

## **Wageningen University & Research 1918 – 2018**

### **One hundred years Science for Impact**

**Testimonials: Research at the frontier of science with impact on society.**  
**48 examples of partly ongoing research by Wageningen University & Research**

### **Masses of microscopic algae for food and feed**

The AlgaePARC is a research facility from WUR aiming to unleash the full potential of algae. This facility is the result of an investment made by a consortium of 19 companies interested in what is considered the “green gold of the future”. Many of the research of the Bioprocess Engineering Group takes place in this facility, aiming to produce high-value products from water, CO<sub>2</sub>, and sunlight. AlgaePARC scientists seek to advance on the state of the art by optimising algae cultivation, improving algae strains, and scaling up the processes.

The advances in algae cultivation and strain development are sky-rocketing. Scientists at AlgaePARC have developed a strain that produced two times the amount of lipids than a wild strain. This strain improvement has been achieved in just two years by selecting the algae that had bigger lipid bodies in its cellular matrix. Because of the microscopic size of the algae, the selection of the best algae has not been a child’s play and required a lot of time and labour. However, the outcome is more than satisfactory and is a great leap towards sustainable algae lipid production.

The AlgaePARC has done an economic analysis to monitor the economic improvement in algae cultivation. According to this study, in 2010 the cost production ratio of algae production was 5 to 6 Euros, while in 2015 this ratio decreased to 2.5 Euros. This reduction is the result of scientific advances thanks to the efforts of scientists from the AlgaePARC. The aim is to reduce the cost production ratio till 1 to 0.5 Euros so that the algae production can be competitive in the market.

Want to know more about the AlgaePARC?

Contact the WUR expert on algae, Rene Wijffels. [rene.wijffels@wur.nl](mailto:rene.wijffels@wur.nl)

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### **How feed for our cattle can reduce the area of arable land**

The industry of animal feed is a sector that strives for constant innovation to provide the best animal growth and welfare while maximising resource

efficiency. The feed conversion ratio that measures how efficient is an animal feed has been increasing 1 to 2 percent per year during the last decades. The industry of animal feed in the Netherlands has engaged with WUR in public-private partnerships, such as Breed&Feed4Food or Feed4Foodure.

The Dutch Animal Feed Research Federation (VDN) has established various objectives for the next years to upgrade animal feeds. Feed formulation can be customised to strengthen the immune system or modify the intestinal flora to promote animal welfare. Moreover, feeds can also influence animals behaviour, leading to less feather picking in poultry or tail biting in pigs. Apart from animal welfare, improving protein and phosphate efficiency in animal feed while reducing its environmental footprint also within the objectives of VDN and WUR.

Regarding animal feed footprint, the FeedPrint tool is the jewel of the crown of WUR research in feed sustainability. This tool calculates the carbon footprint of feed raw materials during their complete life cycle. This tool is used by companies to assess the CO2 emissions of feed during its whole value chain. As the 95% of the CO2 emissions are due to the feed composition this tool enables companies to consider the environmental impact of its feed formulation.

Improving animal feed efficiency and developing sustainable agriculture is within the core values of WUR since its conception 100 years ago.

Do you want to know more about animal feed efficiency?

Contact the expert on animal feed, Leo Marchal. [leo.marchal@wur.nl](mailto:leo.marchal@wur.nl)

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## **Aquaculture in the world is a growing area for human needs for proteins and healthy fatty acids**

The demand for fish and seafood products is increasing while fisheries are becoming overexploited. Aquaculture is expected to meet the increasing consumer demand for fish while alleviating the pressure on fisheries. Sustainable fish feed and recirculating aquaculture systems are promising fields in which WUR are actively working.

Recirculating Aquaculture Systems (RAS) allows fish culture in controlled conditions and in high densities to maximise aquaculture production. These systems minimise water and nutrient discharges into the environment as more than 90% of the water is recirculated. During this recirculation, the water is mechanically and biologically filtered to ensure optimal water quality. Temperature, pH, and oxygen levels are entirely controlled in recirculating systems to assure fish welfare. RAS avoids fish escapes and feed losses, making intensive aquaculture production a viable option.

Ep Eding has been working on recirculating systems at WUR since the conception of these technologies. He aims to develop this technology to reach zero water discharge. Alongside with Ep, Marc Verdegem is working on how to maximise nutrient efficiency in integrated aquaculture systems. These systems aim to use the waste streams of fish to culture molluscs and algae. Ep Eding and Marc

Verdegem, along with their colleagues of the WUR Department of Aquaculture and Fisheries are working to develop a sustainable Blue Revolution.

Triggered to know more about aquaculture?

Contact the WUR experts Ep Eding and Marc Verdegem. [ep.eding@wur.nl](mailto:ep.eding@wur.nl)  
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### **Artificial photosynthesis: Urban buses are running with it**

Plants can produce high energy compounds from water, CO<sub>2</sub>, and the energy they get from the sun. Artificial photosynthesis aims to emulate this process to synthesise high energy molecules (methanol or formic acid) from CO<sub>2</sub>, water, and an artificial source of energy. Methanol and formic acid are used as energy storage when there is a surplus of energy production. There are already urban buses in the market running with these substances as a fuel.

The WUR Agrotechnology and Food Sciences Group, and the Wageningen Food and Biobased Research, have been working along with BIOMCN located in Delfzijl to develop artificial photosynthesis that relies on enzymes. The enzyme approach to artificial photosynthesis is preferred because it mimics nature better and the purity of the final product is higher. This method of artificial photosynthesis has already been successful at the millilitre scale, and the consortium is planning to scale it up to the litre.

The scaling up of this technology would have a positive environmental impact on the environment as this technology is carbon neutral and allows the storage of a surplus of renewable energy. Artificial photosynthesis is a promising technology with the potential to change the renewable energy sector.

Curious about artificial photosynthesis?

Contact the WUR expert, Jules Beekwilder [jules.beekwilder@wur.nl](mailto:jules.beekwilder@wur.nl)

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### **Wageningen and the Great Insect War**

The use of insects for biological control of greenhouses pests is already a reality. Climate control, LED lightings, and robots share the same space along with insects that keep damaging organisms under control. Biological control leads to healthier plants and higher yields, does not have toxic implication to farm workers, does not lead to pest resistance, and there are no pesticide residues on the final product. That is why managers of high technology greenhouses in the Netherlands prefer to use biological control rather than chemical pesticides.

The entomologist Joop van Lenteren from WUR has been a pioneer in biological control, enabling companies to apply the concepts of insect population



dynamics, whereby the release of a beneficial insect controls the population of a damaging insect. Van Lenteren and his colleagues from the WUR Department of Entomology have developed the techniques necessary for insect rearing, shipping, and distribution of millions of insects per week. Wageningen knowledge played such a critical role in the upscale of this technology that a stamp was designed to commemorate its contribution to this game-changing technology.

Van Lenteren disciples work for companies such as Koppert Biological Systems, the biggest company in the world regarding biological control. Koppert has its headquarters in the Netherlands, but it has 25 offices worldwide, employing more than 1400 full-time professionals. Koppert revenues increased year after year, and in 2017 the company registered a turnover of more than 200 million Euros. The success of businesses like Koppert is an indication that pest control has shifted towards biological control thanks to the Wageningen alumni that steered this change.

Triggered to know more about biological control of pests?

Contact our expert Joop van Lenteren [joop.vanlenteren@wur.nl](mailto:joop.vanlenteren@wur.nl)

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### ***Terra preta* and the Carbon Soil Sequestration.**

“Terra Preta”, also known as Amazonian Dark Earths, are fertile anthropogenic soils found in the Amazon. These soils are remnants of ancient, pre-Columbian societies generated between 3000 and 500 years BC. The extraordinary fertility of these soils have led to extensive studies on its composition, origin, and possible applications. It is known that these soils have charcoal originated from the burning of organic matter by pre-Columbian communities. The presence of this charcoal improves soil quality, enabling agriculture in these Amazonian non-fertile soils.

