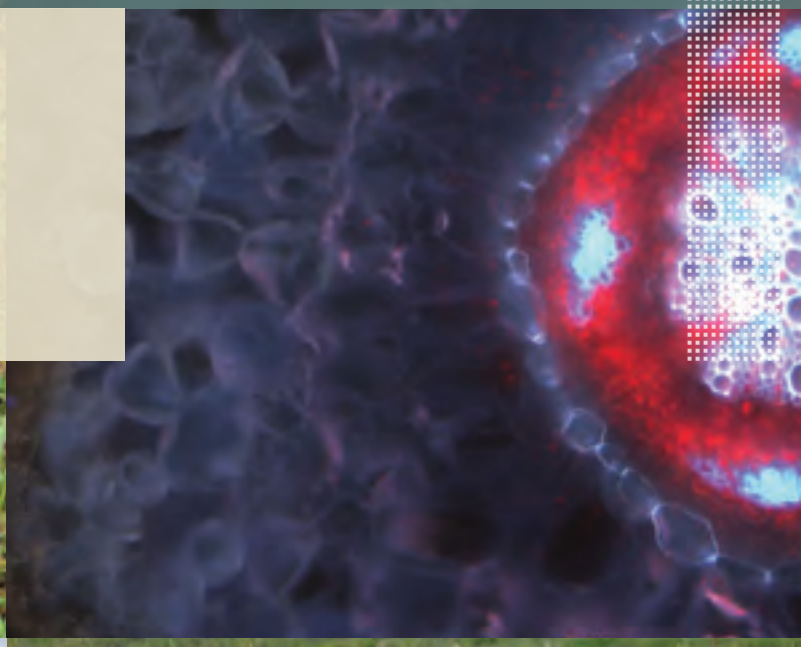
THE UNIVERSITY OF WESTERN AUSTRALIA
Achieve International Excellence

THE UWA INSTITUTE OF AGRICULTURE

Annual Research Report 2011



ACHIEVE INTERNATIONAL EXCELLENCE

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The UWA Institute of Agriculture Annual Research Report 2011

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 organisational 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.

Executive Summary

Agriculture at The University of Western Australia (UWA) builds on a long tradition of excellence and is inspired by the vision of achieving sustainable food security for a growing world.

During 2011, The UWA Institute of Agriculture (IOA) activities spanned across Faculty of Natural and Agricultural Sciences, Faculty of Life and Physical Sciences, Faculty of Medicine, Dentistry and Health Sciences, Faculty of Engineering, Computing and Mathematics, Business School and Faculty of Landscape and Architecture. Throughout 2011 two interlinked themes featured prominently in Australia's national debate: the nation's impending adoption of a carbon economy and climate change adaptation. With agriculture inextricably linked to both, it is not surprising that research related to climate change and carbon emissions dominated the five programs within IOA.

Integrated Land and Water Management has generated valuable new information on building soil carbon in Western Australia, on carbon emissions from local grain production, on biofuel in the context of sustainable energy development, on improving nitrogen-use efficiency in wheat and barley; and on the beneficial integration of livestock and cropping systems to combat poor soils and variable rainfall.

Plant Production Systems, with its strong national and international linkage, has continued to achieve outstanding successes during the year in conservation agriculture, plant breeding, genetics, food and health benefits research, seed production and weed management. The Program is a key contributor in improving crop yield and productivity for farmers in Australia and overseas.

In 2011 the Animal Production Systems Program, has strengthened its collaborations with CSIRO and other external partners to achieve notable successes. These include novel waste treatment systems to capture biogas, and the development whole-system measures to lower methane emissions from sheep, such as studying the genetics of sheep and their diet. The viability and benefits of perennial shrubs as a feed source for sheep was also the focus of several prize-winning PhD projects.

The vital role of policies was recognised in 2011 by the large number of people attending two key events focused on Rural Economy, Policy and Development. The 2011 Industry Forum examined impacts of the deregulation of the Australian wheat industry. The second event illustrated the impact of Australia's impending carbon economy on whole-farm profitability with focus on UWA Future Farm.

Education, Outreach and Technology Exchange embodies leadership, dedication and vision which have been reflected this year again by numerous awards bestowed on its scientists and students. Our excellence in education is also reflected by the 17 PhD students who commenced their studies in 2011. The program's strong links at home and overseas continue to flourish and build capacity and research excellence.

During the year, IOA has made 32 media statements, organised seven Food and Agriculture Lectures, hosted more than 30 visitors, led and contributed to 42 new research projects and generated 223 publications, including 20 book chapters and 7 books.

The above achievements have been made possible with the support from our collaborators, funding bodies, and industry partners. We express our heartfelt thanks for their strong and continued support and commitment in attaining our vision.

Winthrop Professor
Kadambot Siddique AM, FTSE
Chair in Agriculture and Director,
The UWA Institute of Agriculture

1. Integrated Land and Water Management Program

The basic challenge of sustaining yields and profitability in farming systems is inextricably linked to the integrated management of land and water, particularly in times of declining soil fertility and variable climate. Not surprisingly, climate change and Australia's impending adoption of a carbon economy have set the direction for much of this year's research and activities, with projects on greenhouse gas emissions in agriculture/land, water use, nutrient use, soil carbon and soil health.

Emission savings from WA crop production

Our study into the carbon footprint of biodiesel produced from canola grown in Western Australia has shown that the production and combustion of biodiesel (produced from WA canola) generates less greenhouse gas emissions than mineral diesel. The new findings promise big emission savings for Western Australia's canola producers and challenge conclusions from a previous Brazilian study that the replacement of petroleum diesel by biodiesel would not decrease total greenhouse gas emissions.

The one year Life Cycle Assessment study (LCA) was led by Assoc/ Prof Louise Barton (UWA) in collaboration with Dr Wahidul Biswas (Curtin University) and Department of Agriculture and Food Western Australia (DAFWA). This is part of a five year large project on emissions from cropping systems. The study used local emission data recorded at the Cunderdin test site – as opposed to the default emission values recommended by the Intergovernmental Panel for Climate Change (IPCC) – to account for inputs and outputs associated with the production and burning of biodiesel from Canola oil in the three lifecycle stages: on-farm, pre-farm and post-farm. (Inputs measured included fertilisers and pesticides, and outputs included carbon dioxide, methane and nitrous oxide.)

The Cunderdin study showed that IPCC values are currently 50 times greater than the total value of actual emissions and highlights the efficiency of WA Canola growers in minimising greenhouse emissions.

In view of the fact that very few biodiesel production studies have been carried out for semi-arid and arid climates such as Australia, the Cunderdin study challenges the accuracy of the IPCC values for semi-arid and arid climate zones. As semi-arid and arid land regions constitute one third of the global land area and are widely used for agricultural production, this study has the potential to improve the accuracy of global greenhouse gas emission estimates.

The study was funded by GRDC and DCCE and followed on from a similarly funded LCA of paddock-based green house emissions in the production of wheat in WA; emissions from the production of one tonne of grain were similarly lower when calculated using local emission factors and not IPCC default values.

As a direct result of the five years of field experiments, the Australian nitrous oxide emissions standard has been lowered from 1% of N-fertiliser used (IPCC values) to 0.1% (DCCEE values) for Australian grain growers.

Sustainable energy development and the role of biofuel

The Director of The UWA Centre for Energy, W/Prof Dongke Zhang developed a new concept of the 'four imperatives of energy' with significant implications for sustainable energy development. When taken together, the four imperatives of energy – Power Density, Energy Density, Cost, and Scale – allow a comprehensive assessment of the various energy development options.

The data collated by W/Prof Zhang show that any biofuel development will require massive areas of land, due to the low power density of biofuels, their low energy density, high cost and extremely small scale, when compared to fossil fuels and nuclear based energy conversion and use.

For further details see (page 7)
http://bit.ly/HPowMr

Building soil carbon in WA

Scientists from IOA and DAFWA provided the first results for Western Australia from the national Soil Carbon Research Program (funded by the Australian Government's Climate Change Research Program, GRDC and ACIAR.

The program assesses carbon stocks across agricultural sites in Australia, including WA sites in different geographical regions.

Assoc/Prof Daniel Murphy and Dr Andrew Wherret (IOA) and Mr David Hall (DAFWA) measured carbon levels in pasture soils at more than 100 sites on the Esperance sand plain.

Their research found that carbon stocks for soils under annual and perennial pastures for 30 years had carbon stocks averaging 45 t/ha to a depth of 30 cm; modelling using realistic management scenarios suggested that perennial pastures could achieve only small gains in carbon stocks over the next 10 years with a further increase under annual pasture unlikely.

While the amount of carbon soil can store is controlled by soil type, climate and management, the study highlighted the large variation that can occur within the same soil type and region. Clay amendments on the Esperance sand plain have lifted carbon storage by 2 t/ha over 10 years when clay content of topsoil was increased from 1% to 6%.

Ameliorating poor soils

Improving poor WA soils was also the focus of the Sir Eric Smart Scholarship winners Mr Gregory Campbell and Mr Paul Scott, whose respective Honours projects trialled gypsum, compost and lime as soil ameliorants and compared the effectiveness of genetic and chemical (lime and gypsum) strategies in alleviating aluminium toxicity stress in susceptible wheat. Findings suggested that a combination of lime

and aluminium tolerant crops was the most effective approach. For further information see (page 15) **http://bit.ly/p4XSrD**

Improving nitrogen-use efficiency in wheat and barley

Considerable variation has been found among genotypes of both wheat and barley in their nitrogen-use efficiency. In a GRDC-funded three-year project W/Prof Zed Rengel and colleagues have been assessing this variability in the quest to help breed crops with improved nitrogen-use efficiency.

The project focuses on identifying locations on chromosomes associated with quantitative traits linked to nitrogen-use efficiency. By pinpointing quantitative traits loci (QTLs) and developing molecular markers, the project aims to develop molecular tools for plant breeders to help breed crops with improved nitrogen-use efficiency and to accelerate the breeding process.

Following the assessment in 2010 of 119 genotypes and advanced breeding lines of wheat, and of 129 of barley in field and glasshouse trials, the team continued in 2011 with extensive field testing, in order to produce and evaluate results over a three-year period, as a basis for identification of genotypes that consistently show high or low levels of nitrogen-use efficiency across seasons and sites.

The high and low efficiency genotypes will be used to select parent lines from which to produce populations with molecular markers, which in turn lays the foundation for further research in this area.

