AARHUS
UNIVERSITY
DCA – DANISH CENTRE FOR FOOD AND AGRICULTURE

PERSPECTIVE

ANNUAL REPORT 2014
DCA – Danish Centre for Food and Agriculture

Research-based policy support
Knowledge exchange and industrial collaborations
National and international research alliances

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Cover photo
Scientists at Aarhus University work in close collaboration with the industry to find new and sustainable solutions for Danish agriculture. Associate professor Jan Værum Nørgaard is investigating if starfish and mussels can be used as alternative, Danish-produced protein feed. Read more in the article on page 8.
Photo: Jesper Rais

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RESEARCH-BASED POLICY SUPPORT WITH GOOD FUTURE PERSPECTIVES FOR THE AGRIFOOD SECTOR

The food and agriculture sector is of large intrinsic value to the Danish national economy, society and other areas. The value is generated from the production and processing of foods and from the development and export of knowledge, technology and know-how.

Danish food products are sold in high-value and very competitive markets. These sales are often dependent on the products having special qualities or being based on a particular level of knowledge. One of the qualities often attributed to Danish foods is that they are produced with special consideration for animal and consumer health and for nature, climate and the environment. These are also areas where you run into complicated issues that challenge not only the farmers and the processors but also the legislators and authorities that have to create the framework for the production.

DCA completes around 200 policy support assignments within agriculture and food research every year. The scientists who contribute to this process are building up a comprehensive knowledge base for the challenges faced by the sector. This knowledge ensures that legislation and regulations as well as production and innovation can be based on sound knowledge. The expertise and knowledge of the practical issues involved established by the scientists is worth its weight in gold to private companies.

Forward-looking companies have realised that problem-oriented research creates opportunities for the development of technologies and processes that improve resource efficiency and sustainability and add the high qualities to the Danish products that consumers expect to find.

The interest for collaborating with DCA scientists is so strong that the block grant that DCA received from the Ministry of Food, Agriculture and Fisheries in 2014 had a gearing of 150 percent. Via partnerships with the agricultural sector, with national and international foundations and with research programmes, the value of the total research and development in the agrifood area was increased from 270 million to 728 million DKK. As much as 37 percent of the extra funds originated from projects financed by private companies.

Photo: Jesper Rais

Niels Halberg, director of DCA – Danish Centre for Food and Agriculture

In this annual review, examples are presented of the development and collaboration between science and the agricultural sector. In some instances, the need for technological development is driven by competition or by public demand in the shape of new legislation and regulations. In the large majority of cases, collaboration is an integral part of the development strategy of the companies.

It is of course a sign of success that so much of the research is financed by and is taking place in alliances with the commercial sector, but there is an upper limit to everything. In recent years there has been a steady decline in the funds allocated for research-based policy support. This is a growing problem and in some areas it is becoming increasingly difficult to maintain the research that is crucial both for the knowledge-based consultancy tasks undertaken, for the collaboration with private companies and for the sector. ■

AREAS OF RESPONSIBILITY AND ORGANISATION

DCA – Danish Centre for Food and Agriculture provides the framework for Aarhus University's research-based policy support, knowledge exchange and strategic partnerships with the industry.

Aarhus University carries out basic, strategic and applied research in the production of foods and bio-based products such as bioenergy, fodder, fur and fibre. The research forms the basis for a sustainable production in both an economic, social and ethical sense. The production must, in other words, be economically viable, generally accepted by society at large and comply with ethical principles on animal welfare and environmental and climate impact.

To ensure interdisciplinary collaboration in agriculture and food science, Aarhus University has established DCA – Danish Centre for Food and Agriculture. The centre's aim is to coordinate and quality-control research-based policy support. In addition, DCA supports knowledge exchange and forges links with the industry as well as national and international research alliances through a variety of activities.

DCA uses an advisory panel whose task it is to advise DCA on its general vision and strategy, including the relevance of the research for the future advisory needs by society, for national and international research topics, for communication of knowledge to society at large, and for the framework for research-based policy support. The advisory panel includes representatives from the Danish Veterinary and Food Administration, the Danish AgriFish Agency, SEGES, Danish Crown, Organic Denmark, Arla Foods, the Coop, the Confederation of Danish Industry and the Danish Society for Nature Conservation.

The work undertaken by DCA is within the following three areas:
- Research-based policy support
- Knowledge exchange and links to industry
- National and international research alliances

Research-based policy support
Via an agreement with the Ministry of Food, Agriculture and Fisheries, Aarhus University delivers research-based policy support through the agency of DCA to the ministry and other relevant authorities within agriculture, food and the environment. According to this agreement, DCA is committed to carrying out research and maintaining a ready level of expertise within 13 main research areas that are based on the three key research themes.

The three key themes and 13 main research areas are:
1. Development and growth-oriented food industry
   - sustainable livestock production
   - sustainable crop production
   - sustainable technological development and evaluation
   - bioeconomics, bioenergy and rural development
   - resource efficiency
2. Responsible management of natural resources
   - food production and the cultivated soil
   - food production and bioresources
   - food production, landscape, nature and biodiversity
   - food production, additives and the environment
   - food production, climate and greenhouse gases
3. Food security, consumer choice and healthy eating habits
   - food quality
   - consumer behaviour and food preferences
   - food and the impact of eating habits on health

DCA carries out 200-300 advisory tasks per year that range from short memoranda to larger evaluations, scientific reports and reviews. The agreement is based on the arm's length principle whereby the advice from DCA is based solely on the scientific contributions from academic staff. Political and administrative considerations and trade-offs are subsequently made by the authorities.

Knowledge exchange and links to the industry
DCA provides the framework for Aarhus University's strategic cooperation with organisations, sectors and companies within food and agriculture. DCA helps to build clusters and networks between research institutions, companies and organisations.

DCA has a strong focus on forging links to commercial entities and helping with matchmaking and other events that promote collaborative research with companies.

Research results are disseminated through the media, but also through conferences, workshops and seminars where researchers meet farmers, consultants and others from the sector.

National and international research alliances
National and international research collaboration leads to the solution of complex problems.

One of DCA's tasks is to highlight the needs and opportunities for collaborative research in national and international forums. DCA also helps promote opportunities for Danish participation in international research programmes in food and agriculture. DCA advises Danish authorities on national and international research in these areas. ■

Funding
Food and agriculture research at Aarhus University has an annual budget of around 700 million DKK. The research is financed from different sources. A contract with the Ministry of Food, Agriculture and Fisheries commits DCA to providing research-based policy support. In 2014 this contract was worth approximately 280 million DKK.

Many research projects involve alliances with organisations, private companies, authorities and universities in Denmark and abroad. Applied science and other activities that are done in partnership with companies and organisations were in 2014 worth approximately 100 million DKK. Research activities are also financed via the Danish research councils, the EU framework programmes and private foundations and companies.

Structure of DCA
The DCA framework consists of the academic environments in a number of Aarhus University departments that are engaged in research and development in food and agriculture, and a small secretariat that coordinates the research-based policy support and strategic links with the sector, undertakes knowledge exchange and supports national and international research.

Food and agricultural research at Aarhus University is primarily carried out in:
- Department of Agroecology
- Department of Animal Science
- Department of Food Science
- Department of Molecular Biology and Genetics
- Department of Engineering
- MAPP Centre at the Department of Business Administration

Contact DCA
DCA is the gateway for authorities, companies and organisations that seek advice or research collaboration in food and agriculture.

Further information about the activities in DCA and contact details for members of staff can be found on **www.dca.au.dk**.

LAYOUT OF PERSPECTIVE

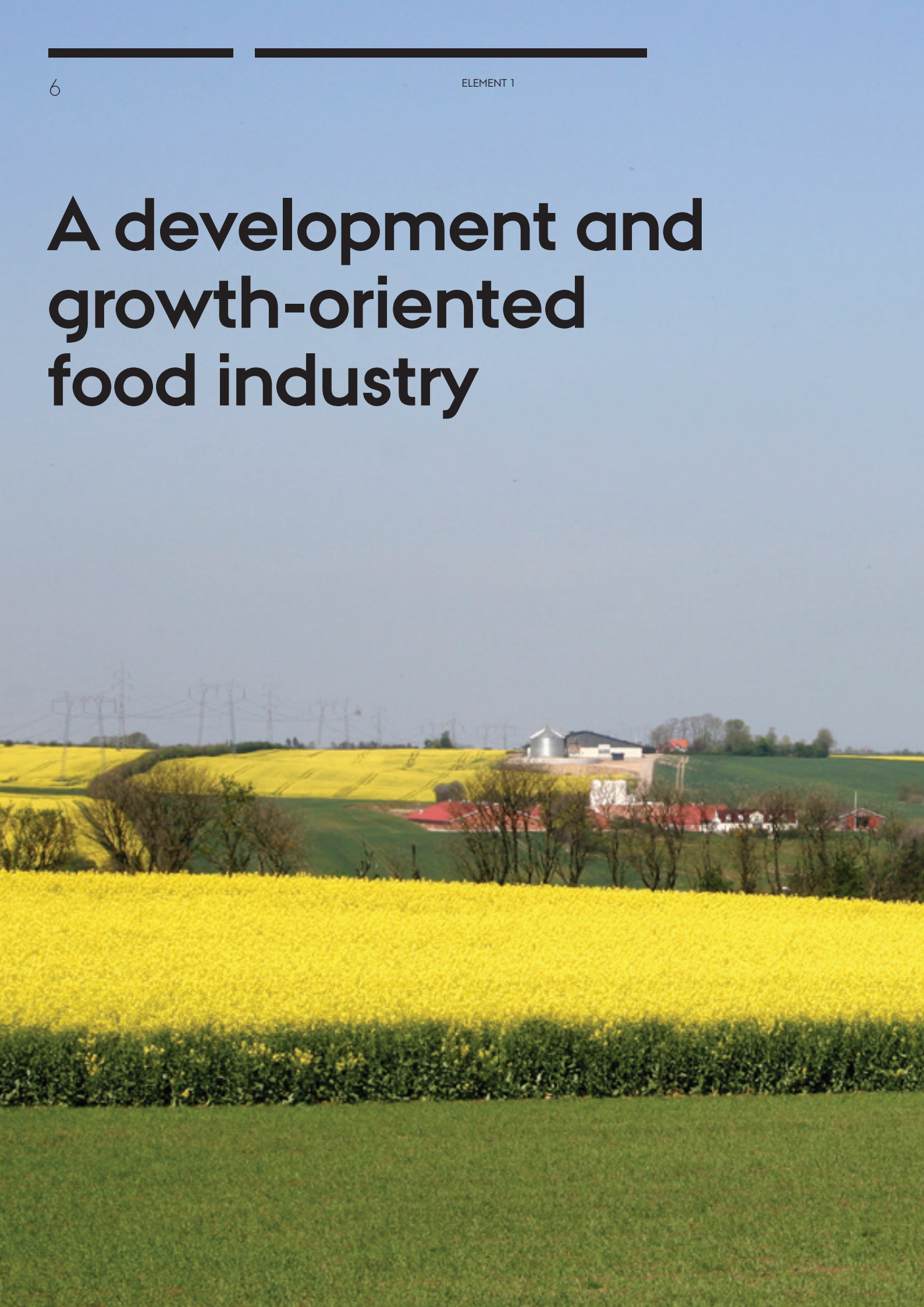
On the following pages you will find examples of research, policy support and links to industry within the three key research themes and 13 main research areas within those themes. The articles have been assigned different colours depending on whether they relate to business collaboration, policy support or research:

ERHVERV
Business articles with focus on collaboration with private enterprises

FORSKNING
Research articles with focus on research projects at Aarhus University

MYNDIGHEDSRÅDGIVNING
Policy support articles founded on research-based policy support

A development and growth-oriented food industry



The Danish food industry faces challenges from increasing competition and greater demands for an efficient use of resources from both the political system and the market.

