ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ANIMAL PRODUCTION

Innovations in animal science and sustainable animal production systems: genetics, feeding and nutrition, animal health, welfare and husbandry.

The University of Bologna covers a wide range of issues:

- Breeding and selection: analysis of animal genomes, application of genomics, transcriptomics, phenomics and biotechnology solutions for sustainable animal productions
- Sustainable conservation and use of animal genetic resources
- Innovations in reproduction technologies
- Feeding strategies to improve milk, meat and egg quality, nutrient utilization and retention, rumen and gut microbial balance, welfare and efficiency
- Innovative farming, handling and monitoring techniques and strategies (including rearing practices, transports and slaughtering) to improve animal welfare and health, product quality and reduce meat abnormalities
- Development of animal welfare indicators
- Precision livestock farming using innovative automatic systems and novel approaches
- Assessment and reduction of the environmental impact of animal production systems
- Application of molecular genetics for authentication and traceability of food products
- Development of innovative techniques for the identification of animal pathogens
- Improvement of the means of control of animal diseases along the whole production chain through a "one health" approach
- Innovations to reduce the use of antimicrobials in farmed animals

HIGHLIGHTS

H2020 projects: **ROADMAP** - *Rethinking of antimicrobial decision-systems in the management of animal production;* **RES4LIVE** - *Energy Smart Livestock Farming towards Zero Fossil Fuel Consumption;* **INTAQT** - *Innovative tools for assessment and authentication of chicken meat, beef and dairy products' qualities;* **TREASURE** - *Diversity of local pig breeds and production systems for high quality traditional products and sustainable pork chains*.

International networks: **FABRE TP** - *Farm Animal Breeding & Reproduction Technology Platform*; **PiGutNet** - *European network on the factors affecting the gastro-intestinal microbial balance and the impact on the health status of pigs;* **RGB-Net** - *A Collaborative European Network on Rabbit Genome Biology*.

Infrastructures: **Centre of Agricultural and Food Genomics**, lab facilities, bio-banks and bio-repository facilities.

Patents: **Patents on the use of DNA markers**, pharmacological preparations for topical antiviral therapies.

Startups: **GRIFFA** - *A food genomics company focused on animal products*.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

AQUACULTURE

Research and development to improve sustainability, competitiveness and resilience of the whole value chain of aquaculture sector.

The University of Bologna can offer multidisciplinary skills and expertise for research, applied studies and technology transfer in the field.

Research at the University of Bologna covers a wide range of issues:

- Optimization of feed and feeding of farmed fish and their effects on growth performance and gut health
- Evaluation of abiotic factors and farming conditions on performance and fish health
- Reproduction and larval rearing of new species for aquaculture, parentage analysis in breeding program, marker-assisted selection
- Diagnosis, epidemiology, prevention and control of transmissible diseases of farmed fish
- Development of sustainable rearing technologies for mollusks
- Fish quality, nutritional profiling of fish products, sensorial evaluation, freshness evaluation, effects of rearing methods and feed on fish quality, metabolic fingerprinting of fish
- Economics of aquaculture: farm management and marketing

HIGHLIGHTS

The University of Bologna contributes to the European progress in aquaculture research taking part to several European funded projects:

Horizon 2020: **NewTechAqua** - *New Technologies, Tools and Strategies for a Sustainable, Resilient and Innovative European Aquaculture;* **FutureEUaqua** - *Future growth in sustainable, resilient and climate friendly organic and conventional European aquaculture;* **Medaid** - *Mediterranean Aquaculture Integrated Development;* **ParaFishControl** - *Advanced Tools and Research Strategies for Parasite Control in European farmed fish;* **PerformFISH** - *Integrating Innovative Approaches for Competitive and Sustainable Performance across the Mediterranean Aquaculture Value Chain.*

LIFE: **LIFE EEL** - *Urgent measures in the Eastern Mediterranean for the long term conservation of endangered European eel.*

