

Faculty of Computing Health and Science

Research Unit Annual Report

RESEARCH UNIT NAME: eAgriculture Research Group

RESEARCH UNIT LEVEL (tick):

- Level I Research Group Level II Research Centre
 Level III Research Institute Centre of Excellence

YEAR: April 2010 to April 2011

BRIEF OVERVIEW (1-2 paragraphs outlining major activities conducted in past year)

The eAgriculture group carried out a number of activities during the year to establish the group following its inception.

- 1) The major activities related to the establishment of some core projects:
 - eAgriculture techniques and methodologies for application to agriculture data
 - Agricultural data mining and geo-spatial visualisation tools
 - Agricultural information dissemination systems
 - The use of ICT to improve the delivery of agricultural information to international farmers
 - Agricultural data repository project
 - Environment sensor networks for real time catchment monitoring
 - Wireless mesh networks for grain quality laboratories
 - European house borer sensor networks
- 2) Other activities centred around the output of research in the form of 2 book chapters, 9 journals, 25 conference papers and 1 other conference proceedings.
- 3) The group also had a number of honours and postgraduate students who were working on projects related to the research group. There were 1 honours student, 4 research masters and 4 PhD/DIT students. During this time there were 3 Research Masters and 2 PhD and completions.
- 4) Other activities have centred on establishing the required infrastructure for the research group; this included the purchase of high end computer for data mining activities, a group virtual server and a multi terabyte array. A lengthy process was undertaken for the acquisition of agricultural and land data sets from Department of Agriculture and Food Western Australia for the research projects for use by staff and students within the group.
- 5) Establishment of the research project with colleagues Associate Professor Martwana "Delivery of Agricultural Information to Khon Kaen villages through the use of Information and communication technologies". This project has started data collection and conducted an industry workshop in KKU.

- 6) The eAgriculture group continued to establish linkages with other researcher in with expertise in the area of eAgriculture. The group now has linkages within Western Australia with Department of Agriculture and Food WA and with other university research groups at University of New England in Australia
- 7) In terms of international research linkages, these have been developed with Thailand at Khon Kaen University with Faculty of Agriculture and the Faculty of Resource Engineering. Within India, the eAgriculture group has strong linkages with researchers at CSRE at IIT Bombay, at IIIT Hyderabad and University of Mumbai and Osmania University, Hyderabad. The eAgriculture Research group also has linkages with researchers at Indian agricultural research centres including NCAP and ICAR and also with International research centres at IWMI at ICRISAT. Both Dr Armstrong and other members of the eAgriculture research group have made visits to both Thailand and India to strengthen these ties.
- 8) eAgriculture research group has also appointed 4 adjunct faculty , including Mr Dean Diepeveen (from DAFWA), Dr Neil Dunstan (UNE), Associate Professor Adinarayana (IIT B) and Professor Krishna Reddy (IIIT Hyderabad).
- 9) We are establishing the reputation of the eAgriculture research group amongst the international research community and are seeking to have other researchers visit or research group. Associate Professor Adinarayana (IIT B) was awarded a visiting fellowship to visit this year. However this does to unforeseen circumstances has been delayed until 2012. We have also had other visitors including Mr Sreedhar from IWMI.
- 10) Other activities have revolved around obtaining grants for the group. We have been successful with 2 grants during the year, including an infrastructure grant of \$45 000 to set up a multi terabyte array for our research group which will add capacity for us to carry out our data mining based projects. We have also renegotiated a research grant that has been jointly funded by iVEC and ECU. "Evaluate methodologies for eAgriculture in Western Australia". This project will now collaborate with a Western Australian Agricultural industry group, the Moora/Milling Pasture Improvement Group. Adjunct faculty have also been successful in acquiring grants with Indian research bodies to the total of \$30 000.
- 11) A lot of the activities being carried out in the last year are to establish linkages and preliminary research output to contribute to the production of international grant submissions in 2012. It is planned to target, ACIAR, AusAID, Australia India Strategic Research Fund and GRDC granting bodies.
- 12) We have established a formal collaboration with a Moora/Milling Pasture Improvement Group. farmer group lead by President Mr Tony White. We also have linkages now with the Grower Group Alliance in Western Australia.
- 13) The other major activity is for the eAgriculture group to set up an International annual workshop related to our research activities. We convened the international workshop "Knowledge Discovery for Rural Systems Workshop" which was held in conjunction with the 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining, in Hyderabad India. This was done in collaboration with the research collaborators in India and Australia. The eAgriculture research group is now making a conference bid for AFITA 2014 conference to be staged in Perth.