The study of this soils have led to the popularization of biochar technology. Biochar is a high-carbon residue produced through modern pyrolysis processes in the absence of oxygen. These technologies produces a mixture of solids, liquid, and gas products with different uses. Biochar is a promising product with potential for carbon soil sequestration, as it remains in the soil for thousands of years. Biochar has also proven to reduce the emissions of greenhouse gases such as nitrous oxide and methane to the atmosphere.

WUR has foreseen the potential of this new technology and has adopted a leading role within the Terra Preta Programme. This programme engages organisations from the Netherlands, Brazil, Bolivia, and Colombia to study the technical, anthropological, economic, and climate aspects of the exploitation of Terras Pretas. The technologies derived from these studies can address climate change while enhancing agriculture, making the Terra Preta programme and biochar a topic in which WUR is a pioneer.

Curious to know more about Terra Preta, biochar, and carbon soil sequestration?

Contact the WUR expert, Thom Kuyper. [tom.kuyper@wur.nl](mailto:tom.kuyper@wur.nl)

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## Being a patient and undernourished

The risk of undernutrition in developed countries is increasing. One out of five patients in hospitals and caring homes is undernourished, and one out of three is at risk of becoming undernourished. Older adults tend to lose their appetite and often develop a preference for soft and sweet foods and drinks, such as soups, juices, bread, porridges, etc. The advice of doctors to eat more, or eat differently, is rarely followed because elderly tend to stick to their habits. Consequently, the risk of undernutrition increases because their preferred diet results in a low protein intake.

The WUR Department of Human Nutrition along with the hospital 'Gelderse Vallei' in Ede have developed a programme to tackle undernutrition in the elderly. The programme, baptised as Cater with Care, fortifies favourite food products among the elderly with added protein without changing taste or texture. The programme has been a success, as 71% of the elderly were able to reach the recommended protein intake, compared with 31% of the patients that followed a regular protein-rich programme.

Implementing this programme required the involvement of WUR, the hospital 'Gelderse Vallei', the NIZO institute for food research, and private companies such as Heinz, Carezzo, and local providers. The outcome of this collaboration has been very welcomed by the population. The concept 'Cater with Care' could be easily extended to other needs, such as diets low in salt, or diets aimed at hospitalized children.

Interested in improving nutrition without changing eating habits?

Contact the WUR expert, Nicole de Roos. [nicole.deroos@wur.nl](mailto:nicole.deroos@wur.nl)

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## Cheese !

The Netherlands is a cheese producing country with various typical cheeses that are exported worldwide. Producing high-quality cheese to reach high-end consumers and restaurants requires constant innovation and scientific research.

WUR has collaborated with the producers of the Remeker cheese to study how different cheese coatings affect the taste and quality of their Dutch cheese. Remeker uses non-heated milk from Jersey cows for its cheese production, and it does not have a traditional cheese coating. WUR has studied if the mould growing on the milk fat coating in the Remeker cheese would affect the quality of this premium cheese that targets restaurants with Michelin stars.

WUR found out that mould on the coating affects the organoleptic qualities of this typical Dutch cheese. These results allowed Remeker to understand the impact of the ripening of their cheese by modifying the cheese coating. The outcomes of this research led to the publication of 5 to 6 articles in professional journals having a worldwide impact on cheese production.

Do you love cheese and you want to know more?

Contact our WUR cheese expert Kasper Hettinga. [kasper.hettinga@wur.nl](mailto:kasper.hettinga@wur.nl)

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## **Adapting to a changing Climate**

Climate change is increasing the problem of urban heat islands. It is well-known that the centre of big metropolises can be up to 9 Celsius degrees warmer than the countryside. The heat waves that affected Europe in the summer of 2003 and 2006 resulted in thousands of heat-related deaths among the elderly. The heat wave that affected France in 2003 resulted in 14.802 deaths according to the according to the French National Institute of Health. This terrifying numbers alarmed the population, demanding city climate change adaptation.

Bert Holtslag and his colleagues from the WUR Department of Meteorology and Air Quality concluded that urban heat islands affect not only big cities in warm areas but also small towns in the Netherlands. The centre of Wageningen during a summer evening is 6 degrees warmer than the countryside. To analyse the factors that contribute to this increase in temperature in cities, WUR has developed a bike equipped with machinery that records radiation from the sun, reflected radiation from buildings, humidity, temperature, etc. Thanks to this data various tools, including an app, have been developed to inform the public authorities and citizens about streets with a high risk of overheating, or the least polluted roads for a bike ride.

This information is also useful to determine what factors make an area more adapted to climate change. The Netherlands is not adapted to hot summers, and cities should have more coverage to avoid radiation. Imitating nature is usually the best solution, and tree coverage is the best alternative to make our streets more livable. WUR keeps on monitoring the effects of climate change while proposing climate solutions to deal with what might be considered the biggest challenge of the 21<sup>st</sup> century.

Want to know more about climate change and climate solutions?

Contact the WUR expert, Bert Holtslag. [bert.holtslag@wur.nl](mailto:bert.holtslag@wur.nl)

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## **Climate migration**

The consequences of climate change will affect all segments of our society. However, the severity of these effects will largely depend on where the communities are located and the wealth of its members. Several WUR departments are working on climate change topics. Ingrid Boas from the Environmental Policy Group is studying how environmental change, including climate change, affects the migration patterns of people affected by disasters and long-term changes in the environment.

Multiple factors affect the decision of people to move. Factors like distance, connections and information, possibilities to work, or cultural and political factors

influence where people will and can settle after a forced departure from their homes, and whether they can or want to leave in the first place. Most affected communities move short distances and within national borders, often maintaining a close link with their hometown or region.

This more nuanced picture of the relationship between environmental change and migration contrasts with the apocalyptic view of climate migration often mentioned in the news and depicted in movies. In this context, Ingrid Boas and her colleagues regularly highlight the complex and everyday empirical realities of the issue when offering expert advice to the Dutch Government, the United Nations, the European Commission, NGOs and the media on this subject. This to ensure that newly designed policies fit with the problems at hand and help those most in need in an appropriate manner, also to avoid stigmatising migrants and the places where it occurs as dangerous.

Triggered to know more about climate migrations?

Ask the WUR expert, Ingrid Boas [ingrid.boas@wur.nl](mailto:ingrid.boas@wur.nl)

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## **Soft matter, hard science**

Colloids, polymers, foams, liquid crystals,... these materials are now called under the generalist name of soft matter. You can find these materials everywhere yet you don't realise. They are present in foods like yoghurt, mayonnaise, puree, butter, or jelly are colloids. Apart from food, the paint of your house, or the fog you see in the mornings, are colloids.

The WUR Department of Physical Chemistry and Soft Matter is researching the properties of these materials. The focus of the group is on fundamental science, but they collaborate with various companies dealing with colloids in different industrial fields. Businesses like AkzoNobel or Canon work with WUR to develop paints with improved characteristics and a lower impact on the environment and workers health. Unilever is researching how light mayonnaise with fewer calories and a different composition can have the same properties as the normal mayonnaise.

WUR also collaborates with other universities to develop new colloid applications. TUDelft engineers outsourced the WUR fundamental knowledge on the soft matter to build self-healing materials. These materials have futuristic applications as they can recover from scratches and fractures to recoup its initial form. These applications that seem to be only possible in science-fiction movies are already a reality in our lives thanks to the collaboration of WUR with other universities and companies.

