



Flanders research institute for  
agriculture, fisheries and food

## **MSCA individual fellowship hosting offers for 2020 call**

The Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) is a public research institute located in Belgium. ILVO performs multidisciplinary, innovative and independent research aimed at economically, ecologically and socially sustainable agriculture and fisheries. Through this research, ILVO accumulates fundamental and applied knowledge which is vital for the improvement of products and production methods for quality control and the safety of end products, and for the amelioration of policy instruments as a foundation for sector development and agricultural policy for rural areas.

Recently, some important management decisions have been made to orientate the research at ILVO in a holistic framework of systems thinking as well as to combine ILVO's tacit knowledge with new technological approaches like genomics, metabolomics, (remote) sensing technology, precision farming, innovative food/feed production technology, new breeding technologies, modelling as well as participatory social sciences approaches. This means that a lot of the research at ILVO is conducted in Living Labs, such as a Food Pilot, fishing vessels, modern greenhouses and animal farming units, and in the context of inter- and transdisciplinary research. To accelerate and further improve this new research process, ILVO is looking to host experienced researchers at post-doc level in the framework of Marie Skłodowska-Curie fellowships.

Possible research items are shown below and are divided over the different research units of ILVO. **Please contact the respective contact persons if you are interested in a specific item or research unit.**

### **Technology and Food Science Unit**

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**\*Heat transfer and mass transport phenomena in thermal food processing.** They are very important, as they determine the processing time and conditions for optimal food quality and safety. We can establish accurate heat-transfer models based on thermal properties of food and e.g. enzyme kinetics determined in laboratory conditions (using T-t curves). From also a modeling perspective, a spatial and temporal discretization of the heat transfer problem will result in exact time-temperature profiles throughout the food, so that the evolution of food quality and safety parameters during thermal processing can be predicted. CFD (computation fluid dynamics) software with auxiliary numerical modelling techniques can be used to optimize thermal food processing.

**\*Development and implementation of molecular and mass spectrometric analysis methods for GMO and food allergen testing, including e.g. ELISA, qPCR (quantitative real-time PCR), ddPCR (droplet digital PCR), LC-MS and MALDI-TOF methods.** Within ILVO's Food Pilot it is possible to prepare allergen-incurred food matrices mimicking real-life food processing. These matrices can be used to study the impact of processing on allergens. This can either be focused on detectability (with ELISA, qPCR (quantitative real-time PCR), ddPCR (droplet digital PCR) or LC-MS or MALDI-TOF), on identifying stable proteotypic peptides or on investigating the modifications induced by this processing. The last two using LC-high resolution mass spectrometry (LC-HRMS).

**\*Precision crop farming.** As a research institute ILVO cooperates with government, industry, academia, civil participants and of course also with farmers to explore possibilities for innovation and economic added-value by the application of remote-sensing techniques in agriculture and precision application technologies for plant-protection products and fertilizers. In addition, ILVO focusses on integration of data to come to smart solutions that can support farmers in their management. Several national and international projects are currently running within this research field, enabling interested post-doc researchers to perform valuable synergetic activities.

**\* Precision livestock farming.** ILVO's precision livestock farming group focuses on (1) development of sensors, algorithms and decision support tools for individual animal monitoring and related research activities, (2) supporting the sector in using these technologies and the information that they provide, (3) innovations together with industry for the digitization of processes such as data exchange. Our current projects include research on automated tools for lameness, claw lesions and health and behaviour monitoring for pigs and cows where we utilize sensors like 3D cameras, thermal cameras and RFID tags. Running innovation projects evolve around API economy, data standards, IoT (internet of things), HPC (high performance computing) and data exchange, for example IoF2020, CYBELE, SmartAgriHubs and DjustConnect. In addition we are involved in projects on farm demonstrations and the support of farmers and advisors in using digital tools. Several national and international projects are currently running within this research field, so we can welcome post-doc researchers with topics that align with these running (and future) projects.

**\*The fusion of Copernicus data, with in-situ farm measurements and other auxiliary data for the forecasting of livestock methane emissions.** For the modeling process, the postdoc researcher will combine modern techniques of data science (Artificial Intelligence, machine learning, deep learning) with traditional spatial analysis to create robust livestock methane emissions prediction models for both classification and regression tasks. The main questions to be answered are:

- What are the drivers or the factors that affect livestock methane emissions over time?
- What is the relation between spatial structure, farm practices, and methane emissions drivers?
- How can we identify the impact of adjacent or nearby livestock activities on rural areas at different analysis scales?
- How can Earth Observation data, can support Greenhouse Gas (GHG) Emissions management?
- How data sharing practices and Artificial Intelligence (AI) federation may accelerate GHG modeling?