ERA-NET: **Novofeed** - *Novel feed ingredients from sustainable sources.*

The Department of Veterinary Medical Sciences (DIMEVET) in its Bologna and Cesenatico - on the Adriatic coast - locations has specific aquaculture infrastructures for trials *in vivo* on fish or molluscs under controlled environmental conditions to study performance, welfare and health of farmed animals and for diagnosis of fish diseases, studies on viral, bacterial and parasitic fish infections, including zoonoses, histopathology, molecular analyses on aquatic pathogens and gene expression analysis.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

ECONOMICS AND MANAGEMENT FOR SUSTAINABLE FOOD CHAINS AND RURAL RENAISSANCE

Exploring and governing the economic drivers and management strategies of sustainable food chains and fostering innovation and vitality in rural areas.

The link between economy and ecosystems is key for the current transition towards sustainable circular agriculture and food systems. Economic and management research is essential to understand factors driving the behaviors of food chain actors and supporting evidence-based agriculture, food and Bioeconomy policies in rural economies.

Research at University of Bologna covers a wide range of issues:

- Analysis of global and local food chains, contracts and integration
- Food markets, competition, market access, market power and international trade
- Agro-food networks and districts, organisation of agro-food system
- Management strategies, organisation of agro-food firms, value creation and distribution, financial, fiscal and pricing issues
- Innovation systems, entrepreneurship, new product development and education in rural business
- Economic aspects of quality management systems, quality and food safety certifications, regulation, standards and traceability
- Food waste reduction strategies and resources efficiency in agriculture and food chains, with a focus on water
- Healthy and sustainable farming (including organic farming, agri-tourism)
- Economics of digitalisation of rural economies and food systems
- Socio-economic trends and labor markets
- Modelling of food supply, farming choices and productivity
- Analysis of policies and mechanisms to ensure sustainable production and resource efficiency for vibrant rural economies
- Interplay and synergies with the Bioeconomy development

HIGHLIGHTS

H2020 projects: **CO-FRESH** - Co-creating sustainable and competitive fruits and vegetables' value chains in Europe; **CONSOLE** - Contract solutions for effective and lasting delivery of agri-environmental-climate public goods by EU agriculture and forestry; **SHOWCASE** - Showcasing synergies between agriculture, biodiversity and ecosystem services to help farmers capitalising on native biodiversity; **FIT4FOOD2030** - *Establishing a sustainable, balanced, multi-stakeholder, multi-level platform* (FOOD2030 Platform) to support the EC in further developing and implementing the FOOD 2030 policy framework and its action plan; **PROVIDE** - *Providing smart delivery of public goods by EU agriculture and forestry*; **SUFISA** - *Sustainable finance for sustainable agriculture and fisheries*; **NEXTFOOD** - *Educating the next generation of professionals in the agrifood system*; **LIFT** - *Low-Input Farming and Territories* - Integrating knowledge for improving ecosystem-based farming; **RUBIZMO** - *Replicable business models for modern rural economies.*

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FISHERIES

Multidisciplinary and holistic research challenges to assess and sustainably manage fishery resources at multiple ecosystem complexity.

The University of Bologna research activities in fishery sciences aim to provide scientific and political/economic data, and issues to the whole fisheries value chain by transdisciplinary research skills on multiple-scale sea ecosystem complexity. Research issues on coastal and small-medium scale fisheries of the semi-enclosed seas as Adriatic and Mediterranean Seas to oceanic off-shore global stocks and populations are addressed.

Research at the University of Bologna covers a wide range of issues:

- Stock and species assessment of fishery resources, fishing impacts on marine ecosystems
- Fish quality, nutritional profiling of fish products, sensorial evaluation, freshness evaluation, effects of rearing methods and feed on fish quality, metabolic fingerprinting of fish
- Fishery genetics, fishery genomics, fish and fish products traceability, population genetics and genomics, conservation genetics
- Small-scale fishery maritime clusters and development of coastal communities, fishery products market and value chain organization in small-scale and coastal , Fishery management plan and property rights
- Fish parasitology, with specific expertise in biology and epidemiology of zoonotic helminths in fish populations

