# Description of the specialization

I. ELEMENTS COMMON TO INNOVATIONS IN THE AGRI-FOOD AND FORESTRY AND WOOD SECTORS

1. Optimisation of production, processing and storage processes in line with the idea of sustainable development.
2. Genetic research, breeding work, molecular and biotechnological methods as well as alternative lines of production allowing to obtain high quality vegetable and animal raw materials.
3. Innovative systems and intelligent methods and tools for monitoring the production process and evaluating the quality of raw materials and finished products.
4. Innovative technologies of agri-food and forestry and wood processing to reduce the energy and water consumption and improve the production quality.
5. Acquisition and processing of bioactive compounds and other raw materials from plant material (including waste biomass) and livestock material from the agri-food and forestry and wood sectors for different industries.
6. Optimisation of management of waste and by-products from the agri-food and forestry and wood industries, including for energy purposes.
7. Methods of monitoring and counteracting the effects of natural hazards, including natural disasters disrupting the sustainable development of agricultural and forestry areas and food security.
8. Methods of monitoring the social effects of technological progress disrupting the sustainable development of agricultural and forestry areas and food security.
9. Processes, materials, measures to increase the efficiency of the protection and use of materials of agricultural and forestry origin from natural disasters and the restoration of land affected by natural disasters for economic use.
10. Innovative business models for organisation of the production, processing, storage, distribution and sale of products of the agri-food and forestry and wood economy.

II. SOIL AND FARMLAND

1. Innovative efforts to improve soil fertility and productivity, such as, *inter alia*:

- counteracting soil degradation, improving the reaction of acid soils, increasing the absorption of fertilisers,
- nutrients for plants in soils, forms of their presence and availability to plants.
- live organisms and organic matter in soil, humus compounds, humification

processes, mineral and organic compounds.
- physical, mechanical and aquatic properties vs three-phase soil system, soil porosity and structure in combination with the mechanisation of agriculture.

2. innovative reclamation of degraded soils and protection of farmland.
3. rationalisation of water management in the plant and animal production.
4. measures to reduce the negative impact of agriculture on groundwater and surface water.

III. BIOLOGICAL PROGRESS IN PLANT AND ANIMAL PRODUCTION

1. Creative breeding of plants, animals and fungi with improved usefulness, with a possibility of using molecular and biotechnological tools, taking into account the issues of biodiversity and resilience of climate and environmental change.
2. Innovative production of high-quality seed and nursery material, with theincreased resistance to diseases and pests.
3. New sources of protein in animal nutrition, high protein plants taking into account the characteristics of these raw materials and health safety.
4. Varieties (or species) which provide the high biological value for use in the processing and formulation of final food products.
5. Methods to improve and implement breeding effects in the production of plants and animals, *inter alia*, taking into account increasing the productivity and reducing environmental nuisance.

IV. TECHNOLOGY OF PLANT AND ANIMAL PRODUCTION

1. Agricultural biologisation methods improving the soil quality and nutritional value of plant resources (*inter alia*, biopreparations, microorganisms, integrated protection of plants and fungi against diseases and pests using innovative biopreparations, biotechnological methods and agricultural treatments).
2. Solutions to increase safety and improve the quality of plant raw materials as regards the application of fertilisers and plant protection products, including the use of the principles of integrated plant protection and sustainable production.
3. Detection and identification of pathogens and pests of plants and fungi using innovative techniques.
4. Innovative methods to improve animal welfare and animal health protection.
5. Nutrition methods and animal breeding systems with a beneficial effect on the nutritional value and health values of products of animal origin, *inter alia*, increasing the productivity and reducing environmental nuisances, including animal welfare.
6. Automated milking and milking robots.
7. Increasing the efficiency of pollination using pollinating insects, including

bumblebees
and solitary bees.

8. Methods to improve the sanitary and health status of commercial animals and animal breeding farms.
9. Processes and systems for optimising management of various types of farms.

