From the Director

The Graham Centre is a major regional hub facilitating the development of more cohesive collaboration and partnerships to improve the efficiency and capacity of research, development, extension and training for food and fibre production.

We have strong partnerships and collaboration with growers, advisers, the private sector, CSIRO, government and Local Land Services. These partnerships are essential given the shrinking bucket of RDE&T funds available and the capacity crisis across the industry.

Our mixed farming systems research aims to develop new knowledge and technologies to enable growers to optimise the potential synergies between crop and livestock enterprises on-farm. The objective is to optimise the benefits and minimise the risks, to increase profits and productivity gains, and to protect the environment.

We are passionate about providing evidence-based information for our growers and advisers and have established a series of forums to do this including, our Livestock Forums (4 July - Sheep and 15 August - Beef), Agribusiness Today Forum (7 August), National Food and Farming Forum (22 August) and Cropping and Pasture Systems Field Forum (4 September).

Our website features research activities, outcomes, events, member profiles and news stories and is our first portal for information and communication with members, stakeholders and the general public. We also utilise social media (Twitter, Facebook and YouTube) to increase exposure and awareness of our research and events, building new connections with industry and the wider community.

On 22 August we are facilitating an industry-wide ‘think tank’ Future Proofing Mixed Farming Systems taking a big picture look at how we need to prepare for future challenges to maintain the competitiveness of our industry regionally, nationally and internationally. We will explore the entire value chain focussing discussion around three key themes: 1. Key drivers of resilient mixed farming systems, 2. Value adding, and 3. Post-farm gate. We hope you can attend.

Enjoy reading this edition of the Innovator.

Professor Deirdre Lemerle

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Pakistani calf rearing trial a huge success

A recent buffalo calf rearing trial carried out in the southern province of Sindh has helped to spark interest and investment in this neglected area of the dairy industry in Pakistan.

The ASLP Dairy Project has been working in Pakistan for the last seven years with a focus on the dissemination of simple research outcomes to small-holder dairy farmers. In the last few years the team has been targeting research into calf rearing practices and trying to assess the benefits (if any) on applying ‘improved’ feeding and management in comparison to the traditional village methods of calf rearing. The outcomes of these experiments may not be mind blowing science to those of us familiar with and who have seen well run calf rearing sheds in Australia or elsewhere. However, the results and growth rates seen in the young Pakistani cattle and buffalo have been a true inspiration to farmers, researchers and government staff who at times did not believe what they saw.

Most of the research experiments the team have been involved with so far have been run in the Punjab, which is the more resource rich province of Pakistan. These experiments have been run in collaboration with the University of Faisalabad, The University of Veterinary and Animal Sciences Lahore and the Livestock Department of Punjab. These experiments have aimed to test simple feeding practices such as the cost benefit analysis of feeding regimens whilst maintaining clean sheds with the recommended vaccination and de-worming programs. Again, although this is simple stuff, the 12 week weaning weights we observed are 20-25% higher (56 kg) than those reported in the same breed of cattle seen on other research farms (45 kg) (Bhatti et al, 2012a). These are encouraging results showing great promise and opportunity for small-holder dairy farmers.

More recently the ASLP Dairy Team has embarked on a similar trial in the southern province of Sindh in Pakistan. This area has less resources than the Punjab and tends to receive much less investment from aid projects and the government. Hence, although it has just as much potential to thrive as other parts of the country, it can be a challenging environment to work in. Despite this, the team worked hard to get the experiment up and running with the collaboration of Sindh Agricultural University, Tandojam and a number of their masters students.

The trial was simple and we wanted to show the capability of buffalo calves to grow when they were:

1. Fed enough quality colostrum after birth in a timely fashion.
2. Housed in a clean environment.
3. Fed one of two regimes (one with buffalo milk, one with cow milk and both with a starter ration).

The particular result regarding which feeding regime was better or not is important, but what’s more important was the general growth rate of the buffalo calves. The fact the animals were managed appropriately at birth, kept healthy and fed sufficient milk, meant their weaning weights (at eight weeks) were around 60 kg; much higher than what is seen in the field. These results were shared widely in the community including a calf rearing seminar in April where farmers, researchers and government staff attended and were amazed to see the size, age and overall health of the young buffalo.

This research has been timely and has helped create quite a stir in the industry as more and more people seek to invest in calf rearing as a viable enterprise. Traditionally young male
animals are killed immediately as they are not worth the financial value of the quantity of milk that is required to rear them. However, the results from this study have shown that animals can be raised and auctioned for more than the cost of rearing. Numerous investors and other researchers are now contacting the ASLP Dairy Team and asking what our secret was for rearing such healthy calves with high growth rates.

The ASLP Dairy Project is managed by the Australian Centre for International Agricultural Research. Charles Sturt University, School of Animal and Veterinary Sciences and the Graham Centre are the commissioned agents for executing the project.

Two papers have been published from the calf trials in Punjab (references below) and the research from the calf trial in Sindh will be presented by ASLP Dairy Team members at the upcoming International Symposium on the Nutrition of Herbivores/International Symposium on Ruminant Physiology (ISNH/ISRP) in Canberra, Australia, 8-12 September 2014.