HIGHLIGHTS

International projects:

- **MEDITS** - *International Bottom Trawl Survey in the Mediterranean.* EU JRC Tender **MEDBLUESGEN** - *Mediterranean blue shark genetics: population genetic study on Mediterranean blue shark for stock identification and conservation.* EU Tender **STOCKMED**; **EU ICCAT GBYP**.
- FP7: **FISHPOPTRACE** - *Fish Population Structure and Traceability*. EU Tender **AQUAGEN** - *Genetic Assignment of Farmed Cod and Sole for Traceability, Biosafety and Environmental Impact Assessment.*
- Interreg Italy-Croatia: **PRIZEFISH** - *Piloting of eco-innovative fishery supply-chains to market added-value Adriatic fish products.*

International PhD programmes:

FishMed-PHD *on Innovative technologies and sustainable use of Mediterranean Sea fishery and biological resources.* **MARES** - *EMJD Programme on Marine Ecosystem Health & Conservation.*

Research centres and laboratories, equipments and infrastructures

The **Department of Biological, Geological and Environmental Sciences (BIGEA) in its Fano location on the Adriatic Sea** is equipped with marine biology and fisheries, laboratories.

Inter-Departmental Centre for Research in Environmental Sciences (CIRSA)

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FOOD & CONSUMER SCIENCE

Understanding and involving consumers to promote healthy and sustainable food choices

Consumer Science at University of Bologna covers all steps from measurement of consumer attitudes and preferences, to the modelling of food choices and their determinants, predicting future consumer trends and supporting private strategies and public policies, especially in relation to healthy and sustainable food choices.

Research at University of Bologna covers a wide range of issues:

- Consumer research surveys: design & data-analysis
- Experimental methods to analyze consumer choice
- Sensory evaluation and its integration in marketing strategies
- Determinants of food choices, consumer profiling and segmentation
- Consumer perception and acceptance of new foods and technologies
- New media and the measurement of consumer attitudes and trends
- Qualitative methods & foresight of consumer trends
- Advanced modelling of novel big data sources (home scan consumer panels, retail scan)
- Econometric modelling of demand and sales forecast
- Food marketing research, including social marketing and promotion strategies
- Food pricing and consumer willingness-to-pay for product attributes
- Food & lifestyle choices and their impact on health, sustainability and household welfare
- Quasi-experimental methods for the economic evaluation of consumer-oriented policies

HIGHLIGHTS

FP7 and H2020 projects: **FoodE** - Food Systems in European Cities; **FOODLAND** - FOOD and Local, Agricultural, and Nutritional Diversity; **DEDIPAC** - a joint initiative involving 13 European countries to explore the determinants of diets to support policymaking; **ECROPOLIS** - aimed at documenting the sensory properties of organic foods through sensory testing and consumer research; **EATWELL**, on evidence-based healthy eating policies and their consumer acceptance; **CONNECT4ACTION** - on communication between consumers, consumer scientists, food technology developers to reduce market failure of new products; **SUSDIET** - on healthy and sustainable diets in relation to consumer preferences and public and private policies that could favor their adoption; **VALUMICS** - on the relationship between value chains and consumer behaviours; **CHANCE** - barriers to healthy dietary habits and exploration of effective ways to overcome unhealthy nutrition with consumers.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FOOD AND HEALTH

Multidisciplinary research and innovation strategy for Healthy Foods and Diets based on innovative sustainable solutions and multi-omics approaches.

The University of Bologna offers a multidisciplinary experience and the required technology for food science and nutrition researches dedicated to healthy dietary strategies, by involving a broad range of professional knowledge and having state-of-the-art equipment.