To date, findings (across all trial sites) on the genotypic response to Nitrogen have shown that under low nitrogen conditions some genotypes of both wheat and barley lost nearly half of their yield while others were able to produce 40 per cent more yield under low nitrogen compared to optimal fertilisation.

Integrating crops and livestock production

Poor sandy soils and low/variable rainfall are two problems shared by many farmers in Australia and Africa. Two projects – one from Africa and one from Western Australia- which demonstrated beneficial integration of livestock and crop productions.

Dr Dennis Garrity, former Director General of the World Agroforestry Centre (ICRAF), presented 'Evergreen Agriculture', a faming system which is rapidly expanding across the African continent. Evergreen Agriculture makes use of appropriate trees as fertilisers, by intercropping them in annual food crop and livestock systems. It sustains a green cover on the land throughout the year, bolsters nutrient supply (through nitrogen fixation and nutrient cycling), increases direct production of food, fodder, fuel, fibre and income (from wood products), while at the same time increasing resilience to climate variability and climate change. To view Dr Garrity's presentation, visit **www.ioa.uwa.edu.au/publications/lectures/2011**

The second project focused on the integration of (trees and) perennial shrubs as drought-hardy and carbon conscious grazing systems into Western Australian pastures. Dr Dean Revell, CSIRO demonstrated the benefits of this approach at the UWA Future Farm Field Day (cf also page 11), namely better use of salinity affected grass. Dr Revell's presentation can be accessed from **www.ioa.uwa.edu.au/future-farm**

The above studies assist in the process of selecting suitable solutions in the inclusion of trees and perennial shrubs in the cropping-livestock production systems.

Tropical cyclones' key role in healthy ecosystems

Dr Gavan McGrath (SEE) and his team assessed vegetation function in relation to soil properties and climate, using data collected by two satellites probing the Earth's gravity. The data indicated a continent-wide drought spanning the north-west to southeast of Australia during the past decade (2000-2011). This measured loss of water was strongly correlated with a decline in vegetation. A significant factor contributing to the drought in northwest Australia is the marked reduction in the number of tropical cyclones, compared to the previous decade, as the variation in vegetation strongly correlated with the (multi-decadal) variation in tropical cyclone frequency. This suggests that these extreme events may be essential for keeping these ecosystems healthy.

Reducing soil water repellency

A decrease in water resources has been a driving force for research to improve water use efficiency, and to limit the water used for irrigation.

Under the Turf Research Project at UWA's School of Plant Biology, W/Prof Tim Colmer and Assoc/Prof Louise Barton identified ways to decrease soil water repellency in turf grass grown in sandy soils. Soil water repellency is a key factor for low water use efficiency, by causing irrigation water to run off the soil surface or to penetrate the soil surface unevenly.

Their field-based experiments showed that granular soil wetting agents can decrease the development of soil water repellency in turfgrass where water for irrigation is limited. The effectiveness of the four products tested was strongly related to the total amount of active ingredient applied. Their research also showed soil water repellency to be more severe in turfgrass with a high amount of organic matter.

Effects of grazing stubble on soil

Recently there has been widespread adoption of 'No-till Cropping' in Western Australia, with more than 80% of farmers using this conservation farming method. Soil cover is one of the key components of a no-tillage system. A major constraint to full residue retention has been livestock grazing that occurs over the summer in the grain belt. A joint project on this aspect, between UWA, WANTFA and the Facey Group, was started in 2010 and continues until 2013. The aim is to determine the effect of grazing stubble over summer on the soil (e.g. compaction and infiltration), the water balance and crop growth and yields in a no-tillage cropping system. The project is part of the Grain and Graze 2 – Western Australia project, funded by GRDC, DAFF Caring for our Community.

Long term effects of a high residue no-tillage system

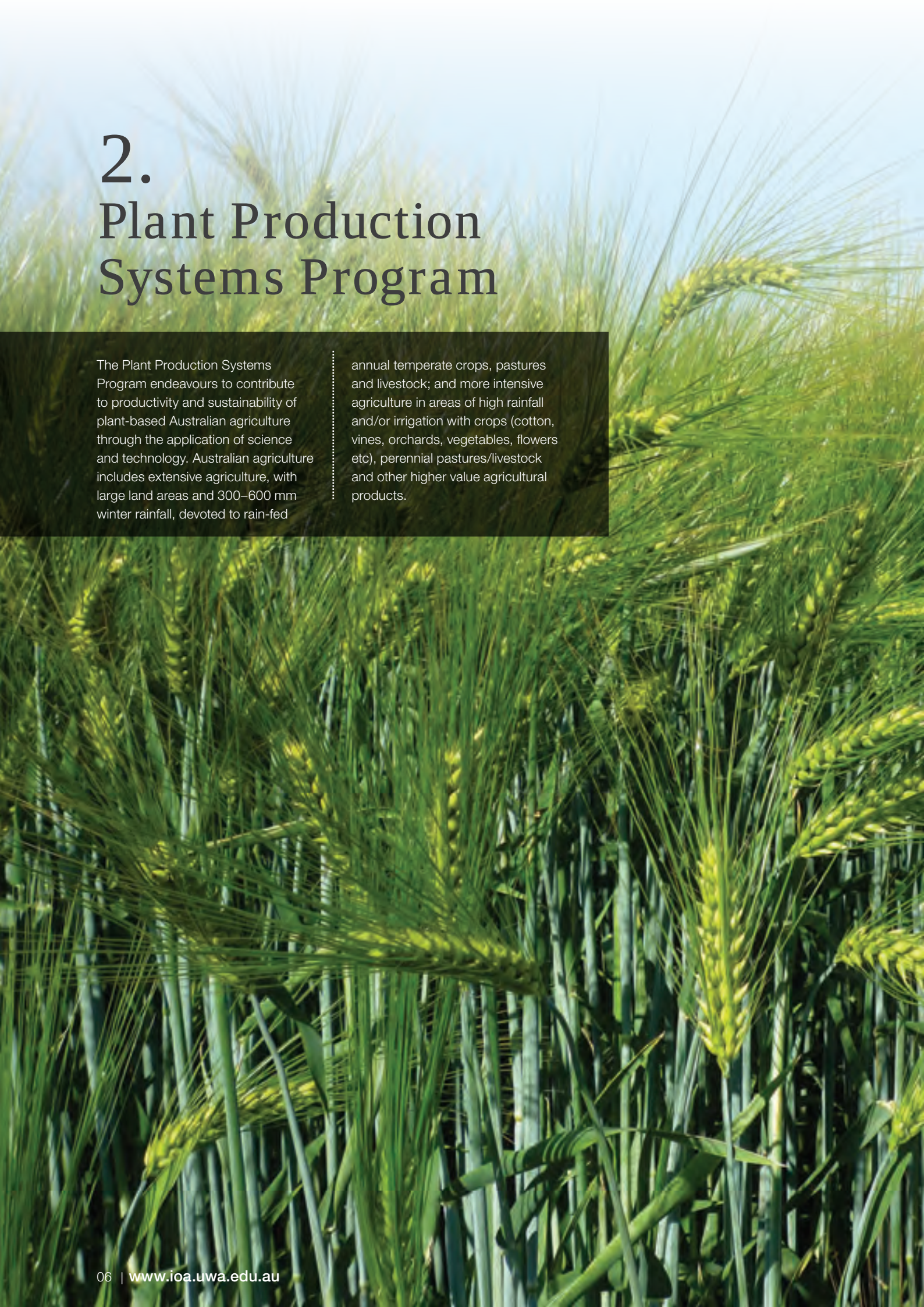
2011 has been the fifth year in a long-term research project between UWA, WANTFA, CSIRO and Planfarm focused on crop rotations and residues. The project tests the long term effects of a high residue no-tillage system, including the occasional use of cover crops, on soil organic carbon levels, weeds, diseases, water use efficiency and yields. The project takes a systems approach and combines all the key conservation agriculture principles i.e. permanent soil cover, minimal soil disturbance, crop rotations and controlled traffic. The trial, run at two sites, involves detailed soil analyses to determine if these high residue systems can sequester soil carbon and improve water use efficiency and crop productivity.

Effects of crop management on nitrous oxide emissions and on the conservation of soil water

Climate variability has already impacted on Western Australian broad acre crop and animal production over the last 10 years, with significant rainfall deficiency in some years. A joint DAFWA-UWA project aims to demonstrate the effect of crop management (rotation/crop sequence and fallow) on emissions of nitrous oxide and the conservation of soil water for subsequent wheat crops. The project is funded by DAFF and GRDC and results so far have shown that previous crop management had no significant effect on nitrous oxide emissions in the following wheat crop. Rather, these emissions appeared to be impacted by the current crop management (seeding and fertilisation) and rainfall. Most soil water was conserved in the chemical fallow in the previous year, although by seeding time there were no significant differences in amount of soil water at one of the two sites. The weedy fallow and wheat had the least soil water at seeding of the following wheat crop.

2.
Plant Production Systems Program

The Plant Production Systems Program endeavours to contribute to productivity and sustainability of plant-based Australian agriculture through the application of science and technology. Australian agriculture includes extensive agriculture, with large land areas and 300–600 mm winter rainfall, devoted to rain-fed annual temperate crops, pastures and livestock; and more intensive agriculture in areas of high rainfall and/or irrigation with crops (cotton, vines, orchards, vegetables, flowers etc), perennial pastures/livestock and other higher value agricultural products.



Herbicide resistance research

Research into herbicide resistance at IOA is carried out under the umbrella of UWA based Australian Herbicide Resistance Initiative (AHRI) 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 2011, the AHRI Harvest Weed Seed Management team ran half day workshops in Victoria and southern NSW to communicate the information that had previously been workshopped with Western Australian farmers. The team, led by Assoc/ Prof Michael Walsh (AHRI) engaged several 'champion' WA farmers to address the importance of harvest weed seed management and how to successfully implement a chaff cart, windrow burning, baling and harvest weed seed destruction system. With assistance from Dr Peter Newman (DAFWA) – the team also covered how to optimise weed seed management systems and discussed the successful use of weed seed targeting systems in an integrated weed management program. Darkan farmer and inventor of the Harrington Seed Destructor (HSD), Mr Ray Harrington, spoke about the HSD, a unique seed destruction system that has helped him to achieve lower weed levels across his farm. Corrigin grower, Mr Lance Turner, discussed the benefits of using a chaff cart and how this has enabled him to drive down weed numbers in his farming operation. Mullewa grower, Rod Messina, discussed the advantages of windrow burning and the techniques he uses to maximise weed seed management.

