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Education material package: Implementation road map

Material prepared under the project *Farm to Fork Academy: V4 for Sustainable Agriculture in Albania,* supported by the **International Visegrad Fund** and implemented by **Albanian Network for Rural Development**, in partnership with Rural Parliament in Slovakia, Hungarian National Rural Network, Local Action Group „Vistula – Terra Culmensis" and Czech-Moravian Association of Agricultural Entrepreneurs

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What are the main reasons for introducing the "For Biodiversity" and "Farm to Fork" strategies?

For many years now, the European Union has been discussing the future of agriculture and the food industry in the context of progressing climate change. Hence, it is not surprising to create new development strategies, such as the "Green Deal", which is supposed to lead to better welfare of people and the planet, better profit for agricultural producers and production of safe food. And so, as part of the "Green Deal", the European Commission has adopted a new strategy "For Biodiversity", the aim of which is the so-called "Return to nature" (production as it was) and the "Farm to Fork" strategy to promote a healthy and environmentally friendly food system. There is still debate in the European Commission on methods to bring the agricultural sector and food production to climate neutrality. It is not easy, because generally understood agriculture and agricultural production are "victims" of climate change, and at the same time have a significant share in the emission of greenhouse gases.

The *"From Farm to Fork"* strategy assumes that by 2030 25% of agricultural land should be used in accordance with the principles of organic farming. It is worth noting that when setting such ambitious goals in the field of organic production, the European Commission must also take into account the cumulative social and economic effects in a given country. Organic crops usually bring lower yields than conventional (integrated) crops. The effect of expanding organic farming areas may therefore be that some countries may become food importers.

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In organic production, protection is aimed at eliminating the causes, not the effects. Therefore, the main factors in the protection of crops against pests are preventive measures and direct treatments. The preventive measures include: determining the correct crop rotation, natural fertilization, plant density, selection of appropriate species and varieties (fast-growing and soil-shading varieties), sowing date and standard, mixed sowing, etc. soil and increase plant resistance in order to minimize the occurrence of harmful organisms.

Only when these methods prove to be insufficient, there non-chemical plant protection products can be used, the ones permitted by law. In the protection against weeds, direct treatments are important, such as mechanical weeding, carried out with the use of harrows, hillers, weeder. On the other hand, the application of spraying treatments with the use of natural plant preparations (e.g. plant extracts, herbal infusions and decoctions produced on the farm) is to fulfill a prophylactic role, i.e. to strengthen, immunize the crop against infections from pathogens or deter pests.

Biological methods play a significant role in integrated plant protection, but mainly in crops under cover. In allotment and home gardens, only bacterial preparations based on Bacillus thuringiensis are used to combat the caterpillars of such butterflies as, for example, early primeval moth. Marshmallow grubs and larvae are controlled with preparations based on entomopathogenic nematodes: Heterorhabditis bacteriophora and H. megidis. Hence, the focus should be on ensuring the safety of beneficial organisms and creating optimal living conditions

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for them. In this case, knowing how to recognize them is important not to consider them as harmful organisms, which is often the case with ladybug pupae, which are confused with the larvae and pupae of the Colorado potato beetle, and adult hoverflies (Syrphidae) are mistaken for wasps. Among the beneficial organisms, ladybirds (Coccinellidae) play an important role, whose beetles and larvae eat aphids with great appetite.[1]

Sustainable farming and the new agricultural culture are based on the protection and construction of arable land. Its main parts will be provided by soil cover crops and no-till, striptease cultivation systems. Leaving plant residues on the soil surface, permanent soil cover, sowing of soil cover plants not only ensure the replenishment of organic matter, but also help to prevent climate damage. Of course, it is essential to provide a modern agrotechnical background for all this!

One of the basic elements of the system is stubble cultivation following water harvesting plants, water-preserving stubble care. Shallow stubble plowing eliminates capillaries, thereby helping the water balance of the soil and reducing evaporation. The operation favors the germination of orphans and weeds. Favorable conditions are developing for soil life. In the loosened layer of soil with the right pH value, the living and growth conditions of the mixed stem residues and microorganisms that decompose plant parts are further improved. Proper technical background is important. High-quality stubble care is made possible by the forage

[1] *METODYKA INTEGROWANEJ OCHRONY ROŚLIN OZDOBNYCH W OGRODACH PRZYDOMOWYCH*, https://www.agrofagi.com.pl/plik,1060,metodyka-integrowanej-ochrony-roslin-ozdobnych-w-ogrodach-przydomowych-pdf.pdf

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harvesters and chaff spreaders of modern harvesting and threshing machines. Evenly distributed, optimally sized residues are most often with disc harrows (heavy and short discs), field cultivators, shovel harrows, work into the soil with mulch cultivators. If we have created favorable conditions for stem-breaking bacteria with the appropriate humic acid technology, and plant residues have been incorporated into the soil during stubble care, we can start planning the use of cover crops that are suitable for our crop rotation and soil conditions and field conditions. Before introducing soil-improving farming practices, it is important to examine and record the initial conditions. The data offsets the costs, the process becomes measurable. Soil test results can later be supplemented with satellite imagery, drone surveys, and yield maps. Reasonable soil improvement and diversified crop rotation also provide the background and basis for the differentiated application of input materials and the introduction of a precision management system. If we have created favorable conditions for stem-breaking bacteria with the appropriate humic acid technology, and the plant residues have been incorporated into the soil during stubble care, we can start planning the use of cover crops that suit our crop rotation and soil conditions and field conditions. Before we start introducing soil-improving farming practices, it is important to examine and record the initial conditions. The data offsets the costs, the process becomes measurable. Soil test results can later be supplemented with satellite imagery, drone surveys, and yield maps. Reasonable soil improvement and diversified crop rotation also provide the background and basis for the differentiated application of input materials and the introduction of a precision

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management system. If we have created favorable conditions for stem-breaking bacteria with the appropriate humic acid technology, and the plant residues have been incorporated into the soil during stubble care, we can start planning the use of cover crops that suit our crop rotation and soil conditions and field conditions. Before we start introducing soil-improving farming practices, it is important to examine and record the initial conditions. The data offsets the costs, the process becomes measurable. Soil test results can later be supplemented with satellite imagery, drone surveys, and yield maps. Reasonable soil improvement and diversified crop rotation also provide the background and basis for the differentiated application of input materials and the introduction of a precision management system.