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Anti-adipogenic activity of Australian canola meal in murine mesenchymal stem cells

PhD student Saira Hussain presented her research findings recently at the Australian Food Science and Technology Conference at the University of Queensland, Brisbane. Obesity is associated with many diseases including cardiovascular diseases, diabetes, atherosclerosis, hypertension and cancer. Potential bioactive compounds from plant extracts may inhibit fat cell (adipocyte) differentiation. Screening of such extracts may contribute to future novel functional food strategies to reduce obesity. Canola meal is a waste product left after extraction of the oil and could be a source of potential bioactive compounds that could inhibit fat cell development.

Saira’s research investigated the extraction of canola meal using a variety of solvents, examining it for its ability to suppress adipocyte (fat development) differentiation in C3H10T1/2 murine mesenchymal stem cells. Accumulation of fat within the C3H10T1/2 cells was measured through Oil Red O staining, while levels of the major adipocyte differentiation factor PPARγ, were analysed by immunofluorescence and quantitative polymerase chain reaction (qPCR).

Overall extracts of canola meal demonstrated significant inhibition of adipocyte differentiation without cell toxicity with acetone and hexane extracts being the most effective.

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Saira Hussain (third from left) with fellow colleagues at the recent Australian Food Science and Technology Conference.
International symposium on fruit flies of economic importance

Dr Olivia Reynolds recently returned from a three week period in Thailand (5-25 May 2014), where she attended the 9th International Symposium on Fruit Flies of Economic Importance. Olivia presented both an oral paper, co-authored by Cheryl Jenkins, Shayne Fell and Jessica Smart, titled ‘Towards a Rapid Identification Technique for Immature Parasitoids’, and a poster, co-authored by Beverley Orchard, Sam Collins and Phillip Taylor, titled ‘A role for Pre-Release Supplementation in Sterile Insect Technique Programs for Bactrocera tryoni (Froggatt)?’

As a member and representative for Australia on the International Steering Committee for the International Symposium on Fruit Flies of Economic Importance (ISFFEI), Olivia had several duties including chairing the poster discussion for Session 7: (Natural enemies and Biological Control), and chairing oral presentation sessions 9 and 10: (Risk Assessment, Quarantine & Post-harvest, and Additional Topics (closing session)).

In addition, Olivia attended several evening meetings, one of which voted on the location of the next ISFFEI, which will be held in Mexico. Led by Olivia, Australia will put in a bid to host the 11th ISFFEI.

Olivia was presented with an award for her role as a member of the International Steering Committee by the Vice President of Thailand and Minister of Agriculture. Olivia was given the honour of saying a few words and presenting Watchreeporn Orankanok, the current ISFFEI Organiser, with a thank you gift on behalf of the International Steering Committee for her outstanding role in organising the symposium.

Olivia also spent time discussing Area Wide Integrated Pest Management incorporating the SIT with key experts including Eric Jang and visited a field site that demonstrated AWIPM and various practices that could also transfer to Australia. Several of these practices have already been discussed with growers, including utilising discarded fruit (particularly large quantities from packing sheds) as a bio-fertiliser.

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Helping woolgrowers make decisions—Graham Centre goes to Hay

Local landholders combined with students from Charles Sturt University and the University of Sydney to attend a forum recently held in the woolshed at Shear Outback. Organised by Professor Peter Wynn, Charles Sturt University and the Graham Centre, and Sally Ware, Riverina Local Land Services, the day focused on the seasonal rainfall outlook, nutritional management of stock in the rangelands during dry conditions and current international wool marketing strategies.

Climate Applications Research Officer with the NSW Department of Primary Industries (DPI), Michael Cashen, spoke about the enormous variability of rain in the district and the general contraction of autumn and spring rainfall. Whilst it is still too early to predict this season, his take home message was to keep a watch on the outlook, as it is likely that El Nino conditions will develop in the Pacific in early spring but the impact may be modulated by conditions in the Indian Ocean.

Pastoral nutrition specialist San Jolly from Productive Nutrition, Clare, South Australia spoke about the limitations of nutrition in the rangelands, particularly in a dry year, for reproductive performance in ewes. High lambing and weaning percentages are the keys to increasing enterprise profitability through the sale of excess stock. This is only possible in dry seasons if producers have the capability to feed ewes in late pregnancy and through lactation. Neither of these practices are routine in these extensive grazing management systems. Failure to do this, however, will result in high lamb wastage and an inability to supplement the enterprise’s wool cheque with the sale of excess store stock.

DPI Rural Support Worker Danny Byrnes and Hay Rural Financial Counsellor Darren Macartney spoke about the new drought declaration process and the assistance that is available now and after a declaration. Danny emphasised the fact that the low rainfall pattern in the Hay district currently, may well trigger a drought declaration in the near future.

Rob Langtry, Chief Strategy and Marketing Officer with Australian Wool Innovation highlighted the challenges confronting the wool industry to maintain its 1% share of the global apparel fibre market. His presentation outlined the
marketing strategies for wool and included many Woolmark campaign clips that are currently being shown to targeted audiences around the world.

Although Australia produces 90% of the world’s fine apparel wool, the profitability of wool production is dependent on maintaining premium prices for a high quality product. Although wool is in the same commodity class as silk, it is easily substituted with cheaper synthetic fibre exhibiting similar wearing properties. The challenge is to increase consumer (and trade) demand pressure for the ‘real’ product at retail prices that sustain profits for the producer.

There is little doubt the industry has turned to China as its next major market. Between 75% and 83% of Australian wool is exported to China for processing, with 32% of all Australian wool being consumed by the Chinese people. The industry clearly needs to learn more about the Chinese economic and political system, and understand consumer attitudes and behavior, the structure of the retail sector and other social, cultural, and environmental factors that influence purchasing decisions made by the consumer in this vast potential marketplace.