The Harrington Seed Destructor harvest research and demonstration trials continued through South Australia and Victoria to evaluate the efficacy of the HSD system in comparison with chaff carts and windrow burning systems. The working of the HSD system was demonstrated to the local farming community at each site.

In the Northern region of Australia, seed collection surveys were conducted prior to the maturity of winter (Oct-Nov) and summer (Jan-Feb) crops. The focus of each survey was to identify the species that potentially can be targeted by the HSD at harvest.

Samples from a large WA crop weed survey undertaken in 2010 by Senior Researcher, Ms Mechelle Owen have been grown, harvested and results quantified to establish the frequency and distribution of herbicide resistance in major weed species, as well as the glyphosate resistance status in WA.

Joint CSIRO-UWA Plant Molecular and Crop Genomics Laboratory

A joint new CSIRO-UWA crop genomics laboratory opened on 4 May 2011, reflecting the close collaboration and longstanding partnership between CSIRO Plant Industry and The UWA Institute of Agriculture. The laboratory provides a state-of the-art agricultural research facility for molecular plant pathology and genomic research (see also Canola Breeders packing a punch, page 8).

Three of the scientists are jointly appointed by CSIRO and UWA, including team leader W/Prof Karam Singh, and the group combines expertise in the expression of gene regulation, plant genetics, genomics, molecular biology, microbiology and bio-informatics.

One key research focus is on the pre-breeding of legumes, which enrich the soil (by fixing nitrogen), act as disease breaks and provide key sources of protein both for animals and humans. In addition, with funding support from GRDC, the team has begun to sequence the narrow-leaf lupin genome which represents the first major plant genome sequencing project to be led from Australia. This project allows the team to translate their expertise in legumes to examine the lupin grain and its potential benefits for human health and they have already identified lupin genes which may help reduce the risk of obesity and diabetes in humans.

The lupin genome project is set to generate a host of new research and breeding opportunities across disciplines and represents an excellent example of the far-reaching significance of research (initially) driven by agriculture: the team is collaborating closely with the Centre for Food and Genomic Medicine in partnership with leading medical, food and plant/agricultural scientists. For further details see (page 10) **http://bit.ly/HPowMr** and (page 7) **http://bit.ly/p4XSrD**

Climate ready wheat

Another joint IOA-CSIRO research collaboration aims to bring on new adapted wheat varieties to maintain (or improve) high wheat yields changing climatic conditions.

IOA Director, W/Prof Kadambot Siddique, Dr Helen Bramley (IOA) and Adj/Assoc/ Prof Jairo Palta (CSIRO and UWA), are assessing the impact of the interaction between elevated carbon dioxide, high temperature and terminal drought on high-yielding traits of wheat. It is the first project that assesses the combined effects of these (simultaneously occurring) climatic changes, and evaluating how wheat crops respond helps quantify the impact of climate change and identify possible improvements.

Another component focuses on identifying wheat genotypes with efficient root to shoot signalling patterns associated with response to water stress.

The project aims to generate the following outputs:

- Wheat lines/varieties identified with greater yield and grain quality under the predicted future climate
- A new method to directly monitor leaf hydration that will assist wheat pre-breeding scientists and breeders select drought and high temperature tolerant germplasm
- The molecular basis for changes in water use under climate change identified and this information to be used to develop molecular markers
- New information about hydraulic mechanisms affected by water deficit and high temperature under climate change, in particular mechanisms related to grain development, stomatal response and plant hormone signalling
- Root architecture and function as a trait to produce improved yield under terminal drought
- Publication of results in high impact, international agricultural and plant science journals
- Training of PhD students in wheat physiology, genetics and climate change adaptation

For further information visit:
http://bit.ly/J3mv0u

Canola Breeders – packing a punch in national canola breeding

Canola Breeders (CB), a national canola breeding company with technical operations based at UWA, turned 10 years old in 2011. CB celebrated this milestone by registering one of the highest yielding HT® (Hybrid Triazine) varieties in Australia, "CB Henty HT®" adding to an already impressive portfolio of varieties for Australian growers.

CB breeding operations occur in laboratories in the UWA Crawley campus, and glasshouse and field sites at UWA Shenton Park field station. Microspore culture and doubled haploidy has improved over the years in the genetics laboratory at UWA, and CB's experienced technical staff have contributed to research publications on improved technology such as flow cytometry (Takahira et al. 2011). This has improved CB's work and also associated research on legume doubled haploidy and tissue culture at UWA.

CB and UWA continue to find synergies in research in pre-competitive areas which has established UWA as prominent national and international Brassica researcher. W/Prof Wallace Cowling, Research Director of Canola Breeders and IOA staff member continues to receive international invitations to speak at conferences, most recently on 'population breeding' at the Canadian Canola Industry Meetings in Saskatoon in early December 2011. Prof Cowling's talk was based on recent work with national biometricians on developing genetic (pedigree) and genomic selection in plant breeding – such methods are inspired by CB's innovative breeding methods, and are now attracting both national and international interest

In 2011 CB made four new staff appointments to add to their business including Dr David Tabah from Spain and Dr Susan Knights from Victoria. These staff will not only be a significant gain to the company but the two mentioned are fortunate to have Adjunct status within IOA.

CB's achievements reflect the successful partnership between its members: The University of Western Australia, the Council of Grain Growers Organisations (COGGO), GRDC and NPZ, Europe's most successful hybrid Canola breeding company.

CB's strong international connections with canola breeding companies in Canada and Europe, which help ensure that it remains at the forefront of canola breeding and seed production. Annual meetings in the field in Chile, Canada and Germany help to promote successful outcomes for the long term of canola breeding and for CB.

UWA and its Institute of Agriculture remains committed to this partnership as it delivers superior Canola varieties to Australian farmers and advances plant breeding and genetics research and teaching at UWA.

For further details see (page 13)
bit.ly/p4XSrD

Large-scale production of superior seed in 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 the next five years, to ensure continuous and widespread access to seeds of high-yielding crop varieties by more than 10,000 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.

Seeds of Life began in 2001 to develop a sustainable national seed system, and SoLIII builds on the milestones achieved in Seeds of Life's first 10 years, including the development and initial strategic distribution of new crop varieties, and significant food productivity improvements. For further details visit **http://bit.ly/IWoJuI and http://bit.ly/HJu8UL**

The program is set to become a long-term success also due to complementary capacity building in education: UWA's first PhD graduate from Timor-Leste, Dr Macal Gusmao, completed a doctorate in agricultural science in 2011 and has returned to the National University of Timor-Leste to continue working on improving crop yields and training agricultural science graduates for his country. For further information visit (pages 3 and 11) and **http://bit.ly/HJu8UL** and **http://bit.ly/I2l941**

Breeding apples with increased health benefits

Research Professor Jonathan Hodgson (School of Medicine and Pharmacology, UWA) and his colleague, Assistant Professor Michael Considine (School of Plant Biology, UWA and DAFWA), collaborated in a three-year research project, funded by ARC, UWA and DAFWA, to assess the effects of flavonoid-rich apples.

Measuring the health effects of different apple varieties on healthy men and women, they found that apples high in anti-oxidants (flavonoids) improve blood vessel relaxation, thereby reducing the risk of developing high blood pressure and heart disease.

As this research confirms that apples can contribute to a direct and measurable effect on human health, it provides the foundation for a long-term investment in research and development towards developing new apple varieties with even greater health benefits.

For further details see (page 8)
http://bit.ly/HJu8UL

3.
Animal Production Systems Program

The Animal Production Systems Program endeavours to develop clean, green and ethical systems for improved animal production. This concept underpins all the research associated with this program, be it as project leader or research partner.

Similarly, the 'clean, green and ethical' motto is firmly embedded in the teaching of both undergraduate and postgraduate degree programs in Animal Science and Animal Production at UWA.

Demonstration projects for on-farm methane management strategies

The UWA Future Farm represents a key site for on-farm measurements and field research.

Located near Pingelly, it is one of four demonstration sites in the (national) Reducing Emissions from Livestock Research Program (RELRP), jointly funded by DAFF and MLA. There are currently four projects that RELRP is demonstrating at the farm:

- Breeding sheep that produce less methane and understanding the biology behind it;
- Investigating whether grazing sheep on Australian native shrubs can reduce their methane production;
- Benchmarking methane production at the UWA Future Farm through a collaboration with researchers from DAFWA and the University of Wollongong;
- Modelling the whole-farm carbon emissions of the UWA Future farm using an adapted MIDAS model. This has helped identify areas to reduce carbon emissions while also maintaining or increasing profits (see also, below 'Whole-farm carbon emissions Field Day').

Other linked projects at the demonstration site include:

- Drought-hardy, carbon-conscious grazing systems (DAFF/FFI) (see below and page 7);
- National adaptation and mitigation initiative (DAFF/GRDC);
- Resilient sheep and maternal efficiency – adaptation to climate change (DAFWA);
- Local carbon neutral initiative (Men of the Trees/UWA);
- Climate change and herbicide resistance in ryegrass (AHRI);
- Integrated Pest Management (IPM) in Australian grains (IPMS group, UWA).

Whole-farm carbon emissions Field Day

A 'Whole-farm carbon emissions' Field Day was held on October 18, 2011 at the UWA Future Farm, to showcase the above projects and the options available to farmers to lower greenhouse gas emissions while maintaining or increasing productivity.

The event attracted 150 people and included presentations and practical demonstrations of on-field measurements.

Presentations can be accessed via **www.ioa.uwa.edu.au/future-farm**, including the talk by NSW farmer Mr David Cattanach, the first farmer to audit carbon emissions on a whole-farm scale, who used the measurement data to identify and improve areas of inefficiency on his farm.

IOA Animal Production System program team up with CSIRO Livestock Industries

The strong relationship between CSIRO and UWA (see also page 7) received a further boost in August 2011, when the UWA group who focus on teaching and research for the animal industries migrated from the main campus in (Agriculture North Wing) to Floreat Park. There they have joined forces with CSIRO Livestock Industries to form a new alliance around the concept of 'Versatile Livestock Systems'. The fact that the entire UWA group, including all academic, research and professional staff, and the full complement of PhD students (more than 20) have relocated is an indication that is not a 'virtual centre' but is rather a full commitment on the part of both UWA and CSIRO. The laboratories are shared, the offices are intermingled along the corridors, and joint programs in research, teaching and postgraduate supervision are being developed.