V. AGRICULTURAL MACHINERY AND EQUIPMENT

1. Innovative technologies and machinery for agriculture, including precision farming.
2. Developing energy-efficient, environmentally friendly technologies and machinery
and equipment for tillage, sowing and fertilising, planting, care and protection of plants, harvesting, preservation and storage of agricultural crops, improving agronomic parameters
and guaranteeing the high quality of agricultural products.
3. Innovative, energy-efficient, low-cost machinery and equipment working in farms, barns, pigsties and fish breeding pools.
4. Equipment and systems for monitoring, support, evaluation, improvement of the production (technological) process taking into account the latest analytical methods e.g. remote sensing (GPS), comprehensive chromatography, spectral analysis, etc. to produce raw materials of the highest biological, health and technological quality.
5. Machinery, technical and organisational implementations for production processes at all stages of the food chain in farms, centres of buying-in, processing (raw materials, products) and slaughtering of animals (including fish) taking into account the factor reducing contamination with pathogenic bacteria.

VI. ORGANIC AND MINERAL FERTILISERS, PLANT PROTECTION PRODUCTS AND GROWTH REGULATORS

1. Innovative organic and mineral fertilisers and biological preparations with dedicated application or controlled release of components.
2. Innovative biologically active substances (natural and synthetic) intended for the production of plant protection products and veterinary medicines.
3. Modern formulations of plant protection products and biocides, reducing their negative impact on humans and the environment, compatible with the principles of integrated plant protection.
4. Innovative organic and organic-mineral fertilisers and microbiological vaccines to enrich soils with biomass and restore their proper microflora.

VII. PRODUCTION AND STORAGE

1. Technologies and equipment for the harvesting and storage of agricultural and agri-food products, reducing storage and transport losses or increasing the durability of these products
   in the food chain.
2. Intelligent warehouses, pigsties, barns, farms, fish-breeding pools using renewable energy sources to complement the energy needs of livestock buildings and structures.
3. New technologies for the production, packaging and storage prolonging the durability of food products, enabling the preservation of high quality, including food safety.
4. New packaging and storage technologies to monitor the food quality *inter alia*, using active and smart packagings.

VIII. PROCESSING OF AGRICULTURAL CROPS AND ANIMAL PRODUCTS

1. High-quality food production including:

   - product innovation in terms of the composition, nutritional value and bioavailability of ingredients,
   - reformulation of existing products aimed at improving their quality,
   - improvement of existing and introducing new innovative food production and processing technologies,
   - measures to minimise the food processing level and to maintain, to the greatest possible extent, nutrients and beneficial bioactive substances,
   - measures to maximise the share of natural raw materials and to reduce the use of food additives,
   - measures allowing to limit the content of or eliminate the antinutrients and allergens in food.

2. Production and evaluation of the quality of foodstuffs for special nutritional uses

and other products with dedicated nutritional and health characteristics adapted to various groups of consumers.
3. New processing methods and technologies for meat products with the increased dietary value.
4. Innovative processing of agricultural products, including vegetables and milk, promoting the quality and increased consumer awareness for health nutritional values.
5. Innovative food preservatives, allowing fresh products to be distributed to the consumer.
6. Production and evaluation of the quality of organic, traditional and regional food.
7. Research, characteristics and implementation of solutions (including technological ones) for raw materials of agricultural and agri-food origintaking into account their usefulness, use and health and food safety in the feed industry.
8. Innovative production and evaluation of the quality of feed and petfood.

IX. FOOD AND CONSUMERS

1. Creating innovative communication and education tools allowing consumers to make informed food choices.
2. Use of innovative technologies to develop tools supporting better nutrition planning and evaluation of the diet at the individual and collective level.
3. Innovative methods to increase the recognisability of high quality food.
4. Creating innovative tools to detect food adulteration.
5. Developing tools and modern research techniques and food quality markers (including bioavailability of ingredients) for the purposes of assessing the impact of food products on human health.
6. Developing methods of analysis and selection of food dedicated at the population and individual level.

X. MODERN FORESTRY

1. Processes of obtaining woody plants with increased immune properties and/or taking into account climate, soil, aquatic and other conditions of biocenoses as well as systems to manufacture and acquire raw materials of plant origin using remote sensing to determine forest characteristics.
2. Environmental management using LCA techniques in forestry and tree farming.
3. Research on biodiversity to improve the quality of treestands and the quality of raw material for the wood industry.
4. Modern methods of acquiring, selecting, taking care and implementing selected species of trees
and shrubs, taking into account selected tree genotypes, so as to select the desired wood performance parameters for the selected branches of the wood

sector and for the cultivation, sustainable use and processing of plantation wood, developing processes of using the DNA methods
in forestry.