Research at University of Bologna covers a wide range of issues:

- Intervention, observational and epidemiological studies aiming at understanding and preventing diet related diseases (DRDs)
- Studies to evaluate the impact of tailored functional foods on the health status and disease risk in the general population and specific subgroups
- Studies to understand the mechanism of action of bioactive compounds and functional foods by multi-omics approach (e.g., metagenomics and foodomics)
- Studies on gut microbiota and gut functions in humans and model animals to develop foods that contribute to gut health from neonate to old age
- Evaluation of digestibility of food and bioaccessibility and bioavailability of nutrients and bioactive compounds by in vitro and in vivo models
- Identification and development of new microbial strains to improve the nutritional value, safety and sensory properties of food products
- Development of communication and marketing strategies enabling citizens to healthy choices

HIGHLIGHTS

H2020 projects: **CIRCLES** - Controlling mIcRobiomes CircuLations for bEtter food Systems; **MyNewGut** - Microbiome Influence on Energy balance and Brain Development-Function Put into Action to Tackle Diet-related Diseases and Behavior. **NEUROFAST** - The Integrated Neurobiology of Food Intake, Addiction and Stress. Explore the neurobiology of addiction, including dietary components and family-genetic influences. **PATHWAY-27** - Pivotal Assessment of the Effects of Bioactives on Health and Wellbeing: from Human Genoma to Food Industry. Best practices and guidelines for submitting health claim dossiers to EFSA.

Networks: Chair of the Scientific Advisory boards of **CLAN** (*National Technological Cluster on Agrifood*).

Infrastructures: **Genomics Laboratories** equipped with NGS technologies for genomics and microbiome metagenomics; **Metabolomics Laboratories** equipped with high resolution NMR spectrometer and Mass spectrometry; **Bioinformatics Laboratories**; **Nutrition Laboratory** equipped with in vitro digestion system.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FOOD PROCESSING, PRESERVATION AND PACKAGING

Optimization and innovation strategies toward sustainable production technologies and packaging solutions for both plant based (fruit, vegetables, cereals, etc.) and animal origin foods, wine and beverages.

Technological innovation is essential to improve food quality and safety, reducing energy demand and increasing process sustainability and product functionality. Research at University of Bologna covers a wide range of issues:

- Non destructive analysis and determinations of quality parameters during processing and storage (sensors, e-nose, Image analysis, etc.) to promote on-line data collection and digital processing
- Impact of different processing and storage technologies (frying, drying, baking, cooking, chilling, freezing, etc.) on plant and animal products
- Optimization of advanced analytical techniques to better guarantee food quality, authenticity and food origins
- Study of pretreatment and the processing conditions to minimize the formation of toxicants in food
- Advanced mathematical and statistical analyses in food engineering for product and process optimization
- Set up and optimization of fermentation processes in order to obtain traditional or innovative products with particular nutritional, functional and organoleptic characteristics
- Factors affecting microbial metabolism and selection of strains to be employed to improve the quality of fermented foods (meat, dairy, bakery, etc.)
- Advanced technologies to obtain active and eco-friendly packaging

HIGHLIGHTS

H2020 projects: **InnoVar** - Next generation variety testing for improved cropping on European farmland; **NextGenProteins** - Bioconversion of underutilized resources into next generation proteins for food and feed; **UNTWIST** - Uncover and promote tolerance to temperature and water stress in Camelina sativa; **OLEUM** - Advanced solutions for assuring authenticity and quality of olive oil); **EcoPROLIVE** - Ecofriendly processing system for the full exploitation of the olive health potential in products of added value;

ERANET: **ECOBERRIES**: Innovative and eco-sustainable processing and packaging for safe and high quality organic berry products with enhanced nutritional value;

Infrastructures: **CIRI Agrifood** has the aim of reinforcing the relation between industry and research centers, promoting the technological transfer in order to meet the needs of the productive sector; it is equipped with innovative pilot plants for food processing and packaging.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FOOD SAFETY AND TRACEABILITY

Multidisciplinary research and innovation strategy for Food Safety Assessment and Hazard Risk Management based on sustainable solutions, early predictive models and traceability biomarkers.