The move was a response to the strong case for scientific progress arising from the alliance and to the long-term strategic needs for the animal science discipline in both organisations. The benefits of the close alliance and co-location with CSIRO are deemed to outweigh the logistical issues associated with being removed from the main campus with its undergraduate students and other disciplines in animal biology and agriculture.

Stress-free stockmanship workshop

Physical, physiological and mental stress impairs animal welfare and their performance and is frequently caused by human-animal interactions. A two-day 'stress-free stockmanship workshop' was held at the UWA Future Farm in early 2011 to improve stockhandling skills.

The workshop was conducted by Mr Bruce Maynard, a stress free stockhandling trainer from NSW who imparted theories, principles and practical exercises to members of the RSPCA and UWA's School of Biology.

The techniques mastered and knowledge gained will help improve animal welfare and performance, as well as reduce the risk of injury to themselves or their handlers.

Best practice for waste management and biogas capture

The pork industry has been seeking more sustainable waste treatment systems and methane mitigation technologies for effluent ponds, to reduce their undesirable effects including greenhouse gas and odour emissions.

IOA's Dr Sasha Jenkins and colleagues from DAFWA and WAPPA identified simple and affordable management practices that fit the bill. One simple and affordable management practice is covering effluent ponds with geosynthetic

materials to create a covered anaerobic pond (CAP) digester that both treats the waste and captures the biogas (methane and carbon dioxide) and has the potential to mitigate greenhouse gas emissions, provide renewable energy and improve community amenity via odour control.

In CAPs, biogas accumulates under the cover and is gradually removed and used either directly as a fuel or converted to electricity via a motor generator.

This APL-funded collaborative project focused on gaining a better understanding of the microbial processes involved in the degradation of waste inside the CAP. Dr Jenkins and her colleagues demonstrated the feasibility of biogas capture technologies through developing monitoring tools for assessing pond health and through enhancing the quality of the biogas and soil improvers, by manipulating the microbial activities through best management practices.

These findings are also highly relevant to other industry sectors where effluent waste treatment is an issue: Dairy Australia, Meat and Livestock Australia (MLA) and the abattoir and meat processing sector are all interested in methane mitigation technologies and marketability of by-products.

Animal welfare

In early 2011, UWA's School of Animal Biology hosted a visiting PhD student from Spain, Ms Deborah Temple, who was undertaking a PhD on pig welfare assessment. Her research formed part of a European broader project aimed at developing a scientifically based system to assess pig welfare in commercial farms and slaughterhouses. Welfare evaluation focused on the principles of good feeding, good housing, good health and appropriate behaviour and relied largely on animal-based measures.

Later in the year, visiting scientist Dr Elize van Lier (University of Montevideo, Uruguay) worked with Assoc/Prof Dominique Blache (UWA School of Animal Biology) and Asst /Prof Joanne Sneddon (UWA Business School) to develop a tool to guide the ethical decision making of stakeholders in the meat supply chain and take into consideration a wide range of ethical issues to improve ethical standards.

This represented a significant step forward, as traditionally efforts to improve ethical standards in a food chain have focused only on only a few issues.

This research can be translated to Uruguayan conditions and further strengthens the collaboration between the two universities which commenced in 2009 with a joint 'Workshop on Clean, Green and Ethical Animal Production' held in Uruguay. (See also IOA Newsletter No 14, August 2011).

UWA's School of Animal Biology and School of Business also joined forces in another Animal Welfare project: Together with visiting scientist Dr. Maria José Hötzel (Universidade Federal de Santa Catarina, Brazil) they investigated the mechanism involved in the adoption of strategies aimed at improving the welfare of dairy cattle. The project employed marketing techniques and social-psychology methodology.

Strengthening collaboration with Ghana University

UWA continues to strengthen its ongoing collaboration with the University of Ghana, formalised in a MoU between the universities.

Dr Frederick Obese, a visiting Scientist (supported by WA Crawford Fund) from the Department of Animal Science spent six weeks at UWA's School of Animal Biology, working with W/Prof Graeme Martin and his team to increase his knowledge on the measurement of hormones and metabolites and their role in energy homeostasis and reproduction in cattle.

International internships

In 2011, the Animal Production System Program attracted again young visiting researchers from across the world: Two research students from Iran, Mr Morteza Hossieni Ghaffari and Mr Jahani Azizabadi Hossain and two others from France, Ms Edith Herbout and Ms Justine Aubril, each spent a six- month internship at the School of Animal Biology, working with Assoc/Prof Zoey Durmic and her team at the Rumen Microbiology Group, UWA-CSIRO Floreat, to understand the mechanism behind the antimethanogenic bioactivity of Australian shrubs (see also page 9 **http://bit.ly/HJu8UL**)

AAABG 19th Conference at UWA

In July 2011, animal breeders and geneticists, industry representatives and guest speakers from around the world attended the 19th Associated for the Advancement of Animal Breeding and Genetics (AAABG) Conference held at UWA. The three-day event featured 100 oral and poster presentations on a wide range of topics, including animal breeding and selection, breeding objectives, statistical genetics, genetic parameters, gene expression, genomics and biotechnology.
The conference concluded with a Breeders' Day which focused on showcasing the genetic changes that have taken place in farm animal species during the past decade.

Global Consortium of Higher Education and Research for Agriculture Conference

In June 2011, Assoc/Prof Dominique Blache delivered a presentation on the UWA Future Farm projects (see also page 11) at the 7th World Conference of the Global Consortium of Higher Education and Research for Agriculture (GCHERA), in Beauvais, France. (see also IOA Newsletter No 15, December 2011). 200 academics, researchers and administrators from more than 150 universities discussed and reflected upon their successes and difficulties in agricultural education. The conference also presented an excellent opportunity for Assoc/Prof Blache to lobby towards bringing the conference to Perth in 2015.

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

The 2011 IOA Industry Forum on the deregulation of Australia's wheat industry highlighted the significant impacts of rural policies across the industry in Australia. Held on 22 July 2011 it attracted a large audience and generated a high level of media coverage.

Five speakers representing key stakeholder groups put forth different perspectives on the impacts, challenges and opportunities that have arisen since the deregulation of the Australian Wheat industry in 2007.

Keynote Speaker Mr Ron Storey, ex AWB Manager, and now a respected crop forecaster and chair of a leading plant breeding company, described deregulation as having been positive overall, with Australian wheat growers proving themselves to be savvy sellers in a price volatile market. At the same time he acknowledged that the segmented market has been unable to provide national grower representation.

Mr Bryce Banfield, representing bulk handler, CBH, argued that deregulation had allowed growers to network with CBH and had also allowed differentiation for WA grain. In his view, grain pools still have a place in the next 5-10 years, but agreed there was a need for increased pool transparency.

Mr Nathan Cattle represented Market Ag, an independent commodity market and price risk management advisory company and suggested, that price volatility was not a direct function of deregulation. To manage price risk effectively, he advised growers to determine the risks, identify the most sustainable products, obtain good market information and question providers how their service/product would benefit them.

Mr John Orr of Premium Grain Handlers, provided a WA grain trader's perspective and welcomed the increase in container trade post-deregulation and acknowledged that this was stretching his company's resources and facilities.

A farmer's perspective was provided by Mr Rod Birch, welcomed the freedom of choice enjoyed by growers since deregulation in dealing with competing grain traders. He was concerned however about the loss of 'Industry good functions' and their effective promotion (prior to deregulation).

The full presentations can be accessed at **www.ioa.uwa.edu.au/publications/industry-forum**

Innovative teaching and learning: Simulation games to facilitate learning about agricultural marketing

The teaching of agricultural marketing took a big step forward in 2011 with the help of a UWA Improving Students Learning Grant. The $600 grant was used to buy a simulation model (the Purdue Agribusiness Management Simulation) which was incorporated in teaching Agricultural Economics and Marketing.

The aim of this project was to enhance the knowledge and skills of students in understanding how the real-life agricultural markets operate and how they can apply economic principles and analytical tools to make decisions in this dynamic competitive environment.

Best practice for sustainable co-operatives

Co-operatives in Australia generate more than $14.5 billion in turnover per year but has received minimal attention in the past from researchers, policy makers, legislators and the public. Thanks to an ARC-Linkage grant under the May 2010 round of the Innovation Australia Linkage Projects scheme, a team of scientists from the UWA Business School, IOA and from industry partners (Co-operative WA, CBH Group and Capricorn Limited) are engaged in a three-year project to review best practice co-operative business models from Australia and around the world. The team has collated field data of national case studies, conducted focus groups, member surveys and international case study analysis to examine the measurement of member value, identify best practice examples of corporate governance, options for raising external capital, and the reasons why co-operatives seek demutualisation.

Based on their findings the team will make recommendations about how co-operatives can improve their sustainability through implementing such best practice; the final year of the project will focus on the public release of reports, publication of scholarly works and the development of teaching and executive materials and coursework.

Research students

Two graduate students joined the Program this year: Mr Manoj Mudalinge has commenced his PhD research which focuses on the economics of rice production in Sri-Lanka. Mr Zhibo Guo is working on his PhD proposal on the price and revenue risk management strategies for Western Australian farmers.

Honours student Miss Fiona Young was awarded the Sir Eric Smart Scholarship for Agricultural Research, for her project 'Assessing the economics of simultaneously sowing a hard-seeded annual legume pasture under a cereal or oilseed crop'.

For further details visit **www.news.uwa.edu.au/ioa/young-sowing-seed-twin**

Exploring the limits of climate change adaptation

In June, Program Leader Assistant Professor Amin Mugera, and an honours student, Mr Steven Kolikow, attended a workshop hosted by the 'World University Networks: Limits to Adaptation group' which comprises scientists from (universities in) Australia, USA and South Africa. The aim of the workshop was to organise a collaborative and targeted research group which explores limits to climate change adaptation in Australia and South Africa.

Mr Steven Kolikow's honours project 'An Interdisciplinary Framework of Limits and Barriers to Climate Change Adaptation in Agriculture' was completed with funding through this group and the findings will be presented at the forthcoming 19th annual conference of the Europe Association of Environmental and Resource Economists in June 2012.

In a collaborative project with Future Farm Industries CRC researchers at UWA's Centre for Environmental Economics and Policy have been investigating farm-level economics of new perennial pasture species and new farming systems for climate change and salinity mitigation or adaptation. Team member and PhD student Donkor Addai has focused in particular on the economics of technological innovation for adaptation to climate change by broadacre farmers in Western Australia.

