

2015-2016 ANNUAL REPORT



Discovery Science *for* Smarter Agriculture
seeds | soil | software



**Mobilizing emerging technology
to the developed and the
developing world.**



Growing science for life

GIFS | GLOBAL INSTITUTE
FOR FOOD SECURITY

PotashCorp - a Founding Partner



Global food security is one of the pressing challenges of the 21st century.

World population is expected to reach nine billion by 2050 amid a backdrop of climate change, water and soil degradation and stagnating yields in staple crops like rice and wheat. We need to make the most of the land we use, and make marginal soils productive.

To ensure we have enough nutritious and sustainably produced food to feed everyone, smarter agriculture and new approaches are needed to mitigate hunger, malnutrition and rising food prices. Discovery research is about finding these solutions.

“The research and investment decisions made over the next decade or so will largely determine the ability of global agricultural systems to meet mid-century demand for food.”

**- The Economist: Global Food Security Index 2015
SPECIAL REPORT, 2015**



Meeting the demands of a burgeoning middle class while mobilizing agricultural technology to feed the disenfranchised billion.

VISION

Ingenious science that delivers sustainable food security for the world.

MISSION

To help feed the world through transformative innovations in agriculture and food production that will benefit Saskatchewan's economic, social and environmental well-being and which will empower developing countries to achieve local food security.

FOUNDING PARTNERS

With initial commitments of up to \$35 million from PotashCorp and \$15 million from the Government of Saskatchewan over seven years, and the support of world-class facilities and centres at the University of Saskatchewan, GIFS will apply Saskatchewan's unique resources, innovation and expertise to address the increasing global demand for safe, reliable food.



MESSAGE FROM THE CHAIR

GIFS PUTS DOWN ROOTS AND GROWS

One of the most rewarding things that a board of directors can experience is to oversee a venture as it truly takes shape, and begins to execute on the mandate its initial stakeholders envisioned, particularly when that endeavor is one whose vision and mission are so important to our global future. It has been my pleasure over the last year as Chair of the GIFS board to see exactly that take place, as the Global Institute for Food Security put its roots down.

In the last fiscal year we've rounded out the GIFS board to include two more very well regarded and experienced members in the form of Dr. Lutz Goedde, Partner at McKinsey, and a leader in the McKinsey's Agriculture and Social Sector practices; and Mr. Steve Visscher, CBE, Deputy Chief Executive International, of the Biotechnology and Biological Sciences Research Council (BBSRC).

We've seen the appointment of an incredibly august scientific advisory panel, drawn from international talent, among them CBEs, multiple award winners and members of the Royal Society and the National Academy of Sciences. The board has overseen the appointment of key staff members to manage the institute and the important functions it undertakes. Altogether the right people are in place at every level of the organization, as it moves forward to achieve its objectives.

In this last year, GIFS really established itself on the global radar screen. Our first international conference saw over 340 attendees and 47 speakers from over 30 countries discussing a new way of thinking about bringing emerging technologies to the developing world; the launch of the Plant Phenotyping and Imaging Research Centre (P²IRC) program attracted over 200 participants representing over 25 collaborating intuitions and industry partners; and we saw the awarding of the Canada Excellence Research Chair in Food Systems and Security and the

appointment of world-renowned scientist Dr. Leon Kochian, from Cornell University.

In these ways and many others, GIFS has taken up a key position on the global stage in discovery research – 'big science' – and its dual mandate to ensure outcomes that benefit both the developed and the developing world have set it apart internationally and led to solid partnerships that stretch from impact translation and extension, through to industrial input and consultation, building on our own pure discovery research.

Lastly, in the last fiscal year, GIFS took its initial \$50M public-private investment funding and effectively doubled it. The net result is a win-win-win for GIFS' stakeholders, not only for the developing world, but also for the developed world, enabling tremendous additional investment in quality research at the University of Saskatchewan, with present and future benefits to the provinces' farmers, and helping ensure continued innovation in the agricultural economy of Western Canada.

In summary, it is the board's view that GIFS has had a tremendously successful year. I would personally like to extend my thanks to my board colleagues for their time and dedication, and to the entire GIFS staff, for their engagement and commitment. We look forward to the coming year with excitement and anticipation, and wish to thank our stakeholders for their initial vision, generosity, and ongoing investment in GIFS' mandate.