5. Modern systems for monitoring, early warning (e.g. satellite observations) and organisation of the reduction in fires and losses they cause.
6. Development of energy crops with the large increase in mass, resistance and high dryness for the production of fuels.
7. Innovative means and methods of protecting treestands against biological pests.

XI. INNOVATIVE WOOD AND WOOD-BASED PRODUCTS

1. Use of wood and forestry biomass to produce substitutes for other non-renewable raw materials.
2. Development of technologies, applications of engineering wood, use and offer of glued construction, building elements of wood, construction of wooden houses for residential purposes and other utility purposes.
3. Searching for new innovative applications of wood and wood-based materials as consumables, wood biocomposites, including those from recycled
4. Products, processes and technologies for obtaining wood and wood-based materials
with the extended durability in the conditions of internal and external use, increased resistance to destructive factors, *inter alia*, biotic factors, fire, atmospheric factors, photolytic aging, intended for: furniture, woodwork, flooring materials, boat-building products, wooden garden architecture.
5. Modern means for the protection of wood and wood-based materials as well as means protecting against erosion and stabilising biologically active substances, including ecological wood preservatives, *inter alia*, based on natural biocides, plant extracts and synthetic products imitating natural ones.
6. High-efficient and energy- and material-saving machinery and lines for milling, processing and treatment of wood and wood-based materials, including cellulose, paper and cardboard.
7. Studies on wood drying technologies combined with technologies to reduce wood swelling and shrinkage.
8. Innovative adhesives to join wood with wood and wood with non-wood materials, varnishes/oils/wood stains and fillers, which take into account the needs of woodwork, industry of floors, wood-based panels and furniture.
9. Modern woodwork with the increased durability, including the use of microcoatings, nanotechnology, mimetics.
10. Large wood and wood-based structures where wood is the main building element.
11. Technologies for the modern wood construction industry based on renewable materials, especially wood.

12. Development of wood-based materials for modern construction applications: new generation materials that would demonstrate better properties, less emissions, biodegradability, but also, during normal operation, resistance to biological agents (fungi, insects, rodents).
13. Technologies for extraction of bioactive compounds from forest goods, wood industry waste,
    including coniferous trees, to be used in the economy.
14. Modern, biodegradable, reusable, demountable wood and wood-based,
    paper, cardboard packagings.
15. Products, processes and technologies for management of waste from the wood-based industries, optimisation of management of post-production residues of solid wood processing, for value added

XII. INDIVIDUALISATION OF FURNITURE PRODUCTION

1. Special purpose furniture, including fixed joinery; high comfort furniture; furniture to eliminate health deficits, furniture to support the proper development and staying in good shape, eliminating adverse effects of civilisation factors, as well as integration of furniture
   with digital and electronic systems.
2. Process innovations in furniture design understood as the work of interdisciplinary teams (from examining needs, through design brief, prototype and its testing, improving the prototype, implementation into the production, to market verification), including the dDevelopment and calibration of tools for the early evaluation of the prototype and design as well as logistic efficiency of the product.
3. Searching for and exploring the possibilities of using materials: new, alternative and with new functional properties (including micro-and nanotechnological modifications) for the furniture industry.
4. Innovative designs and manufacturing processes for furniture fittings and accessories.
5. Technical and technological innovations increasing the productivity, reducing the consumption of materials
   and energy for furniture production.
6. Development of modern systems for joining and assembling wood and wood-based elements and accessory materials in the furniture industry.
7. Innovative furniture production systems, including the development of processes for individualisation of the product or 3D printing techniques.

## XIII. INNOVATIVE PROCESSES AND PRODUCTS IN THE CELLULOSE AND PAPER AND PACKAGING INDUSTRIES

1. Technologies and research aimed at smart tools, methods and processes leading to producing cellulose pulp, paper, cardboard, corrugated cardboard and derived products to minimise the share of basic raw material for the conservation of forest resources (*inter alia*,
   with the increased share of waste paper and other fibres, including synthetics), while achieving high strength parameters.
2. Technologies and processes to produce cellulose and paper products to achieve the effect of reducing the consumption of energy, water and $CO_2$ emissions and products with new utility functions.
3. Smart packagings, highly specialised improvements to increase the environmental friendliness, durability and safety of food, their structure and design.
4. New specialised technological solutions aimed at developing and implementing technologies to minimise waste generation in the paper and cardboard production and new forms of waste management.