University of Bologna offers a multidisciplinary approach to improve food safety, based on a broad range of knowledge and state-of-the-art equipment.
Research at University of Bologna covers a wide range of issues:

- Update omics technologies to detect, identify and characterize food-borne pathogens and chemicals in foods and feed
- Intervention strategies to reduce the antibiotic resistance in farming and food production
- Prevention and control of food-borne zoonoses through a "one health" approach
- Innovative and sustainable bio–technologies, packaging and logistics to improve food safety along the whole food chain
- Selection of starters, biocontrol agents and probiotics to improve food safety
- Strategies to prevent/limit mycotoxin contaminations in the agro-food systems
- Strategies to prevent/limit pests and diseases based on probiotics and prebiotics to reduce pesticide and drug use
- Set up of methods for post-production removal of contaminants
- Predictive microbiology, risk analysis and set up of tools for hazard identification and assessment along the food chain up to consumer level
- Development of analytical and sensorial methods and foodomics applications for food traceability and authenticity

HIGHLIGHTS

H2020 projects: **CIRCLES** - *Controlling mIcRobiomes CircuLations for bEtter food Systems*; **TROPICSAFE** - Diseases management of crops grown in tropical and subtropical areas; **COMPARE** - Information sharing platforms for the rapid identification, containment and mitigation of emerging infectious diseases and foodborne outbreaks; **AUTHENT-NET** - Transnational information on food authenticity to combat food frauds.
International Networks: **DISH** - *Joint Centre for Excellence in Food Safety;* **MoniQA Association** - Monitoring and Quality Assurance in the Total Food Supply Chain; **METRO-FOOD** - Research Infrastructure for promoting Metrology in Food and Nutrition.
Infrastructures: Genomics, proteomics, metagenomics, foodomics laboratories; Bio-analytical laboratories; collection of safe and wild microorganisms for starters, biocontrol agents and probiotic selection; Microbiology Laboratories for isolation and characterization of food-borne pathogens.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

NEW TECHNOLOGIES AND DIGITAL INNOVATIONS IN AGRIFOOD

Precision farming approaches and digitalization of agricultural and food production systems.

Digital innovations, biosystems engineering and innovative technologies are providing a number of major changes in the way agriculture production is managed and is linked to food and non-food processes, as well as to the way it connects with ecosystems and the natural environment. This field is just at its outset and is bringing a number potential opportunities and challenges.

Research at University of Bologna covers a wide range of issues:

