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ANNUAL REPORT 2011

ANNUAL REPORT ILVO 2011



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This annual report describes the results of the two legal entities that join to form ILVO:

- ✓ The Internally Autonomous Agency (IAA) of the Flemish Government
- ✓ ILVO Own Capital (ILVO-OC)

### **ILVO's Mission**

ILVO's mission is to perform and coordinate policy-supportive scientific research and to provide related services with an eye toward economically, ecologically and socially sustainable agriculture and fisheries.

Based on research in the various scientific disciplines, ILVO will acquire knowledge necessary for the improvement of products and production methods, for monitoring and safeguarding the quality and safety of end products, and for improving policy instruments as a basis for the development of the agricultural sector and policies relating to the countryside.

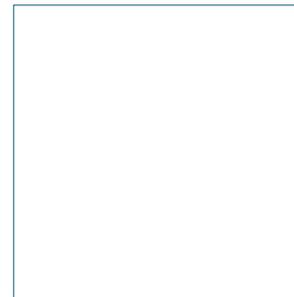
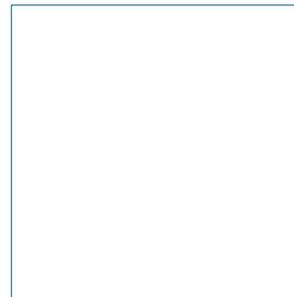
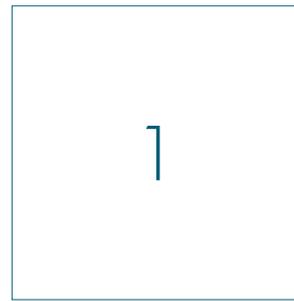
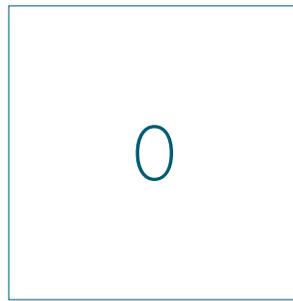
ILVO will regularly inform policy-makers, the agriculture, horticulture and fisheries sectors, and the public about its findings.

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Dear reader,

During the past year ILVO has undertaken a number of tasks to further the competitiveness and sustainability of Flemish agriculture and fisheries. This annual report reflects our work in this area.

In 2011, ILVO turned 5 years old. During this short life, ILVO has met or exceeded most of our hopes and expectations. Yet our work has just begun. Within the limits of the budget and personnel, the team at ILVO is already enthusiastically pursuing the path set out in the last five years and we are looking forward to achieving more of our envisioned accomplishments. But modern science requires a modern infrastructure. A retroactive allocation to the ILVO Own Capital fund has enabled us to create a multi-year plan to update our buildings. In 2011, this has already resulted in the construction of a state-of-the-art greenhouse complex and the updating and expansion of our pilot food processing plant, the Food Pilot. Future plans include a research barn for dairy cows and new pig stalls, along with needed improvements to improve energy efficiency and employee safety.

The influence of ILVO2020 on our management is becoming tangible as we take the first steps to track the financing of internal research projects based on ILVO2020. The external financing acquired in via competitive research proposals and collaboration was positive in the past year. This was also true of scientific output – we have even exceeded the performance indicators set out in the 2011 management agreement. Our internal organisational management has also made great progress toward a new level of maturity. Outside ILVO, the public has been increasingly informed about our accomplishments, activities and research results via the media.

On this five-year anniversary, I wish to thank every member of ILVO's personnel for their support, effort and enthusiasm. I also thank the Minister President of Flanders and everyone else who makes our work possible, directly and indirectly. I especially thank those who finance our research and those who partner with us on our research projects.

Enjoy your reading,

Erik Van Bockstaele  
Administrator-General



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## Eco-friendly cows and greedy jellyfish

In 2011, ILVO's Animal Sciences Unit started a new field of research: the study of greenhouse gases that cattle produce during digestion. Six individual open-circuit chambers ("GUKs" in Dutch), with their sophisticated measuring equipment, are an exciting addition to our research infrastructure. We expect that the GUKs will yield the data we need to find feed strategies that will lead to better performance with fewer emissions.

2011 was also the year in which the Animal Sciences Unit organised two successful study days on animal welfare. How can animal welfare be scored on commercial farms? And which (zoo)technical strategies (feeding, housing and management) can improve certain aspects of animal welfare, including leg and claw problems?

With an eye on the coming legislative requirement to house pregnant sows in group, our sow house was renovated in 2011 to a low-ammonia-emission concept with four pens, each equipped with an automatic concentrate feeder with four kinds of feed.

In the midst of the serious pork (price)-crisis, the Government of Flanders clearly stepped up to help the pig farmers, and the Animal Sciences Unit was also assigned to help. Animal Sciences will start a newly-created Information Centre for Flanders' Pig Farmers ("*varkensloket*") in the Pig Husbandry Practice Centre. This will become the central place for information exchange and information dissemination to the pork industry. It will also become a centralised place to receive urgent and penetrating questions about (future) research about pig husbandry.

In August 2011, ILVO, Kris Peeters (the Flemish Minister of Agriculture and Fisheries), the Department of Agriculture and Fisheries, Natuurpunt and the organisation of boat owners ("Rederscentrale") all signed a covenant to further the sustainability of the Flemish fishing industry. ILVO took to the sea to research the potential for passive fisheries and mariculture within the offshore windmill parks, then hosted an international study-day about the research results. ILVO-Fisheries also coordinates the interreg MEMO project to study the appearance of the invasive American comb jelly in our section of the North Sea. Our research will hopefully lead to an efficient management of this voracious jellyfish.

The 70 researchers of the Animal Sciences Unit study (more) sustainable animal husbandry (cattle, pigs and small farm animals) and the exploitation of the marine resources, protection of the continental and marine environments, furthering animal welfare, and delivery of high-quality and safe animal products. This unit also provides specific services to the agricultural and fishing industries and to the government.

ANIMALAB is the main service provision of the Animal Sciences Unit. A few of the services of this reference lab are research on animal feed and analysis of the nutritional value of animal end-products; measurement of the quality of fish, shellfish and molluscs; determination of the contamination of environmental samples and fat of fisheries products; and biological environmental research. The agricultural and fisheries sectors can also call on us for specialised technological advice and services via contract research and services such as PreventAgri, ADVIS, CIVIS, and others.

## Oh, pardon me!

### Ruminating on methane emissions

Ruminants such as dairy cattle are highly prized for their ability to convert fiber-rich feed into food with high nutritional value (milk and meat). One drawback of this feed conversion is the production of methane, a greenhouse gas that contributes to global warming. The Animal Sciences Unit has developed six open-circuit respiration chambers to study the methane emissions of ruminants in practice.

During the ruminant's digestive process, microorganisms in the rumen produce methane, which is predominantly emitted through the mouth. The methane production is influenced by the composition of the diet and can be partially controlled or reduced through methane-inhibiting substances. Some methane mitigation strategies can be partly tested in the laboratory, but the observed effects are difficult to translate into practice. Animal trials are therefore a must.

Open-circuit chambers offer the most effective way to study ruminant methane production. These chambers work with a small underpressure, which ensures that all the air leaves the chamber via the air outlet. There, the gas is sampled and monitored and the air flow is measured. Based on these parameters, the gaseous emissions are calculated.

Animal comfort was a priority for the design of the rooms. The rooms are furnished with high-quality mats and the animals have many possibilities for visual contact with each other. The animals stay for a maximum of four days in the open-circuit chambers.

In addition to methane, other gases such as nitrous oxide, carbon dioxide and ammonia are determined, so we can examine whether dietary effects on methane may lead to the production of other greenhouse gases. Additionally, a possible shift of emissions from animal to manure can be studied.

**Title:** Development of 6 open-circuit respiration chambers for emission research in cattle.

**Funding:** ILVO and DAIRYMAN (interreg-project)

**Duration:** 2010 - 2011

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## Nitrogen excretion on a dairy farm:

### Is milk urea content an accurate predictor?

Milk urea content, despite being proven as an important and useful indicator of protein utilization in dairy cows, is not reliable as an absolute predictor of N excretion from a dairy herd. Milk urea content is still useful to optimise the cows' ration; however, several factors interfere with the milk urea content and make it unreliable as an absolute predictor of N excretion. It is therefore not recommended to use milk urea content as a monitoring tool for the Flemish environmental action plan.

ILVO scientists performed several feeding trials with dairy cattle in an attempt to quantify factors that interfere with milk urea content. Quantification of these factors would be useful when developing a model that could reliably estimate N excretion. In our studies, relatively small changes in the diet were observed to affect the milk urea content, but these changes often had no effect on the amount of N excreted into the environment. Most of the confounding factors seem to be linked to the water physiology of the cow. As more urine is produced relatively more urea is discharged through urine and less in the milk. We collected data indicating that addition of salts, hot weather, and shifts in the ratio of corn silage to grass silage led to a (not very predictable) change in milk urea content. Our research was unfortunately not able to determine additional milk parameters to increase the reliability of the estimation of N excretion from milk urea content.

**Title:** Milk urea content to predict N-excretion of a dairy herd

**Funding:** Flanders' Government

**Duration:** 2004 - 2011

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## A win-win situation for broiler farmers:

### Efficient use of phosphorus in broiler feed lowers costs and benefits the environment

The dietary phosphorus (P) and calcium (Ca) content is important for the birds' health. Apart from fulfilling the dietary requirements, these minerals also influence the P excretion into the environment and the feed cost. More than 50% of the total P level in poultry diets comes from plant-based ingredients. The major fraction of this P is present as phytic acid (PP). However, poultry lack significant amounts of endogenous phytase, which is needed to hydrolyse phytic acid. Non-phytate-phosphorus (NPP) is therefore normally supplemented to the broilers' diet to obtain optimal performance. Supplementation of NPP has the disadvantage of increasing both the expense and the amount of P excreted into the environment, because the non-digestible PP and the excess NPP are excreted.

Safety margins are normally included, because the nutrient content of the diet always varies due to the natural variation in the raw materials. Studies indicate that Ca and P concentrations in commercial diets can be reduced if done in a balanced way. A balanced reduction of the recommended P and Ca requirements does not negatively affect performance and bone development. The total Ca to total P ratio in the diets should be about 1.4 /1. This avoids the negative effects of excessive Ca intake and also ensures that Ca does not limit P utilisation.

Supplementing exogenous phytase or vitamin D<sub>3</sub> metabolites can have a positive effect on the PP availability. It should help to reduce the amount of dietary non-phytate-phosphorus (NPP) supplementation needed as well as the potential environmental pollution and feed costs.

**Title:** completed section of continuing research  
'Ca- en P-behoeften bij pluimvee'

**Funding:** ILVO, Government of Flanders

**Duration:** continuous

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## Stocking density:

High densities can be harmful, but how much space would the animals choose?

The welfare of broiler chickens is compromised by increased stocking density. For meat-type rabbits this effect is less clear. But the spatial distribution of both species suggests that they prefer to have considerably more space than is available to them in commercial practice.

Our research has shown that a higher stocking density disturbs broiler chickens' rest. These chickens were also more fearful than their counterparts stocked at lower densities. The broilers stocked at high densities also had weaker legs that were more often deformed and affected by dermatitis. The behaviour and health of meat-type rabbits showed a less pronounced reaction to increased density. However, the rabbits' bodily measurements were less symmetrical when kept at high density, which indicates increased stress levels.

Behaviour and health were negatively influenced by high stocking density, but this does not necessarily reflect how much space animals prefer to have. To assess their density preference, we studied how they distributed themselves over their pen. Social animals will seek each others' company when presented with an abundance of space. In contrast, when too little space is available, they will avoid each other and thus maximise their personal space. Broilers avoided each other at densities of 6 animals/m<sup>2</sup> and higher. This suggests that they prefer to have more space than available at this density. Rabbits avoided each other at densities of 10 animals/m<sup>2</sup> and higher. Another test showed that broiler chickens were strongly motivated to acquire additional space, as shown by the great physical effort they made to get extra space.

**Title:** This research is part of the project 'Determination of the optimal stocking density of group-housed farm animals in relation to spatial needs, farm profitability, and societal acceptance

**Funding:** IWT, Cera, Nutreco N.V., Roxell N.V. and various organizations of the poultry and rabbit industry

**Duration:** 2006 - 2011

**Collaboration:** Sveriges Landbruksuniversitet (SLU), Veterinärmedizinische Universität Wien, Ghent University (Fac. Wetenschappen, Vakgroep Terrestrische Ecologie), UA (Fac. Wetenschappen, Vakgroep Evolutionaire Ecologie)

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## A mixed bag: Modernisation and the welfare of dairy cattle

Modernisation has clearly improved the efficiency of milk production, but the consequences for the welfare of dairy cattle are mixed. ILVO investigated dairy cattle welfare housed in modern (cubicle house) and traditional (tying stall) farms. Despite the improved ease of movement for cows housed in modern farms, scores for other aspects of welfare were comparable or even worse.

This experiment took place on 19 traditional and 20 modern dairy farms in Flanders at the end of the indoor period during 2010 and 2011. Traditional farms were defined as tie stalls in which no structural changes had taken place during the last 20 years; modern farms were defined as cubicle houses of maximum 20 years old.

Dairy cattle welfare was measured using the method developed by Welfare Quality®. This protocol allows the overall welfare status to be categorized on the basis of 32 welfare indicators grouped into 11 welfare criteria, which in turn are grouped into 4 welfare principles. Not a single farm received either the lowest ('not classified') or highest ('excellent') welfare category. All farms were categorised as 'acceptable' or 'enhanced'. The overall welfare category hardly differed between modern (50% enhanced) and traditional (53% enhanced) farms. More detailed inspection, however, did reveal some differences. Modern farms scored better for the welfare principle 'good housing' because cows have greater freedom of movement. On the other hand, traditional farms scored better for the welfare principle 'appropriate behaviour' because cows spend more time on pasture, perform fewer undesirable social behaviours (chasing, head butting) and are less fearful of humans.

**Title:** Comparison of the welfare of dairy cattle on traditional versus modern farms in Flanders

**Funding:** ILVO

**Duration:** 2010 - 2012

**Collaboration:** Ghent University (Faculty of Veterinary Medicine. Dep. of Comparative Physiology and Biometrics), HoGent (Dep. BioSciences and Landscape Architecture), KAHO Sint-Lieven (Agro- and Biotechnology)

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Modern



Traditional

Table: Mean scores (0-100) for the various welfare criteria and welfare principles of the modern versus traditional farms (scores in green are significantly better than scores in red).

Criteria	Modern	Traditional	Principles	Modern	Traditional
Absence of hunger	57.3	67.4	Good feeding	53.6	52.3
Absence of thirst	67.8	54.3			
Comfort around resting	36.3	37.9	Good housing	58.1	33.5
Ease of movement	95.0	34.0			
Absence of injuries	37.2	31.8	Good health	29.4	32.9
Absence of disease	31.5	35.4			
Absence of pain induced by management procedures	38.8	53.7			
Social behaviours	93.8	100.0	Appropriate behaviour	40.8	55.6
Other behaviours	48.4	79.5			
Human-animal relationship	38.8	55.2			
Positive emotional state	52.1	50.1			

## Fishery/energy synergy:

### Passive fishing and mariculture in Flemish wind farms

Offshore windmill operators often see fishing and marine aquaculture (“mariculture”) as a burden rather than as an opportunity. Yet the two can be reconciled, and these activities may even be mutually beneficial under certain conditions. This synergy can be technical as well as image-related: the sustainable nature of wind energy matches the sustainability of small-scale passive fishing and mariculture. Various fish and shellfish populations in these areas are expected to increase, as windmill biodiversity studies have shown. Sea bass, crab and lobster populations can be caught sustainably by small scale passive fisheries without disturbing the sea bed.

Flemish mariculture is currently limited to offshore mussel farming in a small area. The intensive use of the North Sea prevents the designation of additional farming areas. According to ILVO, the wind farm areas, where regular navigation is prohibited, are suitable for shellfish and algae farming. In addition, these areas can also be used as open sea farms, a form of mariculture without physical barriers, combined with passive fishing as a harvesting method.

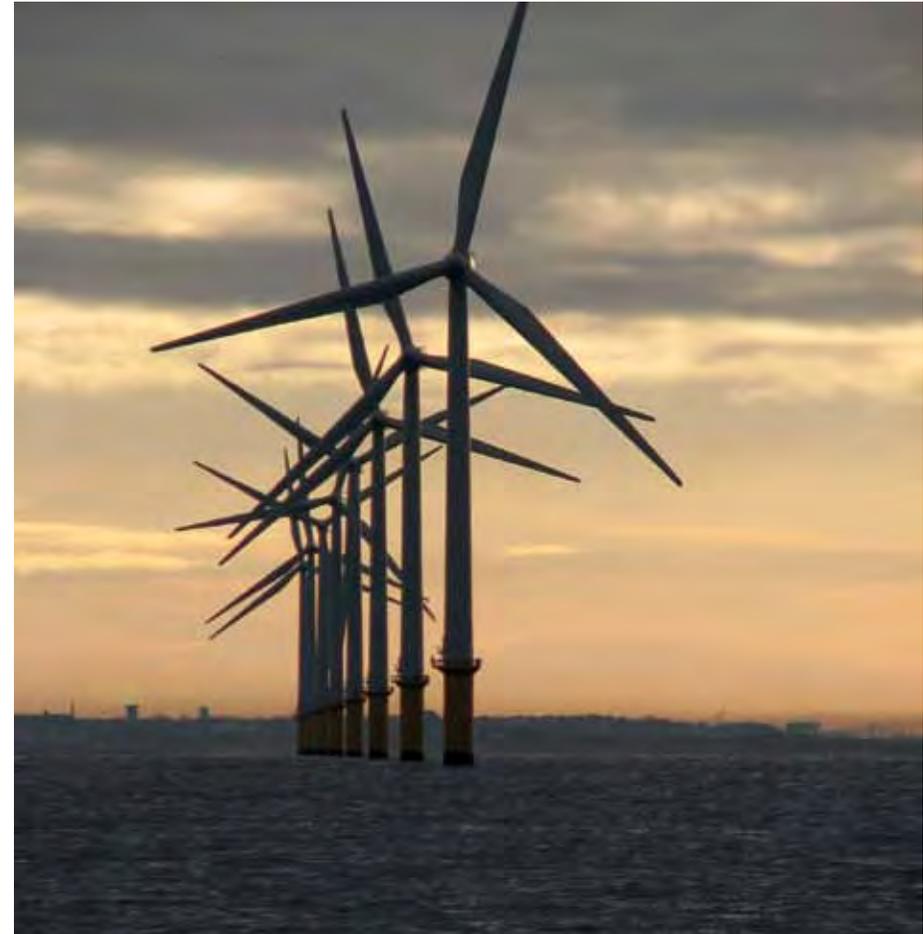
The Flemish government promotes the conversion of fisheries to more sustainable alternatives. Every opportunity for alternative fishing and mariculture therefore deserves investigation. Fishermen using passive fishing techniques are interested in exploiting wind farms, but only within a legal and well-defined framework. The terms of restriction and regulations already established in neighboring countries can serve as an example for our policy makers.

Now that the technical feasibility of fish production in wind farms has been clarified, the initiative should come from the policy makers. ILVO recommends a comprehensive and structured dialogue between all parties involved to reach a compromise. Future regulations should 1) include well-defined limited access and 2) access the existing technical knowledge about fishing and mariculture.

**Title:** MARIPAS – Haalbaarheid van passieve visserij en maricultuur binnen windmolenparken

**Funding:** EVF/FIOV

**Duration:** 2010 - 2011



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## What about sand extraction at sea?

### Bottom dwellers return quickly after extraction stops

The biological impact of intensive sand extraction is dependent on the local natural conditions in the area where extraction takes place. ILVO compared the impact of sand extraction on two sandbanks.

Sand extraction in the Belgian Part of the North Sea started in 1976. The quantities of extracted sand have increased exponentially since the early days. Extraction activities have also shifted from the Kwintebank (about 1 million m<sup>3</sup> per year until 2007) to the Buitenratel (about 1.4 million m<sup>3</sup> per year starting in 2008). Our biological impact study shows that the intensive extraction at the Kwintebank pauperised the benthic community. In other words, fewer species occurred at the seafloor, and they were present in lower numbers. On the other hand, the current extraction on the Buitenratel seems to contribute to a more diverse benthic community.

The Buitenratel is naturally an area of coarse sand. The extraction activities rework and disturb the seafloor, and as such a small percentage of very fine sand becomes available. The presence of this fine sand attracts typical fine sand species, which has even doubled the natural biodiversity at some locations.

After cessation of sand extraction on the Kwintebank, rapid recolonisation was observed. The impoverished community has been colonised by opportunistic organisms, interstitial species (organisms that live between sand grains) and juvenile species.

Intensive sand extraction at sea does not necessarily have long-term negative effects. Recolonisation takes only 1 to 2 years. The recovery of the biomass (total weight, mainly delivered by adults and long-living species) on the other hand, takes 2 to 5 years.

**Title:** ZAND – Effecten van aggregatextractie op de zeebodem en het mariene bodemleven

**Funding:** Concessiehouders via FOD Economie, Directie Kwaliteit en Veiligheid

**Duration:** doorlopend sinds 1979



**Collaboration:** ILVO (Groep Biologisch Milieuonderzoek en Groep Chemische milieumonitoring en Producttechnologie), FOD Economie (Directie Kwaliteit en Veiligheid, Cel Continentaal Plat), KBIN (Beheerseheid Mathematisch Model van de Noordzee (BMM))

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## Is there such a thing as low-impact fishing gear?

### The story of WAKO fisheries

The types of fishing gear classified as 'fixed' or 'passive' gears do not necessarily score higher on a sustainability scale than towed gears. ILVO has developed a methodology to compare the effect on that both types of fishing gear have on the ecosystem. The selected case study focused exclusively on trammel net fishery, which is a passive fishing method, and beam trawls, which are towed across the seafloor.

The former WAKO project (WAKO-I) already shed light on the differences between beam trawl and trammel net fisheries in terms of impact on the ecosystem. Beam trawls mainly affect the benthic ecosystem (sea urchins, crustaceans, shells, etc.), which are damaged not only by the discarding process, but also by the chain mats which can run across the individuals unable to escape trawl passage. The WAKO-II project demonstrated quantitatively that trammel net fishery results in much fewer discards of benthic invertebrates and non-commercial fish. However, the discards of undersized plaice and dab remain high, as the number of crabs (e.g. edible crab, flying crab), which are rarely discarded alive. Additionally, the by-catch of marine mammals in trammel nets might cause important effects on the respective populations. The discarding process also has indirect effects. A total shift from beam trawl fishery (with a high discard amount) to trammel net fishery (with a low discard amount) could imply that scavenging seabirds (mainly gulls) may find less food at sea and turn their back to find it inland. This could increase the 'gull' problems in coastal cities. Beam trawl and trammel net effects vary from region to region and from season to season, as does the presence of (sensitive) species in the ecosystem.

The WAKO-II project has developed a methodology to compare the effects of both types of fishing gear in an integrated manner. The methodology is based on the sensitivity of individual species from different ecosystem levels, which is in turn based on the rate of disturbance and the intrinsic capacity of a species to redress from the damage incurred. The methodology could only be tested for a range of key species due to the limited duration of the project. The next step will be to apply the method on a larger scale, with a larger number of species including species protected by Natura2000. This would result in a spatial plan for different types of fishing gear. Such a plan has the potential to greatly reduce the ecological impact of the Belgian fisheries.