MEMBERSHIP (Full Title of Researchers, including staff, research students, adjuncts in the past year)

Dr. Leisa Armstrong (Leader)
Mr Dean Diepeveen (Adjunct Senior Lecturer) (Co Leader)
Associate Professor Adam Osseiran
Dr Neil Dunstan (Adjunct Senior Lecturer)
Associate Professor J Adinarayana (Adjunct Associate Professor)
Professor P. Krishna Reddy (Adjunct Professor)
Professor Geoff Syme
Dr. Judy Clayden (Senior Lecturer)
Dr. Hiroko Kato (Research Fellow)
Dr. Jinsong Leng (Research Fellow)
Mr David Zhang (Sessional Lecturer)
Mr Aiden Sehovic (Honours student and casual research assistant)
Ms Khumphicha Tantisantisom (DIT student)
Mr Hasham al Musawi (DIT student)
Mr Yunous Vagh (PhD student)

NEW GRANTS (Identify Funding Body, Value of grant, Years funded, Chief Investigator, collaborators, title)

- 1) Edith Cowan University Research Infrastructure Block Grant 2010 (\$45 000) Funded: 2010
Multi terabyte computer array
Chief Investigator: Dr Leisa Armstrong

This terabyte array provides a dedicated secure data storage for extremely large data sets which are being used for data mining and image processing research activities; provide high speed access data storage for access to the SCSS research cluster and iVEC High Powered Computing facilities; and provide the capability of storing the results of data mining processes and storage of large sample data mining data and image processing data sets for use by researchers and postgraduate students;

- 2) iVEC Negotiated Project (\$31467 + in kind support) Funded 2011 to 2012

Title : Evaluate methodologies for eAgriculture in Western Australia

Chief Investigator Dr Leisa Armstrong ,

Collaborators : Moora Milling Pasture Improvement group and iVEC

This project aims to explain the variability seen in crop varieties grown with Western Australia, by applying data mining techniques and tools to information which is publicly available to growers; and identifying the major sources of variability. Simulations will then be carried out to identify the characteristics of the variability-sources and results incorporated into the findings from the data mining activities. This project aims to evaluate current eAgriculture methodologies for their application in Western Australia agricultural industry. It is a subset of a larger project and will deliver knowledge on ways in which the application of eAgriculture and associated data mining techniques may benefit Western Australian grain growers.

- 3) Nortel Development Grant Scheme (\$25 000) Funded 2009 continuing

Title : "Wireless Mesh Networks for grain food laboratory" since 2009

Chief Investigators Dr Leisa Armstrong and Mr Dean Diepeveen (DAFWA collaborator)

This project aims to investigate the potential of using wireless mesh networks to improve the processes in an agriculture science laboratory. The project also aims to determine what constraints in the data collection process may be overcome through the implementation of a wireless mesh network. The project will also assess the usability of the proposed system by

conducting a focus group study of grain laboratory technicians. It is envisaged that such a system could be implemented in other agricultural and plant laboratories.

- 4) Media Lab Asia Rs. 5.50 lakhs (\$14 000) 2010-2011
Title eSaguGGK -Deploying eSagu at Gramin Gyan Kendra
Chief Investigator Prof. P. Krishna Reddy
Collaborators GGK, Benares Hindu University, Varanasi
- 5) Govt. of India, Ministry of Earth Sciences, India Meteorological Department, Agromet Service Cell, Lodi Road, New Delhi -110003
Total - Rs. 74,33,000 (\$16 000) 2010 –to 2012
Chief Investigator Prof. P. Krishna Reddy
- 6) Environmental Trust Research Grant application for the category of Integrated Landscape Management Category in the Seeding Program \$13,800
A decision support system for catchment planning proposed project 1 July to 1 February 2012.
Chief Investigator Dr Neil Dunstan (submitted)