Rural Policies overseas

Program Leader Asst/Prof Amin Mugera presented conference papers related to productivity growth in Africa at the Annual Australia Agricultural & Resources Economics Society National Conference, Melbourne, Victoria, (8-11 February 2011) and at the Western Economic Association's International 86th Annual Conference, San Diego, California (29 June – 3 July 2011). In addition, he presented a paper on measuring technical efficiencies (in dairy farms) with imprecise data at Agriculture & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburg, Pennsylvania, July 24-26, 2011.

Self-help farmer groups in Australia and India

The trend for farmers to form, join or tap into self-help grower groups has been on the increase, both in Australia and overseas. As a result, such farmer initiatives have the potential to become a significant force in shaping rural community and agricultural development.

Australia:

PhD student Miss Beena Anil Biswas has been investigating the impact and effectiveness of grower groups in Western Australia and their role as learning communities, in particular the extent to which WA grower groups promote interactive learning between farmers and industry stakeholders. This question is of critical importance, since industry stakeholders and farmer groups are jointly involved (engaged) in generating and disseminating information.

Her project generates information which will assist grower groups in making informed decisions about their future focus, direction and activities, and enable them to develop appropriate policies and effective targeting of activities. The knowledge gained about the partnerships between researchers and WA grower groups highlights the inherent opportunities and challenges and serves as a useful guide for joint development of proposals to meet industry challenges.

India

Visiting Professor Rajinder Kalra, from Punjab Agricultural University, Ludhiana (India) undertook research on how to make best use of farming groups in India. Working with W/Prof Kadambot Siddique and Prof Matthew Tonts she focused on identifying strategies that can help boost agricultural productivity, profitability and sustainability for self-help farmer groups in India.

During her six month Endeavour Research Fellowship, Prof Kalra examined two types of farmer initiatives: large initiatives operating at state level and focused mainly on economic development; and smaller self-help groups operating at local level with a focus on social development through strategies such as value-adding and home-processing.

The results highlight key characteristics of successful groups and also determine both the facilitating and hindering factors which influence (effective) group functioning. This information represents a big step forward in exploring how farmer groups can play an even greater part in modern India's development.

This research is particularly relevant as historically extension programs were designed and handed down from the top, and the Indian government's shift to a participatory approach only occurred in the 1990's.

As more than 80% of farmers in India own less than one hectare of land, the effectiveness of small self-help farming initiatives is equally important to the nation's well-being as the large farming initiatives.

Food security in Pakistan and India

Pakistan

Food security is a global challenge affecting developing countries hardest, as this is where 90% of undernourished people live. Malfunctioning policies and unjust institutional machinery are powerful factors contributing to food insecurity in developing countries and PhD student Mr Khalid Bashir (from

University of Agriculture Faisalabad) has examined how food security policies can be improved to bring about greater food security in his native Pakistan, where almost a quarter of all households are food insecure, even though at national level, the country is food secure.

Mr Bashir's research is focused on short-term food security policies and addresses the core issue of involvement of multiple policies as well as the implementing bodies. This approach represents a new direction for research in the area of food security policy evaluation, which traditionally has been confined to the assessment of the impact of a single policy.

With its focus on the non-structural food security policies, this study provides researchers with a new horizon to explore, especially the inclusion of the intermediary institutions which can distort intervention outcomes of both structural and non-structural policies.

Mr Bashir presented his (preliminary) findings at the 2011 Postgraduate Showcase (see also page 19).

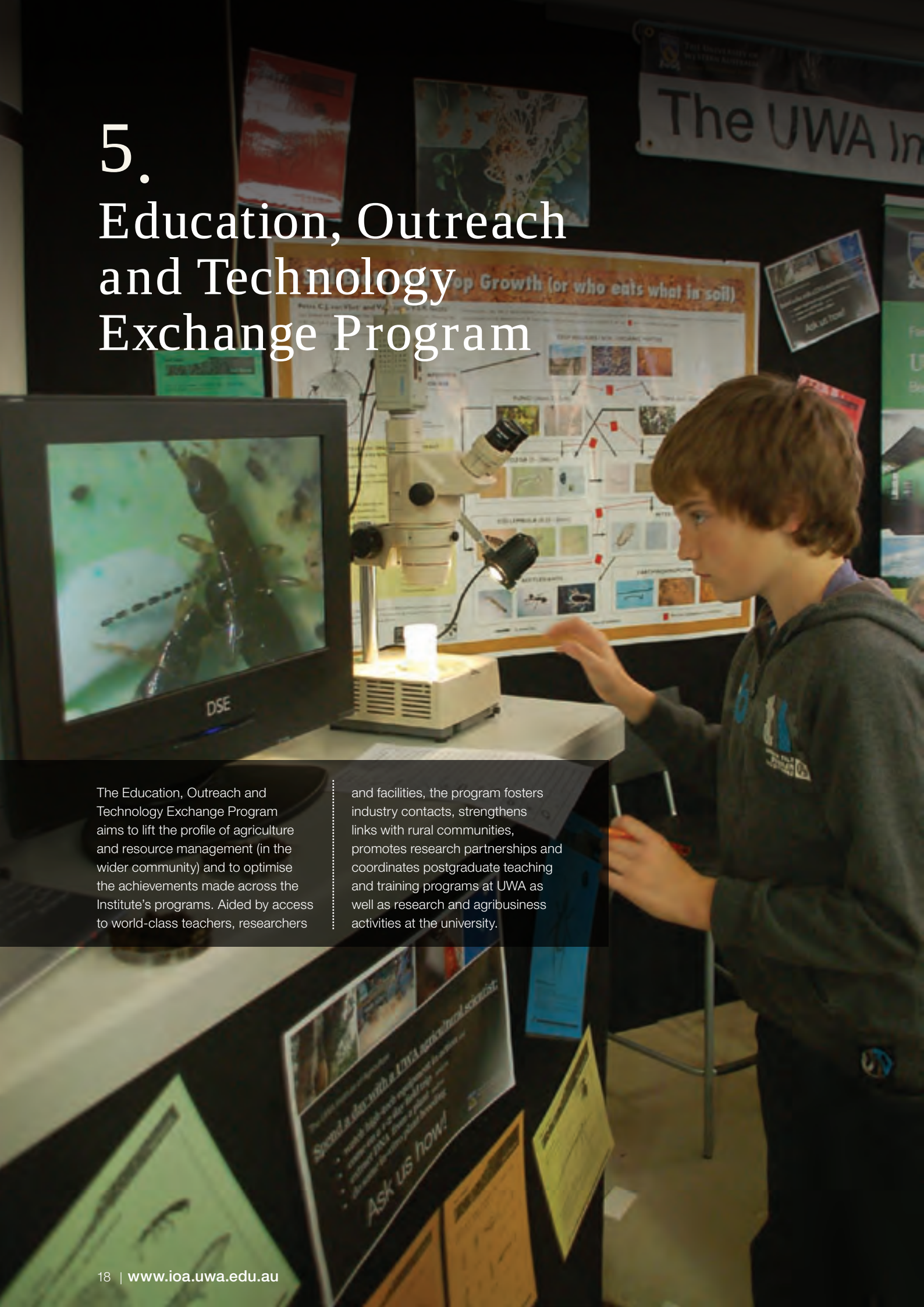
India

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, Griffin University and India's Tata Institute of Social Sciences interviewed 800 rural households in India to investigate how some vulnerable sectors of India's rural population are dealing with the increase in food prices with the aim to identify appropriate policy reforms and interventions to improve food security.

The collated data provide detailed information on a range of characteristics: demographic, economic, labour market and educational profiles of all household members. Analysis of the data will help the scientists to develop detailed food security assessments for the surveyed communities over time, focusing on three key factors: access, availability and utilisation of food.

For further information visit (page 12) of the IOA March newsletter **http://bit.ly/HPowMr**

5. Education, Outreach and Technology Exchange Program



The Education, Outreach and Technology Exchange Program aims to lift the profile of agriculture and resource management (in the wider community) and to optimise the achievements made across the Institute's programs. Aided by access to world-class teachers, researchers and facilities, the program fosters industry contacts, strengthens links with rural communities, promotes research partnerships and coordinates postgraduate teaching and training programs at UWA as well as research and agribusiness activities at the university.

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 2011' seven students from the Faculty of Natural and Agricultural; Sciences, and two from the Faculty of Medicine, Dentistry and Health Sciences presented their PhD projects. Their presentations can be viewed at **www.ioa.uwa.edu.au/publications/showcase**

- Session 1 Chair: Mr Neil Young (Farmer and member of the UWA Institute of Agriculture's External Advisory Board)
- Session 2 Chair: Dr Stephen Loss (CSBP Laboratory Services Supervisor and (member of the UWA Institute of Agriculture's External Advisory Board, CSBP Laboratory Services Supervisor)

Table 1: Postgraduate Showcase 'Frontiers in Agriculture' 2011

Session 1:

School of Animal Biology	
Ms Chelsea Fancote	Saltbush: a natural source of Vitamin E that can improve animal health and meat colour
Ms Jo Elliott	Factors influencing the adoption of lamb survival strategies by Australian sheep producers
School of Earth and Environment	
Ms Noraini Md Jaafar	Biochar use in agriculture, with an emphasis on soil biology
School of Plant Biology	
Mariana Cruz Campos	Living in poor soils: how plants cope with little phosphorus
Mr Kevin Foster	Mechanisms of drought tolerance of albo tedera *(Bituminaria bituminosa var albomarginata)*

Session 2:

School of Plant Biology	
Ms Jessie Moniodis	Improving plantation management and conversation of WA Sandalwood *(Santalum spicatum)*
School of Medicine and Pharmacology	
Ms Catherine Bondonno	Heart health benefits of apples
Ms Aidilla Mubarak	Plum polyphenol composition in relation to total antioxidant capacity
School of Agricultural and Resource Economics	
Mr Khalid Bashir	Hunger: a problem on the rise in Pakistan – why?

Dowerin Field Days

IOA joined DAFWA in the 'Futures in Agriculture' display at the Dowerin Field Days in August 2011.

Over the course of the two-day event, the Institute promoted its cutting-edge research, UWA's agriculture-related courses and the UWA Future Farm (see also page 11) to field day visitors who included farmers, industry representatives and also high school students. Aided by an array of displays and presentations UWA scientists engaged with visitors and illustrated how their research can benefit farmers involved in animal production (reducing methane emissions); soil management (soil carbon) and new crop varieties (salt- and drought-tolerant plants).