The luxury end of the apparel marketplace is where the industry is headed. Let’s hope the world economic situation remains buoyant to support the sales of luxury goods.

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Future Farm Industries CRC field trip

After the FFI CRC Future Farm Live event on 8 April, the CRC Board, staff and others enjoyed a field trip to Cowra, Ariah Park, Wagga Wagga and Holbrook to visit CRC research sites. The trip was organised by Richard Hayes (NSW DPI) (left), pictured here with Matt Newell (NSW DPI) and CRC Chairman Andrew Inglis, at the Cowra EverCrop site. Photo: FFI CRC
Showcasing agricultural careers

With the current skills shortage in agriculture escalating, days such as the Graham Centre’s Science and Agriculture Enrichment Day are critical to showcase careers in agriculture, raising awareness of the industry amongst youth and increasing their enthusiasm to pursue a career in the agricultural industry.

On 13 June almost 100 agriculture and primary industry students from schools across the Riverina (Wagga, Deniliquin, Cootamundra, Tumut, Leeton, Gundagai and Griffith) converged on the Graham Centre to participate in hands-on, interactive workshops addressing meat quality, grain quality and screenings, soil root nematodes and the science of a healthy brain.

A big thank you to Graham Centre PhD students, Steph Fowler, Adeola Alashi, Soumi Mukhopadhyay, Kylie Crampton and Syed Omar, for volunteering their time and running the workshops for the students.

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Harvest weed seed control workshops

Managing problem weeds such as ryegrass, wild oats and wild radish in wheat and canola is becoming an increasingly difficult proposition in southern NSW farming systems as a result of minimum till farming and a continued reliance on herbicides. As a result Delta Agribusiness, Young, in conjunction with the Australian Herbicide Resistance Initiative (AHRI), GRDC and Charles Sturt University (CSU) organised a field day on 19 March to examine practical weed management alternatives, with the focus on the destruction of weed seeds at harvest time. The field day was held at ‘Glaisnock’ a mixed cropping and livestock farm near Young.

The day included presentations from John Broster (CSU) and Mike Walsh (AHRI) on the prevalence of problem weeds and herbicide resistance in our local region, and the options other than herbicides available to combat the problem. Ryegrass herbicide resistance levels around the Young district were compared to those sampled in WA with concerning similarity.

The field day also included commentary from Lance Turner, Ray Harrington and Andrew Messina who are innovative Western Australian grain growers who have had real and on-going success in managing problem weeds by adopting various harvest weed management techniques.

The focus of the workshop was the collection and destruction of weed seeds at harvest time, through the use of a range of techniques including narrow windrow burning, chaff carts, bailing behind the header and chaff grinding using the Harrington Seed Destructor. The practical benefits and disadvantages of each system were examined and a range of integrated weed management strategies were presented. The WA experience of windrow burning and the use of chaff carts to remove and destroy weed seeds after harvest was discussed in detail by the enthusiastic WA growers who were in attendance.

Ray Harrington, the inventor of the Harrington Seed Destructor (HSD) discussed the benefits of his invention and the redesign of the HSD to allow it to be retro-fitted to current headers. The new prototype is significantly smaller than his original invention, can be fitted to most current headers and physically crushes and destroys weed seeds as they pass through the header at harvest time. The HSD requires an additional 75 horse power to run and is likely to be commercially available within the next five years.

Chris Bunny (Growth Farms, Young) gave a practical demonstration of narrow windrow burning at the end of the meeting. Fire temperatures within the narrow windrows of over 400°C were recorded by John Broster (CSU). Windrow burning is the cheapest and potentially
The easiest method of harvest weed seed destruction to adopt but requires a level of skill to ensure the fire burns hot and long enough to destroy weed seeds and to ensure the fire stays in the windrow.

Growers were in attendance from Young, Harden, Wallendbeen and Caragabal from predominantly mixed farms. The implementation of narrow windrow burning of canola stubbles has gained considerable momentum in Young over the last two seasons under the guidance of Delta Agribusiness advisors. All those who were in attendance showed strong interest in increasing their level of harvest weed management techniques on their own farms in the future in an attempt to decrease weed burdens and prevent further development of herbicide resistance.

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Boosting research skills while building international partnerships

Dr Yantao Song has spent the last 12 months at the Graham Centre for Agricultural Innovation as a visiting scientist under the supervision of Dr Guangdi Li, Graeme Sandral and Richard Hayes. Dr Song conducted several experiments in the glasshouse and field looking at weed population dynamics and management strategies under different break crops.

Dr Song was also actively involved in various research projects managed by the Pasture Group in the NSW Department of Primary Industries, including Crop Sequence, EverCrop, N2O emission, Lotus evaluation and Phosphorus use efficiency.

Over the past 12 months, his skills in experimental design, capacity and ability to conduct research have been boosted. He has also learnt how to use the R software for data analysis. Furthermore, he has collected enough data to write at least three scientific papers:

- Influence of break crops and weed management on annual ryegrass (Lolium rigidum) dynamics, weed control and crops yield in south-eastern Australia.
- Aluminium and manganese tolerance of 20 temperate grasses and four temperate legumes in solution culture.
- Do leaf traits predict wheat productivity?