Dr. Lorne Hepworth, BOARD CHAIR
Global Institute for Food Security

Our Directors



Alanna Koch
DEPUTY MINISTER
*Deputy Minister to the Premier,
Government of Saskatchewan*



Dallas Howe
CHIEF EXECUTIVE OFFICER
DSTC LTD



Dr. Lutz Goedde
PARTNER
McKinsey & Company

MESSAGE FROM THE EXECUTIVE DIRECTOR & CEO

GIFS – DISCOVERY SCIENCE, MOBILIZED FOR GLOBAL FOOD SECURITY



Michael Atkinson
PROFESSOR
*Johnson-Shoyama Graduate
School of Public Policy,
University of Saskatchewan*



Stephen Visscher
DEPUTY CHIEF EXECUTIVE
*Biotechnology and Biological
Sciences Research Council*



Lorne Hepworth
BOARD CHAIR
*Global Institute for
Food Security*

The year 2016 was our first full year of implementing on the GIFS strategic plan. It was a year marked with progress both scientifically and organizationally, in which we fully established the foundation for our three strategic pillars of SEEDS (Seed and Developmental Biology), SOILS (Root-Soil-Microbial Interactions) and SOFTWARE (Digital and Computational Agriculture). At the same time, we have grown our operational management team to ensure we can deliver on our mandate.

From a research point of view it's been a time of establishing, launching, and planned expansion:

The SEEDS portfolio grew substantially under the leadership of Dr. Tim Sharbel, who joined GIFS in late 2015. Tim has now built a research group of over 20 postdoctoral fellows, technicians and graduate students who are actively performing research on apomixis (asexual seed development), genome editing and heterosis (hybrid vigour). Tim's group continues to grow and expand, and is expected to exceed 30 by the end of 2017.

The SOILS portfolio received a big boost with the recruitment of Dr. Leon Kochian. Leon joins us from Cornell University and the USDA Agricultural Research Service, where he was the Director of the Robert Holley Center for Agriculture and Health. Leon is a world authority on root physiology and function, as well as an expert in mineral nutrition and transport in plant roots. Leon is the recipient of the Canada Excellence Research Chair in Food Security and Food Systems. This award, worth \$20M, will enable Leon to build a world-leading program in root-soil interactions, mineral nutrition and climate-smart crops capable of sensing their environment and adapting accordingly. Already, Leon's arrival is attracting new talent in crop genomics, bioinformatics and rhizosphere biology to join GIFS. We are thrilled that Leon will also serve as the Associate Director of GIFS.

The SOFTWARE portfolio has grown and thrived through the previously reported award of \$37.2M in the form of a Canada First Research Excellence Fund (CFREF) award for Designing Crops for Global Food Security. Across the U of S campus, we now have over 80 researchers involved in a Plant Phenotyping and Imaging Research Centre (P²IRC), which has been established to forward these goals. This involves collaborations among plant biologists, breeders, computer scientists, engineers, physicists, the Canadian Light Source, the Fedoruk Centre and federal agricultural laboratories including the

National Research Council Canada (NRC) and Agriculture and Agri-Food Canada (AAFC).

Implicit in our strategic plan has been the development of state-of-the-art facilities to allow these researchers to pursue discovery science in these critical areas. The construction of these facilities is now underway. We are also pleased that all of the GIFS research leads are closely aligned to traditional departments and colleges at the University of Saskatchewan, and that numerous mutually beneficial collaborations are already established. GIFS expects to maintain and build a unique identity, but at the same time to contribute to further enhancing University's standing in terms of research excellence, both drawing on and attracting the best while contributing to the University's research goals.

Our international goals were in no way forgotten during this year of rapid growth. In June 2016, we held the first conference on "Emerging Technologies for Global Food Security" in Saskatoon. This brought over 340 researchers and agencies involved in global food security from around the world. This included many leading scientists and policy makers working in critical areas such as photosynthesis, drought stress, soil conservation, nitrogen fixation, plant pathology and nutritional quality, who presented their research and projects at the meeting. The conference was also attended by many of the major agribusiness and food companies from around the globe. Many new cross-discipline project ideas have been spawned by this conference, and we expect to see ongoing impact from this unique meeting.

In summary, GIFS had a year of dynamic growth as it implemented its current strategy. It is the strong belief of all the GIFS team members that the rapid deployment of discovery science and transformative innovation in crops and soils will be a critical element for global food security by 2050. GIFS cannot do this alone. We will continue to build on and expand our international partner network to ensure that we have a means of delivering the most appropriate science to where it is most needed throughout the world.