The **resilience** – or - **elastic resistance** is the ability of a system to maintain its basic functions against a single, repeated or continuous exposure and adapt to a new situation.

Extreme periods of droughts, heat waves and precipitation have been observed in recent years. In addition to climate change, the damage to nature caused by human activities, including industrial agriculture, and the loss of biodiversity also have an impact on the continuity of agricultural production. The drastic reduction in the number of pollinators and the fertility of soils, the increase in the areas involved in production and thus the disappearance of wild habitats are also endangering long-term food security and public health.

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In a warming climate, alien pests, weeds and diseases can settle, to which farming systems can only respond slowly - thus causing significant damage. However, **soil and water are central to the agricultural problems caused by climate change:** large amounts of rain cover the upper layers of the soil at the same time - the environmental sensitivity of cultivated soils is even higher, low land cover and soil structure disturbed by plowing impair drainage and water retention.

Looking at the whole food system, in addition to environmental problems, social and economic processes also affect the continuity of food production and distribution. Of these, important are, for example, the resources needed for production, processing and storage, the availability of labor or the accessibility of transport. Access to food can also be hampered by rising food prices, the remoteness of markets and their supply. The global supply chain operates along a very complex, multi-component logistics, resources, processes and results are precisely calculated. As a result, it can operate relatively oiled, but if sand grains get into the machine, it can easily get stuck. During the COVID-19 epidemic in the spring of 2020, for example, obstacles to the free movement of workers across Europe caused problems, which was mainly a problem when harvesting fresh market crops. Slowing transport due to more expensive production resources, labor shortages and border closures also contributed to the significant increase in the prices of fruits and vegetables, which reduced the availability of these products, as some consumers are unable to pay these higher prices. It is also clear from this example that the environmental and social impacts that threaten food security are

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always more pronounced in already vulnerable groups. as some consumers are unable to pay these higher prices. It is also clear from this example that the environmental and social impacts that threaten food security are always more pronounced in already vulnerable groups. as some consumers are unable to pay these higher prices. It is also clear from this example that the environmental and social impacts that threaten food security are always more pronounced in already vulnerable groups.

Agricultural and food systems in the broadest sense need to provide the right amount and quality of food for an increasing number of people in the coming decades. In addition, the livelihoods of about 2.5 billion people worldwide depend directly or indirectly on agriculture; exposed to environmental disasters, social, economic and political situations. Sudden disasters and crises not only affect the structures of food systems in the short term, but also undermine the structures of food systems in the long term. Large-scale crisis funds and food aid can only provide temporary help - they are not a solution in the long term, and forecasting disasters is only enough to reduce harm. One of the milestones of sustainable development is the resilience of agricultural production and related livelihoods.

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One of the most catchy phrases for industrial agriculture to meet the challenges of climate change is **sustainable intensification**, what means increasing productivity in a given unit area, taking into account social and environmental impacts. Its methods include, for example, advanced irrigation technologies, increasing yields per given input, genetic engineering solutions, and climate-smart technologies to reduce greenhouse gas emissions. According to his critics, sustainable intensification is too general a concept and does not take into account the vulnerabilities of natural systems, injustices and distribution problems in the food system, or address the issue of food waste; that is, that there is still enough food in

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the world, just not everyone gets it, because there are problems with distribution and access. Increased efficiency, insofar as it reduces the diversity of the system, it may even result in a decrease in resilience as it may result in the loss of buffer elements. For example, if a farmer starts growing monocultural field crops and the yield is not as expected due to weather conditions in one year, the farmer loses significant income, but if the farmer has more crops in the same area, albeit at a lower yield, but can expect more stable revenue. Productivity has been able to increase where the achievements of industrial agriculture are readily available, but this increase has been to the detriment of ecosystem services. A narrow interpretation of efficiency can lead to fluctuating yields and fluctuating food prices without striving for resilience. As we produce animal feed on a significant part of agricultural land, it could be an important consideration in the future.

The current paradigm in the dialogue around sustainable agriculture is that production should be optimized taking into account relative economic, social and environmental costs. However, it would be worthwhile to steer the dialogue on how we can build an agricultural system that meets both current and future challenges. Successful agriculture, by its industrial definition, is characterized by high yields and low costs, ignoring externalities; but beyond that, it would be essential to develop food systems that, while taking social justice into account, can simultaneously reduce the quantity and quality of food worldwide, ensure the livelihood of those working in agriculture, and preserve its functions for future generations.

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What makes an agricultural system resilient?

Adaptation means avoiding, reducing harm, and seizing opportunities. **Adaptability is the ability of** a system to change its operation in response to external conditions. For long-term sustainability and adaptation, agricultural systems need to be able to change relatively quickly. **The ability to change (transformability**) is the ability to realize a completely new type of development, it is a fundamental change that includes not only productivity, but also the creation of new structures, functions, feedback opportunities.

In a human-shaped environmental system, high external pressures can cross a critical point at any time. Resilient agriculture allows for adaptation to changing environmental conditions and human needs while remaining within the critical resource framework. Diverse farming systems are more likely to be able to return to their original state after extreme environmental effects such as drought or flood. **Agroecological practices restore the biodiversity of agricultural systems** and also provide habitat for a community of organisms capable of controlling pests and pathogens. The diversity of the production system also strengthens socio-economic resilience: producers reduce their vulnerability if a crop or animal product fails in a given season and can rely on other sources of income. Reducing reliance on external resources also contributes to the economic independence of producers.

