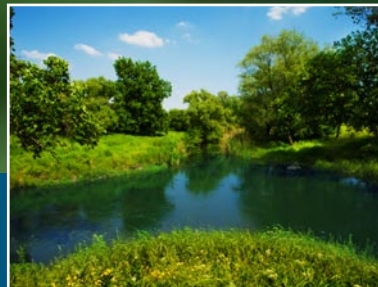


Wageningen UR delta research



A bird's-eye view



Wageningen UR delta research

Wageningen University and Research Centre offers a wide range of expertise when it comes to deltas areas where we live, work and recreate in a sustainable manner. Our activities encompass research, advice, education and capacity building. We do research on physical, chemical and ecological processes in the environment, for example on water, nature, forests, environment, soil, landscape and climate.

We investigate how nature can be exploited in a sustainable manner to improve the quality of life. We have large socio-economic research groups conducting research on themes ranging from lifestyles and livelihoods to economics and governance. Wageningen UR has a profound capacity to blend its disciplinary strengths in transdisciplinary and problem-centered approaches in the search for sustainable environmental practices, policies and management. Depending on the situation we work at local, national or international scale. The effects of climate change on deltas worldwide are a particular focus of our attention.

The Wageningen institutes that specialise in this subject are Alterra and Wageningen IMARES. Alterra is the re-

search institute for our green living environment. Alterra offers a combination of practical and scientific research in a multitude of disciplines related to the green world around us and the sustainable use of our living environment. Wageningen IMARES, Institute for Marine Resources & Ecosystem Studies, is a leading, independent research institute that concentrates on research into strategic and applied marine ecology. In addition to Alterra and IMARES, research of significance for water and deltas is conducted by various other institutes within Wageningen UR, e.g. socio-economic research (LEI), aquaculture (Animal Science Group), agriculture (PRI) and environmental technology (Agrotechnology and Food Science Group).

In this booklet you will find an outline of the work we do on water, climate change and deltas. It is a concise overview of the research, education and capacity building of Wageningen UR that is relevant for deltas, presented in the form of short summaries of projects. More extensive descriptions can be found at www.wur.nl/water. This overview is not complete – please contact us through waterplatform@wur.nl if you have any queries!

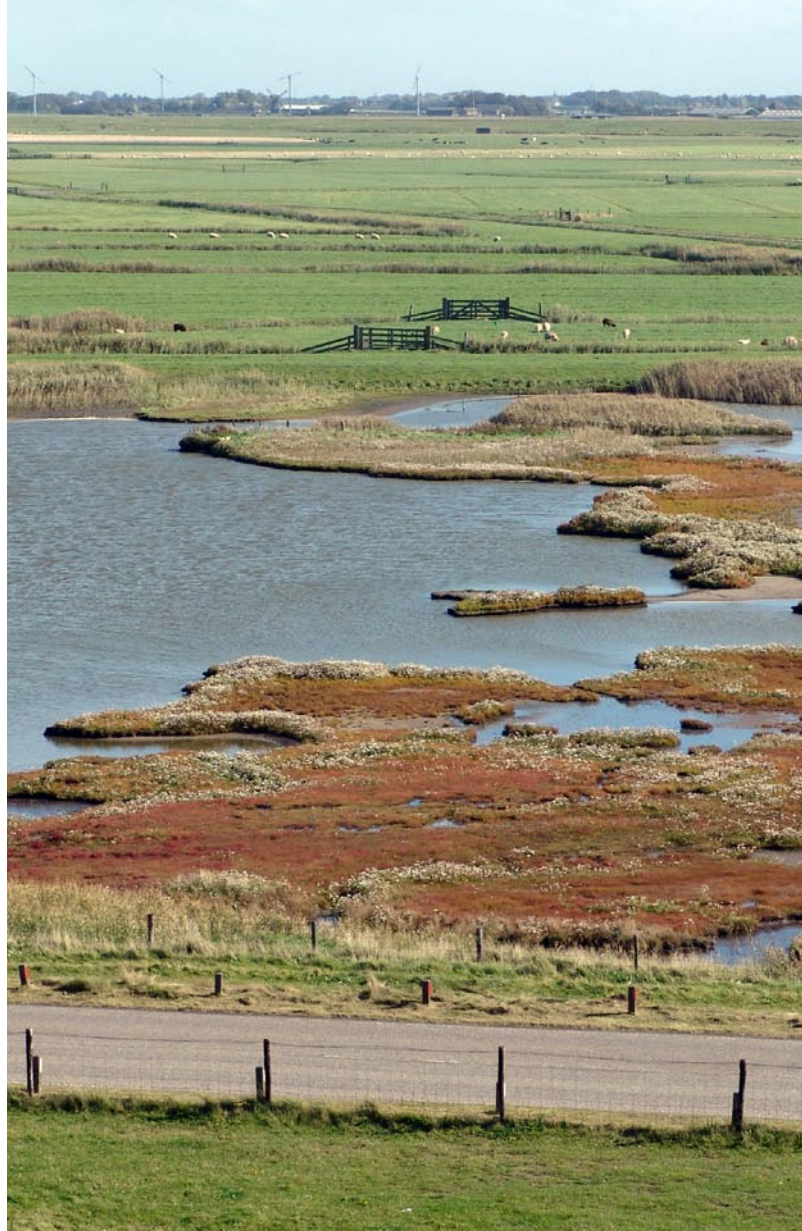
Wim Cofino, Chairman of Wageningen Water Platform



WAGENINGEN UR
For quality of life

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Wageningen UR

Wageningen UR encompasses Wageningen University, Van Hall Larenstein School of Higher Professional Education and former government research institutes of the Dutch Ministry of Agriculture assembled in the DLO Foundation. Wageningen UR has 6,100 staff and 9,200 students. Wageningen UR incorporates education, fundamental and applied research.