Fascinated by the applications of Soft Matter? Want to know more?

Contact the WUR expert, Joris Sprakel. [joris.sprakel@wur.nl](mailto:joris.sprakel@wur.nl)

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## Revolving ways to make a strong crop

Genome editing will lead to advances in society towards improved yields in agriculture, synthetic production of high-value products, or curing certain genetic diseases. However, genome editing requires high precision and efficiency when introducing or deleting genes from the genome.

Wageningen University and Research, and the Massachusetts Institute of Technology have developed a new technique for genome editing coined as CPF-1. Both institutions hold a patent on this revolutionary technology that allows precise and efficient genome editing. Editas Medicine, a company specialised in CRISPR-Cas9 technology, is commercialising CPF-1 for treating the rare inherited eye disease named Leber Congenital Amaurosis 10 (LCA10). This genetic disorder affects one out of 40.000 new-borns and entails severe vision loss or blindness, depending on the genes affected. Editas Medicine is experimenting with eye droplets based on this technology to aim for gene editing in the eye tissue.

Other genetic inherit diseases could be cured using this technology for gene editing. The applications of CPF-1 are not limited to medicine, but they can be applied to multiple fields. The economic resources that WUR is obtaining from the commercialisation of this patent are destined to study other applications of this technology and promising microbiology research.

Curious to know more about the applications of CPF-1?

Contact the WUR expert, John van der Oost. [john.vanderoost@wur.nl](mailto:john.vanderoost@wur.nl)

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## Dairy Industry in East Africa

The demand for milk and milk-derived products in East Africa is expected to increase in the next years. The dairy sector and its production in this African region vary per country. Kenia has a dairy programme that has been running for 40 years, while countries like Burundi lack political support on the milk supply chain. WUR is studying how to develop the dairy sector in various countries with different socio-political situations.

Kenia leads the milk production and milk consumption in East Africa when compared with countries like Burundi, Ethiopia, Rwanda, Tanzania, or Uganda. The milk production in these last five countries is deficient and drags the milk consumption per capita to values below 50 litres per annum. The reasons for this low productivity lay in an inappropriate cattle breeds, low feed supply, diseases, farmer education, high milk losses of up to 50%, or low adoption of dairy industry technologies.

Jan van der Leer, from the Wageningen Livestock Research, is working in these East African countries to improve the milk supply chain. Alongside local institutions, Jan is researching viable entrepreneurship options, such as automatic vending machines, to increase milk quality and its commercialisation. The idea is to move the sector towards a multistakeholder approach in which farmers form cooperatives, the processing industry is settled, and the consumer

demand increases. The development of the dairy industry in East Africa faces many challenges that WUR is currently trying to overcome along with African entrepreneurs.

Curious to know more about the development of the African dairy sector?

Contact the WUR expert, Jan van der Lee. [jan.vanderlee@wur.nl](mailto:jan.vanderlee@wur.nl)

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## **Delta management**

The Netherlands is located in the delta of the rivers Rhine, Schelde and Maas, and most of its territory is below sea level. The expertise of the Dutch regarding flooding protection is worldwide known. Dutch knowledge in delta management is exported to other countries through projects in which WUR collaborates with partners, such as Deltares, foreign governments, or Dutch companies.

Safety in deltas and coastal zones is of paramount importance in the Netherlands as 70% of the country GDP is earned in areas prone to flooding and most people live in these areas. WUR experts in flood management are working in developing countries such as Bangladesh to protect those countries against flooding. In Bangladesh alone, 60 million people live in potentially flooded areas. The consequences of flooding disasters in these areas would be enormous. WUR has developed future scenarios for Bangladesh and has proposed nature-based solutions to deal with erosion in Bangladesh while improving ecosystem services.

Besides Bangladesh, WUR has collaborated in the Delta plans of the Mekong River, in Vietnam; and the Kapuas and Mahakam river, in Indonesia. Each of these locations has its particularities and challenges. Delta management is not all about building dykes and fight against erosion, but also about water quality, natural environment, and local communities. WUR experts are studying how to avoid groundwater salinisation to provide freshwater to communities living in delta areas.

Interested in delta management?

Contact the WUR expert, Ivo Demmers. [Ivo.demmers@wur.nl](mailto:Ivo.demmers@wur.nl)

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## **Drainage Systems**

Agriculture soils require proper drainage to avoid salt accumulation because of constant irrigation. In some urban regions, adequate soil drainage is critical to prevent flooding. Complex pipe systems are buried on land to drain it from an excess of water. These pipes are covered with a coating of a different kind that adapts to the rainfall, irrigation, and soil type or the area. A Turkish entrepreneur has outsourced WUR knowledge from the soil expert Henk Ritzema to develop a universal system for soil drainage.

The Hydroluis Drainage Pipe System uses an innovative plastic coating engineered in a way that plant roots do not colonise the system, the phreatic water level is not affected, and sediments do not clog the pipe. Wageningen University has tested the Hidroluis idea in several countries with different soil types and climate zones. Dutch and WUR knowledge on drainage is usually

outsources by international companies working on the field, as the Netherlands has developed systems to drain water in floodplains.

The commercialisation of innovative drainage technologies like this one avoids mineral accumulation in agricultural land and flooding in urban areas.

Wageningen University is collaborating with international, risk-taking, entrepreneurs to transform scientific knowledge into commercial applications.

Triggered to know more about drainage systems?

Contact the WUR expert, Henk Ritzema. [henk.ritzema@wur.nl](mailto:henk.ritzema@wur.nl)

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## **Drones**

New technologies that come to the market such as drones can have a tremendous potential for scientific developments. WUR has foreseen the impact of these technologies and set up an Unmanned Aerial Remote Sensing Facility (UARSF) in 2012. These technologies can be equipped with the latest sensing technology such as hyperspectral and fluorescence cameras.

WUR has developed techniques regarding the application of these technologies to real cases. Several projects that count with WUR participation have been developed using this technology. The BIOSOS project monitors Natura 2000 protected areas in the Netherlands, the Mediterranean, and Wales. This technique can also be applied to the coastal regions. The coral reefs of Bonaire have been monitored using a hyperspectral camera alongside with diving in selected areas. Another example of a coastal application of this technology is the NatureCoast project that aims to track dune formation in the Zandmotor.

The application possibilities for unmanned aerial systems and the technology that they hold are unlimited. The information we gather with these new technologies enables new and innovative research that leads to an improvement of the quality of life. Wageningen University is using the latest technology to unravel the secrets of Earth.

Curious to know more about these technologies?

Contact our expert

Sander Mucher [sander.mucher@wur.nl](mailto:sander.mucher@wur.nl)

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## **Dutch Embassies on Development and Aid Programmes.**

The Netherlands allocates 0.7 of their GDP to international development and aid. This capital corresponds to the Dutch contribution to fund international institutions like the UN or the World Bank. Besides that, part of this money is also spent in development programmes independently managed by Dutch embassies. This development programmes supported by the Netherlands require detailed monitoring of its outputs, expenditures, processes and partners involved.

The Wageningen Centre for Development Innovation cooperates with Dutch embassies to monitor development and aid programmes to maximise its efficiency and provide advice. The involvement of WUR ensures the application of state of the art technology and techniques in these plans. The WCDI was involved in a total of 60 missions in 15 countries, making up more than 2000 consulting days. In these missions, Wageningen staff works along with regional experts and locals to ensure success.

Dutch firms are usually involved in these programmes providing products or technology not available in the region. This conglomerate of different institutions leads to the implementation of new technologies and changes in social processes in the area. Ultimately, this leads to the empowerment of local communities contributing to food security.

Interested in knowing the role of WUR in development and aid programmes?