Maurice Moloney EXECUTIVE DIRECTOR & CEO
Global Institute for Food Security

Smarter SEEDS

We need to feed more people, more reliably, in diverse environments across the planet. We need to do that in the face of climate change, uncertain weather patterns, changing pest populations and losses that can mean disaster for individual smallholders, and which claim up to 30% of global harvests.

To accomplish this, we believe that the world needs SMARTER SEEDS.

Smarter and more powerful seeds are genetically programmed for disease resistance, drought tolerance and increased yield. These seeds give rise to plants that resist pests naturally, and can take advantage of local diversity, and breed true, with consistent hybrid vigour, generation after generation.

Smarter seeds change the lives of those who plant them, feeding their families, their communities, and the planet. They create economic resilience that raises communities out of poverty, and can create lasting social change in both the developed, and the developing world.



Dr. Tim Sharbel

SEED AND DEVELOPMENTAL BIOLOGY - SEEDS

Dr. Sharbel is the **GIFS Research Chair in Seed Biology** at the University of Saskatchewan. He comes to GIFS from Gatersleben, Germany, where he was a group leader and principal investigator at the Leibniz Institute of Plant Genetics and Crop Plant Research. Sharbel currently leads a multi-national team of over 20 postdoctoral researchers, technicians and graduate students.

Dr. Sharbel works on a crop-breeding tools that could change the way hybrid seed can be made. Sharbel is a world leader in asexual seed formation, or 'apomixis', a naturally occurring form

of plant reproduction where a flowering plant produces seeds without pollination.

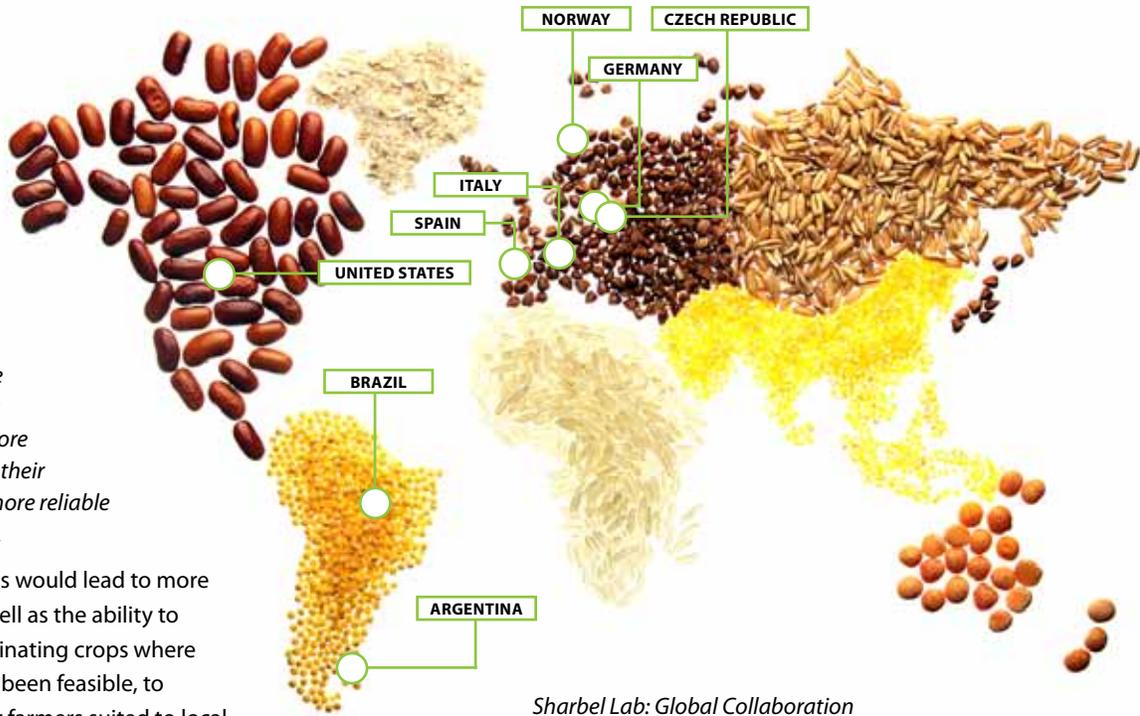
Dr. Sharbel was recently awarded a \$369K Agriculture Development Fund grant to study comparative Genomics of Apomictic Plants: Advancing Novel Tools for Niche Breeding.

His collaborations have also resulted in grant applications currently under consideration for over \$18.7M in additional research funding.