Why at ILVO? ILVO has extended experience in Precision Livestock Farming (PLF) and participates as a core partner in relevant lighthouse EU H2020 projects like IoF2020 and Cybele. ILVO also operates a data-sharing platform that makes use of cloud technology and enables the establishment of connections with various data sources. Additionally at ILVO, the leverage of AI, EO, and cloud technology in the AgriFood sector are daily tasks related to the completion of various research topics in PF and PLF. Moreover the Postdoc researcher will have the full support of motivated and top-level scientists and the opportunity to participate in a highly collaborative environment, that promotes the 2-way transfer of knowledge (between fellow and host and vice versa). Last but not least, the specific research topic is a high priority not only for ILVO but also for the AgriFood industry and the EU.

Useful sources:

<https://www.iof2020.eu/>

<https://www.cybele-project.eu/>

<https://www.copernicus.eu/en>

<http://www.fao.org/news/story/en/item/197623/icode/>

<https://towardsdatascience.com/the-new-dawn-of-ai-federated-learning-8ccd9ed7fc3a>

<https://atmosphere.copernicus.eu/1st-artificial-intelligence-copernicus-workshop>

<https://www.atmos-meas-tech.net/12/6771/2019/amt-12-6771-2019.pdf>

**\*Livestock emissions (gases, dust, odour).** ILVO is the reference institute of the Flemish government for the assessment and development of reduction techniques for livestock emissions (gases, dust, odour). Especially of interest are ammonia and greenhouse gas emissions from mechanically (pigs and poultry) and naturally ventilated (dairy & beef cattle) animal housing systems. Our research and collaboration efforts aim to develop innovative and widely applicable monitoring and mitigation techniques (both front- and end-of-pipe). Therefore we study emission and ventilation processes at different scales (lab, test installations, farm) using advanced measuring techniques (e.g. ultrasonic anemometry, FTIR, laser absorption spectrometry, olfactometry) and modelling tools (e.g. mechanistic modelling, Computational Fluid Dynamics). ILVO has a modern test infrastructure, including real life animal houses. Several national and international (H2020) projects are currently running within this research field, enabling interested post-doc researchers to perform valuable synergetic activities.

#### **\*Application of Artificial Intelligence in in agrifood sector**

Artificial Intelligence (AI) has revolutionized the way raw data is processed. In the omnipresence of cameras and cheap sensors, large amounts of data are produced which have catalyzed the development of faster and more accurate models. Especially in the domain of image analysis where convolutional neural networks have revolutionized the processing chain. ILVO is currently investigating several cases where image analysis could provide additional tools for the farmers to reduce their costs and the overall environmental impact. Using high resolution drone imagery, weeds, diseases and plagues are detected and mapped with object detection. Cameras mounted on robots, spraying beams and tractors are investigated in a step towards edge computing and real-time actionable data. Novel approaches are explored in the domain of anomaly detection to reduce the label cost and increase the models' robustness under field circumstances.

In addition, hyperspectral and RGB cameras mounted on conveyor belts provide a continuous stream of data that can be used for supervised object detection or semi-supervised anomaly detection of food products.

### **\*Application of Earth observation techniques in agriculture and livestock**

The European Copernicus program and NASA's missions provide a large amount of free remote sensing data worldwide. Remote images are acquired by optical, radar and other sensor types with a wide range of spatial and spectral resolutions, temporal frequencies and geographical coverages. We are actually witnessing a democratization of the satellite data, and the research institutes like ILVO have the responsibility to transform these raw data into useful tools, advices and plans for farmers and policy makers. Earth observation data play a key role in an increasing number of ILVO projects at European and national level, dealing with *i*) soil management and conservation with emphasis on the estimation of the soil organic carbon to support farmers and decision makers in the context of the common agriculture policy; *ii*) crop monitoring and yield estimation including the evaluation of the factors which have direct impact on the productivity, to support farmers in their decisions; *iii*) livestock methane emission monitoring and forecasting by the fusion of Copernicus data with in-situ farm measurements and other auxiliary data. We can welcome post-doc researchers with topics that align with the ongoing and future ILVO projects.