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Agriculture must both reduce and adapt to adverse climatic effects, which is most possible if the structure of agricultural production is organized in accordance with local ecological conditions. The basis and elementary condition of this is the proper management of water and soil - retention of water, facilitation of seepage into the soil, reduction of soil erosion. both in animals. They conserve natural resources, do not burden the environment, save water and energy, and build on local knowledge and traditional knowledge.

Soil organic matter content is continuously improved by agro-ecological practices with compost, manure, green manure plants, plant residues which has a positive effect on soil health; biological activity and physical and chemical properties. The high organic matter content increases the water retention capacity of the soil, improves drought tolerance, allows water to enter better, thus reducing the risk of leaching-leaching; but it also stabilizes surface soil particles so it is less exposed to wind-induced erosion.

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Resilient agriculture also meets the needs of food and development, both in the short and long term, locally and globally, without destabilizing the planet's biophysical system - that is, contributing to climate change. The **agro - ecological approach** wants to achieve not only survival but also systemic transformation by conserving natural resources and increasing social capital. Thus, the food system may be able to respond to changing environmental challenges and human needs at the same time. For systemic transformation, production and consumption practices also need to be radically overhauled. No matter how much food an agricultural system produces, if it causes a long-term environmental crisis or makes it impossible for local communities to make a living, it cannot be resilient. From the point of view of resilience, it is essential to maintain ecosystem services and to apply local solutions and practices adapted to a given agricultural region. The global resilient agricultural system will consist of a mosaic of several regions, will be characterized by social and environmental diversity. In addition, strengthening the resilience of rural producers and communities, the use of polycultures, agroforestry systems, animal-plant integrated systems, and ecological soil management can promote resilience. Traditional farming systems can also provide many good examples of climate-resilient production.

The term **functional diversity** covers the diversity of all living organisms and the ecosystem services they provide. Different species or varieties have different roles in an ecosystem, if one group is unable to perform its function, another group can take over the function instead. The **responsive diversity** the set of responses to

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environmental change by living organisms that perform the same ecological function. The higher the responsive diversity, the better the system is able to adapt to the effects of shock and stress. Because of their genetic and ecological uniformity, monocultures perform poorly in both functional and responsive diversity, and these ecological functions must be replaced by external inputs in the event of a shock. For example, in the event of an insect pest multiplying, insecticides must be used, but they also degrade beneficial insects, thus fundamentally destroying the long-term resilience of the system.

It would be important to apply the approach of resilient agriculture at different levels:

- **At plot level:** Performance can be improved through specific agro-ecological practices, taking into account climate change. For example, the installation of shading strips of wood to equalize the temperature, improving resistance to proliferating pests and diseases by increasing variety; improving water infiltration and water retention, reducing evaporation by increasing soil carbon (mulch, cover crops, organic nutrient replenishment), increasing drought resistance
- **Farm level** is important to the livelihood of the farmers level to stand several feet, draw on multiple sources of income by marketing various products and services, minimizing external resources to reduce economic vulnerability

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- **Landscape: At Community level:** Resilience can be strengthened through joint management of ecological services (e.g planting of bushy strips, joint flood water protection, integration of animal and plant production systems)
- **At the level of the food chain:** Coordinated organization of production and consumption

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Examples of best practices, solutions and most innovation start-ups from V4 countries

Collection of on-farm innovations and solutions which are easy to apply, directly benefit farmer entrepreneurs and favor development of rural areas in general. Profitable, beneficial and useful adjustments for farms can significantly support increase of production. These may be, as provided below: innovative, smart farming techniques, like precision agriculture tools and efficient agri-tech methods.

Modern technologies in agriculture: Satellite data use

Every season, farmers face decisions regarding amounts of fertilizer and plant production products needed for their fields. Traditionally, each field has been treated as a single area, with no distinction made regarding soil quality response or mineral richness. Modern agriculture takes account of variations within fields and matches fertilizing strategies to local conditions.

Farms consume large amounts of fertilizers and plant protection products. Satellite surveillance of farmland developed by Polish start-up 'SatAgro' means significant savings for farmers. A desktop control panel allows them to monitor productivity of cultivated land and analyze historical data, including meteorological data, on an ongoing basis. They can then optimize agrochemical doses, which also minimizes environmental impact. The SatAgro application processes satellite data to help farmers monitor crop changes. The data is then used for mapping to show farmers

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where fertilizers and protection products need to be applied. This saves money and is a more environmentally friendly way of increasing crop yield.

The SatAgro application enables the use of automatically processed satellite data in the monitoring of arable fields. Its purpose is to provide up-to-date information on the condition of cultivation and its diversity in space and time, so that customers - farms, can implement precision farming techniques. This type of agriculture assumes that agronomic treatments, including the dosing of agrochemicals, should be better adapted to the local properties of plants and their habitat. This allows for better production results while optimizing the measures used.

The SatAgro application is based on a number of modern technologies: satellite observations (from NASA, the European Space Agency and private operators, including the American company Planet, which is revolutionizing the satellite monitoring sector), internet technologies providing geographic data or computer algorithms for data processing. Thanks to GPS geolocation on mobile devices application not only shows the users current location in the field, but also local map values. Maps and table data can be easily exported to other applications, using popular file formats. With satellite data, it is easier to monitor the state of the crop in each field. Highlight the variabilities in plant growth and plan appropriate, tailored

https://satagro.pl/

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agronomy, from establishment to harvest.

