

**WESTERN SYDNEY
UNIVERSITY**



Global Centre for
Land-Based Innovation

GLOBAL ACHIEVEMENTS 2015–2016

RESEARCH. KNOWLEDGE TRANSFER. INNOVATION.

The primary purpose of the Global Centre for Land-Based Innovation is to uncover the enormous value that lies in the world's scientific research and connect the knowledge within to address specific agricultural and ecological issues in an integrated manner.

Our collaborations from across the globe – with China, the UK, Spain and India have culminated this year in **engaging with the farming community and policy advisors about the benefits of improving soil health; harnessing plant-soil-microbial interactions to increase farm productivity;** exploring key approaches to the functions of microbial dark matters; and fellow researchers and other industry stakeholders joining at the Global Centre to further their training, research, studies and skills.

The opportunity of the Global Centre lies in its connected, collaborative and internationally-focussed approach – finding solutions and delivering management frameworks that are proven to deliver successful outcomes in today's complex operating environments.

The Global Centre invites you to take a closer look at our approach, our capabilities and the opportunities available to address today's pressing issues and deliver a safer future for the world of tomorrow.



Professor Brajesh Singh
Director Global Centre for Land-Based Innovation



THE GLOBAL CENTRE FOR LAND-BASED INNOVATION

OUR INTEGRATED RESEARCH AND INNOVATION FRAMEWORKS HELP INDUSTRIES AND POLICYMAKERS TO MAKE BETTER DECISIONS AND PROMOTE AGRICULTURAL AND ENVIRONMENTAL RESILIENCE BY UNLOCKING KNOWLEDGE, INNOVATION AND VALUE FROM RESEARCH.

Worldwide demand for food and fibre is growing—driven by population growth, changing diets, wealth and, increasingly the diversion of more food crops and land to biofuel production. Additionally in the Asia-Pacific, farm productivity has gone into structural decline and further farm inputs no longer translate into increased yields.

If these trends continue, farm profitability and global food security will be severely impacted. An innovative, multi-disciplinary, and collaborative approach is urgently needed to increase productivity and manage our natural resources for sustainable delivery of food, fibre and biofuels now, and into the future. Climate variability and extreme weather events can further compromise farm productivity and food security. The Centre's partnerships with experts, affiliated scientists and emerging leaders from across the Asia-Pacific region provide an innovative hub to tackle the earth's food security challenges working with industries, policy advisors and global experts.

The mission of the Global Centre is to create and disseminate innovative solutions and evidence-based approaches to promote farm productivity, food security and environmental sustainability.

INNOVATION PARTNERS

- Western Sydney University
- Chinese Academy of Sciences, Research Centre for Eco-environmental Sciences
- Chinese Academy of Science, Institute of Urban Environment
- Tamil Naidu Agriculture University, India





SOIL HEALTH KNOWLEDGE MEETS PRACTICE IN AUSTRALIA'S FARMING HEARTLAND

On October 12th & 13th 2015, the Global Centre held a successful workshop about soil health management practices in Narrabri, to engage with the farming community about the benefits of improving soil health.

A group of Australian and internationally-based scientists met with industry participants to share methods and advances in soil health technologies and practices that influence ongoing soil health and productivity.



Prof Karl Ritz

“These rhizosphere and soil health workshops are essential to increasing productivity and maintaining the resilience of farming systems, but also to keep industries updated on the status of research knowledge and how this can be harnessed in the future.”

Allan Williams - Cotton Research and Development Corporation Program Manager



Finding ways to capture the benefits from plant-microbe relationships in soils could lead to major improvements in agricultural productivity.



Prof Richard Bardgett

HARNESSING THE POWER OF THE SOIL'S RHIZOSPHERE

The rhizosphere is the region directly surrounding plant roots. Bacteria and fungi contained within the rhizosphere are directly linked to plant productivity.

A bi-directional dialogue occurs where plants provide carbon to the rhizosphere microbes, and microbes in turn provide access to nutrients (including nitrogen and phosphorus) and resistance to soil-borne diseases.