UWA's commitment to innovative and sustainable agriculture was highlighted further through its promotion/display about the 'green, clean and ethical' UWA Future Farm.

There was considerable interest both from farmers and industries in the newly developed salt- and waterlogging-tolerant annual pasture legume 'Messina' and in the salt-tolerant chickpea and new lupin species.

Amongst the interactive displays was a competition for school students to spot and name microscopic bugs in the soil enlarged under the microscope. The 12 year old winner claimed his prize and spent a day at UWA's Centre for Integrative Bee Research (CIBER). CLIMA ran a popular seed-identification quiz and prospective students were keen to quiz current Agricultural Science students about 2012 courses offered at UWA.

Further details are reported in the IOA News (December edition, page 7) **http://bit.ly/HJu8UL**

IOA News fulfil multiple functions

The UWA Institute of Agriculture promotes its activities, research, (innovations) 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 tool for cementing and maintaining the Institute's strong connection with and between these groups. Over the course of the year, the target alumni groups were reviewed and extended to reflect the relevance of agriculture to a wide range of disciplines. The IOA News publication is circulated widely in electronic format (3000) and as a printed magazine (2700).

In addition to feature articles, the IOA News provided a comprehensive 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 March, August and December 2011.

Media statements and publications

The UWA Institute of Agriculture cemented its media presence during 2011. The Institute, with the support from Brendon Cant and Associates, issued 32 media statements during the year, which in turn, generated a substantial number of follow-up articles in mainstream newspapers and farming magazines; it also generated a number of radio interviews with key protagonists.

Website

The IOA website is packed with vital information. It is the first port of call for information on UWA agriculture-related activities. The website is updated regularly, holding current and archived information. The archived lecture papers and presentations, and news receive most hits by internet users.

In late 2011, the Institute re-positioned and extended the UWA Future Farm webpage **www.ioa.uwa.edu.au/future-farm** to feature more prominently in order to promote the UWA Future Farm Field Day more effectively.

Public Lectures

There were eight public lectures and one occasional lecture (Table 3) delivered under the banner of IOA 'Food and Agriculture' attracting audiences of between 30 to 90 people.

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

Details of these public lectures are available at **www.ioa.uwa.edu.au/publications/lectures/2011**

Table 2: IOA 2011 Media Statements (Dates and Titles)

Date released	Media Statements
January 12	The battle of the sexes
February 22	Scholarships to boost rebuilding of Pakistan
March 15	AHRI commits to weed research initiatives with RIRDC funds
March 28	Mixed messages for farmers
April 1	Lanzhou and UWA forge ahead on dryland research
April 4	UWA graduates take out top honours in WA Agricultural Awards
April 6	UWA and Spain to join forces in major research projects
April 14	UWA Ag-Science students bury their heads in the sand
May 5	Glyphosate resistant barnyard grass in WA's top end
June 9	Help needed to sniff out most desirable truffle
June 13	A little lupin improves the bread of life
June 14	Cellular trash turns out to be treasure
June 15	Amino acids give wheat better chance of surviving floods
June 15	Boost to UWA minerals and energy research
June 17	Christian devoted to the Ord
June 22	Queen's honours
June 22	Broad-acre farm response to climate change
July 1	Agriculture's future as bright as its bright graduates
July 11	Hunger-beating 'Seeds of Life' for Timor-Leste
August 3	The UWA Institute of Agriculture backs deregulation debate
August 17	Climate Commission launches WA Climate Report
August 22	Esperance carbon stocktake reveals small change
September 2	Study finds safer alternative for sulphur preservative
September 14	A touch of the tar bush
September 20	UWA PhD student 'sheepish' about saltbush
October 5	Eat apples for a healthy heart
October 7	No turning back on UWA relationship with China
October 31	UWA appointment to boost entomology and research
November 15	UWA's first PhD from Timor-Leste to address hunger
December 2	Growing wheat that looks ahead
December 14	Young sowing the seed for twin
December 20	2012 Christmas hams to be affected by honey slump?

Hector and Andrew Stewart Memorial Lecture

On 18 March 2011, Dr John Angus, a cropping system agronomist from CSIRO Plant Industry Canberra, delivered the 2011 Hector and Andrew Stewart Memorial Lecture to a packed audience on the topic 'The remarkable improvements in Australian Mixed Farming'. Dr Angus emphasised the significant contributions made through crop management changes and through the introduction of perennial pastures and the grazing of crops. He commended farmers on embracing innovation and suggested this was a key factor in ensuring a productive and sustainable future for broadacre farming in southern Australia. To view his full presentation, visit **http://bit.ly/HVwPHF**

Table 3: UWA IOA Food and Agriculture Lectures 2011

Date	Presenter	Organisation	Title
February 1	Prof Philip White	The Scottish Crop Research Institute, Scotland	The contribution of plant mineral nutrition to global food security
February 14	E/Prof Ulrich Zimmermann	Department of Biotechnology, Universität Würzburg and ZIM Plant Technology i.G., Henningsdorf (Berlin), Germany	How do plants take up water in a drying climate?
April 8	Assoc/Prof David Edwards	Principal Research Fellow, Australian Centre for Plant Functional Genomics, University of Queensland, Brisbane	Sequencing the hexaploid wheat genome in 42 simple steps
April 8	Dr Jacqueline Batley	ARC QEII Research Fellow,University of Queensland, Brisbane	SNP discovery from amphidiploid species and transferability across the Brassicaceae
September 26	Prof Fu-Suo Zhang	Dean, College of Resources and Environmental Sciences, China Agricultural University	Increase in crop productivity and nutrient use efficiency in China's intensive agricultural systems
November 1	Dr Dennis Garrity	Director General, World Agroforestry Center (ICRAF)	Creating a double-storey agriculture in Africa for food security with environmental resilience
November 28	Prof Christine Foyer	Centre for Plant Sciences, University of Leeds, UK	Redox regulation of growth and stress tolerance

Mike Carroll Travelling Fellowship

Recipients are chosen in accordance with the following seclection criteria: academic performance, relevance of their 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 2010 Mike Carroll Travelling Fellowship was awarded in early 2011 to Mr Lalith Suriyagoda who has studied native pasture legumes in the WA agricultural systems. Mr Suriyagoda used the Fellowship to attend the Plant Nutrition Conference in Hanover, Germany, and to study plant nutrient uptake modeling at the University of Göttingen under Professor Norbert Claassen whose models are widely used in a number of countries.

Mr Suriyagoda's visit has also led to collaboration between University of Göttingen, Germany and the UWA Institute of Agriculture and UWA School of Plant Biology.

The 2011 Mike Carroll Travelling Fellowship was awarded to two recipients later in the year.

Ms Xixi Li has studied how the Australian native tarbush reduces methane productions in the sheep's rumen with the aim of lowering methane emissions from sheep through feed manipulation. For further information see **www.news.uwa.edu.au/ioa/research/touch-tar-bush**

Second recipient Ms Chelsea Fancote has researched how saltbush, a native shrub used to revegetate areas of dryland salinity, can be used as feed to prevent vitamin E deficiency in sheep and improve their meet colour. For more information visit **http://bit.ly/IJX6ly**

Both Ms Li and Ms Fancote used their fellowship to attend the 8th International Symposium on the Nutrition of Herbivores in Wales, UK, where between them they presented a poster and a paper and discussed their research with relevant world leading scientists.

Ms Chelsea also attended the 8th Annual Meeting of the European Association for Animal production in Norway, where she gave an oral presentation.

Education and Training

The UWA Institute of Agriculture undertook and facilitated several training initiatives during 2011, among them:

Intensification of cropping workshop in Bangladesh

In February a three-day training workshop on the intensification of cropping (through short-duration food legumes) was conducted by CLIMA Director Professor Willie Erskine at the Bangladesh Agriculture Research Institute to advance more efficient resource use.

The workshop formed part of a new ACIAR-funded project aimed at increasing legume production locally without reducing rice production by fitting in short-duration food legumes (lentil, field pea and mung bean) between successive rice crops.

This and similar future workshops serve to extend knowledge on the capacity of legume and rice crops to complement each other and increase food security in many developing regions. For further details see (page 5) **http://bit.ly/HPowMr**

Winning collaboration between IOA and Lanzhou University

During 2011, the long-standing ties between The UWA Institute of Agriculture and Lanzhou University (LZU) have strengthened further and continued to produce outstanding results, in a world-class joint project (111 Project), funded by the Chinese Government to promote sustainable agriculture, land care and environmental practices.

(The 111 Program sets out to invite 1,000 world-class academics from the world's top 100 universities to establish 100 innovative research bases in China;) The LZU-IOA collaboration is focused on training researchers and post-graduate students in the study of environmental characterisation of dry and cold eco-systems, development of improved crop and pasture production technologies and animal husbandry practices, and the long-term strategies to adapt to climate change using western China as a model.

In 2011 the joint program of research and teaching between the Institute and the LZU Key Laboratory for Grassland and Arid Ecology at LZU has continued to deliver outstanding benefits/results for both research bodies and enhance the their scientific excellence: Papers presented in 2010 at the jointly hosted 2nd International workshop on "Ecosystem Assessment and Management in Arid and Semiarid Areas – Improving the Productivity and Sustainability of Fragile Arid and Semiarid Agro-ecosystems in the Face of Climate Change" have been published this year in special issues of the journals: Acta Ecologia Sinica, Plant and Soil and Crop and Pasture Science.

The significant achievements made during the first phase of the 111 Project (2007–2011) have led to funding approval for the second phase (2012–2016).

Reciprocal visits between the institutions have further strengthened the collaboration and advanced new initiatives, including the development of a joint Centre for Dryland Agricultural Ecosystems that will conduct collaborative research and development for the benefit of both Australia and China; staff exchange and training programs and PhD student joint supervision and exchanges.

For further details visit **http://bit.ly/HPCTPj** and **http://bit.ly/HJu8UL**

Iraqi Training Programs at UWA

GIS and Remote Sensing training at UWA

In June this year, UWA's School of Earth and Environment and The UWA Institute of Agriculture (IOA) held a four-week training course for 20 trainees from the Directorate of Agriculture in Iraq, under the Iraq Partnership Facility, Coffey International Development, funded by AusAID.

The group was engaged in Geographic Information Systems (GIS) and Remote Sensing training focused on agricultural and natural resource management applications.