**Title:** An integrated impact assessment of trammel net and beam trawl fisheries (WAKO-II)

**Funding:** Belgian Science Policy

**Duration:** 2009 - 2011

**Collaboration:** ILVO (groep Technisch visserijonderzoek en groep Biologisch Milieuonderzoek), INBO, KBIN/MUMM, Ghent University (sectie Mariene Biologie)

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## Reality or fiction?

### A crystal ball for fisheries management

A prediction model for fisheries management is mainly based on biological fishery statistics or stock assessments. Including a number of economic and even social parameters into the fisheries management model would make it a better, more stable and more sustainable. On the basis of a case study for sole in the Belgian part of the North Sea, ILVO researchers attempted to develop such a model.

To date, the Flemish, Belgian and European policy-makers base their decisions on fisheries management mainly on stock assessments, i.e. biological parameters. However, criticism of this type of management is growing among fishermen and vessel owners. They perceive the system as too inaccurate, too variable and uncertain.

In the case study on Belgian sole fisheries, ILVO included an alternative and more elaborated calculation method in the experimental design. The basis of the case study was the data of Belgian sole fisheries. A management tool developed for the herring fishery in the Baltic Sea (designed in 2007) was used as the starting point (model developed by Kulmala et al.). The model was successful because margins of error and uncertainties were quantified and further reduced by accounting for socio-economic parameters such as landings, value and effort.

The Belgian case study shows that the use of a quick scan tool for testing different policy options results in better insight, both in terms of biological and economic performance of a fishery. For example, it appears that the ITQ scenario (individual transferrable quotas between vessels within a fleet or companies) is the best type of fishing: the important parameter 'spawning biomass' (fish that can reproduce) remains well above the precautionary value.

The applied model should now be further refined and expanded, e.g. by applying it to multiple species. The statistical biological/economic model is promising as a quick-scan tool that has predictive power for the existing traditional biological reference points (points below which the fish stocks start to decline), and as well for the calculation of economic reference points.

Recently, a PhD study was started at ILVO to refine this new fisheries management model and extend the model by including other species, (technically) different types of fishing and to apply the model in mixed (more complex) fisheries.



**Title:** Bio-economic quick scan model for fisheries management: the case of dover sole in Belgium. EMBC MsC thesis

**Duration:** 2011

**Collaboration:** ILVO (promotor), Ghent University

**Contact:** ruben.verkempynck@ilvo.vlaanderen.be, els.torrelee@ilvo.vlaanderen.be, ludwig.lauwers@ilvo.vlaanderen.be

## As clear as mud:

### The biological and chemical impact of dredge spoil deposit

At high levels of dredge spoil dumping, the infauna (species residing in the sea bed) are clearly affected. Reports of the chemical impact of dumping do not always agree, but the results suggest that some problems exist and should be examined.

To guarantee the accessibility of Belgian ports, mud is dredged from maritime access roads and dumped further out at sea. On an annual basis, approximately 11 000 000 barrels of dry dredging substance is dumped on 5 set locations at sea, with large differences in dumping intensity between the dumping sites. Yearly, ILVO conducts 2 sampling campaigns to assess the impact of dumping on the marine environment.

On the deposit areas with a higher dumping intensity, the habitat changes and a resulting shift between silt and non-silt preferring benthic species are observed. Part of the infauna is buried during dumping activities, which reduces the number of species observed compared to the reference locations. The epifauna (species which reside on the sea bed) and the fish fauna seem to be only slightly influenced, because they are able to move more rapidly away from the mud being dumped.

Chemical studies reveal large differences in concentration of the monitored pollutants between the deposit sites. The concentrations map mainly to the grain size and the organic content of the samples. However, observed contamination levels in sediment and accumulation in marine organisms did not differ between dumping sites and their corresponding reference sites. During 2009-2010, several dumping sites as well as reference sites revealed levels of cadmium, lead and polychlorinated biphenyl CB118 that exceed the tolerated environmental values as standardised by national and international forums, but these higher concentrations could not be conclusively linked to the dumping of dredge spoil. As long-term exposure to harmful chemical substances can cause negative effects on marine organisms, ILVO will monitor those contaminants on the Belgian Part of the North Sea. The assessment will be extended to emerging contaminants.



**Title:** Effecten van het lossen van baggerspecie op de zeebodem en het mariene bodemleven

**Funding:** Government of Flanders, Departement Mobiliteit en Openbare Werken

**Duration:** doorlopend sinds 1979, 2-jarlijks hernieuwd

**Collaboration:** ILVO (Groep Biologisch Milieuonderzoek en Groep Chemische milieumonitoring en Producttechnologie), Departement Mobiliteit en Openbare Werken, Afdeling Maritieme Toegang (MOW-aMT), KBIN-Beheerseenheid Mathematisch Model van de Noordzee (BMM), Agentschap voor Maritieme Dienstverlening en Kust, Afdeling Kust (MD&K), Waterbouwkundig Laboratorium

**Contact:** lisa.devriese@ilvo.vlaanderen.be, gert.vanhoey@ilvo.vlaanderen.be

### How much greenhouse gas does a Flemish cow on a Flemish ration produce, and during which periods of the day?

Title: Uitstoot van broeikasgassen bij runderen in de Vlaamse context  
Funding: ILVO  
Duration: 2011 - 2016  
nico.peiren@ilvo.vlaanderen.be

### How can we predict dairy cows' methane production?

Title: Continuous registration of methane emitted by cattle and its assessment from milk fatty acid patterns.  
Funding: ILVO, Ghent University  
Duration: 2010 - 2013  
Collaboration: Ghent University (Lanupro)  
sam.decampeneere@ilvo.vlaanderen.be

### Which plant extracts might reduce methane production?

Title: Technological platform to develop nutritional additives to reduce methane emissions from ruminants  
Funding: EU  
Duration: 2010 - 2012  
Collaboration: Aberystwith University (UK), INRA (France), CSIC (Spain), Ghent University  
sam.decampeneere@ilvo.vlaanderen.be

### Can we reduce soya imports by using rumen protected soya?

Title: Reductie van de soja-import door het gebruik van bestendiger soja- en koolzaadschroot in de rundveevoeding  
Funding: Boerenbond  
Duration: 2011 - 2012  
Collaboration: Hooibeekhoeve (LCV, Geel), Proef- en Vormingscentrum voor de Landbouw (PVL, Bocholt), Bedrijfsadviesing Melkveehouderij (Beitem)  
sam.decampeneere@ilvo.vlaanderen.be  
johan.deboever@ilvo.vlaanderen.be, leo.fiems@ilvo.vlaanderen.be

### How can we estimate the nutritive value of DDGS (distillers' grains and solubles) and what are the possibilities for valorising them in animal feed?

Title: Voederwaardering van DDGS als bijproduct van de bio-ethanolwinning voor rundvee, varkens en pluimvee  
Funding: IWT  
Duration: 2009 - 2013  
emma.teirlynck@ilvo.vlaanderen.be  
leo.fiems@ilvo.vlaanderen.be  
johan.deboever@ilvo.vlaanderen.be

### Is it possible to improve the nutritional value of grass and maize silage for dairy cows by adding ferulate esterase-producing lactic acid bacteria during ensiling?

Title: Ferulaatesterase-producerende *L. buchneri* stammen: een nieuw revolutionair concept bij het inkuilen van ruwvoeders  
Funding: PWO HoGent and Pioneer  
Duration: 2010 - 2013  
Collaboration: HoGent  
johan.deboever@ilvo.vlaanderen.be  
sam.decampeneere@ilvo.vlaanderen.be



### Is it possible to develop reliable NIRS calibrations to estimate the cell wall digestibility and rumen bypass starch of silage maize varieties?

Title: Voederwaardeschatting kuilmáissassen op basis van celwandverteerbaarheid en zetmeelbestendigheid  
Funding: Fonds voor Landbouw en Visserij  
Duration: 2011 - 2013  
Collaboration: HoGent, CRA (Gembloux), CIPF  
johan.deboever@ilvo.vlaanderen.be



### Can DDGS replace soya in double-muscléd cows' ration?

Title: Valorisatie van DDGS  
Funding: ILVO  
Duration: 2010 - 2014  
leo.fiems@ilvo.vlaanderen.be

### Can double-muscléd calves be weaned faster and still perform well?

Title: Opfokstrategie bij rundvee  
Funding: Government of Flanders, ILVO  
Duration: 2009 - 2012  
leo.fiems@ilvo.vlaanderen.be



### Can extra fat in the ration of double-muscléd cows during the last months before calving result in a shorter calving interval?

Title: Specifieke welzijns-, gezondheids- en reproductieproblemen in de veehouderij  
Funding: ILVO  
Duration: 2010 - 2015  
leo.fiems@ilvo.vlaanderen.be

### Is it possible to increase the number of viable piglets per birth?

Title: Effect van methylatiepotentieel in de zeug op de kwaliteit van pasgeboren biggen  
Funding: ILVO, Ghent University  
Duration: 2010 - 2013  
Collaboration: Ghent University (Fac. Diergeneeskunde)  
karolien.langendries@ilvo.vlaanderen.be

### How do stall systems, stall management and human and animal activity affect pollution of stall air?

Title: De invloed van staltechnieken, management en dierfactoren op luchtemissies via een multipolluentbenadering  
Funding: ILVO  
Duration: 2011 - 2015  
Collaboration: ILVO-Technology & Food Science  
tim.ulens@ilvo.vlaanderen.be

**How can we detect and prevent claw and leg problems in group-housed sows? What is the effect of trace elements in feed (e.g., zinc) in the development and persistence of claw and leg problems?**

Title: De ontwikkeling en preventie van klauw- en pootproblemen bij zeugen in groepshuisvesting: interactieve effecten van gedrag, voeding en stalvloer  
 Funding: IWT  
 Duration: 2010 - 2014  
 Collaboration: Ghent University (Fac. Diergeneeskunde)  
 elena.nalon@ilvo.vlaanderen.be  
 miriam.vanriet@ilvo.vlaanderen.be

**What is the optimal amount of amino acid in pig feed?**

Title: Optimale aminozuurgehalten in varkensvoerders  
 Funding: ILVO  
 Duration: continuous  
 sam.millet@ilvo.vlaanderen.be

**Which alternatives to non-anesthetised surgical castration of piglets are appropriate for use in practice?**

Title: CASPRAK - Vergelijkende studie op praktijkbedrijven van op korte termijn implementeerbare alternatieven voor het onverdoofd chirurgisch castreren van beerbiggen  
 Funding: Government of Flanders, ILVO, Boerenbond, VLAM  
 Duration: 2008 - 2012  
 Collaboration: KULeuven  
 marijke.aluwe@ilvo.vlaanderen.be  
 sam.millet@ilvo.vlaanderen.be  
 frank.tuytens@ilvo.vlaanderen.be

**How can the welfare of chickens in non-cage systems be improved?**

Title: Layerhouse - Onderzoek naar de verbetering van niet-kooisystemen voor de huisvesting van leghennen  
 Funding: FOD  
 Duration: 2012 - 2015  
 Collaboration: Proefbedrijf Pluimveehouderij (Geel)  
 evelyne.delezie@ilvo.vlaanderen.be

**Do omega-3 fatty acids received via the mother have an effect on the progeny?**

Title: Invloed van maternale transitie van omega-3 vetzuren op uitkipping, kuikenkwaliteit en prestatie tot op slachtleeftijd  
 Funding: ILVO, KULeuven  
 Duration: 2010 - 2014  
 Collaboration: KULeuven  
 astrid.koppenol@ilvo.vlaanderen.be  
 evelyne.delezie@ilvo.vlaanderen.be



**Can rabbits be housed in group?**

Title: Rabbity - Onderzoek naar meer diervriendelijke huisvestingsystemen voor konijnen  
 Funding: FOD  
 Duration: 2012 - 2015  
 Collaboration: Ghent University (Fac. Diergeneeskunde)  
 luc.maertens@ilvo.vlaanderen.be  
 stephanie.buijs@ilvo.vlaanderen.be

**What is the nutritional value of fiber-rich feed ingredients for rabbits?**

Title: Verteerbaarheid van alternatieve vezelrijke grondstoffen van vleeskonijnen  
 Funding: ILVO  
 Duration: continuous  
 Collaboration: Universiteit Tizi-Ouzou (Algerije)  
 luc.maertens@ilvo.vlaanderen.be

**What is the effect of NSP enzymes on the performance of meat chickens and turkeys?**

Title: De bio-efficiëntie van endogene enzymen bij pluimvee  
 Funding: diverse firma's  
 Duration: continuous  
 luc.maertens@ilvo.vlaanderen.be  
 saskia.leleu@ilvo.vlaanderen.be

**Are the current coccidiostats efficient, and do alternatives exist?**

Title: De bio-efficiëntie van coccidiostatica bij pluimvee  
 Funding: various firms  
 Duration: continuous  
 Collaboration: Ghent University (Fac. Diergeneeskunde)  
 luc.maertens@ilvo.vlaanderen.be  
 saskia.leleu@ilvo.vlaanderen.be



**How can one improve the welfare of laying hens in organic production?**

Title: Promoting good health and welfare in European organic laying hens  
 Funding: EU (Core Organic II)  
 Duration: 2011 - 2014  
 Collaboration: 8 international collaborators  
 frank.tuytens@ilvo.vlaanderen.be



**Do cows and horses need shelter against cold and heat?**

Title: PASTRESS - Onderzoek naar de preventie van hitte- en/of koudestress bij dieren die op de weide worden gehouden  
 Funding: FOD Volksgezondheid en Eigen Vermogen ILVO  
 Duration: 2010 - 2014  
 Collaboration: Ghent University (Fac. Diergeneeskunde), KULeuven, Natuurpunt  
 eva.vanlaer@ilvo.vlaanderen.be  
 frank.tuytens@ilvo.vlaanderen.be

**How can one detect meat with boar taint and valorise it?**

Title: Detectie en valorisatie van vlees met berengeur  
 Funding: IWT  
 Duration: 2009 - 2012  
 Collaboration: Ghent University (Fac. Diergeneeskunde)  
 karen.beckaert@ilvo.vlaanderen.be  
 frank.tuytens@ilvo.vlaanderen.be

### Can cortisol in hair be used to score animal welfare over the long term?

Title: Ontwikkeling en validatie van een innovatieve, lange termijn indicator van dierenwelzijn: accumulatie van fysiologische stress-indicatoren in niet-invasief bemonsterde matrices  
 Funding: ILVO  
 Duration: 2010 - 2015  
 Collaboration: Ghent University (Fac. Farmaceutische wetenschappen)  
 johan.aerts@ilvo.vlaanderen.be

### Does a calf grow less quickly if its mother gave more milk during gestation?

Title: A study concerning metabolic programming in high yielding dairy cows.  
 Funding: ILVO, Ghent University (Fac. Diergeneeskunde)  
 Duration: 2011 - 2012  
 Collaboration: Ghent University (Fac. Diergeneeskunde)  
 leen.vandaele@ilvo.vlaanderen.be

### Is selection for boar taint a sustainable alternative for castration of piglets?

Title: Selectie tegen berengeur als duurzaam alternatief voor castratie van biggen  
 Funding: IWT  
 Duration: 2009 - 2013  
 Collaboration: KULeuven  
 sam.millet@ilvo.vlaanderen.be  
 frank.tuytens@ilvo.vlaanderen.be

### Are coccidiostats given to chickens taken up by vegetables fertilised with chicken manure?

Title: Experimental study: uptake of coccidiostats in vegetables  
 Funding: EFSA  
 Duration: 2010 - 2012  
 Collaboration: Ghent University (Fac. Farmaceutische wetenschappen), ILVO Plant Sciences, ILVO Technology & Food Science  
 evelyne.delezie@ilvo.vlaanderen.be

### Can the quality of bedding for meat chickens be influenced by feed and ventilation?

Title: Verbetering van de rendabiliteit in de vleeskuikensector door een optimalisatie van de strooiselkwaliteit  
 Funding: ADLO  
 Duration: 2010 - 2012  
 Collaboration: Proefbedrijf Pluimveehouderij (Geel)  
 luc.maertens@ilvo.vlaanderen.be

### What importance do discards of various species have for the Belgian fisheries industry?

Title: Inschatting van de teruggooi van commerciële vissoorten in de Belgische boomkorvisserij, in het licht van het Europees Visserijbeleid  
 Funding: ILVO  
 Duration: 2008 - 2012  
 Collaboration: Universiteit Antwerpen  
 sofie.vandemaale@ilvo.vlaanderen.be



### Can ecosystem indicators in various marine regions guide fisheries policy and industry management?

Title: Assessing the impact of Fisheries on demersal resources in two European marine Regions, using ecosystem-based indicators - PhD  
 Funding: ILVO, HCMR (Griekenland)  
 Duration: 2010 - 2013  
 Collaboration: HCMR, WUR (Nederland)  
 antonios.stamoulis@ilvo.vlaanderen.be  
 els.torrelee@ilvo.vlaanderen.be



### Which parameters and factors play a role in making the evaluation of fish, molluscs and shellfish stocks?

Title: Het Belgisch Nationaal Data Gathering Programma onder de EU Verordening DCF no 199/2008  
 Funding: EU, Flemish Government  
 Duration: continuuous  
 els.torrelee@ilvo.vlaanderen.be

### How big is the impact of recreational fishing on the sustainability of fish stocks?

Title: Nationaal Data Gathering Programma – inventarisatie van de recreatieve visserij  
 Funding: EU, Flemish Government  
 Duration: continuous  
 annemie.zenner@ilvo.vlaanderen.be  
 els.torrelee@ilvo.vlaanderen.be



### Is use of the data collected in fishery boat self-sampling scientifically appropriate to include in evaluation of the fish stocks?

Title: Incorporatie van de visserijsector in het wetenschappelijk onderzoek: self sampling voor kabeljauw in de Keltische Zee (VlG en VIlG)  
 Funding: ILVO  
 Duration: 2010 - 2014  
 Collaboration: Rederscentrale  
 sofie.vandemaale@ilvo.vlaanderen.be  
 els.torrelee@ilvo.vlaanderen.be

### What is the impact of sand and gravel extraction on the life on the sea bed in the Belgian Part of the North Sea?

Title: Effecten van aggregaat extractie op de zeebodem en het mariene bodemleven  
 Funding: Concessiehouders via FOD Economie, Directie Kwaliteit en Veiligheid.  
 Duration: continuous  
 Collaboration: ILVO (Groep Biologisch Milieuonderzoek en Groep Chemische milieumonitoring en Producttechnologie), FOD Economie, KBIN-BMM  
 annelies.debacker@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be  
 lisa.devriese@ilvo.vlaanderen.be

### What is the impact of dumping dredge material on the life of the sea bed?

Title: Baggerstortingen in Zee. Biologische monitoring voor gebaggerd materiaal voor de Vlaamse Kust  
 Funding: Government of Flanders (Departement Mobiliteit en Openbare Werken)  
 Duration: continuous  
 Collaboration: ILVO (Groep Biologisch Milieuonderzoek en Groep Chemische milieumonitoring en Producttechnologie), Departement Mobiliteit en Openbare Werken, KBIN-BMM, Agentschap voor Maritieme Dienstverlening en Kust  
 gert.vanhoey@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be  
 lisa.devriese@ilvo.vlaanderen.be

**How do sea-based windmill parks influence fauna living in the sandy seabed?**

Title: Effecten van windmolens op de zeebodem en het mariene bodemleven  
 Funding: Concessiehouders via BMM  
 Duration: jaarlijks contract sinds 2005, voorlopig tot eind 2012  
 Collaboration: Ghent University, KBIN-BMM, INBO  
 sofie.vandriessche@ilvo.vlaanderen.be  
 jozefien.derweduwen@ilvo.vlaanderen.be

**Can the spatial management of the European marine ecosystem be streamlined via adoption of simple policy tools?**

Title: Monitoring en evaluatie van de ruimtelijke planning op zee  
 Funding: EU- 7de kaderprogramma, ILVO  
 Duration: 2009 - 2013  
 Collaboration: 21 internationale partners uit 12 landen  
 ellen.pecceu@ilvo.vlaanderen.be, kris.hostens@ilvo.vlaanderen.be

**Can we differentiate between the impact of human activities and the natural variation in the marine ecosystem?**

Title: Algemene Ecologie van het mariene bodemleven in (het Belgisch deel van) de Noordzee  
 Funding: ILVO  
 Duration: continuus  
 Collaboration: internationale Partner binnen ICES  
 kris.hostens@ilvo.vlaanderen.be, gert.vanhoey@ilvo.vlaanderen.be

**Does release of chlorinated sea water from boats have a biological impact?**

Title: Biomonitoring naar de impact van lozingen in de haven van Zeebrugge  
 Funding: Fluxys LNG NV  
 Duration: 2011 - 2013  
 Collaboration: VLIZ  
 annelies.debacker@ilvo.vlaanderen.be

**What is the importance of the pelagic ecosystem and the role of zooplankton in the Belgian Part of the North Sea?**

Title: Semi-pelagische visserij en de rol van het zoöplankton in de Noordzee.  
 Funding: ILVO scholarship  
 Duration: 2009 - 2012  
 Collaboration: Ghent University, INBO, KBIN, VLIZ  
 karl.vanginderdeuren@ilvo.vlaanderen.be



**Can the invasive jellycomb *Mnemiopsis leidyi* also cause problems in the North Sea?**

Title: De impact van de invasieve kamkwal *Mnemiopsis leidyi* in de Noordzee  
 Funding: MEMO Intereg IVa 2 zeeën, ILVO scholarship  
 Duration: 2011 - 2014  
 Collaboration: ILVO (Groep Biologisch Milieuonderzoek en Groep Chemische Milieumonitoring), Ghent University, Deltares, CEFAS, ULCO-LOG, Ifremer  
 lies.vansteenbrugge@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be

**How sustainable is the MSC-certified fishery of seabob shrimp in the Suriname coastal zone?**

Title: Towards sustainable management of the seabob fisheries (*Xiphopenaeus kroyeri*) in the coastal zone of Surinam  
 Funding: VLIR (Vlaamse Interuniversitaire Raad) – VLADOC scholarship  
 Duration: 2011 - 2015  
 Collaboration: Ghent University, ADeKus (Suriname), Heyploeg (België en Suriname)  
 tomas.willems@ilvo.vlaanderen.be



**Is the underwater sound produced by windmills damaging for marine fish?**

Title: Onderwatergeluid als stressor voor mariene vissen  
 Funding: IWT scholarship  
 Duration: 2011 - 2015  
 Collaboration: ILVO (groep Biologisch milieuonderzoek en groep Aquacultuur), Ghent University, KBIN-BMM  
 elisabeth.debusschere@ilvo.vlaanderen.be

**How does processing of shellfish affect marine toxins?**

Title: Marbitox  
 Funding: FOD Volksgezondheid  
 Duration: 2012 - 2013  
 Collaboration: ILVO, WIV (Wetenschappelijk instituut voor Volksgezondheid)  
 karen.beckaert@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be

**How do we decide which is the “optimal” fishing fleet in light of changing insights about sustainability?**

Title: Een gedragen transitie van de huidige visserijvloot naar een duurzame visserij  
 Funding: ILVO scholarship  
 Duration: 2011 - 2015  
 Collaboration: ILVO Social Sciences  
 ruben.verkempynck@ilvo.vlaanderen.be  
 koen.mondelaers@ilvo.vlaanderen.be  
 hans.pollet@ilvo.vlaanderen.be