Political objectives within areas such as ecology, nature and environment, climate, biodiversity, medicine consumption, animal welfare, and animal and plant health result in a demand for new management forms and technical solutions that can both increase employment and boost growth while supporting a green transition.

The authorities have a major challenge in the analysis and implementation of new, alternative forms of regulation and incentive structures that can support the industry's growth and development. A concerted research effort in agricultural production is essential to support the continued development of the sector.

Initiatives based on the existing and future regulation of the industry will provide new knowledge that will involve considerations on the optimum use of resources, protection of the production base, minimising impacts on environment and climate, and a type of future farming that will make space available for coherent high-quality nature. ■

Photo: Janne Hansen

SEAFOOD MENU FOR PIGS AND CHICKENS

LINKS TO INDUSTRY

Starfish and mussels look like promising alternative protein sources for pigs. These are the promising first results from a joint research experiment by the Department of Animal Science, the Danish Shellfish Centre and the association of mussel traders. Feeding mussels to pigs and chickens can also benefit the aquatic environment.

Shellfish and starfish from the fjords have ended up on the menu for pigs at Aarhus University's research centre AU Foulum. They are part of a research project in which Aarhus University has joined forces with the Danish Shellfish Centre and Foreningen Muslingeerhvervet (association of mussel traders) to examine whether these marine products can be used as alternative protein sources for pigs and poultry. In addition to supplying important nutrients to the livestock, the mussel farms may actually help to reduce water pollution in the fjords.

The initial results of the experiments look promising. The digestibility of the mussel and starfish products is good, and the animals seem to find them appetising.

The study on pigs included six pigs that were fed a different diet for each of the study period's six weeks. The feeds were mussel silage, mussel meal, starfish meal, liquid starfish fraction, fish silage and a special nitrogen-free mixture. Fish silage, which served as the control diet, consisted of salmon cut-offs from the industry. Fish waste is already included as part of the piglets' protein intake.

Good digestibility

The studies suggest that both the mussel and starfish products are useful as pig feed. There was a higher digestibility of protein and amino acids in the mussel meal, mussel silage and starfish meal than in the fish waste that was included as a control feed.

Taste-wise, there were no problems either. The pigs turned their noses up at the liquid starfish fraction, but when the whole starfish were served dried and ground, the pigs ate them happily enough. They also liked the mussel products.

The mussel and starfish products were also tested as protein sources for laying hens. Here the results resembled those found for the pigs, i.e. better digestibility of protein and amino acids compared with traditional fishmeal. The hens' production capacities such as egg-laying percentage were also fine with the alternative protein sources.

Photo: Jesper Rais

– The products may be particularly interesting for organic egg producers and organic breeders who find it difficult to locate good sources of protein, says Jan Værum Nørgaard, project participant and associate professor at the Department of Animal Science.

Originally, only the mussels were supposed to be tested as a protein source, but mussel fishers in the Limfjord have in recent years also caught large amounts of starfish in their nets when fishing for mussels.

– Starfish are sent to Poland to be made into fish feed, and this is not a good business for the fishermen. We have therefore also looked at whether starfish could be used as a protein source, explains Jan Værum Nørgaard.

Marine benefits

A further advantage of the concept is that the use of mussels and starfish can benefit the marine environment. Mussels absorb nutrients from the fjords and can thus help reduce the impact of contamination of the fjords from, for example, pig farms. Depending on the time of harvest and water conditions, about 600-900 kg nitrogen and 30-40 kg phosphorus are removed

for the up to 60 tonnes of mussels produced in one hectare of mussel farm.

– We work from a concept of mitigation farming, where the nutrients that enter the fjords from the land and farming can return to the land in the form of, for example, pig feed with protein from mussels and starfish, says Jan Værum Nørgaard.

The agriculture and fishing industries collaborate with scientists and environmental authorities to ensure that mitigation farming of mussels can enable farmers to buy mussel farms where they can be credited with the nutrients removed from the fjords in their own farm nutrient budgets.

A few remaining knots

The pigs and chickens seem to approve of the new products. The biggest challenge now is to create a profitable, efficient and stable production of mussel and starfish products if these are to become a competitive alternative to other protein sources. In practical terms, the challenge is in removing the shells from the mussels, and the water from the mussels and starfish to get a more concentrated protein product.

The Growth Forum of the North Denmark Region and the Danish AgriFish Agency finance the project, which is led by the Danish Shellfish Centre. The Green Development and Demonstration Programme supports the continuation of research in a new project using starfish as a protein source for piglets. ■

Photo: Jesper Rais

According to research by Associate Professor Jan Værum Nørgaard, starfish have potential as a pig feed.

RESEARCH

BIOENERGY WASTE PRODUCTS CAN BE USED AS FEED FOR DAIRY COWS

In a project with DLG, Arla Foods and AgroTech, scientists from the Department of Animal Science have found that waste products from the production of bioenergy are suitable for feeding dairy cows – with no negative effects on feed intake, milk yield and milk quality.

The by-products from the bioenergy industry consist primarily of distiller's grain, glycerol and protein-rich pressed cake and pellets, such as from rapeseed. Distiller's grain is a residue from the manufacture of ethanol from grain and can make up to 30 per cent of the feed ration and substitute high-quality protein sources such as soy and rapeseed products.

The carbon footprint of the waste products is also favourable compared with soy. Where soy has a carbon footprint of 725 g CO_2-equivalents, distiller's grain leaves a footprint of just 300 g.

POLICY SUPPORT

PIG WELFARE IS DOWN TO MANAGEMENT AND PRODUCTION METHODS

Scientists from the Department of Animal Science have searched for a direct link between the consumption of prescribed medication, mortality and animal welfare in finishing pigs at a herd level.

In herds where there was a relatively low level of antibiotic treatment, there was neither lower mortality nor improved animal welfare. A high consumption of antibiotics can on one pig farm be caused by a high disease pressure, and on another farm may reflect an earlier and more comprehensive treatment of sick pigs. Low medicine consumption in a herd may be due to a low disease pressure or high incidence of untreated diseases. There are large variations between herds, suggesting that management conditions and production methods have a large impact on both animal welfare and consumption of antibiotics.

EVOLUTION IS AN IMPORTANT FACTOR IN INTEGRATED PEST MANAGEMENT

LINKS TO INDUSTRY

Weeds, pests and diseases can develop resistance to pesticides, rendering the plant protection less effective. Scientists from the Department of Agroecology use evolutionary and ecological principles to create a better understanding and prediction of resistance.

Although integrated pest management is gaining ground in agriculture, it is of utmost importance for food security that the effectiveness of pesticides is preserved. Unfortunately, the incidence of weeds, insects and fungi that develop resistance to pesticides is increasingly posing a challenge to plant protection.

Many plant protection products are withdrawn from the market due to stricter Danish and European legislation. Development of pesticides with new modes of action has been slowing over the last 20 years. Political proposals for a new tax model for pesticides are only making things worse because products containing any of the ingredients that are less likely to lead to resistance will become far more expensive.

This is the perfect background for initiatives leading to the development of new methods that preserve pesticide efficacy and ensure good crop protection, and scientists from the Department of Agroecology will therefore focus on the use of evolutionary biology in a new development project on plant protection. The project is a partnership with the industry and international researchers. The aim is to maintain effective chemical plant protection in the battle against the weeds, pests and fungal species that can have significant economic impact on agriculture. The outcome could be a reduction in the use of pesticides to the benefit of the environment.

Arms race in the field

Weeds, pests and diseases evolve alongside the cultivation of agricultural crops. You could call it an arms race: Agriculture is continually developing new methods and means of combating the pests that affect the crops, and the pests almost as quickly develop resistance to the chemical agents.

– Our results will help to protect the current arsenal of pesticides against resistance so that we can safeguard crop production and the economic viability of farming, says Associate Professor Michael Kristensen from the Department of Agroecology. He is working on the resistance to insecticides while his colleagues in the department, Professor Per Kudsk and Senior Scientist Lise Nistrup Jørgensen, are working on resistance to respectively herbicides and fungicides.

The scientists will integrate ecological and evolutionary principles to better predict how pests, fungi and weeds will respond to long-term changes in plant protection, the agricultural environment and the climate.

Evolution creates resistance

To shed light on the biological principles involved in the pests' ability to adapt to different cropping systems, the scientists are studying the evolution of resistance in three types of organism:

- Beetles on rape that has been treated with insecticides containing pyrethroids or neonicotinoids
- Common windgrass treated with so-called ALS-inhibiting herbicides
- The Septoria fungus treated with ergosterol-inhibiting fungicides.

The scientists will use molecular tools to follow the micro-evolutionary process leading to the development of resistance. The studies are carried out in the field, in the semi-field facility and in laboratories. The aim is to describe the effect of the genes coding for resistance on the robustness of the pests. The scientists will be looking at both resistant and susceptible specimens of pests.

– Recent developments in genomics and the availability of genome sequences for many animals, plants and pathogens plus advances in bioinformatics give us some rather exciting tools for the rapid mapping of pests at the population level, says Michael Kristensen.

– Our ambition is to combine management, genetic variations and data on robustness in models that can predict and prevent the development of resistance and which are based on objective and measurable criteria.

