



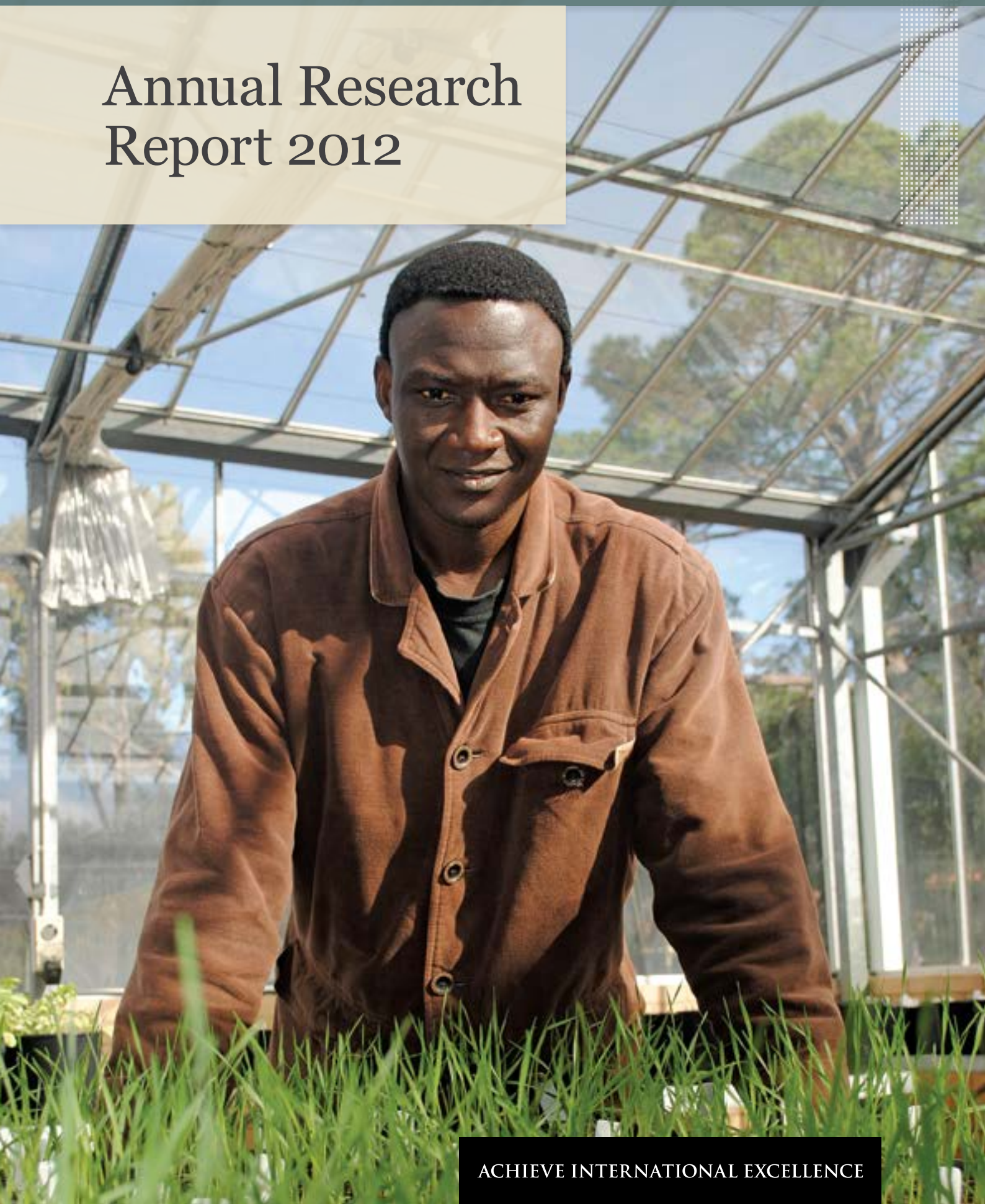
THE UNIVERSITY OF  
WESTERN AUSTRALIA  
*Achieve International Excellence*

A CENTURY OF  
ACHIEVEMENT  
1913 - 2013



THE UWA INSTITUTE OF AGRICULTURE

# Annual Research Report 2012



ACHIEVE INTERNATIONAL EXCELLENCE



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## The UWA Institute of Agriculture Annual Research Report 2012

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# Executive Summary

The UWA Institute of Agriculture (IOA) coordinates agricultural and related natural resource management research and educational activities across the University and is the external face of the University in the above areas.

IOA embodies a long tradition of excellence in agriculture at UWA, which has seen the disciplines of life and agricultural sciences at the University climb to the 26th position globally in the academic ranking of world universities in 2012.

Our achievements, challenges and future directions were highlighted in the Institute's external review in 2012 which marked the fifth anniversary since IOA was re-established in 2007.

Climate change and adaptation was a key focus in 2012, across the Institute's five research and development programs.

**Integrated Land and Water Management** has used molecular techniques to gain a better understanding of the functioning of microorganisms and their interaction with soil carbon, nutrients and plant roots; national programs have examined soil samples and greenhouse gas emissions across Australia and made use of web technology and online tools to collate data and provide information and decision support systems for primary producers in the quest to identify and adopt optimum land management practices. An international cooperation agreement was made to create and test products such as polymers for non-wetting soils to manage soil moisture.

## Animal Production Systems

developed the UWA Future Farm into a core resource that has attracted new international partnerships and served as a demonstration site for on-farm research. It has strengthened engagement with the local community, drawn international and national visitors, and generated an outreach program for students from several high schools. A focus on mitigating greenhouse gas emissions (from livestock) promoted multidisciplinary research, including work on novel (methane-reducing) forages and sheep breeding. The Animal Production Systems group's co-location with CSIRO's Livestock Industry group at Floreat in 2011 has led to intensive collaboration and a long-term strategy linking the two organisations. The program also promoted its message of clean, green and ethical animal production both domestically and overseas,

**Plant Production Systems** has further strengthened its national and international collaborations to deliver climate-ready crops with improved resistance to drought, heat, insect pests, diseases and weeds. Genomic analysis has made a key contribution in developing customised plant breeding programs: it has enabled scientists to identify 'molecular signatures' associated with specific physiological traits during a plant's reproductive period.

Herbicide resistance and weed management research have taken a major leap forward: Widespread adoption of a national approach has been facilitated by more than 50 workshops across Australia on herbicide resistance, by the commercialisation of the high-tech Harrington Seed Destructor and the on-line delivery of modelling tools to assist with selection of weed management practices.

## Rural Economy, Policy and Development

highlighted the pivotal role of policies for ensuring productive agriculture beyond the immediate future. A record audience participated in the IOA Industry Forum 2012 and engaged in the debate on foreign ownership of Australian agricultural land and agribusiness. A second theme was farm modelling as an important tool to assess the impact of policy change, and UWA's expertise in this field was recognized internationally: Professor Kingwell gave an invited talk to representatives of Europe's main research centres and universities at an international workshop convened to assess the European Union's new agricultural policy.

**Education, Outreach and Technology Exchange** has provided leadership to promote and facilitate the adoption of new technologies and practices at home and overseas.





# Mission

Extensive links within Australia and overseas and the high quality of its education and training programs have produced notable successes in translating research excellence into practical benefits for farmers, and in building capacity.

Achievements in education are also reflected in the many prestigious awards to our staff and students this year. A further testimony to our effort is the strong cohort of 23 PhD students, who commenced their research training in 2012.

During 2012 IOA made 31 media statements, organised several Food and Agriculture Lectures, attracted 30 new research projects and published 221 scientific publications.

My heartfelt appreciation goes to our collaborators, funding bodies, and industry partners, who have made the above achievements possible with their unflagging support and commitment to our vision.

**Winthrop Professor**  
**Kadambot Siddique AM, FTSE**  
Hackett Professor of Agriculture  
Chair and Director  
The UWA Institute of Agriculture  
The University of Western Australia



## IOA Mission

To advance research, education, training and communication in agriculture and natural resource management for the benefit of mankind.

## IOA Objectives

To enhance The University of Western Australia's contribution to agriculture and to the management of natural resources in Western Australia, and in selected national and international settings.

## Strategies

- **Integrating:** Bringing together UWA's agricultural research, teaching, training and communication activities; integrating complementary activities across disciplines and organizational units, and providing a focus for leading- edge Research and Development (R&D);
- **Connecting:** Fostering national and international linkages and alliances that bring new knowledge and expertise to UWA and allow the university to share its knowledge with the world
- **Resourcing:** Increasing the pool of resources available for investment in critical R&D in Western Australia;
- **Communicating:** Strengthening communication links with regional industry, farmer groups and the broader regional and scientific communities.



An aerial photograph showing a wide river with a sandy, light-brown bed and blue water. The river flows through a landscape of green agricultural fields, some of which are planted in rows of crops. A small cluster of buildings and trees is visible on the left bank. The background shows a vast, flat landscape under a clear blue sky.

# 1. Integrated Land and Water Management Program

The Integrated Land and Water Management Program aims to address the key challenges in the management of land and water resources in order to sustain yields and profitability in farming systems. In 2012 more so than ever before, sophisticated scientific processes and methods have become indispensable in addressing the mounting challenges arising from climate change and the poor quality of Australia's ancient soils, especially in the context of Australia's carbon pricing policy introduced this year. IOA scientists have applied their expertise and their vision to take into consideration these new developments/factors and have produced ground-breaking research and leadership aimed at sustaining profitable farming long into the future. Their excellence has been reflected in the National Universities Excellence in Research Assessment (ERA 2012) rankings of 4/5 in Soil Science (above world standard) and 5/5 in Environmental Science and Management (well above world standard).

## **Climate Change and Greenhouse Gas Emissions**

The future climate in the southwest of Western Australia has been predicted to have lower and more variable rainfall, which – if correct – requires adaptation and mitigation to sustain productive farming into the future.

## **National agricultural nitrous oxide research programme**

A major DAFF/GRDC-funded project (2009-2012), the National Agricultural Nitrous Oxide Research Programme (NANORP) measured nitrous oxide emissions in a variety of soil and climatic conditions around Australia and investigated cost-effective measures to decrease emissions.

In south-western Australia, research lead by Assoc/Prof Louise Barton (Soil Biology and Molecular Ecology Group Leader, School of Earth and Environment) demonstrated that applying N fertiliser as urea contributed about 80% to total on-farm emissions by emitting carbon dioxide via urea hydrolysis, and nitrous oxide via soil biological activity. A subsequent study investigated if on-farm carbon dioxide emissions from urea can be decreased by substituting urea with grain-legume fixed nitrogen; and if on-farm nitrous oxide emissions could be decreased by raising soil pH (via liming). Soil nitrous oxide and methane emissions were measured on a sub-daily basis from lupin-wheat





rotations (limed and not limed) in the central grain belt of Western Australia, using soil chambers connected to a fully automated system. Nitrous oxide fluxes were found to be low ( $< 10 \text{ g N ha}^{-1} \text{ per day}$ ), and less than those reported for arable soils in temperate climates. Emissions were not enhanced by including lupins in the cropping rotation. Liming decreased total emissions from the wheat-wheat rotation by 30%.

Methane uptake by the soil (i.e. soil was a net sink meaning no emissions to the atmosphere) was lower from the wheat-wheat rotation than from the lupin-wheat rotation, however liming the wheat-wheat rotation

increased methane uptake to a value similar to the lupin-wheat rotation. Findings illustrated that liming provides a strategy for lowering on-farm greenhouse gas emissions from nitrogen fertilised soils in semi-arid environments via decreased nitrous oxide fluxes and increased methane uptake. Assoc/Prof Louise Barton has recently been awarded further DAFF/GRDC funding (2012-2015) to investigate if increasing carbon affects nitrous oxide emissions from cropped soils in the Western Australian grain belt.

#### **Adaptation to climate change in the grain belt of WA**

Under the umbrella of the National Adaptation and Mitigation Initiative (NAMI) project which was led by DAFWA and funded by DAFF and GRDC. UWA scientists Dr Ken Flower and Dr Sudheesh Manalil led a sub-project to demonstrate the effect of different crop sequences and fallow on emissions of nitrous oxide and the conservation of soil water for subsequent wheat crops.

The aim was to demonstrate mitigation and adaptation to climate change in the grain belt of Western Australia. The two-year trial concluded in 2012 and was conducted at the UWA Future Farm near Pingelly and at the DAFWA Merredin Research Station. The different crop sequences tested before wheat included wheat, canola, field peas and various chemical fallow treatments.

Nitrous oxide emissions were relatively low and were of a similar order to those previously reported for Western Australia (see above). Nitrous oxide emissions at Merredin were mostly below detection levels. At Pingelly, crop or fallow management in 2010 had no effect on soil nitrous oxide emissions measured in a wheat crop the following year.

There were, however, significant differences in nitrous oxide emissions over time in 2011, with higher levels

measured after seeding and the application of  $28 \text{ kg N/ha}$  nitrogen fertiliser. The higher level immediately after seeding was presumably due to the presence of added nitrogen ( $18 \text{ kg N/ha}$ ) in the compound fertiliser used at seeding and the cultivation associated with the knife-point seeding.

In terms of water conservation from the previous growing season and summer, the weedy fallow used most soil water followed by the 2010 wheat crop. The chemical fallow conserved the most soil water over 2010 winter and summer but by seeding time at the end of May there was little difference between this and the other fallow treatments; other than the weedy fallow and wheat which still had less soil water.

At seeding in 2011, the plots where canola was grown in 2010 had similar levels of soil water to the fallow treatments, which was unexpected, and this was probably due to the very poor stand of canola in the 2010 drought.

#### **From source to sink: a national initiative for biochar research**

With the current interest in biochar there is an immediate need to understand and quantify the potential benefits and risks of biochar application to soil – in particular in relation to greenhouse gas mitigation, carbon sequestration and its effects on soil quality and agricultural productivity. DAFF-funded research led by CSIRO in collaboration with IOA, University of Sydney, University of New England, NSW Government and GRDC aimed to evaluate the carbon sequestration and greenhouse gas mitigation potential of biochars across a defined set of biochars and soil types. Prof Daniel Murphy (Chair in Soil Science, School of Earth and Environment) investigated the ability of 10 tonnes per hectare of a poultry litter biochar applied to a WA agricultural soil (on the DAFWA Wongan Hills

Research Station) to alter nitrous oxide emissions and/or the microbial populations associated with the soil nitrogen cycle.

Nitrous oxide was measured every few hours in the field from each treatment ( $\pm$  biochar,  $n=3$  field replicates) using chambers connected to a fully automated gas sampling system. Statistical analysis of total nitrous oxide loss over summer (low rainfall, no crop) showed that there was no difference between biochar treatments. The same response was found for nitrous oxide emissions during winter. Biochar did not alter nitrous oxide emissions from this coarse-textured (sandy) agricultural soil. This contrasts with findings from NSW where the same biochar decreased nitrous oxide emissions from soil that was subjected to extensive waterlogging. Findings highlight that the microbial populations interacting with biochar differed between soil types as a response to the aeration versus water filled ratio of soil pores. This initiative has been unique nationally as well as internationally as it has drawn together cross-disciplinary national expertise on different aspects of biochar research.

#### **A fundamental understanding of biochar – implications and opportunities for the grains industry**

Currently there is a debate about the agronomic value of biochar and its effect on soil quality. However, research on the effects of biochar on soil fertility and plant growth through soil-biochar-microbe interactions requires further investigation, in particular while biochars are produced by various combustion processes. The type of feedstock (e.g. wheat chaff, tree cuttings, manures) that is used to produce the biochar has a significant effect on the functionality and stability of the end product. GRDC-funded research led by CSIRO and Prof Daniel Murphy at IOA aimed to assess the degree of

variability amongst different biochars with regard to below-ground C allocation, crop-specific attributes and functions. A series of laboratory, glasshouse, lysimeter and field trials was used to assess the impact of biochar on key aspects of both the soil and plant. Biochar significantly decreased the breakdown rate of native soil organic matter and associated N and P leaching from the sandy soils and increased arbuscular mycorrhizal colonisation of wheat plants. However, there was no yield benefit through application of biochar to sandy agricultural soils. The findings highlight that it is not possible currently to generalise the effects of biochar as there are unique outcomes depending on the field conditions (soil type and climate) and the type of biochar used. The extensive data set on biochar types generated from this and the associated DAFF project is however a first step towards this becoming possible.

#### **Mitigating greenhouse gases with nitrification inhibitors and biochar**

Through the DAFF Carbon Farming Futures – Action on the Ground Program Dr Ken Flower and Dr Sudheesh Manalil set out to: understand the effects of previous crop and fallow on soil carbon and nitrous oxide emissions in summer and in a subsequent wheat crop; reduce nitrous oxide emissions from commonly used nitrogen fertilisers and crop residues through the use of nitrification inhibitors; and test the effect of biochar on nitrous oxide emissions and soil carbon levels. The impact of these treatments on wheat yield is also being assessed.

Treatments were laid out including fallow with and without biochar, wheat and a legume (pea at Cunderdin and lupin at the UWA Ridgefield farm at Pingelly); the latter were sown in June 2012. The two subplots were with or without nitrification inhibitor. Two rounds of soil analysis and of greenhouse gas

sampling were undertaken 15 days and 45 days after nitrification inhibitor application. Initial results showed a significant reduction in the emission of nitrous oxide from subplots treated with a combination of Flexi-N and the nitrification inhibitor DMPP, compared to the control sub-plots treated with Flexi-N alone. Lowest emission was observed in fallow plots. The emission from fallow +biochar plots was intermediate.

#### **Mitigating greenhouse gas emissions in soils amended with livestock manure**

Land application of manures can increase soil carbon but may also increase greenhouse gas (GHG) emissions; nitrous oxide ( $N_2O$ ), methane ( $CH_4$ ) and carbon dioxide ( $CO_2$ ). This research programme combines laboratory and field studies to evaluate the effectiveness of different GHG abatement methods for manure application and for reducing GHG potential from manure generated under improved manure storage systems. The research is also designed to identify the microbial processes involved in GHG q. The project is funded by DAFF Filling the Research Gap program and led by IOA scientist Dr Sasha Jenkins (School of Earth and Environment) in collaboration with APL, MLA, RIRDC Chicken Meat Program, Australian Egg Corporation Limited and DAFWA.

For further information see [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

#### **Low-cost anaerobic digestion technology to treat livestock effluent waste, mitigate greenhouse gas emissions and recapture bioenergy and nutrients**

Piggery effluent waste is usually treated in storage ponds which generate a multitude of undesirable effects including GHG and odour emissions.



One simple and affordable option is covering the effluent ponds to create a Covered Anaerobic Pond (CAPs) digester that both treats the waste and recaptures the biogas and nutrients. However, there is limited knowledge about the microorganisms that govern the waste degradation process and how management practices can be altered to make the conditions more favourable for biogas recovery. Also, there are currently no widely available tools to evaluate the best management practices for maintaining pond health, avoiding pond failure and applying the waste by-products as soil improvers.

IOA scientist Dr Sasha Jenkins (School of Earth and Environment, UWA) manages two APL grants looking at developing microbial diagnostic tools for monitoring microbial communities in CAPs, predicting pond failure and quantifying the risks and benefits of using the waste by-products as soil improvers. These collaborative projects involve UWA, UQ, DAFWA, the Western Australia Pork Producers' Association and five WA pork producers.