The Global Centre hosted an international workshop on harnessing these rhizosphere-soil-microbial interactions to increase crop productivity. This workshop was partly supported by the Cotton Research and Development Corporation (CRDC) with an international cast of expert academics from the US, UK, the Netherlands, China and Australia.

MINING MICROBIAL DARK MATTERS FOR FARM PRODUCTIVITY AND ENVIRONMENTAL SUSTAINABILITY

This workshop, with a backdrop of snow falling in Leura, identified the key approaches to determining the roles and functions of microbial communities which cannot be grown in laboratory conditions so that they can be used in agricultural and environmental applications.

A photograph of a field of green plants, likely a crop field, with a purple overlay. The plants are arranged in rows and are growing in a field. The text is overlaid on the bottom left of the image.

INDUSTRY INNOVATION AND SOLUTIONS



Cotton at Narrabri



Keeping carbon in the soil is essential to maintaining soil health.



Dr Kelly Hamonts (second from right) is leading the YCS project.

MANAGEMENT TOOLS TO IMPROVE COTTON FARM ADAPTATION TO CLIMATE

Working alongside CSIRO, the Global Centre has provided new knowledge on the impact of climate change and extreme weather events on cotton productivity and recommended solutions for adaptation (CRDC-funded research).

IMPROVE SOIL HEALTH AND CARBON CONTENT FOR ENHANCED PRODUCTIVITY IN GRAIN FARMS

Soil carbon is a key ingredient for farm productivity. In collaboration with NSW DPI and WANTFA, the Global Centre has recently identified management practices which promote soil carbon (C) storage in grain farming systems.

For example, we provide evidence that residue retentions can increase level of labile C in soil which fuels nutrient cycling and enhances productivity.

SOLVING THE MYSTERY OF YELLOW CANOPY SYNDROME IN SUGARCANE

Yellow Canopy Syndrome is a widely-occurring syndrome that affects sugarcane in northern Queensland. Its cause is unknown and it results in a range of symptoms from leaf yellowing, plant weakness, lowered sugar levels and reduced yields.

The Global Centre is working with Sugar Research Australia and CSIRO to conduct analyses on the plants, soil and cropping environments, using genetic and chemical tests to diagnose the cause. While a number of factors have been ruled out, the rapid spread of YCS is still of major concern in Australia as it spreads into new regions and potentially new species beyond sugarcane.

Dr Cuijing Zhang



**TRAINING
AND
CAPACITY-
BUILDING**

DR CUIJING ZHANG – CHINESE ACADEMY OF SCIENCES

Cuijing Zhang has worked at the Global Centre for 12 months through her fellowship from the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences. During her stay, Cuijing has worked on a project to examine the impact of climate change on soil microbial communities and its consequences for farm productivity and environmental sustainability.

DR SANGEETA LANKA - INDIAN INSTITUTE OF SOIL SCIENCE

Dr Sangeeta Lenka from India trained at the Global Centre for six months during 2015 on how climate change impacts on soil carbon and health. Her expertise lies on how climate change impacts crop productivity, the effects of tillage on soil organic carbon dynamics and the resilience of soils to organic carbon depletion.

CONCEPCION CANO DIAZ - UNIVERSIDAD REY JUAN CARLOS

PhD student Concepción Cano Díaz from Universidad Rey Juan Carlos trained at the Global Centre on how to analyse genomics data to link biodiversity with ecosystem function.

ANGELA LAFUENTE - UNIVERSIDAD REY JUAN CARLOS

PhD student Angela Lafuente from Universidad Rey Juan Carlos recently spent three months at the Global Centre's labs to study the response of biodiversity and ecosystem functions to climate change in dryland ecosystems.

“I had a great time working with you and I also had time to enjoy Australia. Thank you!”