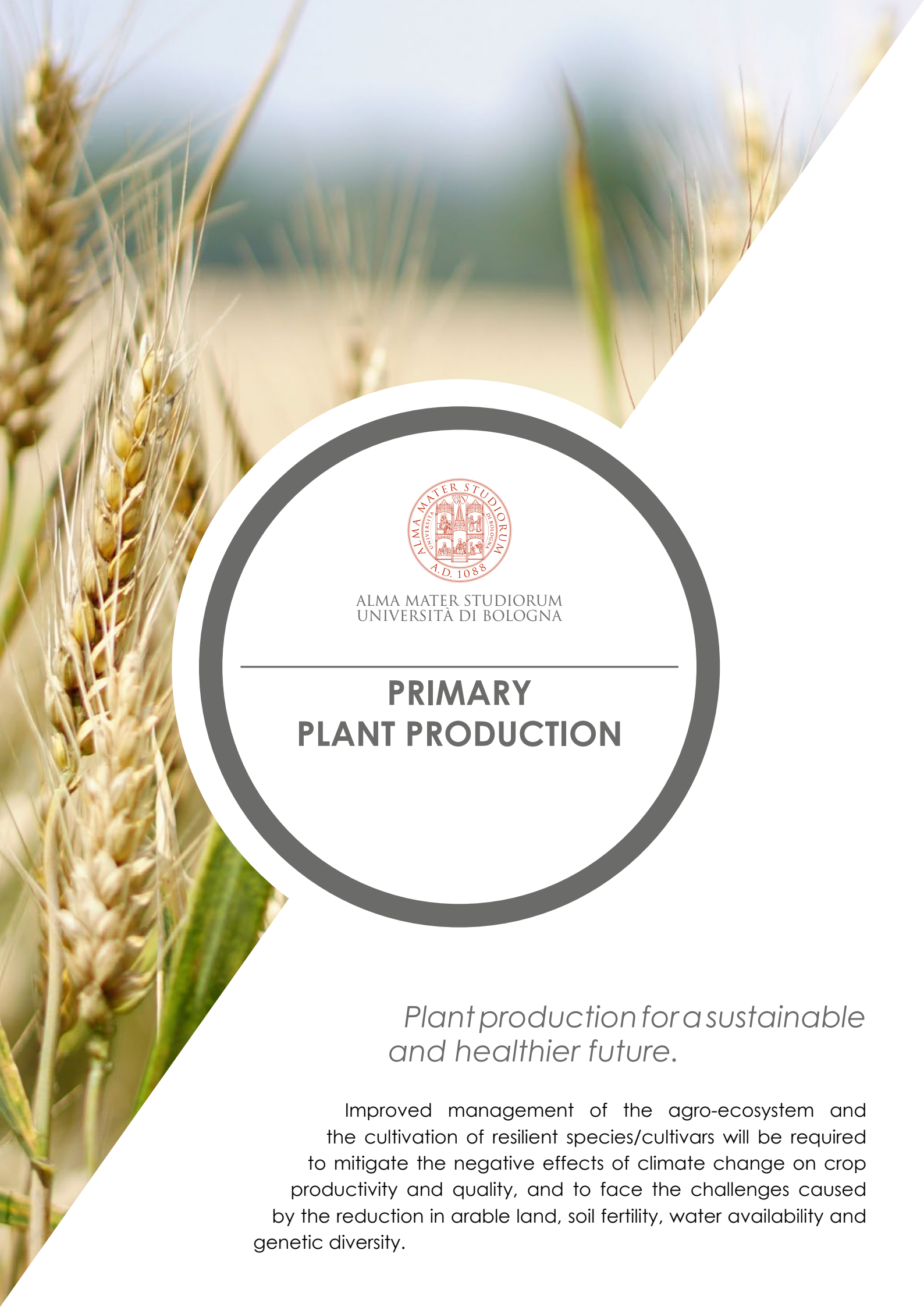
- Precision agriculture applications, with a focus on machines, fertilisation, plant protection and irrigation
- Sensors and modelling for plant growth and product quality management
- Smart solutions and modeling for water management and reuse in agriculture
- Modelling the impact of climate change in agriculture and forest ecosystems, and adapting solutions for resilient production systems
- IoT, ICT and automation in farming systems
- Drones and remote sensing
- New sensors for monitoring soil, water, crops and applications to resource conservation
- Satellite mapping of agricultural and forest landscapes
- Energy saving in buildings and machinery
- Recovery of materials and energy from agri-food waste, wastewater, sludge
- Solutions for traceability from farm to fork
- Digitalization of machine operations, through the acquisition of tractor operating parameters on a fleet of machines

HIGHLIGHTS

FP7 and H2020 projects: **ELECTRA** - Electricity driven low energy and chemical input technology for accelerated bioremediation; **MOSES** – Satellite technologies to support irrigation water management; **SWAMP** – Use of IoT and ICT for smart water management and precision irrigation; **FIGARO** - Flexible and precise irrigation platform to improve farm scale water productivity.

Infrastructures: Official OECD test stations for the certification of agricultural and forestry tractors and performance measures.

Spin off: **Horticultural Knowledge srl** - a company that develops systems for precision fruit growing.



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

PRIMARY PLANT PRODUCTION

Plant production for a sustainable and healthier future.

Improved management of the agro-ecosystem and the cultivation of resilient species/cultivars will be required to mitigate the negative effects of climate change on crop productivity and quality, and to face the challenges caused by the reduction in arable land, soil fertility, water availability and genetic diversity.