PUBLICATIONS, REFERRED BOOKS, CHAPTERS, JOURNAL ARTICLES, CONFERENCE PAPERS, REPORTS

Book Chapters

Dunstan N., (2010). ET: an Enrolment Tool to generate expert systems for university courses, in "Expert Systems", editor P. Vitureanu, INTECH, Croatia, 2010, pp 36-46, ISBN 978-953-307-032-2

Dunstan N., (2010). Domain-wide expert system applications, in, "Expert System Software: Engineering, Advantages and Applications", editors Reiter and Segura, NOVA Science Publishers, USA, 2011, ISBN 9781612091143

Journal Articles

Armstrong, L.J., Diepeveen, D.A., Tantisantisom, K. (2010). An eAgriculture-based decision support framework for Information dissemination *International Journal of Human Capital and Information Technology Professionals (IJHCITP)* <http://igi-global.com/Bookstore/Article.aspx?TitleId=48204>

Diepeveen D., Clarke. P., Ryan, K., Tarr, A., Ma, W. Appels, R. (2010). "NIR spectra of flour samples from a structured population of wheat lines: mapping genetic components of NIR spectra" Accepted by *Journal of Cereal Science*. Ref: JCS10-395 <http://ees.elsevier.com/yjcrs/>

Elund, J., Clayden, J., & Green, L. (2010). Getting to know your avatar in *Second Life*, *Australian Journal of Communication*, 37(2), 73-86.

Hickey, J. M. Kinghorn, B. P. Tier, B. Wilson J. F. and Dunstan N., (2011). A combined long range phasing and long haplotype imputation method to phase SNP genotypes, *Genetics Selection Evolution* 2011, 43:12

Leng J., Lim C. P., Li J., Li D., and Jain L.C. (2010). A role-based cognitive architecture for multiagent teaming. In *Agent and Multi-agent Technology for Internet and Enterprise Systems*, number 289 in *Studies in Computational Intelligence*, pages 229–255. Springer, Heidelberg, 2010.

Leng J. and Peng C. P. (2011) Reinforcement learning of competitive and cooperative skills in soccer agents. *Applied Soft Computing*, 11:1353–1362, 2011.

Leng J. and Hong T. P. (2010) Mining outliers in correlated subspaces for high dimensional data sets. *Fundamenta Informaticae*, 99:71–86, 2010.

Leng J and Huang Z. (2010). Outliers detection with correlated subspaces for high dimensional datasets. *International Journal of Wavelets, Multi resolution and Information Processing*, 9:227–236, 2010.

Uday Kiran, R., Krishna Reddy, P. , Kumara Swamy, M. ,and Syamasundar Reddy, G., (2010). Analysing Dynamics of Crop Problems by Applying Text Analysis Methods on Farm Advisory Data of eSaguTM, *International Journal of Computational Science and Engineering (IJCSE)*, vol. 5, No.2, 2010, pp. 154-164, Inter Science Publishers.

Conference Proceedings:

Armstrong L. J. & Clayden J., (Eds.) Proceedings of the Knowledge Discovery for Rural Systems Workshop 2010, IIIT Hyderabad, Hyderabad India, 21st June 2010 the *14th Pacific-Asia Conference on Knowledge Discovery and Data Mining*.

Conference papers

Adinarayana, J (2011). Can ICT help Farmers Information Needs? National Workshop on ICT in Agriculture: Gaps and Way Forward, NIRD-MLA-ANGRAU, Hyderabad, 25.03.2011

Adinarayana, J., (2010). GeoSense (Geo-ICT and Sensor Network) Server in meeting the information needs for precision agriculture National Workshop on “Information Needs of Indian Farmers”, 29-30.11.2010, ANGRAU/NIRD/MLA, Hyderabad.