The Project 'Evolution-proof pest management (EvoPPM)' is a partnership with Bayer and Rothamsted Research and has received financial support from Innovation Fund Denmark.. ■

Photo: Karl-Martin Vagn Jensen

A cabbage seed weevil attack on rape forms part of the experiment on resistance to pesticides.

RESEARCH

GENOMIC SELECTION: FROM ANIMALS TO PLANTS

Genomic selection has revolutionised Danish livestock breeding. Now, scientists from GenSAP – a strategic research centre at Aarhus University's research centre AU Foulum and under the Department of Molecular Biology and Genetics – will also be utilising detailed genomic analyses in plant breeding. This is an important step when it comes to ensuring sustainable food security.

The advantage of genomic selection is that you can follow in detail the inheritance of all parts of the genome at once, plus the procedure is fast and easy to use on many animals and plants.

The technology is estimated to have led to 50 percent greater advances in cattle breeding. In plant breeding scientists expect to see greater advances in crop yields, seed production, stress tolerance and disease resistance. At the same time, they expect to see a decrease in greenhouse gas emissions due to better feed digestibility and lower nitrogen requirements without loss of yield.

Innovation Fund Denmark is contributing 30.6 million DKK to GenSAP in the period 2013-2017.

POLICY SUPPORT

TIPS TO FIGHT THRIPS

Western flower thrips (Frankliniella occidentalis) is the name of an omnivorous pest which in Denmark causes problems in the production of cucumbers, peppers and potted plants. DCA has prepared a technical memorandum for the Ministry of Food, Agriculture and Fisheries where Associate Professor Michael Kristensen recommends a number of methods that can reduce the risk of thrips.

Many thrips are resistant to insecticides. If market gardeners select chemical control, they should stick to as few insecticides as possible for each generation of thrips in order to reduce the development of resistance. Spraying should be carried out morning or evening when thrips are the most active. For biological control, DCA recommends the use of predatory mites and ticks. A lower temperature and higher humidity in the greenhouse will give poorer living conditions for thrips since they prefer a warm and dry climate.

HUMIDITY CONTROL IN GREENHOUSE PRODUCTION SAVES ENERGY

LINKS TO INDUSTRY

Commercial greenhouse production in Denmark has in recent years been good at saving energy and has therefore saved the environment from greenhouse gas emissions.. Based on plant physiology, scientists from the Department of Food Science are working with the industry to develop new technologies to reduce energy consumption even further through the optimal control of humidity.

When you put your teeth into a Danish tomato or decorate your coffee table with a Danish potted rose, you consume products created in Danish commercial greenhouses. In Denmark it is necessary to grow such products in climate-controlled greenhouses because the Danish climate has many cool and dark days during the year. But it is not without problems.

The greenhouses use advanced climate control and good insulation to create optimum light and temperature conditions for the plants. The challenge is that this can generate moisture, and to remove this more energy is used than is necessary for heating. This is a waste of precious energy and is a problem that scientists from the Department of Food Science intend to solve – in close partnership with the industry and other scientists.

– In a normal intensive greenhouse plant production using artificial light and highly insulating curtains, the humidity is regulated by heating and by opening windows. The result is a higher consumption of electricity and heat than needed. The problem is that the control is preventive and is initiated before it is actually needed. This is to avoid condensation forming in the humid zones in the greenhouse although within a short time you would reach a lower humidity anyway, explains Associate Professor Carl-Otto Ottosen from the Department of Food Science. He leads a project involving the University of Copenhagen, Knud Jepsen A/S plant nursery and the technical suppliers FlexTechnic to develop a technology for optimum humidity management based on knowledge about plant physiology.

Photo: Jesper Rais

Optimum humidity control in greenhouses can lead to additional energy savings, according to Associate Professor Carl-Otto Ottosen.

Several approaches to energy savings
In most horticultural greenhouses, 25-35 percent of the annual energy consumption is used for dehumidification to prevent loss of quality due to mould attacks. The humidity is caused by transpiration of the plants. Evapotranspiration is the loss of water to the air and is affected by air temperature, humidity and light.

– This means that in late afternoon and at night there are often critically high humidity levels that automatically trigger an energy-intensive climate regulation. At certain periods of the year the outdoor humidity can also be very high and it is not possible to regulate the humidity in the greenhouse without heating it, says Carl-Otto Ottosen.

Much of the energy spent can be saved by using a combination of methods that are adapted to different types of plants and installations. One way is to reduce plant transpiration using existing active climate control methods. Another approach is to assess the different methods of dehumidification and ventilation from both a practical and economic sense. These could be passive or could even capture the energy used for moisture management.

The scientists in the project will also develop models that predict the times and periods when humidity is so high that it must be reduced. This requires some knowledge of how plant stomata respond to combinations of climatic conditions – and this is basic knowledge that scientists at Aarhus University have established in their research .

Knowledge put to practical use
The project partners' combination of research knowledge, technical knowledge, practical know-how and close contact with the horticultural industry ensures that the results can be widely and effectively implemented.

– We expect that the horticultural industry with a minimum of risk can reduce the consumption of energy and fungicides by at least 10 percent. It will also strengthen innovative and technological development. It will be a win-win situation for both the individual horticultural production, for the environment and for the climate, says Carl-Otto Ottosen.

The project has a total budget of 12 million DKK to which the Green Development and Demonstration Programme of the Ministry of Food, Agriculture and Fisheries has contributed 7.6 million DKK. ■

RESEARCH

THE ROBOTS ARE COMING

With their ever increasing capacity for autonomy robots are increasingly being left to carry out tasks in the field. But with no driver in the cab to check on things, safety standards need to be very high. Researchers from Aarhus University and a number of companies are working together to develop robots that are sentient – in other words, they can recognize people, animals and obstacles in the field. This is done in the project SAFE – Safer Autonomous Farming Equipment. The 3.5-year project has a total budget of 29 million DKK, of which 15 million is a grant from Innovation Fund Denmark. Another project that also has the participation of Aarhus University is Optimek. The project partners here are working on the development of robotic prototypes for safer mechanical weeding. Optimek has a total budget of 13 million DKK and is supported by the Green Development and Demonstration Programme.

POLICY SUPPORT

DCA ADVISES ON INVESTMENTS IN NEW TECHNOLOGIES

It is an ambition of the Ministry of Food, Agriculture and Fisheries to increase the organic cattle and pig farming area. It is also an ambition of theirs to increase the on-farm processing of sales products of primary producers within the production of cattle, fruit and vegetables, arable farming, and eggs and poultry.

Based on research at Aarhus University, DCA prepares an annual review of the environmental technologies that are used in primary agriculture. The Danish AgriFish Agency can use this review to prioritise applications for funding under the Ministry's environmental technology programme – a programme that includes grants for investments in new green processes and technologies for organic farming.

Photo: René Larsen

New trials from Aarhus University show a boost for yields and the environment when growing green biomass rather than cereals.

GREEN CROPS CAN DOUBLE YIELDS AND PROTECT THE ENVIRONMENT

RESEARCH

Danish crop production can double its yields and significantly reduce its environmental impact by growing green biomass instead of cereals. But these options may only be exploited if effective biorefining methods are developed.

Plant growth is essentially about converting sunlight, water and nutrients into biomass. The better the plants are at this, the better they grow.

The vast majority of Danish farmland is used for growing cereals. Cereals are fairly easy to grow, harvest, transport, store, and, not least, process for feed and flour. The common cereals are, however, not very effective at utilising sunlight and nutrients season-round. In late summer, which can produce both sun and rain, the grain ripens and the plants stop growing.

Sun and soil

Grass and many other green crops, on the other hand, grow for a far longer period and are thus better able to utilise any sunlight and fertilizer. Under Danish conditions, green crops can produce far higher yields than cereals and there is typically much less nitrate leaching from green crops and almost no need to use pesticides.

Completely new experiments at Aarhus University document the benefits of green crops.

– In the crop rotation where we compare green biomass crops with cereals, the yields of several of the green crops are at least twice as high as for cereals, measured in dry matter per unit area, explains Senior Scientist Uffe Jørgensen from the Department of Agroecology.

– When we measure nitrate leaching below the root zone, we see a significant difference between the annual cereals and the perennial grasses. There is much less leaching from both fertilized and unfertilized grasses than from the cereals, he says.

Double up with grass

The grass species festulolium, for example, was given 425 kg N per hectare. This resulted in a yield of 22 tonnes dry matter per hectare. That is more than twice as much as for barley (grain+straw). What is interesting is that nitrate leaching was only one third to one fourth of that from a barley field – and even lower than from an unfertilized clover pasture that produced about eight tonnes of dry matter per hectare.

– The experiment shows that it is possible to decouple the link between production and environmental load. Or in other words:

It is possible to fertilize and produce more while also protecting the environment, says Uffe Jørgensen.

The growing of green biomasses can be used to reduce the environmental impact from farming, for example by replacing cereals with green crops in areas where there is high risk of nitrogen loss.

– It will be much more effective than imposing additional fertilizer restrictions on cereal production, says Uffe Jørgensen. An added benefit for the climate is that the use of perennial crops instead of cereals can help build up soil carbon.

Protein from grass and clover

The question is how interesting it is to grow green biomass when you cannot eat grass.

– It is interesting because green crops typically contain more protein than cereals, says Senior Scientist Søren Krogh Jensen from the Department of Animal Science.

The vast majority of the grain grown on Danish fields is used for pig feed, but the grain has a low protein content compared with the pigs' needs. Therefore, some of the pig's ration is based on imported soy protein. Soy comes primarily from South America, and the soy production for the Danish pig production alone occupies an area one sixth the size of Denmark.

There are many examples of environmental problems associated with soybean cultivation. It would be much more sustainable if protein feed was based on green biomass grown in Denmark.

– The math is fairly simple. If we grow 20 tonnes of biomass per hectare with a protein content of 20 percent, then we can theoretically produce up to four tonnes of protein per hectare which can be used for feed and food purposes. If we succeed in extracting the readily-soluble protein, this will correspond roughly to the part of the protein that is converted to ammonia in the rumen and thus not exploited, explains Søren Krogh Jensen.

Green energy, nutrition and materials

The plan for the future is therefore to extract the readily-soluble protein, dry it and use it as easily-digestible protein for pigs, poultry and calves. The remaining fraction can be used for rumen-friendly cattle feed, bioenergy and bio-based materials. This would be consistent with the vision of replacing fossil fuels with bio-based materials – but without reducing food production.