For more information visit **http://bit.ly/p4XSrD**

Crop improvement for Iraq
In September/October, a group of 19 staff employed by the Iraqi Ministry of Agriculture participated in a five-week Master class in crop Improvement run by UWA's International Centre of Plant Breeding Education and Research (ICPBER) for the Iraq Partnership Facility.

The AusAID sponsored course was created to enhance Iraq's national capacity for crop improvement and to increase plant productivity by developing new cultivars of priority crops with higher yields and greater tolerance to drought and salinity.

The course covered basic genetic and plant breeding principles, as well as 'hands-on' practical experience in the cross-breeding of crop plants. The course also included a field trip to local farms and research stations.

To be selected for the course (by their employer), participants had to demonstrate how they will use and spread the knowledge acquired in their jobs in Iraq. The Master class was the second of its kind following the resounding success of the first course held in 2010.

QTL course

In July, the International Centre for Plant Breeding Education and Research (ICPBER) at UWA ran a new two-day QTL training course in the quest to optimise plant breeding.

The course titled "Mixed model based Quantitative Trait Locus (QTL) mapping in GenStat" presented a flexible mapping approach for QTL and an introduction to the simulation of breeding strategies.

The course was aimed at graduate students and professionals interested in a flexible QTL mapping approach in GenStat for single traits in single environments as well as multiple traits and multiple environments.

Additionally, a simulation of breeding strategies was illustrated using QuGene software. Feedback from the 18 participants was positive.

For more information visit **http://bit.ly/HJu8UL**

Second Australia-China Wheat Genetics and Breeding Workshop

The second Australia-China Wheat Genetics and Breeding Workshop was held in Perth in August to facilitate future collaboration between the two countries in the area of wheat genetics and breeding, with a focus on breeding new cultivars resistant to biotic and abiotic stresses and adapted to the changing climate.

As Chinese wheat breeding programs have operated largely independently, and have not used much exotic germplasm the workshop attracted key cereal geneticists and breeders from both countries and provided an excellent opportunity to share knowledge, research and expertise and wheat germplasm for the benefit of both countries.

Presentations included Examples of successful China-Australia collaborations; Getting the best from resources in Australia and China for wheat genome sequence analyses; Issues associated with molecular breeding and how to overcome them; A case study of Australia – China collaboration in wheat physiology and breeding; Genetic studies and molecular marker development leading to map based cloning – a case study of Fusarium Crown Rot; A case study of Australia – China collaboration in wheat quality research; Drought tolerant pre-breeding in wheat; Characterisation of drought patterns across the Australian Wheat Belt.

The workshop was organised and sponsored by UWA (IOA and School of Plant Biology, Murdoch University (The Centre for Comparative Genomics) and the Wheat Breeding Assembly 2011, Perth.

Masters of Climate Change at Kerala University

UWA has continued to support Kerala Agricultural University (KAU) in its Master of Science Climate Change Adaptation Course (launched in September 2010). Vice Dean of the Faculty of Natural and Agricultural Sciences, W/Prof Lyn Abbott, presented a series of lectures to students in January, and in September, IOA Director W/Prof Kadambot Siddique, delivered a set of lectures to continuing students and welcomed the second cohort to the program. For further details visit (page 11) **http://bit.ly/HJu8UL**

Science for the Future Festival in Singapore

In July 2011, UWA's annual 'Science for our Future Festival' was staged in Singapore where it attracted teachers, alumni and more than 1000 students from Singapore's Junior Colleges and Polytechnic Colleges.

As part of Australia's National Science Week, the three-day event featured talks, displays and dazzling experiments 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 were there to demonstrate how this relates to their area. Among them was the Director of UWA's Institute of Agriculture, Winthrop Professor Kadambot Siddique, who emphasised science's key role in ensuring the sustainability of the world's food supplies.

Other speakers included Nobel Laureate, Winthrop Professor Barry Marshall, former WA Premier, Winthrop Professor Carmen Lawrence, Professor Tim St Pierre and Winthrop Professor Tony O'Donnell, Dean of the Faculties of Science.

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 visit (page 15)
http://bit.ly/HJu8UL

Visitors to IOA

The UWA Institute of Agriculture continues to strengthen its existing linkages while also forging new alliances with organisations and universities worldwide.

This is reflected by high number of visitors to the Institute: In 2011, IOA hosted more than 30 visitors from regional, national and international organisations. These include: Iraqi Prime Minister's Advisory Council with leading representatives from agriculture and education; a delegation from China's Northwest Agriculture and Forestry University and the President of Lanzhou University, China.

Awards and Industry Recognition

Table 4: Staff awards and industry recognition 2011

Recipient	Award	From	In recognition for
Prof Martin Fey	Gold Medal of the Soil Science Society of South Africa	Queen's Honour List	His exceptional contribution to soil science, through his book Soils of South Africa
W/Prof Kadambot Siddique	Member of the Order of Australia (AM)	Queen's Honour List	His lifetime's work in advancing agricultural science as an academic and researcher in the area of crop improvement and agronomy
Dr Helen Bramley	Best paper award for young scientists, 2010	ComBio	"The contrasting influence of short-term hypoxia on the hydraulic properties of cells and roots of wheat and lupin", published in Functional Biology (February 2010)
W/Prof Neil Turner	Dunhuang Award	Gansu People's provincial Government, China	His outstanding service and contribution to the joint UWA and Lanzhou University (LZU) economic, scientific, academic development and education program in Gansu.
Dr James Ridsdill-Smith	The Amos W. Howard Medal and Oration	AW Howard Memorial Trust Committee	For his 40-year career in research on the behaviour, ecology and management of insect and arthropod pests of pasture plants

PHOTO COURTESY HANS SCHMIDT, HS PHOTO CAIRNS

New Research Projects 2011

Table 5: New Research projects 2011

Title	Funding Period	Funding Body	Supervisor's
TeraBase sequencing for mutant, development, environmental and population genomics	2011	ARC-LIEF	Prof James Whelan, W/Prof Karam Singh, W/Prof Andrew Millar, Dr Boris Baer, Prof Ian Small, Prof Richard Oliver
From source to sink: a national initiative of biochar research	2010–2012	CRISO Ex DAFF	Assoc/Prof Dan Murphy, Dr Natasha Banning
Drought hardy and carbon conscious grazing Ssstems	2011–2012	Future Farm Industries CRC	Professor Phil Vercoe
Tender 1.1.01A – Genome Sequencing in Narrow Leafed Lupins	2010–2012	GRDC	W/Prof Karam Singh, E/Prof Craig Atkins, Prof Grant Morahan, Dr Richard Lipscombe, Dr Jen Taylor
Molecular indicators for soil quality	2010–2013	GRDC	W/Prof Anthony O'Donnell
Screening for high-yielding cereals in water-limited agricultural landscapes	2010–2011	GRDC	Prof Edward Barrett-Lennard
Building National Capacity in Education and Research in Applied Entomology	2010–2015	GRDC	W/Prof Kadambot Siddique, W/Prof Graeme Martin, W/Prof Anthony O'Donnell
Conference support – Rhizosphere 3 International Conference Perth WA	2010	GRDC	W/Prof Hans Lambers
Innovative approaches to resistance to necrotrophic pathogens and sap-sucking insect pests	2011–2015	GRDC	W/Prof Karam Singh
Australian Herbicide Resistance Initiative	2011–2015	GRDC	W/Prof Stephen Powles
Sandalwood oil – genetic solutions developed to improve quantity and quality	2010	RIRDC	Prof Julie Plummer
Travel grant – Cashmere Grower Workshop	2010	RIRDC	Ms Aprille Chadwick
Wheat curl mite wheat streak mosaic and high plains virus – detection transmission epidemiology and management	2010–2012	University of Melbourne ex (GRDC)	Prof Roger Jones
Initiating the Australian bush plum (*Terminalia ferdinandiana Excell*) collection	2011	RIRDC	Dr Liz Barbour, Prof Julie Plummer
Development of chemical provenance establishment protocols in selected Australia native plants – Macadamia nuts	2011	Ainse Research Training	Prof Garry Lee
Development of microbial indicators of soil quality to quantify the benefits of risks associated with applying piggery by-products to land	2011–2014	APL	Dr Sasha Jenkins, W/Prof Anthony O'Donnell, W/Prof Lynette Abbott
The application of in vitro techniques to generation acceleration in legumes	2011	GRDC	Prof William Erskine, Asst/Prof Janine Croser
Soil salinity management in central and southern Iraq	2011–2013	ICARDA Ex ACIAR	Prof Edward Barrett-Lennard, Prof Neil Coles
Development of Hydstra import tool to consolidate water quality and bore site metadata	2011	DAFWA	Prof Neil Coles
Genome sequencing in chickpea	2011– 2012	GRDC	W/Prof Karam Singh
Demonstrating adaptation to climate change in the wheat belt of WA through innovative on-farm and virtual-farm approaches (NAMI – National Adaptation and Mitigation initiative)	2011– 2012	DAFWA	Dr Kenneth Flower, Dr Geraldine Pasqual
Second generation sequencing to identify genes controlling flowering in oilseed brassica plants	2011	UWA-UQ Bilateral Research Collaboration Award	W/Prof Wallace Cowling, Dr Jacqueline Batley, Assoc/Prof David Edwards, Asst/Prof Matthew Nelson, Mr Yiming Guo, Mr Kaitao Lai
Evaluate fitness costs in herbicide resistant annual ryegrass	2011	RIRDC	W/Prof Stephen Powles