### Soil carbon storage in Western Australian soils

Maximum storage of soil organic carbon (and thus maximum mitigation of carbon dioxide in the atmosphere) in Western Australian soils is rarely achieved, as sub-optimal climatic conditions (rainfall; summer fallow) and soil management issues (biological, chemical and physical constraints) often restrict plant growth and returns of plant residues. The WA node of the National Soil Carbon Research Program (SCaRP) was funded by DAFF/GRDC with DAFWA and GGA as collaborators. The project, led by Prof Daniel Murphy, analysed more than 4000 soil samples from over 1000 sites across the agricultural 'grain belt' region to identify which land uses and management practices can increase



the levels of carbon, or at least slow down the rate at which it is lost.

Soil carbon stocks ranged from 3 to 231 t C ha<sup>-1</sup> (0-30 cm). Modelling indicated that there was further capacity for carbon sequestration in these soils. However, modelling suggested the 0-10 cm layer is largely saturated in terms of carbon storage. There was greater capacity for these soils to store more soil organic carbon below 10 cm; the findings suggested these layers are currently at less than

half their storage capacity. Strategies that input organic matter to depth are required to use this additional capacity. Based on paddock histories and measured data, annual rates of change in soil organic carbon were: 0.1 t C ha<sup>-1</sup> for stubble retention compared to burning in a low rainfall environment, 0.2 t C ha<sup>-1</sup> for clay addition to sandy soil, and 0.45 t C ha<sup>-1</sup> under perennial pasture (>500 mm rainfall). Carbon modelling suggested annual increases in the range 0 to 0.7 t C ha<sup>-1</sup> were possible

over the next 50 years in the higher rainfall areas. The conclusion is that rapid and large increases in soil organic carbon stocks are not likely in most WA soils; although land areas are large meaning that small gains can be significant in total.

### **Grazing into the future – building soil health and carbon with pasture management**

This project aims to accelerate the uptake of pasture management practices that are innovative for WA. The project is focusing on a chronosequence of perennial pasture grasses and intensive grazing (cell grazing). These are novel practices in WA. When strategically combined, they have potential to increase soil carbon. This project is led by IOA scientist W/Prof Lyn Abbott (Soil Science and Plant Nutrition, School of Earth and Environment) and supported by funding from DAFF, Carbon Farming Futures – Action on the Ground program.

### **Carbon Seminar**

In June 2012, IOA scientists Prof Daniel Murphy, Dr Andrew Wherrett and Assoc/Prof Louise Barton, presented research outcomes from the Federal Government's Soil Carbon Research Program (SCaRP), the National Biochar Initiative (NBI) and the Nitrous Oxide Research Program (NORP) to farmers in Northam in a 'Get the Dirt on Carbon' seminar, focused on helping improve the sustainability of Australian farms.

The SCaRP program analysed soil samples from more than 3,500 sites across the country to identify which land uses and management practices can increase the levels of carbon, or at least slow down the rate at which it is lost. Both the NBI and NORP programs measured nitrous oxide emissions across Australia and assessed cost-effective measures to reduce emission.

This research underpins practical adaptation techniques of farming systems that can assist farmers and industries to lower greenhouse gas emissions and increase productivity. The forum was co-hosted by IOA, Wheatbelt NRM and DAFF, under the federal government's Climate Change Research Program.

For more information see (page 6) [ioa.uwa.edu.au/\\_\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/___data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

### **Soil-plant-microbial interactions**

Our ability to deal successfully with several global challenges for humanity (i.e. feed the increasing world population, manage greenhouse gas emissions and adapt to climate change and variability) is closely linked to a better understanding of the functioning of microorganisms and their interaction with soil minerals and plant roots (i.e. the rhizosphere). Soil is the most diverse habitat on Earth containing 90% of the world's organisms. With the advent of molecular techniques, it has now become possible to identify and study the functions and processes of

diverse (both harmful and beneficial) microbial communities.

### **Management of microorganisms to unlock the phosphorus bank in soil**

Scientists are working to provide grain growers with practical management options that harness soil microorganisms to unlock part of the fixed phosphorus (P) bank in Australian arable soils. Australian grain producers apply \$1 billion worth of phosphorus fertilisers each year, but only 50% is taken up by plants. Much of the remaining fertiliser phosphorus becomes fixed in soil and the phosphorus 'bank' in Australian arable soils is estimated to be worth \$10 billion.

The project involving UWA IOA researchers Assoc/Prof Deirdre Gleeson, Prof Daniel Murphy and Dr Suman George aims to identify management practices that farmers can use to make soil microorganisms release phosphorus from the bank in soil so that it's available for their crops to take up. The research is being funded by the GRDC, as part of its second Soil Biology Initiative (2012-2015) and involves collaboration with the University of New England and the University of Adelaide.





As part of his PhD studies Mr Pu Shen from the Chinese Academy of Agricultural Sciences joined the project team (2011-2013) to study the influence of the carbon-to-nitrogen (CN) ratio of plant residues on the phosphorus release capacity of the soil microbial community. Preliminary data to date suggests that organic matter inputs with a high CN ratio results in a smaller but more diverse microbial biomass than that observed with low CN ratio inputs. These more diverse microbial communities observed upon amendment with high CN substrates may have enhanced strategies for accessing more recalcitrant P in soil, and further analysis of the microbial population data is underway to determine if this is the case.

**Ecosystems' response to climate and anthropogenic disturbances: implications for greenhouse gas emissions and nutrient cycling**

Understanding ecological processes at a scale relevant to microbial interactions and the cycling of nutrients holds the promise for rhizosphere engineering to improve nutrient acquisition, and in particular, for management of GHG emissions. However, despite the widely recognised importance of the rhizosphere, little is known about the spatial organisation of biological and chemical processes occurring therein. This can be attributed to (i) the small scale over which measurements need to occur, and (ii) a prior lack of analytical capacity to conduct measurements at a suitable small scale and without altering the spatial arrangement between soil minerals, organic matter, and plant and microbial cells.

Linking the physical heterogeneity of soil to ecological processes marks a current frontier in plant and soil sciences. Simultaneous analysis of identity (who are they?) and function (what are they doing?) of microbial populations with consideration for maintaining the soil 3-dimensional

structure (where are they located?) is a major challenge for microbial ecologists. Yet this is the scale at which microorganisms and plants interact, decompose organic matter and cycle nutrients including the production of greenhouse gases. It requires study of the links between soil physiochemical heterogeneity and biological processes. Unraveling this complexity at scales relevant to the organisms in question requires working at nano-, micro-, meso- and macro-scales. This is now possible through the application of high resolution microanalysis linked to isotopic analysis using nano-scale secondary ion mass spectrometry (NanoSIMS). This instrument, located within the world class Centre for Microscopy, Characterisation and Analysis (CMCA) at UWA is the only such instrument in the Southern Hemisphere.

Prof Daniel Murphy and Assoc/Prof Deirdre Gleeson, in collaboration with Assoc/Profs Matt Kilburn and Peta Clode from CMCA, along with a number of international collaborators, are applying NanoSIMS to address fundamental questions relating to carbon, nitrogen and phosphorus

cycling in agricultural systems in WA and China and in natural ecosystems of the Arctic (a global hot spot for climate change). This research is funded by an ARC Future Fellowship awarded to Prof Daniel Murphy and the GRDC Soil Biology Initiative II. In association with this research Prof Murphy was awarded a 3-year High-end Foreign Expert visiting Professorship with CAAS.

**Connectivity of pore theory**

IOA scientist Assoc/Prof Deirdre Gleeson has been leading research into the biodiversity of Australian semi-arid soil systems, looking particularly at the influence of water on the microbial diversity observed in soils. Her work, funded by the ARC Discovery program in collaboration with Prof Daniel Murphy and W/Prof Tony O'Donnell (Dean, Faculty of Science), investigated the role of soil water in influencing microbial processes and microbial diversity in soil. The findings of the project will improve our ability to harness beneficial microbial processes for food production under a changing climate.



This research included the first study to assess the influence of water on ammonia oxidising microorganisms in semi-arid soils. Ammonia oxidising microorganisms are a key microbial population in soil because they influence the amount of nitrogen that is available to plants and they are involved in the production of the greenhouse gas nitrous oxide. The research showed that in semi-arid soils, soil water content had less effect on ammonia oxidising archaea than it had on ammonia oxidising bacteria. The research also demonstrated that in semi-arid soils ammonia oxidising archaea are less abundant than ammonia oxidising bacteria, unlike most other regions of the world.

This research is important as climate change is projected to make rainfall more variable, which has implications for these key microbial populations in soil. Also, our understanding of these microorganisms in semi-arid soils may become relevant to other agricultural regions across the globe if climate change causes them to develop into semi-arid regions. In drier soil there was an increase in diversity of bacterial communities; additionally bacterial diversity was lower when water levels were less than field capacity suggesting that low pore connectivity (where soil pores are not connected due to lack of water) increases bacterial diversity – this may be one reason why soil biodiversity is so high.

#### **Impact of farm management practices on soil biological processes**

The Australian dairy industry is intensifying with higher stocking rates and reliance on imported feed and fertiliser to increase milk production per ha. Rising fertiliser prices and the emergence of alternative ('bio') fertilisers and soil conditioners have led to the question whether the benefits of soil biological processes can be increased.

Using high resolution biotechnologies, this Dairy Australia-funded project led by W/Prof Lyn Abbott investigates the impact of dairy farm management practices on the drivers of soil biological processes: the microbial diversity and community structure. The management practices studied include different intensities of nutrient application (especially nitrogen).

Early indications suggest that seasonal changes in environmental conditions may influence bacterial communities as a whole more than paddock management practices. However, further research is needed (and is underway), as soil microbial communities contain a large number of functional groups of bacteria which do not respond in the same way to nitrogen fertiliser application, or to the presence of roots of different species of pasture plants.

#### **Soil quality monitoring program as a national platform**

As part of the GRDC Soil Biology Initiative II, the Soil Quality Monitoring Program and associated website ([soilquality.org.au](http://soilquality.org.au)) are being expanded Australia-wide. The aim is to help grain growers across the nation to better manage soil from a sustainability and production point of view, through a greater understanding of the soil's microorganisms, the functions they perform and how managing the system affects grain yield. The web platform contains regional information and enables farmers to record their own data for comparison against benchmarks; besides serving as a soil quality database for Australian farming systems. It provides simple economic calculators to estimate the cost and benefits of possible measures, and introduces farmers to the concept of nurturing soil as well as crops. The national rollout was accompanied by a GRDC TV article and a 30 minute TV program (Landline, ABC screened on 11 November 2012) and followed on from a number of prior projects in Western Australia that were launched

by Prof Daniel Murphy in collaboration with Dr Frances Hoyle (DAFWA researcher and UWA Adjunct).

For further information see (page 12) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

#### **Molecular indicators of soil quality**

Our soils are widely recognised as being amongst the most biologically complex systems on Earth and one gram of soil can contain thousands of millions of individual organisms and tens of thousands of species. These organisms play a key role in maintaining agricultural productivity by recycling nutrients, by fixing nitrogen, suppressing disease, building soil structure and transforming soil organic matter. There have been numerous attempts to derive a limited set of indicators that can be used as surrogates for this diversity of soil functions. This research programme is using the techniques of molecular biology to describe a set of microbial variables that best describe a healthy and productive soil and how soil management impacts on these variables. Approaches include assessments of diversity and community structure using quantitative Polymerase Chain Reaction (PCR) and high throughput small subunit Ribonucleic Acid (RNA) sequencing. Functional differences between soils subject to different managements (eg till, no-till and till with organic matter additions) are being assessed using shotgun sequencing of soil metagenomes. The work is led by W/Prof Tony O'Donnell and is funded by GRDC as part of their Soil Biology II Initiative.

#### **Microbial sequestration of atmospheric carbon dioxide**

This research programme is part of collaboration between the Soil Biology and Molecular Ecology Group in IOA and the Institute for Subtropical Agriculture, Chinese Academy of Science (CAS) through their Joint



Laboratory for Soil Systems Biology. The work is focused on the use of innovative management practices to limit GHG emissions and the global warming potential (GWP) of major food production systems in China. To date the work has focused on rice paddies and their potential for C sequestration both as a result of microbial autotrophy (CO<sub>2</sub> fixation) and through rice straw incorporation. The programme is led by W/Prof Tony O'Donnell, and is funded through a grant from CAS to Professor O'Donnell who was recently appointed as a Visiting Professor to CAS.

#### **Micronutrient dynamics in cereal genotypes**

People who rely on a cereal-based diet frequently suffer health problems associated with micronutrient deficiency (most frequently zinc and iron) because of relatively low micronutrient content in cereal grains and low bioavailability of these micronutrients in the human digestive tract. There is a world-wide research effort to increase micronutrient content in cereal grains, emphasising grain quality without sacrificing grain yield.

#### **Pakistani visitors work with UWA research group on zinc uptake and transport in plants**

Zinc is an essential nutrient for normal growth and reproduction by both plants and humans. Widespread zinc deficiency in the soils of Pakistan and Western Australia led two Pakistani scientists to UWA to work on mechanisms of zinc uptake by plants and transport of zinc into developing cereal grains with W/Prof Zed Rengel (Soil Science and Plant Nutrition, School of Earth and Environment). Funded by Pakistan's Higher Education Commission, PhD candidate Shahid Hussain (University of Agriculture, Faisalabad) spent six months working with the group on 'Phenotyping the doubled-haploid mapping population of barley for uptake and remobilisation of zinc'. He

conducted greenhouse experiments on a 152-genotype population, paying particular attention to remobilization of Zn from the flag leaf and the two leaves below it as well as from stem and awns into developing grain. The Quantitative Trait Loci (QTL) analysis revealed a number of chromosome locations associated with Zn remobilization from various vegetative parts into grain.

Dr Shamsa Kanwal (University of Agriculture, Faisalabad, Pakistan) visited W/Prof Zed Rengel's laboratory from June-November 2012. She worked on sequential fractionation of Zn in vegetative tissues of parents of barley population differing in Zn accumulation in grain. She also optimised ammonium bicarbonate extraction of vegetative tissues as the first step toward using High Pressure Liquid Chromatography (HPLC) to fractionate Zn-containing compounds in the extract. That work will be continued by Dr Marko Petek (visitor from University of Zagreb, Croatia) in 2013.

#### **Improving nitrogen-use efficiency**

Nitrogen (N) is a widely used fertiliser in agriculture. However, N fertilisers are becoming increasingly expensive, and the N-use efficiency of N fertilisers is around 30% worldwide. Unused N can be leached, or lost through denitrification, with potentially severe environmental impacts.

#### **Harnessing the nitrogen cycle through novel solutions**

Nitrogen is a primary nutrient regulator of plant productivity. Sustainable land management requires that we optimise nitrogen supply for plant production and also minimise nitrogen losses through nitrate leaching and nitrous oxide emissions from soil. To achieve this, it is necessary to understand how management practices can influence the relative dominance of the individual microbial pathways of the nitrogen cycle, and

how carbon availability regulates the relative dominance of the microbial retention (immobilisation) and loss (nitrification, gaseous loss) pathways.

This research, led by Prof Daniel Murphy and Dr Linda Maccarone (Soil Science and Plant Nutrition, School of Earth and Environment) and funded as part of the current GRDC Soil Biology II Initiative, aims to study carbon and nitrogen processes at the rhizosphere scale (micro- and nano-scales) within soils from established field treatments and to link this with an understanding of the location of functionally relevant microbial communities. In doing so researchers are trying to improve fundamental understanding and thus future ability to manage the fate and cycling of N between land, water and atmosphere.

It is not yet fully understood whether it is the nitrifying bacteria or nitrifying archaea that are responsible for nitrification (both of these microbial populations can perform this process). Archaea and bacteria are both single-celled microorganisms, but differ in their genetic structure and biochemistry. The project findings have shown that nitrifying archaea and bacteria live at different soil depths, with nitrifying bacteria inhabiting the surface soil and the nitrifying archaea populations inhabiting the sub-soil (10-90 cm). Nitrifying bacteria are the most numerous overall when compared to the nitrifying archaea, and their decline in abundance with soil depth matches the decline in soil nitrification rates. Understanding the ecology of these microbes and their role in soil nitrification rates, may lead to improved management strategies to decrease N losses from the soil and improve N use efficiency; this would lead to lowered fertiliser costs and less off-site impact to the environment.

### **Nitrogen-use efficiency in wheat and barley**

Considerable variation in N-use efficiency has been found among genotypes of wheat and barley. In a GRDC-funded 5-year project IOA scientists W/Prof Zed Rengel, Dr Hossein Khabaz-Saberi (Soil Science and Plant Nutrition, School of Earth and Environment) and colleagues have been assessing this variability in the quest to help breed crops with improved nitrogen-use efficiency.

Following the assessment of a large number of wheat and barley genotypes in Western Australia, Victoria and New South Wales over 3 years (2009-2011), 24 genotypes of each wheat and barley were selected based on their contrasting N-use efficiency. These selected genotypes (containing commercial cultivars as well as advanced breeding lines) were tested at 4 locations in WA in 2012. For both wheat and barley, the ranking of genotypes for N-use efficiency showed much consistency among the field sites, suggesting that even in the presence of genotype x environment interactions, there are genotypes that consistently show either high or low N-use efficiency.

The work on this project will continue in 2013; wheat and barley genotypes with contrasting N-use efficiency will be evaluated at various locations in WA. In addition, mapping populations from wheat parents differing in N-use efficiency will also be evaluated in field trials in 2013.

Dr Jaffar Hassan (Balochistan University of Information Technology, Quetta, Pakistan) worked for six months with W/Prof Zed Rengel and Dr Hossein Khabaz-Saberi on N-use efficiency and drought resistance in wheat. Photosynthetic measurements were combined with

enzymatic and nutrient analyses in tissues. A significant interaction was found between N-supply and water stress, but not between N-use efficiency and drought resistance in various genotypes.

### **Water – a critical resource**

Climate change and development create major challenges for the protection and sustainable development of water resources.

#### **The UWA Turf Research Program: effectively utilising water allocations**

Southern Australia is expected to experience a significant decrease in water resources due to changing climate. Water allocation is a key water planning method being utilised for irrigating public open spaces.

The importance of maintaining sports turfgrass so as to encourage physical activity is well recognised within the community. The UWA Turf Research Program, led by Assoc/ Prof Louise Barton and W/Prof Tim Colmer (Head, School of Plant Biology), has been awarded funding to develop strategies to best manage current and future water allocations to these turfgrass areas. The project will investigate if turfgrass growth and quality can be maintained with an annual water allocation (7500 kL ha<sup>-1</sup> per year), and the implications of lowering the water allocation. It will also evaluate how best to distribute an annual water allocation during the year. The ability of soil wetting agents to improve the effectiveness of a water allocation is also being assessed. The research is funded by Horticulture Australia Limited (HAL) in partnership with the Local Government and members of the Australian Turf Industry.

The UWA Turf Research Program has been investigating the sustainable turfgrass management since 1996. For further information about the program see [plants.uwa.edu.au/research/turf](http://plants.uwa.edu.au/research/turf). For further information about the “Effectively utilising water

allocations for managing turfgrass in open spaces” project see (page 5) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

### **Protection and sustainable development of water resources**

Dr Paul Close from UWA Albany’s Centre of Excellence in Natural Resource Management (CENRM) coordinated a project aimed at assessing the likely impacts of possible development and climate change in northern Australian aquatic ecosystems, in collaboration with researchers from Griffith University, James Cook University, Charles Darwin University, CSIRO, and from the Environmental Research Institute of the Supervising Scientist (ERISS).