APOMIXIS – TRUE-BREEDING, HIGH YIELDING HYBRIDS, GENERATION AFTER GENERATION

Apomixis is a naturally occurring form of plant reproduction where a flowering plant produces seeds without sexual 'crossing' with another plant. Apomixis is currently largely absent in food crops, and has tremendous potential in plant breeding. Harnessing this phenomenon as a crop-breeding tool could enable hybrids in crops that are currently essentially inbred, and result in more robust seeds that can be tuned to their specific environment, for better, more reliable germination and increased yields.

Inducing asexuality in food crops would lead to more rapid variety development, as well as the ability to exploit hybrid vigour in self-pollinating crops where hybrid seed technology has not been feasible, to produce better crop varieties for farmers suited to local conditions, locally and around the world.



COLLABORATIONS AND PROJECTS

Dr. Sharbel's group has grown to include more than 20 primary researchers from labs around the world, and has established collaborations in Italy, Germany, Spain, Norway, Argentina, Brazil, the United States, and the Czech Republic.

APOMIXIS IN MODEL SYSTEMS

Apomixis fundamentals are studied in model plant systems that exhibit apomixis naturally, including *Boechnera* and *Poa*, to further understanding of the apomixis candidate gene *UPGRADE2*, previously identified by the Sharbel lab.

SEED DEVELOPMENT, FUNCTIONAL GENETICS AND PROTEOMICS IN APOMICTIC PLANTS

The Sharbel lab is studying variation in seed development in apomictic seeds, as well as conducting research on the functional genetics of apomixis, with the goal of improving methods of gene editing in crop plants.

A new research project was launched this year to look at the protein-protein interactions ('proteomics') of both apomictic and sexual seed formation – something not well understood to date.

APOMIXIS TRIALS IN CROP PLANTS

Key trials have begun involving the introduction of apomixis candidate genes into crop species, including chickpeas, lentils, canola and maize, for the first attempt at inducing apomictic behaviour in these important food crops.

HYBRID 'MIMICS' – HARNESSING THE PHENOMENON OF HETEROSIS

Dr. Sharbel's lab is beginning research on the phenomena of hybrid mimics in food crops which have been traditionally difficult to hybridize. This work involves using recurrent selection techniques to produce plants with properties that mimic traditional hybrid vigour ('heterosis') in crops like lentils and wheat.



VITERRA
Lead & First Grain
Research Partner



ROOTS THAT RESPOND

Dr. Leon Kochian
ASSOCIATE DIRECTOR

Tomorrow's agriculture needs smarter, more adapted ROOTS that RESPOND - to drought, salinity, acidity, climate change.

Tomorrow's roots are efficient at nutrient uptake, and are optimized to respond to the soil they are growing in.

Tomorrow's roots help grow more food, help farmers make use of marginal soils, and sequester CO₂.

To head the ROOTS pillar, the Global Institute for Food Security has recruited Dr. Leon Kochian.

Dr. Leon Kochian joined GIFS as associate director, and head of GIFS pillar studying root-soil-microbial interactions. Dr. Kochian has been awarded the Canada Excellence Research Chair in Food Systems and Security at the University of Saskatchewan, and will also hold faculty appointments in plant sciences and soil science in the College of Agriculture and Bioresources.

Dr. Kochian joins GIFS from Cornell University, where he was the Director of the USDA Agricultural Research Service

Robert W. Holley Center for Agriculture and Health, and Professor of Plant Biology and Soil and Crop Sciences.

Dr. Kochian has earned an international reputation for his work on crop adaptation to marginal soil environments.

His research deals with the molecular biology, physiology and genetics of mineral ion transport and root biology processes as they relate to mineral nutrient acquisition, plant response to abiotic environmental stresses, and the role of root architecture in nutrient acquisition efficiency.



DR. LEON KOCHIAN

Leon Kochian is a fellow of both the American Association for the Advancement of Science and the American Society of Plant Biologists, he was elected to the Agricultural Research Service Hall of Fame "for internationally recognized pioneering work using molecular biology, genetics and plant breeding to improve crop yields on marginal soils in developing countries."

He was recently named to **Thomson Reuter's list of 2015's "Most Influential Scientific Minds"**.

About the CERC

The Canada Excellence Research Chair (CERC) in Food Systems and Security will lead a transformative, multidisciplinary program that will tackle food security challenges by:

- 1) **improving crop production, quality and safety;**
- 2) **promoting environmentally sustainable agricultural practices; and**
- 3) **addressing societal and economic barriers that limit impact of new agricultural technologies.**

This multidisciplinary flagship program will bring together biologists, computer scientists, bioinformaticians, engineers, and social scientists.