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LED technologies used in horticulture

'Plantalux' is family-owned Lublin-based start-up dealing with technology supporting plant growth under greenhouse crops. Company's experts designed and then created a COB LED lamp with a selected light spectrum, necessary for the proper course of photosynthesis. Combined with high energy efficiency, this causes almost all electricity to be converted into light absorbed by plants. The company's project involves the commencement of production and the introduction to the market of lighting fixtures for lighting plants (vegetables, fruit, flowers) in greenhouses. Ultimately, the lamp will work with an application supporting its operation and a number of external sensors (humidity, temperature, carbon dioxide, sunlight) in order to optimize plant growth. The company has built an application that works with a number of sensors, which in combination with lamps creates a coherent system, allowing for efficient planning and management of greenhouse production, while reducing electricity consumption. Three types of high-performance LEDs in COB technology (the so-called multi-junction diode) were used as light sources. The combination of high-performance and energy-saving COB LEDs along with the application and external sensors will allow for optimal selection of parameters for plant breeding. This helps to take control over growth time, harvest planning and process automation while minimizing electricity consumption and human labor. In combination with high energy efficiency, this causes almost all electricity to be converted into light absorbed by plants. The LED COB solution allows adjustment to the light of a specific plant growth phase and the individual conditions of a given species. This enables the creation of an optimal

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climate for crops, even in winter, significantly minimizing the costs of plant lighting (three times savings compared to traditional lighting). LED technologies used in horticulture respond to growing needs and expectations from producers in this sector. The market expects solutions that reduce costs and ensure plant safety, while guaranteeing the success of production. Installations based on LED technology is a new possibility that allows to adjust the greenhouse lighting to the individual requirements of the cultivated plants, as well as to changing weather conditions. The benefits of this progress are also gaining more and more support among producers of the greenhouse horticulture industry in Poland. It is believed, that the use of LED lighting in the horticulture industry is increasing due to the multitude of benefits of using this technology, as it is predicted that the lighting industry has good growth prospects and may be a tangible alternative to the increasingly demanding greenhouse horticulture industry.

https://plantalux.pl/en/home/

https://plantalux.pl/downloads/brochure-plantalux-en.pdf

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Collection of agri-data for crops monitoring

As agricultural production is burdened with many risks, well-defined, however, unpredictable, which, if they occur, destroy all production and financial plans. The industry lacks the tools to control and predict unwanted phenomena. Preventive treatments generate enormous costs and have a negative impact on the environment and product quality, without giving any guarantee.

Mission of polish start-up 'Digital Crops' is to develop a platform that will equip farmers, producers, insurance and consulting companies, research units with a tool for monitoring crops, predicting threats, reliable calculations and maintaining the quality parameters of cultivation. It allows to monitor the crop from planning to harvest, from soil research to satellite photos. The basis of Digital Crops' activities are research and development projects that will enable recipients to increase the profitability of crops, cost analysis and optimization of agricultural production. Digital Crops are currently working on numerous of solutions: biological hazard prediction system, counteracting drought - precise irrigation, Increasing the efficiency of agricultural production through the analysis of environmental conditions and an automatic decision support system, Automatic loss estimation based on satellite and drone images for the insurance industry and agri-food producers, optimizing the preparation of crops for wintering, Development of algorithms for estimating the dose of a plant protection product depending on weather conditions, plant development phase.

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Recipients of solutions of Digital Crops are from agricultural and food industry**, insurance industry:** farmers, fruit growers, producers of agricultural chemicals, agricultural consulting companies, state and scientific institutions, moreover, company invites manufacturers of equipment and chemicals, research institutes and contracting companies willing to cooperate what enriches research and development sector in agriculture sector. By producing its own sensors and software, company can adapt the products to particular needs and unique requirements.

One of Digital Crops' adjustments is optimization of phosphorus fertilization: phosphorus is found in the plant in mineral and organic form. Mineral phosphorus, occurring mainly as orthophosphates and to a lesser extent as pyrophosphates, acts as a cell juice buffer system, preventing major changes in pH. It is necessary for the formation of organic compounds, the most important of which are: esters, phytic acid and its salts, phospholipids, deoxyribonucleic acid and coenzymes.

Yet another innovative solution is usage of electromagnetic soil scanning is the basis of precision farming, as the knowledge of the variability of the soil structure within a given field is the basis of modern, modern agriculture - allowing to reduce the use of production resources, e.g. thanks to the precise adjustment of nutrient and water doses to the actual needs of a given crop.

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actual needs of a given crop. One of the most reliable, non-invasive methods used to identify the soil variability of the production field is the measurement of the electrical conductivity. With a large variety of soil conditions within a given field, there may be a significant discrepancy in the fertilization needs of plants. The use of the same, determined for the entire crop dose of fertilizer is associated with inadequate supplying the plants with nutrients - in this case, some of the crops may suffer from nutrient deficiencies (lower yield of plants, negative impact on health), where in other parts of the field too much fertilizer is delivered will be washed into surface water or groundwater, posing a threat to the natural environment. Adjusted

https://www.digitalcrops.pl/

to the actual needs of a given crop, fertilizer doses will not only reduce their negative impact on the environment, but also reduce the amount of financial outlays.

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Czech Agri-Tech solution: Everything for smart farming in one system

Agdata is an agricultural system, thanks to which user has an overview of his farm anytime and anywhere. It is available from the browser and mobile phone. It allows easy planning of crops, field work, property management or, for example, automatic recording of activities. It draws important data from the agricultural registers of the Farmer's Portal and ČÚZK and is closely connected to many physical devices such as GPS or wireless sensors, which provide with real-time telematics of machines or information about warehouse conditions. Use economical GPS units, machine chips and tractor operators to save the amount of time that would be spend otherwise routinely recording every field work.

As soon as a tractor equipped with a GPS unit starts working on the plots, Agdata will record basic information about the tractor driving in the field: additionally, if ID chips are used, it will also recognize what type of field work it is and store information about the connected aggregation and driver.