### **\*Functional plant proteins for healthy, innovative and qualitative food products**

ILVO has a Food Pilot ([www.foodpilot.be](http://www.foodpilot.be)) which is a unique technological application centre for the food and allied industry, encompassing complete processing lines for meat, juices, dairy, heating (UHT, sterilisation, pasteurisation), drying, dry and wet extrusion, mixing and milling as well as analytical labs for microbiology, (bio)chemistry, physico-chemistry and taste panels. To further expand our expertise in the field of proteins, an up to date processing line for the extraction of proteins from different plant-based sources will be available. In combination with the recently installed high-moisture extrusion (HME) unit on our twin-screw extruder, these systems will provide excellent opportunities to perform ground-breaking research in the field of protein extraction and application.

With the increasing interest in the use of different plant proteins by the food industry, the lack of basic knowledge regarding the behavior of these proteins in several industrial-scale processes and different food matrices is becoming a bottleneck for further exploitation. The main objectives of the running and envisaged research projects is to increase basic knowledge on the impact of different processing steps (extraction, drying, high moisture extrusion (HME)) on the quality properties of different plant proteins such as their functionality. Different case studies are possible. As alternative sources of plant proteins both potato and different oilseed crops are relevant. Potato is a very important crop in Belgium from economic point of view. Multiple big processing companies are present in our region and generate by-products from which also proteins with high nutritional value could be extracted. Press cakes from oilseed crops (sunflower, pumpkin, rapeseed,...) represent another attractive raw material for protein extraction. Finally, there's an increasing interest into algae as potential feedstock for the extraction of proteins. Besides studying the impact of the processing steps on functionality of the proteins, the expertise and infrastructure is available to study impact on nutritional value, organoleptic quality, allergenicity, digestibility, ... which are all relevant in the context of process and product development to realize protein diversification and its implementation in a healthy and balanced diet.

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**\*Metabolomics, metagenomics, bio-informatics and systems biology in the context of food- health research.** A new research line has started on the relation between food and health. This applies on production animals as well as on humans. Animals can be used as human model organisms; ILVO has recently acquired mini-pigs for this purpose. Several influencing factors are investigated such as composition of the diet, antibiotic usage, alternatives for antibiotics,

pro- and prebiotics, nutraceuticals. Analytical approaches such as gut bacterial metagenomics, metabolomics, transcriptomics, gut physiology and morphology will be used. Untargeted metabolomics using high resolution mass spectrometry (HRMS) is one of the analytical goals to identify marker metabolites in food and the gut. A thorough bio-informatics and systems biology approach will be needed to link and interpret the multitude of multidisciplinary data for which experienced researchers are invited to join this research line.

**\*Ex vivo gut simulations to explore alternatives to antibiotics and antibiotic resistance transfer phenomena.** The use of antibiotics in animal husbandry is much under pressure because of the rising issue of antibiotic resistance which is now regarded as one of the global threats of human health by the World Health Organization (WHO). There is an urgent need to find, on the one hand, suitable alternatives for the common antibiotics, but on the other hand to know the consequences of justified and remaining antibiotic use in animal husbandry in regard to the spread of antimicrobial resistance. *Ex vivo* simulations of the bacterial gut ecosystem of animals (mainly pigs, poultry) but also of humans are very useful for these kind of studies because they don't need animal experiments and can be more standardized and controlled in the lab. They are based on continuous-fermentation bioreactors in which specific parts of the gut are simulated by inoculation with animal fecal material and computer controlled establishment of gut environmental conditions including (semi-)continuous feeding and excretion. In these *ex vivo* experiments, interesting bioactive components such as phytochemicals, peptides, probiotics, prebiotics, etc. can be tested for their antibacterial activity together with the behavior of introduced pathogens of zoonotic or veterinary importance or antimicrobial resistant bacteria such as E coli. Samples from the bioreactors are analysed by metagenomics, metabolomics, drug residues with LC/MS-MS, spread of antimicrobial resistance through qPCR and epiPCR.