Contact our expert, Herman Brouwer. [herman.brouwer@wur.nl](mailto:herman.brouwer@wur.nl)

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## **Top sport and food**

Olympic athletes are professionals of a particular sport with a commitment to overcome their physical limits. Trainers oversee their performance, and nutritionists supervise their food intake. WUR scientists are evaluating their performance to assess and give advice on their boundaries. WUR is part of Eat2Move, a group that includes the Hospital Gelderse Vallei, the province of Gelderland, the Dutch Olympic sports centre Papendal, and various companies, that aim to study the linkage between diets and physical condition of people.

The most well-known theme of the programme Eat2Move is centred around the performance of Dutch Olympic athletes and their nutrition. WUR is studying how to test through metabolic cues the physical limits of professional athletes before suffering they suffer injuries. WUR is the knowledge centre of Eat2Move, providing the fundamental knowledge necessary to maximise physical performance. The companies of the Eat2Move consortia have developed new food products specifically designed for professional athletes like the Sportsquark, a quark enriched in protein specially designed for professional athletes.

However, Eat2Move is not only focusing on professional athletes. WUR is collaborating with the hospital Gelderse Vallei to study how nutrition can be tailored to patient's needs. Changing diets and physical activity before a surgery influence patients mobility during the recovery. The goal of this collaboration is to provide advice for the fastest improvement of mobility. Nutrition and condition is everyone's concern. Wageningen University is unravelling the secrets behind well-being.

Want to know more about nutrition and physical condition?

Contact the WUR expert, Marco Mensink. [marco.mensink@wur.nl](mailto:marco.mensink@wur.nl)

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## Good fisheries

Fishing is an activity with an economical, social, and environmental impact. The pressure on a fishery depends on the economic value of the fish species and the legislation and quota to which it is subjected. WUR is researching various aspects of this complex activity to minimise environmental impact and maximise economic profit.

WUR collaborates with NGOs like Good Fish Foundation to steer fisheries in fields such as consumer demand, policy making, and stakeholder engagement. The Good Fish Foundation has created the fish guide *Viswijzer* that informs consumers about good fish choices. This guide aims to steer consumer demand towards sustainable fish to trigger changes in the market and ultimately fish captures. Good Fish Foundation has also developed programmes to increase the economic value of fish species usually discarded. Promoting discarded fish among consumers leads to its valorisation in the market while increasing fishermen income.

Good Fish Foundation headquarters are located in Veenendaal, in the surroundings of Wageningen. The NGO has collaboration agreements with WUR, and many alumni are working for the organisation. Along with Good Fish Foundation and other partners, WUR is working to develop sustainable fisheries not only in the Netherlands but also in remote places such as Vietnam or Indonesia.

Want to know more about Fisheries and Good Fish Foundation?

Contact the Good Fish Foundation Secretariat or the fisheries WUR expert Paul van Zwieten. [paul.vanzwieten@wur.nl](mailto:paul.vanzwieten@wur.nl)

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## Nutrition in Africa

Food and nutrition security is a well-known problem in Africa, especially for women and children. Fortifying foods, improving access to food, or providing healthy dietary guidelines are amongst actions that would lead to better nutrition in Africa. WUR has contributed to many of these measures to improve the quality of life on this continent. The Division of Human Nutrition through the research of Inge Brouwer and her team has had an impact on many African countries.

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) located in Mali, was developing new varieties of fonio, also known as the hungry rice for its growth characteristics and potential for food security. ICRISAT was selecting the varieties that had higher productivity. However, these species contained less zinc and iron compared to the traditional variety, and its introduction in the market would have consequences for human nutrition. WUR worked along with ICRISAT to select the ones with higher productivity and best nutritional characteristics.

The involvement of WUR in Africa is well-known, and along with the FAO, Inge Brouwer and her colleagues are developing food-based dietary guidelines for

African countries to help consumers, policymakers and food industry. However, such guidelines are present only in 7 out of the 54 African countries. As the guidelines are county specific, developing them is labour intensive, requiring data on nutrient intake, food access, and other socio-economic aspects. WUR and FAO are closely collaborating with local institutes to make dietary guidelines a reality to improve the quality of life of millions of people.

Curious about nutrition in Africa?

Contact the WUR expert Inge Brouwer [inge.brouwer@wur.nl](mailto:inge.brouwer@wur.nl)

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## **Plant Genomics fo better crops**

The Centre for BioSystem Genomics (CBSG) was a consortium of 15 companies and seven knowledge institutes that worked between 2002 and 2013 on whole genome sequencing, primarily of potato and tomato. The first genome of the potato was completed in 2011, and the tomato genome was finished in 2012, leading to two publications in Nature. Sequencing these first genomes required the involvement of multiple institutions and their completion took many years. Nowadays, the rapid advancements in genome technologies permits the sequencing of 150 tomato genomes at WUR facilities in a few months.

The CBSG focus on tomato and potato was the result of a strong strategic choice driven by the private partners, as the Netherlands is responsible for ca. 70% of the worldwide seed production of both species. Dutch breeding companies still partner with WUR for genomic projects at the pre-competitive stage enabling all companies to benefit from genome data generation, annotation and mining. The WUR research valorisation in plant genomics is outstanding; this can reduce the breeding time for a new variety by 30-40%, and save 5 to 25% of the economic costs of breeding programmes (Source: CBSG).

Tomato varieties with fruits of different colours, shapes, sizes and taste are now being developed faster thanks to the information that genomics provides to breeding companies. Companies such as Syngenta, KeyGene, RijkSwaan, or Enza Seeds engage in such projects together with WUR, and this ultimately shall lead to more and better crop varieties. Genome technologies are available at WUR and industry is already actively implementing such approaches in their plant breeding programmes. Public-private partnerships are flourishing to advance us faster towards a revolution in plant breeding.

Fascinated by these new technologies? Meet the expert behind Plant genomics at WUR.

Contact the WUR expert on genomics, Robert Hall. [robert.hall@wur.nl](mailto:robert.hall@wur.nl)

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## **High Valued Compounds**

The commodities you use on a daily basis like your shampoo or food flavourings are composed of many different compounds. The industries that produce them demand a steady and reliable supply of specific natural compounds at a stable

price. However, outsourcing these compounds might be difficult, expensive, or unsustainable.

The WUR Department of Agrotechnology and Food Science is studying the production pathways of these natural compounds to produce them synthetically. WUR has developed the synthetic production of artemisinin or taxol. These compounds have a medical use; artemisinin is used to fight malaria, while taxol is used against cancer. Stable production of these substances is essential to supply medicines to the population.

Valencene is another compound whose production pathway has also been developed at WUR. This natural compound is found on oranges, and it can be extracted from them. However, diseases outbreaks and climate conditions can affect orange production and valencene extraction, jeopardising industries that rely on this compound. The pathway developed by WUR is currently used by the company Isobionics that produce valencene in a bioreactor. Isobionics offers a product with a stable purity, quality, and price to the other industries.

Other compounds with economic interest developed at WUR include santalol and bisabolol. These compounds are used in the cosmetic industry. The synthetic production of santalol would reduce the demand for sandalwood, from where it is currently extracted, and have a positive environmental impact.

Interested in knowing more?

Contact Jules Beekwilder the WUR expert on synthetic production  
jules.beekwilder@wur.nl

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## **Horticulture without soil**

Traditional agriculture relies on the soil to grow crops. Growing vegetables on substrates such as stone wool, coconut fibres or gravel have already been implemented in Dutch greenhouses. The 98% of the tomatoes, sweet peppers and cucumbers in the Netherlands are grown on substrates. Hydroponic systems optimise the use of water and nutrients while permitting a full control of temperature, root oxygenation, electrical conductivity, etc. Besides, hydroponics avoids most soil-borne diseases, which are the cause of yield losses in soil between 10 and 50%.