We feel that our organization is uniquely equipped to deal with the problems of today. Our university staff profit from the network of professionals and the more applied researchers, and our applied research departments keep in touch with the most recent developments in fundamental science and technology. This combination of top class science that is firmly based in society enables us to explore the potential of nature to improve the quality of life.

RESEARCH

Wageningen UR research focuses on four main areas:

Environment and climate

Wageningen UR offers a unique range of expertise when it comes to nature and green space. We do research on fresh and marine water, nature, forests, environment, soil, landscape, climate, recreation and many other aspects that are important for the development and management of the living environment. Depending on the situation, we work at local, national

or international scale. The effects of climate change are a particular focus of our attention.

Economics and society

Socio-economic research complements the technical research done at Wageningen UR and gives it added value. We focus on agriculture, horticulture and fishery, management of rural areas, agribusiness and the production and consumption of food. Our research assists governments and businesses in their entrepreneurial choices, management of production chains, spatial planning, environmental performance, natural resource management, European agricultural policy and world trade.

Food and food production

Wageningen UR works on knowledge that helps us to create safe, healthy and above all tasty food. Food that is healthy and safe for us, but also for our environment. Wageningen UR develops more efficient production and distribution methods in which wastage of natural raw materials is minimized. Wageningen UR also incorporates the newly created knowledge into its education programmes.

Plant and animal

Wageningen UR studies plants and animals in the wild as well as those that are part of sustainable fisheries and agricultural production systems. We do this in many ways. Our researchers map genes,

study interaction between plants and insects, design greenhouses and crop management systems and do research on the behaviour of pigs, chickens, cattle and dogs. Our knowledge contributes to the creation of a good living environment and socially responsible production of healthy and tasty food.

EDUCATION

Both Wageningen University and Van Hall Larenstein School of Higher Professional Education offer a broad range of educational programmes.

Van Hall Larenstein

BSc programmes in rural and environmental management

Coastal Zone Management
Environmental Management
Environmental Science
Fair Trade Management
International Agriculture
International Water Management
Regional Development and Innovation
Rural Development and HIV-AIDS
Social Inclusion, Gender and Rural Livelihoods
Training, Rural Extension and Transformation
Tropical Forestry
Water Technology

Wageningen University

Programmes for education and capacity building for delta management

BSc programmes

Soil, Water, Atmosphere
Forest and Nature Management
International Land and Water Management
Landscape Architecture and Spatial Planning
Environmental Studies
Applied Communication Science

MSc programmes

Climate Studies (Earth System Science)
Environmental Sciences
Forest and Nature Conservation
Geo-information Science
Geographical Information Management and Applications
Hydrology and Water Quality
International Land and Water Management
Landscape Architecture and Planning
Leisure, Tourism and Environment
Meteorology and Air Quality
Urban Environmental Management
Management of Marine Ecosystems
Integrated Water Resource Management
Aquaculture and Fisheries
Soil Science
Biology



HYDROLOGICAL PROCESSES IN CABAUW

In the early 1970s the Royal Netherlands Meteorological Institute installed a 200-metre-high measuring tower in the village of Cabauw in the province of Utrecht. More recently, a hydrological measuring network was set up in this flat and artificially drained peat area. Hydrological quantities such as discharge (both into and out of the catchment), groundwater and soil moisture are measured by the Hydrology and Quantitative Water Management Group of Wageningen UR. These data series are used for statistical analyses of the water balance terms, in-depth studies for specific processes (land-atmosphere interactions) and as a starting point for hydrological modelling.

Contact: claudia.brauer@wur.nl

WATERVAST

Watervast provides a solution to two major water management problems in the Netherlands: protection against flooding and handling of contaminated sediments. In 1995 the country faced a serious threat of

flooding during the high water period in the Rhine and Meuse river area, and some parts of the population had to be evacuated. Such events are expected to occur more frequently as a result of climate changes. Watervast is an innovative concept which involves building compartment dikes to reduce the social and economic risks of flooding during high water levels. These dikes will allow new developments that strengthen the landscape.

Contact: joop.harmsen@wur.nl

THE EFFECTIVENESS OF UNFERTILIZED BUFFER STRIPS

We are investigating the effectiveness of unfertilized buffer strips along property boundaries for reducing the load of P (and N) towards the adjoining open water system. The study was initiated in response to an agreement made between the Netherlands and the European Union. The EU wants buffer strips of at least 5 metres wide to be created along water ways, as is already the case in other European countries. The Netherlands has doubts about the effectiveness of buffer strips in flat areas, but does not want to exclude the possibility of implementing the measure, given the water quality targets specified in the EU Water Framework Directive (WFD). The flat Dutch landscape has mainly permeable soils,



with little surface run-off or drained soils. Most of the discharge therefore probably passes underneath the buffer zone, certainly in plots of land with pipe drains. The effect of a buffer zone will be determined in six geohydrological situations. In each of these we have chosen an experimental site where we determine the load towards the adjoining ditch for a reference treatment and for a buffer strip treatment.