Focusing on the plant root system, a critical and underappreciated aspect of plant breeding, the program will accelerate plant breeding far beyond that of current breeding practices, producing new crop varieties with higher yields and greater capacity to thrive in marginal conditions.

The CERC will work with farmers and producers in developed and developing worlds to aid in the adoption of these improved crop varieties and novel agricultural technologies.



The ROOTS Pillar will build on the CERC platform, to encompass **ROOT-SOIL-MICROBIAL** interactions

High Throughput Root Phenomics Platforms.

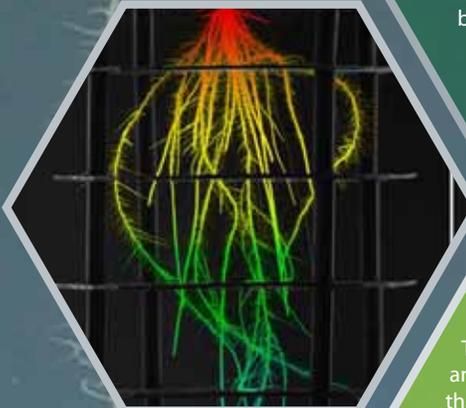
This work involves the development of technologies and techniques for high throughput phenotyping of root development, architecture and physiological function as well as the framework for integrating these digital root phenotypes into crop molecular breeding pipelines.

Targeted Breeding of Superior Root Traits.

This work will enable the leveraging of root phenotyping data sets to facilitate targeted plant breeding for root traits at a speed and breadth far beyond that of current breeding practice, generating new crop varieties capable of thriving in marginal soil environments.

Improved Crop Varieties in the Developed and Developing Worlds.

The ROOTS program will develop and release improved crop varieties that can substantially improve yields in the face of abiotic and biotic stresses. This work will examine societal and economic issues limiting the acceptance of new agricultural technologies by farmers, regulators and society in general.



Tomorrow's roots help grow more food, help farmers make use of marginal soils, and sequester CO₂.

AG THAT COMPUTES:

THE P²IRC PROJECT

We know that global food security over the next 35 years will depend on doing more with less, while increasing crop yield per hectare by 70% – a formidable figure that will require a profound leap forward in our understanding of how plant genomes determine productivity traits.

In short, if we could ‘design’ a crop genome for high productivity, we could help avert food shortages globally.

In 2015 the University of Saskatchewan and the Global Institute for Food Security were awarded a \$37.2M Canada First Excellence Research Fund Grant for the development of a centre dedicated to Designing Crops for Global Food Security.

The Plant Phenotyping and Imaging Research Centre (P²IRC) was established in 2016 as a direct result, and brings together plant phenomics, genetics, bioinformatics and computer science with public policy. Its aim is to create a high throughput digital connection between phenotyping and genotyping that will revolutionize crop breeding, unlocking the potential for vastly improved yields, diversity and breeding flexibility.

P²IRC Plant Phenotyping and Imaging Research Centre



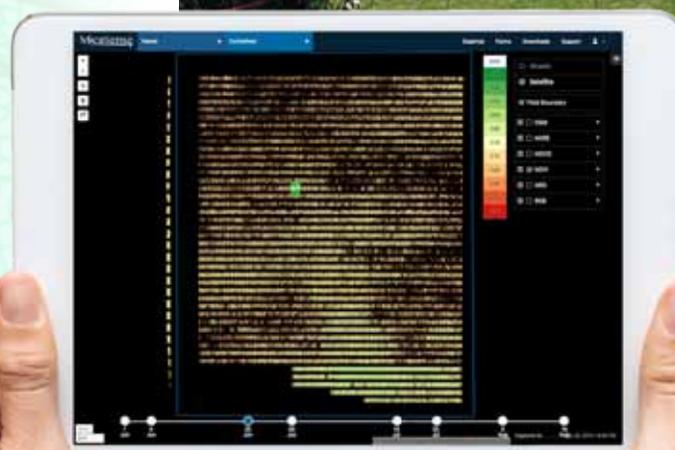
THE P²IRC INAUGURAL SYMPOSIUM

This year the P²IRC program hosted over 200 researchers, industry and government representatives and graduate students for two days of plenary talks, workshops and networking opportunities at the inaugural P²IRC symposium in Saskatoon. The symposium showcased themes and projects in the P²IRC program, and invited further international collaboration while showcasing the P²IRC locally, nationally, and internationally.