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Source: https://www.agdata.cz/wp-content/uploads/2020/06/agdata_meteo_detail-177x142.jpg

In addition, user can monitor the progress of work in real time in his browser, providing constant overview of the progress of work.

Satellite Imaging, provided under Agdata:

- Supports early identification of problematic vegetation sites;
- identification of variability within the parcel;
- makes it easy to find a problematic place in the field;
- facilitate comparison of crop performance in individual fields;
- enable monitoring the impact of agrotechnical work;
- provide basis for the creation of variable maps;

https://www.agdata.cz

- It costs only 19 CZK for ha per year (0,75 EUR)

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Hungarian IT-Agri tech tool - AGRIGO

Example of Hungarian agri-tool, easy, intuitive based on monitoring solutions that include sensors, cloud-based data storage, and online user interface. The system allows the following measurements: temperature, light, humidity, door opening, monitoring of power failures, connection and control of electrical equipment, and connection of existing automation systems (for example silo scale, water meter etc.). The central unit provides remote access over the Internet, allowing users to reach or even interfere anywhere in the world, and receive instant alerts on their mobile devices via email or sms in case of critical sensor values or unauthorized door openings.

Sectors that Agrigo is focused on: 1. Poultry farms, measuring stable temperature, egg counting, power failure and door opening; 2. Greenhouses, checking: Temperature, humidity, light sensor, soil moisture, power failure and door opening; 3. Pig farms, checking: Temperature, power failure and door opening; 4. Apiaries, measuring: Hive temperature, displacement sensing, opening detection 5. Aquaculture, focused on: water temperature and pollution accumulation; 6. Mushroom farms, for which temperature, power failure and door opening are measured.

https://agrigo.farm/product

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Vertical farming: alternative to modern plant breeding

Vertical farming is a method developing quite strongly in the world, but is still mostly focused on consumer use. Polish start-up 'Vertigo Farms' was the first in Europe that managed to obtain pure extracts from plants grown with this technique. At Vertigo Farms, the plants are not only cultivated in a completely ecological way, but also thanks to supercritical extraction with carbon dioxide, they obtain maximum nutritional value. Firstly, plants are dried, then carbon dioxide is passed through dried plants in a gaseous, which allows to extract oily substances from plants and to obtain essential oils for further processing or as the end product. Carbon dioxide reaches a supercritical state at a temperature of 31.1 degrees C. When a molecule is in a supercritical state, it has the properties of both a liquid and a gas. The carbon dioxide can then escape into the small spaces, but can also act as a liquid solvent. The physical properties of supercritical carbon dioxide can be easily manipulated, allowing it to bind to any molecule. Moreover, the extraction of supercritical carbon dioxide removes pollutants and is environmentally friendly.

In the case of Vertigo Farms, plants are free of chemicals thanks to breeding and extraction, resulting in a completely clean and ecological product. This method is primarily the health of consumers, but is also good for the environment. There is no need to transport extracts or entire raw materials from the other side of the world, what contributes to carbon dioxide emissions; moreover, chemicals are not used and farmland is degraded. Additionally, solution leads to saving water, as the

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technology uses 90 to 95% less water than comparable cultivation in traditional agricultural methods. Vertigo Farms facilitates production of crops from which it is possible to make extracts, which go to food, cosmetics and medicines, which have the highest quality, free from microplastics, heavy metals, and contaminants that

http://vertigofarms.eu/

negatively affect humans health.

Leveraging regular security cameras - SERKET

Inspired by the hardworking farmers who feed the world, Serket is an award-winning technology company that is developing a sensor-free artificial intelligence that uses camera vision to enhance farm productivity and promote the health of individual animals. By monitoring changes in animal behavior in real time, we enable farmers to pin-point sick livestock and intervene immediately.

Serket helps to ensure that these challenges are met with innovative solutions to identify problems early on and lead the whole industry to new growth opportunities. SERKET developed the world's most advanced technology for pig farms today: technology that's transformational for animals, farmers and the production of meat. Using regular security cameras and artificial intelligence to identify health,

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reproduction and environmental changes early on, we translate visual information into actionable data.

Start-up addresses the tendency of artificial intelligence being rapidly becoming essential in agriculture in terms of farming efficiency, sales and logistics, and overall productivity. Due to that, its goal to help improve the livestock management process by helping to reduce global antibiotics use and day-to-day operational challenges. Ability to make agriculture a more natural and engaging industry for the next generation can help feed more population in future, while also strengthening the industry as a cornerstone of a sustainable civilization.

With Serket, farmers can minimize antibiotics usage, reduce feeding costs, and lower mortality rates to animal welfare and raise healthier livestock. Start-up mission is to make agriculture a more natural and engaging industry for future generations. Given the very nature of its business, the pig farming industry is continuously faced with challenges such as: the high mortality rate in farms; the excessive use of antibiotics and animals welfare issues.

https://www.serket-tech.com/

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Polish smart climate change adjusted vineyard support tool

Tool proposed by 'Vinum40', polish agri-tech start-up is the response for effect of climate changes on the agriculture - visible especially in European viticulture, as weather anomalies, droughts, hailstorms, that vine-growers have to face them every year. Around 60% of global wine production is performed in Europe. Traditional wine regions in Europe are the ones that will be negatively affected by climate changes in the nearest future. As the remedy for this problem, scientists recommend vineyard relocation or cultivation of other grape varieties, more suitable to extreme environmental conditions.

In order to determine the factors affecting the terroir, there are comprehensive environmental conditions analysis provided: Vinum 4.0 uses satellite data regarding land topography, climate, vegetation cover. Furthermore, there is defined the type of the soil according to European Soil Database and investigate for potential sources of pollution. According to historic climate data, Vinum 4.0

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calculates: Winkler Index, duration of growing season, to determine winds, average rainfall, average solar irradiation, and the occurrence of weather anomalies. All this information enables to find the most suitable locations for the vineyard.