**How can we work toward an objective certification of fresh fish?**

Title: Squid  
 Funding: EVF  
 Duration: 2012 - 2013  
 Collaboration: ILVO, VIV (Vlaamse VisVeiling)  
 karen.beckaert@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be



**What is the connectivity between tarbot and brill populations in European waters, to form the basis for sustainability management?**

Title: Connectiviteit van tarbot en grietpopulaties in Europese wateren als basis voor een duurzaam beheer  
 Funding: ILVO scholarship  
 Duration: 2009 - 2012  
 Collaboration: ILVO, KULeuven  
 sara.vandamme@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be

**How can the SumWing be optimised for fisheries on the seabed?**

Title: SumWing-Zuid (NL)  
 Funding: VIP-Nederland  
 Duration: 2011 - 2012  
 Collaboration: Imares, Nederlandse visserijsector  
 bart.verschueren@ilvo.vlaanderen.be

**How can we develop a beam-trawler with reduced contact with the sea bed?**

Title: Aquaplanning gear (NL)  
 Funding: VIP-Nederland  
 Duration: 2011 - 2012  
 Collaboration: Imares, Nederlandse visserijsector  
 bart.verschueren@ilvo.vlaanderen.be

**How can we develop a beam-trawler with an alternative mechanical stimulation to reduce the intensity of the seabed disturbance?**

Title: T-Line (NL)  
 Funding: VIP-Nederland  
 Duration: 2011 - 2012  
 Collaboration: Imares, Nederlandse visserijsector  
 bart.verschueren@ilvo.vlaanderen.be

**How can we develop a beam-trawler with alternative stimulation based on turbulent water?**

Title: Hydrorig II (NL)  
 Funding: VIP-Nederland  
 Duration: 2011 - 2012  
 Collaboration: Imares, Nederlandse visserijsector  
 bart.verschueren@ilvo.vlaanderen.be

**What is the optimal fleet structure for the Flemish fisheries and which possibilities are there for the transition?**

Title: ADVIS, Advies voor de Visserijsector  
 Funding: EU, Government of Flanders  
 Duration: 2009 - 2011  
 hans.polet@ilvo.vlaanderen.be

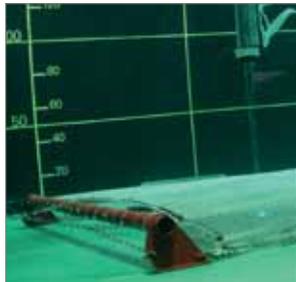


**What are the effects of the various types of pulse fields on marine organisms?**

Title: scholarship Marieke Desender (personel project)  
 Funding: IWT  
 Duration: 2012 - 2015  
 Collaboration: Ghent University  
 marieke.desender@ilvo.vlaanderen.be

**What are the safe limits of electrical pulse parameters for a pulse fishery without negative effects on the marine ecosystem?**

Title: Scholarship Maarten Soetaert (personel project)  
 Funding: IWT  
 Duration: 2012 - 2015  
 Collaboration: Ghent University  
 maarten.soetaert@ilvo.vlaanderen.be



**How can we reduce the waste products and water use in fish farming?**

Title: ZORAS - Zero Output Recirculating Aquaculture System – ZORAS  
 Funding: EVF  
 Duration: 2010 - 2012  
 Collaboration: ILVO Animal Sciences, ILVO Technogy & Food Science  
 daan.delbare@ilvo.vlaandren.be

**How can the commercial shrimp farming be improved?**

Title: Karakterisatie van nucleaire receptoren en hun rol in groei en ontwikkeling van de Noordzeegarnaal (*Crangon crangon L., Crustacea*)  
 Funding: IWT  
 Duration: 2011 - 2014  
 Collaboration: ILVO-EV, Ghent University  
 ruben.dewilde@ugent.be



**How can the communication between scientists and the fishing industry be improved to disseminate and demonstrate innovative ideas?**

Title: CIVIS, Communicatie en Innovatie in de visserijsector  
 Funding: IWT  
 Duration: 2009 - 2013  
 Collaboration: Rederscentrale  
 hans.polet@ilvo.vlaanderen.be

**How can we promote Flemish fish products?**

Title: Fish2Know  
 Funding: EVF  
 Duration: 2012 - 2014  
 Collaboration: ILVO, VLV (Vlaamse VisVeiling)  
 karen.bekaert@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be

**What are the effects of pollutants in grey shrimp?**

Title: Onderzoek naar de effecten van pollutanten in grijze garnaal  
 Funding: ILVO scholarship  
 Duration: 2007 - 2011  
 Collaboration: ILVO, Ghent University, UAntwerpen  
 yves.verhaegen@ilvo.vlaanderen.be  
 johan.robbens@ilvo.vlaanderen.be

**Can the technological improvements to a towed fishing boat be translated into a fair price for the final fish product?**

Title: VALDUVIS  
 Funding: EU & Government of Flanders  
 Duration: 2012 - 2013  
 Collaboration: ILVO Social Sciences, Vlaamse Visveiling  
 hans.polet@ilvo.vlaanderen.be

**In which way can innovative ideas quickly impact the environment?**

Title: ELVIS (Elektrisch Vissen)  
 Funding: Waddenfonds, VIP-Nederland  
 Duration: continuous  
 Collaboration: Imares, Nederlandse visserijsector  
 bart.verschueren@ilvo.vlaanderen.be



**How can the intrinsic value of innovation be used in practice?**

Title: TIME, Transferring Innovation for Maritime Economy  
 Funding: Interreg  
 Duration: 2010 - 2012  
 Collaboration: Inotek  
 hans.polet@ilvo.vlaanderen.be



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## Lots of glass and woody ornamentals

On June 10<sup>th</sup>, 2011, Kris Peeters, the Flemish Minister-President, cut the ribbon to officially open the brand-new research greenhouses. This glass house of science is built on the initiative of the Government of Flanders, with ILVO, Ghent University and Hogeschool Gent as partners. The greenhouse complex has 47 compartments, 39 underground storage tanks, and has 3650 m<sup>2</sup> of greenhouses and 800 m<sup>2</sup> of research labs. The Plant Sciences Unit has expressed a strong intention to share the research with the growers enabled by this new infrastructure.

The improved network, "Technology Pool for Ornamentals", presented to the ornamental plant growers in February, binds ILVO to three other scientific institutes to form a tight collaboration to share knowledge.

In August, ILVO was honored to be able to christen a plant bred right here in our greenhouses: the new butterfly bush "*Buddleja ARGUS*" (in white and purple). This non-invasive cultivar can form an ideal source of biodiversity in parks without disturbing the local ecosystem. This new plant is proof that sustainability goes together with increased scientific knowledge.

The popular study-day about the energy (and other) applications of woody plants (*Miscanthus*) showed that the combination of fundamental plant, crop and economic research generated a great deal of interest.

The plant protection research group has strengthened its contribution to European networks on quarantine and regulated organisms. Participation in these networks also results in continual updating of our knowledge about diseases and plagues in terms of what problems may appear in Flemish plant production.

The Plant Sciences Unit is also increasing its interest in the soil. We have expanded our analyses for soil research (in the Crop Husbandry research area) and are doing experiments about biochar, organic materials, no-till farming and composting. We expect to get some interesting research results in the coming few years.

The 75 researchers in the Plant Sciences Unit study and identify bacteria, fungi, viruses, insects, mites and nematodes that can negatively affect plants and sustainable ways to combat these diseases and plagues. We also work on applied genetics and breeding, where the researchers explore the fundamental processes of growth and development of a crop, and where various approaches to crop husbandry are examined for their effect on the crop, soil quality and the environment.

The separate Plant Sciences Business Unit is responsible for the development and marketing of high-quality starting plant material (seeds, grafts), for diagnosing plant diseases and plagues, for chemical analyses on feed, soil and substrates, and for the detection and management of quarantine organisms.

## Found in translation:

### Plant breeding based on tools for phenomics and genomics

Efficient breeding relies on understanding the link between how the plant grows and flowers (phenotype) and its genetic characteristics (genotype). ILVO researchers translate the knowledge of genes obtained from model plant species into applications for agricultural crops. The development of genomics and phenomics tools is essential for such translational research. ILVO has developed tools for *Lolium perenne* that enable us to study the relation between phenotype and genotype.

Tools to automatically quantify morphological characteristics (phenomics) such as plant growth and architecture in large collections of plants grown in the field were required. During two consecutive growing seasons, the height, the biomass and the number of vegetative and reproductive stems of 3600 *Lolium perenne* plants were measured every 6 weeks. This enabled researchers to describe the dynamics of the growth of the plants. Pictures were also taken of the plants: a top-view image directly after mowing (ground coverage) and 1 week later (regrowth capacity) and a side-view image at heading date (plant morphology and volume). For both types of images, specific image analysis algorithms are developed that enable correct and objective quantification of the plant dimensions. Even pictures taken in the field under a range of weather and light conditions can be automatically analysed. Until recently, this automatic analysis was only possible for pictures taken at well-defined light conditions in the lab.

ILVO has also developed a parallel line of genomics research. The objective of translational research is to translate the genomic, genetic and physiological knowledge in model species to breeding in agricultural crops. First, specific genes are selected that are known to control growth in model plant species. Next, strategies and bio-informatic tools are chosen to identify the corresponding DNA sequence in the genome of the crop. ILVO therefore created a new DNA sequence database that contains approximately 20 000 genes of *Lolium perenne*. The description of their gene functions is at an advanced stage. Genes are classified into gene families and regulatory gene networks by comparing them to all available genome knowledge of the model species. We are now studying to what extent the genetic diversity in the breeding population (genepool) contributes to heritable characteristics such as heading date, plant architecture, and fodder quality and whether this is suitable for molecular support of the breeding programme.



**Title:** Plant Architectuur – De genetische controle van plantarchitectuur bij twee representatieve landbouwgewassen als basis voor opbrengstverbetering via een aangepaste teelttechniek en een efficiëntere veredeling.

**Funding:** IWT

**Duration:** 2009 - 2013

**Collaboration:** KULeuven, VIB

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## Miscanthus:

### A new crop for Flanders?

Field trials, genetic studies and lab analyses at ILVO revealed that *Miscanthus* has a potential as energy crop in Flanders. It appears to be most appropriate as a sustainable renewable energy resource in small-scale on-farm applications with a intermediate heat demand. Energy is an important production factor in many Flemish agriculture systems. The annual yield of one hectare *Miscanthus* can replace 8000 liters of crude oil. Despite this potential to use *Miscanthus* as an energy crop, the acreage of *Miscanthus* is limited.

In 2007, ILVO installed a field trial on sandy loam soil to collect yield data. The currently-used variety is *Miscanthus* x *giganteus*, a sterile clone. It is multiplied through rhizomes, can be installed for twenty consecutive years and has a low fertilizer demand. Annual harvests are done with a maize harvester in February/ March and yield a dry woody biomass. In the installation year, yield was only 3.3 ton DM/ha, but in 2010 en 2011 yield increased to a mean value of 22.8 ton DM/ha. We simulated that the costs for installation of the crop and the technical installations of a biomass burner have a return on investment of 5 years. Through demonstration, diffusion through enerpedia.be, and diverse activities and individual coaching of farmers, *Miscanthus* culture is starting to take off in Flanders.

Use of a single or few genotypes of *Miscanthus* confers risks, especially when pests or diseases develop. ILVO is therefore studying the potential of seed-multiplied *M. sinensis*. This may lead to not only small-scale heating applications but also conversion to second generation bioethanol. Screening of a collection of *M. sinensis* genotypes indicates that although *M. sinensis* 'Silberfeder' has a lower yield, it has a higher saccharification efficiency. This results in a higher glucose yield with 'Silberfeder' (148 g glucose.plant<sup>-1</sup>) compared to *M. x giganteus* (111 g glucose.plant<sup>-1</sup>). Given the only very recent advent of breeding incentives in this species, we can expect new genotypes to be released with high potential for heating purposes as well as bio-based applications. This is the research theme of a recently initiated EU-FP7 project OPTIMISC, which ILVO is part of.



*Kris Peeters visits the ILVO stand at the "Farm Equipment Trade Show"*

Title: Evaluatie van snelgroeïende grassen voor bio-ethanolproductie & EnergieBewustBoeren

Funding: ILVO scholarship, EFRO-cleantech, EU

Duration: 2007 - 2011 & 2010 - 2012

Collaboration: HoGent, Vlaamse praktijkcentra

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## Grass and clover:

### Breeding for a green environment and human health

Cattle nutrition may affect the quality of the meat and milk as well as influence the environment. More linolenic acid in the grass increases the omega-3 fatty acid in milk and meat, with the accompanying benefits for human health. When the cows use the protein present in the grass more efficiently, nitrogen losses to the environment are decreased.

In this research project, we studied the variation and heritability of two grass and clover quality parameters: the content of linolenic acid and the fraction of rumen escape protein. This information is important for plant breeding.

Grass and clover species show clear differences and a good heritability for both traits. However, more rumen escape protein in the herbage is linked with less digestible protein in the intestine.

We determined the content of linolenic acid and the fraction of rumen escape protein of some varieties of the grass and clover species, namely: perennial and Italian ryegrass, timothy, tall fescue, meadow fescue, cocksfoot, and white and red clover in a field plot trial under mowing. We carried out positive and negative selections of both traits and compared the progenies in pot trials.

Timothy had the highest linolenic acid content, and Italian ryegrass the lowest among the grasses. Clover had a higher linolenic acid content than the grasses. The development of a variety of perennial ryegrass with 10% more linolenic acid should be achievable. A grass-clover mixture based on such a variety would guarantee an herbage rich in omega-3 fatty acids.

We obtained a nuanced answer to the protein use efficiency question from an extensive study of the crude protein yield, the organic matter digestibility, the sugar content, the protein digestibility, and degradability. A selection trial to enhance the rumen escape protein fraction revealed that the protein use by the cow could only be increased a small amount because of the negative correlation between the fraction of rumen escape protein and the protein digestibility in the intestine. To decrease the nitrogen loss, a better avenue to explore seems to enhancing the sugar content and the cell wall digestibility.



Title: Improvement of the herbage quality of grass-clover mixtures

Funding: IWT

Duration: 2007 - 2010

Collaboration: Ghent University-Lanupro, ILVO Plant Sciences, ILVO Animal Sciences

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## Magnetic detective work

Searching for a practical fast detection system for detecting *Pseudomonas cichorii* in irrigation water for vegetables

Many lettuce growers in Flanders have a problem with mid-rib rot. Mid-rib rot is caused by the bacterium *Pseudomonas cichorii*. Even very low concentrations of *P. cichorii* (100 bacteria per ml of irrigation water) can infect the vegetables being grown.

ILVO has taken an important step toward developing a fast detection test to find *P. cichorii* in irrigation water. The final, workable test has not yet been developed. Such a test would make it possible to perform faster, cheaper water analyses, and to do them more frequently, which would help the grower in his management. Currently, the detection occurs via RT-PCR, which requires time-consuming and expensive sample preparation.

This research project explored the possibilities of immunomagnetic separation (IMS) in combination with flow cytometry (FCM). In IMS, magnetic beads (microscopic magnetic balls) are used to “capture” cells. With a magnet, the beads are concentrated in the sample. Then a live/dead coloring step is done to color live cells green and dead cells fluorescent red. Flow cytometry, a technique to count and analyse microscopic particles in a flowing liquid, is then used in the final analysis.

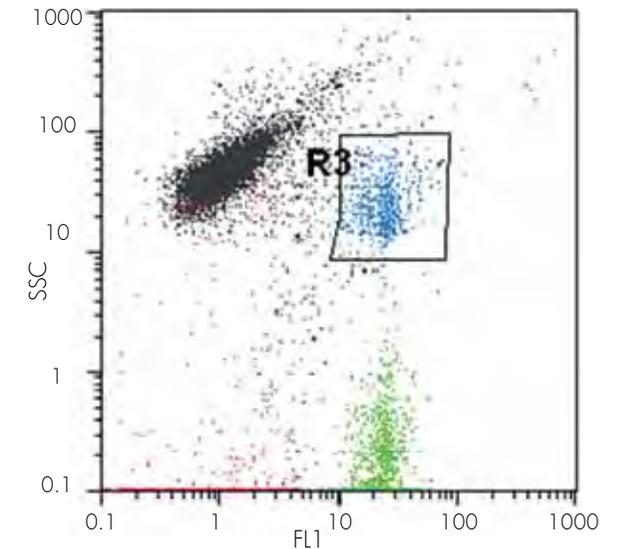
This research showed surprising characteristics of the bacteria *P. cichorii* seems to be exceptionally sensitive to mechanical stress caused by centrifuging or shaking the sample. During the sample preparation, 90% of the bacteria simply disappeared. The vanished amount depended on the medium in which the bacteria were centrifuged. Because of this remarkable sensitivity to mechanical stress, detection was not always successful. This sensitivity of the bacteria has never been observed before.

Title: Flow cytometry in plant pathology: a case study on *Pseudomonas cichorii*

Funding: ILVO PhD scholarship

Duration: 2007 - 2011

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FCM output of *P. cichorii* detection based on IMS. Every dot on the graph represents a bead. Black: unbound beads; green: alive, unbound bacteria; red: dead, unbound bacteria; blue (R3): alive bead-bound bacteria

## Gorgeous...and sterile

### *Buddleja* ARGUS®, not just another pretty butterfly bush

In 2011, ILVO released two new butterfly bushes, *Buddleja* ARGUS® White and Velvet. Both have valuable characteristics for growers and consumers. *Buddleja* ARGUS® is very easy to maintain and its beautiful white or purple flowers attract as many butterflies as common butterfly bushes. One important difference is that common butterfly bushes are invasive species, but the quasi-sterile *Buddleja* ARGUS® will not proliferate.

The development of *Buddleja* ARGUS® started eight years ago. This new perennial is one of the results of the research project "Interspecific hybridisation in woody ornamentals". Under controlled conditions, crosses between two *Buddleja* species (*Buddleja davidii* and *Buddleja lindleyana*) were made. The crossing parents have different chromosome numbers. This causes the fruits to abort before they are fully developed. Ten weeks after pollination, the specialized plant breeder can then harvest the unripe fruits, dissect the seeds and then grow them on an artificial growing medium. This process is called "in vitro embryo rescue".

The obtained plants are then acclimatised and planted in the field for further evaluation and selection. The hybrid character of the progeny is analysed by morphogenic parameters and molecular and cytogenetic techniques. Out of hundreds of regenerated seedlings, ILVO finally selected *Buddleja* ARGUS® White and Velvet. The quasi-sterile nature of the plants is an effect of the interspecific cross. This remarkable butterfly bush was baptised on August 4, 2011 in Leuven in the presence of Louis Tobback, the plants' "godfather". BEST-select cvba will now commercialise these new *Buddleja* species.

Title: Breeding of ornamentals

Funding: BEST-select cvba

Duration: continuous

Collaboration: Best-Select cvba

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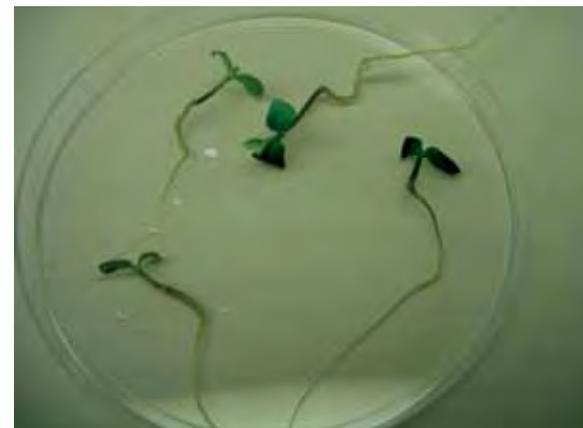


*Interspecific hybridisation of Buddleja.*



*emasculation and pollination*

*seed obtained from an interspecific cross is placed on an in vitro medium*



*in vitro interspecific seedling*

## Grassland resowing in spring on derogation farms:

### Alternatives for no fertilisation at all?

In most of Flanders (except for in the Polder region) farms under derogation are only allowed to plough down grassland between February 15 and May 31 in an attempt to restrict the risk of nitrogen leakage to the environment. In the year in which permanent grassland is ploughed, no fertiliser may be applied. This severe restriction leads to low grass yield and protein content. Is cutting management, in combination with a moderate N-fertilisation, a workable alternative?

In 2008-2010 permanent grassland was resown in spring on 3 soil types and a mowing trial with 3 N-levels (0 N, 140 N and 280 N/ha) was established. On sandy and sandy loam soil a grazing treatment with 0 N was included.

Yield of dry matter and crude protein was slightly higher under cutting conditions with 0 N in comparison with grazing 0 N. The average nitrate residue in the soil was the same very low amount (15 kg NO<sub>3</sub>-N/ha).

The application of N fertilisers under cutting conditions had a significantly positive effect on grass yield (6.2, 8.8 and 10.2 ton DM/ha for 0, 140 and 280 N/ha, respectively, and on the crude protein content (15.8%, 17.8% and 18.7% for 0 N, 140 N and 280 N/ha, respectively). The average nitrate residue was low to very low (13 kg, 12 kg and 27 kg NO<sub>3</sub>-N/ha for 0 N, 140 N and 280 N/ha, respectively) on 5 plots. The nitrate residue exceeds the threshold of 90 kg NO<sub>3</sub>-N/ha substantially on 2 plots. The weather conditions, which influence grass growth and N-mineralisation can greatly influence this.

Cutting management combined with a substantial N fertilisation results in higher grass yields in comparison with 0 N grazing/cutting but the risk for exceeding the threshold of 90 NO<sub>3</sub>-N/ha cannot be denied.



Title: Duurzame plantaardige productie  
 Funding: ILVO, Agricultural Centre of Forage Crops  
 Duration: 2007 - 2011  
 Collaboration: Hooibeekhoeve  
 Contact: alex.devliegher@ilvo.vlaanderen.be

## Improved soil quality generates higher crop yields: Fact or fiction?

Recent legislative restrictions and the trend toward sustainable agricultural farming systems are reducing the input of mineral fertilisers and pesticides. This implies a greater reliance on the self-regulating processes of the soil such as supply of nutrients, water regulation and disease suppression. With the new emphasis on sustainable agriculture comes the awareness of the importance of soil quality in terms of soil productivity. Possible tools for the maintenance and the improvement of soil quality are conservation tillage systems, crop rotations and cover crops, the use of organic fertilizers such as animal manures and compost, etc.

Tools for assessing soil quality are needed to ensure sustainable agriculture and to evaluate the effects of management practices on soil processes. To this end, a Soil Quality Index (SQI) was designed that involved chemical, physical and biological soil parameters. Further, as soil quality measurements are 'stand-alone' tools unless they are either linked to important soil functions or used to predict sustainability or productivity, crop yields were used as a functional goal.

ILVO researchers performed a six-year, on-going field experiment (Ghent University experimental farm), comprising a crop rotation (potatoes, fodder beet, forage maize and Brussels sprouts) and farm compost (FC) amendment. Our results demonstrated that the repeated amendment of FC significantly improved soil chemical, physical and biological properties, leading to a consistently higher SQI. Crop yields also increased significantly after the fourth annual FC application. The positive effect of continual FC amendment on crop yields was attributed both to a slow release of nitrogen and improved soil quality. The latter was shown by a significant, positive relation between SQI and crop yields. After thorough validation, the SQI could help when providing advice to farmers to choose suitable management practices for enhancing soil quality to achieve desired functional goals.