Contact: gert-jan.noij@wur.nl

CLIMATE AND LAND USE CHANGE IN THE RHINE BASIN

The aim of this study is to develop new insights regarding the impacts of climate and land use change on the hydrological regime of the Rhine basin. The expertise gained will help water managers to make the right decisions concerning adaptive water management measures, which take into account the consequences of environmental change.

Contact: wilco.terink@wur.nl
www.newater.info
www.hwm.wur.nl

GROUNDWATER-SURFACE WATER INTERACTION

The main objective of the research project is to improve our knowledge of nutrient and water cycles in soils and different transport routes of nutrients to the surface water. The knowledge obtained will be used and implemented in many other projects (STONE, ex ante evaluation of the Water Framework Directive, monitoring at catchment scale, NL-CAT) and will help us to understand how we can reduce nutrient losses from land to surface waters.

Contact: frank.vanderbolt@wur.nl

NETHERLANDS HYDROLOGICAL INSTRUMENT

Dutch hydrological institutes Alterra and Deltares are working together to build a new nation-wide hydrological model, the Netherlands Hydrological Instrument (NHI). The NHI consists of coupled models and input-data on land use, soil water, groundwater and surface water and describes hydrological events in space and time. The instrument will be used by the ministries involved in national water policy matters. It is being developed to describe effects of land and water management and will be extended to perform water quality calculations.

Contact: piet.groenendijk@wur.nl
www.nhi.nu

HYDROLIBRARY

The Hydrotheek (hydrolibrary) is the online repository for water professionals with thousands of publications in the field of hydrology, aquatic ecology, water management, flood control, sanitation and waste water treatment in the Netherlands. The collection is an initiative of the Foundation for Applied Water Research (STOWA) and is maintained by Wageningen UR Library. The online database provides easy access to free online publications and to books and articles available in Wageningen UR Library. The free monthly Hydrotheek newsletter and the weekly alert keep you up to date on all new Dutch 'water' publications.

Contact: paulien.vanvredendaal@wur.nl
www.stowa.nl/hydrotheek

EGYPTIAN-DUTCH ADVISORY PANEL

The Egyptian-Dutch Advisory Panel on Water Management started in 1976 as bilateral cooperation on land drainage after the completion of the High Aswan Dam. Since then a strong partnership has evolved between Egypt and the Netherlands involving cooperation

between ministries and other organizations in both countries. The current Panel functions as a think-tank for the Egyptian Minister of Water Resources and Irrigation, who chairs the partnership. The Panel formula is simple, cost-effective, and successful. Benefits for both countries include human resource development and capacity building, institutional reform, technical solutions, policy formulation and enhanced coordination between projects, institutions and partners.

Contact: wouter.wolters@wur.nl

INTEGRATED WATER RESOURCES MANAGEMENT TEAM

Our mission: to lead the development and provision of knowledge, tools and measures for supporting sustainable management of land and water resources without comprising the sustainability of vital ecosystems and human communities. Our approach is based on three integrated elements: research, education and advisory services.

Contact: jochen.froebrich@wur.nl



WATERLOGGING IN PAKISTAN

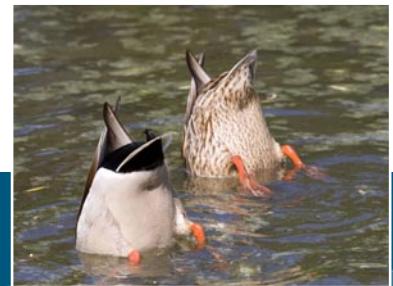
The agricultural sector in Pakistan suffers dearly from waterlogging and salinity problems. A bilateral cooperation agreement on waterlogging and salinity control between Pakistan (IWASRI-International Waterlogging and Salinity Research Institute) and the Netherlands (Alterra-ILRI) led to the creation of the Netherlands Research Assistance Project NRAP (1988-2000). The partnership that evolved had two main activities: work on technical aspects of drainage and the development of a participatory approach to drainage. The cooperation achieved results in each of the fields of activity and it has been instrumental in assisting the partner institute IWASRI to become a nationally and internationally recognized centre on waterlogging and salinity research. The partnership demonstrated that millions of US\$ could be saved thanks to the results of the joint research.

Contact: wouter.wolters@wur.nl

A DUTCH NATIONAL WETLAND CORRIDOR

The Netherlands have international responsibility for the conservation of wetlands. The implementation of a national wetland corridor offers a great opportunity to realize synergistic adaptation measures needed for biodiversity and water conservation. A national wetland corridor will enable wildlife species to follow the poleward shift of suitable climate conditions, and will offer ample space for water conservation measures.

Contact: eveliene.steingrover@wur.nl



WIND ENERGY AND MARINE LIFE

The Dutch government has expressed its ambition to realize 6000 megawatts of offshore wind energy by the year 2020. Spatial planning is a key issue in the creation of offshore wind farms. Wageningen IMARES contributes by monitoring the effects on marine life, such as benthos, fish, birds and sea mammals. IMARES uses this knowledge to develop models that determine the cumulative effects of wind farms in this heavily used part of Dutch waters.

Contact: chris.karman@wur.nl

ENERGY AND NUTRIENTS FROM DOMESTIC SEWAGE

Domestic sewage was until recently almost exclusively considered as a hygienically risky, polluting stream, which should be removed and treated as far as possible from the production site. New sanitation concepts and corresponding treatment techniques, based on source separation and prevention of dilution, provide

for the recovery of energy (biogas), nutrients (N, P and K) and water for reuse. These advances also make feasible the removal of pharmaceutical residues, hormones and pathogens.