Title	Funding Period	Funding Body	Supervisor's
Sustainability of wheat-selective pre-emergent herbicides in a changing climate	2011–2012	RIRDC	Dr Roberto Busi
Diagnostic tools for detection of non target site herbicide resistance	2011–2012	RIRDC	Assoc/Prof Qin Yu, Dr Shaofang Wang, W/Prof Stephen Powles,
Tackling Australia's weed seed bank liability with the seed persistence tool kit	2011–2012	RIRDC	Dr Rowena Long
The impact of lime-amended bioclay (LABC) in soil biological processes	2011–2013	Water Corporation WA	W/Prof Lynette Abbott, Dr Robert Humphries
Sterol interference as a new approach to the control of insect pests of crops		Hexima Limited	W/Prof Steven Smith
Sustainability of wheat-selective pre-emergent herbicides in a changing climate	2011–2012	RIRDC	Dr Roberto Busi, Asst/Prof Michael Renton, W/Prof Stephen Powles
Farm practices that increase soil organic carbon	2011–2014	Wheatbelt NRM	Assoc/Prof Daniel Murphy, Dr Andrew Wherrett
Seeds of Life (SoL III)	2011–2015	ACIAR & AusAID	Prof William Erskine, Adj/Prof Harold Nesbitt, W/Prof Kadambot Siddique
Presentation of harvest weed seed management forums and cropping tour in northern NSW and southern QLD	2012	GRDC	W/Prof Stephen Powles
Integrates assessment of prescribed burning	2011–2012	Bushfire CRC	W/Prof David Pannell
Abiotic stress in rice: plant physiology and environment monitoring (training course)	2011	Crawford Fund for International Agriculture Research	Prof Timothy Colmer, Dr Abdelbgi Ismail
Management of microorganisms to unlock the phosphorus bank in soil	2011–2014	GRDC	Assoc/Prof Daniel Murphy
Variability in methanogenic potential of the pasture legume *biserrula pelecinus*	2011	MLA ex DAFF	Prof Philip Vercoe
Managing carbon in livestock systems – modeling options for net carbon balance	2011–2012	MLA ex DAFF	Prof Philip Vercoe
Bone seed viability project	2011	Perth Region NRM	Dr Rowena Long, Dr Shane Turner
Better fertiliser management to improve the health of coastal waterways	2011	Geographic Catchment Council	Dr Neil Coles
Harvest weed seed management workshops and evaluation of the Harrington Seed Destructor	2011–2012	RIRDC	Dr Michael Walsh
Understanding and management of resistance to Group M Group L and Group I herbicides – national project	2011–2012	University of Adelaide ex GRDC	W/Prof Stephen Powles
Tools for adoption of optimal weed management strategies in cropping systems	2011–2012	CSIRO ex GRDC	Asst Prof Michael Renton, W/Prof Stephen Powles
National integration of crop sequence strategies and tactics	2011–2014	CSIRO ex GRDC	Asst Prof Michael Renton
Capacity building for statistics	2012–2014	GRDC	Dr Katia Stefanova, W/Prof Kadambot Siddique
OECD co-operative research programme-investigating environmental benefits and farmers' management responses arising from European Union's Nitrate directives	2011	OECD	Asst/Prof Colin McGregor
Understanding and management of resistance to group M, group L and group I herbicides	2011–2013	University of Adelaide ex GRDC	W/Prof Stephen Powles
Securing Chickpea productivity under contemporary abiotic stresses – improvement of podding and seed filling under heat, drought and salinity	2011–2014	DIIR AISRF Indo-Australian Science and Technology Fund	Prof Tim Colmer, W/Prof Kadambot Siddique, W/Prof Neil Turner, Dr Vincent Vadez, Dr Pooran Gaur, Dr Rajeev Varshney, Prof Harsh Nayyar
Coping with flooding – nutrient transport in oxygen deprived roots	2012–2014	ARC Discovery Projects	Prof Timothy Colmer, Assoc/Prof Sergey Shabala, Prof Mikio Nakazono

Students

17 postgraduate research students commenced their studies during 2011 in agriculture and related areas, building on the tradition of excellence in agriculture education and research at UWA, which has been recognised 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.

Table 5: PhD students commencing in 2011

Name	Topic	School	Supervisor(s)	Funding Body
Ms Monica Kehoe	Unravelling the cause of black pod disease of narrow-leafed lupin and developing a control solution	Plant Biology	Prof Roger Jones Adj/Assoc/Prof Bevan Buirchell Prof Martin Barbetti	ARC Studentship, GRDC Studentship top-up
Ms Brenda Coutts	Studies on the epidemiology and control of virus disease of oilseeds, legumes and vegetables in WA	Plant Biology	Prof Roger Jones Prof Martin Barbetti	DAFWA
Ms Heidi Waddell	Phosphorus-use efficiency of Austrodanthonia	Plant Biology	Assoc/Prof Megan Ryan W/Prof Hans Lambers	APA, UWA Safety Net top-up
Mr Mike Ashworth	Evolved Glyphosate resistance in wild radish (Raphanus raphanistrum L) populations with the use of Glyphosate resistant genetically modified canola	WANTFA, AHRI and School Plant Biology	W/Prof Steve Powles, Assoc/Prof Mike Walsh Dr Ken Flower	GRDC Scholarship, APA
Mrs Renu Saradadevi Biju	Root-shoot signal in water transport in wheat under drying climate	IOA and School of Plant Biology	W/Prof Kadambot Siddique, Dr Helen Bramley Dr Jairo Palta (CSIRO)	Australian Endeavour Fellowship, IOA
Mr Manoj Rajakaruna Mudalige	The efficiency equity trade off and poverty impact of rice sector policies in Sri Lanka	ARE	Asst/Prof Amin Mugera Prof Benedict White	Australian Endeavour Fellowship
Mr Goh Sou Sheng	Investigation of the fitness costs associated with glyphosate resistance	AHRI and School of Plant Biology	W/Prof Stephen Powles Dr Roberto Busi Dr Martin Vila-Aiub	Malaysian Rubber Board
Mr Adam Jalaludin	To establish the biochemical and genetic basis of glufosinate resistance in Eleusine populations	AHRI, IOA and School of Plant Biology	W/Prof Stephen Powles Assoc/Prof Qin Yu	UWA SIRF
Mr Yongjuan Guan	Cellular and molecular changes in the testis of rams on different levels of nutrition	IOA and School of Animal Ciology	W/Prof Graeme Martin Dr Irek Malecki	IPRS, UWA SIRF
Mr Max Bergmann	Drought tolerance in Canola	IOA and School of Plant Biology	Dr Ken Flower W/Prof Kadambot Siddique	APA, GRDC top-up Scholarship
Mr Muhammad Munir Iqbal	The use of new genome sequence information for grain legume improvement	School of Plant Biology	Prof William Erskine Assoc/Prof Mathew Nelson	Australian Endeavour Fellowship

Name	Topic	School	Supervisor(s)	Funding Body
Ms Veronique Florec	The economics of prescribed burning: Which fire regime for which area?	SARE	W/Prof David Pannell Prof Michael Burton	UWA UPAIS and Safety-Net top up Scholarship, Bushfire CRC top-up Scholarship
Mr Zhibo Guo	Risk management of agriculture in Western Australia.	SARE	W/Prof Benedict White Asst/Prof Amin Mugera	UWA UPAIS and Safety-Net top-up Scholarship
Ms Isabel Arevalo-Vigne	Effectiveness of science communication and biosecurity management and adoption.	SARE	Assoc/Prof Nancy Longnecker W/Prof Benedict White Asst/Prof Amin Mugera Prof Ross Kingwell	self-funded
Mr James Skurray	The management and transfer of groundwater use: institutional impediments, hydro-economic aspects, and the limitation of third-party impacts.	SARE	W/Prof David Pannell Asst/Prof Ram Pandit	APA Ad Hoc Award, UWA Safety-Net top-up
Mr Steele West	Benefits and risks of Large Farm investment from an investment, security and ethiscal perspective	SARE	W/Prof Benedict White Asst/Prof Amin Mugera	self-funded
Mr Martijn Van Grieken	The relation between landholder scale heterogeneity, transaction costs and natural resource management.	SARE	W/Prof David Pannell Dr Stuart Whitten Dr Malcolm Wegener	self-funded

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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
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Mr Neil Young
Farmer

Mr Philip Gardiner
Farmer and MLC (Agricultural Region)

Mr David Fienberg
Managing Director, Australasian Lupin Processing Centre, CBH Group

Dr Peter Trefort (retired 30/9/11)
Director, Hillside Meats

Dr Tony Fischer (retired 30/9/11)
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Dr Jim Fortune
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Mr Dawson Bradford
Farmer, Chair of Lambex, and Chairman, WAMMCO)

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Regional Services Director, DAFWA

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Executive Team

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

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IOA Members 2011

In March 2011 IOA invited relevant staff from the university to join the Institute as its members with the aim to provide a forum to explore opportunities for future collaborative research, teaching and postgraduate training in agriculture and related areas.

Table 6: IOA membership 2011

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Publications 2011

Refereed journals

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Acronyms

AAAC	Australian Association of Agricultural Consultants
AHRI	The Australian Herbicide Resistance Initiative (at UWA)
ACIAR	The Australian Centre for International Agricultural Research
APA	Australian Postgraduate Award
APL	Australian Pork Limited
ARC	Australian Research Council
AusAID	Australian Government's overseas aid program
CAP	Covered anaerobic pond
CEEP	Centre for Environmental and Economic Policy (at UWA)
CBH	Corporate Bulk Handling Group (company)
CLIMA	Centre for Legumes in Mediterranean Agriculture (at UWA)
COGGO	Council of Grain Growers Organisation
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DCCEE	Department of Climate Change and Energy Efficiency
DAFWA	Department of Food and Agriculture Western Australia
DEEDI	Department of Employment, Economic Development and Innovation, Queensland
DIIR	Department of Innovation, Industry and Regional Development
FFI CRC	Future Farm Industries Co-operative Research Centre
GIS	Geographic Information Systems
GRDC	Grains and Research Development Corporation
HSD	Harrington Seed Destructor
ICARDA	International Centre for Agriculture Research in the Dry Areas, Syria
ICPBER	International Centre of Plant Breeding Education and Research (at UWA)
ICRAF	World Agroforestry Centre, Nairobi
IOA	The UWA Institute of Agriculture
IPM	Integrated Pest Management
IPRS	International Postgraduate Research Scholarships
IRRI	International Rice Research Institute, Philippines
KAU	Kerala Agricultural University, India
LCA	Life Cycle Assessment
LIEF	Linkage Infrastructure, Equipment and Facilities (funding scheme)
LZU	Lanzhou University, China
MLA	Meat and Livestock Australia
OECD	Organisation for Economic Cooperation and Development.
IPPC	Intergovernmental Panel for Climate Change
PEC	Perth Education city
QTL	Quantitative Trait Locus
RIRDC	Rural Industries Research and Development Corporation
RSPCA	Royal Society for the Prevention of Cruelty To Animals
SARE	School of Agricultural and Resource Economics (at UWA)
SIRF	Scholarships for International Research Fees
SoL	Seeds of Life (project in Timor-Leste)
UPA	University Postgraduate Awards
UPAIS	University Postgraduate Award (International Students)
UWA	The University of Western Australia
UQ	University of Queensland
WAPPA	Western Australian Pork Producers' Association

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