However, there are some major challenges that need to be solved first. The first challenge is to extract the protein from the green biomass in a quality and at a price that is competitive with soy protein. Secondly, there is a challenge in converting the residual product to a product for which there is a demand and which will therefore have a value. Finally, there are a number of challenges related to the harvest, transport, storage and processing of green biomass. The large volume of water, in particular, is a challenge. ■

POLICY SUPPORT

BIOBASE IS A NEW JOINT VENTURE PLATFORM FOR A BIO-BASED ECONOMY

Aarhus University will until 2017 be investing about 50 million DKK in the BioBase research platform which will form the foundation for research in bio-production. New biorefining technologies mean that it will be possible to replace problematic fossil materials with biomass. The platform consists of four integrated sub-platforms:

- Green biomass through diversified land use and smart management
- High-quality protein from green biomass
- From biomass to energy through hydrothermal liquefaction (HTL)
- Societal, environmental, ecological and economic assessments

Pilot facilities will be established within the platforms to form the cornerstones for development work with companies. This is achieved, among other things, via the cluster facility in BioCluster.dk.

LINKS TO INDUSTRY

MORE BIOENERGY BANG FOR YOUR BUCK

A new calculation tool developed by Aarhus University, SEGES and Agro Business Park can help to get the best out of biomass resources at a low environmental impact and energy loss but at a reasonable cost and quality. The tool can be used to select the most suitable type of biomass for a biogas or bioethanol plant. The model tool can also be used to analyse different concrete scenarios before any investment or adaptations to existing value chains take place. This is achieved through answering questions like: Should we invest in local biomass resources or should we import them from outside the local area? Is it cost-effective transporting biomasses longer distances? What type of biomass would be the most suitable?

SUGAR CAN REPLACE SULPHURIC ACID IN SLURRY

LINKS TO INDUSTRY

Scientists from the Department of Engineering have found that ammonia emissions may be halved if the farmer boosts the naturally occurring lactic acid bacteria in the slurry by adding sugar. The method will benefit both conventional and organic farming and biogas plants and supress excessive fertilisation with sulphur.

Ammonia gas from animal manure is one of the largest sources of air pollution in Denmark and is harmful both to the environment and to humans. Many farmers today acidify the slurry by adding sulphuric acid since slurry with a low pH can reduce the evaporation of ammonia by up to 70 percent. In 2014, 18 percent of Danish manure was acidified.

Acidification of slurry with sulphuric acid is a recognized chemical method to reduce nitrogen volatilisation in conventional animal husbandry. The method cannot be used on organic farms, since the use of sulphuric acid is not permitted in an organic context. Nor is slurry acidified with sulphuric acid particularly useful in a biogas plant. If the concentration of sulphuric acid in biogas reactors exceeds 10 percent, the production of biogas will drop and the excessive fertilization considered problematic on some soils such as in the Netherlands will be avoided. New techniques for acidification are therefore welcomed.

Sugar in the slurry

New research from Aarhus University suggests that sugar can replace sulphuric acid as an additive to slurry. Together with SEGES, AgroTech and JH Agro A/S, scientists have developed a new technology that can reduce the loss of nitrogen from manure using lactic acid bacteria. The effects will primarily be a smaller loss of nutrients to the environment and lower emissions of greenhouse gases. More of the nitrogen is therefore kept in the manure rather than lost, which is beneficial to the farmer's yields in the field.

It is thought that agriculture can halve the harmful ammonia emissions by pouring sugar into the slurry. The sugar acts as a growth medium for the bacteria that produce lactic acid, and lactic acid has the same effect on ammonia as sulphuric acid.

Initially, the scientists tested how the slurry reacted to a combination of lactic acid bacteria and sugar. The effect turned out to be positive, where the additive could even cause the pH to drop below what was necessary.

- We have since discovered that you do not need to add microorganisms, for those naturally present in the manure are perfectly capable of doing the job themselves if you provide the right conditions for growth. And grow they will if you add sugar, says Maibritt Hjorth, chemist and Assistant Professor in the Department of Engineering.

The future is sweet

The big advantage of using sugars is that the farmer to a certain extent can use whatever residues he has from the farming practice. Sugars are also easier to handle than sulphuric acid which must be bought in.

Acidification using sugar is close to implementation, but Maibritt Hjorth points out that there are some very delicate balances that researchers still need to control. They need to examine how quickly and in what order the various residues decompose, how the desired pH level is achieved in the longer term, and how the slurry is properly managed without it becoming too expensive for the farmer.

The project 'Reduced nitrogen evaporation using bio-acidification of slurry' is funded by the Green Development and Demonstration Programme (GUDP) under the Ministry of Food, Agriculture and Fisheries. ■

Photo: Peter F. Gammelby

New research from Maibritt Hjorth and her colleagues shows that sugar can replace sulphuric acid as a means of reducing ammonia emissions.

RESEARCH

SPRAYING IS ALL ABOUT TECHNIQUE

You have to choose the right spraying technique to get the best biological effect of the treatment and to minimise losses to the environment.

When pesticides are sprayed onto crops, losses occur in the form of drift. This is the part of the liquid that is carried outside the designated area for spraying. It is therefore important to check that the technique used can reduce the amount of drift.

Spraying under favourable weather conditions (at a moderate temperature and relatively high humidity) is a worthwhile approach. Drift can also be reduced by driving at a moderate speed of up to 6 km/h, by keeping the boom at the correct height of 40 cm and by using coarse atomisers such as compact air injection nozzles.

POLICY SUPPORT

VOLUNTARY AND MARKET-BASED ACCOUNTABILITY INITIATIVES PROMOTED

Regulation, subsidies and taxes are the usual strategies that authorities use in order to encourage food manufacturers to develop and run a responsible and sustainable production. The methods cannot, however, be applied to the production of soy and palm oil. Inspired by the initiatives of authorities in several other countries, DCA compiled a catalogue of instruments that can promote voluntary, market-based accountability initiatives.

Other countries primarily use non-control instruments. These instruments often seek to support or promote voluntary arrangements and to subsidise the formation of partnerships in the supply chain. The Netherlands is one of the leading countries in the promotion of sustainable international supply chains, partly via co-financing of the activities by the authorities.

Responsible management of natural resources

Foto: Janne Hansen

Nature and its resources will both now and in the future form the basis for food production and for commercial and recreational functions.

There is focus on the protection of nature and the environment, on biodiversity, climate change and food security, which is why knowledge of the potential, the status quo and the extent of natural resources is needed. Resources are affected by production, which also has to undergo a green transition. This creates a demand for more effective and targeted measures and for regulations that are more innovative than traditional measures that increasingly have relied on dictates and controls.

Authorities must therefore use scientific expertise to monitor, assess and document the potential and limitations of natural resources in addition to the positive and negative effects on resources of agricultural production. There should also be focus on the implementation of alternative forms of regulation that promote the responsible management of resources.

The current and future regulation of natural resources will continue to demand ever more knowledge and documentation about the associated industries and production. ■

SOIL UNDER PRESSURE

RESEARCH

The majority of the food we eat originates directly or indirectly from the soil. But soil fertility is under threat because of the way we treat it. This is a topic to which much research is being devoted at Aarhus University, working alongside the agricultural industry and the authorities.

Many of us may have a tendency to take the soil a little for granted. It has always been there and does not seem likely to disappear any time soon. We must, however, be better at cherishing it, because as they say, we do not inherit the earth from our ancestors, but borrow it from our children.

Soil has many important functions. Virtually all the food we eat comes originally from the soil, either directly in the form of crops that we eat or indirectly in the form of feed for our livestock. The soil is a growth medium for crops for food, feed, fibre and energy.

The soil also fulfils many other important functions. It filters water to keep our groundwater reservoirs pure. It facilitates the turnover of plant residues and manure so important nutrients are supplied to the crops and not lost to the environment.

The soil is not a free-for-all

There is in other words a need to protect the soil and ensure that its many vital functions will endure in the future. The soil is, however, under intense pressure from a variety of factors that affect its fertility. Poorer fertility means declining yields – and this at a time when the world population is growing and increasingly demanding a sustainable supply of foods.

Scientists from Aarhus University are helping to highlight the problems and create knowledge that can form the basis for sound practices and legislation.

– The threats to arable land should be taken seriously. We must not put the basis for the existence of future generations at risk, says Senior Scientist Per Schjønning from the Department of Agroecology.

Soil is compacted

Globally, the human use of land has led to processes such as erosion, soil compaction, desertification, salinisation, urbanisation, pollution and loss of organic matter and biodiversity. In Denmark, we have three main problems with arable land:

- Soil compaction under the plough layer
- Erosion due to wind, water and soil tillage
- A decreasing organic matter content

For all the threats it is true that following a change it takes a long time for the soil to recover.

Heavy farm machinery on soil causes soil compaction below the plough layer and scientists from the Department of Agroecology have shown that these injuries are largely permanent.

– The very heavy machinery used today carries a higher risk that the compaction will reach ever deeper soil layers, says Per Schjønning. He is the Danish project manager of the five-year EU project RECARE (www.recare-project.eu) that is preparing the ground for sustainable solutions in farming, with direct inputs from farmers and other stakeholders.

The project has assembled a multidisciplinary team to uncover the severity and extent of the threats to soil and to find innovative solutions to prevent further land degradation in Europe. Scientists from 27 different organisations and companies, including Aarhus University and Kongskilde Industries A/S, share knowledge about actual soil conditions and define measures that can be used to address the main problems.

Wind, water and tillage erode the soil

Another major problem that scientists at the Department of Agroecology are working with is erosion. Wind, water and tillage erode our farmland. Erosion is widespread in Denmark and can reduce soil quality and yield potential and threaten the environment.

There was a time when about 500,000 ha of agricultural land was exposed to wind erosion and where soil losses of more than 10 tonnes of soil per ha were not considered unusual. This has improved greatly since the widespread introduction of winter crops, and windbreaks have considerably reduced the

risk of wind erosion.

Erosion caused by water can still be a problem. This depends on a complex interaction between topography, climate, soil type and cultivation practices.

Erosion as a result of soil tillage occurs when a hilly area is ploughed, or otherwise managed intensively. Tillage erosion acts as an efficient conveyor belt moving soil from hilltops to hollows in the field, without changing much in the middle part of the slopes. Soil loss is typically 20 tonnes per ha per year. Studies show that erosion mainly occurs in fields with winter crops and ploughed fields.