**\*Untargeted food analyses with MALDI-TOF mass spectrometric and InfraRed spectroscopic techniques .**

Untargeted food analyses is an emerging discipline which can be used for quality, safety or authenticity control of food processes or products as on-line or at-line applications. It is based on database building and recognition of patterns of the (bio)chemical composition or physico-chemical properties of food products. Suitable analytical techniques which enable fast pattern acquisition are MALDI-TOF (positive and negative ionization mode) and infrared spectroscopic techniques such as NR-IR and FT-IR. It is the aim to build large databases of properties and characteristics of specified food products and perform pattern recognition with the aid of artificial intelligence which can be in the form of machine learning. ILVO has the necessary analytical infrastructure and expertise in artificial intelligence to start with this new untargeted platform of food analyses.

## Plant Sciences

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**\*Precision crop phenotyping.** Precision phenotyping is very relevant in the context of plant breeding. ILVO develops dedicated plant phenotyping tools based on the capture and analysis of images obtained under controlled environments, in the greenhouse or in the field. In the field we use drones that can be equipped with different cameras (visual, NIR, thermal, hyperspectral). We have phenotyping experience with different crops, including forage grasses, maize, wheat or soybean. In the context of these activities, ILVO is partner of the Belgian plant phenotyping node.

**\*Functional-Structural Plant Modelling.** Functional-Structural Plant models (FSPM) are mathematical descriptions of plants, in which ecophysiology is merged with plant architecture. As such, virtual three-dimensional plant models are generated and used to perform *in silico* experiments. These models are innovative tools for studying competition (e.g. crops with weeds) and mutualism (e.g. agroforestry) between species. Furthermore, FSPMs are used to design ideal theoretical phenotypes for specific climatic/geographical areas, or specific growing systems, assisting breeders to select and cross plants with interesting beneficial traits.

**\*Pollen metabarcoding.** Next generation sequencing (NGS) and more specifically amplicon sequencing can be used to investigate the taxonomic composition of complex samples. Based on the sequence variants present in the pool of amplicons, the taxonomic composition is determined. At ILVO, we have both wet-lab (library preparation) and dry-lab (bioinformatics) experience with molecular barcodes corresponding to different groups of organisms, such as bacteria (16S), fungi (ITS2), nematodes (18S). We have the ambition to extend our molecular toolbox with protocols for pollen metabarcoding using one or more barcodes suited for plants, for example *rbcL*, *matK* or ITS. These protocols can be used to investigate pollination networks and plant-pollinator interactions, aspects of particular relevance for optimizing the seed yield of insect-pollinated crops.

**\*Exploring genetic diversity in breeding gene pools.** In an integrated approach, we develop strategies that combine functional gene annotation and candidate gene selection for agronomical relevant traits. For instance, pathways that control plant architecture (related to yield), or secondary metabolite biosynthesis (related to quality). We then design highly efficient Next Generation Sequencing (NGS) based genotyping assays to screen for genetic diversity in breeding germplasm, and combine this with bioinformatics approaches to predict the functional consequences of DNA-polymorphisms. This approach to identify naturally occurring genetic polymorphisms is complemented with the development of highly multiplex CRISPR-Cas genome editing techniques for the targeted introduction of sequence variants in multiple genes of the same pathway or multiple members of a given gene family. Combined, these techniques allow to identify or create elite breeding materials.

**\*Unravelling plant behavior using machine learning.** Grasslands cover a large part of the agricultural and natural area, and are therefore agronomical and ecologically of substantial importance. In the face of Climate Change, it is essential to understand the behavior of grasses in response to the environment in which they grow to safeguard the diversity they harbor and

the ecosystem and economic services that they deliver. ILVO has completed several projects with multi-location field experiments in which large sets of phenotypic and genomic data have been generated. We use machine learning techniques to explore patterns in the reaction of plants to their environment, and develop predictive models of their response to future climatic conditions. These machine learning models are used to study the effect of Climate Change on grassland adaptation at the genotype and phenotype level, and assist breeders in the selection of plants with the highest potential.

**\*In vitro regeneration of (recalcitrant) protoplasts.** ILVO- Plant Science Unit has gained experience in protoplast regeneration in various crops. Regeneration is very species dependent and the process has been thoroughly monitored, however without in-depth understanding of its molecular and physiological backgrounds. Comparing regenerative and non-regenerative circumstances for particular genotypes will provide more insight. The effects of culture system, phytohormone addition, medium refreshment...will be evaluated. More precisely, we want to study phytohormone metabolism with an array of chromatographic tools, evaluate genome silencing and DNA condensation with molecular and microscopic tools and link these to particular regeneration events (first divisions, callus formation, organogenesis...). Subsequently the effect of significant parameters will be tested on non-regenerative genotypes.