Firstly, there is soil analysis performed, which includes inter alia pH measurement, plant nutrients concentration, clayey soil particles content, soil dry matter density, soil water holding capacity and soil contamination. Additionally, there is also the air pollution analyzed, what includes measurements of nitrogen oxides, sulphur dioxide, fine particles PM10 and PM2,5, and ozone.

Sensors used by Vinum 4.0 are long-lasting wireless devices, which do not need any external power sources or battery replacement to operate due to the usage of photovoltaic cell. Sensors are energy-efficient thanks to ultra-low power communication protocol, and low-power electronic components. Vinum 4.0 provides with an information regarding temperature, insolation, air and soil humidity, precipitation and wind. What is more, system provides reliable weather forecast, and notifications regarding an occurrence of adverse weather conditions or anomalies. User is notified of possible adverse weather conditions and a need of irrigation or fertilization, moreover, there is provided with historic data and statistical information about particular vineyard. All the weather parameters data are collected – that makes them accessible anytime when needed. Authors of system claim that growing vineyard is a long-term investment and process full of hard work, and it is how tool supports vine-growers and vineyard owners. Vinum 4.0 is a system for vineyards site selection, vineyard monitoring and management, which is based on satellite and wireless sensors data. The user - vine-grower or vineyard

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owner is provided with a mobile application and a set of wireless sensors to monitor environmental conditions in the vineyard - system helps to find the most

www.vinum40.eu

suitable site and to manage the vineyard.

Use of drones in agriculture

Alzagro, start-up founded in Hungary, designs and produces drones for the Agriculture industry. The drones can gather the samples of specific grains in just 10 seconds, then check their quality and content of protein, sugar, moisture, gluten or other ingredients.

Later, the data is processed by the NIR analysis system, which provides farmers with clear insight into the quality of their grains and helps to make a precise evaluation of their harvest.

https://www.alzagro.com/

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Hungarian Smart Vineyard

Startup that has forever changed the wine industry in Hungary. It provides complex care for vineyards by microclimate monitoring, disease prevention and measuring all-weather parameters with special integrated LHT sensors. The company provides both portable hardware and user-friendly software which is very intuitive in use.

SmartVineyard systems include precision sensors capable of capturing the most accurate weather parameters. Special integrated LHT sensor was designed to measure all parameters (from leaf moisture to humidity) that play a key role in the ignition of grape diseases. Specially designed for grapes, the sensor is portable and can be placed among leaves to deliver viticulturists the most reliable results. Understanding vineyard varieties, SmartVineyard precision viticulture system was designed to measure micro-zones. Thus, the most accurate disease, weather information could be delivered, on which dozens of viticulturists rely today. With the deployment of SmartVineyard sensor station, precise monitoring of microclimatic conditions and the intensity of fungal diseases becomes possible. The peculiarity of SmartVineyard systems is the ability to calculate local grape disease intensity from the data captured by the on-site sensors. These disease related predictions, alerts, forecast can be easily monitored via charts and graphs on computer or smartphone. Such information on diseases like downy mildew, powdery mildew or

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botrytis can support viticulturists in planning their grape protection activities.

Polish wheat bran tableware

'Biotrem' is a Polish technology company developing an innovative production process of bio-based tableware and packaging. Biotrem's wheat bran tableware production process was invented by Mr. Jerzy Wysocki, whose family's milling traditions date back to the beginning of the twentieth century. Biotrem's modern and booming production facility offers a wide range of fully biodegradable tableware and cutlery produced from natural and edible wheat bran. Their technologies are protected by numerous international patents.

Clean, environmentally friendly technological process of manufacturing of disposable wheat bran tableware is based on natural raw materials – wheat bran and small amounts of water. The rest is done by high pressure and high temperature. Biotrem's disposable products, made from wheat bran, are an excellent alternative to any disposable tableware, i.e. made from paper or plastic, which production is burdensome to the environment. Production process does not require significant amounts of water, mineral resources, or chemical compounds.

From 1 ton of pure, edible wheat bran there 10,000 units of plates or bowls can be produced. What's more important, Biotrems products are fully biodegradable – through composting – in just 30 days. Biotrem's disposable wheat bran tableware is suitable for serving hot and cold meals. It can be used in classic ovens or microwave ovens.

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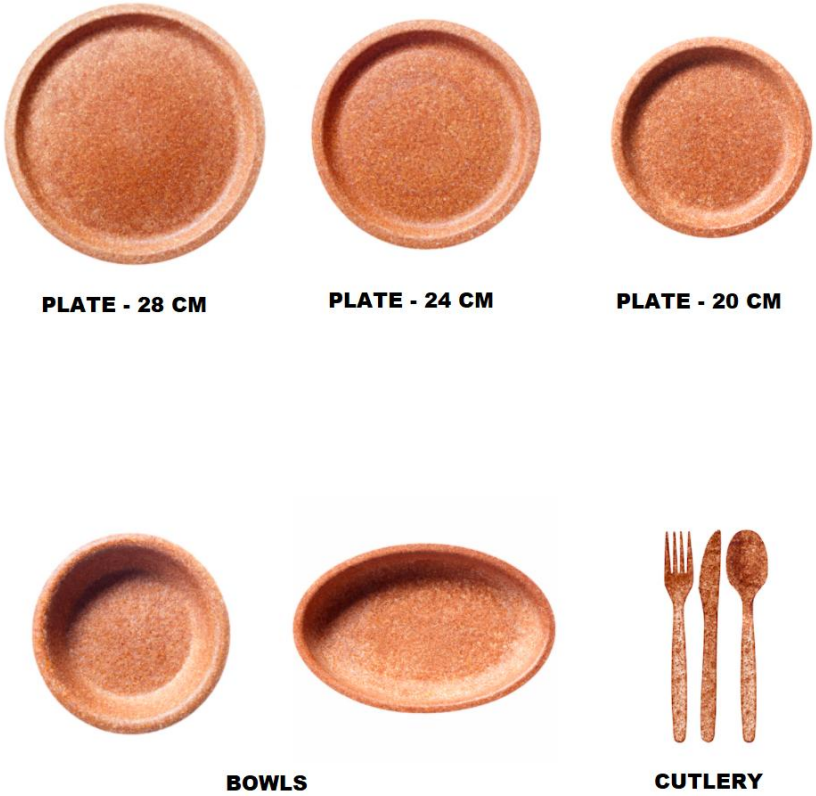
Biotrem products are robust, stable and can be comfortably and safely used at home, on a picnic, in the bar, during the open-air even or in the restaurant. Moreover, once their plates and bowls are made from clean edible wheat bran, they are also edible!