– On heavily eroded areas, water and wind erosion causes the loss of fine-grained material, organic matter and nutrients. This is detrimental to the soil structure, to its water-holding capacity and the environment. In the long term it will affect the yield potential. Since tillage erosion occurs across all hilly, cultivated terrain and results in a significant redistribution of land, particularly this type of erosion can in the long term result in severe soil degradation, says Senior Scientist Goswin Heckrath from the Department of Agroecology. ■

Photo: Per Marcussen

If we do not take good care of our soil resource, we risk destroying it so that it loses its ability to grow crops.

LINKS TO INDUSTRY

BIOCHAR AS A SOIL IMPROVER

Biochar is the leftover product from the pyrolysis of a biomass such as straw and woodchips. Biochar has increasingly caught the interest of scientists in recent years because it may offer some of the solutions to reducing greenhouse gas emissions and increasing carbon storage in soil.

- Biochar has the potential to be used as a soil amender since it is by nature porous and has a large surface that can retain water and nutrients in the root zone. In this way you reduce the risk of leaching and loss of nitrogen to the environment, says Associate Professor Lars Elsgaard from the Department of Agroecology, who is participating in an EU project on biochar in soil.

Research in this area is still fairly new and several aspects need looking into. One of these is the use of biochar as a filter in soil to prevent the leaching of pollutants to groundwater and the aquatic environment.

POLICY SUPPORT

REGULATIONS TO MINIMISE EROSION

New regulations by the Ministry of Food, Agriculture and Fisheries restrict the farmers' ability to till land that slopes 12 degrees or more. The purpose of the restriction is to prevent water erosion. The regulations draw on knowledge gathered by DCA, where scientists have drawn up maps that are used to identify the areas where there is a risk of erosion.

In the new regulatory framework, inclination is not the only aspect that determines whether an area is classified as being at risk of erosion. Factors such as soil type, rainfall and landscape form are also included in the assessment.

Scientists are happy that this issue has now been brought into the open, since erosion is a problem in many places in Denmark – a problem which leads to reduced soil fertility and yields in the long term.

ORGANIC FARMING PROTECTS AGAINST GROUNDWATER POLLUTION

POLICY SUPPORT

Organic farming in water catchment areas can provide additional protection against pesticide pollution of our drinking water, but all farms in the catchment area need to convert.

Pesticide residues are relatively common in Danish groundwater. Pesticide pollution in an area that is subject to water extraction, such as a groundwater catchment zone, can originate from point sources, such as an industrial site, or from diffuse sources, such as the spraying of an agricultural area with pesticides.

A study by the Geological Survey of Denmark and Greenland (GEUS) in 2012 showed that pesticide residues or their breakdown products can be found in about 39 percent of samples from control extractions in the aquifers. For about 11 percent of the samples the concentrations exceeded the permitted levels. Another survey showed that in the period 1999-2008 around 3,300 drinking water boreholes were closed in Denmark. There may be many reasons for the closing of boreholes, but the water from approximately 600 of the abandoned wells exceeded the pesticide limit.

Organic farming is pesticide-free

One of the principles of organic farming is that pesticides are not permitted. This type of farming can therefore be used as a measure to protect the groundwater resource.

– Organic farming in groundwater catchment areas will provide extra protection against pesticide pollution of drinking water, but all farms in the catchment area need to convert, says Preben Olsen, academic employee at the Department of Agroecology.

Drinking water is abstracted from underground water reservoirs, which are supplied with water from large or small catchment areas. There is much variation across the country regarding the depth to the water table and not least in the groundwater recharge, that is how much of the rainfall replenishes the aquifers compared with how much ends up in e.g. streams.

Precipitation in Jutland is much higher than on Zealand while there is a much greater demand for drinking water on Zealand because of the higher population density.

Scientists at DCA therefore suggest using organic farming as a groundwater protection tool. The use of the tool will make sense, particularly in those parts of Zealand that supply drinking water to Copenhagen. As groundwater recharge on Zealand is low, the closing of contaminated abstraction wells and the finding of new freshwater resources is costly, organic farming in the current catchment areas can provide greater water security.

Preben Olsen emphasises that it will take many years before the effects of organic farming are reflected in the groundwater quality. Often it may take 10-20 years or more before the rain that falls today can be poured from the tap. ■

Photo: Jesper Rais

Use of organic farming in catchment areas would make good sense around Copenhagen, says Preben Olsen from the Department of Agroecology.

LINKS TO INDUSTRY

IMPROVING THE FEED VALUE OF GRAIN

Some of the protein and phosphorus that pigs consume via feed grain is converted and subsequently excreted to the environment in manure and urine. It would be an advantage if this grain instead could be better utilised. Arable farmers are also keen to achieve higher yields per hectare for their cereal crops. At a time of focus on global resources and increased self-sufficiency in protein, there is growing interest in looking at feed grain from a different angle.

To achieve a better utilisation of the nutrients in the grain and reduce protein and phosphorus losses – with subsequent environmental impacts and need of imports – requires interdisciplinary knowledge of animal nutritional needs, grain processing, feed metabolic rate and an optimal use of enzymes. This is done in collaboration with, among others, Sejet Plant Breeding, SEGES – Pig Research Centre and a number of enzyme producers.

RESEARCH

SCOPE FOR A DANISH BLUEBERRY PRODUCTION

The common blueberry (Vaccinium myrtillus), which grows in the wild in Denmark, has as yet not been put into commercial production anywhere in the world. These berries are highly sought after because of their good taste, high concentration of natural pigments and alleged health benefits. But the high costs associated with their picking, transport and low yield make wild blueberries expensive.

Scientists at Aarhus University have therefore researched and developed the knowledge and methods needed for a possible future effective and rational Danish production of the common blueberry. Development of low-cost ways to propagate blueberry plants by cuttings is crucial so that high-yielding varieties can be used rather than low-yielding seedlings. The scientists have also developed customised fertilizer solutions and methods to ensure a fast and optimal production of blueberry plants in plant nurseries.

PIGS IN THE WOOD

LINKS TO INDUSTRY

By keeping organic sows and their piglets on areas planted with trees, the farmer can improve animal health and welfare. It is also a better solution for the environment than putting pigs onto grass.

At the Department of Agroecology at Aarhus University scientists are working on projects that study the combination of forestry with livestock production. The ambition is to reduce the environmental load and improve pig health and welfare in organic herds by letting the sows and their piglets spend a longer time together – here in a forested area rather than on open grassland. The reason is that traditional organic pig production is facing a multitude of challenges, from environmental aspects to climate impact and animal welfare.

– In the organic systems used today the climate impact is not that different from a conventional production. Neither do the housing systems with their outdoor areas work that well from a hygiene point of view plus they generate large ammonia losses, explains Section Manager and leader of the pECOSYSTEM project, John E. Hermansen.

Post-weaning scours can also be a large problem when young free-range pigs are weaned from their mothers and transferred to an indoor pen. The scientists are therefore investigating a new form of organic pig production system where the environment and pig health and welfare are in focus.

The project is testing the practical aspects of the system at two organic pig producers and is recording the effects on animal health, welfare and productivity, and on the emission of nutrients and carbon storage.

One of the farmers in the project is planting poplars on up to 30 percent of the outdoor area for pigs on one of his farms. In between the poplars the farmer is planting other types of trees to increase biodiversity, animal welfare and aesthetics.

– The fact that farmers in the project are willing to plant poplar and other tree species shows how much they believe in the positive aspects of the concept, comments Senior Scientist Anne Grete Kongsted from the Department of Agroecology on the farmers' voluntary extensive and long-term changes to their land use.

Organic pork from wood-ranging pigs

The concept is based on a production that integrates free-range pig farming with a production of woody biomass for bioenergy. The trees in the pigs' paddock are used for biomass production. The trees can also reduce the losses of some of the nutrients that the pigs excrete in the manure and urine. By converting the trees to energy, they can help reduce the emission of greenhouse gases from the production. The trees also provide shade and occupation for pigs young and old.

Part of the project involves weaning the pigs at a later age than normal and finishing them in a new housing concept with an enriched outdoor area. The young pigs therefore spend more time outdoors with the sow, which can give healthier and more robust pigs. Less disease and greater comfort will improve animal welfare and reduce the need for antibiotics.

– The new production form may give us a more competitive, credible and resource-effective organic pig production, says John E. Hermansen.

The 3.5-year project has been granted 8.9 million DKK from the Ministry of Food, Agriculture and Fisheries' Green Development and Demonstration Programme. Project participants are Aarhus University (project leader), Udviklingscenter for Husdyr på Friland (development centre for free-range livestock), SEGES – Pig Research Centre, Organic Denmark and two organic pig farmers.

pECOSYSTEM is an Organic RDD2 project which is financed by the Ministry of Food, Agriculture and Fisheries and coordinated by the International Centre for Research in Organic Food Systems (ICROFS).

Experience from pECOSYSTEM will be very useful in the Agforward EU project involving the same scientists. One of the project's objectives is to define the barriers to the implementation of the agroforestry concept combining forestry and free-range pig production and how the concept can be expanded. This project has 23 partners from 10 European countries. ■

RESEARCH

ANIMAL-FRIENDLY AUTOPILOTS FOR AGRICULTURAL MACHINERY

Scientists at the Department of Engineering at Aarhus University are collaborating with the University of Southern Denmark to devise different solutions to minimise the number of animals that are hit by machinery in the field and to develop a sensitive security system for large agricultural machinery and the agricultural robots of the future.

In the project Safer Autonomous Farming Equipment (SAFE) scientists are collaborating with the two major manufacturers of agricultural machinery, Kongskilde Industries and CLAAS, and two smaller specialised firms, Conpleks Innovation and KeyResearch. The companies' expertise in agricultural machinery is combined with the scientists' expertise in sensor technology and signal processing enabling them to jointly develop and adapt sensors and intelligence to the individual types of machinery.

On completion of the project the ambition is to have developed early prototypes of the sensitive security system.

POLICY SUPPORT

DCA ADVISES ON PRO-WILDLIFE HARVESTING METHODS

The industry and the authorities have for many years been on the lookout for harvesting methods that help protect wildlife. DCA recommends three methods that farmers can use to avoid collisions with wildlife during harvesting.

One method is to use deterrents such as the presence of a dog, the smell of a predator, polystyrene boxes in the field or sounds that alarm the wildlife. Another method is to use intelligent driving patterns during harvesting. This gives the game an escape route so it does not get trapped in the middle of the field. The third method – and that recommended by DCA – is wildlife detection using either a dog, electronic and infrared sensors on tractors, or drones that can survey areas and send warning signals to the driver if wildlife is spotted.

Trees give shade and comfort in the outdoor pig run, with subsequent advantages to animal welfare and the environment.