Contact: grietje.zeeman@wur.nl

POWER GENERATION BY REVERSE ELECTRODIALYSIS

In principle, sustainable energy can be derived from the difference between the chemical potentials of concentrated and diluted salt streams. An example of a system which can generate electricity from this energy source is reverse electrodialysis (RED). Although a promising concept, the amount of research that has been done on RED is very limited and outdated. A few decades ago, researchers claimed that RED was not economically feasible because of the high membrane price. However, recent developments indicate that these costs can be reduced considerably.

Contact: jan.post@wur.nl





ROBUST PEATLANDS

Peatlands in the Netherlands are threatened by subsidence of the soil surface, less favourable conditions for farming and rising costs of water management and infrastructure. This project focuses especially on water management strategies to reduce soil subsidence and to create water systems which are more robust and adapted to climate change. In addition, the use of subsurface drains is being tested as a way of achieving this situation.

Contact: ceesc.kwakernaak@wur.nl

THE SALINE COASTAL FRINGE

The Dutch coastal zone, a 'saline coastal fringe', is used intensively for agricultural production, fisheries, aquaculture, recreation and nature. These different demands lead to conflicting claims. Wageningen UR is investigating how these claims are developing in

the light of climate change. As technological solutions play a limited role, social solutions must be found to these claims if conflict is to be reduced.

Contact: lodewijk.stuyt@wur.nl

DUTCH CLIMATE ATLAS

Wageningen UR provides provincial policy makers with multidisciplinary knowledge to enhance their awareness on climate-induced conflicts and opportunities with regard to rural planning. In a series of maps, the 'climate-proofing atlases' depict the effects of climatic change on local weather, river discharge statistics, groundwater tables, salinization risks, risks of drought and flooding. They also provide guidelines on how to convert effects of climate change into guidelines for sustainable rural development.

Contact: lodewijk.stuyt@wur.nl

CHANGING WATER RESOURCES IN NORTHERN INDIA

Climate change is expected to affect the major phenomena in the hydrological system of Northern India:



the monsoon precipitation in summer and the growth and melt of the snow and ice cover in the Himalaya. This will in turn affect hydrology and water resources availability, especially in the Ganges, Indus and Brahmaputra river basins, where snow and glacier melt form a great part of the rivers' flow. The rapid socio-economic development that India is currently undergoing also has a large impact on the use of water resources. Adaptation measures are necessary in order to anticipate the potential negative effects of changes in water resources availability and demand. This project will recommend appropriate and efficient response strategies that strengthen the cause for adaptation to hydrological extreme events through a participatory process.

Contact: catharien.terwisscha@wur.nl

EFFECTS OF CLIMATE CHANGE ON NUTRIENTS IN WATER

Climate change may alter soil nutrient emissions, and as a result, the retention of nutrients in the surface water will be affected. This could stimulate or hamper the realization of the ecological goals of the European Union Water Framework Directive. This study will estimate these effects and describe the policy

implications. The results and conclusions can be used to improve national policy and to adapt regional implementation of the Water Framework Directive.

Contact: frank.vanderbolt@wur.nl

THE PEER CLIMATE CHANGE INITIATIVE

In order to support the development and implementation of climate policy, PEER (Partnership for European Environmental Research) started two projects with the objective of identifying policy-relevant lessons and major knowledge gaps. This project addresses national adaptation strategies through six themes: drivers of adaptation policies, science-policy interactions, communication and awareness-raising for adaptation, multilevel governance, policy integration, and review and implementation of national adaptation strategies.

Contact: rob.swart@wur.nl



CLIMATE PROOFING THE NETHERLANDS

Knowledge for Climate is a research programme intended to develop knowledge and services that will make it possible to 'climate-proof' the Netherlands. Government organizations (central government, provinces, municipalities and water boards) and businesses actively participate in the research programming by providing additional resources (matching). The programme develops the knowledge required to be able to calculate investments required in spatial planning and infrastructure over the coming twenty years so that they can withstand climate change. The research programme focuses on eight areas, or hotspots: Schiphol Mainport, Haaglanden area (The Hague), Rotterdam region, major rivers, the south-west Netherlands delta, shallow lakes and peat meadow areas, dry rural areas and the Wadden Sea. Investments will also be made in improving climate prediction and climate effect models, with a National Climate Facility established for the purpose. An important part of the programme is knowledge transfer and international cooperation.

Contact: Programme Office
info@kennisvoorklimaat.nl
www.knowledgeforclimate.org

CLIMATE CHANGES SPATIAL PLANNING

Climate change is likely to have a large impact on land use and water management in the Netherlands, and therefore also on spatial planning in this country. The programme "Climate *changes* Spatial Planning" focuses on enhancing joint learning between these two communities and spatial planners. Its mission is to make climate change and climate variability the guiding principles for spatial planning in the Netherlands.

Contact: Programme Office
info@klimaatvoorruiimte.nl
www.climatechangesspatialplanning.nl

BROADENING DUTCH DIKES

We are exploring the potential for 'climate buffers' and 'broad dikes' as safe, climate-proof and multifunctional flood protection measures. The objective is to compile an overview of all the possible implementations of robust flood protection, and in addition to specify a procedure that allows qualitative knowledge (e.g. about safety and different functions) to be combined with quantitative knowledge (e.g. costs and return periods of floods).