A Droganfly drone captures the crowd at the P²IRC Launch & Media Event.

Image Source: Andrew Carson, Droganfly Innovations Inc.



Spatial and genetic variability (NDVI shown) of durum wheat in early season ground cover.

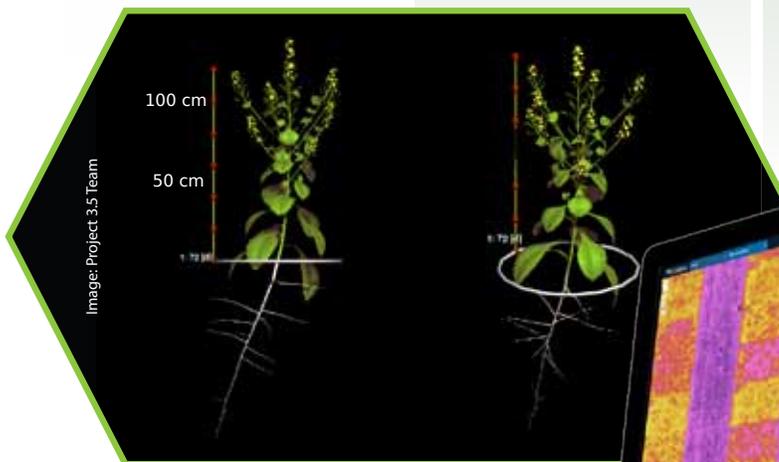
Image Source: Project 1.2 Team

The P²IRC research program explores four key themes that will generate a range of data-rich technologies, products and services that could fundamentally transform seed and plant breeding in crops including wheat, canola and lentils, all of vital importance to global food security. The University of Saskatchewan possesses a unique combination of expertise in genomics, plant breeding, and rhizosphere science, as well on-campus infrastructure for synchrotron and cyclotron-enabled imaging and a high performance computing. The project involves cross-Canada as well as global collaborations in each area, bringing together the best of existing knowledge, and scientific talent.

By 2022, P²IRC will be the unique resource for plant breeders around the world, improving global food security and bolstering Canada's agricultural sector by accelerating plant breeding efforts.



THEME 1:	THEME 2:	THEME 3:	THEME 4:
<p>PHENOMETRICS</p> <p>Leveraging the power of precision digital phenotyping and genomics for crop breeding</p> <p>High-throughput phenotyping platforms will be able to identify breeding lines with potentially revolutionary traits for higher productivity and open up the vast untapped resource of wild genetic diversity in wild crop plant relatives.</p>	<p>IMAGE ACQUISITION TECHNOLOGIES</p> <p>Using advanced imaging techniques to understand crop characteristics</p> <p>This theme investigates the potential to acquire high-fidelity images from satellites, UAV's, light sources and lasers, and neutron imaging to create digital databases of plant phenotypes, enabling predictive precision farming, genotyping and plant breeding.</p>	<p>COMPUTATIONAL INFORMATICS OF CROP PHENOTYPE DATA</p> <p>Understanding how digital data can revolutionize plant breeding</p> <p>This theme investigates the use of infrastructure, tools, and techniques required for high-throughput, multiplexed technologies for managing digital phenotypic data. It involves collaborative exploration by groups of genomic scientists, breeders, bioinformaticians, and other computer scientists.</p>	<p>SOCIETAL AND DEVELOPING WORLD IMPACT</p> <p>Exploring the global gaps in policy, regulatory, production, distribution and marketing systems</p> <p>Transformative science, like the ability to design ideal crop plants, can advance technology beyond regulators' ability to undertake risk assessments, and elicit opposition from consumers. This theme helps to identify regulatory and commercialization barriers, with the understanding that technologies will only have a profound effect on global food security when breeders can use them effectively.</p>



A 3D L-system-based model of canola development.
 Image Source: Mikolaj Cieslak*, Sally Vail**, Raju Soolanayakanahally**, and Przemyslaw Prusinkiewicz*
 * Biological Modelling and Visualization Laboratory, University of Calgary
 ** Agriculture and Agri-Food Canada



56 lines of flowering Canola imaged in RGB for phenotyping calibration.
 Image Source: Project 2.1 Team

 UNIVERSITY OF SASKATCHEWAN
Plant Phenotyping and Imaging Research Centre
 WWW.CS.USASK.CA/RESEARCH/PHENOTYPING-CENTRE