**Title:** Invloed van teeltsystemen op de bodemkwaliteit in relatie tot gewasopbrengst  
**Funding:** ILVO (bursaal)  
**Duration:** 2007 - 2011



*Long-term field trial with crop rotation (potato, fodder beet, forage maize and Brussels sprouts) and annual application of farm compost*

**Collaboration:** Ghent University (Faculteit Bio-ingenieurswetenschappen, Vakgroep Plantaardige productie), HoGent (Faculteit Toegepaste Bio-ingenieurswetenschappen, Vakgroep Plantaardige productie)  
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## Hygienic detective work:

### What is the status of quarantine organisms in Belgium?

Many organisms (insects and mites, nematodes, bacteria, viruses, fungi and invasive plants) have the potential to cause important damage either in the plant industry or in the natural plant stock. For most of these organisms, this potential is estimated in a so-called Pest Risk Analysis (PRA), which can be used to guide possible management strategies. For a few organisms, however, the presence or absence or the distribution in Belgium has not been mapped. ILVO works to determine the status of an organism through information-gathering and conducting an in-field survey. These results are reported to the Belgian crop protection organisation. Via the Belgian organisation, the results can also be passed on to the European phytosanitary committee. The scientists of ILVO's crop protection research area are active in the European networks on quarantine and regulated organisms. In cooperation with several experts, ILVO has determined the status of the following seven organisms:

- *Chalara fraxinea*: responsible for the death of common ash.
- *Phytophthora fragariae* var. *rubi*: has potential to halt raspberry cultivation.
- *Diaphania perspectalis*: could cause great harm to the Buxus stock in Belgium.
- *Chrysanthemum stunt viroid*: causes important damage in horticulture.
- *Tomato apical stunt viroid*: a mysterious pathogen whose host plant range is uncertain, as is the importance for the Belgium tomato cultivation.
- *Tomato Spotted Wilt Virus*: along with the introduction of the western flower thrips, a European vector, this pathogen has greatly expanded in Europe. It has potential for increasing economic damage in a wide range of cultivations.
- *Potato Stolbur Mycoplasma*: this new pathogen for Belgium shows different symptoms in several host plants.

Title: FYQUARSTAT – Status of damaging organisms for plants and plant production in Belgium

Funding: Federal Public Service 'Health, Food Chain Safety and Environment', Service for contract research, ILVO

Duration: 2009 - 2011

Collaboration: CRA-W, pcfruit vzw

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Larve of the box tree moth  
*Diaphania perspectalis*

## High-tech tracking of a quarantine organism:

### Characterisation and molecular detection of Chrysanthemum white rust

*Puccinia horiana*, causal agent of chrysanthemum white rust, is one of the most important fungi on chrysanthemum and has an international quarantine status. Chrysanthemum white rust is currently mainly controlled by fungicide treatments. Stricter legislation on pesticide applications has however restricted their use. This change has stimulated interest in sustainable disease control by means of breeding for resistance and more targeted fungicide applications. Nevertheless, a lack of knowledge about the pathogenic diversity and the epidemiology of the fungus has hindered these strategies.

The bioassay developed in this study, which was based on the characterization of the fungus, will encourage efforts toward oriented resistance breeding. The molecular detection will be used to study the epidemiology of the disease and can also be used in warning systems.

During this research project, a worldwide collection of isolates of chrysanthemum white rust was gathered and characterised. Using specific bioassays, we showed that several rust strains displayed differential pathogenicity on a set of cultivars. This variation is caused by at least seven gene pairs involved in the interaction between the fungus and the plant. Genetic characterisation using newly developed SNP markers enabled us to identify different strains and determine their worldwide spread. This revealed that international trade was responsible for bringing the pathogen to different parts of the world. We also developed a molecular detection method for the registration and quantification of fungal spores in air samples taken on chrysanthemum fields. Using this detection system, we determined that the pathogen is mainly spread at night and its sporulation is strongly related to rainfall and relative humidity.

Title: Detection and characterization of *Puccinia horiana* on Chrysanthemum

Funding: ILVO PhD grant

Duration: 2007 - 2011

Collaboration: Paraty Breeding NV, Plantum, PRI

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*A heavily infected chrysanthemum with white rust. Typical symptoms appear as pale pustules on the lower side of the leaves.*

## Red alert for tomatoes and potatoes?

### Transmission risk of the potato spindle tuber viroid (PSTVd)

A number of years ago, national phytosanitary inspection services became concerned about a potential PSTVd epidemic in tomato and potato. Numerous PSTVd-infections had been found on ornamental relatives of tomato and potato, namely *Brugmansia* sp. and ornamental solanaceae such as *Solanum jasminoides*. Tomato and potato are the two most (economically) important host plants for this pathogen. In ornamental plants, a PSTVd infection remains latently present (symptomless) during the entire crop cycle and causes no damage. In tomato and potato, however, this viroid can cause yield losses of 50% and more.

Together with the project partners, ILVO studied a series of risk factors that may play a role in the PSTVd transmission between various cultures. A collection of PSTVd isolates was compiled, the sensitivity of the most common commercial tomato and potato cultivars against PSTVd was evaluated, and a number of transmission experiments in and between the different cultures (especially from ornamentals to tomato) was set up. Finally, with a strategy for prevention and control in mind, a series of commercially available disinfectants was tested to evaluate whether disinfectants claiming to inactivate viruses and viroids would also kill the PSTVd virus.

We found that the transmission risk from ornamentals to potato was generally very low. Transmission from ornamentals to tomatoes presents a greater risk because they are both grown in greenhouses. Direct contact between the crops is the main mode of spread. Therefore, limiting contact between leaves and altering cultivation practices can already greatly reduce the potential for transmission within and between the cultures. Other transmission pathways such as insects (including bees and bumblebees), seeds, and pollen have been proven experimentally to some extent, but in practice, these 'vectors' are of minor importance. When disinfecting work surfaces, not only the disinfectant, but also the contact time with the work surface is important when attempting to inactivate PSTVd.

**Title:** TOPOVIR – Etude de la transmission du *Potato spindle tuber viroid* (PSTVd) aux plantes ornementales, aux cultures de pomme de terre et de tomate et application à d'autres pospiviroïdes.

**Funding:** FOD contractueel onderzoek

**Duration:** 2009 - 2011

**Collaboration:** Scientia Terrae, CRA-W (promotor)

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*Leaf symptoms caused by the potato spindle viroid on tomato*

### Breeding without sex: how to create new genetic variation in plants and how to introduce new characteristics using DNA fragmentation and fusion?

Title: Asymmetric protoplast fusion as tool for the introgression of genetic characteristics in agricultural crops and ornamentals  
Funding: ILVO  
Duration: continuous  
Collaboration: Russian State Agrarian University  
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### Do plants with a doubled chromosome number have less stress?

(focus on rose and apple for changes in (a)biotic stress resistance towards drought and diseases)  
Title: Polystress – the role of polyploidisation in (a)biotic stress resistance of horticultural plants  
Funding: IWT  
Duration: 2010 - 2014  
Collaboration: KULeuven (Divisie Fruitteeltcentrum), Ghent University (Vakgroep Plantaardige Productie)  
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### What is the switch that makes azalea flower?

(identification of parameters influencing and regulating flowering quality in azalea)  
Title: Flowering regulation and quality in azalea: interaction of genetics, physiology and cultivation  
Funding: IWT  
Duration: 2009 - 2012  
Collaboration: PCS, Ghent University (Vakgroep Plantaardige Productie)  
jan.deriek@ilvo.vlaanderen.be

### How to isolate and locate interesting genes in crops to gain more knowledge of genetic backgrounds and breeding?

Title: Development and application of genomic and cytogenetic techniques for a better use of plant genetic resources  
Funding: ILVO  
Duration: continuous  
jan.deriek@ilvo.vlaanderen.be

### Plant diseases and pests: Which genotypes are more resistant? How can we develop more resistant varieties to reduce pesticide use?

Title: Improvement of disease and pest resistance by breeding  
Funding: ILVO  
Duration: continuous  
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### What are the current challenges in breeding research? How to create new starting material (prebreeding and cultivars)?

Title: Breeding of agricultural and horticultural crops  
Funding: ILVO  
Duration: continuous  
Collaboration: diverse  
joost.baert@ilvo.vlaanderen.be



### Climate change: let the grass grow?

(focus on drought tolerance and winter hardiness in Tall Fescue and Meadow Fescue)  
Title: Development of fodder grass resistant for abiotic stress  
Funding: ILVO, EU  
Duration: continuous  
Collaboration: IUNG-PIB (Poland)  
jan.deriek@ilvo.vlaanderen.be



### Does jasmonic acid play a key role in the natural defence of azalea towards *Tarsonemidae*?

Title: Plant resistance to *Polyphagotarsonemus latus* (Acari: *Tarsonemidae*) in ornamentals  
Funding: IWT  
Duration: 2011 - 2015  
Collaboration: PCS  
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### What is the effect of grass mixtures, inorganic N fertilisation level, mowing frequency, and either removing hay or leaving it on the field on carbon storage in agricultural grasslands or verges, 10 years after conversion from arable land?

Title: Effect of different management practices on carbon storage under grassland  
Funding: ILVO  
Duration: 2011 - 2012  
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**What is the effect of compost application, soil tillage (plowing vs. non-inverse tillage) and slurry type (cattle slurry vs. pig slurry) on soil quality, crop yield and the occurrence of pathogenic nematodes and fungi?**

Title: BOPACT – soil management in relationship to soil quality and disease occurrence – long term field trial  
 Funding: ILVO  
 Duration: 2010 - 2017  
 Collaboration: ILVO Plant Sciences, Crop Husbandry & Environment and Crop protection  
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**In the near future, can we increase the practical seed yields of Italian ryegrass grown at the Belgian mixed cattle farms by using a more intensive and arable approach comparable with the intensive winter wheat growing technique?**

Title: Optimizing the seed production technique of Italian ryegrass – ICG Flanders  
 Funding: various  
 Duration: 2010 - 2012  
 Collaboration: ILVO, ICG (Agricultural Centre Cereals), Agrisemza (seed growers), Semzabel (seed trade) and agrochemical companies (BASF, Bayer, Syngenta en Nufarm)  
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**What is the link between fertiliser management, the soil organic carbon content, the soil phosphorus fractions, the crop yield and P leaching in the short and long term?**

Title: Innovative methods to maintain or to improve the soil fertility while meeting fertiliser policy objectives  
 Funding: ILVO  
 Duration: 2010 - 2013  
 Collaboration: KULeuven, Wageningen UR and Ghent University  
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**How can soil management contribute to high quality yield and soil fertility?**

Title: Organic crop systems optimization  
 Funding: ILVO  
 Duration: continuous  
 koen.willekens@ilvo.vlaanderen.be

**What is the relation between nitrogen dynamics (affecting crop quality) and soil condition?**

Title: Nitrogen utilization and crop quality in function of soil condition  
 Funding: SYMBIOS  
 Duration: 2009 - 2013  
 Collaboration: Ghent University and PCG Kruishoutem  
 koen.willekens@ilvo.vlaanderen.be



**What is the effect of biochar on crop yield, the N-cycle, soil moisture characteristics and greenhouse gas emissions from soil?**

Title: Biochar: soil-improvement possibilities for Flanders  
 Funding: Interreg IVB North Sea Region Project  
 Duration: 2009 - 2013  
 Collaboration: Provincie Groningen (NL), Productschap Akkerbouw (NL), WUR-Alterra (NL), NMI (NL), University of Edinburgh (UK), RISO DTU (DK), Bioforsk (NO), HAWK (DE), Ghent University (BE)  
 victoria.nelissen@ilvo.vlaanderen.be



**Can flower borders attract natural enemies of plague organisms to agricultural fields and form an effective natural plague control?**

Title: Natural plague control with flower margins  
 Funding: Bayer Cropscience  
 Duration: 2011 - 2012  
 Collaboration: ILVO Plant Sciences, Crop Husbandry and Environment research area and Crop Protection research area  
 bert.vangils@ilvo.vlaanderen.be

**How can the use of the available organic manure be optimised to create a closed nutrient loop and the cultivation of healthy organic crops?**

Title: Optimal application of organic manure of chickens and ruminants for a healthy organic crop  
 Funding: ADLO  
 Duration: 2010 - 2012  
 Collaboration: ILVO, Ghent University, Inagro  
 bert.reubens@ilvo.vlaanderen.be

**How do farming practices such as soil tillage and the cultivation of green manure crops interact with soil quality?**

Title: Bodembreed-Symbiose  
 Funding: Interreg  
 Duration: 2009 - 2012  
 Collaboration: about 15 partners - see www.bodembreed.eu  
 bert.reubens@ilvo.vlaanderen.be

**How can we increase the selenium content and optimize the selenium speciation in vegetables?**

Title: Selenium in food crops: increase the uptake of bioactive selenium compounds  
 Funding: FWO  
 Duration: 2008 - 2011  
 Collaboration: Ghent University, CODA  
 bart.vandecasteele@ilvo.vlaanderen.be

**How can farmers use maize stover as substrate for anaerobic digestion and which measures can they take to maintain the soil carbon levels within the crop rotation?**

Title: MIP-2-project EOSAN: with energy and food production towards a more healthy soil  
 Funding: MIP-project  
 Duration: 2010 - 2012  
 Collaboration: OWS, Ecopower, Nyrstar, UHasselt  
 bart.vandecasteele@ilvo.vlaanderen.be

**What is the optimal manure dosage for cereals to increase the retention of nitrogen by catch crops during winter, and thus to reduce nitrate leaching?**

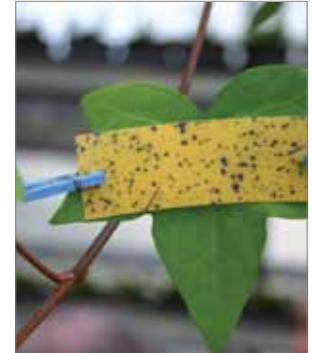
Title: Best agricultural practices for crops in combination with catch crops  
 Funding: TWOL  
 Duration: 2011 - 2014  
 Collaboration: Ghent University, Inagro, BDB, HoGent  
 bart.vandecasteele@ilvo.vlaanderen.be

**How can we combine high agricultural production with minimal environmental impact?**

Title: Invloed van teelt- en cultuurtechnieken op land- en tuinbouwproducties  
 Funding: various  
 Duration: continuous  
 Collaboration: Landbouwcentrum Voedergewassen, ADLO  
 alex.devlieghe@ilvo.vlaanderen.be

**Can classical crop protection strategies also be assisted or replaced by alternative products or methods?**

Title: Evaluation of classical and alternative crop protection strategies  
 Funding: ILVO, IWT  
 Duration: continuous  
 Collaboration: several research centres, ADLO, Wageningen UR, KULeuven, Ghent University  
 martine.maes@ilvo.vlaanderen.be



**On which basis do policy-makers make decisions and measures with respect to certain harmful organisms for plants? What is the possible impact of the introduction of an exotic organism as biological control?**

Title: Pest Risk analysis of plant pathogenic organisms and the use of bio control organisms  
 Funding: FOD – POD, ILVO  
 Duration: continuous  
 Collaboration: PCFruit, CRA-W, Proefstation voor de Groenteteelt, verschillende Europese onderzoekslabo's, Ghent University, ULB, INBO  
 nicole.viaene@ilvo.vlaanderen.be



**What are the new technological developments for reliable diagnostics of bacteria, fungi, viruses, nematodes, insects, mites, asymptomatic contaminations, latent contaminations, pathogen populations, sampling, plant extraction, soil extraction, water contaminations, etc?**

Title: Development of diagnostics of diseases and plagues  
 Funding: ILVO, Europees 7 KaderProgramma, IWT  
 Duration: continuous  
 Collaboration: Ghent University, several research centres, CIMMYT (Turkije), Ankara University, CAAS (China), SESvanderhave N.V., Wageningen UR, Myscience - AVW Agroscope I, KHK - Katholieke Hogeschool Kempen  
 martine.maes@ilvo.vlaanderen.be

**How can you tell which are the disease resistant, tolerant or sensitive individuals within the plant range and the available, efficient products?**

Title: Bioassays for the screening of resistance of classical and alternative crop protection products  
 Funding: ILVO  
 Duration: continuous  
 Collaboration: PCS - Proefcentrum voor de Siereteelt  
 martine.maes@ilvo.vlaanderen.be



**Which are the urgent questions and problems within the agriculture and horticulture concerning damage from and distribution of viruses, viroids and phytoplasmas?**

Title: Current virus problems within the agriculture and horticulture  
 Funding: ILVO, Europees 7 KaderProgramma, IWT  
 Duration: continuous  
 Collaboration: Generalitat de Catalunya - Departament d'Agricultura, Alimentacio i Accio Rur, Ghent University, diverse private partners, Wageningen UR, Productiesectoren groenten en fruit, Proefstation voor de Groenteteelt, Inagro  
 kris.dejonghe@ilvo.vlaanderen.be

**Is the increasing bacterial rot in potato a result of a new evolution in the bacterial community and can we change the trend?**

Title: *Dickeya* in aardappelpootgoed  
 Funding: ILVO, Government of Flanders - L&V, FOD - POD  
 Duration: continuous  
 Collaboration: Interprovinciaal Proefcentrum voor de Aardappelteelt vzw, Ghent University, NPPO - National Plant Protection Organisation, Wageningen UR, KULeuven Gentechnologie  
 johan.vanvaerenbergh@ilvo.vlaanderen.be

**How can we improve the chance for detection of harmful root knot nematodes (*Meloidogyne*) in the field and are there useful cultivation measures?**

Title: Problems and control of root knot nematodes (*Meloidogyne* spp.)  
 Funding: FOD - POD  
 Duration: 2010 - 2012  
 nicole.viaene@ilvo.vlaanderen.be



**What to do with *Globodera*, two known potato cyst nematodes with different virulence types, and how do they behave in the field?**

Title: Control of *Globodera* in the potato sector  
 Funding: ILVO  
 Duration: continuous  
 Collaboration: Ghent University (Vakgroep Gewasbescherming)  
 nicole.viaene@ilvo.vlaanderen.be

**Is the bacteria *Xanthomonas fragariae* a threat for the strawberry production and how can we estimate and control the infection?**

Title: The *Xanthomonas fragariae* problems within Flemish strawberry production  
 Funding: IWT  
 Duration: 2008 - 2012  
 Collaboration: Ghent University, PCFruit - Proefcentrum Fruitteelt, PCH - Proefcentrum Hoogstraten  
 martine.maes@ilvo.vlaanderen.be



**Can we control plagues by parasitising harmful insects with useful nematodes?**

Title: Control of insects with entomopathogenic nematodes  
 Funding: IWT  
 Duration: continuous  
 Collaboration: PCFruit, Ghent University, Guangdong Entomological Institute, HAAFS - Hebei Academy of Agriculture and Forestry Sciences  
 nicole.viaene@ilvo.vlaanderen.be

**Which factors determine that *Cylindrocladium buxicola* causes so much damage in boxwood and how can we attain integrated control of this disease?**

Title: Integrated control of *Cylindrocladium buxicola* in boxwood  
 Funding: IWT  
 Duration: 2009 - 2013  
 Collaboration: PCS - Proefcentrum voor de Sierteelt  
 kurt.heungens@ilvo.vlaanderen.be

**How can we monitor physiological and morphological reactions of plants to their environment in a quick and accurate way? How can we apply this information in plant genetics and breeding?**

Title: Development of medium-throughput phenotyping techniques and modelling plant growth  
 Funding: IWT, EU, several private companies  
 Duration: continuous  
 Collaboration: diverse Europese partners  
 peter.lootens@ilvo.vlaanderen.be



**What are the future energy crops in Flanders? What is the energy balance of these crops and are they suitable for cropping on marginal land?**

Title: Evaluation and genetic improvement of fast growing monocot species as biomass crop for second generation bio-energy in Flanders  
 Funding: Ghent University, ILVO, EU  
 Duration: continuous  
 Collaboration: HoGent, Ghent University, several Flemish practice centers, several European companies  
 hilde.muyll@ilvo.vlaanderen.be



**How can we translate physiological and genetic knowledge of plant growth from lab to crops such as ryegrass or clover in order to breed more effectively?**

Title: Translational research: translation of knowledge obtained in model organisms to crops  
 Funding: IWT  
 Duration: continuous  
 Collaboration: Ghent University, PSB-VIB  
 tom.ruttink@ilvo.vlaanderen.be

**Which genes control the initiation and outgrowth of shoots? Can we exploit those genes to improve yield and persistency in ryegrasses and clover?**

Title: Exploitation of traits related to plant architecture in ryegrass and clover  
 Funding: EU, IWT, ILVO  
 Duration: continuous  
 Collaboration: KULeuven, several private companies and European partners  
 gerda.cnops@ilvo.vlaanderen.be



**How can we protect genetic diversity in natural populations and how should we use them in breeding?**

Title: Population genetics of wild species and wild crop relatives  
 Funding: FWO, VLIR  
 Duration: continuous  
 Collaboration: KULeuven, VLIR-partners  
 isabel.rolan-ruiz@ilvo.vlaanderen.be



LIEVE HERMAN

Unit Head Technology & Food Science  
lieve.herman@ilvo.vlaanderen.be

## **A factory, disease-resistant potatoes, an odour lab and ingenious robots**

After extensive remodelling of the food processing plant, which will only be completed in 2012, the Technology and Food Science Unit opened the doors to the fully renewed and modernised Food Pilot. The investment of 4 million euros was given to ILVO and Flanders' FOOD via the Society for the Promotion of Innovation and Technology in Flanders (IWT). We expect, along with the Flemish and international food industry (meat, dairy, vegetable, fruit, fresh and ready-to-eat foods) that the Food Pilot will be an essential complement to the innovation and optimisation of food production companies. We also want to offer the farmers better processing of their primary products so the consumer gets served only the highest-quality food products.

In March, we presented the report on the testing of the co-existence of GMO and conventional maize. The ILVO researchers could prove that the legislative isolation distance of 50 m between the two types of crops is more than enough to guarantee the safety of the surrounding non-GMO crops: no mixing occurred that would lead to the maize being labelled as "GMO maize". We also received encouraging results in the first phase of the controversial field experiment with Phytophthora-resistant GMO potatoes (developed by Wageningen University). This field experiment proved the working hypothesis that the genes of interest, introduced into a conventional potato, offered real disease resistance under normal Flemish field conditions. The second phase of research in 2012 will normally result in even clearer data.

Together with a number of other partners, ILVO founded a Consortium on Knowledge about Air Emissions in Animal Husbandry. Many intensive livestock buildings have been built and renovated in Flanders during recent years. This has caused some problems with building permits, and particularly problems with odour. To better assess, measure and reduce these emissions and their impact on the surrounding areas, the Technology and Food Science Unit has started to develop a real odour lab.

In the Agricultural Engineering research area, our research team has been part of the ICT-AGRI-Era net, which is a European knowledge network for ICT, automation, and robotics in agriculture. As part of that project, we compiled an extensive publication and an accompanying electronic database of European research groups with their specialties and capacities. No less than 10 researchers in the Technology and Food Science unit have received their PhD: 7 in the food safety research area, 2 in the Product Quality and Innovation research area, and 1 at Agricultural Engineering.

Of the 69 researchers employed in the Technology and Food Science Unit, the Agricultural Engineering group focused on mechanisation in agriculture. This requires a combination of traditional technical competencies and modern mathematic and IT-based methods. Food Safety also deserves attention for their study of microbiological and chemical food safety and quality of foodstuffs of animal and vegetal origin. The research on product quality and innovation focuses on the authenticity of animal and plant products, including GMOs and allergens, and on improving the functional quality and valorisation of foodstuffs.