Biotrem's current production line's performance is estimated at approx. 15 million pieces of biodegradable disposable plates or bowls a year. Production in placed in Zambrow – located in an ecologically clean, traditionally agricultural region of Poland, which have a permanent access to high quality raw material. Standardization and reproducibility of the production process guarantees an easy and rapid reaction to the growing market demands.



Biotrem offer, source: http://biotrem.pl/pl/#products-intro

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The patented technology allows the company to manufacture a biodegradable disposable tableware from sustainable organic raw materials, such as wheat bran, corn bran, cassava by-products, seaweed, algae, and also from bio-based polymers. With own production facility and state-of-the-art machine park (developed internally and patent-protected),

Biotrem delivers its products to mass-market clients including selected restaurant chains and premium retailers, either directly or through independent distributors.

http://biotrem.pl/en/

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Organic farming combined with tourism – Juchowo Village in Poland

Biodynamic agriculture is associated with cultural and agrarian development, aimed at restoring soil fertility in the context of social trespass. This is the keynote of the Rural Project run in three villages Juchowo, Radacz and Kądzielna. Juchowo Farm has been pursuing above goals since 2000. In the future, the project will create a model research and development farm for Central and Eastern Europe, dealing mainly with research and all issues related to biodynamic and ecological farming. It also will provide education and training for people working on biodynamic farms and in the field of natural environment. In the area of Juchowo Farm, soil structure that has been neglected for several years was rebuild, moreover, on fields and meadows, thanks to biodynamic cultivation, it was possible to create conditions that allow healthy development of organisms in the soil and the restoration of the humus layer, what makes possible to rebuild the necessary fertility of the soil. For this purpose, the is a focus on preparing compost and distributing it on the fields. Green fertilizers, cover and catch crops, as well as the crop rotation practiced by us, give the organisms living in the soil the necessary nutrients. Activities of this type performed as part of minimal soil treatment support the formation of good soil structure. As a result, good food products for humans and animals can grow on it. Due to that, biodiversity is maintained, which is a significant contribution to the sustainable protection of natural resources. Biodynamic agriculture in Juchowo operates in a closed cycle: cows receive feed

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produced on farm. Manure is composted, and the compost fertilizes their fields. This type of economy operating in a closed system is the base of active life in the soil and maintains soil fertility. The cultivation of legumes, diversified crop rotation, careful treatment of the soil and the renewal and maintenance of water infrastructure (drainage system) are also important elements of a well-functioning circulation on the farm.

Horticultural crops are grown in the small village Kądzielnia, on the edge of a large forest complex and wide peat meadows. Several varieties of vegetables and herbs are grown here throughout the whole year. Carrots, lettuce, beans, onions, red beets, and cabbage are grown in long patches. Together with flowers and herbs, thanks to their full color and various shapes, they enrich the diverse landscape of the frontal moraine. In the foil tunnels there are veggies growing which require both warm soil and high temperatures, like tomatoes, auberges and cucumbers. Cows play an important role on the farm. They process low-value protein for high-quality milk, meat, and manure.

Cows feed primarily on grass. As a rule, grazing of animals takes place during the summer. Only when it is

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too hot, they remain in the stables and are fed with fresh fodder from the fields. During the winter, the cows receive hay made from grasses, clovers and lucerne, which after a slight drying in the meadows is dried in the hay halls with preheated air (solar energy or wood-fired stoves). Thanks to this, fragile and brittle leaf of legume plants and herbs are preserved. The hay hall is large, its capacity allows for gathering hay collected from the area of 100 ha. The fields are covered with green cover all the time, which prevents soil drying and erosion. This is very important for soil protection. In the meadows there are sown, among others, nitrogen-binding plants (legumes), which are a source of protein for animals and nutrients for soil, because legumes can bind nitrogen from the air and thus build a soil layer. Farm's mixtures of grass with clovers always contain 2% of various herb species to cover the need of animals for plant minerals. Two or three swaths of hay during the season from own and rented meadows provide feed for a herd of cows in the winter.

There are also domestic and international visits organized, which are an alternative and innovative form of both formal and informal teaching that complements traditional school teaching. During the visits, children and young people participate in practical classes of an interactive nature. The knowledge gained on the farm can be used in biology, geography, environment, ecology or economics lessons. Visits to the farm are particularly suitable for pupils who are troubled to participate in traditional school activities. Teaching in a different environment can therefore benefit groups of children and young people with special educational needs, at risk of exclusion or with learning difficulties and organic farming, as a thriving economic

https://www.juchowo.org/en/about-us.html

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sector, needs motivated young people to work.