**\*Mass spectrometric analysis for plant (a)biotic stress hormone profiling using LC-MS/MS and LC-HRMS methods.** Within ILVO-Plant Sciences Unit breeding involves the evaluation of stresses in plants. Plant hormone analysis by MS is available for different stress related hormones such as salicylic acid, jasmonic acid, abscisic acid, etc. The goal is to reveal relationships between plant developmental stages, genotype, etc. and plant hormone regulated stress responses. Stresses involve drought, insects, mites and pathogens.

**\*Ornamental plant breeding.** ILVO-Plant Sciences Unit has ongoing breeding programmes in azalea, nursery plants and garden roses in close collaboration with growers. Therefore different techniques are used linked to (interspecific) hybridisation and to overcome pre- and postzygotic incompatibilities: embryo rescue, genomic and fluorescent in situ hybridisation (GISH and FISH), molecular markers, ploidy and genome size estimation, fertility testing, etc. Specific breeding goals we focus on are new innovative genotypes, scent, disease resistance, compact plants, etc. Research can be performed on a specific crop for a specific breeding goal using different techniques.

## Animal Sciences

**Contact person: Sam De Campeneere; [sam.decampeneere@ilvo.vlaanderen.be](mailto:sam.decampeneere@ilvo.vlaanderen.be)**

**\*Welfare & behaviour of farmed animals.** ILVO animal science unit has great facilities and long-standing expertise for conducting research on assessing, monitoring and improving the welfare of poultry, pigs, cattle and other farmed animals. These facilities include behavioural surveillance hard- & software, sensor technologies (such as automated real-time UWB position tracking) and experimental herds (cattle, poultry and pigs). Our expertise and research includes all stages of the production chain, including early-life conditions, production phase, depopulation, transport and slaughter. Interested post-doc researchers are welcome to contact the research group for suggestions of research topics or for discussing their own research proposals as long as they contribute to a better understanding of the behaviour and/or to a better quality of life of farmed animals.

**Contact:** Frank Tuytens ([frank.tuytens@ilvo.vlaanderen.be](mailto:frank.tuytens@ilvo.vlaanderen.be))

**\*Youngstock feeding and management.** ILVO is running several trials with dairy (Holstein) and beef (Belgian white & blue) young stock on colostrum management & feeding management. Especially of interest are the impact of feeding and management strategies on growth performance, rumen development, rumen and intestine microbiome development and function, feed efficiency. Our research and collaboration with e.g. Ghent University, University of Liège combines specialties of feed, feed evaluation, performance trials and in depth microbiome analyses techniques. Besides trials in our specialized animal facilities, we also work closely together with Flemish dairy and beef farms to translate interesting findings to the sector. Interested post-doc researchers are welcome to perform synergetic research activities in the area of microbiome development and evolution, rumen physiologic research and/or immunological research in cattle young stock.

**\*Non-invasive monitoring of nitrogen excretion and efficiency in cattle.** ILVO animal science unit has a long track record on feeding trials, feed evaluation and nitrogen balance trials. We are well equipped in these research area with up to data dairy cattle production facilities, several single and few double cannulated cows within our herd to perform in sacco feed evaluation trials. Recent research is oriented towards low protein diets both in dairy and beef in order to work on ammonia emission reduction in a source oriented way. Within the different feeding and nitrogen balance trials, we have collected a elaborative set of feed, milk, urine and feces samples. Interested post-docs could develop a non-invasive or limited invasive ready to use monitoring system for nitrogen excretion, ammonia emission and nitrogen efficiency based on milk, saliva, blood and/or spot urine samples.

**\*Livestock emissions on animal level.** ILVO animal science unit has an experience of almost a decade to measure greenhouse emissions of individual animals. The facility contains open circuit chambers and different onsite gas emission analyzers including GreenFeeds. This makes measurement possible in our research barn and at animal farms. Our research and collaboration efforts aim to investigate the effect of different diets and additives on the production of greenhouse gases by the targeted animals. Most research is done on dairy cows and methane since they are the major emitters and with the most impact in animal agriculture. Interested post-doc researchers test new or promising diets and additives to mitigate on-farm methane emissions.