Research at the University of Bologna covers a wide range of issues:

- Identification of sustainable agro-ecological practices for low-input agricultural systems and organic farming
- Innovative uses of arable, vegetable and fruit crops for food/feed, nutraceutical and biobased production
- Molecular screening of genetic resources and genomics of crops for the identification of beneficial genes
- Application of new breeding techniques to enhance crop sustainability and food quality
- Interaction of crops with the microbiota, pathogens and insects
- Use of drones for precision agriculture and high-throughput phenotyping
- Mechanization and automation of agricultural practices
- Post-harvest protection of fruit by tuning chemical, physical and biological means
- Tailor the agroecosystem management to optimize the synthesis and accumulation of high-value compounds for food (dietary and nutritional features), feed and biobased applications
- Carbon balance in the soil-plant-atmosphere continuum for developing a more sustainable Life Cycle Analysis (LCA)

HIGHLIGHTS

H2020 projects: **WeLASER** - Sustainable weed management in agriculture with laser-based autonomous tools; **UNTWIST** - Uncover and promote tolerance to temperature and water stress in Camelina sativa; **FOODLAND** - Food and Local, Agricultural, and Nutritional Diversity; **InnoVar** - Next generation variety testing for improved cropping on European farmland; **DIVERSIFOOD** – *Dealing with crop diversity and networking for local high-quality food systems*; **LEGVALUE** - *Fostering sustainable legume-based farming systems and agri-feed and food chains in the EU*; **MAGIC** – *Marginal Lands for Growing Industrial Crops. Turning a burden into an opportunity*; **EUFRUIT** – *European Fruit Network*.

Patents: over twenty new plant varieties; methods and compositions for modulating flowering and maturity in maize, promoting the growth of herbaceous plants, accumulating organic matter in the soil, monitoring fruit quality and ripening.

Infrastructures: **Experimental farm** with more than 200 ha of land.

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

WASTE MANAGEMENT

Moving towards a sustainable and integrated management of the waste cycle.

The research of the University of Bologna covers a wide range of issues:

Prevention

Design of policy interventions and environmental impact assessment methodologies; Production, stabilization and packaging of stable by-products/ raw material; Implementation of industrial symbiosis practices and exchange of materials among different value chains - Food waste: Georeferenced mapping of industrial food by-products; Analysis of consumers and business behaviour; Awareness campaigns to sensitize populationn

Re-use

Development of a new generation of reliable, robust and cost-effective packaging materialss; Recommendation on legislation to re-use components from end-of-life products

Recycling

Pre-treatment plants to remove hazardous, rare earths and valuable components; Development of urban systems and technologies for circular and regenerative cities; Development of new plants, processes and technologies to recycle by-products and secondary raw materials from end-of-life products; Application of LCA to assess alternative recycling scenarios

Recovery

Innovative waste to energy plants; Chemicals and energy recovery from biomass

Disposal

End of life landfills

HIGHLIGHTS

The University is member of the Emilia Romagna Region **Food Crossing District**.

The **Italian Circular Economy Stakeholder Platform** and it is **partner of the EIT Raw Materials, EIT Food, EIT Climate-KIC**.

LOWINFOOD - Multi-actor design of low-waste food value chains through the demonstration of innovative solutions to reduce food loss and waste; **MERLIN** - Increasing the quality and rate of multilayer packaging recycling waste; **PRESERVE** - High performance sustainable bio-based packaging with tailored end of life and upcycled secondary use; **USABLE PACKAGING** - Unlocking the potential of Sustainable BiodegradabLe Packaging; INGREEN - Production of functional innovative ingredients from paper and agro-food side-streams through sustainable and efficient tailor-made biotechnological processes for food, feed, pharma and cosmetics; **RES URBIS** - *Resources from urban bio-waste*; **REFRESH** - *Resource Efficient Food and dRink for the Entire Supply cHain*; **NOAW** - *Innovative approaches to turn agricultural waste into ecological and economic assets*. **Bio-Based Industry JU: FIRST2RUN** - *Flagship demonstration of an integrated biorefinery for dry crops sustainable exploitation towards*; **Agrimax** - *Developing and demonstrating the production of multiple, high-value products from crop and food-processing waste*.