Adinarayana, J. Khire, M.V. Sudharsan, D Tripathy, A K.. Jose, A., Kodilkar, karandikar, Udai B Desai, Merchant, Naveen CPRG, N. Namdeo, Devasekhar, Ninomiya, Hirafuji, Kiura, Futkatsu, Tanaka, Hideo Yoichi, Yugo Miki. (2010). GeoSense (Geo-ICT and Sensor Network) Initiative in Precision Agriculture International Conference of the Asian Federation for Information Technology in Agriculture (AFITA 2010), 03-07 October 2010, Bogar, Indonesia. (*Through Video-Conferencing*) (http://www.afita.org/view.php?id=20110221172739_528499)

Adinarayana., J (2010). GeoSense – GeoICT and Semsor Network initiative in precision agriculture International Workshop on Knowledge Discovery for Rural Systems (KDRS'2010) in conjunction with 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD-2010), 21-24 June, Hyderabad, India (<http://sites.google.com/site/kdfforruralsystems/home>)

Bhargav S., and Krishna Reddy, P. (2010). *A framework to identify temperature-based suitable crop cultivation period using sliding window approach*, in proceedings of the Workshop on Knowledge Discovery for Rural Systems 2010 (KDRS2010), 21 June 2010, Hyderabad, India (held in conjunction with PAKDD2010).

Diepeveen, D., Clarke, P., Bellgard, M., Appels R. (2010). *Understanding the genetic components of NIR spectra*. http://www.promaco.com.au/2010/asc/asc_ozcots_program.pdf

Dunstan N., (2010). *Data mining techniques for land use catchment planning*. Proceedings of the Knowledge Discovery for Rural Systems Workshop 2010 IIIT Hyderabad, Hyderabad India, 21st June 2010 p23

Denman, B. and Dunstan, N. (2010). *Education for all and cross-border provision of higher education in the asia-pacific*. World Congress of Comparative Education Societies, Istanbul, June, 2010.

Huang Z. and Leng J. (2010). *Analysis of hu's moment invariants on image scaling and rotation*. In Proceedings of the 2nd International Conference on Computer Engineering and Technology, pages 476–480, 2010.

Huang Z. and Leng J. (2010). A novel binarization algorithm for ballistics imaging systems. In Proceedings of the 3rd International Congress on Image and Signal Processing, pages 1287–1291, 2010.

Huang Z. and Leng J. (2010). *An online ballistics imaging system for firearm identification*. In Proceedings of the 2nd International Conference on Signal Processing Systems, pages 68–72, 2010.

Kardikar, K. Adinarayana, J. Tripathy, A. K. Sudharsan, D. Kodilkar, A. Desai, U. B. Merchant, S. N. Tanaka, K. Ninomiya, S. Kiura T., Hirafuji, M. Raji Reddy, D. and Sreenivas; G. (2011). Energy Balance and Weather Profile Studies using Sensor Network based Flux Tower – A preliminary Approach (Conference on Geospatial Technologies and Its Application (Geomatrix'11) 26-27 February 2011, IIT Bombay, India, Pp: 97-107.

Leng J. (2010). *A novel subspace outlier detection approach in high dimensional data sets*. In Proceedings of the 3rd International Conference on Computer and Electrical Engineering, pages 162–165. IEEE Press, 2010.

Leng J., Huang Z., and Li D. (2010). *Analyzing features of cartridge cases for ballistics recognition*. In Proceedings of the 14th International Conference on Image Processing, Computer Vision, and Pattern Recognition, pages 720 –725, 2010.

Leng J., Huang Z., and Li D. (2010). *Features extraction and classification of cartridge images for ballistics identification*. In Proceedings of the 23rd international conference on Industrial engineering and other applications of applied intelligent systems, IEA/AIE'10, pages 331–340, Berlin, Heidelberg, 2010. Springer-Verlag. 9.

Leng J., Huang Z., and Li D. (2010). *A novel approach for identifying firearms with ballistic projectile images*. In Proceedings of the 14th International Conference on Image Processing, Computer Vision, and Pattern Recognition, pages 774 – 748, 2010.

Leng J., Valli C., and Armstrong L. (2010). *A wrapper-based feature selection for analysis of large data set*. In Proceedings of the 3rd International Conference on Computer and Electrical Engineering, pages 166 – 170. IEEE Press, 2010.

Sehovic, A. Armstrong L.J. , Diepeveen D.A. (2010). *Interrogation of water catchment data sets using data mining techniques*. in Editors: L.J. Armstrong and J. Clayden "Proceedings of the Knowledge Discovery for Rural Systems Workshop 2010" p35 at the 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining., IIIT Hyderabad, Hyderabad India , 21-24 June, 2010 - Hyderabad, India.