**\*Macromineral requirements and interactions between minerals in pig diets.** The development of phytase allowed to produce low phosphorus pig feeds. However, in the field, nutritionists fear the effect on bone health. In this renewed context of low phosphorus diets, there is increased interest and questions on the interactions between minerals and how these affect the requirements. While this knowledge is well studied in poultry, in pig diets there are still ample questions remaining on the digestible calcium and phosphorus content for optimal growth, bone health, intestinal health and minimal excretion to the environment. ILVO has the equipment and expertise to carry out performance trials, digestibility trials, determination of body composition to get better insights in these questions.

**\**In vitro* methods for pig feed evaluation.** Optimal nutrition starts with proper evaluation of feedstuffs. Especially, byproducts show a large variation in quality so that correct feed evaluation is crucial for incorporating them in pig diets. As *in vivo* trials are time-consuming and expensive, ILVO is developing *in vitro* methods and NIRS techniques to estimate the digestibility, energy and protein value of pig feeds.

**\*Increase the taste and quality of the Flemish pork.** Flemish pig industry has selected for animals with a high lean meat percentage, low feed conversion and high cutting efficiency. Recently, however, concerns are increasing about the low sensory and technological meat quality for both the fresh market and processed meat products. One of the problems is the high incidence of Pale Soft and Exudative (PSE) like meat. In addition, pork is characterised by a low intramuscular fat percentage, which leads to less tasty meat. Flavor, tenderness and juiciness are nevertheless the most important factors during the choice and purchase of (pork) meat. The intended stop of surgical castration in 2018 highlights questions about meat quality, as the production of intact boars can negatively influence the sensory quality of pork. Immunocastration can offer an alternative, both regarding the risk of boar taint and the improvement of meat quality, but more information is needed (e.g. optimal timing of the second vaccination, differences can be expected based on the pigs' genetics). The general aim is to improve the taste and quality of the Flemish pork meat to meet the demands of the consumers and the producer. This aim will be implemented in 5 objectives: 1) charting of the needs of the sector (for fresh and processed meat) 2) implementing a fast online/at-line measuring method for meat quality, 3) using the choice of genetics (terminal sire line) and timing of immunocastration to produce more tasteful and quality pork meat, without negative effects on zootechnical results and carcass quality, 4) gaining insight into the variation of meat quality within the current offer of pork in Flanders according the lean meat percentage and sex of the most common sire lines, and 5) informing and sensitizing the sector via a guide on how to produce more tasty and appealing pork meat with better technological quality.

**\*Extended production cycle in laying hens**

Laying hens are kept in production until the age of 75-80 week, but the actual egg production period is only 55-60 weeks long. During a single laying cycle a hen can produce on average 360 eggs. Extending the egg production period and keeping hens longer, possibly until 100 week of age would not only contribute to increased profitability but also to more sustainable food production. However, there are several bottlenecks in extending the production period of laying hens such as declining persistency and egg quality, decreased bone quality, health and welfare. To tackle these problems, a multifactorial approach is needed. Improved genetic selection has to be accompanied by optimal nutrition and management to be able to produce 500 eggs until 100 week of age which should be feasible by 2020, as layer breeding companies predict. ILVO has the equipment and expertise to carry out layer performance trials, digestibility trials, determination of egg quality and body composition to get better insights in these questions.

### **\*To reduce emissions from the poultry industry**

For the poultry industry, concerns about emissions such as ammonia, odor and dust are multifaceted and include issues of poultry performance, health, and welfare, and environmental impact. Pressure is being placed on poultry producers to reduce their emissions but at the moment they are lacking efficient and affordable solutions. Research is needed to improve or develop methods of new techniques in poultry husbandry management or concerning adaptations in nutrition to reduce the poultry emissions. Environmental pressure is an important scientific topic within ILVO that has the expertise as well as the equipment for investigating emission reducing strategies.

### **\*Alternative protein sources for the poultry industry**

In the last years more attention is being put on the use of local feed resources, particularly for protein sources, both for broilers and laying hens. The feed industry and by-product industry is active in this topic and several alternatives to soya have appeared in the last 10 years: macro and micro algae, new by-products from the rapeseed and sunflower processing industry, legumes (peas, faba beans, etc) , insects, single cell protein production from bacteria and/or yeasts and extraction of protein from grass and other green crops. However, there is still information lacking and research is needed on how poultry react to these protein sources in terms of performance, health and welfare. ILVO has the expertise and the facilities to carry on scientific research that evaluates the impact of new feedstuffs and protein sources on animal digestive physiology, health and performance.