Contact: pier.vellinga@wur.nl

CLIMATE AND PEOPLE IN TROPICAL PEAT SWAMP FORESTS

The Carbopeat project aims to:

- Precisely determine how much carbon is sequestered in tropical peat soils worldwide.
- Conduct an international exchange of expertise about the carbon balance in tropical and other peat soils.
- Conduct research into cost effective ways to manage the carbon sequestered in peat.
- Explore potential compensation for and trade in this carbon.
- Provide expert assistance to international conventions, industry, EU and government agencies and public bodies.

Contact: henk.wosten@wur.nl
www.carbopeat.org

SOIL SUBSIDENCE IN PEAT POLDERS

More than 70 percent of Dutch peat soils are in use as permanent pasture for dairy farming. This activity causes soil subsidence, mainly through decomposition (oxidation) of the peat. The project explores the possibilities for applying 'Toemaak' to reduce soil

subsidence and mitigate CO2 emissions. Toemaak is a mixture of ripened dredge and straw manure, used for restoring soil fertility and for strengthening of the top layer.

Contact: idse.hoving@wur.nl, jaap.olie@deltares.nl

SUSTAINABLE AGRICULTURE IN THE MEDITERRANEAN

Scarce water resources, intensive water competition between users – in particular agriculture and tourism – and frequent drought episodes are common challenges in the Mediterranean. Agriculture is the sector most affected by anticipated water scarcity. Aqua-Stress aims for participative development of water stress mitigation strategies for sustainable agriculture in the Mediterranean.

Contact: jochen.froebrich@wur.nl
www.aquastress.net



SUBMERGED DRAINS TO CONSERVE PEAT SOILS

More than 70 percent of Dutch peat soils are in use as permanent pasture for dairy farming. Drainage of these peat soils results in subsidence, mainly through decomposition (oxidation) of the peat. Subsidence of peat soils makes water management increasingly complicated and expensive. Submerged drains diminish oxidation, subsidence and CO₂ emissions by raising the groundwater level in summer to about the ditchwater level. In this way only the upper part of the peat is exposed to oxygen and decomposes.

Contact: janjh.vandenakker@wur.nl,
www.waarheenmethetveen.nl

XEROCHORE: ASSESSMENT OF RESEARCH NEEDS AND POLICY CHOICES IN AREAS OF DROUGHT

In recent years, large parts of Europe have suffered from extreme drought, a phenomenon that is likely to become more frequent and more severe. The overall aim of Xerochore is to provide a roadmap that identifies the main research gaps in different drought

disciplines, based on a state-of-the-art review. Drought disciplines include the natural system (hydrology and climate), human influences, and social, economic and environmental impacts.

Contact: louise.wipfler@wur.nl
www.feem-project.net/xerochore

PREDICTING SOIL SUBSIDENCE AND GREENHOUSE GAS EMISSION IN PEAT SOILS

The SWAP-ANIMO model has been used to predict soil subsidence, greenhouse gas emission and nutrient loading of the surface water for a peat soil in an experimental field on agricultural grassland at Zegveld, the Netherlands. To evaluate the effects of water management and land use on subsidence, greenhouse gas emission and nutrient loading, scenario runs were performed with the validated model. In these scenarios, special attention was given to the effects of submerged drains for enhancing subsurface irrigation. These drains are currently being studied in the Netherlands.

Contact: rob.hendriks@wur.nl



NEW ROLE FOR DUTCH DRINKING WATER SECTOR TOWARDS CONSUMERS

Dutch drinking water companies are looking for new roles to complement their core business of delivering good quality water to households. These new roles not only fit within a corporate social responsibility strategy, but can also provide direct market opportunities. This research project gives an overview of potential new roles for Dutch drinking water companies and conducts a survey to assess consumer perceptions of these new roles. It also throws light on the relationships between Dutch drinking water companies and their domestic consumers, assisting the companies in their strategic decision-making concerning new roles towards consumers. Furthermore, the project contributes to the emerging branch of literature on utility management; domestic consumption and the environment. The project is part of the Client 21 programme of the Dutch Water Industry Research (Bedrijfstak Onderzoek) research programme coordinated by KWR Watercycle Research Institute.

Contact: dries.hegger@wur.nl
www.kwrwater.nl



WEED AND ADJUST CROPS TO SAVE WATER

In the Aquastress study, on how to improve agricultural water management in the Flumendosa basin in Sardinia, Italy, two water-saving alternatives for agriculture were studied. First, how can agriculture benefit more from rainfall? Results show that with a better match between crop rooting characteristics and accompanying soil profiles, farmers can save on one or more irrigation gifts. Second, how can agricultural practices be improved? Removal of active undergrowth – grasses and weeds – in orchards can reduce water requirements considerably. The undergrowth consumes water from the moisture that is stored in the soil after rainfall and irrigation gifts.

Contact: rob.kselik@wur.nl
www.aquastress.net

MANAGING LAND AND WATER RESOURCES IN THE BAVIAANSKLOOF RESERVE

The Baviaanskloof is a 75 kilometre long valley in the Eastern Cape Province in South Africa. The area is a biodiversity hotspot and is recognized as a unique World Heritage Site. Various land and water problems have become manifest, such as increased hill slope

and stream bank erosion, and water shortages. These are having detrimental effects on ecosystems and on agriculture. The project aims to support sustainable development and management of land and water resources so as to conserve biodiversity and to improve rural livelihoods.