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Chinese delegation visits the Graham Centre

A high level Chinese delegation from Beijing recently visited the Graham Centre on 27-29 May, 2014. The delegation consisted of four scientists specialising in invasive weeds and pests; Dr Guoliang Zhang, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences, Dr Weidong Fu, Chinese Academy of Agricultural Sciences, Dr Yun Wei, Beijing University of Chemical Technology, and Dr Hanwen Ni, China Agricultural University. Dr Guoliang Zhang gave a lunch presentation on ‘Research on invasive biological species in China’ as part of their visit.

The delegation had in-depth discussions with a number of researchers across CSU and NSW DPI, including Drs Hanwen Wu, David Gopurenko, Aisuo Wang, Xiaocheng Zhu and Mr Phil Bowden. A broad range of research areas was discussed, including agricultural extension, weed biology and ecology, weed survey, weed invasion mechanisms, integrated weed management, allelopathy, identification of allelochemicals, separation technology and materials for purification of bioactive compounds, and DNA barcoding in biosecurity research. The delegation was very impressed with the quality of weed research being conducted in Wagga. Future collaborations between China and Australia were also discussed.
Agribusiness Today Forum: The Business of Beef
Thursday 7 August 2014, Blayney Community Hall

Presentations and discussion on:
- Australian beef production and profitability in a global market
- Future of Australian beef markets
- Retailers and processors perspectives on the challenges in a competitive market
- Strategies and technologies for producers to improve profitability

Register now!
Individual - $22 per person
Family (up to 4 attendees) - $55 per ticket
Student - $11 per person
(Includes morning tea and beef lunch)
Register online www.trybooking.com/FFND or E: events@rdacentralwest.org.au or T: 02 6369 1600

Graham Centre Beef Forum

Friday 15 August 2014
Convention Centre, Charles Sturt University, Wagga Wagga

For further information contact Toni Nugent, E: tnugent@csu.edu.au T: 02 6933 4402
The School of Agricultural and Wine Sciences (SAWS) is currently reviewing and developing the learning and teaching guidelines for the development of our Bachelor of Agricultural Science degree.

We would like to know what you think a future graduate needs for Australian Agriculture in the 21st Century…

- If you were to employ this graduate, or expect this graduate to be a producer, what would be your ideal Agricultural Science Graduate?
- What is it that upon graduation, this graduate should be able to do?
- What skills (not just technical) should the graduate have?

We are giving you an opportunity to influence the process. In a couple of sentences tell us what YOU think. Send in your submission to Sergio Moroni at smoroni@csu.edu.au

The best submission will be awarded with 2 bottles of red wine and a box of chocolates.

Note: This is not open to staff currently participating in the Smart Learning process nor their immediate family members.

Graham Centre Cropping & Pasture Systems Field Forum

Wednesday 3 September 2014

Graham Centre Field Site
Coolamon Road, Wagga Wagga
Marker assisted selection of bio-control bacteria: learning from Ohio State University

Plant disease significantly reduces global crop production and losses account for, on average, 42% of the six most important food crops. If global crop losses were reduced by 1%, an extra 25 million people would have enough to eat, without the extra use of resources.

The use of chemical pesticides is still the mostly used weapon to tackle plant pathogens. Dr Serge Savary, International Rice Research Institute, stated that the reliance on pesticides to suppress disease can be considered as analogous to the reliance on the fire brigade to put out fires once they have started; emergencies call for rapid remedies and just as the water used to put out fires may cause widespread damage to the threatened property, so pesticides may have unwanted but unavoidable consequences for the environment.

With the exception of synthetic chemicals, demand for biopesticides has continued to expand dramatically throughout the world. The increased demand for biological options for plant disease management means the discovery of novel biocontrol agents through molecular approaches must be explored.

On a recent United States Department of Agriculture fellowship to Ohio State University, Mohd Mostofa Kamal was given the opportunity to receive specialised training on marker-assisted selection of bacterial biocontrol agents for the control of plant pathogenic soil borne diseases. Kamal learnt how the potential strains can be targeted and isolated from a number of bacterial populations using selective markers.

Professor Brian McSpadden Gardener, Department of Plant Pathology, Ohio State University, has developed three marker-assisted approaches to search for new and effective biocontrol bacteria.

The first approach relies on prior knowledge of the genetic mechanisms of biological control. Bacterial populations can be targeted using gene-specific primers, and different strains harbouring variations in these genes are identified and selectively isolated.

The second approach relies on removing the genetic redundancy inherent in most bacterial collections screened for biocontrol activities. The genetic diversity of a neutral marker such as the 16S gene can be amplified and screened using restriction analysis. By doing so only the most distinct species and genera can be selected for bio-assays.

The third approach relies on comparative molecular analysis of bacterial community structure from healthy and diseased plant samples. Quantitative associations between the relative abundance of markers and the relative health of plant samples allows for identification of candidate biocontrol markers. These markers can then be used to develop selective isolation protocols that are used to recover a much reduced set of likely active bacteria. These approaches can be adapted to study Bacillus, Pseudomonas and other bacteria for which molecular markers exist.

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Improving farming and marketing systems in southern Lao PDR

The lowland and upland farming systems of rainfed southern Lao PDR face a significant risk of hunger and rising rural poverty. The Government of Lao PDR recognises that its southern region has an agricultural economy in transition, and the poor need assistance to participate in and benefit from the transition process.