WUR is researching the improvement and the implementation of this technology, their goal is to reach zero water emissions containing plant nutrients and plant protection products by recovering the drain water and in a next stage transpiration water. High tech Dutch greenhouses have already implemented this technology that allows growing one kg of fresh tomatoes with only 16L of water. Researchers reduced the energy spent to grow tomatoes in Dutch greenhouses up to a 75%, commercial growers realized already more than 50% when compared with the production in the 90s.

Apart from improving the efficiency of this technology, WUR researchers are working on implementing low-cost systems in developing countries such as

Jordan, Algeria, or Rwanda, among others. The investment of a high-tech Dutch greenhouse is recovered in ten years, while the investment spent in a conventional tunnel greenhouse can be recovered in two. WUR seeks maximum impact of its research in hydroponics by implementing them in low-tech greenhouses along with the development of low-cost hydroponic systems to realize higher production levels using less water per kg fresh product.

Curious about hydroponics? Want to know more about soilless horticulture?

Contact the WUR expert. Erik van Os. [erik.vanos@wur.nl](mailto:erik.vanos@wur.nl)

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## **Integrated Farm Planning in Burundi**

Farming in Burundi is usually not a choice but a consequence of fate. These farmers are not motivated because they did not have the means to gain agricultural knowledge. Consequently, their farming practices do not allow yield increases and their income is insufficient. Many farmers want to leave rural areas and change professions. The Integrated Farm Planning developed by Aad Kessler from Wageningen Environmental Research aims to promote farm entrepreneurship to avoid these issues.

The Integrated Farm Planning provides agricultural knowledge from experts to farmers in developing regions. By implementing some simple practices, like improved seeds or specific fertilisers, they can triple their yield. This improvement allows them to further invest in their farm to keep on increasing its production. That way farmers become entrepreneurs by choice, creating cooperatives, exchanging land, teaching other farmers, etc.

More than 30.000 households have been reached through the WUR programme led by Aad Kessler, improving their income and food security. The farmer intrinsic motivation to reinvest in the farm is very high, encouraging them to stay in their villages. The agriculture knowledge that the first generation of farmers receives from WUR is transmitted to other farmers, having a long-lasting impact.

Triggered to know more about the impact of WUR in farmers lives?

Contact the WUR expert, Aad Kessler. [aad.kessler@wur.nl](mailto:aad.kessler@wur.nl)

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## **Greenhouse LED Lighting**

The marketisation of LED lights entailed a revolution in the lighting industry. This energy efficient technology can be used in multiple settings, including greenhouse illumination for crop culture. This technology allows the customisation of light wavelength and intensity while saving 40% of the electricity compared with the traditional high pressure sodium lamps.

WUR is working along with lighting companies, growers and breeders to improve the percentage of light use by plants up to 30%. This increase in light efficiency would lead to higher yield productivity and efficiency. The use of LED lights in greenhouses allows the stable production of high-quality vegetables all year round. Greenhouse LED lighting enables the vertical production of crops that are

stacked in shelves inside buildings in urban areas. These vertical farms are proliferating in many urban areas with demand for locally grown vegetables.

Alongside with higher yields, LED lights allows the culture of crops with higher nutritional values. WUR research has found that intense LED lighting provided to tomato plants lead to a 100% increase in the content of vitamin C compared with traditional farming. This increase in vitamin C content has also been acknowledged in lettuce. WUR researchers are studying how LED lights affect the plant composition to improve the flavour of aromatic plants such as basil.

Thrilled about the applications of LED lighting to crop culture?

Contact the WUR expert on lighting in Greenhouses and Vertical Farms, Leo Marcelis. [leo.marcelis@wur.nl](mailto:leo.marcelis@wur.nl)

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## **The Fight Against Malaria**

Malaria is the most prevalent infectious disease transmitted by insects, causing more than 200 million new cases of malaria each year. Half a million young children die of malaria every year. They are most vulnerable, as their immunological system has not yet developed resistance.

Malaria infections have a high social and an economic impact in many African countries. On average, 10% of an African household income is spent on the medical treatment of malaria. This expenditure on malaria treatment along with the incapacitation to work while being infected with malaria negatively affects the economy of countries in which malaria infections are an everyday issue.

The efforts of WUR to fight malaria are focused on mosquito control, as this has proven to be most effective for control of the disease. Willem Takken has studied which human scents mosquitoes detect to recognise their victims. He has spent 25 years researching this topic till his research group found the answer. Nowadays, these scents are mimicked to trick mosquitoes into traps rather than that they bite human beings.

Willem Takken has recently led the project SolarMal that combined the introduction of solar-powered light in African regions with electric odour-baited traps for mosquitoes. The implementation of this plan resulted in the reduction of malaria from Rusinga Island (western Kenia) while providing households with solar energy. As part of the SolarMal project, Willem has collaborated with different companies to develop efficient mosquito traps, such as the Biogents AG in Regensburg and Vecotech Ltd in London.

The translation of WUR knowledge into projects and products that control mosquito populations is expected to have a large impact on malaria, contributing to its eradication.

Want to know more about malaria?

Contact the WUR expert Willem Takken [willem.takken@wur.nl](mailto:willem.takken@wur.nl)

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## Coffee from small farmers for world export

Coffee is an essential beverage for many people. The increasing demand for coffee and consequent increase in production will lead to negative environmental and social impacts if its production is not managed sustainably. To tackle coffee sustainability challenges, the Colombian Coffee Growers Federation (FNC), together with Nestle and Nespresso, Wageningen University and Research, the Colombian and Dutch government, has founded Manos al Agua. This public-private partnership focuses on the environmental, social and economic conditions of coffee farming families through the inter-sectoral cooperation for sustainable coffee farming.

The partnership has developed a set of good practices regarding saving water and implemented e-learning programmes for coffee growers that have led to a reduction of 35% of water consumption. This programme has reached more than 3.500 coffee plantations in Colombia. The project covers five regions along The Andes reaching 11.000 coffee farmers. Manos Al Agua is supporting the shift towards resistant coffee varieties (e.g. against plagues such as coffee rust and berry borer) with more than 4.6 million new coffee trees planted. Alongside that, 330 hectares were reforested with more than 260.000 trees, and other bioengineering activities were undertaken, such as landslide prevention.

The ecological implications of these actions are closely monitored by the partnership to ensure positive results and impact. The social impact created by the project shown in the changed mindset of the Manos al Agua participants, such as community groups, extension service, coffee departments and local authorities, will be key to the lasting success of the project.

Are you a coffee lover and you want to know more about Manos al Agua?

Contact the WUR expert, Laura Miguel Ayala. [laura.miguelayala@wur.nl](mailto:laura.miguelayala@wur.nl)

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## The molten Arctic...

The ice coverage in the Arctic Ocean is retreating, leading to a more dynamic marine environment. Sailing in these waters is risky if there is not enough information about marine conditions. The weather and sea-ice forecasts provided by various meteorological agencies is continuously improving in accuracy as well as extending towards sub-seasonal to seasonal time horizons. This information is essential for strategic decision-making on Arctic marine operations and the safety of ships manoeuvring in these remote frozen waters. Close to 50.000 cruise passengers are visiting the Svalbard archipelago (Norway) and remote indigenous communities, like Qaanaaq in Greenland, need to be supplied seasonally by boat with essential goods. However, how, when and in what form marine climate services should be made available in order for it to be useful and usable remains unclear.