Contact: herco.jansen@wur.nl

WEATHER AND MALARIA MOSQUITO LARVAE

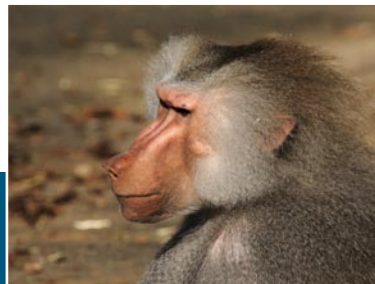
The work shows how meteorological variables can affect the life-history characteristics of larvae of *Anopheles arabiensis* and *Anopheles gambiae* and the temperature of their aquatic environment. Meteorological variables and water temperature in differently-sized, semi-natural habitats, which were exposed to the ambient environment, were studied in western Kenya. In addition, the growth, development and survival of the immature stages of the malaria vectors were investigated in identical habitats.

Contact: bert.heusinkveld@wur.nl

SEALAND SOLE

This project aims to develop a new rural sector by combining agricultural and aquacultural production components, based on the sustainable application of seawater and a closed nutrient cycle. Sealand Sole farms combine the production of North Sea sole and ragworms with microalgae and shellfish production, while the remainder of the nutrients will be used for seaweed saline vegetable production. The research project is a joint effort of nine private companies (Grontmij, Hesy Aquacultuur, Prins en Dingemanse, Neanthes, Rabobank, Roem van Yerseke, United Fish Auctions, Schelpdierenkwekerij Wilhelminadorp – Neeltje Jans, the Southern Dutch Federation of Agriculture and Horticulture ZLTO, Wageningen-UR and Hogeschool Zeeland. It is financially supported by the Province of Zeeland and the Ministry of Agriculture Nature and Food Quality.

Contact: willem.brandenburg@wur.nl



CHANGING THE WAY WE THINK ABOUT WATER AND AGRICULTURE

The Comprehensive Assessment of Water Management in Agriculture evaluated the benefits, costs and impacts of the past 50 years of water development. It formulated 8 policy actions, of which the first is: 'Change the way we think about water and agriculture'. Instead of a narrow focus on rivers and groundwater, 'view rain as the ultimate source of water that can be managed. And instead of isolating agriculture as a production system, view it as an integrated multiple-use system and as an agro-ecosystem, providing services and interacting with other ecosystems'. Potential policy implications of this recommendation could be huge.

Contact: petra.hellegers@wur.nl





SINDERHOEVE FIELD STATION FOR AQUATIC AND TERRESTRIAL RESEARCH

The Sinderhoeve is a field station with facilities that include experimental ditches, mesocosms, laboratories and former agricultural land. The experimental ditches and laboratories operate in compliance with the OECD principles of Good Laboratory Practice. All facilities are available to conduct aquatic and terrestrial research on the behaviour and effects of chemical substances in the environment.

Contact: theo.brock@wur.nl

MEASURING THE RELEASE OF POLLUTANTS FROM SEDIMENTS

In many Dutch waterways sediments are polluted as a result of industrial and human activities. Increasing environmental awareness has resulted in cleaner surface waters in the last decade. However, the sediments still bear this inheritance from the past. Pollutants are a mixture of organic contaminants and



heavy metals. We do not know for sure whether these pollutants can be released from the sediments, which would increase surface water concentrations and jeopardize water quality standards set by the Water Framework Directive. The project addresses the question of whether pollutants are released from sediments in field situations and which methods are best suited to measure this release.

Contact: marieke.delange@wur.nl

MONITORING NITRATE IN THE UPPER LAYER OF GROUNDWATER

A feasibility study on monitoring the upper five metres of groundwater has sought a new compliance checking level for nitrate in groundwater. Changing the monitoring depth of nitrate in groundwater would offer an opportunity to comply with the objectives of the EU Nitrates Directive and the Water Framework Directive without unnecessary restriction of the total nitrogen application standards. This change in the compliance checking level lacks expediency, however, because the current nitrate concentration in the upper five metres of groundwater in soils vulnerable to nitrate leaching fails to show a decrease. The nitrate concentrations decrease in depth in the upper five meters of

groundwater in other soils. But the uppermost metre of groundwater also flows via shallow subsurface flow to surface waters, and transports nitrate and other nitrogen compounds.

Contact: piet.groenendijk@wur.nl

STONE MODEL CALCULATES AGRICULTURAL NUTRIENT EMISSIONS

The integrated modelling system STONE was designed to evaluate, at national and regional level, the effects of changes in the agricultural sector – such as changes in fertilizer recommendations and cropping patterns – and in policy measures on the leaching of nitrogen and phosphorus from agricultural land areas to groundwater and surface waters. STONE consists of a chain of models, which are applied sequentially to a large number of unique simulation units representing the variation in biophysical conditions in the Netherlands. Computed results on nutrient leaching to groundwater and surface waters compare fairly well with field observations.

Contact: piet.groenendijk@wur.nl

DISPOSING OF PESTICIDES STOCKS IN AFRICA

Large amounts of pesticides have been shipped to Africa for locust control since the 1950s. Stockpiles of pesticides that took too long to arrive or never arrived at their destination are a problem. High concentrations of pesticides are found in soils near stockpiles and pose a serious risk. The Africa Stockpiles Programme (ASP), launched by FAO, is designed to help Africa to dispose of the pesticides in an environmentally sound manner. Northern removal technologies, such as incinerators or bioreactors, or removal and transport of high amounts of contaminated soils are not feasible. Instead, an approach that makes use of African conditions has been investigated. Following a risk-based approach, site specific remediation technology using biodegradation and isolation have been developed and implemented.