Responding to this challenge, a multidisciplinary research team has undertaken a project of strategic and adaptive field research during the 2010-13 wet seasons and 2011-13 dry seasons. This project brings together institutions in Lao PDR and Australia under the Rice-based Systems Research program managed by the Australian Centre for International Agricultural Research (ACIAR). The research is led by Charles Sturt University (CSU) in partnership with NSW Department of Primary Industries, the International Centre for Tropical Agriculture (CIAT), Provincial Agriculture and Forestry Office (PAFO), National University of Laos (NUOL), National Agriculture and Forestry Research Institute (NAFRI), International Rice Research Institute (IRRI) and the University of Queensland.
A key element of this project involved the analysis of farmers’ value chain and marketing operations, and synthesis of best-bet technologies. This systems research commenced with a transect analysis from lowlands to uplands, and from subsistence to commodity agriculture, based around several hubs in Savannakhet and Champassak provinces.

Adaptive on-farm research was established on approximately 300 farms in 10 villages associated with these hubs.

“The trials aimed to improve productivity and income from diversified systems through resource management, direct seeding, short-duration post-rice crops such as pulses, vegetables and forages, and the integration of ruminant livestock,” Professor Len Wade, Graham Centre and CSU, explained.

“More intensive studies followed, directed towards understanding the interactions underpinning these diversified mixed-farming systems.”

On-farm research provides an opportunity for stakeholders to participate in the research process. This facilitates communication between researchers and stakeholders, leading to improved design, acceptability, awareness and finally adoption of appropriate technology.

“We implemented an on-farm research project in southern Laos from 2010 to 2013,” said Dr Tamara Jackson, Graham Centre and CSU.

“Despite their limited experience with research before the project, a survey of local extension staff and farmers identified multiple benefits as a result of their engagement in the project. In addition to improved technical and research skills, there was positive development in communication, confidence, attitude and critical thinking.”

“On-farm research also provided an excellent opportunity for researchers and PAFO and District Agriculture and Forestry Office (DAFO) staff to garner locally relevant knowledge and appreciate how improved crop production contributes to enhanced livelihoods of communities,” Dr Jackson added.

“In particular, the project was very effective in bringing DAFO staff into the farming communities, significantly boosting their level of engagement.”

Focal villages

A further key component of this project is the use of Focal Villages. These were established in 2012 to represent the common agro-economic zones, and act as hubs for integrating project learnings for delivering new knowledge and technology, and for out-scaling project results.

Professor Wade highlighted the encouraging outcomes of the Focal Village model, noting that “Adoption of promising new technologies has commenced with farmers adopting ‘Sub-1’ rice with submergence tolerance, new upland rice cultivars with higher yields, and forage grasses previously unknown in southern Laos.”

“To improve their livelihoods, farmers are also trying other diversification and integration strategies including mechanised direct seeding, supplementary irrigated post-rice crops, livestock forage production and feeding.”

“Market awareness is also improving and although the first signs of technology adoption are visible, sustained success in the longer term will require effort beyond the life of the project. Perhaps the greatest strength of this project is this robust framework in the provinces, with international and Lao staff co-located, and a pathway for delivery established through the use of Focal Villages.”

Dr Jackson added, “Focal Villages have value in terms of being a physical presence around which activities can be..."
planned. This helps practically to apply the concept of integration at the project level. An integrated approach, it requires increased capacity in terms of staff skills (technical skills, facilitation, stakeholder engagement, monitoring and evaluation and impact assessment), ongoing support, and appropriate allocation of resources.

“Integration is not new at the household or even the whole farm level. However, it is time-consuming, and requires a different approach from local stakeholders compared to traditional methods,” Dr Jackson said.

A special edition of the Lao Journal of Agriculture and Forestry will feature 12 papers drawing together the results of this project.

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Farmer participatory research: a sustainable approach to smallholder’s profitability

Fodder shortage is the leading limitation to livestock productivity in Pakistan, primarily because of the scarcity of quality fodder and seed at the village level. The formal seed supply system is insufficient to meet the domestic requirements of fodder seed, and there is a dire need to fill the gap between the demand and supply of fodder and the seed of fodder crops. Berseem clover (Trifolium alexandrinum L.) is being used as the target fodder crop due to its rapid growth, multi-cut nature, and good recovery after cutting with excellent palatability and nutritive value. In addition, it has the ability to fix large amounts of atmospheric nitrogen (N) and enrich soil fertility through N fixation. It also has a high level of acceptance amongst farming communities.

Involving the farming community in fodder seed production is critical, both in terms of variety selection and its adoption. This will only be possible through the evolution of high yielding varieties, standardisation of their production technology and seed production of fodder varieties through the involvement of farmers as seed entrepreneurs to meet the domestic requirements. The purpose of the research project is to enhancement the benefits from livestock rearing by alleviating fodder constraints through fodder seed production and utilising the modern agronomic practices for better fodder and seed yields with minimum production costs.

Farmer participatory research gives a voice to farmers and elevates local knowledge about the role of science in food security. Another benefit from participatory research is an expected increase in fodder crop biodiversity through varietal selection when using improved varieties on farmer’s fields in different villages across the region.

Field studies

Field studies were conducted in farmer fields in the Kasur and Okara districts of Pakistan, to evaluate different seed sources and crop management practices through farmer participatory research. Three different seed sources of berseem clover; farmer own-saved seed (FS), market seed (MS) and research institute seed (RS) were plotted using best agronomic practices for quality fodder and seed production. Farmers were involved in variety evaluation and selection based on different fodder and seed parameters and the improved set of agronomic practices. The improved set of agronomic practices for quality production consists of; use of quality seed, inoculum, balance fertilisers, irrigation and cutting management.