WUR is working along with the Danish and Norwegian Meteorological institutes to improve and co-produce marine climate services in the SALIENSEAS project coordinated by Machiel Lamers of the Environmental Policy Group. This project aims to improve the quality of Arctic marine climate services and make it

accessible to end-users. In co-producing these services end-users will obtain trustable marine climate services tailored to their strategic and operational decision making. The Environmental Policy Group is working on this science/end-users interface to increase the usefulness and usability of this emerging knowledge type in the dynamic Arctic ocean environment.

The outcome of this project leads to a more secure supply of goods to remote communities in the Arctic. Besides, there are around 60 cruise vessel operations that also benefit from this meteorological data. Well-planned and safe operations would benefit businesses and communities in the Arctic, improving their quality of life. WUR is working on projects like SALIENSEAS to make these visions a reality.

Looking forward to knowing more about navigation and ecotourism in the Arctic?

Contact the WUR expert Machiel Lamers. [machiel.lamers@wur.nl](mailto:machiel.lamers@wur.nl)

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## **Agriculture on Mars**

We, as human species, have already been in the Moon, but not yet in Mars. The idea of interplanetary travel to Mars is within the plans of many spatial agencies. However, going to Mars requires more effort than going to the Moon. Settling a self-sustainable base with human beings operating it is necessary. Hence, it is essential to produce food on Mars so that the crew can be fed.

WUR is a pioneer in agricultural research on Mars through the innovative research of Wieger Wamelink. Wieger got a research fund from Wageningen Environmental Research to study the challenges and opportunities in Martian and Moon soils. Wageningen knows the optimal conditions to grow plants, but there was no real experiment with crops grown in these soils. The lack of nitrate in the ground because of the absence of bacteria is a challenge for Martian agriculture. On the bright side, the Martian sterile environment allows the introduction of only beneficial bacteria, avoiding pathogens, and being an opportunity for Martian agriculture.

Fervent debates about Mars agriculture are held at WUR Departments about the possibilities of Martian agriculture. Alongside with WUR, NASA is experimenting with potatoes, and the ESA is doing experiments on artificial substrates. That is all the research regarding biological matter on the space, as the spatial agencies of China and Russia are focusing its research on other fields. Consequently, WUR is one of the frontrunners in agriculture outside of Earth. WUR is celebrating its centennial this year; in a hundred years' time, we hope to have a WUR Department on Mars.

Thrilled about Martian agriculture?

Contact the WUR expert, Wieger Wamelink. [wieger.wamelink@wur.nl](mailto:wieger.wamelink@wur.nl)

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## **A History of Meteorological Observations**

WUR is celebrating its centennial in 2018. Two years after Wageningen University had been founded, in 1920, the first precipitation measurements were already being recorded. Standard meteorological observations at Wageningen University started in 1927, as precipitations are critical for agriculture performance. Thanks to the link between agriculture and climate conditions, Wageningen University has one of the longest records of meteorological observations in Europe.

The WUR Meteorology and Air Quality Group runs the weather station De Veenkampen where state of the art technologies monitor the current climate conditions. All meteorological measurements are available to the public via their website. This data is analysed by public institutions that predict the weather forecast, but also by private companies. Anticipating the weather and giving advice to companies so they can react in time to harsh conditions is done at MeteoGroup, located in the Business and Science Park Wageningen.

Meteorological data are also used for long-term projects, such as climate change and weather trends. Bert Holtslag wants to connect local weather with air quality and other meteorological data to look at the bigger picture and unravel the mysteries of the Earth's atmosphere. Wageningen University is leading in the field of climate change and meteorological observations thanks to this early studies in meteorological observations that were maintained and intensified over the last 100 years.

Want to know more about WUR meteorological observations its research?

Contact the WUR expert, Bert Holtslag. [bert.holtslag@wur.nl](mailto:bert.holtslag@wur.nl)

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## **Dairy Science**

Dairy science at WUR is as old as the university itself. Since its very beginning, WUR has studied how to improve milk production and its quality. The sector has changed during the last 100 years, just like the research focus of WUR in dairy. WUR has extensively studied dairy processing and related industrial processes. Nowadays, dairy companies like FrieslandCampina undertake their own R&D regarding dairy products and production processes. In the meantime, at WUR the focus of the dairy department has shifted towards more fundamental insights in milk composition and functionality.

A major example of this approach is the Milk Genomics Initiative of Wageningen University that studies which genes are responsible for milk composition. Thanks to this project, it is possible to breed cows that produce the best milk composition for cheese production, or cows that produce milk with specific healthy fatty acids. The Milk Genomics Initiative gathered the data of more than 2000 cows from 400 different farms, constituting the first biobank and database of this kind in the world.

The Milk Genomics Initiative involved three different WUR departments and had led to the publication of 12 PhD theses and more than 60 scientific papers.

Breakthroughs in fundamental research like this initiative set the basis for developing products at a later stage. Thanks to this WUR project, farmers will be able to specialise their production and dairy companies will be able to select the best milk for each product.

Interested in the latest insights in milk composition?

Contact the WUR expert on dairy science, Kasper Hettinga.

[kasper.hettinga@wur.nl](mailto:kasper.hettinga@wur.nl)

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## **Modernisation of Agriculture**

The modernisation of agriculture in the Netherlands entailed the transformation of a society with famine after the second world war to becoming the second exporter of food by value in the world. Agriculture became a profession leading to a drop in prices. In the 50s, the Dutch agriculture sector was not modernised, and 50% of the salary of an average Dutch citizen was spent in food, while nowadays we only allocate the 10% of our salary in food. WUR has been the knowledge creator that led to that modernisation of Dutch agriculture.

The WUR department of Rural Sociology studied which characteristics differentiated traditional farmers from modern farmers with higher yields. The connection of the farm to electricity and sewage, little distance from a paved road, and access to agricultural scientific magazines increases the production in a 10%, making a difference between a traditional farmer and a modernised farmer in the 70s. The WUR role in the modernisation of agriculture was not limited to research. The university worked closely with farmers and promoted social entrepreneurship.

The Rural Sociology Department has also engaged with farmers to develop environmental cooperatives in the Netherlands. The objective of these unions was to undertake scientific research, along with farmers, on traditional farming practices that sometimes were forbidden as a result of non-informed policymaking. WUR has had an impact on agriculture not only by increasing the yield but also by influencing political decisions in The Hague and international institutions.

Want to know more about the contribution of WUR to modern agriculture?

Contact the WUR expert, Han Wiskerke. [han.wiskerke@wur.nl](mailto:han.wiskerke@wur.nl)

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## **Fertilizers for Africa**

Nitrogen is an essential nutrient for plant growth. Although almost 80% of the atmosphere is nitrogen, plants cannot assimilate it unless it is fixed in the form of ammonium in the soil. Rhizobia are bacteria that colonise the roots of legumes crops and fix nitrogen. The inoculation of grain legumes - beans, cowpea, groundnut and soybean - with these bacteria increases the yield and saves fertilisers, giving an enormous boost to agricultural production.

The project N2Africa aims to introduce *Rhizobium* inoculants in African agriculture. Together with the use of improved varieties of the crops and good agronomic management, the inoculants enhance the yield of grain legumes and get more fixed nitrogen into farmers' fields. The potential of *Rhizobium* has been recognised by the Bill & Melinda Gates Foundation which has funded this project. Professor Ken Giller and his WUR colleagues have been closely involved in the project, providing Wageningen expertise to the project. N2Africa activities led to the implementation of a known technology that was not used before by developing new products and the market for *Rhizobium* inoculants.

N2Africa has reached more than 700,000 farmers located across 11 African counties. Reaching such high numbers has only been possible thanks to national partners, NGOs and various African entrepreneurs. The increase in yield depends on multiple factors, such as the crop species and variety, the climate and soil conditions and above all good agronomic management, including Rhizobium inoculation. N2Africa is involved in monitoring and evaluating the yield increases and understanding where, when and for which farmers the technologies work best. The deeper understanding gained allows N2Africa to enhance the targeting of technologies in demonstration and dissemination campaigns throughout Africa to maximise its economic and societal impact.