## Marine Sciences

**General contact for marine sciences:** Hans Polet ([hans.polet@ilvo.vlaanderen.be](mailto:hans.polet@ilvo.vlaanderen.be))

### **\*Monitoring and improving welfare of marine harvests**

Monitoring and assessing the welfare of marine harvests such as wild-caught fish is of increasing interest i) among consumers seeking sustainably caught seafood, ii) producers committing to eco-friendly certification schemes and iii) researchers and managers safeguarding the ethically correct handling and culling of commercial fisheries catches. While scientific methods for assessing fish welfare and monitoring diseases are constantly evolving, the enormous diversity in fish species and production methods, the lack of scientific data and policy gaps, and the uptake of new innovation in the field, remain important challenges. At ILVO, we have developed protocols and biomarker methods, including digital image analysis techniques, to quantify welfare states of commercially caught fish, to evaluate sustainability of fisheries operations, and freshness and quality of raw and processed seafood products. To guarantee fishers a high return for their catch, improve market access, preserve a healthy food production, we seek a skilled applicant to refine these methods or develop new approaches to meet future policy needs. The successful applicant will get the opportunity to help shape our research agenda in this field. This work will support recent legislation to maximize the survival of fish released at sea, or evaluate industrial-scale humane slaughter methods of fish.

### **\* Modelling multispecies fish assemblages to underpin spatial fisheries management.**

Fishing opportunities in European seas are set by Total Allowable Catches and single-species quota. Aligning fisheries catches with these fishing opportunities is a challenge in mixed (demersal) fisheries. Belgian beam trawl fisheries are recurrently facing these difficulties as indicated by high discards of various commercial fish species. Fishers have the opportunity to address this challenge by choosing where and when to fish. Belgian fishers have the advantage of being able to allocate fishing effort across various European seas, including the North Sea, English Channel, the Celtic Seas, Irish Sea and the Bay of Biscay. ILVO has a good understanding of the stocks and the respective fishery catches in all of these areas from a wide range of fishery-dependent data as well as fishery-independent data, i.e. from scientific surveys in these areas. The integration of these data sources to investigate an improved matching of fishing opportunities with fishery catches is at the forefront of cutting-edge research in fisheries science. ILVO is addressing this challenge using spatial and temporal modelling approaches, such as Bayesian hierarchical modelling and VAST. We welcome post-doc researchers with strong geostatistical interests to address this fisheries challenge.

**Contact:** Jochen Depestele ([jochen.depestele@ilvo.vlaanderen.be](mailto:jochen.depestele@ilvo.vlaanderen.be))

### **\*High-precision fisheries: improving the collection and use of marine fisheries data**

The fusion of fisheries data – specifically collected for management purposes – with the new generation of environmental data – stemming from e.g. satellite imagery, and remote sensing and camera's on fishing vessels – is key for a targeted and sustainable exploitation of the marine ecosystem. Combining this wide variety of data will enable to further unravel the complexity of the marine ecosystem thereby allowing to better understand how local environmental conditions are related to fish abundance at high spatiotemporal resolution. This new dimension of predictive power can be translated into real-time advices for fisheries managers and fishermen on how to optimize their decisions given the spatiotemporal dynamics of the ecosystem. However, managing and processing such large amounts of

variable data sources is not part of the standard fisheries scientists' toolbox and requires new skills. To address this challenge, ILVO seeks post-docs with an interest in data mining and big data techniques, and an irresistible urge to understand what's happening under the sea level.

**Contact:** Klaas Sys ([Klaas.Sys@ilvo.vlaanderen](mailto:Klaas.Sys@ilvo.vlaanderen))

**\*Development of an ecosystem-based approach for managing brown shrimp (*Crangon crangon*) in the Southern North Sea.** As a research institute, ILVO cooperates with governments (national and EU level), fishing industry representatives, academia and with fishers to explore possibilities for sustainable resource exploitation. Assessment and management of stocks, ecosystem effects of fishing, the development of innovative fishing gears and monitoring of ecosystem status and functioning are core research lines. ILVO plays a key role in the evaluation of (Belgian) fisheries by collecting necessary data in order to give advice on fishing opportunities (TAC) as an active member in ICES Working Groups.