Use of inoculum bacteria (Rhizobium trifolii) produced better results over non-inoculated crop. Inoculated crop produced significantly higher plant height, stem diameter and leaf size, which results into higher and better quality
fodder and seed production. After selecting the best seed source and crop management practices, seed entrepreneurs (small farmers) produced fodder and seed, and distributed it to the local farmers in the villages through village-based forage seed enterprises (VBFSE) to earn profit. A regular income was generated by selling the excessive fodder as berseem clover is a multi-cut forage crop and seed is sold at the end of the growing season.

Improved seed from the Fodder Research Institute, Punjab performed significantly better than other seed sources in the farmer’s field. Getting the three fodder cuts and leaving the fourth cut for seed production proved to be the best cutting regime for producing maximum quality fodder and seed yields. The maximum fodder and seed yields recorded in the Okara district were 81.49 t/ha and 545.28 kg/ha, respectively. The maximum net income was calculated to be $3079/ha (SAUD) using the improved seed with best crop management practices at the village level with smallholder farmers.

Farmer participatory research for varietal selection, seed production and distribution through VBFSE will help alleviate fodder shortages and ultimately decrease the incidence of poverty amongst 70% of the rural population that are dependent on livestock for food and income. VBFSE is a self-sustained solution to the poor small farmers as seed entrepreneurs not only have the basic seed but also the scientific knowledge to reproduce and distribute the seed to earn significant net profits. A regular income was generated from selling fodder each month, which improves the livelihood of the smallholder farmers and meets their day to day feed expenses.

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Chickpea tasting day for Wagga Wagga residents

Wagga Wagga residents have experienced wine tasting at many farmers markets as part of a Charles Sturt University (CSU) research project. But what they were not expecting was to go to the farmers market and be encouraged to taste Australian desi chickpeas cooked in traditional Indian recipes; all in the name of research. That’s exactly what happened in November 2013 and May 2014, when Graham Centre PhD student Soumi Paul Mukhopadhyay conducted her consumer testing in the Wagga Wagga Senior Citizens Community Centre (Wiradjuri Hall), to identify Australian consumers’ perception and preference for cooked chickpeas.

Soumi’s PhD research is investigating the sensory qualities of Australian desi chickpeas and their consumer acceptance across three different cooking methods.

Soumi’s first taste testing focused on fried split chickpeas, while her second focussed on puffed whole chickpeas and cooked chickpea dhal. Soumi said her first study was a huge success with 185 consumers enthusiastically participating, while her second study saw a massive 220 consumers (120 participants for cooked chickpea dhal and 100 for puffed whole chickpeas) participate. Many of the participants from the first study also returned for her second study.

Soumi started her research with 13 Australian desi chickpea samples. Through her CSU sensory panel, Soumi selected six different chickpea cultivars to be used for the first consumer test. In her second and final study for puffed chickpeas and cooked dhal, each participant was given 5-6 different varieties to taste.

The tasting of chickpeas in their individual cooked forms was straight forward; between each sample the participants rinse their mouth with drinking water to remove any carryover effects. All samples were evaluated using the 0 - 9 cm hedonic scale (where 0 = is extremely dislike, 9 = extremely like) in a single session by each participant, putting a mark at any point of the scale depending on their liking for that specific sample. Following the final sample evaluation, each participant completed a survey questionnaire which included demographic (i.e. age, sex, income level), questions related to product usage information (i.e. frequency of usage), awareness, attitudes, drivers of consumption and taste preference of Australian consumers for all the chickpeas used in the study.

Soumi is now analysing the data she has gathered from her consumer tests. The results will be helpful for her to connect any trends in consumer liking for the same chickpea varieties for different cooking methods. In the final stage of her research, unlocking these mysteries and connecting the dots will be one of her biggest challenges, which she says she will enjoy.

Contact: Ms Soumi Paul Mukhopadhyay
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Getting more out of legume crops and forages for southern farming systems

The two most important series of biochemical reactions in plants, that agriculture depends on, are photosynthesis and biological nitrogen fixation. Photosynthesis converts atmospheric carbon dioxide (CO$_2$) and sunlight into carbohydrates that provide plants with both their structure and energy requirements. Biological nitrogen fixation converts atmospheric nitrogen (N$_2$) into nitrogen-rich amino acids, the building blocks of proteins, and an all-important class of chemical compounds fundamental to life.

Not all plants can fix N$_2$ with the majority only able to access it as nitrate or ammonium ions from the soil. Plants in the legume family are unique because they contain the most important representatives of agricultural plants that can fix N$_2$ directly from the atmosphere.

Of all the developed nations, Australia’s dryland agricultural systems, because they are extensive and therefore must be low-cost, are perhaps the most dependent on biological nitrogen fixation. Consequently much effort has focussed on the breeding and agronomy of legume crops and pastures.

Research shows that as a ‘rule-of-thumb’, 20-25 kg N/ha can be added to the soil with every tonne of dry matter produced by a legume crop. However, over the last 10 to 15 years there has been increasing concern that the nitrogen (N) contribution of legume crops to southern Australian farming systems has been declining. The reasons why this is happening are not really clear and may be complex with a number of factors involved and possibly interacting with one another. Some of the causes of this problem might include, the overall reduction of crop and pasture production of the last decade caused by the millennium drought, low quality or unadapted rhizobia leading to poor nodulation and disease causing pathogens, insect pests or residual herbicides causing a reduction in crop productivity.