We have also provided many accredited lab analyses on authenticity of food products and food safety (including GMO analyses). Other services include work as the National Reference Lab for milk and milk products, determining the water content of poultry meat, allergens and GMOs, as well as reference work for the Milk Control Centre Flanders (MCC). We have an accredited lab for spray technology, a certification service for sprayers, and a service to follow up the certified milk and cooling tank technicians. Clients from industry and research institutes can test new food and feed processing techniques in the newly-renovated and expanded Food Pilot factory. Emissions from livestock buildings can be measured, as well as measurements to help adjust spray equipment. Advice on new practices and technologies is always available for dairy farms, dairy producers (TAD Zuivel) and SMEs.

## **Salmonella and the egg:** New ways to avoid contamination

Previous research has shown how eggs defend themselves against *Salmonella* on several levels. This doctoral research deepens this knowledge and explores some possible eggshell treatments to reduce the risk of contamination.

Each year in Belgium, approximately a thousand salmonellosis cases caused by *Salmonella* Enteritidis are reported. The principal causes are raw or undercooked eggs and the dishes using raw eggs (e.g., mashed potato).

First, this research has clarified the antimicrobial defence of each component of the egg: e.g., the stronger the vitelline membrane is, the smaller the risk of being penetrated by *Salmonella*. The cuticle (the natural organic layer on the eggshell) protects the egg content against *Salmonella* shell penetration. When eggs collide with the equipment or each other, microcracks can be induced in their shell, but these microcracks do not seem to present a major risk.

Another focus of the research was on some potential eggshell treatments to reduce the risk of *Salmonella* Enteritidis contamination. A relatively new approach is coating the eggs with chitosan, an antimicrobial and biodegradable polysaccharide. The results are positive: coating with a 2% chitosan solution results in eggs that remained longer “fresh” and in a strong reduction of *Salmonella* shell penetration. An egg washing procedure was also examined. A Swedish commercial washing procedure showed that the protecting cuticle was not harmed during this process. In other words, washing can contribute in a certain degree to the reduction of the shell contamination without damaging the natural shell protection of the egg. However, neither treatment is yet permitted in most parts of the EU.

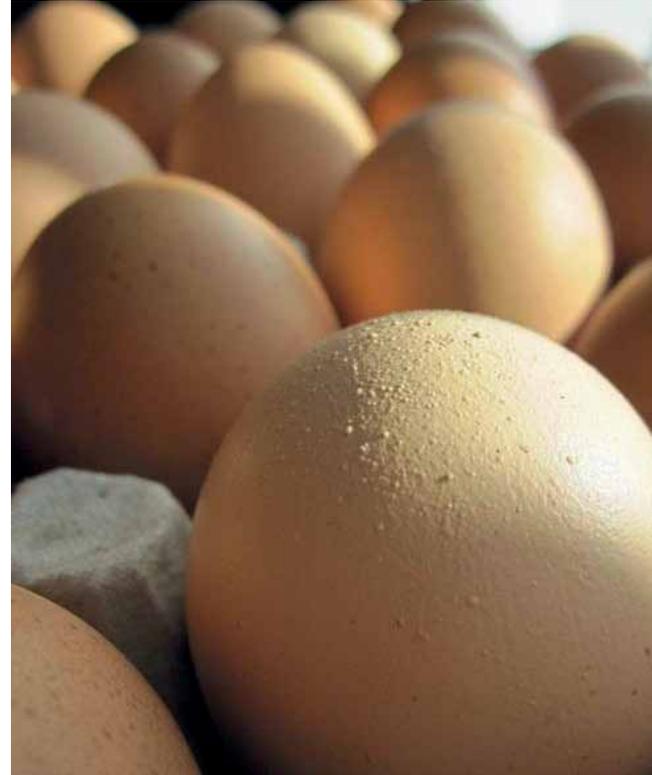
**Title:** Horizontal contamination of table eggs with *Salmonella* Enteritidis: mechanisms and control

**Funding:** EU, ILVO

**Duration:** 2007 - 2011

**Collaboration:** KULeuven, Universiteit van Glasgow (UK), INRA (FR), Egnology (BE)

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## Udder-ly important: Mastitis bacteria brought to light

Udder infection (mastitis) is the subject of constant concern on many dairy farms. Mastitis lowers milk production and can negatively affect the general welfare of the cow. Mastitis is mainly caused by bacteria that penetrate the udder and elicit an inflammation reaction. The bacterial group that most frequently cause this infection worldwide are the coagulase-negative staphylococci (CNS). CNS mastitis is usually subclinical, i.e. the cow does not show any visible symptoms and no visible abnormalities are observed in the milk, but the milk shows an elevated somatic cell count. This doctoral research took an important step toward diagnosis of CNS and improved understanding of which of the various species cause udder infection (mastitis).

The CNS group consists of about 50 different species. The lack of accurate methods to differentiate these species hindered efforts to understand which of these species cause udder infection and what the infection sources are.

In this project, we validated a DNA-based method by which CNS can accurately be identified. The method was then used to identify CNS isolates from milk and environment of six Flemish dairy farms.

Several conclusions could be drawn from this research: 1) of the more than 20 detected species of CNS, a number of species are clearly restricted to the environment - only a few cause chronic udder infections; 2) environmental sources as well as transmission from cow to cow play a role in the spread of CNS infections; 3) the infection source (stall air, slatted floors, sawdust bedding, etc.) of the CNS species is very diverse and depends on the species; 4) antimicrobial resistance was more often detected in environmental than in mastitis-causing species; and 5) a connection with pathogenicity was not detected.



**Title:** Epidemiology and characterization of coagulase-negative *Staphylococcus* species from dairy farms

**Funding:** IWT

**Duration:** 2007 - 2011

**Collaboration:** Ghent University

**Contact:** els.vancoillie@ilvo.vlaanderen.be

## Food safety:

### Can coccidiostat residues in chicken manure be taken up into our vegetables?

Chicken manure is a viable fertiliser for vegetable cultivation in Europe. ILVO researchers have investigated whether residues of coccidiostats (anti-parasitic medication) can be taken up by vegetables and then ingested by humans. The uptake of these substances from the manure appears to be very limited. Upon composting the chicken manure, residues seem to disappear along with the risk of uptake in vegetables.

Animal trials were set up in which chickens received feed containing the maximum allowed concentration of six coccidiostats (monensin, salinomycin, lasalocid, nicarbazin/narasin and diclazuril). All of the compounds were present in the manure and the litter, with the lowest concentration being for diclazuril and the highest for monensin. Composting the litter reduced the presence of the residues by 80 to 90%. Keeping the manure at room temperature also reduced the residues of some substances.

The chicken manure was then used in five vegetable cultivations: lettuce, carrot, potato, zucchini and tomato. Carrots were the only vegetable to take up a coccidiostat (i.e. nicarbazin) in a measurable concentration. In a separate trial, the researchers added the compounds directly to the soil. In that trial, potatoes took up lasalocid and nicarbazine. In carrots, the same compounds were found but in a lower concentration, and in zucchini, only nicarbazin could be detected.

The low residue concentrations found in the vegetables are, in light of the average consumption of vegetables, not a public health concern. If one should desire to avoid any risk of uptake, composting the chicken manure appears to eliminate any coccidiostat residues.

These results are preliminary and will only become final once the EFSA report is published ([www.efsa.europa.eu](http://www.efsa.europa.eu)).



**Title:** Experimental study: uptake of coccidiostats in vegetables  
**Funding:** EFSA  
**Duration:** 2010 - 2011  
**Collaboration:** Ghent University  
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## “MAP” of a bacterium: Preventing illness in cows and humans

*Mycobacterium avium* subsp. *Paratuberculosis* (MAP) is a pathogenic bacteria causing paratuberculosis (Johne’s disease) in cattle. Paratuberculosis is an incurable inflammatory bowel disease which can also affect humans. Some people infected with MAP develop a chronic intestinal infection known as Crohn’s disease.

This study yielded three significant results: 1) ways to reduce or eliminate MAP on dairy farms; 2) information about survival of MAP in dairy products; and 3) improved detection methods.

The first important result was knowledge about how to reduce or eliminate MAP on dairy farms. One example is the discovery that MAP in colostrum is an important contributor in the route of infection. In this study, we developed a milk fractionation technique to remove MAP from the colostrum while still preserving the immunoglobulins essential to the calves’ health.

Second, we gained information about the survival of the bacteria in milk and dairy products. MAP was detected in raw milk, but was also detected under certain conditions of the current pasteurization techniques. Certain cheeses and yoghurt can also contribute to the transmission of MAP in the food chain. MAP inoculated into dairy products (e.g. yoghurt) can survive during the product’s entire shelf life.

The third important result was the development of a fast and accurate MAP detection method. We were able to optimize the detection and isolation of MAP in a variety of matrices. In the future, these rapid and reliable techniques will play a crucial role in eliminating paratuberculosis infections in cows and humans.

**Title:** Detection techniques and strategies for the elimination of *Mycobacterium avium* subsp. *Paratuberculosis* (MAP) in milk and dairy products

**Funding:** IWT, FOD Department of Health

**Duration:** 2009 - 2011

**Collaboration:** KULeuven, IWT, FOD Volksgezondheid

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## Stevia: Sweet nothings

The stevia plant has potential as a healthy, low-calorie sugar replacer according to ILVO researchers. The sweet-tasting compounds in the plant, called steviol glycosides, are a healthy, low-calorie sugar alternative for diabetics and obese people. ILVO research has shown that steviol glycosides stay intact during heating and acid conditions, but occasional off-flavours and/or variations in taste quality still need to be addressed.

Steviol glycosides are 200 to 300 times sweeter than sucrose and have nearly no calories. The common sweet-tasting compounds found in the stevia plant, *Stevia rebaudiana*, are called stevioside and rebaudioside A (both are steviol glycosides). These compounds were EU-approved as food additives in November 2011. High concentrations of stevioside also have a pharmacological effect.

ILVO researchers have tested steviol glycosides in diverse food products such as dairy products, fruit preparations, biscuits and chocolate. These compounds appear to be resistant to high temperatures and acid conditions. Those results are promising, but steviol glycosides don't always pass the taste-test.

As is common with intense sweeteners, the sweet taste of steviol glycosides is not the same as the sweet taste of sugar. The sweet taste of steviol glycosides comes slowly and is lingering. Off-flavours, such as a bitter taste or liquorice flavour, have also been detected. The composition of the commercial mixtures of steviol glycosides often varies, leading to variations in taste quality, sweetness and off-flavours. Our research results indicate that stevia and steviol glycosides are promising sugar replacers but more work is needed before they will be ready for commercialisation.

**Title:** Stevia I – The use of stevia and steviol glycosides in the preparation of food products

**Funding:** IWT, Flanders' FOOD and consortium of Flemish food companies

**Duration:** 2009 - 2011

**Collaboration:** KHBO, KULeuven

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## The plant factory

### Evaluation of *Arabidopsis* as a production platform for molecular farming

*Arabidopsis thaliana* (sand rocket) is suitable for the production of high-quality proteins (e.g., enzymes or vaccines) in greenhouses. The plant is able to produce sufficient quantities of seed, provided that correct cultivation techniques are applied. This finding is described in a recent ILVO doctoral thesis on molecular farming, a discipline that examines medical and biochemical applications of genetically modified plants.

*Arabidopsis* has been primarily known as a plant model for laboratory experiments in biotechnology laboratories. Sand rocket is one of the first plants of which the DNA is fully described. It has a short cultivation cycle which allows to change its genome relatively easy via biotechnology. However, after the experimental phase with *Arabidopsis*, molecular farmers have so far always chosen to work with other plant species.

This research brings the broader application of molecular farming another step closer. An opinion survey suggests that Flemish greenhouse plant growers would be interested in this new biotechnological application, on the condition that yield and production guaranteed.

On the basis of cultivational trials on 96 varieties (ecotypes) of *Arabidopsis*, opinions were formulated about the proper seed yield. Related *Arabidopsis* species were also evaluated for use in molecular farming.

The use of seeds as tissue in molecular farming production may in specific cases compete with other technologies for the production of valuable proteins. Seeds from a controlled greenhouse cultivation with GMO authorisation are sometimes cheaper in production and allow long-term stable preservation.

The economic prospects for using *Arabidopsis* to produce a small amount of high-quality proteins or enzymes are favourable.



**Title:** Evaluation of *Arabidopsis* as a production platform for molecular farming

**Funding:** ILVO-PhD scholarship

**Duration:** 2007 - 2011

**Collaboration:** VIB

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## Side by side Testing the Flemish co-existence regulations in practice

In 2010, ILVO planted a 12-acre pilot field to test the co-existence of genetically modified maize and other maize productions under field conditions.

In the centre of the field, one plot was sown with the genetically modified maize MON810, the only variety that is authorized for cultivation in the EU. Around it, non-GM corn was sown. Typical Flemish agricultural practices were imitated as faithfully as possible. Over 500 maize-and pollen samples were collected to determine whether GM maize was present, and if present, how much. We first examined the risks during sowing by emptying the machine in the usual way. Via DNA analyses, the researchers observed that this typical methodology does result in mingling during sowing. Up to 300 metres in the non-GM field, sporadic MON810 maize plants were observed via seed grains that remained in the field. ILVO proposes a relatively simple solution for this: after a seed turn, it is enough to simply open the screws and manually thoroughly empty the reservoir at the bottom of the seed discs. This takes no longer than 15 minutes.

To investigate the degree of cross-pollination, ILVO sowed plots of conventional maize at distances of 0 metres, 50 metres and 80 metres from the GM corn plot. In those plots, localised samples were systematically taken. The average levels of GM maize in the fields at 50 meters or more distance from the GM maize field did not exceed 0.04% anywhere.

The harvesting machines were also examined. Investigation showed large amounts of threshed GM corn stuck in the interior threshing drums, tedders and sieves, which then mingled in the first threshing corn harvested from the non-GM field. Disassemblage and thorough cleaning of the harvester would theoretically be possible, but this would be too time-consuming. A more attainable solution proposed by the researchers for threshing machinery is to harvest a strip of non-GM corn directly after the GM corn harvest. This procedure would "rinse" the thresher. A chipper gives no risk of mixing of its harvests, however. Transport also poses no problems if the agricultural vehicles are not overloaded.



In conclusion, the research confirmed that the isolation distance of 50 metres proposed by the Flemish Government is more than enough to keep the level of GM admixture in conventional maize pollen due to airborne pollen below the 0.9% threshold. Farmers and wage workers wishing to plant GM corn in the future should also keep ILVO's best practices advice in mind to carefully handle any remaining seed and threshed plant parts in the machines, thus avoiding possible mixing of GM and conventional corn.

**Title:** The Flemish regulation on co-existence: a practical evaluation

**Funding:** Flemish Government

**Collaboration:** ILVO Plant Sciences, ILVO Animal Sciences and ILVO Technology & Food Science

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isabel.taverniers@ilvo.vlaanderen.be, marc.deloose@ilvo.vlaanderen.be

## Optimisation of the spray application technique in ornamental plant production

### Everything you ever wanted to know about spray booms

Ornamental plant production is an important horticultural activity in Flanders. Traditionally, because of the great diversity in grown species and growing systems, growers use high pressure spray equipment (spray guns and lances) almost exclusively. However, as more and more companies scale up, they want to automate labour-intensive activities, including crop spraying. For this reason, spray boom equipment is becoming increasingly popular amongst the growers. In spite of important advantages, e.g., the better uniformity of the spray liquid distribution, growers still have many questions about the optimal settings of this type of equipment.

In this project, we evaluated various spray application techniques in different types of ornamental crops. The spray experiments involved the comparison of different spray systems (spray lances and booms with or without air support), nozzle types, spray directions and application volumes.

The experiments showed that boom systems may considerably improve crop protection management in greenhouses by improving the homogeneity of the spray liquid distribution in the canopy and reducing spray loss. The effectiveness of horizontal booms can be negatively affected by nozzle type and boom configuration. An important effect of air support, spray direction and spray volume was observed. Additionally, these techniques may increase productivity, reduce labour costs and decrease operator exposure. In conclusion, the use of spray boom systems is a promising technique for safe and efficient application of plant protection products.

**Title:** Optimisation of the spray application technique in ornamental culture

**Funding:** IWT

**Duration:** 2006 - 2011

**Collaboration:** Proefcentrum Sierteelt

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## Energy-efficient ventilation in pig and poultry housing Code of Good Practice now available

Minor adjustments to existing ventilation systems or simple measures can substantially reduce electricity consumption or the cost of mechanical ventilation. Farmers are generally not familiar enough with many of these recommendations.

This demonstration project resulted in a published Code of Good Practice. This document outlines energy saving practices, values them, and in some cases verifies them with measurements in practice. The annual energy consumption of four animal housing units (2 poultry houses and 2 pig stalls) was monitored and the energy profile was analysed. A test construction was built with 3 fans, 40 cm in diameter each, with one fan powered by direct current (DC) and two fans powered by alternating current (AC). They were also Triac- or Frequency driven, respectively. The fans were equipped with throttling valves to reduce the air flow by 25, 50, or 75%. The energy consumption of the fans was logged at various rotation speeds and different positions of the throttling valves.

The energy benefit of a DC powered fan is very large and varies between 55% to 70% compared to an AC Triac-controlled fan. Frequency-driven AC fans can reduce energy use by 20% to 50%. Myriad minor adjustments will also decrease the energy demand, such as the use of discharge cones, increasing the temperature set point in the summer period, and matching ventilation demand and the average weight and precise number of animals present.

The farmer is also encouraged to self-compute a number of energy saving measures by means of a calculation module.

**Title:** Code van goede praktijk voor het energie-efficiënt gebruik van mechanische ventilatie in de intensieve veehouderij

**Funding:** Afdeling Duurzame Landbouwontwikkeling (ADLO)

**Duration:** 2009 - 2011

**Collaboration:** Inagro, Innovatiesteunpunt voor Land- en Tuinbouw, Proefbedrijf Pluimveehouderij

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**Which** storage conditions during the apple-juice production process minimise the risk for growing fungi that produce the patulin toxin?

Title: Development of molecular identification and detection techniques of patulin producing fungi to study the influence of storage conditions of apples on the expression of patulin producing genes  
 Funding: FOD Volksgezondheid  
 Duration: 2008 - 2012  
 Collaboration: Ghent University  
 els.vancoillie@ilvo.vlaanderen.be

**How** can human infection with the instestinal bacterium *Campylobacter jejuni* be prevented by changes to poultry feed?

Title: Control of *Campylobacter jejuni* colonisation and excretion with broilers by means of organic acids and antibacterial compounds produced by lactic acid bacteria  
 Funding: FOD Volksgezondheid  
 Duration: 2009-2012  
 Collaboration: Ghent University  
 marc.heyndrickx@ilvo.vlaanderen.be

**How** can we develop an appropriate methodology for sampling and detection, together with remediation, for the MRSA pathogen?

Title: Study of contamination patterns and germ-host interaction to control of MRSA in pigs and other animals nuts  
 Funding: IWT  
 Duration: 2009 - 2012  
 Collaboration: KATHO, KULeuven, CODA and Ghent University  
 geertrui.rasschaert@ilvo.vlaanderen.be



**How** do the pathogenic bacteria *Salmonella* and *E. coli* O157 survive on greenhouse-grown butterhead lettuce, and how damaging are they in these circumstances?

Title: Survival and virulence of the zoonotic pathogens *Salmonella* and *E. coli* O157 in greenhouse-grown butterhead lettuce  
 Funding: FOD Volksgezondheid  
 Duration: 2009 - 2013  
 Collaboration: ILVO Plant Sciences  
 marc.heyndrickx@ilvo.vlaanderen.be

**Which** strains of the *Bacillus cereus* bacteria are responsible for production of toxins in food poisoning?

Title: Research to toxin production by *Bacillus cereus*; characterisation and detection of tribes responsible for food poisoning  
 Funding: FOD Volksgezondheid  
 Duration: 2009 - 2012  
 Collaboration: Ghent University, UC and WIV  
 marc.heyndrickx@ilvo.vlaanderen.be

**What** is the risk of acquired antibiotic resistance during food production and resulting of mild conservation of food products?

Title: Risk of induction and transfer of antibiotic resistance during the food production and conservation  
 Funding: FOD Volksgezondheid  
 Duration: 2010 - 2014  
 Collaboration: Ghent University  
 els.vancoillie@ilvo.vlaanderen.be

**How** do the NoV, HAV and HEV viruses (which are transferrable via certain foodstuffs) spread, and how can we contribute to an effective risk analysis?

Title: Research of NoV, HAV and HEV viruses which are transferrable via certain foodstuffs and their contribution to risk assessment  
 Funding: FOD Volksgezondheid  
 Duration: 2011 - 2013  
 Collaboration: Ghent University, WIV and Uliège  
 els.vancoillie@ilvo.vlaanderen.be



**How** do migrating components of printing ink and glue on packaging and foods behave, and what is their risk for public health?

Title: Study of the stability and reactivity of migrating components of printing inks and adhesives, used in food packaging  
 Funding: FOD Volksgezondheid  
 Duration: 2011 - 2014  
 Collaboration: Ghent University  
 hendrik.deruyck@ilvo.vlaanderen.be

**What** are possible guidelines efficient cleaning and disinfection in the food industry?

Title: Efficiency guidelines for cleaning and disinfection in the food industry  
 Funding: Flanders' FOOD en industriële partners uit de voedingsindustrie  
 Duration: 2011 - 2013  
 Collaboration: VITO  
 valerie.dejonghe@ilvo.vlaanderen.be

**How** can we increase the stability of candy fillers while maintaining structure and taste?

Title: More stabile candy fillers while maintaining structure and taste  
 Funding: IWT-Tetra  
 Duration: 2011 - 2013  
 Collaboration: Ghent University  
 geertrui.vlaemynck@ilvo.vlaanderen.be

**How** can the freezer stability of food products be improved by adding certain ingredients?

Title: Improvement of the freezer stability of food products  
 Funding: IWT  
 Duration: 2011 - 2014  
 Collaboration: Industriële partner  
 jan.deblock@ilvo.vlaanderen.be



**Can** Phytophthora-resistant GM potatoes contribute to more sustainable potato cultivation in Flanders?

Title: Evaluation of genetically modified potatoes in function of their resistance against blight  
 Funding: diverse  
 Duration: 2011 - 2012  
 Collaboration: Ghent University, VIB, HoGent, BASF, WUR  
 bart.vandroogenbroeck@ilvo.vlaanderen.be  
 marc.deloose@ilvo.vlaanderen.be

**How** can the Flemish grey shrimp be better valorised as a safe and high-quality product via use of innovative, sustainable techniques and modern processing methods?

Title: Valorisation of the Flemish grey shrimp by research of and application of innovative, sustainable techniques and modern processing methods  
 Funding: EVF (Europees Visserij Fonds)  
 Duration: 2011 - 2014  
 Collaboration: KULeuven  
 geertrui.vlaemynck@ilvo.vlaanderen.be



**How** can we make ice cream and dairy desserts with 30% less calories which maintain the same taste and mouth-feel as the full-calorie equivalent?

Title: Research of ice and dairy desserts with less calories  
 Funding: Flanders' FOOD en industriële partners uit de voedingsindustrie  
 Duration: 2011 - 2012  
 jan.deblock@ilvo.vlaanderen.be

**How** can the off-flavours arising from sweetening with steviol glycosides, the intense non-sugar sweetening compounds originating from the stevia plant?