Sudharsan, D. Adinarayana, J. Tripathy, A. K. Naveen, CPRG Desai, U. B. Merchant, S. N. Tanaka, K. Ninomiya, S. Kiura, T. Hirafuji, M. Raji Reddy, D. and Sreenivas, G. (2011). ICT & WSN based Dynamic Real-time Precision Agricultural system Conference on Geospatial Technologies and Its Application (Geomatrix'11), 26 to 27 February 2011, IIT Bombay, India.

Sudharsan, D. Adinarayana, J. Tripathy A. K., Naveen CPRG., Desai, , U. B. Merchant, S. N. Tanaka, K. Ninomiya, S. Kiura, T. Hirafuji, M. Raji Reddy, D. and Sreenivas, G. (2010). Dynamic Simulation and

Comparison of Rice Growth and Yield Prediction by Wireless Sensor Network Technology 3rd International Rice Congress, 08-12.11.2010, Hanoi, Vietnam. Pp 10-15,
<http://ricecongress.com/pdflink/4254.pdf>).

Sudharsan D., Adinarayana, J. Desai, U. B. Merchant, S. N..Khire, M.V Tripathy, A. K., Kodilkar A, Ninomiya, S. Hirafuji, M. Kiura, T. Tanaka, K. Fukatsu, Raji Reddy T. Sreenivas D, and Vijayalakshmi, (2010) .Geo-ICT and Sensor Network based Decision Support Systems in Agriculture and Environment Assessment Summer School on The Global Governance of Climate Engineering, 12-16.07.2010, Max-Plank Institute Heidelberg, Germany (<http://www.climate-engineering.uni-hd.de/events/mkss.html>)

Sudharsan, D. Adinarayana, J. Desai, U. B. Merchant, S. N. Khire, M.V.. Tripathy, A. K Naveen, CPRG Kodilkar, A. Ninomiya, S. Hirafuji, M. Kiura, T. Tanaka, K. Fukatsu, T. Raji Reddy Sreenivas D, and Vijayalakshmi (2010) Geo-ICT and Sensor Networks in Rural Systems MGNREGA workshop, 14.05.2010, NIRD, Hyderabad, India

Tripathy A.K. , Adinarayana J., Vijayalaxmi, K., Raji Reddy., Desai U.B., Merchant S.N., Sudharsan D., Naveen CPRG., Kodilkar A.K. Ninomiya S., Hirafuji M., Kiura T., Tanaka K., (2010). Towards Crop-Pest/Disease-Weather Interactions through Data Mining Techniques International Workshop on Knowledge Discovery for Rural Systems (KDRS'2010) in conjunction with 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining (PAKDD-2010), 21-24 June, Hyderabad, India (<http://sites.google.com/site/kdforruralsystems/home>)

Tripathy A.T., Adinarayana, J. Sudharsan, D. Kodilkar, A. Karandikar, K. Desai U. B Merchant, S. N.. Vijayalaxmi, K Sreenivas G. and Raji Reddy, D. Tanaka, K. Kiura, T. Ninomiya, S. and M. Hirafuzi; (2011) Data Mining for Knowledge Extraction in Agriculture Pest/Disease Management Conference on Geospatial Technologies and Its Application (Geomatrix'11) 26-27 February 2011, IIT Bombay, India, Pp: 44-52.

Vagh Y., Armstrong L.J. , Diepeveen D.A. (2010). *Application of a data mining framework for the identification of agricultural production areas in WA* in Editors: L. J. Armstrong and J. Clayden "Proceedings of the Knowledge Discovery for Rural Systems Workshop 2010" at the 14th Pacific-Asia Conference on Knowledge Discovery and Data Mining., IIIT Hyderabad, Hyderabad India , 21-24 June, 2010 - Hyderabad, India.