Angela LaFuente



TRAINING COURSE IN CHINA

The Global Centre's Emerging Leader Dr Tom Jeffries contributed to a training course on bioinformatics analysis organised in Beijing.



SOIL HEALTH WORKSHOP

Held in Ningbo, China, the workshop was organised on soil health hosted by Prof Yongguan Zhu at the Urban Environment Observation and Research Station of the Chinese Academy of Sciences.



WORKSHOP ON MICROBIAL ECOLOGY

Prof Brajesh Singh, Prof Ian Anderson and emerging leaders Dr Kelly Hamonts, Dr Barbara Drigo and Dr Tom Jeffries contributed to the workshop on microbial ecology organised by Global Centre partner, the Chinese Academy of Sciences in Beijing, China.



TRAINING FOR FARMERS AND CONSULTANTS

The Global Centre conducts annual workshops in cropping regions on the topic of soil health. The inaugural Soil Health Workshop was held at Narrabri, NSW, to focus on the opportunities that improving soil health can have on farm sustainability, productivity and profitability.



GLOBAL SOIL BIODIVERSITY ATLAS



GLOBAL
SOIL BIODIVERSITY
INITIATIVE

GLOBAL SOIL BIODIVERSITY ATLAS

Multiple scientists from the Global Centre contributed chapters to the newly-released Global Soil Biodiversity Atlas (funded and supported by the EU), which was co-edited by the Global Centre Director, Prof Brajesh Singh. This document is now launched with the aim of influencing policy decisions on soil conservation and soil biodiversity for a sustainable Earth.

Other contributors from the Global Centre included:

- Dr Uffe Nielsen
- Dr Pankaj Trivedi
- Dr Catriona Macdonald

GLOBAL FORUM FOR INNOVATION IN AGRICULTURE

The Global Centre has recently provided scientific support for this key international event attended by multiple governments and UN organisation.



EU PHYTOMICROBIOME AND INTERNATIONAL BIECONOMY FORUM

The Global Centre is providing expert advice on these two large initiatives for sustainable increases in farm productivity, food security and economic growth of participating countries.

EXPLORING RESEARCH COLLABORATIONS BETWEEN INDIA AND AUSTRALIA

India represents a major export market opportunity for Australia and the Global Centre is leading the development of research links between universities and researchers in each country.



POLICY ENGAGEMENT

MEDIA ENGAGEMENT



GLOBAL CENTRE INTERVIEW FEATURE ON DIGITAL FARM TV

Digital Farm TV is an online news platform for agriculture and agribusiness that provides weekly rural news and innovation reports in high-resolution video. They also provide a platform for industry to maintain an in-depth conversation with key stakeholders, food and fabric consumers and government agencies.



Digital Farm TV has twice run bulletins on the Global Centre's mission and activities, highlighting impacts the Global Centre's research efforts on farm productivity and sustainability.

COTTON AND SUGAR CANE INDUSTRY MEDIA RECOGNITION

Recent media coverage has included updates on research into the challenging Yellow Cane Syndrome issue in Queensland Sugarcane and industry updates issued by Sugar Research Australia to its members.

Australian Cottongrower and the Cotton Research and Development Corporation's industry publication Spotlight also ran features on the new cotton climate change chambers and soil health workshop at Narrabri.



**CLIMATE CHANGE AND
COTTON PRODUCTION IN
MODERN FARMING SYSTEMS**

ICAC Review Articles on Cotton Production Research No. 6



M. P. BANGE, J. T. TRAKER, P. J. BATH, K. J. BROUGHTON, G. A. CONNOR, A. Q. LIU,
S. M. DOOTENBERG, Y. GRANG, P. INCTON, S. T. THORP, K. S. BEERY AND R. R. SPURGE

**NEW BOOK ON COTTON
UNDER CLIMATE CHANGE
SETS OUT LATEST
RESEARCH**

Researchers from the Global Centre have contributed to a new best-practice guide that considers the latest research into cotton production under a rapidly changing climate, integrating research findings from experiments at Hawkesbury and Narrabri in NSW.