Photo: Kristine Riis Andersen

EARLY SOWING OF WINTER WHEAT CAN REDUCE NITRATE LEACHING

RESEARCH

Research at Aarhus University shows that a soil cover in autumn and winter is imperative if nitrogen leaching is to be reduced. Early sowing of winter crops may be an option to achieve this.

The use of nitrogen in Danish agriculture is subject to restrictions that have helped halve nitrogen leaching over the past 25 years. The restrictions have also resulted in lower yields and protein levels in crops. The Commission on Nature and Agriculture has therefore proposed differentiated nitrogen regulations from 2016. This implies that nitrogen losses in some areas of the country should be reduced even more than they have been so far.

There is therefore a continuing need for new or improved measures that can maintain or increase crop production while reducing nitrogen leaching. Traditional measures have included the use of catch crops and break crops and delayed ploughing. From autumn 2014, early sowing of winter wheat was introduced as an instrument whereby five hectares of winter wheat sown before 7 September can replace one hectare of catch crops.

Interest in the introduction and use of early sowing as a measure to reduce nitrogen leaching has been considerable. This is not least because yields from winter wheat are generally higher than from a crop sown in spring following a catch crop.

Sowing time affects nitrogen uptake and yield

The reason for introducing early sowing as an instrument is based partly on results from field trials conducted at Foulum and Askov with early and normal sowing. These trials were performed with nitrate leaching measurements and with measurements of nitrogen uptake through autumn and winter.

The leaching measurements showed less leaching with early sowing. Measurements in biomass have also shown that nitrogen uptake in autumn and winter is higher after early sowing. The trials are inconclusive on the effect of early sowing on the yield at harvest, but there is potential for increased yields if sowing density, crop protection and harvests are optimised.

To determine the value of moving the time of sowing forward, it is necessary to establish a normal time of sowing that the effect of early sowing can be compared against. The average date for sowing winter wheat was estimated to be 23 September based on approximately 4,500 observations from the LOOP monitoring programme (1989-2011) carried out by GEUS in collaboration with the Danish Nature Agency.

Based on a non-linear relationship between sowing date and nitrogen uptake during the autumn, the scientists calculated that if the sowing date was advanced to 7 September, this would increase nitrogen uptake and reduce leaching by approximately 7 kg N per hectare.

The effect of early sowing is further examined in the VIRKN project under the Green Development and Demonstration Programme, where Aarhus University and SEGES will determine the effect on leaching of both traditional and new measures such as cover crops and early sowing at increasing rates of nitrogen application. The experiments started in spring 2015 and will continue in the coming years.

Many aspects to early sowing

Early sowing can, in principle, be used for all varieties of winter wheat, but may in practice be limited by the availability of machinery and manpower. To be able to carry out sowing before a given date, the preparations for sowing will have to start even earlier, which may interfere with harvesting operations. Therefore, the farms that are expected to be able to benefit most from this are those with a relatively large machine park.

A short period of time from harvest to early sowing may also mean that new certified seed is not always available and instead home-produced seed or seed from the previous year must be used.

The treatment frequency for insecticides is expected to increase with early sowing, while the need for disease control is not expected to change dramatically. The risk of the fungal disease take-all is higher with early sowing, which is why early sowing should preferably be practised on first-year wheat fields.

Seed dressing against take-all can become imperative. Early sowing can also increase problems with grass weeds and the development of resistance in weeds. The risk of take-all and resistance means that the early sowing instrument should be adapted to both crop rotation and weed pressure on the individual property. ■

LINKS TO INDUSTRY

SEMINAR ON PROS AND CONS OF EARLY SOWING OF WINTER WHEAT

In June 2014, advisors, consultants and farmers were gathered for a seminar on the early sowing of winter wheat. The event took place at Aarhus University's research station in Askov.

The seminar focused on current production and environmental challenges linked to the early sowing of winter wheat. One such challenge is weed and disease control. The presentations also elicited questions about the effect on nitrate leaching and yield, and how early sowing can be carried out in practice.

The event was held under the auspices of the research project PlantePro that is a joint effort between Aarhus University, SEGES, University of Copenhagen, Sejet Plant Breeding I/S and Novozymes A/S. The project is financed by the Green Development and Demonstration Programme under the Ministry of Food, Agriculture and Fisheries.

POLICY SUPPORT

POTENTIAL NITROGEN REGULATION MEASURES

Aarhus University, in collaboration with the University of Copenhagen, has compiled a catalogue of measures that can be used to regulate emissions of nitrogen from agriculture to the environment. The catalogue is to be used in conjunction with the preparation of new action plans for the aquatic environment and for targeted nitrogen regulations.

Denmark must comply with the EU Water Framework Directive that stipulates that a good ecological status must be achieved for all water bodies. One of the main factors influencing the marine environment is the input of nitrogen, including that originating from agriculture. It is therefore important to document how various measures can minimise the loss of nitrogen from agriculture to the environment.

Early sowing of winter wheat can reduce emissions of nitrogen to the environment.

Photo: Jonne Hansen

FROM GREENHOUSE GAS TO PROTEIN FEED FOR PIGS

LINKS TO INDUSTRY

Rather than heating up the atmosphere methane can instead be turned into meat. Scientists and the industry are attempting to produce a pioneering and climate-friendly protein feed for pigs

Imagine that the pork chop you are eating is ultimately based on bacteria, natural gas and minerals. Does that sound a little too far-fetched? This is nevertheless a realistic and not too distant option with the development of a new protein feed for pigs. The new feed can replace animal protein such as soy imported from distant countries. This means that the protein fed to the pigs can be produced in a local factory rather than through the clearing of yet more rainforest.

In a new project supported by Innovation Fund Denmark, scientists from Aarhus University have joined forces with the company UniBio A/S (producers of a special protein feed based on bacteria), the Technical University of Denmark, the University of Southern Denmark and the feed company Vestjyllands Andel to further develop UniBio's protein product so that it is tailored to the pigs' requirements and has a much lower impact on the environment.

– The world's population is growing in both numbers and wealth. This means a growing demand for meat. It also means a growing demand for protein sources like soy to feed the pigs, which puts additional pressure on the environment and climate. Hence the need for a new way of thinking, says one of the participants in the project, Professor Hanne Damgaard Poulsen from the Department of Animal Science.

Optimising the protein profile

The project aims to develop protein products that are tailored to the pigs' amino acid requirements. The products will be based on protein produced by the bacterial species Methylococcus capsulatus. It eats methane and converts the gas into biomass with a high crude protein content. This biomass can be converted into a protein granule that can be used to feed pigs.

The company UniBio has patented the design of the fermentation facility that enables the production of the unicellular protein UniProtein® via this process. The product now needs to be tailored to the pigs' needs and the environmental advantages established.

The building blocks of proteins are amino acids. The pigs require the individual amino acids in certain quantities balanced in relation to the other ingredients in the feed. By tailoring the diet to the pigs' requirements for individual amino acids, you avoid giving pigs more protein than they need. This would also avoid excess nitrogen from the redundant part of the protein passing through the pig and into the manure, ultimately ending up on the field where it can affect the environment.

A gift for the environment

Using scenario analyses, laboratory tests and experiments on pigs, Hanne Damgaard Poulsen and her colleagues at Aarhus University will identify the amino acids that are essential for the work with a protein diet adapted to pigs at various stages of their lives. The scientists will also make sure that the new protein products are tested on pigs and their digestibility and nutrient balance mapped.

Photo: Jesper Rais

Professor Hanne Damgaard Poulsen is working on developing a new type of protein feed for pigs

By producing a protein feed based on bacteria and natural gas, the impact of meat production on the climate and the environment can be significantly reduced. In the major oil-producing and oil-consuming countries, much natural gas is being burned off which could instead be used to produce the new protein feed. By tailoring the protein to the pigs' needs, the pigs are better able to utilise it, which benefits both the pigs and the environment.

The 3.5-year project has a total budget of 28 million DKK, of which Innovation Fund Denmark has contributed 15 million DKK. Project partners are Aarhus University, the Technical University of Denmark, the University of Southern Denmark, UniBio A/S and Vestjyllands Andel. ■

RESEARCH

ADAPTING CROPS TO CLIMATE CHANGE

Being an agricultural crop in Denmark is a real challenge. Climate change is expected to lead to periods of drought that are both longer and more numerous. Farming has also in the last 25 years been required to significantly reduce the amount of fertiliser used on crops. The crops therefore risk being starved of both nutrients and water. There is therefore a demand for crops that are better able to utilise water and nutrients in addition to producing far higher yields than now.

In a number of different projects scientists at Aarhus University are working on the adaptation of crops to climate change. An example of such a project is Radimax where deeper-rooted crops are being developed to improve their water and nutrient uptake. This will make them more robust and able to cope with the expected effects of climate change, providing better growth and higher yields.

POLICY SUPPORT

MORE FAT, LESS GAS

Methane gas from the microbial decomposition of feed in the rumen of cows makes up the majority of total methane emissions from agriculture. Methane is a powerful greenhouse gas and its generation also means a loss of energy for the cow. It is therefore important to quantify the emission of methane from Danish dairy cows and to design feeding strategies to reduce emissions without compromising on milk yields.

The addition of fat to the diet of cows is a promising method for reducing methane emissions. This is according to a scientific report prepared by scientists at the Department of Animal Science for the Ministry of Food, Agriculture and Fisheries.

There have been similar experiments abroad, but the experiment in Foulum differs in that it also focuses on whether the effect is sustained over time. According to the experiment, the emission of methane rises over the lactation period, but by increasing the levels of fat in the diet this rise can be moderated. A side benefit is that the addition of fat up to a certain level will increase milk yield.

Photo: Jesper Rais

Food security, consumer choice and healthy eating habits

Consumer perception of food quality, safety and health is of enormous importance for society and for the food industry's sale and export of foods.

Political ambitions in the area of food security, health, export and growth call for knowledge about the developments in the food market.

There is therefore a need for new knowledge about the demand for nutritious and healthy foods to help create a basis for economic growth and employment in the community. Knowledge should also support development of the production and promote healthy eating habits in the population.

Authorities need to monitor and assess food quality, safety and health as well as consumer behaviour and to implement structures that promote healthy eating habits, responsible and credible marketing and labelling of food products. ■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MILK IS FULL OF HEALTHY STUFF

RESEARCH

Two different research projects at Aarhus University will look closely into the contents of health-promoting substances in milk. One project will examine whether the carbohydrate content of milk can produce better infant formulas and the other project will be looking at milk's slimming properties.