Curious about the N2Africa project?

Ask Ken Giller, WUR Professor and N2Africa Project Leader: [ken.giller@wur.nl](mailto:ken.giller@wur.nl)

N2Africa Putting nitrogen fixation to work for smallholder farmers in Africa – [www.N2Africa.org](http://www.N2Africa.org)

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## **NetherCrops (NetherQuinoa and NetherVanilla)**

Before the discovery of the Americas, there were no potatoes, tomatoes, or corn fields in Europe as these are American species. Varieties of these crops have been selected, and nowadays they are commonly grown all over the world. However, there are many crops whose consumption requires long-distance transportation as they are not locally produced. WUR is researching how to grow exotic species in the Netherlands, such as quinoa or vanilla.

Wageningen scientists work on the development of new quinoa cultivars suitable for cultivation in Europa. This species can grow in cold climates with poor soil quality and give a significant yield. Quinoa has a high price in the market, and it is considered a superfood. Companies are interested in evaluating the possible cultivation of quinoa in the Netherlands, while WUR scientists focus on testing new varieties to maximise production.

Vanilla is another exotic species whose production WUR scientists are researching. Vanilla is grown in greenhouses, making then flowering, and artificially pollinating them to get the fruit. WUR has found the balance between humidity and temperature to allow the development of aerial roots in vanilla without mould growing on them. The result of this innovation is a stable product

with a standardised quality and an expected volume when compared with the traditional supply chain.

Curious to know more about the new NetherCrops?

Contact Ruud Timmer to know more about NetherQuinoa. [ruud.timmer@wur.nl](mailto:ruud.timmer@wur.nl)

Contact Filip van Noort to know more about NetherVanilla [filip.vannoort@wur.nl](mailto:filip.vannoort@wur.nl)

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## No longer potato blight

*Phytophthora infestans* is the pathogen that causes potato late blight. This disease caused the Irish Great Famine between 1845 and 1849. During this period a million-people died of hunger, and another million emigrated from Ireland. Late blight can be controlled using chemical biocides and by natural resistance of the potato host. However, *Phytophthora* mutates very fast, thereby evolving biocide resistance and host resistance breakdown.

The WUR Department of Plant Sciences is working to develop potato varieties that are resistant to *Phytophthora*. The traditional breeding of potato is time and resource intensive. Because of the heterozygosity in the genome, it is impossible to re-produce improved versions of established varieties, forcing agriculturists to find alternative solutions.

Novel breeding techniques, such as cisgenesis and CRISPR-Cas9, are currently being used at WUR to improve disease resistance of potato varieties. These technologies allow the introduction of active copies of natural resistance genes. The other way around, studying the genes responsible for the susceptibility of a plant to a given pathogen, allows identifying unwanted genes. In this case, WUR uses CRISPR-Cas9 technology to eliminate the susceptibility genes so that plants can become unattractive to pathogens.

The impact of these developments on business and society are enormous as potato is a popular crop with high demand. WUR research on plant pathogen resistance is essential to ensure sustainable agriculture and food security while avoiding new episodes of the Great Famine.

Curious about WUR efforts to fight potato pathogens?

Ask our expert Jack Vossen [jack.vossen@wur.nl](mailto:jack.vossen@wur.nl)

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## Plant meats for the future

The demand for animal protein is increasing with its consequent higher environmental impact when compared with plant-based diets. Meat replacements offer the possibility to shift towards a vegetarian diet without giving up meat taste. Despite the good quality of these meat replacements, we need innovation to make more structures, more versatile and cost-effective products.

Atze Jan van der Goot, along with his team from Food Processing Engineering, Wageningen Food and Biobased Research, and TUD, has developed the formulation and machinery necessary to perfectly imitate meat texture through innovative shear technology. Thanks to the machinery developed based on the

expertise developed by WUR scientists, plant proteins adopt a disposition similar to the one found in meat muscles, imitating meat texture. These developments have attracted the interest of the food industry.

A consortium coined as Plant Meat Matters merges the efforts of eight companies with WUR to develop the new generation of meat substitutes. The meat texture is the unique selling proposition of this WUR plant meat. Flavouring this meat substitute, making it juicier, and improve its nutritional characteristics are currently being researched in the consortium. The ambition of the Plant Meat Matter consortium is to commercialise in the following years.

Wanting to know more about shear technology for the development of the Plant Meat Matters?

Contact the expert behind this invention, Atze Jan van der Goot.  
[atzejan.vandergoot@wur.nl](mailto:atzejan.vandergoot@wur.nl)

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## **How the bacterial communities take care for the wellbeing of the plant**

Plants have a community of bacteria and fungi named as the plant microbiome. These communities have a positive impact on plant health; being also referred as the "natural biotic resilience of a plant" or the "second genome of plants".

WUR researchers have analysed the composition of the microbiomes of various plant species having discovered new microorganisms species not yet found because they cannot be cultured under laboratory conditions. The focus is on analysing which parameters improve microorganism growth on natural conditions. It is known that seeds have already their own microbiome, so promoting its development is the most straightforward way to benefit agriculture

The agricultural industry is very interested in the potential of the plant microbiome. WUR works along with companies, such as Incotech, Koopert, Enza Zaden, or LTO Glaskracht to advance in the state of the art of the microbiome while developing its first applications. Some microorganisms that promote plant growth are already commercialised, yet it is necessary more fundamental research to unleash the full potential of the plant microbiome. WUR scientists are studying these fascinating microbial communities to understand better their role and possible applications.

Want to know more about the plant microbiome?

Contact the WUR expert on plant microbiome, Leo Van Overbeek.  
[leo.vanoverbeek@wur.nl](mailto:leo.vanoverbeek@wur.nl)

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## **Electricity from plant roots**

Plant-e is a spin-off from the sub-department of Environmental Technology of Wageningen University that produces electricity from living plants. This revolutionary technology is the first one in the world that generates electricity with a negative carbon footprint. This technique uses the electrons released by

the bacterial breakdown of plant roots exudates to produce environmentally friendly electricity.

Plant-e was founded in 2009 by Marjolein Helder and David Strik only half a year after the start of Marjolein's PhD-project in energy production from living plants. The combination of a PhD and Plant-e led to the quick development and application of this pioneering technology. After the completion of her PhD, Marjolein decided to focus on the commercialisation of this technology as CEO of Plant-e, and David pursued his scientific career at WUR in related technologies.

Plant-e has commercialised modular gardens and Do It Yourself kits for offices and high schools. The activity of the company allows employing seven full-time professionals and 13 part-time jobs. The company plans to scale up and install the systems in plains, polders, or mangroves to produce more electricity and maximise its positive environmental impact.

Want to know more about Plant-e? Looking forward to supporting them?

Contact Plant-e CEO, Marjolein Helder. [office@plant-e.com](mailto:office@plant-e.com)

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## **Poultry in Ethiopia**

The Dutch animal husbandry sector is specialised in cow, pig, and poultry. The success of these animal farming in the Netherlands is well-known worldwide, and Dutch knowledge is exported to other countries. The Holland-Africa Poultry Partners is a partnership of professional and committed companies, NGOs and knowledge institutes from the Netherlands specialised in solutions and knowledge transfer for the international poultry sector.

Ethiopia was one of the fastest growing economies in Africa during the last years, with an agriculture sector that represents 44% of its GDP and 61% of Ethiopian exports. WUR, as part of Holland-Africa Poultry Partners, has spotted the potential of the Ethiopian poultry sector and has committed to its development. WUR has contributed to the integration of the value chain for eggs and meat production. Alongside, WUR has formed Ethiopian farmers in the fields of feeds, hatcheries, vaccines, drugs, and entrepreneurial practices.