This issue is particularly important in the newer cropping belt of the south-eastern high rainfall zone where nitrogen-hungry wheat and canola are the main crops, and there is relatively little use of pulses, grain legumes or leguminous forages. Farmers from these zones would like to increase their use of leguminous crops to reduce the reliance on expensive N fertiliser. Such legume crops or pastures would act as a ‘break-crop’ to the wheat-canola rotations that predominate, allowing different weed control methods while reducing the build-up of disease causing pathogens.

Legume break-crops in these situations act to enhance farming systems sustainability by reducing the rate of herbicide resistance development and build-up of cereal and canola pathogen and insect pest populations. Many farmers in these regions continue to keep large numbers of grazing animals and want to better integrate their grazing and cropping activities. Legume forage production needs to be better integrated into mixed farming rotations, providing benefits for both cropping and animal production.

NSW Department of Primary Industries and Graham Centre Scientists, Mark Norton and Graeme Sandral, Development Officer, Helen Burns and CSIRO’s Mark Peoples are working with GRDC and a number of farming systems groups including Holbrook Landcare Network, Southern Farming Systems and MacKillop Farm Management Group, in a new four year project starting in July 2014, to study the contribution of leguminous break-crops to mixed farming systems and encourage their greater adoption.

Contact: Dr Mark Norton
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Hard seeded legumes hit the jackpot

Hard-seeded legumes including biserrula, bladder clover, gland clover and French serradella are radically changing the cropping rotation on Mike O’Hare’s property at Beckom, NSW.

Mike runs a 2000 hectare mixed crop and livestock, with half sown to crop each year. Mike has traditionally used subterranean clover as his pasture base but after the drought had to rethink his strategy with a near zero survival rate.
In 2009 Mike introduced hard seeded legumes into his rotation. He started with a small area (5-8 ha of each) of biserrula, bladder clover, gland clover and French serradella. Only about 120 mm rainfall was received for the growing season, but all species survived and set seed. Since then Mike has header harvested seed of bladder and gland clover and used a combination of header and suction harvesting for biserrula. The seed harvested has been used to sow the rest of the property.

In 2014 Mike has established a seedbank of 750 ha of biserrula and 750 ha of a bladder/gland clover mix in various stages of the rotation. By the end of 2014, this area will increase to 1000 ha of each.

Prior to the drought lucerne mixes were the mainstay of Mike’s pasture phase, but he now has only 35 ha of lucerne remaining.

“Annual legumes are more cost effective, more reliable and more flexible,” Mike said.

Legumes only get to set seed every fourth year. Mike’s typical rotation for all annual legume species is:

Year 1—Hard seed legume summer sow (graze and let set seed)
Year 2—Regeneration of annual legume (graze and spray out in September)
Year 3—Canola
Year 4—Wheat
Year 5—Regeneration of legumes from seedbank (graze and let set seed)

Research by CSU, NSW DPI and the Department of Agriculture WA, shows seed production levels and hard seed break down are different in NSW compared to WA. For example, biserrula (Casbah) does not regenerate well in the second year in WA but does so in NSW.

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Associate Professor Scott Norman

Position: Associate Professor in Theriogenology

Organisation: School of Animal and Veterinary Sciences, CSU

Career Brief: I broke in horses and did some jackarooining on a Brahman commercial and stud beef operation to make pocket money while at school. This got me interested in veterinary science. After graduating from The University of Queensland in 1983, I worked in a rural veterinary practice in Goondiwindi, Qld. It was also a teaching practice, and this experience stimulated me to further my education and investigate an academic career.

In 1986 I undertook a comparative theriogenology residency position at The University of Florida. At the completion of my residency, I passed both the American National Board examinations, and the Diplomate examinations for the American College of Theriogenologists. However, it wasn’t until 2009 that I applied for and received Australian specialist registration in veterinary reproduction via the Australian Veterinary Boards Council.

Returning from the US, I worked in a mixed rural practice, and started developing bovine, ovine, equine and canine reproductive services for the practice. After spending two horror seasons assisting many heifers with calving difficulty, and discovering there was limited information on how to prevent the problem, I decided to embark on a part-time PhD investigating management techniques to reduce dystocia in beef heifers.

I started my first full-time academic position as Lecturer in Veterinary Reproduction with The University of Queensland, School of Veterinary Science in 2001 and I joined CSU in 2005.

Research interests: Not surprisingly, my research interests revolve around theriogenology. Ranging from basic research into embryo and semen quality; the pharmacology of antibiotics after intrauterine infusion; and most recently, the telemetric monitoring of cattle at the time of parturition (what we call the “calf alert” project).

Teaching activities: My main role has been in curriculum development to ensure the vertical integration of theriogenology teaching within the veterinary, animal and equine sciences courses, plus development of the clinical extra-mural (CEM’s) activities of the Phase 3 veterinary students. I currently coordinate Veterinary Reproduction in third year, plus veterinary reproduction subjects in years 4, 5 and 6.

Professional Links: My team and I, work closely with Meat and Livestock Australia. We have also had close association with RIRDC, with two completed projects since 2008.

I am an active member of the Australian Veterinary Association, the Australian Cattle Veterinarians, and president elect of the Australian Reproduction Veterinarians.