Title: Avoiding of off-flavors by use of steviol glycosides  
 Funding: Flanders' FOOD en industriële partners uit de voedingsindustrie  
 Duration: 2011 - 2013  
 Collaboration: KULeuven, KHBO  
 jan.deblock@ilvo.vlaanderen.be



**Which** innovative possibilities are there for valorisation of grey shrimp and the by-products arising from shrimp fishing and processing (undersized shrimp, discards, cooking water and shrimp heads and tails)?

Title: Innovative and potential valorisation possibilities for the grey shrimp and by-products of shrimp fishing and processing  
 Funding: EVF (Europees Visserij Fonds)  
 Duration: 2011 - 2014  
 Collaboration: KULeuven  
 geertrui.vlaemynck@ilvo.vlaanderen.be

**Which** factors are associated with teat dimensions of dairy cows (Holstein) in Flanders, what proportion of variation in teat dimensions at the different levels (herd, cow, quarter, and observation) can be explained by these factors, and what is the relationship of teat dimensions with udder health?

Title: Teat morphology: associated factors and the relationship with udder health in Holstein cows  
 Funding: ILVO FOC grant, Ghent University  
 Duration: 2009 - 2012  
 Collaboration: Ghent University (Faculty of Veterinary Medicine)  
 ingrid.zwertvaegher@ilvo.vlaanderen.be  
 stephanie.vanweyenberg@ilvo.vlaanderen.be

**What** effect does particulate matter have on occupational safety and health, animal health and emissions in pig husbandry?

Title: Characterization and evaluation of particulate matter in pig husbandry in Flanders with relation to occupational safety, animal health and emissions  
 Funding: IWT  
 Duration: 2009 - 2012  
 Collaboration: Ghent University (Faculty of Veterinary Medicine - Department of Obstetrics, reproduction and herd health)  
 nele.vanransbeeck@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be

**How** can we measure and control the ventilation rate of naturally ventilated barns?

Title: NATVENT – Development of a practical measuring method to assess the ventilation rate of naturally ventilated barns  
 Funding: IWT  
 Duration: 2011 - 2014  
 Collaboration: Ghent University (Faculty of Bioscience Engineering - Biosystems Engineering)  
 philippe.vanoverbeke@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be



**In** what way can computer simulations of air flows support the development of more sustainable and more comfortable animal housing systems?

Title: AIRMODEL – Modelling air flows and ammonia behaviour in and around naturally ventilated animal housing systems  
 Funding: ILVO  
 Duration: 2009 - 2012  
 Collaboration: Ghent University (Faculty of Bioscience Engineering - Biosystems Engineering & Faculty of Engineering and Architecture, Department of Flow, heat and combustion mechanics)  
 merlijn.depaepe@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be

**How** can we improve the sustainability of agriculture and horticulture in Flanders by directed competitive and ecologically and economically sound improvements in efficiency throughout the value chain?

Title: Development of an exergy-based measuring and evaluation instrument to steer for sustainable agricultural and horticultural production in Flanders  
 Funding: ILVO  
 Duration: 2011 - 2015  
 Collaboration: Ghent University (Faculty of Bioscience Engineering -EnVoc), ILVO Social Sciences, ILVO Plant Sciences, ILVO Animal Sciences  
 sophie.huysveld@ilvo.vlaanderen.be  
 veerle.vanlinden@ilvo.vlaanderen.be,  
 hilde.muyll@ilvo.vlaanderen.be  
 ludwig.lauwers@ilvo.vlaanderen.be  
 nico.peiren@ilvo.vlaanderen.be



**How** can we ensure that analytical tools perform well enough to guarantee implementation of the EU legislation on GMOs (and will continue to perform well) in the face of new legislation, an increasing number of authorised GM events, and the potential presence of non-authorised events?

Title: Development and implementation of methods and procedures for detection of GMOs, including non-authorized GMOs, in food and feed  
 Funding: FOD  
 Duration: 2012 - 2015  
 Collaboration: WIV, CRA-W  
 isabel.taverniers@ilvo.vlaanderen.be

**Can** we improve the spray distribution of plant protection products in order to reduce residues, the amount of pesticides and spray drift?

Title: An integrated approach to investigate and optimize the orchard spray application process  
 Funding: IWT  
 Duration: 2009 - 2013  
 Collaboration: PCFruit vzw, KULeuven – BIOSYST - MeBioS  
 david.nuyttens@ilvo.vlaanderen.be  
 dieter.foque@ilvo.vlaanderen.be



**What** is the importance of dust drift from pesticide seed dressing during sowing, and can we develop dust drift reducing measures and innovations in seeding techniques?

Title: Measures and innovative techniques to reduce dust drift from pesticide seed dressing during sowing  
 Funding: IWT  
 Duration: 2011 - 2015  
 Collaboration: KULeuven – BIOSYST - MeBioS  
 david.nuyttens@ilvo.vlaanderen.be  
 dieter.foque@ilvo.vlaanderen.be

**Can** we use entomopathogenic nematodes as insecticides in vegetable growing?

Title: Optimizing the spray application of entomopathogenic nematodes in vegetables  
 Funding: IWT  
 Duration: 2009 - 2012  
 Collaboration: Ghent University, Inagro  
 david.nuyttens@ilvo.vlaanderen.be,  
 eva.brusselman@ilvo.vlaanderen.be,  
 bert.beck@ilvo.vlaanderen.be



**How** can knowledge of bioactive compounds of vegetables and fruit lead to innovation in processing and marketing?

Title 1: Ideas for diversification of the leek assortment, its processing and marketing based on metabolite profiling  
 Funding: IWT-PhD fellowship  
 Duration: 2008 - 2012  
 Collaboration: James Hutton Institute (Schotland), PCG, VUB, Ghent University  
 nathalie.bernaert@ilvo.vlaanderen.be  
 bart.vandroogenbroeck@ilvo.vlaanderen.be  
 marc.deloose@ilvo.vlaanderen.be

**How** can knowledge of bioactive compounds of vegetables and fruit lead to innovation in processing and marketing?

Title 2: Developing and evaluating improved processing and valorisation strategies for apple and pear  
 Funding: ILVO-VITO scholarship  
 Duration: 2009 - 2013  
 Collaboration: VITO, PcFruit, Better3Fruit  
 domien.depaepe@ilvo.vlaanderen.be  
 bart.vandroogenbroeck@ilvo.vlaanderen.be  
 marc.deloose@ilvo.vlaanderen.be



**Do** cows change their gait when they develop health problems and can the GAITWISE-system measure these changes in gait?

Title: Validation of an early detection system for lameness in cattle: GAITWISE  
 Funding: ILVO  
 Duration: 2010 - 2012  
 Collaboration: Ghent University (Faculty of Veterinary Medicine), ILVO Animal Sciences  
 annelies.vannuffel@ilvo.vlaanderen.be

**How** can we objectively assess odour and odour nuisance in the intensive animal husbandry?

Title: Actualisation of the methodology to determine odour and odour nuisance in the intensive animal husbandry in Flanders  
 Funding: ILVO, Provinciebestuur West-Vlaanderen  
 Duration: 2011 - 2014  
 Collaboration: Ghent University (Faculty of Bioscience Engineering -EnVoc), Inagro  
 nathalie.hove@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be

**Which** analysis techniques are best to detect allergenic epitopes in a specific and sensitive way in processed food products?

Title: Gebruik van faag display technologie voor de selectie van monoklonale antilichamen bruikbaar in allergenen onderzoek en diagnostiek  
 Funding: diverse  
 Duration: continuous  
 Collaboration: UAntwerpen, VIB  
 isabel.taverniers@ilvo.vlaanderen.be  
 bart.vandroogenbroeck@ilvo.vlaanderen.be

**How** can one objectively judge the quality of Belgian cold cuts?

Title: KWALICHARC - Objectivering van de kwaliteitsbeoordeling van Belgische charcuterie  
 Funding: Flanders' FOOD en industriële partners uit de voedingsindustrie  
 Duration: 2011 - 2013  
 geert.vanroyen@ilvo.vlaanderen.be



**Which** alternatives exist to treat bloody diarrhea in pigs caused by the *Brachyspira* bacteria?

Title: Optimalisatie van bestrijding van infecties met intestinale bachyspiren bij varkens  
 Funding: IWT  
 Duration: 2011 - 2015  
 Collaboration: ILVO Animal Sciences, Ghent University  
 marc.heyndrickx@ilvo.vlaanderen.be

**Which** factors influence the viscosity, melting point and texture of chocolate?

Title: Onderzoek naar factoren die de reologische specificaties van chocolade beïnvloeden  
 Funding: IWT  
 Duration: 2009 - 2012  
 Collaboration: Ghent University  
 jan.deblock@ilvo.vlaanderen.be

**Can** we use imaging techniques and image processing to get a better insight in the complex spray application process of plant protection products?

Title: Integration of imaging techniques for the quantitative characterization of pesticide sprays  
 Funding: ILVO, Nicéphore Cité (F)  
 Duration: 2011 - 2015  
 Collaboration: AgroSup Dijon (F), Université de Bourgogne (F), Ghent University  
 david.nuyttens@ilvo.vlaanderen.be  
 sofija.minov@ilvo.vlaanderen.be

**Can** drinking and eating patterns of individual fattening pigs in group housing be used to alert the farmer for production or health problems?

Title: PIGWISE; early detection of welfare, health or production problems in fattening pigs  
 Funding: IWT, Europees project ICT-Agri  
 Duration: 2011 - 2015  
 Collaboration: KULeuven (MeBioS), ICT-Agri consortium (GAUG University (DE); ISMB Research Institute (IT); ASE University (DK); KULeuven-MeBioS), ILVO Animal Sciences  
 jarissa.maselyne@ilvo.vlaanderen.be  
 annelies.vannuffel@ilvo.vlaanderen.be



**Can** lameness in sows be detected based on how they distribute their weight on their legs and how does lameness influence the reproduction of sows? What are the risk factors of lameness in group-housed sows?

Title: Detection, economical impact and prevention of lameness in Group housed sows  
 Funding: IWT - scholarship for strategic basic research  
 Looptijd: 2010 - 2014  
 Collaboration: Ghent University (Faculty of Veterinary Medicine)  
 liesbet.pluym@ilvo.vlaanderen.be  
 annelies.vannuffel@ilvo.vlaanderen.be



**Which** preventive techniques can be used to safeguard the internal climate of animal housing systems and to control the related emissions?

Title: A multi-pollutant approach to assess the influence of housing technology, management and animal related factors on air emissions  
 Funding: ILVO  
 Duration: 2011 - 2015  
 Collaboration: ILVO Animal Sciences, Ghent University  
 tim.ulens@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be

**How** can we dehumidify modern glasshouses in an energy and exergy efficient way?

Title: Development of a dehumidification technique for glasshouses based on a heat mass exchanger and mechanical vapour recompression  
 Funding: ILVO  
 Duration: 2009 - 2014  
 Collaboration: Ghent University (Faculty of Bioscience Engineering -EnVoc), Ghent University (Faculty of Engineering and Architecture -FloHeaCom)  
 filip.bronchart@ilvo.vlaanderen.be  
 peter.demeyer@ilvo.vlaanderen.be





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## Business risk analysis and good architecture

In December 2011, ILVO's Social Sciences Unit presented ARAMIS, a software package that helps agricultural firms manage their financial and management risks. This was just a preliminary presentation, however, because ARAMIS is still in development. Social Sciences and the Faculty of Business Economic Sciences at the University of Hasselt developed this software with funding by an IWT grant. The web-based application, REMI, makes ARAMIS and several other management-support tools available to a wide public. These tools are often simplified business economic tools, such as the Pigs2win model which helps pig farmers to make strategic optimisation choices.

Together with ILVO Fisheries, Social Sciences created the VISEO think tank, where researchers in the areas of fishing gear, ecosystem and society come together to perform integrated social scientific research about the transition to more sustainable fisheries. ILVO works closely with the VLIZ, the ALVB, the Fisheries Service and the organisation for ship owners (Rederscentrale).

This year, we also worked on a set of guidelines for high-quality agrarian agriculture. Social Sciences, in collaboration with the Policy Working Group on Agrarian Architecture, strives to give a support framework for sustainable and aesthetically responsible construction, within the existing societal and legislative context. Via this type of research, Social Sciences wishes to develop expertise in the understanding and guidance of multi-stakeholder processes.

In August 2011, together with the Flemish Department of Agriculture and Fisheries (ADLO), the Social Sciences Unit published the booklet "Back to the Future". This booklet presented past, present and future of the Flemish ornamentals sector: what worked and didn't work in this sector during the last 50 years? During an accompanying

presentation, more than 100 professional growers of ornamental plants could learn how they could learn from the lessons learned by other horticulturists, and apply them to their future.

The Social Sciences Unit also wishes to be one of the "motors" behind interdisciplinary research within ILVO. One of these accomplishments, the Master's thesis entitled "Multifunctional cultivation and creative combinations of valorisation avenues – *Miscanthus x giganteus* as an example" earned the "Landbouwkrediet Award" in the Master's thesis of bioengineering category for 2010-2011.

The Social Sciences Unit has a team of 32 researchers. This unit is the social-economic research centre at ILVO. In 2006, we developed the following mission for this unit: "to offer and clarify, on a scientific basis, the societal choices for sustainable and competitive Flemish agriculture and fisheries".

This mission, together with the pattern of expectations from the clients (government, industry, and fellow researchers) led to a three-pronged structure within the unit: (1) the integrated approach to sustainability, according to various levels of agricultural systems and decision-making, (2) the dynamic dimension of development processes within the agricultural and fisheries sectors and in rural areas and (3) the spatial qualities and the development of the urbanising countryside.

The dynamics of the unit and its research portfolio lead to a changeable research organisation and a broader mission which is still targeted to the social context of a changing countryside. The unit started with three research areas, but starting in 2012, Social Sciences will gather its forces into two research areas: (1) Agriculture and Farm development and (2) Rural development. The former focuses on the dynamics of agriculture becoming a competitive and sustainable industry, and the latter studies change processes and their management in a rural context.

## A key to the future

### The guide for agrarian architecture in Flanders

The look of the Flemish farmstead has evolved greatly over the last couple of decades. Picturesque farmsteads featuring local and regional characteristics are gradually being replaced by large farm buildings with a uniform appearance across all regions. The expansion of scale is another characteristic of contemporary stables and farmsteads. Furthermore, the agricultural sector is faced with considerable challenges to meet the legal and technical demands accompanying these large constructions. To face these challenges, a working group of policy makers and other stakeholders developed a guide for agrarian architecture in Flanders. This guide provides a framework that should enable farmers, architects, and policy makers to develop sound building projects where legal, technical, societal and aesthetic demands are all taken into account.

Agrarian architecture is a dynamic, context-dependent process that starts from the day that a farm manager begins to dream about a new building until the moment that the building is fully operational. Depending on the magnitude and complexity of the project, the process comprises a certain number of phases and stages. To reach the goal of constructing an agricultural building that functions well on the technical, economic and architectural levels, all of these stages must be covered completely and thoroughly. In addition to managing this construction project well, the farm manager must have a clear view on the future development of his business.

The objective of this guide is twofold. The overall aim is to improve the quality of agrarian buildings in the Flemish countryside. We therefore describe all the stages of the process in the guide. The guide is also meant as a way to change the mentality of all the actors involved.

Title: Beleidswerkgroep Agrarische Architectuur

Funding: Government of Flanders – (Beleidsdomein Landbouw en Visserij)

Duration: 2010 - 2011

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## Tradable permits:

### A perfect idea in an imperfect market

Tradable permits have been introduced to restrict the use of limited resources, e.g. milk- and sugar quotas, nutrient allocation rights, nutrient production rights and single farm payments. This research project created different models to get more insight in the farm management with tradable permits and its spatial consequences. Under perfect market conditions, tradable permits are the most efficient policy instrument. But the reality of the trade of permits reveals an imperfect market.

Three reasons were identified for market failure during this research: 1) government intervention due to social reasons or environmental concerns, 2) a lack of market information for the market player and 3) deviating behaviour of the market player. In spite of these market imperfections, tradable permits are still more efficient than other policy instruments.

To minimize market imperfections when creating a permit market system, enough attention must be paid to: 1) a well-functioning market 2) initial permit allocation to individual farmers and 3) the necessity to maintain different systems of tradable permits.

Under a tradable permit system, structural growth of the sector stays possible. The farmer can define his own behaviour and has the responsibility to work according to government policy aims.

A number of the models created in this research project will be made available for farmers, policy makers, interest groups, etc. using the web-application called REMI (Resource Economic Modelling Interface) in the spring of 2012.

Title: Prijsvorming en allocatie van verhandelbare rechten in de land- en tuinbouw

Funding: IWT

Duration: 2006 - 2011

Collaboration: Ghent University (Vakgroep Landbouweconomie)

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## “Rural sustainability” does not mean the same to everyone

### Searching for common ground

An exploratory study revealed significant definition and perception differences concerning the concept of “sustainability of agriculture and the rural area”. ILVO researchers analysed 21 in-depth interviews on the subject of rural sustainability. Those interviewed were representatives from 7 groups of rural stakeholders (agricultural associations, agricultural unions, banks, government agencies, actors in the agro-food chain, and NGOs). This data can help policy makers to frame their approach to creating a more sustainable future in rural areas. Certain stakeholders will support a suggestion, while others could experience it as threatening. The research on discourse also brings a range of socially relevant research topics to light.

Three main discourses were identified:

The agri-ruralistic discourse targets on the preservation of (family) farming and the rural area in its current condition. In this group, the viability of the farm gets more attention than ecological or macro-economic aspects of sustainability. Urbanisation and the many claims on rural areas are problematic and cause social and psychological problems among farmers. To the agri-ruralistic stakeholder, citizens seem to ignore the effort that farmers make to reduce agricultural impact on nature and the social environment. Society sets increasing conditions on food and food production, but consumers are not willing to pay for the value added by the farmer.

In the utilitarian discourse, the economic dimension of the agricultural sector takes centre stage. Does agriculture have the right to claim the scarce open space in Flanders, which is situated at the heart of the European transportation hub and industrial center? Yes, but only if its financial returns are higher than any other economic activity. Agriculture should therefore broaden its focus towards other, (more) profitable applications such as biofuel, clothing, medicine, etc. In this discourse, the science and technology sectors are encouraged to help the agricultural sector become more competitive and to focus on more efficient and greener technologies.

The hedonistic discourse focuses on including a wide range of relations and experiences concerning agricultural activities. The creation of networks of local and regional actors within and outside the agricultural sector is seen as being the best way to encourage sustainable rural development. Social, ecological and even



cultural aspects take precedence over economic factors. The stakeholders in this discourse call for new alliances between farmers and urban dwellers on the one hand, and farmers and conservationists on the other.

This exploratory research has raised the important research question, “What can agriculture do for society – how can it add value to society at large?”

Title: SADLIV – Sustainability of agriculture and rural areas in Flanders

Funding: ILVO

Duration: 2010 - 2011

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## Building the right instrument and using it in the discussion about sustainable production processes

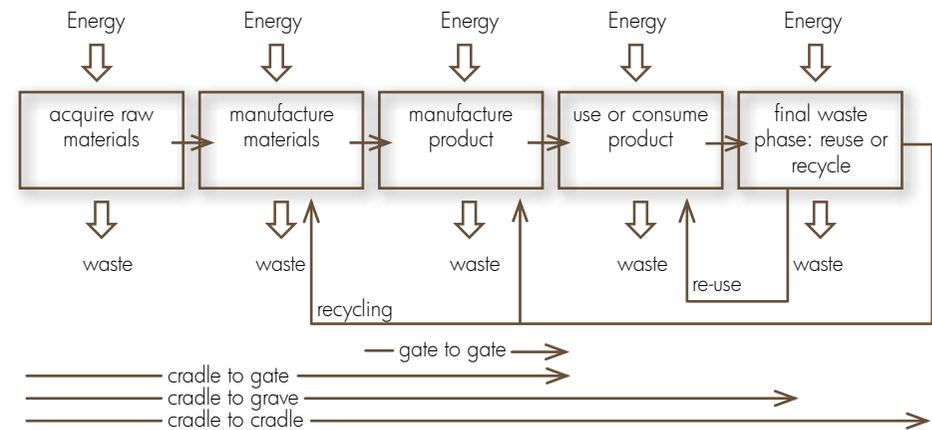
### Beyond the eco-label

Agriculture today should evolve into an economically competitive sector that complies with several social expectations while facing ecological constraints. Both national and international reports have recently questioned the sustainability of distinctive agro-sectors. The discussion is appealing to ILVO that has a history of sustainable research and would like to be involved in the discussion. For that reason, ILVO is developing a tool to cover the economic and social aspects of sustainability in addition to the traditional ecological aspects, such as the carbon footprint.

To begin, ILVO researchers made an overview of existing tools and methods including their advantages and disadvantages. Life-cycle analysis (LCA) appeared to be the most popular method but it has important limitations. The "exergy-LCA" (ELCA) model, in which exergy quantifies the quality of energy, can partly overcome those limitations. The most important advantages of the ELCA are the use of a single unity (J) to quantify the results and the applicability to a number of environmental problems.

Sustainable initiatives such as logos and labels appear to focus on ecological aspects, but recently attention is shifting towards socio-economic aspects. Most of the initiatives are organized at the national level without any kind of harmonisation of the calculation method. Stakeholders, upon questioning, are more interested in a sustainability analysis of production processes, rather than the sustainability of the products alone. These stakeholders consider animal husbandry to be an ideal case to build the tool, because animal husbandry tends to spark controversy. Other agricultural production systems can follow after the tool is developed.

A research agenda was drawn from the conclusions of this preliminary study. The next step is the development of a scientifically sound, exergy-based and resource-driven tool (the subject of a doctoral study) to indicate inefficiencies in the agricultural production process and to improve them.



Title: Voorstudie voor levenscyclusonderzoek (LCA) op Vlaamse land- en tuinbouwproducten

Funding: ILVO

Duration: 2010 - 2011

Collaboration: ILVO-Technology & Food Science

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## Multifunctional agriculture and regional identity (MUSICAL): Forces for positive change in the countryside

The MUSICAL-project has demonstrated that multifunctional agriculture can contribute to a unique regional identity by offering environmental and landscape services, green care, farm products, etc. When farmers cooperate with other regional actors to promote this regional identity, and together bring the regional characteristics to the attention of residents as well as visitors, this has positive effects for the farmers and for the region.

Through interviews with regional actors, focus groups with residents, farmers and policy representatives and (online) surveys for regional residents and farmers, we investigated the possibility for multifunctionality and regional identity as forces for change in the countryside. The research was conducted in 10 Belgian regions as well as in the Netherlands and Ireland.

Regional identity, despite meaning different things to different people, promotes cooperation between regional actors in rural development processes. Cooperation of this sort requires both coordination and harmonisation between regional actors. Good interaction between spontaneous regional initiatives and imposed policy measures is also indispensable. Farmers are important partners in this story and they can anticipate the opportunities that regional identity offers. For example, they can receive compensation for landscape management or gain extra income by selling farm and regional products. This calls for consideration of alternative financing models and a larger market for farm and regional products.



Title: Multifunctionality and local identity as paradigms for a sustainable and competitive agriculture

Funding: Federal government service research policy, Program 'Science for Sustainable Development'.

Duration: 2006 - 2011

Collaboration: Ghent University (Department Agricultural Economics, Department Mobility and Spatial Planning), KULeuven (Division of Geography), Fondation Rurale de Wallonie.