HIGHER DEGREE BY RESEARCH LOAD (list name of candidate and degree type)

Name: Ms Hasham Al Musawi

Degree :DIT

Title: Investigation of the provision of agricultural learning resources: A comparative study within Western Australia

Status : Proposal to be completed by June 2011

ECU: Dr L. Armstrong and Dr J. Clayden

Ms Khumphicha Tantisantisom

Degree: DIT

Title: Information Dissemination in Multiple Formats for Farming Communities in Thailand

Status: Thesis to be submitted by Aug 2011

ECU: Dr L. Armstrong and Dr J. Clayden

Name : Mr Yunous Vagh

Degree: PhD

Title: Developing a data mining framework for the investigation of agricultural and land use production data – a Western Australian perspective.

Status: proposal passed

ECU Dr L. Armstrong and Mr D. Diepeveen

Name: R. Uday Kiran

Degree: PhD

Thesis title: Improved Multiple Minimum Support Based Approaches to Mine Frequent Patterns

Status: Thesis Proposal Defended and to be completed by May 2011

IIIT Hyderabad (Professor Krishna Reddy)

Name: Mohit Goyal

Degree: MS by Research

Title: Extending Speculation to Process Distributed Read-only transactions and Analysis of SEmantics-based Read-only Transaction Processing Protocols with Benchmarks

Status: Thesis submitted

IIIT Hyderabad (Professor Krishna Reddy)

Name: S. Bhargav

Degree: MS by Research

Title: Discovering Coverage Patterns From Click stream Data For Banner Advertisement Placement

Status: Thesis submitted.

IIIT Hyderabad (Professor Krishna Reddy)

Name: Sushanta Kumar

Degree: MS by Research

Title: Finding Similar Judgements

Status: Thesis under preparation.

IIIT Hyderabad (Professor Krishna Reddy)

Name: Abhishek Sainani

Degree: MS by Research

Title: Improved labelling approach for short text documents.

Status: Thesis under preparation Status: Thesis proposal submitted.

IIIT Hyderabad (Professor Krishna Reddy)

HIGHER DEGREE BY RESEARCH COMPLETIONS (List name, degree, title of thesis)

Name: O. Harsh,

Degree: PhD

Title Knowledge Reuse and Management in Information Systems, completed 2011 Neil Dunstan (co supervisor)

UNE (Dr Neil Dunstan)

Name: T. Ragunathan

Degree: PhD

PhD Thesis Title: Speculation-based protocols for improving the performance of read-only transactions, November 2010.

IIIT Hyderabad (Professor Krishna Reddy)

Name: Sumit Maheswari

Degree: MS by Research

MS Thesis Title: Mining Special Features to Improve the Performance of Product Selection in E-commerce Environment and Resume Extraction System, March 2010.

IIIT Hyderabad (Professor Krishna Reddy)

Name: M.Kumaraswamy
Degree: MS by Research
MS Thesis Title: An Improved Context-based User Interface by Exploiting Temporality of Attributes for Desktop and Small Screens, April 2010.
IIIT Hyderabad (Professor Krishna Reddy)

Name: Gaurav Ruhela
Degree: MS by Research
MS Thesis Title: Exploring Open Web Directory for Improving the Performance of Text Document Clustering, May 2010.
IIIT Hyderabad (Professor Krishna Reddy)

VISITORS AND COLLABORATIONS (List the organisation's name and short summary of the nature of the collaboration. Separate into local, national and international)

Australia

- *Department of Agriculture Western Australia.*
Collaborating with Mr Dean Diepeveen on research related to projects including eAgriculture and data mining and geospatial techniques, wireless mesh networks project, and agricultural dissemination. Mr Diepeveen is also an associate supervisor of Yunous Vagh and Aiden Sehovic. Also collaborating with Phil Gould from the GIS, which is providing GIS and land data sets for our research group. We also have a linkage with Dr Mohammad Hamza in respect to his assistance with one DIT student project.
- *University of New England*
Dr Neil Dunstan has been collaborating and we have produced a co-authored paper for the international workshop that our group convened.
- *Australian National University*
Dr Barry Croke has visited in December 2010 in discussions with Professor Geoff Syme as to possible collaborative project related to agricultural data mining project with Indian collaborators as part of an ACIAR research grant.
- *Western Australian Agricultural Industry*
We have become aligned with the Grower Group Alliance in Western Australia. Dr Armstrong attended the annual general meeting and conference of the GGA in 2010.
- *Moora Milling Pasture Improvement Group:*
This farmer group is the industry partner on our iVEC industry grant. We have visited the group's annual field day in September. The president Mr Tony White has visited our research labs a number of times to meet with the members of our research group. Mr Tony White has agreed to chair a industry consultative committee that is to be formed in 2011 for the eAgriculture research group