Contact: joop.harmsen@wur.nl



MONITORING EMISSIONS FROM SOIL SURFACES TO SURFACE WATER

Is agriculture the most important source of surface water pollution? What should a monitoring system entail to enable the evaluation of the effects of the manure policy and measures? In order to be able to answer these questions, it is necessary to have insight into the nutrient emissions from soil surfaces to surface water systems. The Monitoring Catchments project aims to offer this insight.

Contact: dorothee.leenders@wur.nl
www.monitoringstroomgebieden.nl

PROFITABLE WETLANDS ON THE LANKHEET ESTATE

To improve the quality of surface water in an economically viable and sustainable way, we have introduced a new form of land use on the rural estate 'Het Lankheet' near Haaksbergen, in the east of the Netherlands. Five hectares of arable land were



transformed into constructed wetlands with reed. The wetlands purify surface water, can temporarily store water during peak flows, produce biomass that can be transformed into green energy and contribute to the recovery of terrestrial ecosystems by using purified water to increase groundwater levels. This pilot serves as an example for the future implementation of the system on 150 thousand hectares of similar land types throughout the Netherlands. Profitability is of key importance: the gains must be higher than current profits from maize, grass or cereals if wetlands management is to become an interesting alternative for farmers and other land owners.

Contact: bastiaan.meerburg@wur.nl
www.waterparkhetlankheet.nl

SALINIZATION IN RESILIENT AND SUSTAINABLE NATURAL AREAS

The Dutch coastal plains are becoming more saline as a result of soil subsidence, climate change and changes in water management. The effects on the current biodiversity are uncertain. While salinization may be a threat, it can also offer opportunities for the formation of high-quality natural areas. In the project we will identify nature types that are likely to be af-

ected by salinization, investigate critical components with respect to salinization effects, and develop critical loads for salt for Dutch nature types. The project outcome will assist policy makers in the field of nature and water management.

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NEW FIELD DRAINAGE SYSTEMS

Wageningen UR has initiated two new field drainage projects to investigate the applicability potential of composite, controlled drainage systems in the Netherlands. The incentives are water quality and water quantity. The projects assess management of nitrogen and phosphorus loaded effluents and soil salinization, and how to mitigate the effects of climate-change induced summer drought on water quantity in areas of nature and agriculture.

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EVALUATING MEASURES FOR CLEAN WATER

Before implementing the EU Water Framework Directive in the Netherlands, its likely impact on nutrient losses from agriculture was evaluated. This has provided the Ministry of Agriculture, Food Quality and Nature with information about the consequences of the implementation of the directive, and revealed the cost-effectiveness of measures. The results will also be passed on to other government ministries and regional authorities. To achieve regionally defined targets, two factors were evaluated: first, the proposed measures to counter the losses of nutrients and heavy metals from agricultural land to surface waters, and second, the possible additional necessary measures.

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DATABASE OF EFFECTS OF AGRICULTURAL MEASURES ON WATER

The European Water Framework Directive aims to achieve a high standard – good ecological status – of the quality of surface and groundwater in Europe by the year 2015. To meet this deadline, a programme of measures has to be implemented by water basin authorities and individual farmers by 2009. This project will identify the most effective measures (individual or in combination) for reducing the load of nitrate, phosphate, heavy metals and crop protection chemicals to surface and groundwater.

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RIVER REHABILITATION

Alterra-Wageningen UR has much experience in conducting strategic studies for river rehabilitation, varying from small streams to large lowland river systems. Research involves themes such as river ecosystem classification and modelling, description of historical

references, analysis of process conditions for rehabilitation and river reach suitability, environmental flow requirements, and river delta scenario studies including plan design and plan evaluation, and the monitoring of re-meandering schemes. Research is funded by a variety of stakeholders at the regional, national, and international (Bangladesh, Brazil, China) level.

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DEEP CONTROLLED DRAINAGE FOR LESS NITROGEN LOSS

Conventional drainage has been widely used in the Netherlands to improve hydrological conditions for agricultural purposes. This drainage results in lower groundwater levels and a higher risk of nitrogen losses, but it decreases phosphorous losses to the environment. Deep controlled drainage presents opportunities to reduce the negative effects of conventional drainage on nitrogen losses.

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HEAVY METAL LEACHING IN DE KEMPEN

In De Kempen region, in the Dutch province of Brabant, zinc has been produced in zinc smelters since the 19th century. Atmospheric emissions from the zinc smelters have stopped, but heavy metals present in the soil can leach into groundwater and surface waters, posing a potential threat. A model study showed that most of the contamination still resides in the soil, whereas surface water concentrations are decreasing.

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THE MANGROVE ECOSYSTEMS IN THE MAHAKAM DELTA

The aim of the research cluster is to understand the integrated impact of human interferences and natural processes such as sea-level rise, climate change, upstream controls and ecological changes on the sediment and mangrove dynamics in the Mahakam delta, in the past, present and future. We will pay special attention to determining the resilience and restoration potentials of mangrove ecosystems and developing models that forecast catastrophic changes in coastal ecosystems. We also aim to understand issues of governance at all levels, and how ecosystem nestedness and governance nestedness can be linked.

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HYDRAULIC INTERACTION IN THE MAHAKAM REGION

The research on the hydraulic interaction between channels, lakes and aquifers in the middle Mahakam region is part of the East Kalimantan Programme. The aim is to understand the liquid discharge dynamics of the central reaches of the River Mahakam. The final goal is to establish through modelling the dominant hydrological mechanisms controlling floods and droughts in the area.