Brown shrimp (*Crangon crangon*) is considered a key species in the coastal ecosystem of the Southern North Sea. The brown shrimp stock is a commercial target but also an important prey to a large variety of predators, mostly fish. Currently, brown shrimp fisheries are not subjected to European TAC legislation or management. However, recent significant fluctuations in population dynamics have raised the question if there is any indication that the brown shrimp stock is fished at unsustainable levels. Ecosystem-based management including the role of predators, food availability and climate change could provide a better understanding of the brown shrimp stock dynamics. ILVO invites post-doc researchers with a high interest in fisheries and modelling to develop an ecosystem-based approach for managing brown shrimp (*Crangon crangon*) in the Southern North Sea, to discuss the ecological and socio-economic implications and to recommend measures to reach a long-term sustainability for the brown shrimp stock.

**Contact:** Lies Vansteenbrugge ([Lies.Vansteenbrugge@ilvo.vlaanderen](mailto:Lies.Vansteenbrugge@ilvo.vlaanderen))

### **\*Marine algae as a source of high value products: valorization of mycosporine-like amino acids**

Diverse marine species, including many macro- and micro-algae species, are able to produce mycosporine-like amino acids (MAAs). These molecules are mostly imine derivatives of mycosporins which contain an amino-cyclohexenimine ring linked to an amino acid, amino alcohol or amino group. MAAs are produced by algae to protect themselves against ultraviolet radiation from sunshine and oxidative stress. Therefore, MAAs have an enormous valorisation potential to use as sunscreen agents, pharmaceutical agents, anti-cancer agents, anti-photoaging molecules, activators of cell proliferation and stimulators of skin healing. In addition, these MAAs might be used in industrial applications, such as packaging materials or coatings to avoid weathering.

This postdoc research aims to valorize the potential of these MAAs by focusing on the analysis, extraction and production of MAAs from selected algae species, in order to maximize MAAs production. For this, divers approaches will be developed. By changing environmental conditions and stress factors, optimal breeding conditions will be selected and applied. More advanced molecular approaches for metabolic engineering (i.e. CRISPR/Cas) will be used to steer metabolic pathways to increase MAA production. Production of MAAs will be monitored via LC-HRMS. A testing facility will be set up to assess both pharmaceutical and industrial features and to explore the potential for other applications.

At ILVO, the infrastructure and analytical instrumentation is present to efficiently breed macro- and microalgae, and to analyze MAAs, and experience with CRISPR/Cas is available through several other projects.

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**Participatory farm modelling.** ILVO has a research line focusing on the participatory development of farm models that support on-farm decision making. In order to facilitate adoption of these models in practice, stakeholders are involved in the development process from the very beginning onwards. They help in defining the system and system boundaries to be modelled, and contribute to incorporating tacit knowledge from practice into the models. Models are developed for different agricultural sectors (pig, dairy, etc.) and are transformed into user-friendly decision support tools. Besides analyzing participatory model development as a process, an important focus of the research lies in analyzing the interplay between strategic ‘long term’ decisions and operational ‘short term’ decision making, and dealing with this interplay in modelling efforts.

**Participatory GIS for open space management.** Open space is under pressure due to the increasing population density and processes of urbanisation and counter-urbanisation. Remaining open space is scarce and the subject of debate. Various functions such as nature development, residential development, recreation, food production, flood protection,... compete and claim the same valuable pieces of land. Both rural, urban and peri-urban communities are faced with the question of how to deal with these competing claims and how to preserve/manage open space in a context of urbanisation. Specifically in the context of climate change, these issues will become even more prominent, as open space is a crucial asset for climate adaptation. Within this research line we explore the potential of using participatory GIS as a tool to stimulate this dialogue and envisioning processes within resourceful community management of open space. Participatory GIS is a methodology that can be applied to reveal stakeholder’s values for specific places (often referred to as “public participation GIS”) or to gather (spatially explicit) tacit knowledge from stakeholders (referred to as “participatory mapping”). Moreover, it can be applied to support multi-actor discussions and problem solving processes in spatial planning. This field of research is situated on the interface between community participation digital geospatial techniques.

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