Designed to give the cotton industry new insights and methods for producing and harvesting cotton under more extreme climates, the guide has attracted worldwide interest and reflects the excellence of Australia's cotton science in collaborations between CSIRO, Western Sydney University and other partners.

Global Centre authors include Dr Yui Osanai, Prof Brajesh Singh and Prof David Tissue with collaborators Dr Mike Bange of CSIRO and Katie Broughton (PhD candidate).

A/Prof Sathaa A Sathasivan and Professor Brajesh Singh from the Global Centre for Land-Based Innovation are working to improve our ability to disinfect the drinking water supplies of more than seven million Australians in a new ARC Linkage project, “Smart Management of Disinfectant in Chloraminated Water Supplies”.

PROJECT SUCCESSSES

ARC LINKAGE: SMART MANAGEMENT OF DISINFECTANT IN CHLORAMINATED WATER SUPPLIES

Providing consistently safe and reliable drinking water is one of the essential needs of public service utilities. Ensuring that water is supplied continuously to extremely high standards of cleanliness is far more complex than most people realise and involves the ongoing management of water storages and intensive disinfection using a range of chemical and physical methods.

One of the main disinfecting agents used is chloramine, a compound similar to chlorine but with the addition of ammonia. In fact, that distinctive 'swimming pool smell' is from chloramines as chlorine reacts with nitrogen-containing compounds in water. Water utilities are moving to using chloramine on account of its longer-lasting action and greater stability where it is especially good for warm water or water with high sediment or organic matter loads.

One of its drawbacks, however, is that chloramine exists in a range of states from monochloramine as well as small quantities of dichloramine and trichloramine, the proportions of which water utilities have to spend considerable time and funds to manage. Chloramines can react with a range of microbes in water and inside pipes that convert chloramine to ammonia and nitrites, which then have to be treated with high doses of chlorine.

This project is funded by the Australia Research Council Linkage scheme led by Western Sydney University with the University of New South Wales, Swinburne University of Technology, Arizona State University, CSIRO and Sydney Water Corporation.



Image: Sathaa Sathasivan

Flickr/Joe Jungmann



Native bees like this one are important pollinators and if European honeybee populations come under threat from organisms like the *Varroa* mite, growers may become far more reliant on non-honeybee pollinators.



PROJECT SUCCESSSES

AUSTRALIA AND INDIA JOIN FORCES IN \$7M EFFORT TO SAVE BEES, STRENGTHEN OTHER POLLINATORS

The \$7 million five-year program will be delivered by some of the country's top researchers from Western Sydney University, Bayer CropScience, Syngenta Asia-Pacific and Greening Australia, and executed with support from Horticulture Innovation Australia through its strategic co-investment Pollination Fund. The multifaceted project will operate in parallel to the All India Coordinated Research Program (AICRP) of the Indian Council of Agricultural Research on Honey Bee Health and Training, which is being conducted through 26 research centres across India.

The research will focus on:

- **Characterising and securing alternative pollinators:** Reducing the dependence on honey bees by identifying the roles of different insect pollinators in the pollination of key horticultural crops in field situations.
- **Increasing pollen and nectar on farms:** Developing an understanding of the contribution of floral resource species to bee colony and population health, and devise farm-level floral enhancement schemes.
- **The effects of climate change on pollinators:** Testing how climate manipulations influence the timing, quality and quantity of nectar and pollen available to bees.
- **Bee virus research:** Determining what viruses are harboured by native bees and to what extent these are shared by honeybees.
- **Grower involvement and adoption:** Informing and educating growers and land managers about bee population health - floral resources, diseases, soil and pest management. "Australia is the last country in the world that is free of the parasitic *Varroa* mite that is thought to be a major factor behind widespread colony collapses in the United States, Canada, Europe and Japan," he said.