The team undertook a detailed analysis of a range of likely high-priority, at-risk ecological assets and asset types and the findings have provided water planners and managers with new information which will improve the understanding of water-dependent ecological assets across northern Australia and the risks to those assets arising from hydrologic changes due to water resource development or climate change. The new knowledge gained from this project will be used to inform land and water use planning, catchment level water planning and local decision-making for improved management of northern Australia’s water resources.

The project was aligned with the National Water Initiative, funded by the National Water Commission and conducted under the umbrella of the Northern Australia Water Futures Assessment (NAWFA), an Australian Government initiative to provide the information required to assist in the protection and sustainable



development of northern Australia's water resources. Further information is available at [environment.gov.au/water/policy-programs/northern-australia/ecological.html](http://environment.gov.au/water/policy-programs/northern-australia/ecological.html)

**Adapting to climate change: a risk assessment and decision framework for managing groundwater dependent ecosystems with declining water levels**

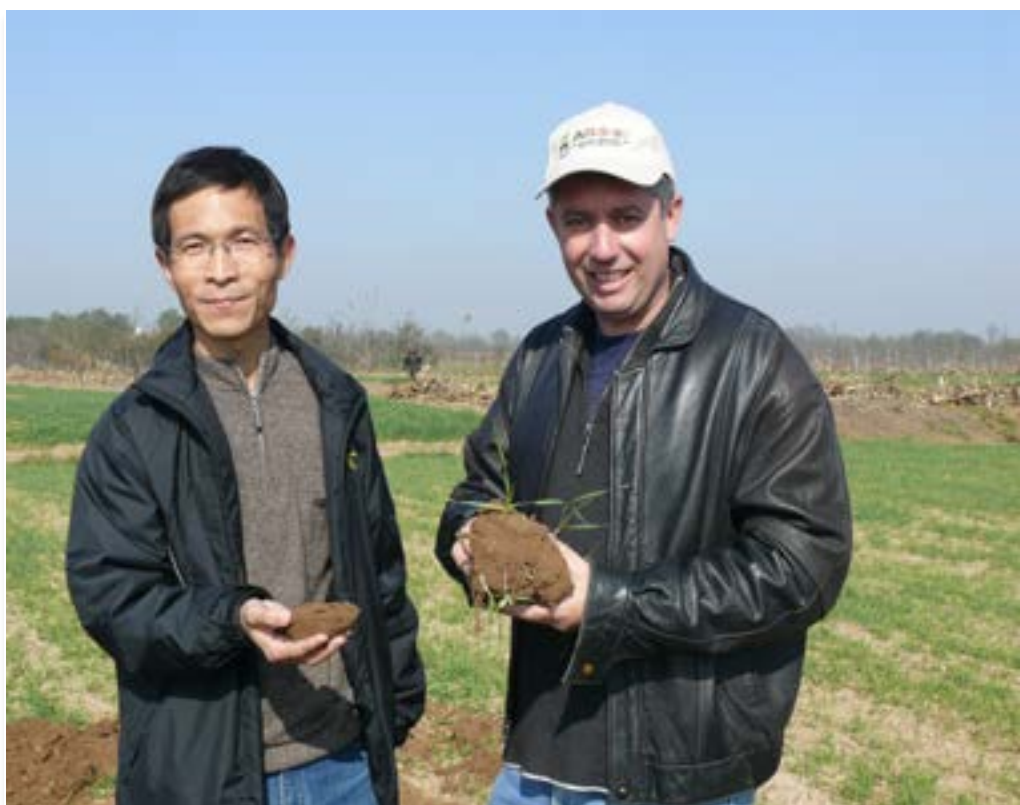
Dr Paul Close (CENRM) and colleagues from Murdoch University, have developed and tested a risk assessment and decision-making tool for managing groundwater dependent wetlands and caves (GDEs) with declining groundwater levels.

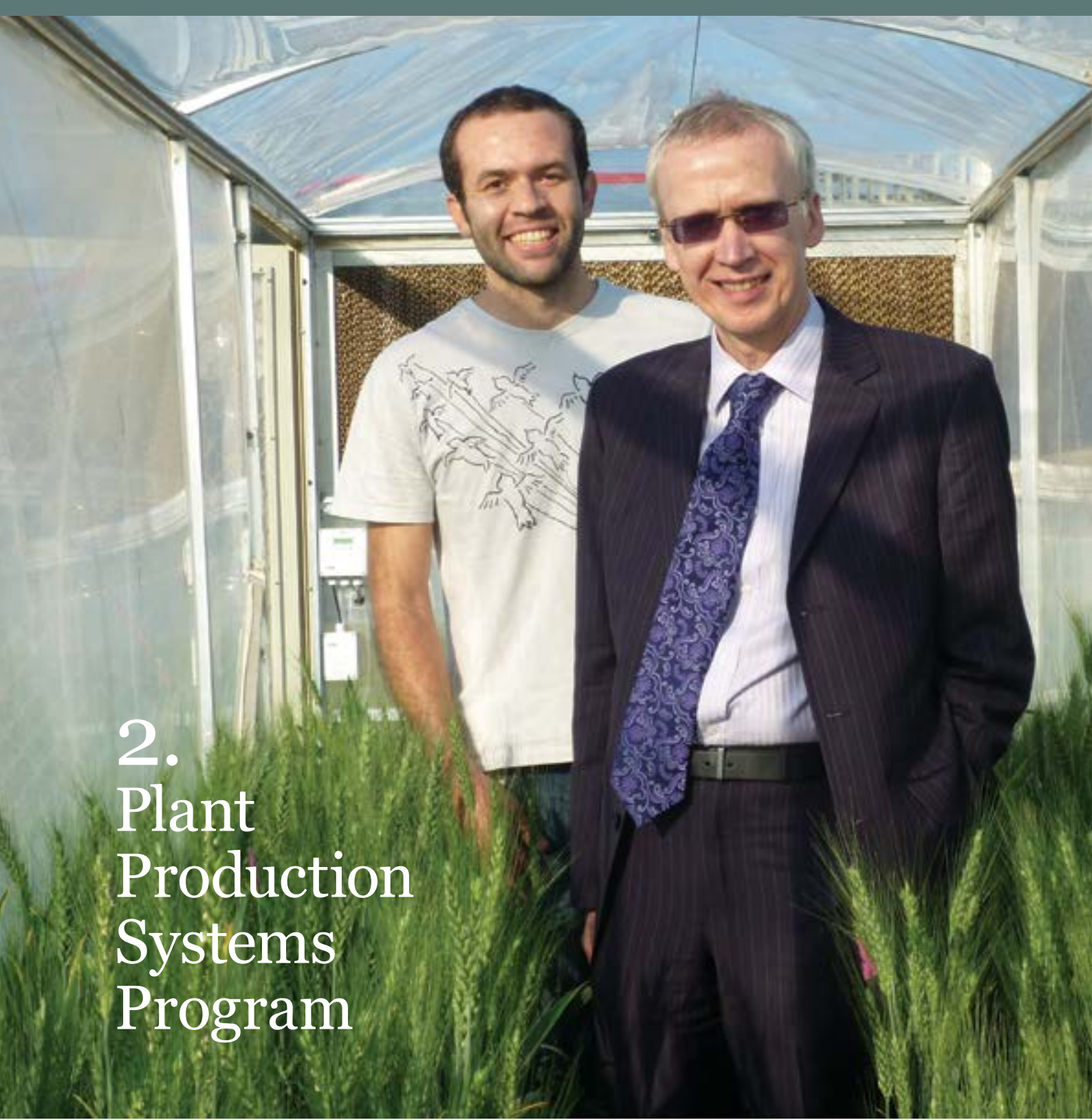
Past, present and future hydrological scenarios projected for climate change have been encapsulated into GIS to provide a basis of the spatial risk assessment tool. Appropriate hydrological and/or physiochemical attributes of wetlands have been identified from extensive datasets on the Gngangara Mound and Blackwood River, that might describe thresholds for a range of biota including fringing vegetation, macro-invertebrates, fish and frogs. Conceptual models of wetland ecosystem function have been developed for wetlands, rivers receiving baseflow and caves.

**Polymer research to improve soil moisture management and cropping productivity**

IOA soil scientists have joined an interdisciplinary team of leading material researchers, biologists and agricultural scientists in an international research project to create products such as polymers and sprays for non-wetting soils to control the distribution of soil moisture. The joint project follows a cooperation agreement between German-based BASF Crop Protection and the Melbourne-based Cooperative Research Centre for Polymers. The agreement aims to develop new products that will help farmers better manage water and nutrients in the soil and thereby improve dryland productivity.

As 30 per cent of Australia's cropping land does not retain all its water and produces only 10 per cent of the nation's broad-acre crops, this collaboration marks an important step in building technology and innovative leadership that demonstrates our commitment to farmers in Australia and around the world. The UWA scientists involved in the project are Prof Daniel Murphy, W/Prof Tony O'Donnell, Dr Jeremy Bougoure, Dr Falko Mathes, Assoc/Prof Louise Barton, Assoc/Prof Deirdre Gleeson, Dr Matthias Leopold, Dr Gavan McGrath and W/Prof Andy Whiteley from Soil Science and Plant Nutrition, School of Earth and Environment and Assoc/Prof Peta Clode from CMCA.



A photograph of two men standing in a greenhouse. The man on the left is wearing a white t-shirt with a graphic of a kangaroo and a boomerang. The man on the right is wearing a dark suit, a light blue shirt, and a patterned tie. They are both smiling. The greenhouse has a curved transparent roof and walls. Tall green plants are in the foreground.

## 2. Plant Production Systems Program

### **No-till cropping systems**

#### **Effect of summer grazing on no-till crop yields**

Soil cover is one of the key components of no-till cropping. A joint project on the impact of summer grazing by sheep on the soil and no-till crop yields was initiated in 2010 and continues until the end of 2013. The project partners are UWA, WANTFA and the Facey Group. The aim is to determine the effect of summer grazing on stubble levels,

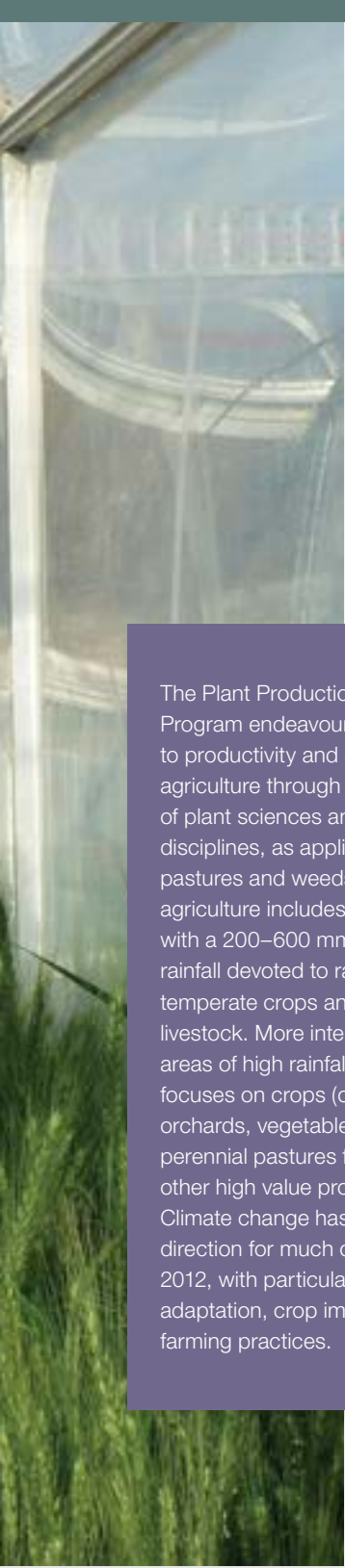
soil compaction, water infiltration and subsequent crop growth and yields. The results so far have shown that summer grazing has little impact on subsequent crop growth and yield, provided sufficient levels of cover remain to prevent soil erosion.

The project is part of the Grain and Graze 2 – Western Australia project, funded by the GRDC and DAFF Caring for our Country.

#### **Long term effect of high residue levels on soil and crop yields in a no-till cropping system**

This project, funded by GRDC, involves UWA, WANTFA, CSIRO and Planfarm and is in its sixth year. The research tests the long-term effect of different rotations, including cover crops, and levels of crop residue on the soil-water balance, soil quality (including soil carbon) and crop yield and profitability. Weeds and insect levels are also monitored.





The Plant Production Systems Program endeavours to contribute to productivity and sustainability of agriculture through the advancement of plant sciences and related disciplines, as applied to crops, pastures and weeds. Australian agriculture includes extensive areas with a 200–600 mm growing-season rainfall devoted to rain-fed annual temperate crops and pastures for livestock. More intensive agriculture in areas of high rainfall and/or irrigation focuses on crops (cotton, vines, orchards, vegetables, flowers, etc), perennial pastures for livestock and other high value products. Climate change has, again, set the direction for much of the research in 2012, with particular focus on crop adaptation, crop improvement and farming practices.

The aim is to determine if soil quality and crop water use efficiency and yield can be improved by the use of high residue levels and low disturbance seeding. The project uses a systems approach and combines the key principles of conservation agriculture i.e. permanent soil cover, crop rotations, minimal soil disturbance and controlled traffic. The trial is run on two sites that have sandplain and red sandy clay loam soils.

### **Improvement of (future) wheat cultivars and yields through:**

#### **Mapping of biotic and abiotic resistance traits in cereals**

A team of scientists headed by Assoc/Prof Guijun Yan (Deputy Leader, Plant Production Systems Program, School of Plant Biology) is working in collaboration with CSIRO, INRA, InterGrain Pty Ltd, DAFWA and several Chinese institutions, on the genetics of resistance in wheat and barley to some important biotic and abiotic stresses.

Fusarium crown rot, yellow spot, heat and drought tolerance and nutrient use efficiency are being investigated in Australian and Chinese germplasm.

Elite, disease resistant and stress tolerant wheat lines from China have been introduced to Australia and recently passed quarantine. In 2013 they will be evaluated in Western Australia for biotic and abiotic tolerances and suitable populations for QTL mapping and gene cloning are under development.

The team has developed close working relationships with Chinese scientists and the Chinese co-hosted The Third Australia-China Wheat Genetics and Breeding Workshop in Shijiazhuang, China in May 2012, with more than 100 participants. The fourth Workshop will be held on 5 September 2013 in Perth, with funding support from GRDC.

#### **Identifying climate-adapted properties and mechanisms in wheat in response to water supply**

As part of the joint CSIRO-IOA climate-ready wheat research project, Dr Helen Bramley (IOA) and colleagues have been investigating selected aspects of a new method to directly monitor leaf hydration, in the quest to identify new adapted wheat varieties to maintain (or improve) high wheat yields in changing climatic conditions: Their findings regarding

the ability of 'Zimmermann probes' to monitor the hydration status of wheat and curve kinetics from the probe outputs are being examined in more detail, to determine whether these probes can be used to identify genotypes that are able to maintain leaf hydration better under drought.

The collaboration between IOA, CSIRO and German inventor Zimmermann was further strengthened through four exchange visits (in 2012) between the collaborators, with support from the Group of Eight- DAAD German Research Cooperation scheme.

In September 2012, Dr Bramley gave an invited presentation at the ComBio Conference in Adelaide on new research results from the 'Climate Ready Cereals' project. The invitation was part of the best paper award bestowed on her by the Australian Society of Plant Scientists in 2011.

A related project on *Brachypodium distachyon*, a close relative of wheat, revealed that this species is a suitable model plant for investigating the molecular regulation of hydraulic mechanisms controlling water use of cereal crops. Dr Bramley and colleagues detected 8 aquaporin genes (proteins embedded in the cell membrane that regulate the flow of water) which vary in expression between roots and shoots. One aquaporin is of particular interest as it was only expressed in roots and its abundance increased when transpiration increased during the early part of the day. This aquaporin may be involved in regulating water flow through the plant to match water supply and demand.

The *Brachypodium* research was funded by a UWA Research Development Award (2011) and was conducted in collaboration with the ARC Centre of Excellence in Plant Energy Biology. Funding is being sought to continue the project.

### **Climate change and drought effects in wheat**

In the quest to develop climate-ready wheat, a PhD project supported by UWA, CSIRO and DAFF has examined the interaction between elevated CO<sub>2</sub>, high temperature and water stress (in wheat). Mr Eduardo Dias de Oliveira compared three scenarios in specially designed tunnel houses at UWA's Shenton Park Research Station with and without drought and elevated CO<sub>2</sub> conditions at 2°C, 4°C and 6°C above ambient temperature.

Growing two bread-wheat genotypes – the vigorous line 38-19 and the non-vigorous cultivar Janz – in the tunnel houses he found that at 2°C above ambient temperature, yields for both cultivars were enhanced regardless of whether they were well-watered or not. By contrast, the combination of elevated CO<sub>2</sub> at 4°C or 6°C above the ambient temperature tended to decrease wheat biomass and grain yield.

The information generated from this project will have a significant impact on the future of crop production in the Mediterranean-type climatic wheat-growing regions of Australia, where climate change is expected to have a severe impact on annual yields.

Mr Dias de Oliveira's PhD is supervised by W/Prof Kadambot Siddique (IOA), Adj/Assoc/Professor Jairo Palta (CSIRO) and Dr Helen Bramley (IOA). Mr Dias de Oliveira presented his research at the IOA Postgraduate Showcase 2012 (see also page 31).

### **New era in lupin research and grape research**

#### **Research into medicinal properties and applications of lupin**

A multidisciplinary team of scientists is researching potential medicinal properties and applications of lupin (grain) to help combat diabetes, obesity and food allergy.

The project is funded by the European Marie Curie Fellowship program and focuses on the molecular aspects of lupin seed proteins and examines their molecular role and potential to increase insulin sensitivity and/or reduce appetite; it also investigates the connection between a specific class of lupin proteins' and food allergy. Project findings are expected to help with the developments of patented allergy diagnosis kits and allergy vaccines, and with breeding lupin lines with reduced levels of allergenic proteins.

The 3-year project is led by W/Prof Karam Singh (IOA and CSIRO Plant Industry) at the CSIRO-UWA Plant Molecular and Crop Genomics Laboratory, in collaboration with UWA Prof Grant Morahan (Western Australian Institute for Medical Research (WAIMR)), Dr Penelope Smith (The University of Sydney) and Dr Juan D. Alche (EEZ – Spanish Council for Scientific Research), and Dr Jose C Jimenez Lopez, who was awarded a Marie Curie Fellowship to come to IOA to contribute his expertise to this project.

For further information see (p10) [uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

#### **Development and production of table grapes in a subtropical climate**

Scientists from UWA, DAFWA and the WA table grape industry are investigating the disorderly development and production of table grapes in the subtropical northwest of Western Australia (Carnarvon, 24°52 S, 113°37 E).

Led by Assist/Prof Michael Considine (School of Plant Biology and DAFWA), the five-year ARC Linkage project aims to solve long-standing production issues that have limited the expansion and export of table grapes. In partnership with W/Prof Jim Whelan (ARC Centre of Excellence in Plant

Energy Biology) the team brings to the industry unsurpassed expertise in analysis.

Although table grapes can tolerate a wide range of latitudes, growth outside their native temperate climate brings challenges, many of them due to the grapes' long reproductive cycle (18 months) which is tightly regulated by the (distinct) seasons: Subtropical climates have a diffuse transition between seasons and this makes managing grape growth and production an intensive process, both in terms of labour and the use of (expensive) chemicals. As a result, few varieties are productive, bud dormancy and viability is poor, flower abscission is high, and yield is low and variable.