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MORPHOLOGY AND HYDRAULICS IN THE MAHAKAM LAKES REGION

The research is part of the East Kalimantan Programme. The aim of the project is to describe the morphological development and the hydraulics of the Mahakam in the lakes region, and to test conventional theories on this river section, so that the future development of the area can be predicted.

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WATER MANAGEMENT IN PARAGUAYAN BIODIVERSITY HOTSPOT

The Pantanal is the largest area of wetland of the world except for rainforests. Equal in size to Great Britain – about 250 thousand square kilometres – it is one of the world's biodiversity hotspots. The main objective of INREP is to strengthen the cooperation between policy makers, stakeholders and scientific institutions in Brazil, Bolivia and Paraguay, the European science community and NGOs working in the region for sustainable water management at river-basin scale and efficient water use in the Pantanal.

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TOOLBOX FOR MULTIDISCIPLINARY PROJECTS

A toolbox is available which supports the application of models in multidisciplinary projects. Elements include a glossary tool, a process support tool and quality assurance guidelines for model-based water management. These tools all provide practical guidance on achieving good modelling practices.

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WATERWISE FOR DISCUSSIONS AMONG STAKEHOLDERS

Spatial planning of land use and integrated water resources management are closely related, or at least they should be. Spatial planners and water managers should communicate more on their joint interests. The Waterwise tool is an attempt to integrate spatial planning with strategic water management decisions and choices. The tool stimulates discussions between stakeholders competing for limited water and land resources.

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DEVELOPMENT OF MALAYSIAN COASTAL PEATLANDS

The objective of the project on agricultural development in coastal peat swamps of Sarawak, Malaysia, was to provide the State of Malaysia with tools to properly coordinate and enhance the overall develop-



ment of coastal peatlands, as well as to avoid conflicting land use. To this end, a set of guidelines for agricultural development in the coastal peat swamps of Sarawak has been developed. These guidelines provide advice on best practice in planning, assessment, design, implementation and management of water management systems for agricultural activities in the coastal peat swamps of Sarawak.

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PEATLANDS IN THE HUMID TROPICS

PEATWISE aims to develop a curriculum on the sustainable development of peatlands by introducing innovative educational methods and tools to promote the wise use of resources and to enhance sustainable economic development. The focus is on in the areas of Sarawak, Malaysia and Central Kalimantan, Indonesia. The project covers the entire sequence of curriculum development, the production of educational tools and course materials, and training staff to disseminate knowledge.

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**RESILIENCE OF MANGROVE FORESTED
COASTAL ECOSYSTEMS**

The Wageningen University funded multidisciplinary programme on rebuilding resilience of coastal populations and aquatic resources (RESCOPAR) focuses on the interaction between the ecological, social and political dynamics of the resilience of mangrove forested coastal ecosystems. Four themes are researched: governance processes related to trade in fish products; local and individual decision making around seafood production; White Spot Syndrome Virus disease management of aquaculture productivity; ecosystem health and fishery productivity in coastal waters in relation to adjacent aquaculture practices. The research activities are carried out by four social and seven natural-science PhD students in Vietnam and Indonesia in collaboration with the Universities of Can Tho, Mulawarman, Diponegoro and Gadjah Mada, with the multilateral organization NACA and the NGO WWF-Indonesia. Most of the PhD research projects started in 2007 and will be defended in 2011.

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**QUASIMEME INTERNATIONAL LABORATORY
PROFICIENCY TESTING PROGRAMME**

International marine monitoring is conducted to provide the information required for environmental management of our oceans and coastal zones. These programmes can test for a range of contaminants, such as metals, PCBs, PAHs, organotins, toxaphene, brominated flame retardants, in different matrices. Wageningen UR operates the Quasimeme international laboratory proficiency testing programme to assist laboratories so they can provide data that meet international quality standards.

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ROLE OF VALUATION FOR WATER MANAGEMENT

The main purpose of the project is to draw generic lessons from a number of case studies about the role of valuation in supporting water management decisions. Water valuation enables us to assess the implications of various kinds of allocations of the available water among users, while taking into account equity, sustainability and environmental sustainability. Valuation shows whether there is scope for improving the overall benefits from water use. Insight into the value of water enhances the ability of decision makers to evaluate tradeoffs between alternative water management regimes and courses of social action that alter the use of water and the multiple services it provides.

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HELOPHYTE FILTERS ARE COST EFFECTIVE

LEI determines the costs for the agricultural sector of the EU Water Framework Directive measures. One example is the costs incurred by manure-free zones and helophyte filters. The costs comprise costs of investments, management and maintenance, and income

effects. The income effects have been calculated using the Dutch Regionalized Agricultural Model (DRAM). On average, helophyte filters involve high costs compared to other supplementary measures. However, helophyte filters can help achieve greater reductions in nutrient emissions, which makes them cost effective.

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PREDICTING ECONOMIC IMPACTS OF WATER FRAMEWORK DIRECTIVE

The Water Economic Modelling for Policy Analysis (WEMPA) project aims to develop an integrated hydro-economic model for the Netherlands. The model predicts the direct and indirect economic impacts of policy measures and instruments at national and river basin level. The RegiOptimizer module computes a cost-effective package of measures to attain the regional Water Framework Directive (WFD) goals against least costs. It combines economic optimization with the water quality model WFD-explorer.

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A Wageningen UR publication

Text: Wageningen UR

Coordination and editing: Bureau Bint, Wageningen

Photos: Wageningen UR, Shutterstock, Fotolia and 123RF

Design: TIM Grafische Vormgeving

Printer: Grafisch Service Centrum

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