Project partners Syngenta Asia-Pacific, Bayer CropScience and Greening Australia will bring significant strength and experience to the research. Syngenta is armed with knowledge from a number of its large-scale projects including Operation Pollinator and Hives on Farms. Bayer Australia and Bayer India will bring experience gained from its successful Feed-a-Bee and Bee Care programs which accelerate uptake at farm level. Greening Australia offers expertise in the use of native wildflower species as floral resources.

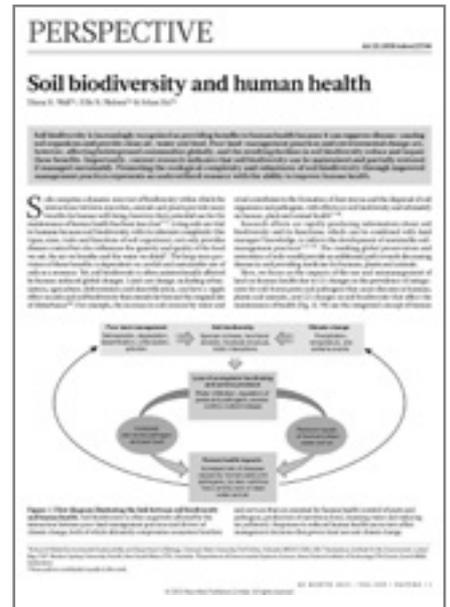
Horticulture Innovation Australia Chief Executive Officer John Lloyd said the project will help give growers, and the general population, increased certainty about the future of Australian fruit and vegetable production.

"This exciting \$7 million project will deliver ground-breaking research that will ultimately help position Australia as a world-leader in bee health and pollination research and development," he said.

"For this reason, it is crucial that we put practical measures in place to support honey bee health and identify and develop new pollination opportunities and techniques."

KEY SCIENTIFIC PUBLICATIONS





SOIL ARIDITY AND MICROBIAL DIVERSITY

A new study drawn from more than 80 dryland sites across the world published in the Proceedings of the National Academy Of Sciences (PNAS) and a second study published in Nature Communications indicates that increasing soil aridity reduces the abundance and diversity of microbial communities which carry out the main ecosystem services such as primary production, water filtration and climate regulation.

With drylands covering nearly 41% of the Earth's land surface and home to around 38% of the world's people, these changes pose additional challenges to the sustainability of natural and human populations in dryland regions.

Predictions include a growth in the land mass of dryland ecosystems by 10% before the year 2100, indicating that there is considerable need to understand how drying landscapes result in changes to the microbes and their ability to support life in dryland regions.

NATURE PAPER SHOWS THE CRUCIAL ROLE OF SOIL AND ITS BIODIVERSITY IN SAFEGUARDING HUMAN HEALTH

The role of soil biodiversity in protecting human health is underappreciated, and poor land management practices and environmental change are endangering lives needlessly, according to a new research paper published in Nature.

Co-authored by Dr Uffe Nielsen from Western Sydney University, in conjunction with Professor Diana Wall of Colorado State University and Dr Johan Six of the Swiss Federal Institute of Technology, the Perspectives Paper outlines ten reasons why healthy and biodiverse soils are directly connected to human health.

"We are losing soils and soil biodiversity at a rapid pace, with substantial negative ramifications on human health worldwide," says Dr Nielsen.

"People understand that properly managing soils is key for the global food supply, and that soils are eroding. But less recognized is the role of living organisms in soils, and how management of those organisms benefits human health."



Dr Nielsen says a new approach towards soil is needed to recognize their centrality to human health, starting with the UN Sustainable Development Goals, which currently only mentions soil in 4 of 17 targets.

Image Opposite: Global Centre researchers at environmental research facilities in Spain.

Contact information

Global Centre for Land-Based Innovation

Western Sydney University
Locked Bag 1797
Penrith NSW 2751 Australia

+61 2 4570 1329

b.singh@westernsydney.edu.au

+61 2 4570 1451

j.greig@westernsydney.edu.au



WESTERNSYDNEY.EDU.AU/GCLBI