The team's examination of the vine physiology in Carnarvon has established, that dormancy per se is not limiting fruitfulness and production, whereas bud necrosis, preceding bud burst, is a very real problem for the industry.

The next phase in the project will include genomic analyses of field samples (taken at different dates) to identify molecular signatures associated with bud necrosis, which will enable researchers to identify the underlying causes – an important milestone in the quest to find a cure and advance the table grape industry in WA's tropical northwest. The project is due for completion in 2014.

#### **Chickpea breeding successes at home and overseas**

In 2012 chickpea research generated strong interest at postgraduate student level as well as outstanding successes by IOA scientists in collaborative chickpea breeding and pre-breeding research carried out in Australia and overseas.



### Abiotic stress tolerance in chickpea

In January, W/Profs Kadambot Siddique and Neil Turner travelled to the International Crops Research Institute for the Semi-arid Tropics (ICRISAT) in Hyderabad, India and to Panjab University in Chandigarh, India, for a meeting with research partners in the AISRF project 'Securing chickpea productivity under conditions of stress due to heat, drought and salinity'.

At ICRISAT, they viewed experiments designed to evaluate the phenotypic and genotypic basis of salt tolerance, heat tolerance and drought tolerance, of a range of chickpea genotypes. At Panjab University, they viewed experiments designed to determine the biochemical basis of heat tolerance in chickpea genotypes.

For further information see (page 8) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0004/2031673/95490\\_IOA-News\\_web2.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0004/2031673/95490_IOA-News_web2.pdf)

The subsequent project meeting took place in Perth in September, during which the original AISRF project team (led by Tim Colmer at UWA and Vincent Vadez at ICRISAT) were also joined by new partners from ACPFG. The new partnership resulted from a successful bid to AISRF for a Grand Challenge Project, under the leadership in Australia of Dr Tim Sutton (ACPFG) and in India of Dr Rajeev Varshney (ICRISAT). The project team reviewed gains made in identification and understanding of genotypes with good salt, drought, and heat tolerances. The group also viewed the 2012 field trials near Bindi Bindi (saline site) and York (yield and yield components in a water-limited environment).





### **New desi chickpea varieties released**

Also in 2012, two new chickpea varieties were released. These varieties were developed by Prof Tanveer Khan (School of Plant Biology and IOA) and W/ Prof Kadambot Siddique (IOA) in partnership with DAFWA and COGGO. 'Neelam' and 'Ambar' are both desi type varieties and combine good seed quality, adaptation to WA conditions and high levels of resistance to ascochyta blight, a disease that destroyed the burgeoning chickpea industry in the late 1990s.

Both varieties require minimal or no fungicide application, which translates to reduced production costs and greater attractiveness for growers. The two varieties are expected to play a pivotal role in re-establishing the WA chickpea industry, which has been struggling to recover following the devastation caused by ascochyta blight.

The project was supported by germplasm bred under the GRDC National Chickpea Breeding Program and sourced from the NSW DPI and the DPI Victoria.

For further information see (page 5) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

### **Influence of climate change on plant virus and bacterial diseases**

The anticipated influences of individual parameters associated with climate change on diverse aspects of fungal pathogens and the diseases they cause have been investigated in depth in different types of cultivated plants.

However, this has not been done for viral and bacterial pathogens and the diseases they cause. In the quest to address this omission and unravel the likely effects of climate

change on plant virus and bacterial disease epidemics, with support from UWA and DAFWA, Prof Roger Jones and W/Prof Martin Barbetti (School of Plant Biology) compiled a comprehensive collection of past primary research papers on the subject. They then wrote a review paper which started by providing background information on current climate change predictions, the increasing worldwide importance of viral and bacterial diseases, critical features of their pathosystems and the general influence of environmental factors upon them. They then developed comprehensive climatic and biological frameworks and used them to determine the likely influences of direct and indirect climate change parameters on the many different host, vector and pathogen parameters that represent the diversity of viral and bacterial pathosystems.

This approach proved a powerful way to identify the relevant international research data available, as well as many information gaps where research is needed in the future. Analysis of the available data suggested that climate change is likely to modify critical components of viral and bacterial epidemic components in different ways, often resulting in epidemic enhancement but sometimes having the opposite effect, depending on the type of pathosystem and circumstances. With vector-borne pathosystems and new encounter scenarios, the need to consider the effects climate change parameters have on diverse types of vectors and the emergence of previously unknown pathogens added important additional variables.

To safeguard world food security and biodiversity, considerable research is needed on the increasing difficulties in controlling damaging plant viral and bacterial epidemics predicted to arise from future climate instability.

### **'Canola Breeders' develop new dual herbicide tolerant canola**

Canola Breeders Western Australia Pty Ltd ('Canola Breeders') is a small Australian company co-owned by UWA, the Grains Research and Development Corporation (GRDC) and Norddeutsche Pflanzenzucht Hans-Georg Lembke KG (NPZ). The company has its technical base at The UWA Institute of Agriculture (IOA) where it has operated as a private entity since 2001.

NPZ has been a strong supporter of research at UWA since 2001, and is an industry partner in a current ARC Linkage project investigating heat and drought tolerance in field rape or Brassica rapa. This project is lead by W/Prof Wallace Cowling at IOA, and supports research of two PhD students and Assist/Prof Sheng Chen.

Recently, Canola Breeders approached the world's leading weed herbicide resistance expert, W/ Prof Stephen Powles, for advice on the company's new dual herbicide-tolerant canola. In a world-first for canola, Canola Breeders has developed HT Duo™ hybrid canola varieties, which combine the Roundup Ready® trait with new-generation triazine tolerant (TT) germplasm. This provides growers with a new option for the control of herbicide-tolerant weeds through the in-season application of both atrazine and glyphosate. W/ Prof Powles strongly urged Canola Breeders to educate growers in the use of full rates of atrazine and glyphosate for the most effective use of this 'double knock' strategy to control herbicide tolerant weeds. This has started with an education campaign in 2013 led by Canola Breeders to promote 'best practice' for use of its new HT Duo™ hybrid canola varieties in farming systems.

## Herbicide resistance research

Research into herbicide resistance at IOA is carried out under the umbrella of the UWA-based Australian Herbicide Resistance Initiative (AHRI), led by W/Prof Stephen Powles, with major GRDC-funding to underpin a wide range of research activities from the molecular study of herbicide resistance through to applied research for weed management. AHRI works closely with DAFWA, DEEDI and the University of Melbourne to understand the impact of herbicide resistance and facilitate a national approach to resistance management across Australia. In the quest for a national approach, AHRI conducted approximately 50 workshops and presentations at regional, national and international levels.

## Commercialisation of the Harrington Seed Destructor

One of the most anticipated technologies in Australian agriculture, the Harrington Seed Destructor (HSD), progressed to commercial production in 2012 with GRDC awarding the license to de Bruin Engineering of Mount Gambier, South Australia.

Since 2005 AHRI has collaborated with agricultural innovator and farmer Ray Harrington on a mechanical device trailed behind the grain harvester known as the HSD which processes the chaff material and destroys weed seeds exiting the harvester.

The first HSDs were commercially available in time for the 2012 harvest.

## Sakura® low dose trials

In a world-first, AHRI, supported by GRDC, ARC and Kumiai Chemical Co., tested whether ryegrass could evolve resistance to the pre-emergent herbicide Sakura® prior to its commercial release in Australia.

AHRI found that recurrent selection at below label rates of Sakura® (60 g/ha) could rapidly lead to resistance evolution in ryegrass. After only three generations of selection under controlled conditions in the laboratory, one ryegrass population with resistance to multiple other herbicide modes of action, but not initially Sakura®, showed a clear capacity to evolve resistance to Sakura®.



### Herbicide Resistance Survey

After extensive surveying across the entire WA cropping zone in December 2010, herbicide evaluations were carried out in 2011 for 466 ryegrass populations. Resistance results for ryegrass were disseminated during 2012 to participating farmers, Crop Updates and in several presentations as well as via the media and the AHRI website. Brome grass, barley grass, wild radish and wild oat resistance levels were determined during the 2012 growing season, with results to be released during 2013 and 2014.

### Ecological modelling of weeds, diseases and pests in agricultural systems

Computer simulation models can provide a valuable tool in the management of pests, weeds and diseases. In 2012 a variety of projects have advanced knowledge in this area and generated a range of new simulation models, including:

#### RIM (Ryegrass Integrated Management) simulation model

AHRI has upgraded RIM with GRDC funding a decade after the model was first developed. Aimed at farmers, agronomists and students, RIM's new interface has simpler and more flexible settings and enables users to build sustainable cropping strategies; observe the effects of numerous options on ryegrass numbers; and view the financial implications of their choices. New features include options such as harvest weed seed control, the ability to visually compare two different strategies in terms of seed bank dynamics, ryegrass burden on yields, or budget allocation for various weed control techniques.

RIM will be officially released in February 2013 at the Global Herbicide Resistance Challenge Conference, to be held in Fremantle and organised by AHRI, and will continue to be a key tool to investigate crop management options and assess diversified strategies for successful weed control. It will be made available for

download on AHRI's website  
[ahri.uwa.edu.au/RIM](http://ahri.uwa.edu.au/RIM)

### Models on weed dynamics

Assoc/Prof Michael Renton and his team have developed three models, each focussing on a different important aspect of agricultural weed management. Together with the well-established bio-economic model RIM (Ryegrass Integrated Management) (see above), from which they draw, these models form a complementary family for tackling weed management issues.

- LUSO (Land Use Sequence Optimiser), funded by GRDC and CSIRO, is a bio-economic model and optimisation framework for analysing the drivers of decisions regarding 'break-crops' and land-use. LUSO is available from [github.com/saamrenton/LUSO](https://github.com/saamrenton/LUSO)
- PERTH (Polygenic Evolution of Resistance To Herbicides), funded by GRDC and RIRDC, and developed with support from AHRI, and CSIRO, is a tool for analysing the effect of different long-term management options on the risk of evolving herbicide resistance in agricultural systems. PERTH is freely available by contacting [michael.renton@uwa.edu.au](mailto:michael.renton@uwa.edu.au)
- The Weed Seed Wizard, funded by the Co-operative Research Centre for Australian Weed Management and GRDC, and developed in collaboration with DAFWA, DAFFQ, UA, and DPI, Victoria, is a tool to track and predict the number, ages, soil depth, dormancy levels, viability and germination of seeds of many species in the soil, and thus the weeds appearing at different times within and across a number of years. The wizard is available from [grains.agric.wa.gov.au/weed-seed-wizard-download-and-help](http://grains.agric.wa.gov.au/weed-seed-wizard-download-and-help)

For more information see (page 10)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

### General Model of Biological Invasion (GMBI)

The practical benefit of a biological invasion model is closely linked to how quickly it can generate accurate predictions, as rapid response is critical following the incursion of an invasive organism.

Assoc/Prof Michael Renton and Research Associate David Savage have developed a General Model of Biological Invasion (GMBI) that is flexible and abstract enough to represent a very wide range of possible invasive organisms, but contains enough biological realism to allow it to be quickly parameterised using expert knowledge and opinion on the species' biology. They tested the model's ability to represent a range of very different invasive organisms: a perennial weed, a wind-dispersed fungal pathogen, an insect and a bird; they also developed a system for how the GMBI would be used in the case of a real incursion.

### Controlling phosphine resistance in the stored grain pest beetle

There is a world-wide need to develop sustainable management strategies to control the development of phosphine resistance in the stored grain pest beetle *Rhyzopertha dominica*.

PhD candidate Dr Mingren Shi and his supervisor Assoc/Prof Michael Renton have developed cutting-edge individual-based simulations of the population and evolutionary dynamics of *Rhyzopertha dominica*, calibrated these models with a wealth of recent experimental data, and used them to evaluate a range of short-term tactics and longer-term strategies for managing populations and for avoiding or delaying the evolution of resistance.



### **Bactrocera simulator to manage Queensland Fruit Fly incursions**

The Queensland fruit fly (*Bactrocera* spp) commonly known as 'Qfly' can thrive in most commercial fruits and vegetable and spreads rapidly between habitats, posing a major threat to Australia's \$6.9 billion horticultural industry. An interdisciplinary team of scientists from UWA, DAFWA and the Plant Biosecurity Cooperative Research Centre (PBCRC) have developed a computer simulator which simulates and predicts the spread of Qfly following an incursion.

Prof Mark Reynolds (School of Computer Science and Software Engineering), Dr Juan J. Garcia Adeva, UWA research engineer who creates simulation technology, and DAFWA entomologists Dr John Botha and Dr Darryl Hardie, have created the 'Bactrocera simulator'.

The simulator contains several sub-models which consider population growth, time, host quality, seasonality, means of spread and the speed of spread of Qfly after it is detected in a new habitat. It can potentially be used to simulate and predict the spread of any *Bactrocera* species.

As the *Bactrocera* simulator also allows users to enter real data into the sub-models to estimate and predict the worst case-scenario for Qfly spread following an incursion, it represents an important decision support-tool that can be applied at all levels of government within Australia and allows a national approach to any incursion.

Comparisons of actual outbreak data against the predictions of the simulator showed good indications of matching but further work is needed to determine a quantitative level of accuracy.

For further information see (p 8) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

Management and economic impact of invasive pest incursions was also

the focus of complementary research, on the economic impacts of invasive species under climate change, which was undertaken by staff from UWA's Centre for Environmental Economics and Policy (see also page 28).



# 3.

## Animal Production Systems Program



The Animal Production Systems Program is pursuing a vision of 'clean, green and ethical (CGE) systems for animal management':

- Clean – minimize use of hormones, drugs and chemicals;
- Green – minimize environmental footprint, especially emissions of greenhouse gas (GHG);
- Ethical – maximize animal welfare.

The CGE concept underpins all of our degree programs, outreach activities and research. By its nature, much of the research into CGE management is interdisciplinary and is carried out within the context of the 'UWA Future Farm 2050' project.

### The strengthening relationship with the CSIRO Division of Animal, Food & Health Sciences

In August 2011, IOA Animal Production Systems joined forces with CSIRO's livestock industry researchers to form a new alliance around the concept of 'Versatile Livestock Systems'. The two organisations now share offices and laboratories and this close association has led to deep collaboration through:

- Joint projects, particularly in the area of GHG management;
- A long-term strategy linking the two organisations, and including the UWA Future Farm resource;
- Postgraduate project supervision by CSIRO scientists;
- Involvement of CSIRO scientists in undergraduate teaching in Agriculture and in Animal Science, including course delivery and undergraduate project supervision.





## UWA Future Farm 2050 – a core resource

[ioa.uwa.edu.au/future-farm-2050](http://ioa.uwa.edu.au/future-farm-2050)

The UWA Future Farm 2050 is based on “Ridgefield”, the University’s farm near Pingelly, where the aim is to imagine the best-practice farm for 2050, and employ these practices now. Importantly, the Ridgefield enterprise must be profitable, whilst facilitating local, national and international multidisciplinary research into future farming systems. It is also part of a developing

world-wide network of future farms, in a range of socio-economic and geographical regions, where we are taking the science out of the laboratory and into the field.

### Specific research projects in animal production in the UWA Future Farm 2050 Project include:

- Novel forages that reduce methane emissions from livestock (detailed below);
- Measurement of methane emissions from livestock (see below);
- Increasing ‘maternal efficiency’ to reducing the ‘emissions intensity’ of livestock industries (detailed below).

### Other projects and activities associated with UWA Future Farm include:

- Mitigating GHG with nitrification inhibitors and biochar (see page 4);
- Adaptation to climate change in the grain belt of WA (see p 3);
- Restoration of the ecosystem and biodiversity (see below);
- ‘City Kids to the Country’ – outreach to primary and secondary school students: (see below);
- International engagement (see below):
  - A major attraction for Chinese visitors (see below);
  - Worldwide Universities Network (see below).

## International engagement with the UWA Future Farm project

### Worldwide Universities Network (WUN)

The UWA Future Farm 2050 Project has led to a 2012 grant from WUN on ‘Sustainable and responsible production of healthy food from healthy animals’. IOA Deputy Director W/Prof Graeme Martin has partnered with Prof Mark Eisler (Chair in Global Farm Animal Health; School of Veterinary Sciences, University of Bristol) to establish links with the Food Security and Land Research

Alliance at the Rothamsted Research Station near Bristol. This program also includes our partner organisation, Kerala Veterinary & Animal Sciences University (KVASU) in India.

### Visitors from China

In 2012, the Future Farm Project welcomed a major delegation from Zhejiang Province during the celebration of the 25th anniversary of the WA-Zhejiang Sister-State relationship. Mr Shi Jixi, Zhejiang’s Director-General of Agriculture, led the 20-strong delegation and was impressed by the integrative nature of the UWA Future Farm Project, with the needs of the farmer family being considered as important as the various enterprises in the operation. The delegation were also introduced to the work of Chinese PhD student, Ms Xixi Li (School of Animal Biology), who is studying the ability of *Eremophila glabra*, or ‘Tarbush’, to reduce methane emissions by sheep (see below).

Other senior visitors during the year included the China Consul General for WA, Madam Wang Yiner, Prof Fengming Li (Lanzhou University), and Prof Luo Hailing (China Agricultural University).

It was also a big year for visits to the Future Farm by Chinese university students. Elite undergraduate students from NWAUFU (19 students), SCAU (two cohorts of 15 students) visited Ridgefield and studied the UWA Future Farm Project as part of 4-week short courses on Western Australian agricultural systems. A similar group from Singapore also visited Ridgefield during 2012.

## Local engagement – city kids to the country

In this program organised by Mr Bruce Ivers, there were five visits to Ridgefield by secondary school students from John Curtin College of the Arts and Applecross Senior High School.



W/Prof Graeme Martin had visited all five classes and outlined the UWA Future Farm 2050 Project as a means of providing context for the activities during the field trip. Under the guidance of Mr Ivers, the students grew over 4,000 seedlings (20 different species) in their school glasshouses and then planted them in a restoration area at Ridgefield. A total of about 220 students from Lower School (Science, Society & Environment) and Upper School (Biology and Geography) participated and learned about re-establishing biodiversity on farming land, seedling establishment techniques, changes in the landscape over a long timescale, dryland salinity, climate change and emissions mitigation, and sustainable housing.

The program is set to expand further in 2013 to promote the study of agriculture at UWA to high-school students from the city. (The program has been particularly successful in fostering new links with schools from southern suburbs, located closer to other universities). For further information see (page 3)

[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

#### **Greenhouse gas emissions from livestock**

2012 was the final year of the four-year Reducing Emissions from Livestock Research Program (RELRP), a \$30m national program of cooperative R&D, funded jointly by Meat & Livestock Australia (MLA) and the Commonwealth Department of Agriculture, Fisheries & Forestry (DAFF), under the policy, "Australia's Farming Future" ([daff.gov.au/climatechange/australias-farming-future/](http://daff.gov.au/climatechange/australias-farming-future/)). UWA was a major participant with IOA Deputy Director, W/Prof Graeme Martin, as a member of the National Steering Committee and Prof Phil Vercoe and colleagues, including CSIRO scientists, participating in research projects on methane measurement and emissions mitigation. Much of the work was based at 'Ridgefield', one of five National Demonstration Sites funded through RELRP. Other RELRP projects focused on emissions of nitrous oxide, another major agricultural greenhouse gas.