International

Thailand:

- *Khon Kaen University*
A research project is ongoing with Dr Niwat Martwanna from Khon Kaen University on the use of ICT to improve the dissemination of information to agricultural government workers in

Northern Thailand. I recently led a ECU delagation to Northern Thailand region to investigate application of ICT technologies to improve rural livelihoods of Thai farmers . A workshop was conducted in November 2010 with more than 50 government officers, researchers and local farmers as part of this research workhop.

- *Kasetsart University and Thailand National AGRIS Centre Thailand*
Other research collaborations have also been forged with Kasetsart University, including the Thailand National AGRIS Centre Thailand with Dr Aree Thunkijjanukij and with IT researcher Dr Asanee Kawtrakul . As yet these have only been discusion on possible research projects. More linkages wil be forged with these groups in 2012.
- *2 Farming Villages in Phrae province, Thailand*
As part of a DIT project, Dr Armstrong, Clayden and their doctoral student have been working with 2 villages on the use of mobile phones to disseminate agricultural information. Research activities are expected to continue with these farming groups into 2012.

India:

- *Various universities and research centres*
- IIT Bombay, IIIT Hyderabad, NCAP, Delhi, ICAR, Delhi, University of Mumbai, and Osmania University
- Collaborations with researchers in India have developed through a number of visits to IIT Bombay (Ass. Prof. Adinaryana) and IIIT Hyderabad (Prof. P. Krishna Reddy) and Dr Rajni Jain at NCAP, Delhi and Dr Alka Arora at ICAR, in Delhi and University of Mumbai and Osmania University.

Working with organisations such as the Indian Institute of Technology Bombay Indian, IIIT Hyderabad, National Centre for Agricultural Economics and Policy Research., Delhi and the University of Mumbai, the research looks at a range of different areas including agricultural sustainability, integrating leading edge technologies to monitor and model agricultural production, precision agriculture and the use of data mining to improve agricultural productivity and rural livelihoods. The research group has conducted a number of research workshops in India with these researchers in the area of agricultural data mining, wireless sensor networks and agricultural informatics.

Dr Armstrong and the eAgriculture group has established projects with researchers from these institution on how data mining and other technologies can be used to improve agricultural systems management, food security and response to climate change. Their research, like all other collaborations, is expected to result in important findings in their field. Dr Armstrong also visited IASRI, IIIT Hyderabad, Osmania University, IIT Bombay and University of Mumbai. We have also had visits from international researchers including Sreedhar Acharya from International Water Management Institute in November 2010, who interacting with members of the research group and postgraduate students. Other research collaborations by Professor Krishna Reddy include Media Lab Asia, New Delhi a Govt. of India, Ministry of Earth Sciences, India Meteorological Department, Agromet Service Cell, Dehli.

COMMUNITY ENGAGEMENT ACTIVITIES AND LINKAGES (Provide a brief overview of any significant activity)

The eAgriculture Research group has participated in the following community engagement activities locally in Western Australia and internationally including:

Western Australia

- Participation in the Moora Milling Pasture Improvement group annual field day. Presentations in ECU research week, and ML and JO open days.
- We have also participated in activities run by the Grower Group Alliance including their annual conference workshop.
- We have also attended various seminars and presentations within that Agricultural research community and through iVEC high powered computing centre
- Other activities have involved interactions with students from Narrogin Agricultural College students to visit or eAgriculture research laboratories at SCSS.

International

Thailand

- In Thailand we have visited farming communities, participated in land mitigation tree planting ceremonies, different farmer groups, agricultural extension offices and other government initiatives. A delegation from our research group was hosted by the Phrae District government.
- In the Khon Kaen region we have visited a number of farmers and farmer groups, community radio station and other district offices. We have also run an industry workshop for more that 50 agricultural industry people at Khon Kaen University.