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**How can we shed light on the process and method of developing glasshouse clusters, from idea to construction?**

Title: Glastuinbouwbedrijven in industrieel-ecologische clusters: Op weg naar duurzaamheid en samenwerking in Vlaanderen  
 Funding: ILVO scholarship  
 Duration: 2008 - 2011  
 Collaboration: WUR (Wageningen)  
 joost.dessein@ilvo.vlaanderen.be

**How can the various kinds of pig farms become more sustainable?**

Title: Indirecte duurzaamheidseffecten in tijd en ruimte van technologiekeuzes in de Vlaamse landbouw: de case study van de intensieve varkenshouderij  
 Funding: ILVO scholarship  
 Duration: 2008 - 2012  
 Collaboration: WUR (Wageningen)  
 bert.vandervennet@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be

**How do we decide which is the “optimal” fishing fleet in light of changing insights about sustainability?**

Title: Een gedragen transitie van de huidige visserijvloot naar een duurzame visserij  
 Funding: ILVO scholarship  
 Duration: 2011 - 2015  
 Collaboration: ILVO Animal Sciences  
 ruben.verkempynck@ilvo.vlaanderen.be  
 koen.mondelaers@ilvo.vlaanderen.be  
 hans.pollet@ilvo.vlaanderen.be



**How do the control and intervention measures for Salmonella work? Are they reliable, and how cost-effective are alternative intervention strategies?**

Title: Optimalisatie van de bestrijding van Salmonella infectie bij varkens  
 Funding: FOD – Volksgezondheid, Veiligheid van de Voedselketen en Leefmilieu  
 Duration: 2009 - 2012  
 Collaboration: CODA, Ghent University, DGZ  
 erwin.wauters@ilvo.vlaanderen.be

**Which criteria are important to support decision-making about agricultural spatial planning and how can these criteria help the planning processes in Flanders?**

Title: Afwegingsinstrument voor planning van landbouwruimte  
 Funding: Government of Flanders (Beleidsdomein Landbouw en Visserij)  
 Duration: 2007 - 2012  
 Collaboration: ADLO, VLM  
 eva.kerselaers@ilvo.vlaanderen.be

**Which transformations are happening in the Flemish countryside? What typifies them and what is their impact on spatial quality?**

Title: Onderzoek naar de ruimtelijke kwaliteit van Vlaamse plattelandsgebieden in transitie  
 Funding: ILVO scholarship  
 Duration: 2009 - 2013  
 anna.verhoeve@ilvo.vlaanderen.be  
 elke.rogge@ilvo.vlaanderen.be

**Using a participative process, how can an attractive and economic and rural image be created for the Middle West Flanders and “Westhoek” region?**

Title: Tought4Food  
 Funding: Vlaamse Minister Economie – EFRO, D2 EFRO 2007 – 2013, Provincie West-Vlaanderen, VLM  
 Duration: 2010 - 2012  
 Collaboration: Provincie West-Vlaanderen, VLM West-Vlaanderen, Katholieke Hogeschool Zuid-West-Vlaanderen vzw  
 christophe.rogolle@ilvo.vlaanderen.be  
 elke.rogge@ilvo.vlaanderen.be

**How can we design a policy-supportive instrument, made on the basis of farm-specific information, that advises a control strategy to help dairy farmers combat infection?**

Title: ECOWORM – Bedrijfsspecifieke economische-epidemiologische beslissingsondersteuning in de melkveehouderij  
 Funding: IWT scholarship  
 Duration: 2011 - 2014  
 Collaboration: Ghent University (Laboratorium voor Parasitologie (Faculty of Veterinary Medicine), Vakgroep Landbouweconomie (Faculteit Bio-Engineering)  
 mariska.vandervoort@ilvo.vlaanderen.be  
 jef.vanmeensel@ilvo.vlaanderen.be

**How, and to which degree, do the mechanisms of certification and labelling contribute to both engaging small producers in global markets and stimulating local development processes?**

Title: Analyse économique des chaînes de valeur agricoles sous le régime des certificats et labels de qualité au Mali.  
 Funding: ILVO  
 Duration: 2008 - 2012  
 Collaboration: Institut d’Economie Rurale (Mali) en UAntwerpen (Instituut voor Ontwikkelingsbeleid en –Beheer)  
 famory.sinaba@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be



**What does ILVO contribute to the network for the organisation and coordination of research for organic agriculture (“NOBL”)?**

Title: CoreOrganic  
 Funding: EU  
 Duration: 2010 - 2013  
 Collaboration: partners uit 21 Europese landen  
 lieve.decock@ilvo.vlaanderen.be

**Using models, how can we shed light on the most important problems of choice that agribusinesses have to solve to reach their goals?**

Title: Ontwikkeling van kernmodellen voor akkerbouw-, melkvee- en varkensbedrijven  
 Funding: Government of Flanders  
 Duration: 2011 - 2013  
 Collaboration: Ghent University (Vakgroep Landbouweconomie)  
 jef.vanmeensel@ilvo.vlaanderen.be  
 lies.debruyne@ilvo.vlaanderen.be

**What is the past and future of the regional development process in two regions in East Flanders (Vlaamse Ardennen and Meetjesland)?**

Title: Participatieve evaluatie LEADER-werking in Vlaanderen  
 Funding: Provincie Oost-Vlaanderen  
 Duration: 2011 - 2012  
 lies.messely@ilvo.vlaanderen.be  
 elke.rogge@ilvo.vlaanderen.be

**How can we compare economic rabbit farm performances, and how can we evaluate improvement opportunities?**

Title: Ontwikkeling van een beslissingsondersteunend model voor de optimalisatie van zoötechnische resultaten bij konijnen  
 Funding: IWT-LA  
 Duration: 2007 - 2012  
 Collaboration: Ghent University (Vakgroep Landbouweconomie)  
 jef.vanmeensel@ilvo.vlaanderen.be

**What structure is needed to bridge the gap between raw data and data analyses and simulation models?**

Title: Agricultural data: from registration to application  
 Funding: diverse  
 Duration: 2011 - 2013  
 Collaboration: AMS, Ghent University (Vakgroep Landbouweconomie)  
 dakertia.claeys@ilvo.vlaanderen.be



**How can an exergy-based approach contribute to revealing the trade-offs between ecological and economic farm performances?**

Title: Exergie analyse van economische en milieukundige verruiling op varkensbedrijven  
 Funding: Government of Flanders  
 Duration: 2011 - 2012  
 Collaboration: ILVO Technology & Food Science, Ghent University (Vakgroep Duurzame Organische Chemie en Technologie)  
 ludwig.lauwers@ilvo.vlaanderen.be  
 veerle.vanlinden@ilvo.vlaanderen.be  
 Jef.vanmeensel@ilvo.vlaanderen.be

**What is the workability of alternative strategies and instruments for the payment for public services delivered by agricultural firms?**

Title: Strategieën en instrumenten voor de vergoeding van publieke diensten van landbouw  
 Funding: IWT  
 Duration: 2010 - 2012  
 Collaboration: Ghent University (Vakgroep Landbouweconomie)  
 michiel.dekrom@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be



**How does the process of sustainable development of agricultural firms work in practice, and how do business models for agriculture take shape?**

Title: Social Sustainability Discourse(s) and farming strategies  
 Funding: ILVO scholarship  
 Duration: 2011 - 2015  
 Collaboration: Ghent University (Vakgroep Sociologie)  
 seppe.verdonck@ilvo.vlaanderen.be  
 michiel.dekrom@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be

**What is the role of various network forms and innovation processes and how can they better address the needs of farmers and growers?**

Title: Netwerken als katalysator voor innovatie in land- en tuinbouw  
 Funding: IWT  
 Duration: 2010 - 2014  
 Collaboration: Ghent University (Vakgroep Landbouweconomie)  
 michiel.dekrom@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be

**Which actors are present in the Flemish countryside? Which are the notable evolutions, underlying dynamics, and expectations?**

Title: Platteland in verandering: een analyse van de actoren en hun onderlinge dynamieken  
 Funding: ILVO scholarship  
 Duration: 2010 - 2014  
 christophe.rogolle@ilvo.vlaanderen.be

**How can we measure and analyse firm-specific risk for sustainable risk management?**

Title: ARAMIS – Bedrijfsgerichte opvolging en analyse van risico in de land- en tuinbouw  
 Funding: IWT  
 Duration: 2009 - 2013  
 Collaboration: Universiteit Hasselt (Centrum voor Milieukunde)  
 frankwin.vanwinsen@ilvo.vlaanderen.be  
 erwin.wauters@ilvo.vlaanderen.be

**How do social and cultural factors influence the creation and solution of natural resource conflicts?**

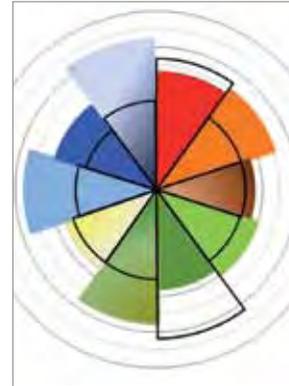
Title: The nature of conservation conflicts in Tanzania's National Parks: a case study of Saadani National Park  
 Funding: BTC (Belgische Technische Coöperatie)  
 Duration: 2011 - 2015  
 Collaboration: Sokaine University of Agriculture (Tanzania) en Ghent University (Faculteit Politieke en Sociale Wetenschappen)  
 Michael Muganda, joost.dessein@ilvo.vlaanderen.be

**How do interactions between genotype, environment and feed influence the breeding value of boars, and how can we translate this into advice for farmers about boar selection?**

Title: Genotype – milieu - interacties bij het bepalen van de fokwaarde van beren  
 Funding: IWT-LA  
 Duration: 2011 - 2015  
 Collaboration: ILVO Animal Sciences, KULeuven (Afdeling Huisdierengenetica)  
 jef.vanmeensel@ilvo.vlaanderen.be  
 sam.millet@ilvo.vlaanderen.be

**How and to what extent does a more sustainable production of saffron contribute to regional development in Morocco?**

Title: Saffraanteelt als drijfveer voor regionale ontwikkeling in Souss-Massa-Draâ, Marokko  
 Funding: Fonds destiné à favoriser la Recherche Appliquée Maroc – Belge (FRAB)  
 Duration: 2011 - 2014  
 Collaboration: Université Ibn Zohr - Ecole Nationale de Commerce et de Gestion d'Agadir, Agadir (Marokko), L'Institut IFAS-Maghreb, Rabat (Marokko)  
 nathalie.erbout@ilvo.vlaanderen.be  
 joost.dessein@ilvo.vlaanderen.be



**Which indicators are suitable for the evaluation of 'soil', 'use of ' and 'entrepreneurship' on the farm?**

Title: De duurzaamheidsster op bedrijfsniveau  
 Funding: Government of Flanders (Beleidsdomein Landbouw en Visserij)  
 Duration: continuuus  
 karoline.dhaene@ilvo.vlaanderen.be  
 hilde.wustenberghs@ilvo.vlaanderen.be  
 nicole.taragola@ilvo.vlaanderen.be



**How can we increase the competitiveness and the effectiveness of organic dairy production and at the same time optimise societal and ecological benefits?**

Title: SOLID – Sustainable Organic and Low Input Dairying  
 Funding: EU – FP7  
 Duration: 2011 - 2016  
 Collaboration: consortium van 25 partners, lead partner Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, UK  
 fleur.marchand@ilvo.vlaanderen.be  
 lies.debruyne@ilvo.vlaanderen.be

**How to define and measure 'sustainable fruit production'?**

(focus on three levels: fruit company, species (apple, pear and strawberry) and cultivar)

Title: Duurzaamheidsaspecten fruitteelt  
 Funding: AMS, Departement Landbouw en Visserij  
 Duration: 2011 - 2012  
 Collaboration: Proefcentrum Fruitteelt vzw, Fruitteeltcentrum KULeuven  
 rolinde.demeyer@ilvo.vlaanderen.be  
 hilde.wustenberghs@ilvo.vlaanderen.be  
 fleur.marchand@ilvo.vlaanderen.be

**How can farm resource management be improved in a profitable way in dairy farms across Northwest Europe, supported by an extended knowledge transfer network?**

Title: DAIRYMAN - Improving regional prosperity through better resource utilization on dairy farms and stakeholder cooperation  
 Funding: EU – Interreg IVB  
 Duration: 2009 - 2013  
 Collaboration: consortium van 14 partners, lead partner Plant Research International – Wageningen University and Research centre, Nederland  
 lies.debruyne@ilvo.vlaanderen.be  
 jo.bijttebier@ilvo.vlaanderen.be

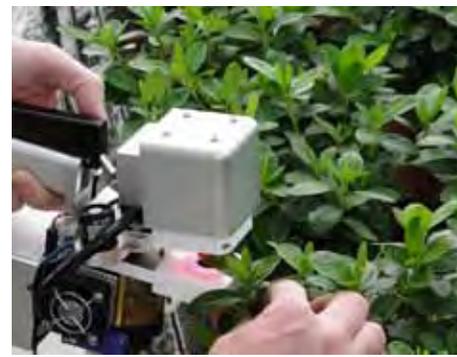
## SERVICES & PRODUCTS

The fundamental and practical scientific research performed at ILVO forms the foundation of the services we provide. All of the agricultural and fisheries-related industries can choose from an ever-expanding list of highly specialised services. These service activities deliver a win-win situation for all involved: the clients know that they are receiving only the most up-to-date scientific knowledge and advice, and by performing these services, ILVO stays in touch with the daily complexities of the agribusiness and fisheries sectors.

For the first time, this annual report gives a well-structured overview of the services and products available from ILVO. For more information, contact the person(s) noted below. Businesses, individuals and organisations requesting a service from ILVO always receive a fair and unchanging price quote, and that confidentiality can be guaranteed whenever possible within the applicable legislation.

This list does not contain the advice that ILVO offers to the government nor the expertise offered via participation in numerous national and international networks.

- ✓ PRODUCTS
- ✓ LABORATORY ANALYSES
- ✓ REFERENCE LABORATORIES
- ✓ INSPECTION AND CERTIFICATION
- ✓ TECHNICAL / TECHNOLOGICAL SERVICES



## PRODUCTS

Breeding of ornamentals and agricultural varieties (mainly grasses) at ILVO is always done to increase both sustainability and profitability of the plants. New ornamental cultivars bred at ILVO are commercialized via two cooperatives. New agricultural varieties are sold to multiplication companies worldwide.

ILVO Fisheries has witnessed a growing demand for sea water. ILVO owns a direct pipeline that brings water from deep in the North Sea onto land and can thus sell sea water on demand.

### Ornamental Plants

Azalea - Azanova  
johan.vanhuylenbroeck@ilvo.vlaanderen.be  
kristiaan.vanlaecke@ilvo.vlaanderen.be

Woody Ornamentals - Best Select  
johan.vanhuylenbroeck@ilvo.vlaanderen.be  
kristiaan.vanlaecke@ilvo.vlaanderen.be

### Field and Greenhouse Plants

RVP varieties  
marianne.malengier@ilvo.vlaanderen.be  
kristiaan.vanlaecke@ilvo.vlaanderen.be

### Seawater

daan.delbare@ilvo.vlaanderen.be

### Marine Organisms

hans.polet@ilvo.vlaanderen.be

## LABORATORY ANALYSES

ILVO has dozens of specialised and mostly accredited labs for scientific research. These labs can also be visited by the public. All tests are performed by experienced and well-trained staff under supervision by a scientist. As needed, the researchers examine whether such tests would be appropriate for use under practical and industrial conditions.

### Food Science

Chemical food safety  
els.daeseleire@ilvo.vlaanderen.be  
lisa.devriese@ilvo.vlaanderen.be

Microbiological food safety  
koen.dereu@ilvo.vlaanderen.be  
lisa.devriese@ilvo.vlaanderen.be

Ingredients, authenticity and quality  
jan.deblock@ilvo.vlaanderen.be  
karen.bekaert@ilvo.vlaanderen.be

Organoleptic research  
jan.deblock@ilvo.vlaanderen.be

GMO detection  
isabel.taverniers@ilvo.vlaanderen.be  
bart.vandroogenbroeck@ilvo.vlaanderen.be  
marc.deloose@ilvo.vlaanderen.be

Allergies  
isabel.taverniers@ilvo.vlaanderen.be  
bart.vandroogenbroeck@ilvo.vlaanderen.be  
marc.deloose@ilvo.vlaanderen.be

In vitro screening and gastro-intestinal simulations  
marc.heyndrickx@ilvo.vlaanderen.be  
geertrui.rasschaert@ilvo.vlaanderen.be

“ ILVO has been famous for years for its breeding of grass and clover. Three new Italian ryegrass cultivars were included in the Belgian variety list in 2011 and will be marketable starting in 2012. We guarantee the production of high-quality starting seed through the use of outstanding growers' seed and correct crop husbandry. This high-quality seed is then sold to seed multipliers throughout the world. In 2011, our seed stocks shrunk because of excellent sales combined with a poor harvest due to a dry spring and wet fall.  
Marianne Malengier, RVP Varieties, ILVO Plant Sciences

## Agricultural Engineering

Under-water weighing of vegetables and fruit      bart.eloot@ilvo.vlaanderen.be

Spray application technology      david.nuyttens@ilvo.vlaanderen.be

## Plants and Soil

Plants, soil and substrates      bart.vandecasteele@ilvo.vlaanderen.be  
chris.vanwaes@ilvo.vlaanderen.be

Diagnostic Centre for Plant Diseases      martine.maes@ilvo.vlaanderen.be

Ploidy analysis      leen.leus@ilvo.vlaanderen.be

Molecular markers      jan.deriek@ilvo.vlaanderen.be  
isabel.roldan-ruiz@ilvo.vlaanderen.be

## Animal/Marine Sciences

Animal feed      johan.deboever@ilvo.vlaanderen.be

Blood analysis - animal      johan.Aerts@ilvo.vlaanderen.be

Intermediate products (rumen fluid and intestinal content)      johan.deboever@ilvo.vlaanderen.be

Excretion products (excreta, faeces and urine)      johan.deboever@ilvo.vlaanderen.be

Animal end products (milk, meat, eggs)      johan.deboever@ilvo.vlaanderen.be

Marine environment (fishing boat, sea water)      bart.verschueren@ilvo.vlaanderen.be

Marine sediment      lisa.devriese@ilvo.vlaanderen.be

Epibenthos      sofie.vandendriessche@ilvo.vlaanderen.be

Macrobenthos      jan.wittoeck@ilvo.vlaanderen.be

Plankton      karl.vanginderdeuren@ilvo.vlaanderen.be

Fish      karen.bekaert@ilvo.vlaanderen.be

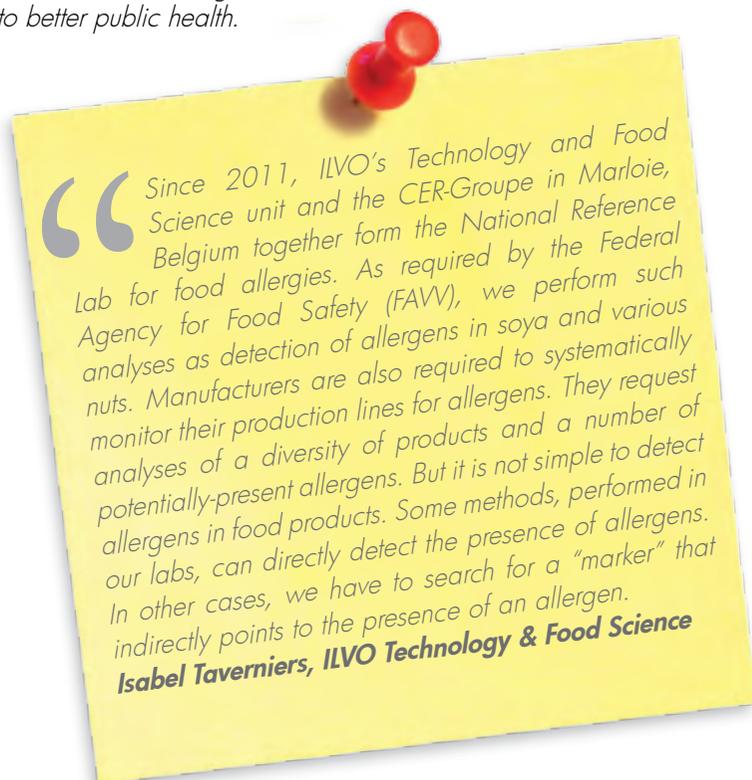
“ We run a dairy farm in Bassevelde. In autumn 2011, we let ILVO's Crop Husbandry group test the soil of 44 agricultural fields. The nitrate residue was determined for each of the soil samples. The "Water" management agreement requires that we take such samples on a regular basis.  
**Filip and Elsy Van Beneden-Claeys, dairy farmers, Bassevelde**

“ If feed companies wish to test a new product or additive, they can call on ILVO for testing. Companies choose this testing at various phases: during product development, to fill in a request for certification at the European Union, or to use the resulting data to inform their customers. Our feed tests with animals examine nutrient utilisation, production performance and the quality and composition of the end product (meat, milk or egg). We also examine the effect on animal health and the environment. ILVO guarantees a custom-designed experimental plan, objective analysis, and advice.  
**Sam De Campeneere, ILVO Animal Sciences**

## REFERENCE LABORATORIES

Who analyses the lab analyses for their reliability? Who is the independent referee? The answer, in a growing number of cases, is "ILVO". This year, the federal government of Belgium added GMO detection in food matrices and detection of allergens in food, to the list of reference analyses performed at ILVO's Technology and Food Science Unit. We are also officially mandated to perform independent and reliable tests and monitoring of labs and instruments to ensure that industrial, private or public labs exactly measure what they say they measure. Customers with questions or doubts about the exactness of a lab analysis performed elsewhere can also go to ILVO for help.

Of course, being chosen as a reference lab illustrates the excellence of ILVO's labs. But even more importantly, this reference work contributes to correct analyses throughout the nation, which guarantee that the correct assessments will be made and lead to better public health.