The work done under this scheme was featured on ABC Catalyst (February 2013) and can be seen on two DAFF videos: [IOA.uwa.edu.au/future-farm-2050/news-and-events/videos](http://IOA.uwa.edu.au/future-farm-2050/news-and-events/videos)

In 2012, the very successful RELRP program was replaced by a new initiative, the National Livestock Methane Program (NLMP), part of the Carbon Farming Initiative. W/Prof Martin is still involved as a member of the National Investor Advisory Group and Prof Vercoe has been assigned to coordinate much of the research on emissions mitigation, including the 'pan-genomics' research that encompasses the interactions between the genomes of the animal and its internal microbial fermentation vat.

#### **Measurement of methane emissions from livestock**

As one of five national demonstration sites in the Reducing Emissions from Livestock Program, Ridgefield was a major resource for the measurement of methane emissions from sheep and for optimizing field measurements for sheep grazing systems.



Three different field-based measurement systems were tested, including portable accumulation chambers (PAC), open path infrared technology (OPFTIR) and the 'poly tunnel'.

The PACs were used to obtain methane measurements of individual sheep to assist with the estimation of genetic parameters (eg, heritability) and assessment of selection programs for reducing emissions. By contrast, the OPFTIR and poly tunnel systems were used to estimate methane emissions from flocks of grazing animals – the poly tunnel can be used to measure emissions from 20 sheep at one time, whereas the OPFTIR system can be used to measure larger numbers (>50) at paddock scale.

A key to the research has been estimating the baseline methane emissions from sheep grazing the traditional or 'business as usual' pastures so that we can estimate the impact of a change in practice (new grazing systems) on emissions.

Another objective has been to correlate the three different measurement systems to validate the paddock scale estimates we have obtained. All of the work has been undertaken as part of a national initiative to reduce methane emissions from livestock funded by DAFF, MLA and AWI.

#### **'Maternal efficiency' and carbon footprint in sheep**

The Australian sheep-meat industry has two major and urgent needs – to reduce its carbon footprint, and to increase the size of the sheep flock. These two goals might seem incompatible but they can both be achieved by increasing reproductive efficiency: sheep that are not reproducing are only producing greenhouse gas, thus increasing "emissions intensity" (the amount of greenhouse gas emitted per kilogram of product). One major inefficiency in reproduction is delayed

breeding – traditionally, farmers do not breed their female sheep until they are 2 years old, wasting a year of productivity and also adding a year of greenhouse gas production; delayed breeding also lengthens the generation interval and thus retards genetic progress.

UWA PhD student, Mr Cesar Rosales Nieto (School of Animal Biology), is working with DAFWA and is searching for practical ways to breed sheep at one year of age. He is focusing on the genetics of body composition, particularly muscle development, and has shown that, in ewe lambs, genetic improvement for rapid muscle development can advance puberty and increase the reproductive efficiency of the ewe lambs.

This represents a whole new direction in reproductive physiology (which for nearly five decades, had been based on the dogma that pubertal development depends on the deposition of body fat). Mr Rosales Nieto presented his findings in August 2012 at the annual conference of the European Association of Animal Production in Bratislava, Slovakia. After the conference, he visited laboratories in Germany, France and Spain to discuss his work and the possibility of collaboration with UWA. His research was funded by the Sheep CRC and his travel through a UWA Postgraduate Research Travel Award.

#### **Spreading the word about methane-fighting forages**

PhD student, Ms Xixi Li, is investigating the ability of an Australian native plant, *Eremophila glabra*, ('tarbush') to reduce on-farm greenhouse gas emissions by reducing the production of methane in the rumen. Ms Li has worked out how much *Eremophila* is needed in the sheep diet to reduce methane production, and studied the way that it works using a rumen simulator ('Rusitec'). Last year, Ms Li travelled to Bangkok where she presented

some of her work at the 15th Congress of the Asian-Australasian Association of Animal Production Societies. She received travel awards from the congress and also won a UWA Postgraduate Research Travel Award.

In addition to mitigation of methane emissions, native shrubs such as *Eremophila* can bring many other benefits: i) combat gastro-intestinal worms, offering an alternative to the drugs that are rapidly becoming ineffective due to resistance; ii) offer green feed during the autumn when the quality and quantity of pasture are at their annual nadir; iii) help control the water table, and therefore salinity, because they are deep-rooted; iv) attract native wildlife.

The last of these points will mean that shrub-based livestock systems should become an integral part of the overall ecosystem and biodiversity plan for the farm, alongside other more dedicated areas for ecosystem restoration and intervention (see below).

#### **Ecosystem restoration and intervention ecology (ERIE)**

Dr Rachael Standish and Mike Perring, from the ERIE team, have been managing the Ridgefield Multiple Ecosystem Services Experiment which aims to restore and sustain function in degraded ecosystems, an increasingly important but challenging task in agricultural regions. On Ridgefield, the team is applying current ideas in ecology to ecological restoration, and seeking insights into how management interventions can sustain and restore multiple ecosystem functions in an era of rapid environmental change.

The initial plantings in 2010, the year of lowest rainfall on record, are now flourishing and providing data on carbon storage and other ecosystem services.



## **The science of animal ethics and welfare**

Animal ethics and welfare is a major aspect of the CGE vision that underpins the IOA program on Animal Production Systems. The leader of this discipline is Assoc/Prof Dominique Blache (School of Animal Biology) who leads a team of postgraduate students investigating a wide variety of projects in the field, and participates in an international network with colleagues in, for example, France, Spain, Brazil and Uruguay.

In July 2012, Assoc/Prof Blache gave an invited plenary presentation on 'Global Trade and Animal Ethics and Welfare' at the two-day international conference 'Perspectives for the Colombian Agricultural Sector in Relation to Globalization'. The conference was hosted by the Faculty of Agricultural Sciences of the University of Antioquia, Medellin, Colombia.

As part of his visit, Assoc/Prof Blache also conducted a one-day intensive course on Animal Ethics and Welfare for postgraduate students at the Faculty of Agricultural Sciences, in a first step towards the establishment of formal collaborations between UWA and the University of Antioquia.

His visit was supported by ICETEX, a Colombian governmental organisation that enhances educational initiatives. For further information see (p 14) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

## **CGE animal production for developing countries?**

In August 2012, IOA Deputy Director W/Prof Graeme Martin convened a workshop on 'CGE Animal Production in Developing

Countries' at the International Congress on Animal Reproduction, Vancouver, Canada. The CGE concept is driven by consumer demand in high-profit markets for food that is safe and healthy, with low environmental impact and considerate of animal welfare. Importantly, CGE management is not expensive, difficult, or 'high tech' – it simply involves application of basic knowledge of reproductive physiology and behaviour. Therefore, it should enable smallholder producers to target consumers with discretionary spending power, so they can get higher prices and thus emerge from a subsistence economy. In his workshop, W/Prof Martin led discussion of this hypothesis.

## **CGE Animal Production – making sure we don't compromise ram fertility**

In January 2012, IOA Deputy Director W/Prof Graeme Martin presented a plenary lecture, at the 38th Annual Conference of the International Embryo Transfer Society, Arizona. He forwarded the hypothesis that gamete quality is linked to changes in testicular mass. When the testis is growing or shrinking, there is a change in the efficiency of sperm production per gram of testicular tissue, indicating effects on the rates of cell loss during the process of spermatogenesis, probably through apoptosis. This is important for CGE animal production because it involves manipulation of gamete production by photoperiod, nutrition, genetics, and behaviour ('mating pressure').

For further information visit (page 2) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0004/2031673/95490\\_IOA-News\\_web2.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0004/2031673/95490_IOA-News_web2.pdf)

## **New agreement between UWA and Poultry Cooperative Research Centre (CRC)**

A new agreement between UWA and Poultry CRC has provided funding for research into game bird (Japanese quail, Pekin duck, turkey, silky hen, meat pigeon, guinea fowl, partridge and pheasant) health and welfare, nutrition and environment, and education issues.

Assoc/Profs Irek Malecki and Dominique Blache (both from the School of Animal Biology) have combined forces to work on game bird farming, reproductive physiology, and welfare, to help improve Australia's game bird industry which is worth more than \$250 million per year to the Australian economy and has a steady annual growth of about 10%.

Unlike Asia, Australia is relatively free from major poultry diseases, and is therefore set to play an increasingly important role in the Australasian region as a supplier of breeding stock and game bird products (meat and eggs). The project findings will help develop best practice guidelines and assist major producers (of duck and quail) to improve welfare, efficiency and competitiveness of their operations.

## Japanese visitor sparks new ideas for assisted reproduction technologies in domestic fowl

Prof Koji Ashizawa (University of Miyazaki, Faculty of Agriculture, Miyazaki, Japan) shared his expert knowledge about the regulation of domestic fowl sperm motility with UWA Honours and Postgraduate students during a visit in August 2012. His research has shed light on how, in birds, sperm are activated after being deposited in the female tract, de-activated on arrival at storage sites in the oviduct, and then activated again in preparation for fertilization of the egg.

He sparked new ideas during his informal lecture and lengthy discussions, and opened opportunities for collaboration in a critical area for assisted reproduction technology. A better understanding of the mechanisms involved in the control of sperm movement in the oviduct is an important milestone towards the development of sperm cryopreservation (preservation by cooling to sub-zero temperatures) for livestock industries and animal conservation programs.

## Extending collaborations in Kerala, India

In a five-day visit to Kerala Agricultural University (KAU) and Kerala Veterinary and Animal Science University (KVASU) in early 2012, IOA Deputy Director W/Prof Martin presented an invited paper at the National Seminar 'One Health Initiative in Addressing Food Safety Challenges'. W/Prof Martin's visit paved the way for formal collaboration arrangements with KVASU in the areas of: animal nutrition with respect to methane emissions, animal physiology with an emphasis on stress and environmental temperature and linking KVASU's farm to the UWA Future Farm 2050 Project (see page 21).




During his visit, W/Prof Martin also gave a guest lecture to Master of Climate Change students at KAU; held a workshop for academic staff and postgraduate students at KVASU; visited the KVASU Livestock Research Station, and

met with academics and senior officials from both universities. For further information see (p 14) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0004/2031673/95490\\_IOA-News\\_web2.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0004/2031673/95490_IOA-News_web2.pdf)



# 4.

## Rural Economy, Policy and Development Program



The Rural Economy, Policy and Development Program aims to enhance the sustainability of rural industries, communities and regions. This is achieved through innovative education and research with a focus on: improving rural productivity and prosperity; addressing their environmental challenges; contributing to their broader economic and social development; and enhancing rural policy and planning processes.

### Industry Forum

On 19 July 2012, the annual IOA Industry Forum was held for the 6th consecutive year. It generated both a high level of interest in the public and a high level of publicity in the mainstream media with this year's hot topic 'Foreign ownership of Australian agricultural land and agri-business: challenges and opportunities'.

The Honourable Terry Redman, MLA, Minister for Agriculture and Food; Forestry and Housing formally opened the Industry Forum in front of a record audience of over 100 farmers and industry representatives.

Following the formal opening, five speakers from key stakeholder groups presented their perspectives on the impact, challenges and opportunities inherent in foreign ownership of Australian agricultural land.

Mr Mick Keogh, Director of the Australian Farm Institute gave the keynote address and attributed much of the public unease about foreign ownership of Australian farm land to the lack of information and reliable data. He considered the risks arising from market concentration to be far greater than those arising from foreign agribusiness ownership.



Mr Duncan Calder, President of the Australia-China Business Council, WA, focused on the willingness of Chinese investors to adapt to Australian expectations and preferences, and on the opportunities generated by their flexible approach. In his view, adopting a pro-active approach with clear goals and regulations was the key to maximise benefits.

Pastoralists' and Graziers' Association president Mr Rob Gillam emphasised the need to reorientate our thinking towards foreign investment and ask ourselves how we can work more with foreign investors to attract greater investment.

Western Farmers' Federation President Mr Dale Park described the public debate on foreign investment in Australian agriculture as taking place in a 'fact-free' arena, due to the absence of (reliable) information and data about the extent of foreign ownership in Australian farmland.

Nuffield scholar and Bruce Rock farmer Mr Michael Foss discussed factors affecting corporate investment in farmland. He welcomed foreign investment because it could help reduce production risks to farmers, but pointed out that corporate investors were more attracted to countries with higher productivity

The full presentations can be accessed from [ioa.uwa.edu.au/publications/industry-forum](http://ioa.uwa.edu.au/publications/industry-forum)

### International co-operative research exchange

An international research exchange, led by Prof Anu Rammohan (UWA Business School) was held at UWA on 8 November 2012, as part of the Sustainable Co-operative Enterprise Project undertaken by scientists from UWA Business School and IOA, and from industry partners (Co-operative WA, CBH Group and Capricorn Limited and Ravensdown Fertiliser Co-operative).

The project team, in collaboration with international research partners have reviewed best practice co-operative business models from Australia and around the world with the aim to generate recommendations about how co-operatives can improve their sustainability through implementing such best practice.

The research exchange served as a forum where the participants from 40 research partners across Europe, USA and China explored key issues, including the role of co-operative and mutual businesses in economic development.

The project is funded under an ARC Linkage grant between UWA and its industry partners.

For further details see (page 7) at [ioa.uwa.edu.au/\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/_data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

### Food security in rural India

A collaborative ARC Discovery Project provides insights on food security from rural India. A team of scientists from UWA's Business School, University of Sydney, Griffith University and India's Tata Institute of Social Sciences have analysed data from interviews across 800 rural households in 8 strategically selected states in India, with the aim to identify appropriate policy reforms and interventions to improve food security.

The collated data include information on demographic, economic, labour market and educational profiles of all household members, and have shown a wide range of differences across the selected states with regards to wealth, land ownership and dependence on food-based social safety nets. Although analysis of the data revealed a big variation in the level of food security, it also showed a significant link between food security and household wealth and land ownership,

Food-based safety nets were shown to be largely insignificant, whereas access to Above Poverty Line (APL) cards had a significant negative association with being in the 'chronic food insecurity' category.



When taken together, the project findings point to economic factors as being influential in mitigating food insecurity.

**The economics of technological innovation for adaptation to climate change by broadacre farmers in Western Australia**

PhD Candidate Mr Donkor Addai, from the School of Agriculture and Resource Economics (SARE) generated a high level of interest in local farming community with his research on the economics of technological innovation for adaptation to climate change by broadacre farmers in Western Australia, which he presented at the IOA Postgraduate Showcase 2012 (see also page 31). He examined a range of adaptation options and their economic impacts under different climate change scenarios. His study found that, towards 2030, given currently available farming technologies and adaptation options, farming in the case study region would still be profitable under most scenarios. In the longer run, towards 2050, current farming systems would still be profitable unless climatic changes are at the more serious end of predicted ranges: a 20% rainfall reduction and a 4.0°C temperature increase. In all cases, adaptation

has an important role in reducing the negative impact or increasing the positive impact of climate and CO<sub>2</sub> changes on farm profit.

With the introduction of climate change mitigation policies and associated schemes, the impact on the sector will be minimal if the agricultural sector is excluded from these schemes; if the sector is included, however, the impact on farm profit is negative unless the carbon price is very high. The adverse effects of carbon pricing on agriculture are greatest for minor climate change. While carbon pricing under extreme climate change has less of an adverse effect on farm profits, extreme climate change itself remains highly damaging to farmers.

Mr Addai's presentation can be accessed at [ioa.uwa.edu.au/publications/showcase](http://ioa.uwa.edu.au/publications/showcase)

**Economic impacts of invasive species under climate change**

In September 2012, Assist/ Prof Morteza Chalak and W/Prof David Pannell, from the Centre for Environmental Economics and Policy, participated in a World Universities Network (WUN) workshop 'Invasive species under climate change:

economic impacts', held at the University of Alberta (UA), Canada. The workshop focused on socio-economic and bio-physical impacts of invasive species and promoted a shift of research focus from prevention to management of invasive species through novel interventions, including adaptation.

Collaborations with UA continue on this topic, with support of a UWA collaborative research grant awarded to Assist/Prof Chalak.

(For other research on pest management see also pages 18-19)

**UWA Professor advises on EU policy change**

In June 2012 DAFWA chief economist and UWA Prof Ross Kingwell addressed representatives from Europe's main research centres and universities engaged in farm modelling, statistical collection and data management, at an international workshop convened to assess the European Union's new agricultural policy.

In his invited talk, Prof Kingwell presented Australian examples of the use of farm modelling in policy assessment and emphasised that the impact of a policy change is



determined by more than one factor; and that depending on the nature of the policy change, farm businesses and their environment can be affected differently and some changes can occur quickly or slowly.

For further details see (page 2)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

### New Honours units

2012 saw the introduction of two new Honours units, to equip students with the knowledge, skills, and tools they require to understand, analyse and solve issues unique to the rural economy, policy, and development:

- Agricultural Economics (AGRI4402) is a level 4 unit that focuses on the economics of agribusiness strategy in light of contemporary issues in agribusiness. The focus of this unit is on the theoretical underpinning of agribusiness strategy and the application of theoretical and empirical models to the strategic analyses of real agribusiness firms. This unit is taught by Assist/Prof Amin Mugera (SARE) and Prof Ross Kingwell (SARE). A key feature of this unit is the use of the Harvard Business School case study approach to enable students develop problem solving skills related to the problems and opportunities of coordinating food production, processing and marketing along the value chain. 32 Honours and Masters students enrolled in this unit.
- Applied Demand and Production Analysis (ECON5510) is a postgraduate unit that focuses on the economics of producer and consumer behaviour and the specification and estimation of

demand and production systems for agricultural commodities. This unit is taught by Assist/Prof Amin Mugera and Assoc/Prof Atakelty Hailu. The aim of the unit is to provide students with advanced level quantitative skills in economics highly valued by employers of agricultural economists and natural resource managers such as the Australian Bureau of Agricultural and Resource Economics (ABARE), DAFWA and many private sector organisations. Ten students enrolled in this unit.

### Research Students

Two new PhD students joined the program in 2012 through SARE. Mr Masood Mohamed research focuses on the vulnerability of rural households and business enterprises to flood disaster in Punjabi Province Pakistan. Mr Steele West is working on his research proposal on the impact of capital structure on the efficiency, productivity and financial health of broadacre farms in Western Australia.

Two honours students completed their project on policy issues relevant to the Western Australia rural economy. Miss Emma Downsbourough's project 'Consumer preference and willingness to pay for a local label attribute in Western Australian fresh and processed food products' investigated consumer attitudes towards and preferences for locally produced food products in Western Australia. Miss Joanna Lang's project 'Financial analysis of on-farm grain storage and handling in Western Australia' analysed the benefits and costs of on-farm storage investment in Western Australia.

### Conference participation

Program Leader Assist/Prof Amin Mugera, together with his PhD students, participated in a number of international conferences, presenting papers on a range of topics related to the rural economy and policy:

Assist/Prof Muger presented papers at the Agriculture and Applied Economics Association's (AAEA) 2012 conference in Seattle, Washington (August 2012), at the Australian Agricultural and Resource Economics Society (AARES) 2012 conference in Fremantle, Perth (Feb 2012), and at the Western Economic Association International 87th Annual Conference in San Francisco, California (June 2012).

Postgraduate students Mr Manoj Mudalinge (SARE) and Mr Abatania Luke (SARE) also presented a paper each at the AARES 2012 conference.





# 5.

## Education, Outreach and Technology Exchange Program

The Education, Outreach and Technology Exchange Program aims to raise the profile of agriculture and resource management (in the wider community) and to help take the achievements made across the Institute's programs from the laboratory into the paddock, through education and training programs in regional and selected national and international settings.