India

- In India, we have had a number of engagement activities with the IT sector and agricultural sector. Members of the eAgriculture research group were part of the recent India ambassador program and visited a number of IT companies and agricultural research centres in Delhi, Hyderabad, and Mumbai.
- The eAgriculture research group convened a workshop at PAKDD2010 conference in Hyderabad which had more that 60 participants from agricultural and it industry government officers and private industry from across India. Visits have also been made to ICRISAT and IWMI agricultural research centres in Hyderabad
- *Professor Krishna Reddy:* Developing eSagu system (which is an IT-based personalized agricultural advisory system) since 2004. The objective of eSagu system is to deliver a quality agricultural expert advice by considering farm as unit. The advice is provided at regular intervals to each farm. Investigations are going on to enable agricultural experts to improve both quality and efficiency of advice delivery in eSagu by building tools to provide different kinds of information. The eAquaSagu System has been built and operated to deliver timely expert advice to fish farmers. The impact study results show significant benefits have been accrued to farming community. An eAgriclinic software has been built which allows the professor to give the farm problem cases (text, photos, and video) to the students. Efforts are being made to develop an IT-based agromet advisory system in collaboration with Indian Meteorological department/ Ministry of Earth Sciences. Efforts are being make to develop "eVet: An IT-based Advisory System for Livestock Management" using eSagu paradigm. Encouraged by the results and benefits of eSagu system, we are making efforts with Media Lab Asia to develop an integrated agricultural service program (IASP). Under IASP, along with agricultural advisory service, other services such as input, finance, insurance and marketing will be provided to the farmers for more profitability and inclusive economic development. A new diploma course "Post-graduate Diploma in Applied Agriculture and Information Technology (PGDAAIT)" has started to impart applied agriculture skills to the agriculture students.

- Indian IT Sector: Dr Armstrong and 4 students from eAgriculture research group visited a number of IT companies and agricultural research institutes as part of the Student Ambassador Program to India 2010. Visits include companies such as Infosys, NASSCOM, Aricent, EvalueServer, Zensar Technologies, Datamatics Financial Services.

FUTURE PLANS AND DIRECTION (Provide an overview)

The future plans for the eAgriculture group are to continue with the development of the research group to a point where we can be established as a Level 2 centre. This will be geared around the following:

- The development of research capabilities and infrastructure for the staff and postgraduate students working in the research group. This includes the acquisition of agricultural data sets for research and the high powered computing capacity for geospatial data mining
- The group is working towards producing higher quality research outputs which will lead to greater percentage of publication in journals.
- Establish Agricultural industry linkages with strategic groups in Western Australia to obtain Grains Research and Development Corporation funding. The Moora/Milling Pasture Improvement group is the main focus of this activity. The successful completion of the iVEC industry project aims and to use these findings and research output will be used for the application of a GRDC grant.
- To strengthen the international collaborations with research partners which will lead to research projects that can be used to leverage for international collaboration grants
 - in Thailand with a view to submitting ACIAR and AUS Aid projects grant proposals with KKU, Thailand group; and
 - in India an ACIAR project grant Australia India strategic research fund grant proposal with colleagues at IIT Bombay, IIIT Hyderabad and NCAP, Delhi and other collaborating research centres in India
- To improve the national and international reputation of the eAgriculture Research group through the following activities
 - Our long term plans include the establishment of a dedicated journal to be published through our research group and the establishment of an eAgriculture society for the Australia Pacific.
 - To conduct the AFITA 2014 Conference in Perth in 2014. Conference bid proposal has been submitted for consideration
 - Conducting of an annual eAgriculture peer reviewed research workshop.
 - Greater staff exchanges and visiting fellowships for both members of the eAgriculture to visit research colleagues on Thailand and India and for those colleagues to visit ECU.
 - Greater linkages with collaborating research groups and the co supervision of research masters and PhD students in the field of eAgriculture
 - The development a postgraduate course in the area of eAgriculture and the publication of a text book on eAgriculture.

Dr Armstrong will be on academic study leave in the first half of 2012. This will provide the group with the avenue to achieve these goals in the next few years.

DATE OF NEXT FORMAL REVIEW