### Certified national reference labs (NRL)

NRL Allergies	isabel.taverniers@ilvo.vlaanderen.be
NRL GMO's	isabel.taverniers@ilvo.vlaanderen.be
NRL Milk and dairy products	koen.dereu@ilvo.vlaanderen.be
NRL Plant diseases	martine.maes@ilvo.vlaanderen.be
NRL Water content in poultry	hadewig.werbrouck@ilvo.vlaanderen.be

### Mandated reference work

Coordination of the milk control centre of Flanders	hadewig.werbrouck@ilvo.vlaanderen.be
VCU and DUS research – variety lists	joke.pannecouque@ilvo.vlaanderen.be
Coordination of fisheries management	els.torreele@ilvo.vlaanderen.be
Air emissions and sustainable production techniques (LNE)	peter.demeyer@ilvo.vlaanderen.be eva.brusselman@ilvo.vlaanderen.be

### Other reference work

Ring tests dairy industry	hadewig.werbrouck@ilvo.vlaanderen.be
Fish quality indices	karen.bekaert@ilvo.vlaanderen.be
Animal marine laboratory (ANIMALAB)	johan.aerts@ilvo.vlaanderen.be

## INSPECTION AND CERTIFICATION

*The safe production of primary agricultural products requires machines in perfect working order. Milk machines, spray installations or any other agricultural equipment must both work well and be well-maintained. The government has selected ILVO to inspect certain installations. To do so, one must have technical and chemical-biological knowledge. In addition to periodic inspections and certifications, ILVO is also actively involved in the training of maintenance technicians.*

### **Milk technique**

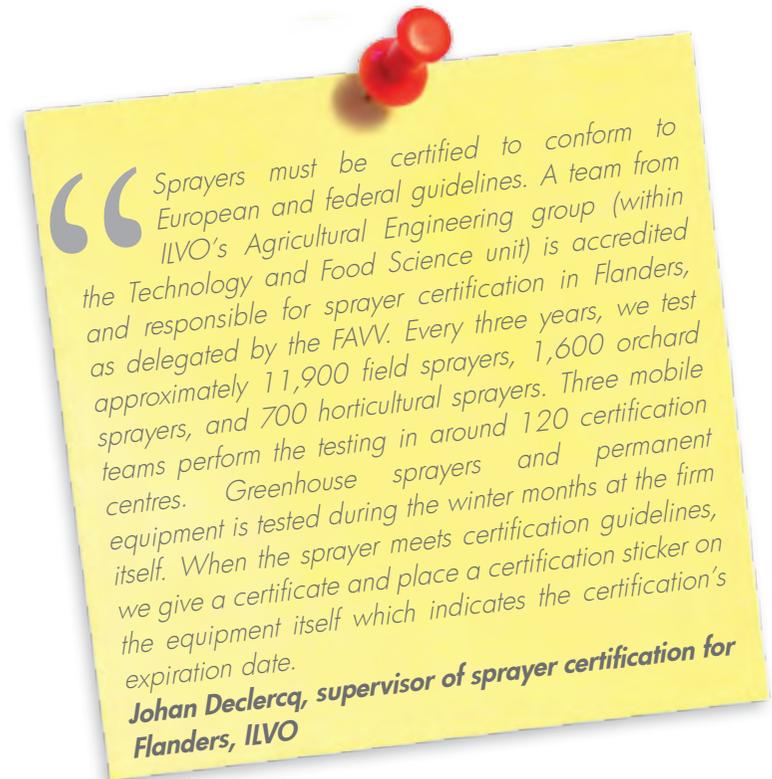
Inspection/certification of milking machines ("Control")      stephanie.vanweyenberg@ilvo.vlaanderen.be  
sarah.delaeter@ilvo.vlaanderen.be

Quality inspection of maintenance of milking machines ("Control")      stephanie.vanweyenberg@ilvo.vlaanderen.be  
sarah.delaeter@ilvo.vlaanderen.be

### **Spray application technology**

Certified inspection of sprayers in Flanders      johan.declercq@ilvo.vlaanderen.be

**Testing of agricultural equipment**      jurgen.vangeyte@ilvo.vlaanderen.be



“ Sprayers must be certified to conform to European and federal guidelines. A team from ILVO's Agricultural Engineering group (within the Technology and Food Science unit) is accredited and responsible for sprayer certification in Flanders, as delegated by the FAVV. Every three years, we test approximately 11,900 field sprayers, 1,600 orchard sprayers, and 700 horticultural sprayers. Three mobile teams perform the testing in around 120 certification centres. Greenhouse sprayers and permanent equipment is tested during the winter months at the firm itself. When the sprayer meets certification guidelines, we give a certificate and place a certification sticker on the equipment itself which indicates the certification's expiration date.

**Johan Declercq, supervisor of sprayer certification for Flanders, ILVO**

## TECHNICAL / TECHNOLOGICAL SERVICES (TO SMEs, BUSINESS AND GOVERNMENT)

*Businesses and organisations wishing to progress through innovation can call on ILVO's scientific expertise. The key to our service provision and advice is flexibility. Experience has taught us that the process of sharing scientific expertise with diverse industrial sectors requires custom-made services that address the customers' specific needs and requests. Some examples of this can be found in the knowledge network for ornamental plants (Sierteelt Sietinet), the Welfare Quality Protocol, which ILVO developed to measure animal welfare in agribusiness, and the possibility to pilot-test new food products in the updated, expanded Food Pilot.*

### Plant Sciences and Crop Husbandry

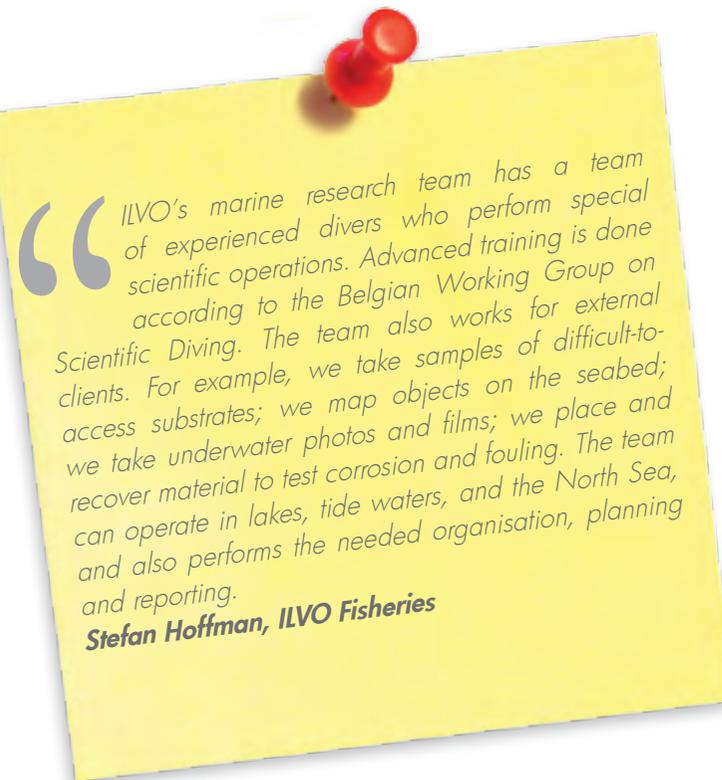
Experimental field tests	kristiaan.vanlaecke@ilvo.vlaanderen.be
Development of crossing schemes	johan.vanhuylenbroeck@ilvo.vlaanderen.be
Pre- and post-control of seeds and propagation material	johan.vanwaes@ilvo.vlaanderen.be
Monitoring growth	peter.lootens@ilvo.vlaanderen.be
Disease resistance screening	martine.maes@ilvo.vlaanderen.be isabel.roldan-ruiz@ilvo.vlaanderen.be
Genetic analyses	leen.leus@ilvo.vlaanderen.be jan.deriek@ilvo.vlaanderen.be isabel.roldan-ruiz@ilvo.vlaanderen.be
Image-based analysis of shape and color	peter.lootens@ilvo.vlaanderen.be
"Sietinet" for ornamental plants	johan.vanhuylenbroeck@ilvo.vlaanderen.be

### Animal husbandry

Feed evaluation and feed preservation	johan.deboever@ilvo.vlaanderen.be
Excretion experiments - poultry	evelyne.delezie@ilvo.vlaanderen.be els.daeseleire@ilvo.vlaanderen.be
Behaviour and welfare of farm animals	frank.tuyttens@ilvo.vlaanderen.be
Zootechnical tests with dairy cows	sam.decampeneere@ilvo.vlaanderen.be
Zootechnical tests with meat cattle	leo.fiems@ilvo.vlaanderen.be
Zootechnical tests with pigs	sam.millet@ilvo.vlaanderen.be
Zootechnical tests with small farm animals	luc.maertens@ilvo.vlaanderen.be evelyne.delezie@ilvo.vlaanderen.be
(Gas)emissions from cattle	sam.decampeneere@ilvo.vlaanderen.be nico.peiren@ilvo.vlaanderen.be
PreventAgri: safety on the farm	robin.desutter@ilvo.vlaanderen.be

## Fisheries, aquaculture and marine environment

Test setups for marine experiments (including aquaculture)	daan.delbare@ilvo.vlaanderen.be
Scientific diving	stefan.hoffman@ilvo.vlaanderen.be
Design and testing of fishing boats	bart.verschueren@ilvo.vlaanderen.be
Evaluation of sustainability	kris.vanraeynest@ilvo.vlaanderen.be
Safety in fisheries	hans.polet@ilvo.vlaanderen.be
Cost/profit analyses for aquaculture activities	kris.vanraeynest@ilvo.vlaanderen.be daan.delbare@ilvo.vlaanderen.be
Technological advice for aquaculture activities	kris.vanraeynest@ilvo.vlaanderen.be daan.delbare@ilvo.vlaanderen.be
CIVIS (fishing gear and guidance)	kris.vanraeynest@ilvo.vlaanderen.be



## Food and feed technology

Food Pilot	katleen.coudijzer@ilvo.vlaanderen.be
Advice for dairy ("TAD-Zuivel")	katleen.coudijzer@ilvo.vlaanderen.be
Fish quality	geertrui.vlaemynck@ilvo.vlaanderen.be

## Agricultural Engineering

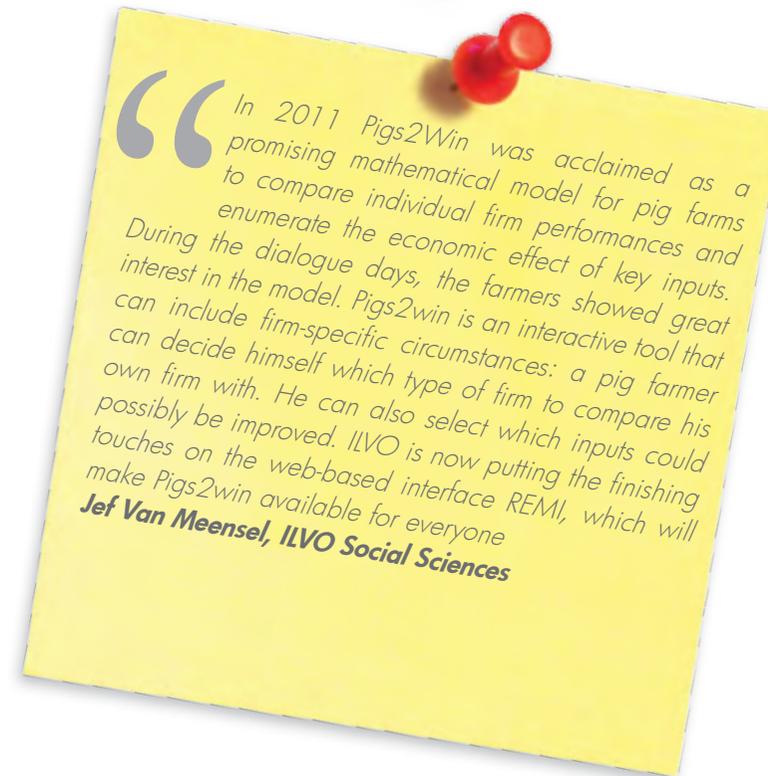
ICT/automatisation	koen.mertens@ilvo.vlaanderen.be
Design of machines	jurgen.vangeyte@ilvo.vlaanderen.be
Low-emission stalls (indoor climate and emissions)	peter.demeyer@ilvo.vlaanderen.be eva.brusselman@ilvo.vlaanderen.be
Spray tech lab	david.nuyttens@ilvo.vlaanderen.be
Automatic animal tracking	annelies.vannuffel@ilvo.vlaanderen.be
Sustainability of stall materials and stall equipment	veerle.vanlinden@ilvo.vlaanderen.be stephanie.vanweyenberg@ilvo.vlaanderen.be
Analysis of mechanical impact during potato harvest	bart.eloot@ilvo.vlaanderen.be

“The Food Pilot has evolved from a dairy-oriented research unit to a multifunctional pilot food processing plant. In addition to the dairy installations, we can now perform tests on meat, ready-to-eat foods, vegetables and fruit. Food companies from Belgium and other countries can come to us for research and development. With our diversity of equipment, we can always set up the desired production line on a semi-industrial scale. Through investments in multifunctional and adaptable equipment, we can compare several currently-used industrial techniques and give advice about the best result for the clients' production process.  
**Katleen Coudijzer, Food Pilot, ILVO**

“To guarantee the consistent quality of our endproduct, we monitor the entire potato production process, including sowing and harvest. Each year, we ask ILVO to use their “electronic potato” to help us test the precise adjustment of harvesters and reception yards. This measuring probe is made in the form of a potato. It takes the same route as the other potatoes in the harvester or the reception yard, and takes precise measurements of all movements and forces the potatoes encounter. With this test, we can find out precisely what causes damage due to harvesting or blue discoloration. And an ounce of prevention in the form of optimal settings, is better than...  
**Veronique Moens, Farm Frites, Sint-Truiden**

## Social Sciences

(Participatory) process facilitation	elke.rogge@ilvo.vlaanderen.be
Sustainability analysis	fleur.marchand@ilvo.vlaanderen.be lies.debruyne@ilvo.vlaanderen.be
Models to support decision-making	jef.vanmeensel@ilvo.vlaanderen.be erwin.wauters@ilvo.vlaanderen.be eva.kerselaers@ilvo.vlaanderen.be
Data management and data modelling	dakerlia.claeys@ilvo.vlaanderen.be





## Attention and clarity

### Science in an easy-to-swallow format

In 2011, ILVO burst out of its shell with an active media plan that resulted in nearly 40 press releases and 11 press events and press conferences. The trade press made good use of the information, reports and the results they were given. For ILVO, this meant reaching the agribusiness and agricultural firms, the members of the agricultural organisations and the food- and fisheries industries with relevant news and updates about ILVO.

The popular media also found its way to agricultural and fisheries research. Newspapers, magazines, radio journalists, and camera teams from all of the Flemish and national channels reported on ILVO. The co-existence of genetically modified (GM) and conventional maize, gas exchange chambers, the GM potato experiments, the baptism of a non-proliferating butterfly bush (Buddleja), a ravenous jellycomb in the North Sea, the modernised capacities of the Food Pilot, the report "50 years of growing ornamentals": all of this was delivered neatly onto the lap of the citizen and consumer. A good thing, too, because the general consciousness stands to be raised about innovation in modern agriculture and fisheries and the studies done about primary agricultural products.

About 20 journalists called out of the blue with questions for us, such as "Do you know something about the connection between artificial lighting and cows' milk production?" "What is really going on these days with sustainable fisheries?" "Which entomologist can tell us something about the Colorado beetle and potato culture?" "We're looking for an expert for a debate about GMO's." "Can a grass specialist come to speak on the popular Flemish radio show "The Media Madammen"?" Add to those another 62 questions that were answered by ILVO researchers on the popular science website "www.ikhebeenvraag.be". By providing clear and accessible answers to questions posed by the general public, ILVO proves its worth as a service to society. In addition to using the press as a link to Flemish citizens, we also

communicated directly with our stakeholders. ILVO published 27 thematic reports, called "ILVO mededelingen" (ILVO bulletins). Hits were the practical stall-ventilation guide, the bulletin about feed for dairy cows, and the annual recommended list of plant races. Four extended electronic newsletters (called the "Nieuwsgolf" or "News Wave" in English) were sent to more than 4000 addresses. ILVO organized about 35 study days and demonstrations both alone and with partners, and we also participated in trade shows. Again and again, ILVO researchers presented their latest innovations and discoveries in a practical and focused manner.

On [www.ilvo.vlaanderen.be](http://www.ilvo.vlaanderen.be), some 123,000 people visited the site (10,250 per month) to look at a total of 331,737 pages (nearly 28,000 pages per month). The number of website visitors increased 27% over 2010, which is an increase of even more than 50% compared to 2009.

Of the visitors to our website in 2011, 13% surf more than 10 times per year to the ILVO website and 2000 of these visit the site more than 200 times per year. Most (82%) choose to read the site in Dutch, but 18% also read it in English.

ILVO's ICT team has an important announcement: we have decided to purchase the Danish PURE software system and are now busily preparing it for implementation together with a new website. PURE is a specially designed database that stores information about scientists and their scientific output. This user-friendly database will be linked with ILVO's new website and will contain the scientists' curriculum vitae, their publications, activities, research network, and research projects.

The scientific output, the number of peer-reviewed articles, book chapters and the annual research bulletins are not only proof of the advanced professional level of ILVO's researchers, but is also a sign that ILVO navigates easily between fundamental research and policy-supportive and popularising work. The publication list at the end of this annual report only highlights the most important articles that have been published, but it does illustrate the diversity of research performed at ILVO.

## Keeping Our House in Order

### Management Control and Finances

#### Finances

ILVO's finances rest on a double support. As an Internally Autonomous Agency (IAA) of the Flemish Government, ILVO receives a basic subsidy for the operations, investment and personnel paid by the Flemish Government. In addition to this subsidy, ILVO has traditionally gained approximately 50% of its income from the separate corporate personality called ILVO Own Capital (OC). ILVO, being a scientific institute, can also receive various grants to carry out project research.

Both annual accounts are controlled through appropriate channels. The financial statement of the Own Capital is presented to the Management Commission of ILVO, in which the Inspector of Finance sits. The accounts are audited by the IVA Central Accounting and the Court of Auditors.

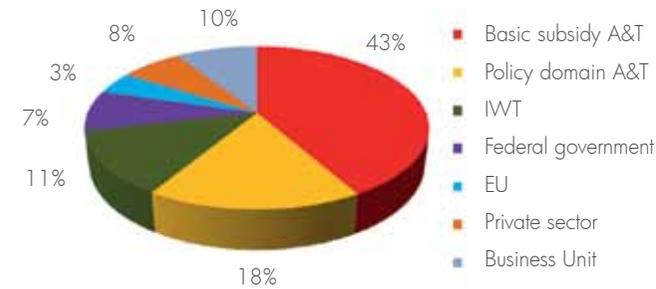
Each year, ILVO management combines the income from the Flemish Government and OC to form a complete picture of the total operational cost of the institute.

#### Internal Control

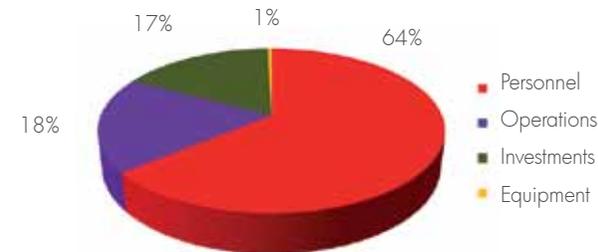
In May 2010, ILVO received a good score from the Internal Flemish Audit Administration (IAVA) for its method of approaching the organisational process. This score is based on a general progress audit within the framework of 'Beter Bestuurlijk Beleid'. In the future, ILVO plans to continue to optimise and maximise control of its internal processes, to pursue the goal of meeting its strategic and operational goals.

The ILVO Quality Handbook, which describes ILVO's operations in detail, along with the work processes and their risk analysis is continually being updated.

In Fall 2011, the Committee of Scientific Directors (COWEDI) set ILVO's future operational objectives for 2012. These short-term objectives guarantee the realization of the long-term strategic objectives.



**Incoms sources 2011**



**Expenses 2011**

Each year, the COWEDI also evaluates the degree of internal control by allocating an internal maturity score to each of the thematic management measures. This system in turn influences a specific performance indicator.

To follow up the operational objectives for 2011, new critical success factors (KSFs) and their related critical performance indicators (KPIs) were set. The research units and ILVO's management are required to adhere to these performance indicators. The consolidated Balanced Score Card (BSC) system gives a general overview for ILVO. The KPIs were evaluated by the COWEDI during their annual strategic seminar.

## Personnel Services

*Total staff composition as of 31/12/11, number of staff expressed in full-time equivalents (FTE)*

	male/FTE	female/FTE	total/FTE	percent OC (%)
A-level	126/123,7	137/122,6	263/246,3	57,9/59,9
B-level	56/53,8	66/54,1	121/107,9	49,6/50
C-level	80/74,6	45/35,7	126/110,3	45,6/54,4
D-level	34/33,1	42/28,9	76/62	13,2/15,8
Total	296/285,2	290/241,3	586/526,5	50/51,5



## Environment, Welfare and Facility Management

2011 was a key year for ILVO's infrastructure. The Government of Flanders gave the go-ahead to make ILVO, through its 'Own Capital', responsible for investments in buildings and infrastructural maintenance. Two additional members of staff were recruited to start up and/or monitor a number of building projects. Their task is very complex: to make sure that the consultation between contractors/suppliers and the team of scientists involved in a project is both very clear and flexible. Transparent reports allow the management to make adjustments in accordance with changing needs.

Despite limited budgets, ILVO continued to invest in environment-friendly measures in 2011. The new waste water sewer is a fact. We are on schedule to connect the different sites to a collector of Aquafin, as soon as it is installed. Animal site 92 and Plant site 96 have already been connected to the new sewer. Plant site 109 and Technology & Food site 115 will follow. Technology & Food site 370 in Melle continues to treat waste water using its own waste water treatment plant.

The size and nature of our roofs provide an opportunity for companies to hire the roof for the placement of photovoltaic cell. However, no private companies showed any interest in doing so.

Despite the very diverse working conditions at ILVO - working among livestock, in a seed separator, a mill, a testing factory for food or in laboratories, or on board a ship - the number of industrial accidents is minimal. We believe this is due to sustained efforts that are made to safely organise or renovate work stations, to systematically raise the employees' awareness and to closely involve them in matters concerning personal safety.

## ILVO2020 and the call for Coordinated Actions: from brainstorming to practice

ILVO2020 embodies an in-depth thinking process that spans the whole institute. It has initiated a number of new actions. Nine horizontal research programs were distilled from this process of reflection, uniting ILVO's policy-supportive and fundamental research in the 2011-2013 Research Programme. ILVO2020 sets the scene for future research and aims to improve communication efforts and valorisation of the research output.

At the end of 2011 - for the first time in ILVO history – ILVO dedicated a substantial amount of money (the equivalent of four PhD grants, including a bench fee) to support a 'big challenge' identified by ILVO2020. These projects are known as 'Coordinated Actions' (CA). An extended consultation of all stakeholders resulted in 10 clearly defined, Coordinated Actions. Decisions were made on the selection procedures: a first CA call was launched in December 2011. This is an inspiring milestone in ILVO's history.

Defining the CA was a participatory process: brainstorming within the ILVO2020 discussion groups was initiated in spring of 2011. Several strategic research topics with a sound multidisciplinary approach and a clear fit within ILVO's management agreement were identified by ILVO scientists. Experts from the Agricultural and Fisheries Administration, representatives from the Practical Centers and Advisory Committee Working Groups were consulted in a later stage of the thinking process. This stakeholder consultation was officially completed during the plenary meeting of the Advisory Committee on April 27<sup>th</sup> 2011.

Finally, on May 23<sup>rd</sup>, 10 Coordinated Actions were defined by ILVO's Management Committee:

1. Valorising byproducts in the food production chain
2. Creating added value in the agrofood chain
3. Development of climate- and environmentally friendly agricultural and fisheries systems
4. Economically and societally responsible production
5. Creative and qualitative responses to new challenges in the agricultural and fisheries areas
6. Optimal use of raw materials in animal feed
7. Integrated soil and nutrient management in plant and animal production
8. Optimisation of the fishing gear and methods
9. Optimisation of integrated plant protection
10. Efficient use of water for animal and plant production

A first call for CA projects was launched on December 1<sup>st</sup>. Horizontal discussion groups and an online discussion platform drove the multidisciplinary CA drafting process. CA projects are clearly focused on innovating, strategic research projects, with a clear contribution to promoting ILVO as a leading research institute.

What does 2012 have in store? Following a first selection round, only a few project proposals will be allowed to continue to the next stage. External experts will be consulted in order to make a balanced final decision on which project will be awarded the first ILVO CA. The due date for this decision is May 15<sup>th</sup> 2012. Stay tuned!

publications

## PUBLICATIONS

### Animal Sciences

#### Scientific publications (A1)

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