With access to world-class teachers, researchers and facilities, the program fosters industry contacts, strengthens links with rural communities, promotes research partnerships and postgraduate teaching and training programs at UWA as well as research and agribusiness activities at the university.

### UWA graduates shine at Young Professionals in Agriculture awards

The high quality of UWA teaching programs in agriculture and related disciplines was reaffirmed at the 2012 Young Professionals in Agriculture awards, where UWA graduates claimed the top prizes.

The annual event is hosted by WA's Division of the Ag Institute Australia and showcases the work of tertiary students studying agriculture-related subjects at WA universities and who have completed an undergraduate degree.

Ms Danielle Whyte received the top award for her research into herbicide resistance in wild radish populations; second prize went to Miss Fiona Young for her work on assessing whole-farm benefits of twin sowing; and the third prize was claimed by Mr Robert Jeffery for his research into the effect salinity tolerance has on the germination of pasture legumes. The award for best presentation went to Joseph Steer for his study of how the genetic aspects of both the wool and faeces of sheep relate to flystrike.

For further details see (page 11)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)





## Postgraduate Showcase

The high standard of research training and achievement in UWA's postgraduate programs, in agriculture and related areas, is put on display at the Institute's Postgraduate Showcase: each year, IOA invites some of UWA's top postgraduate students in an agriculture-related field to present their research to an audience of farmers, academics, scientists as well as industry and government representatives.

In the Postgraduate Showcase 'Frontiers in Agriculture 2012' eight students representing four schools presented their research.

Their presentations can be viewed at [ioa.uwa.edu.au/publications/showcase](http://ioa.uwa.edu.au/publications/showcase)

**Table 1: Postgraduate Showcase 'Frontiers in Agriculture' 2012**

Ms Kirrin Lund, School of Animal Biology and IOA, Faculty of Science: The guts of alpaca nutrition

Ms Annisa, School of Plant Biology and IOA, Faculty of Science: Heat tolerance in Brassica rapa: developing an efficient screening method'

Ms Mechelle Owen School of Plant Biology, AHRI and IOA, Faculty of Science: Quantifying herbicide resistance in the Western Australian grain belt

Mr Eduardo Dias de Oliveira, School of Plant Biology and IOA, Faculty of Science: Wheat responses and adaptation to climate change in south-western Australia

Mr Shuo Wang, School of Earth and Environment and IOA, Faculty of Science: Controlling quality and texture through digitizing breads and doughs

Mr Daniel Dempster, School of Earth and Environment and IOA, Faculty of Science: Biochar and the nitrogen cycle: unraveling the interaction

Ms Beena Anil: School of Earth and Environment and IOA, Faculty of Science: Grower groups: their emergence, role in farmer learning and future challenges

Mr Donkor Addai: School of Agricultural and Resource Economics and IOA, Faculty of Science: The economics of technological innovation for adaptation to climate change by broadacre farmers in Western Australia

## Dowerin Field Days

The Dowerin Days, held in late August every year, represent the biggest agricultural Expo in Australia and an excellent forum to strengthen relationships between scientists, growers, community and industry.

In 2012, IOA again joined DAFWA in the 'Futures in Agriculture' display, to showcase innovative research and to engage with visitors. First-year Science student Rachel Asquith provided her perspective about the study of agriculture under UWA's new undergraduate course structure which commenced in 2012, while

PhD student Max Bergmann (School of Plant Biology) explained the wide range of opportunities in agriculture at postgraduate level.

Potted quinoa plants and salt and drought tolerant chickpea varieties attracted a substantial number of growers keen to diversify their crops with new cultivars. Assist/Prof Jon Clements, a researcher from UWA's International Centre for Plant Breeding Education and Research (ICPBER) and instrumental in introducing quinoa as a commercial crop to WA in 2012, shared his knowledge with growers/visitors, providing them with the information needed to make good decisions.

Other displays included a slide presentation on the progress made at UWA's Future Farm (see also pages 21-23) and highlighted UWA's commitment to innovative and sustainable agriculture.

Amongst the interactive displays was a competition for school students to spot and name microscopic bugs in the soil enlarged under the microscope, and a seed-identification quiz, complemented by CLIMA's 'Passion for Pulses' cookbook.

The varied nature of the IOA display ensured its popularity with farmers, industry representatives, food lovers and prospective students alike and reinforced the universal value and relevance of agriculture.

For further details see (page 11) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

## IOA News fulfil multiple functions

IOA promotes its activities, research, and collaborations as well as the achievements of its students and staff to alumni, agribusiness, growers and industry, funding bodies, research institutions, and UWA staff.

The quarterly IOA News publication represents a key medium for cementing and maintaining the Institute's strong connection with and between these groups. The IOA News publication is circulated widely in electronic format (3000) and as a printed magazine (3000).

In addition to feature articles, the IOA News provided a list of new publications, visitors, new research projects and in doing so, serves as a valuable reference tool and snapshot of developments in agriculture and related areas at UWA.

The IOA News was published in April, August and December 2012.

### Media statements

The Institute cemented its media presence during 2012 with 31 media statements, which in turn, generated a substantial number of follow-up articles in mainstream newspapers and farming magazines; and a number of radio interviews with key protagonists.

**Table 2: IOA Media Statements 2012**

Date released	Title
January 23	Leaf Gui unlocks secret geometry
February 7	Smash and destroy weapon to wage war against weeds
March 1	Leading crop scientist warns against herbicide overuse
March 9	Plant scientists unlock fire and witchcraft secrets
March 26	UWA trio shine in Academy of Science
March 26	Wolfing down lupins to fight 'diabesity'
April 3	Japanese research to help WA lupin growers
May 8	Crop root study to boost Australian grain production
May 10	Agricultural scientist honoured for 'inspiring influence'
May 15	Top British soil scientist joins UWA
May 16	WA's 'feed the world' Professor lauded
May 25	Toxin profile revealed in first study of 2003 WA outbreak of head blight in wheat
May 31	DNA discovery key to drought resistant crops
June 4	Plant biologist wins national award
June 14	WA economist addresses agricultural policy workshop in Europe
June 19	Scholarship winner uses maths brain for good grain
July 9	Salt-tolerant chickpea project to boost crop production
July 16	\$6.7 million to boost low-carbon farm research
July 19	Native plants join battle to save biodiversity hotspot
July 20	Are ewe eating for two, three, four...
August 6	One chromosome key to combating global food threat
August 7	Huge open-air lab for new water management studies
August 15	UWA joins world top 100 universities
August 24	Resistance evolution in weeds puts 24-D under the microscope
August 27	New polymer research aims to boost dryland crop productivity
September 6	Chinese visit hails UWA Future Farm research
September 13	New chickpeas set to revive Australian pulse industry
September 24	UWA researcher to receive China's highest award
October 3	Environmental economist elected to Social Sciences Academy
October 18	Learning Links program puts high school students on world stage
October 24	Destructive pea weevils on the way out





## Website: [ioa.uwa.edu.au](http://ioa.uwa.edu.au)

The IOA website is the first port of call for information on UWA agriculture-related activities.

The website is updated regularly with information about IOA events and with hyperlinks to other relevant (internal and external) web pages, to enable visitors to explore the activities of IOA and its partners in depth.

Current information is complemented by archived media releases, lectures and presentations, all of which are readily accessible to provide a comprehensive and cumulative picture of the Institute's activities.

In 2012 the UWA Future Farm extended its web presence from a single web page to a subsite [ioa.uwa.edu.au/future-farm-2050](http://ioa.uwa.edu.au/future-farm-2050), containing more than ten pages, to reflect and better promote the growing number of activities taking place there.

Other web developments in 2012 include the addition of a list of partner organisations [ioa.uwa.edu.au/collaboration](http://ioa.uwa.edu.au/collaboration), to illustrate the Institute's vast network of connections within UWA, with business and industry, with government and with institutions at home and overseas.

## Mike Carroll Travelling Fellowship

Recipients are chosen on their academic abilities, relevance of studies to an important area of Australian broadacre agriculture, their potential to benefit from the experience, and their enthusiasm to impart the findings of their travels to the scientific, farming and wider community on their return to WA.

The 2012 Mike Carroll Travelling Fellowship was awarded in late 2011 to Ms Aanandini Ganesalingam (School of Plant Biology) whose research in applied statistics focuses on the application of factor

analytic models to speed up plant breeding programs.

The fellowship enabled her to visit the oldest standing agricultural research institutes in the world – Rothamsted Research in England, and study four weeks under the supervision of Professor Robin Thompson, an internationally renowned expert in factor analytic models.

Ms Ganesalingam succeeded in halving the computation time for data analysis in plant breeding programs, which will make commercial selection more efficient for all crops and all traits in Australian agriculture.

For further details see (page 7) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

## Public Lectures

There were three public lectures ([ioa.uwa.edu.au/publications/lectures/2012](http://ioa.uwa.edu.au/publications/lectures/2012)) and one workshop ([crrcare.com/education/training/soil\\_health.html](http://crrcare.com/education/training/soil_health.html)) (Table 3) delivered under the banner of IOA 'Food and Agriculture' attracting audiences of between 30 and 90 people.

The local and international speakers were all well-received and their subject matter provoked interest and discussion in a range of areas.

Table 3: IOA Food and Agriculture Lectures 2012

Date	Presenter	Organisation	Title
February 22	Prof Nina Fedoroff	Distinguished Professor, King Abdullah University of Science & Technology and Evan Pugh Professor, Penn State University	Where will the food come from in a hotter, more crowded world?
September 21	Prof John Milne	Editor-in-Chief, The Rangeland Journal, Hon. Professor, University of Aberdeen, Scotland	Structural change in UK pastoral agriculture: what is the end game?
July 31	Prof Hugh Blair	Acting Director, National Research Centre for Growth and Development, New Zealand	Mother's eating habits affect her daughters' milk production

## STRENGTHENING LOCAL LINKS THROUGH TRAINING, OUTREACH AND EDUCATION PROGRAMS IN WA

### UWA scientists mentor high-school students

Year 10 High-school student Abbey Mardon represented Western Australia at the prestigious International BioGENEius Challenge finals in Boston in June 2012, with her high-level biotechnology research project on the removal of biological phosphorus in the waste treatment process in piggeries. Abbey was

mentored by IOA scientist Dr Sasha Jenkins who emphasised the practical value of Abbey's project to the livestock industry.

One of this year's semi-finalists, Year 11 student Thomas Gambuti, was a semi-finalist for the second year running, researching agricultural projects under the mentorship of Dr Natasha Teakle (School of Plant Biology). For further information see (page 12) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf)

Newly appointed entomologist Assoc/Prof Christian Nansen provided a stimulating and rewarding experience to three high-school students, who came under the auspices of a work experience program from UWA's local partner school Shenton College. During their two weeks the Year 10 students accompanied Assoc/Prof Nansen on a field trip, assisted with the collection of bugs, with the design of experiments in the laboratory and the recording of data and observations. For more information visit (page 8) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

### IOA support for Faculty's largest high school outreach program

The Institute has continued its support for the Faculty of Science's largest high school outreach program, the Primary Industry Centre for Science Education (PICSE), which has had significant success in attracting high school students to the study of agriculture and related disciplines. IOA staff participated in judging the entries for the Science Investigation Awards, held in July at UWA, and contributed a cash prize. For further details see (page 7)

[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

### Soil symposium brings leading soil scientists to UWA

In November 2012, the Institute co-hosted a symposium, bringing six renowned agricultural scientists together at UWA, to discuss the role of soil in achieving agricultural productivity gains.

The speakers addressed a wide range of issues and challenges, including biological aspects of soil health, soil carbon storage, environmental sustainability, and soil ecosystem services in relation to food security.

The presentations can be accessed via [crccare.com/education/training/soil\\_health.html](http://crccare.com/education/training/soil_health.html)

### New Master program in Integrated Water Management

The Master in Integrated Water Management program was launched at UWA's Albany centre in August this year to train students in water issues linked to agriculture, mining, and community engagement.

The program enables students to develop skills to resolve conflict, mediate between cross-cultural groups and grasp complex scientific concepts while investigating how land-use relates to the water cycle. Students will examine the effects of water resource management and allocation and participate in problem-based learning, case studies and field-work through CENRM.

The new course forms part of a suite of programs coordinated by the International Water Centre – a joint venture involving four leading Australian universities – UWA, UQ, Monash and Griffith; it has national and international networks and provides a breadth of expertise and experience in modern and complex water management issues connected to climate change and population growth.

CENRM was contracted to teach this course in its first semester to 50 University of Queensland students at the Albany site.

For further information see [news.uwa.edu.au/201208074892/events/huge-open-air-lab-new-water-management-studies](http://news.uwa.edu.au/201208074892/events/huge-open-air-lab-new-water-management-studies).

## Memoranda of Understanding (MoU)

2012 was a successful year both for cementing existing international partnerships and for forging new ones. This was reflected in a number of new formal agreements (MoUs), as well as a range of activities as part of an ongoing collaboration.

Table 4: Memoranda of Understanding with external organisations

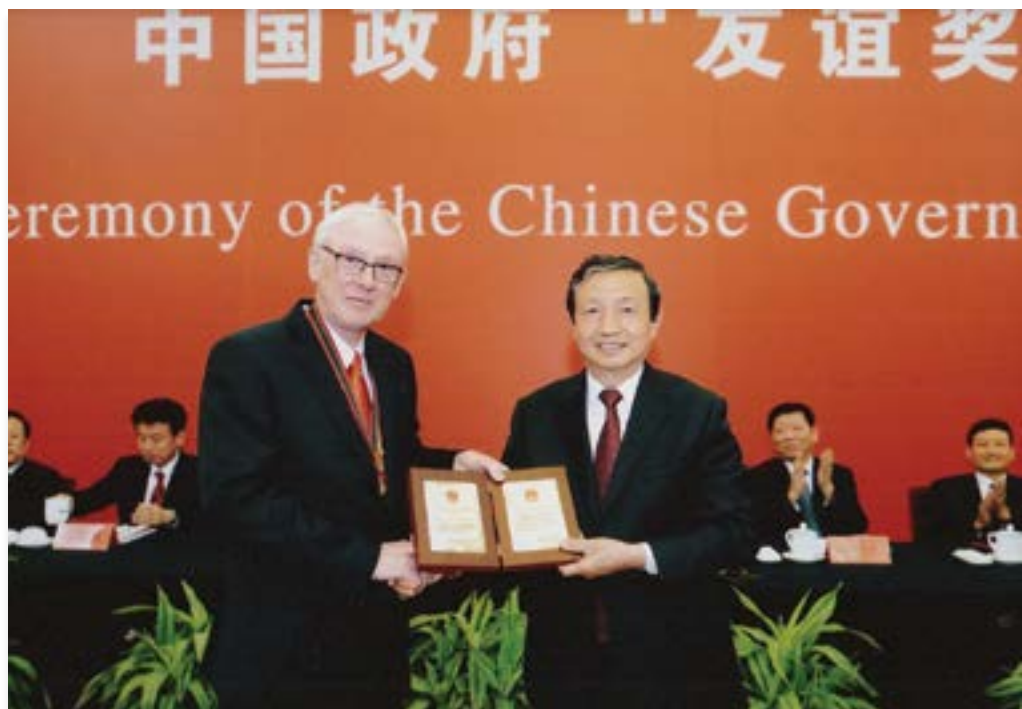
Date	MoU Partners	Focus of MoU
January 9	Faculty of Veterinary Medicine at Universitas Gadjah Mada, Indonesia; and IOA	Academic Cooperation
March 5	College of Food and Agricultural Sciences at King Saud University, Riyadh, Kingdom of Saudi Arabia; and UWA Faculty of Science	General Academic Agreement
March 21	Key Laboratory for Arid and Grassland Ecology at Lanzhou University, China; the International Centre for Agricultural Research in the Dry Areas (ICARDA), Syria; and IOA	General Academic Agreement
April 13	Guangzhou University, China; and UWA (Extension of existing MoU)	General Academic Agreement



## Extensive links with China

2012 saw further strengthening of the links between UWA and China on several fronts:

- Four cohorts of elite undergraduate students participated in short-term study programs (4 weeks) at UWA in 2012. They came from the Northwest Agricultural and Forest University (NWAUFU), the South China Agricultural University (SCAU) and Lanzhou University (see also page 21).
- Delegations from key organisations in China visited UWA to progress joint research and student exchanges. They were:
  - a delegation from the College of Animal Science and Technology, Yangzhou University (YZU); focused on animal breeding, and production, and on short-term study programs for YZU undergraduate students;
  - a delegation from the College of Animal Science and Technology, China Agricultural University (CAU); with view to investigate new technologies to improve lamb meat quality in China;
  - a delegation of Huazhong Agricultural university (HZAU) ; focused on the undergraduate articulation program and exchange students. HZAU also organised a visit by three academics from UWA's School of Agricultural and Resource Economics to initiate collaborative research;
  - a delegation from SCAU; to inspect the key laboratories at UWA, visit the Faculty of Science, explore potential future cooperative research fields and meet the SCAU students on the short-term study program;
  - a delegation of government officials from Zhejiang



Province, to promote additional collaboration in research and education between UWA and provincial institutes in Zhejiang (see also page 21)

- delegations from Zhejiang University (August and November 2012) and from Tarim University (November 2012); the visits resulted in UWA entering into a tripartite relationship with the two universities, under the 'Three Brothers Program', established by the Chinese Ministry of Education, with the aim of supporting tripartite relationships between high-ranking foreign universities and selected Chinese universities. For more information see (page 12) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)
- delegations from Huazhong Agricultural University and from Lanzhou University (see also page 21)

## Symposium enhances links between Japanese and Australian plant scientists

The 4th Japan-Australia Symposium, titled 'Plant Sciences for Agriculture IV', held at Murdoch University in December 2012, focused on plant physiology, ecophysiology, molecular biology, pathogens and symbioses and attracted 50 participants from scientific organisations and universities of Japan and Australia, including 11 participants from UWA. Four of the UWA contingent gave oral presentations: W/Prof Hans Lambers, W/Prof Tim Colmer, Assist/Prof Ricarda Jost, (all in the School of Plant Biology) and Dr Xinhua He (CAAS and Adjunct in the School of Plant Biology) while several other UWA researchers and PhD students presented posters.



### ICPBER Plant Breeding Course

In July 2012, the first 5-day course on 'Microspore culture and flow cytometry for doubled haploid in plant breeding' was held at UWA's International Centre for Plant Breeding Education and Research (ICPBER) for a group of Indonesian university lecturers (3), postgraduate students (5) and employees (3) of a large Javanese seed company.

The course was the brainchild of IOA scientist W/Prof Wallace Cowling, who secured funding support from the Crawford Foundation, after identifying this training need (in Indonesia) in 2011.

With this plant breeding technique, pure lines (which are needed to produce hybrid cultures) can be generated within one year, as opposed to nine years required by the traditional cross-breeding method.

Course participants learnt how to use this technique and teach it to others. This workshop represented an important step forward in Indonesia's quest to achieve food self-sufficiency.

### STRENGTHENING INTERNATIONAL LINKS THROUGH OVERSEAS TRAINING, OUTREACH AND EDUCATION PROGRAMS

In 2012, the Institute again undertook, facilitated and participated in a range of outreach and training initiatives outside of Australia, to help building capacity overseas and foster the exchange of knowledge, skills and technology in agriculture and related disciplines.