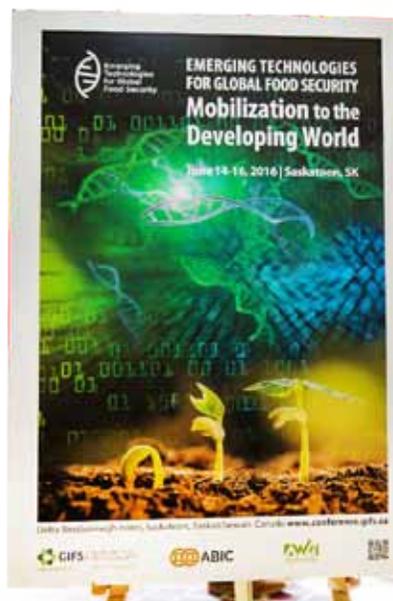
#GIFSCONF2016

Emerging Technologies for Global Food Security: **Mobilization to the Developing World**

An international group of over 340 scientists, policy makers and industry representatives converged on Saskatoon to attend **Emerging Technologies for Global Food Security**, with a focus on **Mobilization to the Developing World**.

The conference was held June 14–16th at the Delta Bessborough Hotel and focussed on how to move innovations in agricultural research quickly – not only to the developed world, but also to the developing world, in as little as four years from lab bench to field.

Speakers and panellists included well-known scientists and representatives working in the developing world – **Ruth Oniang'o** and **Zeyaur Khan** – as well as researchers and policy advisors, including **Mark Lynas**, **Barbara Burlingame**, and **Rattan Lal**. From industry, speakers included **Neal Gutterson** from Dupont Pioneer and **Anne Roulin** from Nestle SA, among many others. (For full speaker list, see conference.gifs.ca)



#GIFScnf2016 included an **IQ² debate moderated by Rex Murphy on the question “Is biotechnology necessary to deliver food security to 9 billion people?”** This debate was also open to the public and well attended, both in person and online. Conference participants were treated to a dinner speech by Rob Saik, on the question **“Will biotechnology be allowed to feed 9 billion people?”**

The Emerging Technologies conference has already resulted in several new projects and cross-disciplinary collaborations focussed on food security in the developing world.



#GIFScnf2016 made over **270,000**

impressions via social media. Those impressions spanned the globe

882

people watched the Livestream in real time – average view was 30 minutes, from 42 countries



Global Food Security Requires a Global Conversation

As the global population reaches nine billion in the next 30 years, the question of how to feed everyone, everywhere, every day, becomes everyone's business.

At this conference GIFS brought together the world's preeminent researchers, thinkers and policy makers on agriculture and the developing world to discuss the problem.

#GIFScnf2016 was deliberately 'democratized', so that no matter where you were in the world, you could be part of what was happening – take in a panel session or hear a keynote speaker, and attend the debate – in person or online, while interacting with speakers and panelists via Twitter.

Organized in partnership with:



Conference material was viewed online via YouTube over

6,000 times

47

Speakers and Panelists – preeminent scientists, R&D from industry, developing world agriculture and food security policy makers and associations.

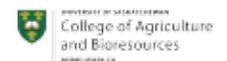
341

Delegate attendees from 25 countries

#GIFscon2016 | Partners



International Development Research Centre
Centre de recherches pour le développement international



"The conference was superb - among the very best I have ever attended.

A superb mix of academics, private sector, NGOs and practitioners, as well as an excellent cross section of countries represented. I learnt a huge amount!"

- Professor Jennifer Thomson,
University of Capetown,
South Africa

GIFS

GETS #SOCIAL

Engaging with the Public
on Issues of Food Security
and Discovery Science

GIFS has undertaken social engagement in all areas – in communications, in public dialogue, and in our research.

Over the year, GIFS:

- ◆ Hosted a public debate on the use of biotechnology to achieve food security;
- ◆ Launched a presence on YouTube, Twitter, Facebook and LinkedIn, driving awareness and social engagement on issues related to food security, discovery research and biotechnology;
- ◆ Managed research in areas of public policy, social license and developing world impact.



Over 80 days
of viewing since June

Added over
100 hours
of video content



From 18 to
over 600 followers
since June,

Trending during
#GIFScnf2016
globally



Developed a
LinkedIn presence

Made connections
to over

250 influencers
& industrial contacts
globally



From 0 to
800+ followers
globally

Reached over
900,000 people



Social License & Developing World Impact

GIFS work in the areas of Social License and Developing World Impact is led by Dr. Peter Phillips and Dr. Stuart Smyth.