Cooperation is necessary for growth. WUR has collaborated with companies like VDL Agro, Vencomatic, ISA Hendrix, PasReform, and de Heus Feed to bring Dutch knowledge on poultry to African countries. The Ethiopian poultry industry has benefited from this knowledge exchange, and now it is better prepared to face the challenges of poultry farming and its commercialisation.

Curious to know more about the Holland-Africa Poultry Partners?

Contact the WUR expert on poultry, Adriaan Vernooij. [adriaan.vernooij@wur.nl](mailto:adriaan.vernooij@wur.nl)

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## **Measuring the sustainability of consumer products**

In 2009 a group of companies, NGOs, and universities came together to develop a system for measuring the sustainability of consumer products. This new system would create a benchmark for companies to work on continuous

improvement of sustainability with their supply chain partners. This conglomerate of institutions working on this sustainability benchmark was named The Sustainability Consortium.

Wageningen University is one of the universities that lead the consortium, along with the University of Arkansas and the Arizona State University. The consortium has developed 128 toolkits to assess the sustainability of different consumer products. The toolkits identify the most important sustainability issues for the product category (hotspots), lists a set of indicators to measure the sustainability of products within this product category, and include a set of opportunities to improve the sustainability performance. Nowadays, there are more than 2500 suppliers in the database that altogether have a total of 200 billion dollars revenues in sales. The Sustainability Consortium aims to stimulate competition between suppliers to appear first in the database.

The impact of The Sustainability Consortium on business is enormous as the group includes about 100 companies, NGO's and universities such as Unilever, Cargill and WWF. The consortium is a multi-stakeholder non-profit organisation, so the members share responsibility and undertake activities to keep the consortium activity ongoing.

Triggered to know more about The Sustainability Consortium?

Contact the WUR expert Koen Boone [koen.boone@wur.nl](mailto:koen.boone@wur.nl)

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## **The invention of the waste water treatment reactor**

The acronym for this technique for wastewater treatment stands for Upflow Anaerobic Sludge Bed (UASB) reactor. The UASB reactor was developed in Wageningen by Gatze Lettinga, a professor from WUR. Gatze realised the potential of this technology and did not patent it because he wanted it to be spread as fast as possible to have the greatest impact on society. The technology spread quickly and nowadays there are UASB reactors in any corner of the world and in different sectors.

The Dutch industry welcomed the development of the UASB reactor. The Dutch companies Paques BV and Biothane-Veolia have developed the market for UASB reactors, entailing the commercialisation of this technology. Despite the lack of a patent, WUR is leading the research regarding UASB reactors, with ongoing projects focussing on salty wastewater treatment, or nutrient recovery. There are various Wageningen spin-offs regarding UASB reactors, like LeAF. LeAF is a spin-off that offers laboratory services, feasibility studies, and training, amongst others, regarding the UASB reactor to private enterprises and public institutions.

The UASB reactor is a WUR invention that has had a massive impact on business, society and the environment. WUR scientists are working to increase the applicability of this technology to other industries, regions, and applications to have even a greater impact.

Want to know more about the UASB Reactor?

Contact the WUR expert, Miriam Van Eekert. [miriam.vaneekert@wur.nl](mailto:miriam.vaneekert@wur.nl)

*"Anaerobic granules only happen when a Dutch is standing close to a UASB reactor"* Anonymous British scientist.

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## **The Applications of the UASB Reactor**

The commercialisation of the UASB reactor has led to a revolution in water treatment and contributes to a more circular economy. Thanks to emeritus prof. Gatze Lettinga, WUR is the frontrunner in UASB technology (Upflow Anaerobic Sludge Bed Reactor). Nowadays there are UASB reactor "ambassadors" all over the world as the department of Lettinga in the 80s was already very international.

This WUR-born technology is used in different industrial sectors to treat wastewater. Heineken, Shell, and COSUN, among many other companies, have a UASB reactor at their facilities. Recently, the first UASBs were installed in a housing estate and three office buildings in The Netherlands to treat domestic wastewater, collected with vacuum toilets. This invention allows the treatment of high volumes of water in a small reactor volume, requires little energy as aeration is not necessary, and produces energy in the form of biogas.

Besides water treatment, the primary purpose of this technology, the UASB reactor transforms between 80 to 90 % of the organic pollutants into biogas. Households can use this biogas for cooking or for building acclimatisation. There is also research undergoing to produce fatty acids, bioplastics, and electricity using the anaerobic processes in the reactor. The success of such research projects would entail a revolution in the circular economy, as a wide variety of products could be produced from waste.

Wageningen University is a pioneer in the circular economy that is being developed around the UASB reactor.

Want to know more about all the possibilities of the UASB reactor?

Contact the WUR expert, Miriam Van Eekert. [miriam.vaneekert@wur.nl](mailto:miriam.vaneekert@wur.nl)

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## **Veterinary vaccines for healthy cattle**

Wageningen Bioveterinary Research is the national reference laboratory for animal diseases in the Netherlands. Animal diseases are monitored in their facilities with 250.000 tests per year performed on horses, livestock, wild fauna, and fish. Wageningen Bioveterinary Research role in society becomes of paramount importance when emerging zoonosis, such as bird flu, alarm the population. However, WUR researches work all year round to avoid animal diseases outbreaks.

Besides monitoring livestock health, Wageningen Bioveterinary Research has developed various veterinary vaccines such as the bluetongue vaccine. The vaccine against the bluetongue virus was generated using reverse genetics that allows the development of entirely protective vaccines against the different serotypes. The mortality of the bluetongue virus is not very high, but animals lose their condition very rapidly, and the recovery of the animals is lengthy.

Thanks to this vaccine animal welfare is improved, and farmers report fewer losses than when the stock is unvaccinated.

The DIVA vaccines is another WUR invention that allows the differentiation between vaccinated and infected animals. This differentiation is critical to differentiate infected animals from vaccinated ones, being of great help in case of disease outbreaks. Wageningen Bioveterinary Research keeps on developing new vaccines while monitoring disease outbreaks that could endanger animal welfare.

Interested in the vaccines developed at WUR?

Contact the WUR expert on animal vaccination, Astrid de Greeff.

[astrid.degreeff@wur.nl](mailto:astrid.degreeff@wur.nl)

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## **For land protection and nature creation - the Zandmotor (Sand motor)**

The Zandmotor is a mega-engineering coastal infrastructure located in South Holland was constructed as a pilot project for the long-term sand nourishment of the Dutch coast. The construction of the Zandmotor entailed the relocation of 22 million m<sup>3</sup> of sand, creating a peninsula that extends 2 km along the coast and protrudes 1 km into the sea. This process was undertaken by dredging companies and supervised by universities, political institutions and consultancy companies.

Wageningen Marine Research studied the effect of the Zandmotor on the development of the marine benthic fauna, while Wageningen Environmental Research analysed dune plant colonisation. Engineering consultancy companies like Witteveen+Bos developed measurement plans and databases for monitoring dune dynamics in coordination with WUR and Deltares. The Zandmotor is the result of collaboration between various institutions of different nature.

The Zandmotor created new habitats and attracted new fauna, flora and tourists to the area, especially kite surfing enthusiasts and nature lovers. This innovative idea for sand nourishment is already being exported to other parts of the world. WUR is proud for being part of the Zandmotor consortium and for becoming a knowledge exporter.

Want to know more about the Zandmotor?

Scan the QR code to watch a video about the Zandmotor.

Contact our expert Jeroen Wijsman [jeroen.wijsman@wur.nl](mailto:jeroen.wijsman@wur.nl).

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