#### Science for our Future Festival in Indonesia

In October 2012, UWA's annual 'Science for our Future Festival' was staged across three Indonesian cities where it attracted over 2000 participants, including students from 20 high schools, and approximately 500 academics and young scientists from 30 universities.

The event took place from 8-13 October and formed part of Australia's National Science Week, aimed to promote science to school students and develop in them an understanding how science contributes to shaping our society.

Some of UWA's leading academics gave presentations on how this relates to their area, including IOA Director, W/Prof Kadambot Siddique,

who emphasized the key role of science in ensuring sustainability of our food supplies.

Other speakers included Nobel Laureate, W/Prof Barry Marshall, former WA Premier, W/Prof Carmen Lawrence, Prof Tim St Pierre and W/Prof Brendon Waddell, Deputy Dean of the Faculty of Science.

Further activities included a lunch forum where 100 gifted and talented mathematics and science students engaged with presenters; a series of young researcher forums, and a dazzling display of science experiments.

The festival, now in its third year, brought together the scientific and academic community in Indonesia and is highly respected in both countries.

The three-day event was supported by the Australian High Commission in Singapore, Perth Education City (PEC), IDP Education and Taylors College in Perth.

For further information see (page 9) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

#### Strengthening links with Pakistan

The link in agricultural education between Pakistan and Australia was further strengthened in 2012. Two students commenced their PhD under the Pakistan Flood Reconstruction scholarship and two others under an Endeavour Scholarship (see also page 44).

Three of those students are working on stress physiology of different crops under the supervision of W/Prof Tim Colmer, and Dr Tanveer-ul-Haq from the University College of Agriculture, Dera Ghazi Khan, Pakistan, who joined the School of Plant Biology's Stress Physiology group in August 2012 for a 10-month sabbatical visit.



## Thriving links with Iraq

2012 marked a significant milestone for UWA's existing agricultural links with Iraq, and the commencement of exciting new links:

Thanks to the Institute's strong links with the Iraqi Ministry of Agriculture, UWA provided English language training and postgraduate studies in agriculture and related areas for 14 Iraqi Ministry of Agriculture staff, with funding support from AusAid and ACIAR.

In addition, UWA's first three Iraqi postgraduate students graduated in 2012 (two with a Master in Agricultural Science and one with a Master of Food Science).

The Institute's strong links with Iraq were also reflected in other events and developments, namely:

- a visit to UWA in July 2012 from His Excellency Sheik Humam Baqir Hamoudi, Chairman of the Foreign Affairs Committee of the Council of Representatives of Iraq. (See also cover story of August newsletter [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2152884/97454\\_IOA-News-No17-web.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2152884/97454_IOA-News-No17-web.pdf))

- UWA's first visit to the Kurdish Regional Governate of Iraq in October, following a commitment made earlier in the year to UWA by the Kurdish Regional Governate's Ministry of Planning, to provide scholarships for 20 postgraduate students over a period of five years. This initiative has since produced over 50 applications for postgraduate admissions to UWA. For further details see (page 4) [ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)
- In September IOA Director, W/ Prof Kadambot Siddique and Program Leader (Rural Policy, Economy and Development) Assist/Prof Amin Mugera attended a research meeting to review past achievements and prepare working plans for the next three years of an ACIAR/AusAID funded project – Development of Conservation Cropping Systems in the Drylands of Northern Iraq. The project aims to promote zero tillage in Iraq and is led by ICARDA in Syria and coordinated in Iraq through the University of Mosul and the Ministry of Agriculture.

## Cropping intensification in Bangladesh through travelling workshop and field day

A UWA-led travelling workshop and a field day in the western districts of Bangladesh demonstrated options to diversify cropping beyond rice and increase legume resource capture in the cropping system, by fitting in short-duration lentil, field pea and mung bean between successive rice crops.

The workshop was part of a project funded by ACIAR to intensify cropping in the rice-based cropping systems in western Bangladesh with short-duration food legumes.

The workshop was conducted during the first winter cropping season of the project under Prof William Erskine (Director, CLIMA), Dr Ken Flower (School of Plant Biology) and Dr Imran Malik (CLIMA). It was attended by 45 local farmers and by Researchers from the Bangladesh Agriculture Research Institute (BARI).



Project partners are the International Rice Research Institute (IRRI) in Bangladesh with researchers from BARI and input from the national extension system and non-government organisations (NGO).

For more information see (page 5)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0004/2031673/95490\\_IOA-News\\_web2.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0004/2031673/95490_IOA-News_web2.pdf)

The success of both the workshop and field day was reinforced in October 2012, when a team of eminent Bangladesh scientists (representing BARI and IRRI) visited UWA to discuss project progress and possible future collaboration with CLIMA, IOA and the School of Plant Biology. They visited field trials and the WA grain belt and expressed a keen interest in further capacity building for Bangladeshi scientists through short term training and postgraduate study at UWA.

For further information see (page 13)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0003/2233335/2012-December-Newsletter.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0003/2233335/2012-December-Newsletter.pdf)

### Improved food crop varieties for Timor-Leste

A long-term agricultural development program, Seeds of Life (SoL), continues to build Timor-Leste's capacity to feed itself and lift subsistence farmers out of poverty, through production increases in Timor Leste's staple food crops.

In February 2011 SoL entered its third phase, supported by AusAID, ACIAR and the Timor-Leste Ministry of Agriculture and Fisheries (MAF), with a \$27.5 million grant over five years to ensure continuous and widespread access to seeds of high-yielding crop varieties by local farmers by the end of the five-year period.

Led by CLIMA, SoL III focuses on the Integration of seed production into (low-cost) informal local community seed production groups, in order to generate high quantities of superior seed at low cost and hence wide-spread use by local farmers.

(High quality seed of SoL-released varieties is initially multiplied under Government supervision. Small amounts of the seed/planting material is then distributed to Community Seed Production Groups at the village level.)

2012 has seen a dramatic rise in the number of such local groups (i.e. from 280 in 2011 to 680 in 2012). This is due, in part, to the addition of three new districts into the SoL project, and also due to intensification with existing active groups (in 7 districts). Furthermore, there are currently 350 NGO groups using SoL crop varieties (a total of 1030 groups), and by 2014 all 13 districts will possess groups growing SoL varieties.

It is planned to have 1,500 of these groups operating within two years allowing up to 65,000 farmers to take advantage of the increased production from the new varieties.

Of the thousands of crop varieties tested since 2007, ten varieties have been released (comprising three maize, three sweet potatoes, two cassava, one rice and one peanut), yield advantages of the new varieties range from 25 to 150% above local varieties when averaged across one thousand on-farm trials.

### King Saud University and UWA collaborate on dryland agriculture

King Saud University (KSU), Kingdom of Saudi Arabia, and IOA have commenced collaboration on dryland agriculture, crop and animal improvement, water use efficiency, food science and natural resource management, following the signing of an MoU between KSU and UWA's Faculty of Science in late 2011.

Postgraduate research training and joint research projects of mutual benefit have been identified as priority areas.

For further details see (page 10)  
[ioa.uwa.edu.au/\\_\\_data/assets/pdf\\_file/0004/2031673/95490\\_IOA-News\\_web2.pdf](http://ioa.uwa.edu.au/__data/assets/pdf_file/0004/2031673/95490_IOA-News_web2.pdf)





# Awards and Industry Recognition

**Table 5: Awards and industry recognition 2012**

Name	Award and Industry Recognition
W/Prof Neil Turner	Chancellor's Medal; Friendship Award – China's State Administration of Foreign Experts Affairs (SAFEA)
E/Prof Craig Atkins	Chancellor's Medal
Adj/Prof James Ridsdill-Smith	Inaugural AW Howard Medal
W/Prof Harvey Millar	Fenner Medal for distinguished research in biology by a scientist under 40
W/Prof Lyn Abbott	Appointment to the new expert panel ' Domestic Offsets Integrity Committee'
W/Prof David Pannell	Elected Fellow to the Australian Academy of Social Sciences; Quality of Research Communication Award (AARES)
W/Prof Han Lambers	Elected Fellow to the Australian Academy of Science; Finalist for WA Scientist of the Year award
W/Prof Stephen Powles	Elected Fellow to the Australian Academy of Science; Finalist for WA Scientist of the Year award
E/Prof David Lindsay	Induction into Western Australia's Agricultural Hall of Fame
W/Prof Kadambot Siddique	Hackett Professor of Agriculture Chair; WA finalist for Australian of the Year Award 2013
Mr Rob Williams	Order of Australia (OAM)
Dr Muhammad Farooq	Return Fellowship from Alexander von Humboldt Foundation, Germany
E/Prof Walter Stern	Inaugural Fellowship awarded by ASA for contributions to agronomy
Mr James Smart	Eric Smart Fourth Year Honours Project Scholarship
Mr Robert Jeffrey	Young Professionals in Agriculture Award (3rd prize)
Mr Mohd Norsazwan Ghazali	Eric Smart Fourth Year Honours Project Scholarship
Miss Aanandini Ganesalingam	Mike Carroll Travelling Fellowship
Miss Louise Fisk	Most meritorious oral presentation by a researcher under the age of 35, at the Soil Science Society Conference held in New Zealand
Dr Sasha Jenkins	DAFF 2012 Science and Innovation Award for Young People in Agriculture'
Ms Xixi Li	Postgraduate Travel Award
Mr Cesar Rosales	Postgraduate Travel Award

# Visitors to IOA

The high number of visitors to IOA in 2012 is another testimony to the strong linkages and thriving alliances the Institute has developed:

Almost 40 visitors from regional, national and international organisations came to IOA in 2012, including delegations from key organisations in China (see also page 35), including the People's Government of Zhejiang Province and The People's Republic of China; The Australian Ambassador to Burma; the Ambassador of the United Arab Emirates, The Gabonese Minister of Agriculture, the Vice Chancellor of Punjab Agricultural University, the Ambassador of the Islamic Republic of Afghanistan, and the High Commissioner of Ghana.

# New Research Projects 2012

Table 6: New research projects 2012

Title	Funding Period	Funding Body	Supervisor/s
Adapting to climate change – a risk assessment and decision framework for managing groundwater dependent ecosystems with declining water levels	2012	Murdoch University ex Griffith University ex National Climate Change Adaptation Research	Prof Peter Davies Assoc/ Prof Barbara Cook Assist/Prof Peter Speldewinde Assist/Prof Paul Close
Policy (measuring and managing methane emissions from livestock: from lab to landscape)	2012 – 2014	University of Melbourne ex CSIRO Sustainable Agriculture Flagship Cluster	Prof Phil Vercoe
Ecosystems response to climate and anthropogenic disturbances: implications for greenhouse gas emissions and nutrient cycling	2011 – 2015	ARC Future Fellowships	Prof Daniel Murphy
Advancing our understanding of plant responses to low phosphorus availability beyond the transcriptome	2011 – 2015	ARC Future Fellowships	Dr John Hammond
New perspectives on paleoclimate records and hydrological regimes in arid zones of Australia	2011 – 2015	ARC Future Fellowships	Assist/Prof Grzegorz Skrzypek
Climatic forcing of ecological function in temperate marine habitats – bridging the gaps	2011 – 2015	ARC Future Fellowships	Dr Thomas Wernberg
Comparison of open-circuit calorimeters and micrometeorological methods	2012 – 2014	University of Melbourne ex CSIRO Sustainable Agriculture Flagship Cluster	Prof Phil Vercoe
Cross validation of micro meteorological measurement techniques, tracer techniques and respiration chamber protocols	2012 – 2014	University of Melbourne ex CSIRO Sustainable Agriculture Flagship Cluster	Prof Phil Vercoe
Landscape evaluation of methane emissions from ruminant livestock – campaign in North West Western Australia	2012 – 2014	University of Melbourne ex CSIRO Sustainable Agriculture Flagship Cluster	Prof Phil Vercoe
The effect of Antimicrobials on the anaerobic digestion of piggery waste	2012	DAFF	Dr Sasha Jenkins
Environmental decisions hub	2012 – 2014	University of Qld ex Dept of Sustainability, Environment, Water, Population and Communities DSEWPC/NERP	W/Prof David Pannell
Phosphorus-efficient pasture systems	2012 – 2015	CSIRO ex MLA	Assoc/Prof Megan Ryan
Mitigating greenhouse gases with nitrification inhibitors and biochar in fallows	2012 – 2015	DAFF	Dr Ken Flower Dr Sudheesh Manailil
Perennial forage shrubs project	2011 – 2013	Future Farm Industries CRC	Prof Philip Vercoe Assist/Prof Zoey Durmic
Strategies to provide resistance to the economically important fungal pathogen, <i>Rhizoctonia Solari</i>	2012 – 2015	GRDC	W/Prof Karam Singh
Characterisation of Lupin B conglutin seed proteins with a focus on health benefits and their role in allergenicity	2012	Marie Curie Fellowship	W/Prof Karam Singh Prof Grant Morahan E/Prof Craig Atkins
Developing a small native vegetable industry based on <i>platysace deflexa</i>	2012 – 2014	RIRDC	Dr Geoff Woodall
Determination of factors responsible for aphid-borne pea seed-borne mosaic virus epidemics in pea and development of effective virus management tools	2012 – 2015	ARC Linkage Project; partners: DAFWA	Prof Roger Jones Assist/Prof Michael Renton Ms Brenda Coutts
Farming in a biodiversity hotspot – harnessing native plants to reduce deleterious off-site phosphorus flows	2012 – 2015	ARC Linkage Project; partners: DAFWA	W/Prof Hans Lambers Assoc/Prof Meg Ryan Dr Edward Barrett-Lennard Assoc/Prof Philip Brookes Prof Mark Tibbett
Functional network analysis of plant metabolism in response to salinity and temperature through targeted proteomics	2012 – 2015	ARC Linkage Project; partners: Agilent Technologies, DAFWA	W/Professor Andrew H. Millar Adj/Prof Rudolph Grimm Dr Thomas Biddulph
Identifying the biochemical and molecular bases of 2,4-D herbicide resistance in the economically important weed <i>Raphanus raphanistrum</i> (wild radish)	2012 – 2015	ARC Linkage Project; partner: Nufarm Australia Ltd.	W/Prof Stephen Powles Mr Andrew Wells



Title	Funding Period	Funding Body	Supervisors
Characterisation of a major quantitative trait locus on wheat chromosome 3BL responsible for Fusarium crown rot resistance	2012 – 2016	ARC Linkage Project; partners: InterGrain Pty Ltd, National Institute for Agricultural Research, Shijiazhuang Academy of Agricultural and Forestry Sciences, China	Assoc/Prof Guijun Yan Dr Chunji Liu, Dr John Manners Dr Catherine Feuillet
Unleashing the power of genomics for lupin marker development and crop improvement	2011 – 2013	GRDC	Assoc/Prof Matthew Nelson W/Prof Karam Singh Prof William Erskine Assist/Prof Jonathan Anderson
Long term no till farming systems	2012	GRDC	Assist/Prof Ken Flower Dr David Minkey
Investigating the effects of stock handling training in sheep feedlots	2013 – 2014	MLA Research Program	Dr Samantha Bickell
Mitigating the greenhouse gas potential of Australian soils amended with livestock manure	2012 – 2014	APL ex DAFF, Carbon Farming Futures – Filling the Research Gap	Dr Sasha Jenkins
Grazing into the future – building soil health & carbon with pasture management	2012 – 2015	DAFF, Action on the Ground Program	W/Prof Lyn Abbott Assist/Prof Natasha Pauli
Carbon farming futures – does increasing soil carbon in sandy soils Increase soil nitrous oxide emissions from grain production	2012 – 2015	DAFF, Filling the Research Gap	Assoc/Prof Louise Barton Prof Dan Murphy
New chemistry for wild radish control	2012 – 2015	GRDC	W/Prof Stephen Powles Assoc/Prof Michael Walsh
Strategies to provide resistance to the economically important fungal pathogen Rhizoctonia solari	2012 – 2015	GRDC	W/Prof Karam Singh



# Students

24 PhD students commenced their studies during 2012 in agriculture and related areas, building on the tradition of excellence in agriculture education and research at UWA, which is also reflected in the high number of awards, prizes, scholarships, medals and grants won by students and staff at UWA in the area of agriculture and resource management (see also page xx).



**Table 7: PhD students commencing in 2012**

Name	Topic	School	Supervisor(s)	Funding Body
Mr Goh Sou Sheng	Investigation of the fitness costs associated with glyphosate resistance	Plant Biology, AHRI and IOA	W/Prof Stephen Powles Dr Roberto Busi Dr Martin Vila-Aiub	Malaysian Rubber Board
Ms Chandima Hanchapola Ariyaratna	Rice-wheat comparative and functional analysis of novel genes associated with salt tolerance	Plant Biology and IOA	W/Prof Tim Colmer Dr Michael Francki	UWA SIRF; UIS and UIS Top-Up Scholarship
Mr Umair Afzal Khan	Waterlogging tolerance in barley	Plant Biology and IOA	W/Prof Tim Colmer Assoc/Prof Patrick Finnegan	Endeavour Postgraduate Award
Hameed Alsamadany	Heat and drought tolerance in wheat	Plant Biology	Assoc/Prof Guijun Yan Adj/Assoc/Prof Chunji Liu	Scholarship, Government Saudi-Arabia
Mr Hamad Aziz Khan	Salinity tolerance in chickpea	Plant Biology and IOA	W/Prof Tim Colmer W/Prof Kadambot Siddique	Endeavour Postgraduate Award
Ms Rasika Kankanamalage	Racial status of <i>Pseudocercospora capsellae</i> in Western Australia, the identity and mechanisms of host resistance in oilseed Brassica	Plant Biology and IOA	W/Prof Martin Barbetti Dr Mingpei You	UWA SIRF; UIS and UIS Top-Up Scholarship
Ms Yupin Li	Pythium root rot of Phaseolus bean – interactions of host resistance with water availability	Plant Biology and IOA	Prof Martin Barbetti Dr Mingpei You W/Prof Tim Colmer	IPRS and UWA Safety-Net Top-Up Scholarship
Ms Meitha, Karlia	Physiology and molecular analysis of respiratory control and oxygen signalling in grapevine bud dormancy	Plant Biology and IOA	Assist/Prof Mick Considine W/Prof Tim Colmer W/Prof Christine Foyer Dr Dennis Konnerup	AusAID
Ms Rushna Munir	Waterlogging tolerance in chickpea	Plant Biology and IOA	W/Prof Tim Colmer W/Prof Kadambot Siddique	UWA-Pakistan Flood Reconstruction Scholarship
Ms Eviness Nyalugwe	Understanding resistance phenotypes to oilseed Brassica viruses: strain specificity, inheritance, field deployment and usefulness	Plant Biology and IOA	Prof Roger Jones Prof Martin Barbetti	UWA SIRF; UIS and UIS Top-Up Scholarship