Milk has many good qualities. Scientists from the Department of Food Science and the Department of Molecular Biology and Genetics will in two projects seek greater insight into these qualities and whether milk can be used to benefit our health. The research is done in partnership with other universities and the industry.

Beneficial sugars

In the one project, scientists from the Department of Food Science will be looking at some of milk's carbohydrates, the so-called free oligosaccharides. These carbohydrates can stimulate the growth of beneficial bacteria in the human gut, especially in young children, where they help to jumpstart the child's intestinal flora.

By nature, human milk contains much more of these complex carbohydrates than cow's milk. This means that children who drink infant formula based on cow's milk do not get the same amount of beneficial sugars as children who are breastfed.

Scientists from Aarhus University are collaborating with colleagues from the University of California, Davis (UC Davis) to generate new knowledge on the content of carbohydrates in cow's milk and whether it is possible to increase the amounts through breeding. They will examine the variation in quantity and composition of the carbohydrates in Danish cow's milk from two different dairy breeds and whether there is a genetic predisposition. This has the keen interest of Arla Foods, among others, which is why the dairy giant is contributing financially to the project, along with the Danish Dairy Research Foundation.

– The ultimate goal is to produce an infant formula that has a higher carbohydrate content. The free carbohydrates have a beneficial effect on the gastrointestinal tract as they can prevent the colonisation of harmful microorganisms on the intestinal wall. Harmful organisms may be bacteria or virus particles that can cause diarrhoea in young children, says project manager and Professor at the Department of Food Science, Lotte Bach Larsen.

US microscope

The project is based on milk samples collected in the large Danish-Swedish Milk Genomics Initiative, which has collected more than 700 milk samples from Danish Holstein and Jersey cows. All samples are sent to UC Davis, where content and composition of free carbohydrates are profiled for each milk sample using advanced technical equipment.

Photo: Jesper Rais

Professor Lotte Bach Larsen and Associate Professor Trine Kastrup Dalsgaard from the Department of Food Science are studying the healthy components of milk.

The scientists in the Department of Food Science then link the findings to the breeds to see if they can identify the causes of the variation in the carbohydrate content, thus making it possible to breed for higher levels of carbohydrate in milk.

Why does milk slim?
Milk also contains substances that can help suppress body weight. Scientists from the Department of Food Science are part of a project where they will identify the substances and mechanisms involved.

They already have a possible clue in that whole milk contains one or more substances that either directly or via the intestinal flora influence the absorption and metabolism of fat and thus are able to regulate body weight.

The study involves humans, pigs and intestinal cells derived from humans.

– Our first results confirm that there is something in milk that affects the metabolism of fat, says Associate Professor Trine Kastrup Dalsgaard from the Department of Food Science.

In the studies of intestinal cells the scientists found that some substances in milk activate a particular gene – the Fasting Induced Adipose Factor (FIAF) gene. When the gene is turned on, it starts processes that affect fat metabolism in the body. The components that affect this gene are found mainly in the fatty fraction of milk.

Unique fatty acids
More precisely, it is the short- and medium-chain fatty acids in milk that exhibit this effect. These fatty acids are collectively called SMCFAs and they are unique to milk. Intake of dairy products has previously been associated with reduced fat absorption in humans and calcium seems to play a role.

However, recent data shows that SMCFA in milk appears to switch on a particular gene in the body that initialises particular processes. One of the processes is the production of a protein called the FIAF protein – and it is the FIAF protein that has a regulatory effect on fat metabolism, particularly the regulation of fatty acids in the blood. It is therefore of potential interest in the prevention of metabolic diseases related to obesity.

The five-year project has a budget of 30 million DKK and has received 19.6 million DKK from the Danish Council for Strategic Research. The project is a collaboration between Aarhus University, University of Copenhagen, Gothenburg University, BGI-Shenzhen in China, the National Institute for Nutrition and Seafood Research (NIFES) in Norway and Arla Foods. ■

LINKS TO INDUSTRY

COMPOST QUALITY AFFECTS THE QUALITY OF ORGANIC BREAD WHEAT

For organic farms it may be a challenge to source adequate nutrient supplies for their crops when the use of conventional manure is phased out in 2022. Generally, there is a need for a strong nutrient supply in order to be able to grow wheat with a high protein content and good bread-baking qualities.

The interdisciplinary project RoCo has therefore examined the baking and bread quality of different bread wheat varieties grown with nutrients supplied from six different types of compost and a control treatment. The nutrient supply from the different composts affected the sensory quality of the bread. The effect also appears to be dependent on the wheat variety used.

RoCo is financed by the Green Development and Demonstration Programme, coordinated by ICROFS and is a partnership between Aarhus University, University of Copenhagen, KomTek Environment Ltd, Solum A/S, SEGES, the Danish Agricultural Advisory Service and Organic Denmark.

POLICY SUPPORT

DOES ORIGIN MATTER FOR A CARROT?

Does the taste, nutritional value or perception of a product's quality differ depending on where it comes from? The Danish Veterinary and Food Administration would like to have some solid facts about the importance of the origin of food products and therefore asked DCA to examine the extent of the knowledge on this.

It turns out that there is very little knowledge about the effect of local conditions such as soil conditions, climate or growing conditions on taste, nutritional value or other qualities in fruit, vegetables or meat, despite the fact that the market for food products with distinctive regional characteristics has grown in recent years.

The perception of the effect of local conditions on the characteristics of a product is called terroir. The place of origin can also have an effect on consumer attitudes to and expectations of a product

MATCHING TASTINESS WITH HEALTHINESS

LINKS TO INDUSTRY

It is a real dilemma when consumers turn their noses up at the very foods that are so good for them. This is because the healthy chemicals in plants often have a strong and bitter taste. Scientists from Aarhus University are working with a number of research institutes and the industry to change this situation.

Many Danish vegetables contain plant chemicals that can help reduce the risk of type 2 diabetes and heart disease. There is therefore every reason to pile them high on the plate when vegetables are served. However, not all consumers are equally keen on all types of greens.

The reason is that the healthy chemicals have a tendency to give the vegetables a strong and bitter taste. Particularly cabbages and root vegetables contain these phytochemicals that have a bitter taste, but many consumers prefer sweet and mild-tasting vegetables.

Research from farm to fork

In a large research project scientists from Aarhus University and Aarhus University Hospital are investigating with a host of other project partners whether new strategies and methods can be developed to increase consumer interest in eating the bitter and strong-tasting cabbages and root vegetables. The project spans cultural-historical, sociological, sensory, health-related and agronomic perspectives. The scientists are focusing on the following:

- The link between consumer preferences for cabbage and root vegetables and their diversity in taste and content of healthy substances
- The link between consumer preferences and sensitivity to the bitter taste
- Potential health benefits of vegetables and cabbage with varying contents of healthy plant chemicals with focus on patients with type 2 diabetes
- How to modify and mask the bitter taste by changing growing and storage conditions and during cooking using taste interactions
- Explaining current consumer patterns from cultural-historical patterns and using them to evaluate the branding and market potential of the vegetables as part of New Nordic cuisine.

– The combined results can be used to entice consumers to eat more of the bitter and strong-tasting root vegetables and cabbages, which can improve consumer health, says Associate Professor Ulla Kidmose from the Department of Food Science who leads the project.

Healthiness and taste can be controlled

Scientists from the Department of Food Science have shown that the bitter or sweet tastes of the cabbage and root vegetables are determined already at the growth stage. The same is true for their contents of healthy substances. Experiments have shown that the variety used and the fertilisation regime are two very important factors for the taste and healthiness of cabbages and root vegetables.

The first part of the experiment included white cabbage, kale, carrot and celeriac. Different old and modern varieties of vegetables were allocated different rates of nitrogen and sulphur fertiliser. The old varieties that are very variable in their sensory qualities were sourced from the Nordic gene bank, NordGen.

The scientists recorded yield at harvest and assessed the taste and sugar content of the vegetables plus their contents of healthy substances such as flavonoids and glucosinolates.

– We found that fertilisation and choice of variety can be used to modify the content of healthy substances and the sensory traits in cabbages and root vegetables, says Science Team Leader Hanne Lakkenborg Kristensen, who was responsible for this part of the project.

The vegetables were then assessed by a taste panel to create a taste profile which is then compared with the chemical analyses of the various ingredients naturally present in the vegetables. The scientists also examined the consumer intake of different types of cabbage and root vegetables and the most important factors influencing that intake, plus the link between consumer sensitivity to the bitter taste and their preference for it.

– One way of getting people to eat more of these vegetables may be to change the taste of the vegetables without changing their health impact. Another way could be to utilise the fact that we experience taste differently. People who are less sensitive to the bitter taste may be able to directly increase their intake, says Ulla Kidmose.

Strong and bitter is healthier than sweet and mild
In the next part of the experiments, the scientists selected a number of cultivation strategies for cabbage and root vegetables that tasted either bitter/strong or sweet/mild. The vegetables used were kale, pointed cabbage, white cabbage, celeriac, carrot and beetroot.

The vegetables were included in the diet of test persons with type 2 diabetes. A control group of test persons received a normal diet without extra cabbage and root vegetables. Another group received cabbage and root vegetables that tasted sweet or mild, while a third group received cabbage and root vegetables that tasted bitter or strong. The scientists measured a number of physiological parameters on the participants, including the concentration in blood of glucose, insulin and fatty acids, blood pressure, weight and fat distribution.

The investigations showed that a high intake of cabbage and root vegetables had a beneficial effect on patients with type 2 diabetes. Fertilisation and use of varieties with a strong and bitter taste had a larger positive impact on patients with type 2 diabetes than the varieties grown for their milder and sweeter taste.

The project is called MaxVeg and is supported by the Danish Council for Strategic Research. The project is a joint venture with the University of Southern Denmark, Aarhus University Hospital, INRA in France, Måltidkonsulenterne (meal experts), Diabetesforeningen (Danish diabetic society), SeedCom, Frugtformidlingen and several vegetable growers. The project is led by the Department of Food Science. ■

Photo: Jesper Rais

Associate Professor Ulla Kidmose is testing whether greens like cabbage and root vegetables can be made more palatable.

POLICY SUPPORT

NEW NORDIC FOOD IS JUST FOOD

Researchers from the MAPP Centre at Aarhus University have analysed the potential and market value of utilising the values and expertise associated with the new Nordic food concept. It would appear that new Nordic food, which is heavily into the use of Nordic ingredients and food traditions, is expected to endure as a niche for some time to come and that it in the longer term will end up being perceived as everyday food. But the values behind the concept will live on. They are seen as ideals that should apply generally to all Danish foods.