I am a Diplomat of the American College of Theriogenologists and a Member of the Australian and New Zealand College of Veterinary Scientists (Reproduction Chapter).

A typical day for me includes: Feeding animals, knocking over a few emails over breakfast, then checking in at the Ganmain Veterinary Clinic to see if there are samples to submit to the CSU Veterinary Diagnostic Laboratory, then off to work.

Teaching, meetings, emails ... I like to set aside at least 30 minutes to work on a paper, book chapter or conference presentation.

My main project at the moment is: The development of a telemetric Calf Alert device. It’s now at the exciting, but somewhat nervous (will it work as planned?), stage of field trials.

My favourite part of my job is: I get a lot of joy in having students ask me questions about theriogenology that I am unable to answer. Questions that show they have thought deeply about the subject and have come to the realisation that there is still exciting information to be discovered.

When I am not in the office I like: To ride my bicycle or any reasonable form of exercise, work on old cars (1959 American V8’s, and Jag XJS) with my wife - Jenni, maintain our property at Ganmain, help in the Ganmain veterinary clinic.

When I am driving I like to listen to: A fairly eclectic range of audio - ABC local and 24 Hour News radio, The Stray Cats and similar genre, ‘80’s and ‘90’s pop and audio books.

Dr Scott Norman enjoys students asking questions about theriogenology that he is unable to answer. He says it shows they are thinking deeply about the subject and realise there is still exciting information to learn.
Dr Olivia Reynolds

**Position:** Senior Research Scientist (NSW DPI) and Senior Adjunct Lecturer (CSU)

**Organisation:** NSW DPI, Elizabeth Macarthur Agricultural Institute

**Career Brief:** My career in the field of agricultural entomology spans over 13 years. I was awarded my PhD (CRC Cotton Scholarship on ‘The Influence of Host Plants on the Mating behaviour of Helicoverpa armigera’) in 2003 and after backpacking Europe for two years I entered into a postdoctorate (University of the Witwatersrand and the South African Sugarcane Research Institute) Postdoctoral Fellowship on ‘Silicon and plant defence against biotic and abiotic stress’. In late 2006, I accepted a job with NSW DPI and am now a Senior Research Scientist within Biosecurity.

**Research activities:** My research has concentrated on the management of Australia’s most significant biosecurity horticultural pest, Queensland fruit fly, Bactrocera tryoni (Froggatt) (Diptera: Tephritidae), centred around environmentally friendly and sustainable control techniques including the sterile insect technique. I have also continued to expand my program of research with respect to silicon and plant defence.

**Teaching activities:** My main teaching activities focus on postgraduate and postdoctoral fellows. I currently supervise one PhD student working on developing an adult probiotic diet to enhance fitness and mating performance of sterile male Queensland fruit flies and a complementary postdoctoral fellow (soon to start) looking at probiotic larval diets. I also co-supervise an international Brazilian student looking at silicon and induced plant defence, who will spend one year (2015) of her PhD in my lab.

Over recent years, I have been invited to give guest lectures to undergraduate students and assist in practical workshops including those from University of Sydney, Macquarie University, AQIS and CSU. I also hold the post of Senior Adjunct Lecturer at CSU. I am passionate about sharing my knowledge with students and thoroughly enjoy the interaction with them.

**Professional Links:** My main collaborations are with researchers both nationally and internationally including those from CSU (Orange and Wagga), NSW DPI (EMAI, Wagga, Ourimbah and Orange), Sydney University, CSIRO, Macquarie University, United States Department of Agriculture (USDA), Hawaii and the International Atomic Energy Agency (IAEA).

My key appointments include Member of the International Fruit Fly Steering Committee, International Symposium on Fruit Flies of Economic Importance; Regional Coordinator, Tephritid Workers of Asia, Australia and Oceania, Tephritid Workers Database; Australian Bio-Protection Initiative foundation member; Member of the Domestic Quarantine and Market Access Working Group; Editor, open-access journal, Insects and Editor, International bulletin Fruit Fly News.

**A typical day for me includes:** Speaking with staff/students, planning the next step in my projects, writing industry articles/journal publications and grants, attending meetings/teleconferences for several committees of which I am a member, talking with one of my collaborators about a project or potential project and emails.

**My main project at the moment is:** Area Wide Integrated Pest Management utilising the Sterile Insect Technique which is part of the SITPlus consortium comprising CSIRO, SARDI, Plant & Food NZ/Australia and NSW DPI.

**My favourite part of my job is:** Seeing my team/collaborators hard work written up and published.

**When I am not in the office I like:** I love to travel which may include any variation on visiting a different country, location or place within my home city, Sydney with my husband and two boys.

**When I am driving I like to listen to:** I enjoy talkback radio and a station with a focus on a current topic such as Triple J or ABC Rural radio but on my lengthy commute to work I admit to most frequently tuning in to Kyle & Jackie O.
## EVENTS CALENDAR

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<tr>
<th>Date</th>
<th>What</th>
<th>Where</th>
<th>More information</th>
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<tr>
<td>4 July</td>
<td>Graham Centre Sheep Forum</td>
<td>Convention Centre</td>
<td>Toni Nugent</td>
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<td>7 Aug</td>
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<td>Blayney Community Hall</td>
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### Spring Edition of the Innovator

The Spring Edition of *the Innovator* will be available October 2014. Submission of articles for this edition close on **Friday, 29 August 2014**. Please email articles to Toni Nugent.