service

High-performance agricultural service providers in Poland include:

The Agency for Restructuring and Modernization of Agriculture, which in addition to providing extensive consulting services for the agricultural market, has been developing the infrastructure and system monitoring system based on the Splunk software for several years

Also Agricultural Advisory Centers, operating regionally and nationwide, are important institutions supporting the agricultural market.

To enterprises that support agriculture, including in terms of providing solutions to the market include:

- eAGRONOM Sp. z o.o. - eAgronom - a program that facilitates farm management
- KST Konsulting Sp. z o.o., producer UNIFORM Agri - UNIFORM Agri - dairy herd management software

- KUHN-MASZYNY ROLNICZE Sp. z o.o, producer NOBILI S.p.A. - Innovative remote monitoring system of field crusher KUHN CONNECTED SHREDDER -
- SatAgro Sp. z o.o. - SatAgro service module supporting precise soil research and fertilization based on the abundance and satellite images
- CLAAS Polska Sp. o.o - DATA CONNECT - interface enabling the exchange of data on the location, status, speed and fuel level of many brands of tractors and machines
- RHIZA - This is a company that provides independent solutions supporting precision farming in Poland. The company's basic services include: mapping field and crop boundaries, planning precise sowing and fertilizing, rates of variability of doses and abundance, crop growth models and models of disease / pest occurrence (predicting pressure exerted by pests and diseases), forecast yields.

1.4. High-performing research bodies, by typology

In Poland, the main research role, driving and analyzing the state of agriculture is mainly played by universities and research institutes. Among them, the greatest role is played by :

- Institute of Machine Operation, Ergonomics and Production Processes
- Agency for Restructuring and Modernization of Agriculture in Warsaw
- Central Center for the Study of Varieties of Crop Plants in Stupia Wielka
- Institute of Agricultural and Food Biotechnology prof. Wacław Dąbrowski in Warsaw
- Institute of Agricultural and Food Economics - National Research Institute in Warsaw
- Institute of Plant Breeding and Acclimatization - National Research Institute in Radzików
- Institute of Agricultural and Forest Environment of the Polish Academy of Sciences in Poznań
- Institute of Plant Protection - National Research Institute in Poznań
- Institute of Horticulture in Skierniewice
- Institute of Technology and Life Sciences in Falenty
- Institute of Cultivation, Fertilization and Soil Science - National Research Institute in Puławy
- Institute of Natural Fibers and Herb Plants in Poznań
- Institute of Animal Production - National Research Institute in Krakow
- National Center for Agricultural Education in Brwinów

- National Agricultural Support Center in Warsaw
- National Institute of Rural Culture and Heritage in Warsaw
- The Vegetable Research Institute Emil Chroboczek in Skierniewice
- the Institute of Pomology and Floriculture. Stephen Pieniazek
- Institute of Plant Breeding and Acclimatization in Radzików
- Central Center for the Study of Varieties of Crop Plants
- Institute of Building, Mechanization and Electrification of Agriculture
- Institute of Animal Production - National Research Institute in Krakow
- National Veterinary Institute - National Research Institute in Puławy

1.5. Overview of existing networks

In Poland, the leading networks that distribute solutions, information, and manage communication and funding are Agricultural Advisory Centers, oriented in every region in Poland (ODR). The National Center for Agricultural Support takes care of the regional institutions of the ODR.

In addition, supporting and important in the implementation of system solutions for innovation, as well as the distribution of equipment, machines are also:

- Network for innovation in agriculture and in rural areas - SIR, operates within the National Rural Development Network (NRN subnet) and is of an open nature. Network participants can be all entities involved in the development of agriculture and rural areas. The tasks of the Network for innovation in agriculture and rural areas, including the tasks of an innovation broker, are carried out by WODRs located in all 16 voivodships
- The European Innovation Partnership for efficient and sustainable agriculture (EIP-AGRI) is a new tool to support the agricultural and forestry sector. Its primary goal is to increase efficiency, sustainable economy and create opportunities to solve current problems such as strong competition, unstable market prices, climate change or tougher environmental regulations.
- The EIP-AGRI network focuses on establishing partnerships and contacting people from various specialties within the EIP-AGRI network to carry out work focused on various fields within the EIP-AGRI operational and focus groups.
- ENTAM European Agricultural Machines Research Network, of which a Polish institution is also a member,

An important role in the distribution of solutions and knowledge of precision farming is also played by scientific conferences implemented by institutes and universities in Poland, including:

- the conference "Precision Future of Agriculture, organized by the Center for Precision Agriculture in Medium Ducks.
- Innovative Agriculture conference organized at the Polagra fair
- Conference "Precision farming in Poland - today and tomorrow"
- Scientific conference 'Organic farming - current state and development perspectives - techniques, technologies, food production', whose leader is the Industrial Institute of Agricultural Machines - The main purpose of the conference is to present the results of scientific research related to organic farming and pro-ecological activities in modern agriculture, carried out in scientific units and universities in the country.
- Conference "Agriculture of the 21st Century" - problems and challenges - organized by the "Krzyżowa" International Conference Center.