Shortening local food supply chains: boost for micro farmers: Processing Incubator in Dwikozy

The Centre for Business Promotion and Entrepreneurship in Sandomierz, acting in a partnership with the Commune of Dwikozy, intends to establish and operate a processing incubator, also referred to as a kitchen incubator in Dwikozy. The Project is implemented under the "Świętokrzyskie Mountains Our Future" Programme co-financed by the Swiss-Polish Cooperation Programme.

The Center for Business Promotion and Entrepreneurship in Sandomierz, Poland is a non-profit foundation founded in 1991 by the Senator of the Republic of Poland Zbigniew Romaszewski and TechnoServe, an American, non-profit organization supporting the development of entrepreneurship in many agricultural regions of the world.

The Center for Business Promotion and Entrepreneurship aim is to lead and accelerate the economic transition in rural Southeastern Poland. Its early programs concentrated on agribusiness development. In recent years, its efforts expanded into general business development as well as into public sector economic and development planning and non-governmental organizations.

The Processing Incubator is a place where a farmer, agritourism farm or other owners of plant raw materials can start processing them, using the incubator's

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infrastructure, machinery and equipment and consultancy offered by the incubator operator.

For a food producer, using an incubator infrastructure can be the first step in setting up their own processing facility. Instead of starting with the costly investment of building a new plant, an unprocessed food producer can test his processing skills and marketability (packaging, labeling, distribution and sale) of his own original product in accordance with sanitary regulations. Processing and introducing new products to the food market entails certain health safety requirements. These requirements in Poland are particularly high. The requirements related to the packaging of products and the information that should be on the packaging are also important. Fulfillment of these requirements by a novice manufacturer, in a situation of uncertainty as to the market success of the offered product, don't encourage him to start business. Introducing a new product to the market often requires a trial period in order to select the best production technology and the best devices before their final purchase. Also, the adaptation or construction of suitable premises and the purchase of equipment for small production batches may not be profitable at all. A processing incubator is created for such needs, to verify the demand and the profitability of the production of a new product. Its task is incubation, helping to produce and launch a new product on the market, as well as testing the success of a new idea.

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Fig.1 Models of Incubator operational scheme

Souce: http://dobresandomierskie.pl/#inkubator

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The prime objective of the project is to activate, incubate and provide assistance to farms in the production process and marketing of local products by providing them with access to full technical infrastructure, which meets the sanitary and hygienic requirements necessary for the production. Following the establishment of the incubator, it will be possible to place new local products on the market based on the region's rich fruit and vegetable resources, which will contribute to boosting its potential with regard to the supply of local products available in the territory concerned. It will allow the local population, and most importantly, the tourists, to

https://www.opiwpr.org.pl/en/about-us

http://dobresandomierskie.pl/

develop a taste for both fresh and processed fruit and vegetables which Sandomierz Land is famous for. Economic benefits will be experienced by those farms which engage in the production and sale of products processed on the basis of their own fruit and vegetables.

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Commercialization of the Local Action Group Kitchen incubator

The LAG (Local Action Group) "Gościniec 4 Żywiołów" operates in the four municipalities of the Wadowice county Kalwaria Zebrzydowska, Lanckorona, Mucharz and Stryszów. A kitchen incubator is a facility with equipment designed for small processors of agricultural products, caterers or farmers, who can prepare and process their products in a well-equipped and prepared for this purpose, in accordance with the health and safety rules. The creation of an incubator kitchen causes the emergence of new local products from the area of the LAG “Gościniec 4 Żywiołów” and its surroundings, which will contribute to the economic development of whole area of the LAG “Gościniec 4 Żywiołów” based on local resources.

As part of the project implemented in 2011-2017, titled: "*Local product of Małopolska - development of local entrepreneurship and processing based on a partnership initiative of economic education of residents and the regional system of marketing products from Małopolska*", the LAG “Gościniec 4 Żywiołów” Association was responsible for the creation of the first Incubator Kitchen in Poland. The project was co-financed under the Swiss-Polish Cooperation Program, and the implementing institution was the Partnership for the Environment Foundation from Krakow. The kitchen incubator was built on the site of the former school in Zakrzów (in Stryszów commune); the decaying building has been completely modernized, expanded (first floor and staircase) and equipped with an elevator as well as equipment and devices for food processing. Thanks to comprehensive equipment,

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companies planning to start their prowess in the food industry and catering services do not have to incur significant investment costs when "starting" the company - by renting a kitchen incubator they significantly reduce their costs. In addition, they are not at risk of business failure. The building uses ecological solutions - a heat pump with recuperation and a gas boiler room. The value of the completed project is almost 2 million PLN (around 450k EUR). In addition to the Swiss fund, the Gościniec 4 Żywiołów association's own resources and financial support were also provided by the Stryszów commune by handing over the school building in Zakrzów along with the land for a 10-year lease period. It is also a place for running the activities of local catering companies and the created social cooperative "Smaki Gościniec".

The "Smaki Gościniec" social cooperative was established in 2015 by the ecological and cultural association "Na Bursztynowym Szklaku" and the association "Gościniec 4 Żywiołów". It hires unemployed people, brings together individual and small food producers from the Wadowice poviat. The main area of activity of the Cooperative are the following industries: catering and tourism. The cooperative deals with the production of ready meals and dishes, the production of, among others juices, bread and confectionery. These products are full of flavors and fragrances of local cuisine and do not contain preservatives and taste enhancers.

The cooperative gives the possibility to new workplaces of the unemployed, including farmers, especially female, employment of disabled people, possibility of training in food production, work on professional equipment, participation in

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competitions, fairs, special events. Cooperative activities, among others, include: sale of products at various cultural events and fairs, organization of permanent

http://gosciniec4zywiolow.pl/

points of sale of cooperative products as well as cooperating farmers and producers catering services, support for training, conferences, seminars, and business meetings and production of ready meals and dishes, food production incl. juices, bread and confectionery.

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