RESEARCH

MISSION: 300,000 PUBLIC SECTOR MEALS TO BE ORGANIC

About half a million meals are currently served for public sector workers every day. The government has an ambition that 60 percent of these meals should be organically sourced by year 2020. To this end, the Danish Veterinary and Food Administration asked DCA to look into the extent to which consumer approval of the use of organic products in the public sector is determined by context and association and whether consumers know about the gold, silver and bronze organic cuisine labels and what they represent.

The results of the investigation showed that Danes to a large extent have a positive attitude to the promotion of organically-sourced produce in public catering establishments. This is particularly the case for women, for people living in towns, for the young and for people with a higher income and higher education. The investigation also found that there is poor familiarity with the organic cuisine labels. This could be because of their, as yet, limited distribution.

TIME FOR **ERSATZ DIETARY FIBRE?**

LINKS TO INDUSTRY

Scientists from the Department of Animal Science are developing a new dietary supplement that bypasses the fibre bit and goes directly to the crux: butyric acid. The aim is to promote colonic health.

We have heard it before: dietary fibre has a positive effect on gut flora. But not everyone enthuses over crunching carrots or crispbread in large amounts. The question is whether you can get away with eating less fibre but still get the benefits of them.

Scientists at Aarhus University believe you can. They have started developing a dietary supplement that will make it easier to achieve the recommended daily intake of dietary fibre without eating oceans of ryebread and vegetables.

The dietary supplement is based on modified starch. The idea is that by eating the supplement you can prevent problems in the colon such as cancer and inflammatory conditions. This means that you can get the beneficial effect without eating the somewhat boring fibre in the traditional way.

Mimics the effects of fibre

The good thing about dietary fibres is that they strongly increase the production of butyric acid in the gut. Butyric acid is a short-chain fatty acid that is produced when microorganisms convert dietary fibre in the colon. Butyric acid is the preferred source of energy for the colonic cells and is of specific importance for cell division and development. Butyric acid also has a positive effect on inflammation and cancer in the colon and is thus crucial for the maintenance of colonic health.

If you do not eat sufficient fibre, you have too little butyric acid in the colon.

– The typical Danish diet has a high content of red meat, fat and easily digestible carbohydrate such as sugar and white flour. The typical diet has a low fibre content. The low fibre content restricts the production of butyric acid and therefore increases the risk of inflammatory conditions and colon cancer, says postdoc and leader of the project, Tina Skau Nielsen from the Department of Animal Science.

A high fibre intake is not always easy to practise, since dietary fibre can have a negative effect on taste. Realistically it also takes a long time to chew your way through foods with a naturally high fibre content. There is therefore a need for other ways of producing butyric acid for the colon. This is where starch enters the picture.

Tina Skau Nielsen uses enzymes to modify starch from, for example, maize, potatoes and wheat so that it behaves more like fibre. The molecule becomes more branched so that instead of being quickly decomposed in the small intestine, it makes it all the way down to the colon where microorganisms convert the modified molecule to butyric acid. The scientists also wish to couple butyric acid directly to starch. This will give a product that much more effectively than hitherto can deliver butyric acid directly to the colon.

First rats then humans

In the first instance the product will be tested on rats that will be fed a lot of fat and protein so that their diet mimics our own unhealthy low-fibre diet. The rats are subsequently fed the modified starch product to see whether it can counteract the negative effects of the unhealthy diet on colonic health.

When the scientists have tested whether it has a positive effect on rats, the next step will be the development of a usable product that can be taken by people as a dietary supplement – to specific groups of patients, for example – or as an additive in certain foods. It will, however, take at least five years before research gets that far.

The 2.5-year project has a total budget of 3.3 million DKK that has been granted by The Danish Council for Independent Research | Technology and Production. The other project partners are CSIRO Food and Nutritional Sciences in Australia, University of Copenhagen and the food ingredient supplier KMC. ■

Photo: Flemming Nielsen

Rats are fed a diet to mimic a human unhealthy diet, and subsequently a diet with a starch product.

RESEARCH

THE SECRETS OF OUR FOOD HABITS REVEALED

New food products are being developed to promote health, but the challenge is often to ensure that the products also appeal to our senses so that they become a permanent part of our diet. A product needs to appeal to our brain, to the context in which it is eaten, and to our senses and feelings.

The scientists at the Department of Food Science use professional sensory panels where a number of test persons are presented with new products. Based on this, the scientists can make objective evaluations of taste, smell and appearance.

One of the questions the test persons will be asked is what kind of feelings a new food product evokes in order to get knowledge about consumer perceptions and emotional reactions to the food products. Other psychological factors such as music, memories and the people you mix with also play a large part in how you experience your meal. These conditions are also mapped by the scientists – all with a view to improving our eating habits.

POLICY SUPPORT

CONSUMERS RESPOND TO KEYHOLE CAMPAIGN

When in the supermarket you have to pick the products to put into your trolley, does the presence of a green Keyhole symbol on the product make a difference to your choice? Can consumers be persuaded to purchase Keyhole-labelled products if a campaign targets these products?

The answer is yes according to a survey carried out by scientists at the MAPP Centre at Aarhus University at the request of the Danish Veterinary and Food Administration. The sale of Keyhole products rose by up to 10 per cent when a targeted campaign was run.

Knowledge about the effects of campaigns is central for quality assurance and for the further development of such initiatives in the coming years.

Photo: Jesper Rais

LIVESTOCK RESEARCH ON THE AGENDA IN COPENHAGEN

Around 950 scientists and advisers from 60 countries took part in the 65th meeting of the European Federation of Animal Science, EAAP 2014, in Copenhagen at the end of August. Aarhus University was one of the organisers of the conference, together with University of Copenhagen and the Knowledge Centre for Agriculture.

The main theme of the conference was quality and sustainability in livestock production and comprised topics such as resource efficiency, sustainability, animal welfare, agroecology and product quality. A main theme was the discussion of the role of animal husbandry in future food production. The global demand for food of animal origin is growing strongly and this creates challenges in relation to nature, environment and climate.

Photo: Colourbox

ARLA INVESTS MILLIONS IN RESEARCH AT AARHUS UNIVERSITY

In October 2014, Arla turned the first sod for a new innovation centre at the Agro Food Centre in Aarhus. The centre represents an investment of 270 million DKK and is expected to stand completed in autumn 2016. From 2015 Arla will be investing a further 62.5 million DKK in a new research centre, with Aarhus University and University of Copenhagen as research partners.

The funds are earmarked for research in how dairy products may strengthen the immune system, prevent diseases such as type 2 diabetes and counteract malnutrition. The funds will finance 40 PhD and postdoc positions in the research area of the nutritional and health aspects of dairy products.

Photo: Lars Kruse

ADJUSTMENT OF ACTIVITIES AT AARHUS UNIVERSITY

The management at Aarhus University have decided that the research facilities and activities at AU Flakkebjerg will remain in Flakkebjerg in order to fully exploit its capacity for growth in collaboration with the industry and regional partners.

The food science activities, on the other hand, will be moved from Foulum and Årslev to Aarhus where the Department of Food Science is expected to be housed in Agro Food Park in Skejby. The move is the result of the wish to strengthen the research environment in food production and strengthen collaboration with private companies. The policy support is likewise expected to be strengthened and students will have better opportunities to participate in food research.

In connection with spending cuts at Aarhus University, the activities at Jyndevad research station are gradually being phased out. Existing experiments will therefore be wound up within the next four years.

Illustration: Colourbox

DCA ON THE SOCIAL MEDIA

DCA is on Facebook and LinkedIn where you can get the latest news regarding food and agriculture research at Aarhus University.

Photo: Janne Hansen

RESEARCH STATION ANNIVERSARIES

The Aarhus University research station at Jyndevad in southern Denmark celebrated its 75th anniversary in 2014. This was commemorated with a seminar where a number of presentations were given by different scientists from Aarhus University on, for example, irrigation and energy crops.

The Askov research station, also in southern Denmark, had a noteworthy anniversary to celebrate, where fertiliser experiments have now been carried out for 120 years. This makes them some of the oldest experiments in the world. DCA has published a report describing the unique experiments and some of their history. The research station was established in 1885.

Photo: Lise Balsby

AGRICULTURAL RESEARCH AT AARHUS UNIVERSITY IS WORLD-CLASS

Aarhus University is one of the best in the world at agricultural research, according to the National Taiwan University's (NTU) list of university rankings within agricultural research. Aarhus University was ranked no. 11 in 2014. In Europe, Aarhus University was only outperformed by three other universities.

Photo: Colourbox

AARHUS UNIVERSITY IN A EUROPEAN INTEGRATED PEST MANAGEMENT ALLIANCE

A new EU initiative, C-IPM, helps to coordinate the European research effort on integrated pest management. The Danish participant is the Danish AgriFish Agency, which is represented by the Department of Agroecology and by DCA – Danish Centre for Food and Agriculture.

As many as 32 partner organisations including ministries of agriculture and research institutions from 21 European countries, participate in C-IPM, which has been granted €2 million from the EU ERA-Net scheme, the aim of which is to coordinate a strategic research agenda and organise and implement transnational funding applications.

SUCCESSFUL INTERNATIONAL CONFERENCE ON HORSE BEHAVIOUR

More than 200 scientists, veterinarians and professional riders from several continents made their way to Denmark for the 10th international horse research conference, ISES 2014, held near Vejle. The conference was organised by scientists from Aarhus University and its main themes were stress, learning and training of horses. Scientists from the Department of Animal Science gave several presentations. The research results presented at the conference have been published in a report by DCA. HRH Princess Benedikte was the protector for the conference.

Photo: Colourbox

375

Number of scientists (including PhD students) at Aarhus University working in food and agricultural science

280

Amount of money (million DKK) received by DCA in 2014 for research-based policy support from the Ministry of Food, Agriculture and Fisheries

714,5

Total amount (million DKK) used by DCA on food and agricultural research via gearing of the funds from the Ministry of Food, Agriculture and Fisheries

150

Approximate number of commissions that DCA carried out as part of the agreement with the Ministry of Food, Agriculture and Fisheries

13

Number of key research areas that the agreement with the Ministry of Food, Agriculture and Fisheries covers

18

Number of reports published by DCA in 2014.
See the full list on dca.au.dk

8232

Number of times DCA reports were downloaded from dca.au.dk in 2014

66

Number of meetings and other events in 2014 which were open to the public

51

Number of PhD dissertations approved in 2014

727

Number of scientific publications

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