Name	Topic	School	Supervisor(s)	Funding Body
Mrs Chandima Ranawana	Assessing the role of transpiration in ameliorating leaf temperature in wheat	IOA and Plant Biology	W/Prof Kadambot Siddique Dr Helen Bramley Dr Jairo Palta (CSIRO and UWA)	Endeavour Postgraduate Award; UWA SIRF
Mr Hieu Sy Tran	Black spot disease complex in field pea – pathogens involved and interactions with host resistance	CLIMA, Plant Biology and IOA	Prof Martin Barbetti Dr Mingpei You Prof Tanveer Khan	AusAID
Mrs Hoai-An Nguyen	Developmental analysis of transformation in the legume narrow-leaf lupin	Plant Biology, ICPBER and IOA	Assoc/Prof Susan Barker, Prof William Erskine,	AusAID
Ms Leila Heidarvand	Genetic characterization of Mn tolerance in bread wheat ( <i>Triticum aestivum</i> L.)	Earth and Environment	W/Prof Zed Rengel Assist/Prof Hossein Khabaz-Saberi	UWA SIRF; UIS and UIS Top-Up Scholarship
Mr Bidhyut Banik	The mechanism of antimethanogenic potential in <i>Biserrula pelecinus</i>	Animal Biology, Plant Biology and IOA	Prof. William Erskine Assist/Prof Zoey Durmic Dr Clinton Revell (DAFWA)	APA and UWA Safety-Net Top-Up Scholarship
Ms Liu Fan	Improving yield of lean meat in lamb through a novel feed additive	Animal Biology and IOA	Prof Phil Vercoe, Assoc/Prof Dominic Blache	UWA China Scholarship
Mrs Qiu Xiaoyan	New reproductive technologies	Animal Biology and IOA	W/Prof Graeme Martin	UWA SIRF; UIS and UIS Top-Up Scholarship
Mr Joseph Steer	Explanation of the unknown variation contributing to flystrike resistance from <i>Lucila cuprina</i> in merino sheep	Animal Biology and IOA	Prof Phil Vercoe	UPA and UWA Safety-Net Top-Up Scholarship
Mr Kai Tang	Low-carbon farming options in WA	Agricultural and Resource Economics and IOA	Assist/Prof Chunbo Ma, Assoc/Prof Atakelty Hailu Assist/Prof Marit Kragt	IPRS and UWA Safety-Net Top Up Scholarship
Mr Govinda Prasad Sharma	Economic analysis of coffee production in Nepal	Agricultural and Resource Economics and IOA	Assist/Prof Ram Pandit Prof Ben White	Endeavour Postgraduate Award
Mr Muhammad Masood Azeem	Assessing climate change vulnerabilities of Pakistan's agriculture and the capacity building for poverty reduction	Agricultural and Resource Economics and IOA	Prof Steven Schilizzi Assist/Prof Amin Mugeru W/Prof Kadambot Siddique	UWA-Pakistan Flood Reconstruction Scholarship
Ms Asha Gunawardena	Optimal use of policy instruments to control waste water pollution in Kelani River in Sri Lanka	Agricultural and Resource Economics and IOA	Assist/Prof Ram Pandit Prof Ben White	Endeavour Postgraduate Award
Ms Katrina Davis	The economics of conservation in the developing world	Agricultural and Resource Economics and IOA	W/Prof David Pannell Prof Steven Schilizzi	APA and UWA Safety-Net Top-up Scholarship; Ad-Hoc Top-Up Scholarship



# The UWA Institute of Agriculture (IOA) Team

Table 8: New appointments in 2012

Professor Felix Dakora	Adjunct Professor
Professor Feng-Min Li	Adjunct Professor
Mr Michael Perry	IOA Business Manager
Miss Rebecca Wallis	Development Officer, Grower Group Alliance

## IOA appointed staff (2012)

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### Ms Rebecca Wallis

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## Program Leaders and Deputy Leaders

The Program leaders co-ordinate research, development and related activities in their respective areas.

### Integrated Land and Water Management

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**Deputy Leader: Prof Daniel Murphy**

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### Animal Production Systems

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**Deputy Leader:**

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### Plant Production Systems

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**Deputy Leader:**

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### Rural Economy, Policy and Development

**Leader: Assist/Prof Amin Muger**

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**Deputy Leader: Position vacant**

### Education, Outreach and Technology Exchange

**Leader: W/Prof Kadambot Siddique**

Email: kadambot.siddique@uwa.edu.au

**Deputy Leader: POSITION VACANT**

## Executive Committee

The Institute is governed by its Executive Committee with the Dean Faculty of Science, as Chair. The Executive consists of representatives from the four schools within the Faculty of Natural and Agricultural Sciences, the IOA Director and –on a rotational basis– a representative from relevant Research Centres.

**W/Prof Tony O'Donnell (Chair)**

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## External Advisory Board

The External Advisory Board (EAB) provides the Institute with industry interaction, advice and feedback. EAB members represent a cross-section of agricultural industries and natural resource management areas.

**Mr Bruce Piper (Chair)**

Farmer and Chairman, COGGO

**Mr Neil Young**

Farmer

**Mr Rod Birch**

Farmer

**Mr Philip Gardiner**

Farmer and MLC (Agricultural Region)

**Mr David Fienberg**

Managing Director, Australasian Lupin Processing, CBH

**Dr Jim Fortune**

Agricultural Consultant

**Mr Dawson Bradford**

Farmer, Chair of Lambex, and Chairman, WAMMCO

**Ms Verity Klemm**

Strategic Project Manager, Science and Planning Directorate, Department of Water

**Dr Don McFarlane**

CSIRO, WA Co-ordinator: Water for a Healthy Country Flagship

**Mr Terry Hill**

Regional Services Director, DAFWA

**Mr Ben Sudlow**

Manager, Fertiliser Sales and Marketing, CSBP

**Mr Andrew Ritchie**

Australian Associate of Agricultural Consultants

**W/Prof Tony O'Donnell**

Dean, Faculty of Science, UWA

**W/Prof Kadambot Siddique**

Hackett Professor of Agriculture Chair and Director, IOA, UWA

**Mr Mike Perry (Executive Officer)**

Business Manager, IOA, UWA

# IOA Members 2012

IOA members comprise relevant staff and adjunct staff from UWA who have accepted the invitation to join the Institute as members.

Table 6: IOA membership 2012

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# IOA Publications 2012

## Refereed journals

- Abaasa E, Hill PW, Roberts P, Murphy DV and Jones DL (2012). Microbial activity differentially regulates the vertical mobility of nitrogen compounds in soil. *Soil Biology and Biochemistry* **53**: 120–123.
- Abiko T, Kotula L, Shiono K, Malik AI, Colmer TD and Nakazono M (2012). Enhanced formation of aerenchyma and induction of a barrier to radial oxygen loss in adventitious roots of *Zea nicaraguensis* contribute to its waterlogging tolerance as compared with maize (*Zea mays* ssp *mays*). *Plant, Cell & Environment* **35**: 1618–1630.
- Adhikari KN, Edwards OR, Wang S, Ridsill-Smith TJ and Buirchell B (2012). The role of alkaloids in conferring aphid resistance in yellow lupin (*Lupinus luteus* L.). *Crop and Pasture Science* **63**: 444–451.
- Ahmad-Hamdani MS, Owen MJ, Yu Q and Powles SB (2012). ACCase-inhibiting herbicide-resistant *Avena* spp. populations from the Western Australian grain belt. *Weed Technology* **26**: 130–136.
- Alghamdi SS, Migdadi MH, Ammar MH, Paull GJ and Siddique KHM (2012). Faba bean genomics: current status and future prospects. *Euphytica* **186**: 609–624.
- Anderson WK, Flower KC and Siddique KHM (2012). Yield and soil improvement in rainfed crop production. *Indian Journal of Agronomy* **57**: 209–216.
- Anjum SA, Farooq M, Xie X, Liu X-J, Ijaz MF (2012). Drought-induced modulation in lipid peroxidation, proline contents, antioxidative enzymes, growth and yield of two contrasting pepper cultivars. *Scientia Horticulturae* **140**: 66–73.
- Aryamanesh N, Byrne O, Hardie DC, Khan T, Siddique KHM and Yan G (2012). Large-scale density-based screening for pea weevil resistance in advanced backcross lines derived from cultivated field pea (*Pisum sativum*) and *Pisum fulvum*. *Crop and Pasture Science* **63**: 612–61.
- Athorn RZ, Stott P, Bouwman EG, Edwards AC, Blackberry MA, Martin GB and Langendijk P (2012). Feeding level and dietary energy source have no effect on embryo survival in gilts, despite changes in systemic progesterone levels. *Animal Production Science* **53**: 30–37.
- Banning NC, Lalor BM, Cookson, WR, Grigg AH and Murphy DV (2012). Analysis of soil microbial community level physiological profiles in native and post-mining rehabilitation forest: which substrates discriminate? *Applied Soil Ecology* **56**: 27–34.
- Barbetti MJ, Banga SS and Salisbury PA (2012). Challenges for crop production and management from pathogen biodiversity and diseases under current and future climate scenarios – Case study with oilseed Brassicas. *Field Crops Research* **127**: 225–240.
- Bashir MK and Schilizzi S (2012). “Have policies in Pakistan been effective for improving food security?” Wanted: Disaggregated policy assessment. *World Applied Sciences Journal* **17** (9): 1182–1191.
- Bashir MK, Schilizzi S and Pandit R (2012). Are the determinants of food insecurity for landless households different from that of other rural households? *Pakistan Journal of Agricultural Science* **49** (3): 393–400.
- Bazihizina N, Barrett-Lennard EG and Colmer TD (2012). Plant growth and physiology under heterogeneous salinity. *Plant and Soil* **354**: 1–19.
- Bazihizina N, Barrett-Lennard EG and Colmer TD (2012). Plant responses to heterogeneous salinity: growth of the halophyte *Atriplex nummularia* is determined by the root-weighted mean salinity of the root zone. *Journal of Experimental Botany* **63**: 6347–6358.
- Beausoleil NJ, Blache D, Stafford KJ, Mellor DJ and Noble ADL (2012). Selection for temperament in sheep: domain-general and context-specific traits. *Applied Animal Behaviour Science* **139**: 74–85.
- Beltran JC, Pannell DJ, Doole GJ and White B (2012). A bioeconomic model for analysis of integrated weed management strategies for annual barnyardgrass (*Echinochloa crus-galli* complex) in Philippine rice farming systems. *Agricultural Systems* **112** (1): 1–10.
- Beltran JC, Pannell DJ, Doole GJ and White B (2012). Economic implications of herbicide resistance and high labour costs for management of annual barnyardgrass (*Echinochloa crus-galli* complex) in Philippine rice farming systems. *Crop Protection* **31**: 31–39.

Bennett RG, Colmer TD, Real D, Renton M and Ryan MH (2012). Phenotypic variation for productivity and drought tolerance is widespread in germplasm collections of Australian *Cullen* species. *Crop and Pasture Science* **63**: 656–671.

Berger JD, Buirchell BJ, Luckett DJ and Nelson MN (2012). Domestication bottlenecks limit genetic diversity and constrain adaptation in narrow-leaved lupin (*Lupinus angustifolius* L.) *Theoretical and Applied Genetics* **124**: 637–652.

Bonato M, Cornwallis CK, Malecki IA, Rybnik-Trzaskowska PK and Cloete SWP (2012). The effect of temperature and pH on the motility and viability of ostrich sperm. *Animal Reproduction Science* **133**: 123–128.

Bondonno CP, Croft KD, Puddey IB, Considine MJ, Yang X, Ward NC and Hodgson JM (2012). Nitrate causes a dose-dependent augmentation of nitric oxide status in healthy women. *Food & Function* **3**(5): 522–7.

Bondonno C, Yang X, Croft KD, Considine MJ, Ward NC, Rich L, Puddey IB, Swinney E, Mubarak A and Hodgson JM (2012). Flavonoid-rich apples and nitrate-rich spinach augment nitric oxide status and improve endothelial function in healthy men and women: a randomized controlled trial. *Free Radical Biology & Medicine* **52**: 95–102.

Borger CPD, Michael PJ, Mandell R, Hashem R, Bowran D and Renton M (2012). Linking field and farmer surveys to determine the most important changes to weed incidence. *Weed Research* **52**: 564–574.

Borger C, Renton M, Riethmuller G and Hashem A (2012). The impact of seed head age and orientation on seed release thresholds. *Functional Ecology* **4**: 837–843.

Brand Z, Cloete SWP, Malecki IA and Brown CR (2012). Genetic parameters for eggshell traits in ostriches. *British Poultry Science* **53**: 316–324.

Brand Z, Cloete SWP, Malecki IA and Brown CR (2012). Heritability of embryonic mortalities in ostrich eggs and factors affecting hatching failure of fertile eggs during artificial incubation. *Animal Production Science* **52**: 806–812.

Bramley H, Ehrenberger W, Zimmermann U, Palta JA, Rüger S and Siddique KHM (2012). Non-invasive pressure probes magnetically clamped to leaves to monitor the water status of wheat. *Plant and Soil*. DOI 10.1007/s11104-012-1568-x.

Busi R, Gaines TA, Walsh MJ and Powles SB (2012). Understanding the potential for resistance evolution to the new herbicide pyroxasulfone: field selection at high doses versus recurrent selection at low doses. *Weed Research* **52**: 489–499.

Chai TT, Simmonds D, Day DA, Colmer TD and Finnegan PM (2012). A GmAOX2b antisense gene compromises vegetative growth and seed production in soybean. *Planta* **236**: 199–207.

Chalak M and Pannell DJ (2012). Optimising control of an agricultural weed in sheep-production pastures. *Agricultural Systems* **109**: 1–8.

Chen YL, Dunbabin VM, Diggle AJ, Siddique KMH and Rengel Z (2012). Assessing variability in root traits of wild *Lupinus angustifolius* germplasm: basis for modelling root system structure. *Plant and Soil* **354**: 141–155.

Clipson N and Gleeson DB (2012). Fungal biogeochemistry: a central role in the environmental fate of lead. *Current Biology* **22**(3): R82–R84.

Cloete, SWP, Brand TS, Hoffman L, Brand Z, Engelbrecht A, Bonato M, Glatz PC and Malecki IA (2012). The development of ratite production through continued research. *World's Poultry Science Journal* **68**: 323–334.

Commander L, Rokich DP, Renton M, Dixon KW and Merritt DJ (2012). Optimising seed broadcasting and greenstock planting for restoration in the Australian arid zone. *Journal of Arid Environments* **88**: 226–235.

Considine MJ, Wan Y, D'Antuono MF, Zhou Q, Han M, et al. (2012). Molecular genetic features of polyploidization and aneuploidization reveal unique patterns for genome duplication in diploid *Malus*. *PLoS ONE* **7**(1): e29449. DOI:10.1371/journal.pone.0029449.

Cox BA and Jones RAC (2012). Effects of tissue sampling position, primary and secondary infection, cultivar, and storage temperature and duration on the detection, concentration and distribution of three viruses within infected potato tubers. *Australasian Plant Pathol* **41**: 197–210.

Cowling WA (2012). Sustainable plant breeding. *Plant Breeding* DOI 10.1111/pbr.12026.

Dempster DN, Gleeson DB, Solaiman ZM, Jones DL and Murphy DV (2012). Decreased soil microbial biomass and nitrogen mineralisation with Eucalyptus biochar addition to a coarse textured soil. *Plant and Soil* **354**: 311–324.

Dempster DN, Jones DL and Murphy DV (2012). Organic nitrogen mineralisation in two contrasting agro-ecosystems is unchanged by biochar addition. *Soil Biology & Biochemistry* **48**: 47–50.

Djajadi, Abbott LK and Hinz C (2012). Synergistic impacts of clay and organic matter on structural and biological properties of a sandy soil. *Geoderma* **183–184**: 19–24.

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# Acronyms

<b>AAAC</b>	Australian Association of Agricultural Consultants
<b>ACPFG</b>	Australian Centre for Plant Functional Genomics
<b>AHRI</b>	The Australian Herbicide Resistance Initiative (at UWA)
<b>ACIAR</b>	The Australian Centre for International Agricultural Research
<b>ACPFG</b>	Australian Centre for Plant Functional Genomics
<b>AISRF</b>	Australia-India Strategic Research Fund
<b>APA</b>	Australian Postgraduate Award
<b>APL</b>	Australian Pork Limited
<b>ARC</b>	Australian Research Council
<b>AusAID</b>	Australian Government's overseas aid program
<b>AWI</b>	Animal Welfare Institute
<b>CAAS</b>	the Chinese Academy of Agricultural Sciences
<b>CEEP</b>	Centre for Environmental and Economic Policy (at UWA)
<b>CENRM</b>	UWA Albany's Centre of Excellence in Natural Resource Management
<b>CBH</b>	Corporate Bulk Handling Group (company)
<b>CGE</b>	Clean, green, ethical
<b>CLIMA</b>	Centre for Legumes in Mediterranean Agriculture (at UWA)
<b>COGGO</b>	Council of Grain Growers Organisation
<b>CSIRO</b>	Commonwealth Scientific & Industrial Research Organization
<b>DAFF</b>	Department of Agriculture, Fisheries and Forestry
<b>DAFFQ</b>	Department of Agriculture, Fisheries and Forestry, Queensland
<b>DCCEE</b>	Department of Climate Change and Energy Efficiency
<b>DAFWA</b>	Department of Agriculture and Food Western Australia
<b>DEEDI</b>	Department of Employment, Economic Development and Innovation, Queensland
<b>DIIR</b>	Department of Innovation, Industry and Regional Development
<b>DPI</b>	Department of Primary Industries
<b>EERIE</b>	Ecosystem Restoration and Intervention Ecology
<b>ERISS</b>	Environmental Research Institute of the Supervising Scientist
<b>FFI CRC</b>	Future Farm Industries Co-operative Research Centre
<b>GHG</b>	Greenhouse Gas
<b>GGA</b>	Grower Group Alliance
<b>GIS</b>	Geographic Information Systems

<b>GRDC</b>	Grains and Research Development Corporation
<b>HSD</b>	Harrington Seed Destructor
<b>ICARDA</b>	International Centre for Agriculture Research in the Dry Areas, Syria
<b>ICPBER</b>	International Centre of Plant Breeding Education and Research (at UWA)
<b>ICRAF</b>	World Agroforestry Centre, Nairobi
<b>INRA</b>	National Institute for Agricultural Research; Paris, France
<b>IOA</b>	The UWA Institute of Agriculture
<b>IPM</b>	Integrated Pest Management
<b>IPRS</b>	International Postgraduate Research Scholarships
<b>IRRI</b>	International Rice Research Institute, Philippines
<b>ISI</b>	Institute for Scientific Information
<b>KAU</b>	Kerala Agricultural University, India
<b>LCA</b>	Life Cycle Assessment
<b>LIEF</b>	Linkage Infrastructure, Equipment and Facilities (funding scheme)
<b>LZU</b>	Lanzhou University, China
<b>MLA</b>	Meat and Livestock Australia
<b>NAWFA</b>	Northern Australia Water Futures Assessment
<b>NWAFU</b>	Northwest Agricultural and Forest University (in China)
<b>OECD</b>	Organisation for Economic Cooperation and Development.
<b>IPPC</b>	Intergovernmental Panel for Climate Change
<b>PEC</b>	Perth Education city
<b>QTL</b>	Quantitative Trait Locus
<b>RIRDC</b>	Rural Industries Research and Development Corporation
<b>RSPCA</b>	Royal Society for the Prevention of Cruelty To Animals
<b>SARE</b>	School of Agricultural and Resource Economics (at UWA)
<b>SCAU</b>	South China Agricultural University
<b>SIRF</b>	UWA Scholarships for International Research Fees
<b>SoL</b>	Seeds of Life (project in Timor-Leste)
<b>UIS</b>	University International Stipend
<b>UPA</b>	University Postgraduate Awards
<b>UPAIS</b>	University Postgraduate Award (International Students)
<b>UWA</b>	The University of Western Australia
<b>UQ</b>	University of Queensland
<b>WAPPA</b>	Western Australian Pork Producers' Association
<b>WUN</b>	World Universities Network









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