Dr. Peter Phillips

Peter Phillips is an international political economist, Professor of Public Policy and Graduate Chair at the Johnson-Shoyama Graduate School of Public Policy. His research concentrates on issues related to governing transformative innovation.



Dr. Stuart Smyth

Dr. Stuart Smyth is an Assistant Professor in the Department of Agriculture and Resource Economics at the University of Saskatchewan, where he holds the Industry Research Chair in Agri-Food Innovation. His research focuses on sustainability, agriculture, innovation and food.

Ongoing Projects

As part of our work in the P²IRC project, GIFS is undertaking:

- One of the first farmer surveys in Canada to gain insights on how big data will impact/benefit farmers and what returns they anticipate and what privacy concerns might exist.
- A first of its kind survey of plant breeders and regulators on how they make risk-based decisions, using a global panel of over 600 participants, undertaken in the context of the variety of new plant breeding techniques (NBT) to enhance our understanding of how the products of these NBTs might be regulated.
- A partnership with the International Food Policy Research Institute for their new Gates Foundation/ USAID funded, "Biotechnology and Biosafety Rapid Assessment and Policy Platform" project in Ethiopia, Ghana, Nigeria, Tanzania and Uganda.

Public Debate: Is Biotechnology Necessary to Feed 9 Billion People?

This first of its kind 'Oxford Style' debate on the use of biotechnology was open to the public and drew a crowd of over 400 people, who participated in a discussion on whether the use of biotechnology is required to achieve global food security by 2050.



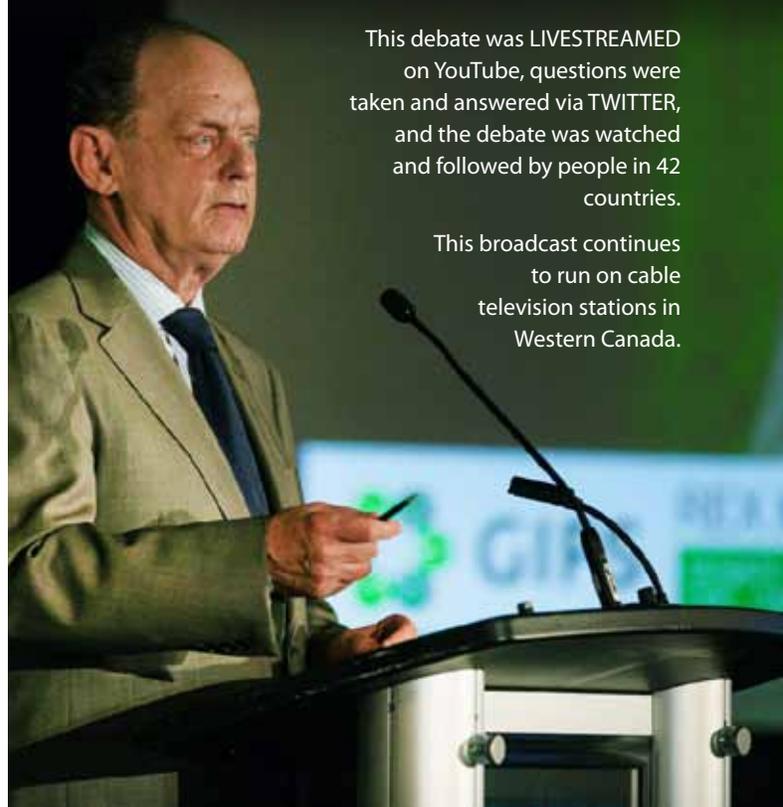
FOR:

Mark Lynas, Cornell Alliance for Science, Ithaca, NY, and Oxford, UK & **Jennifer Thomson**, University of Cape Town, South Africa

PANEL

AGAINST:

Barbara Burlingame, Massey University, New Zealand & **Peter Langridge**, University of Adelaide, Australia



This debate was LIVESCREENED on YouTube, questions were taken and answered via TWITTER, and the debate was watched and followed by people in 42 countries.

This broadcast continues to run on cable television stations in Western Canada.

GIFS GOES GLOBAL

HIGHLIGHTS & MILESTONES: A YEAR AT GIFS

Early Impact Projects

#DIVSEEK – www.divseek.org

Assessing and identifying new sources of genetic variation is a critical part of any long-term strategy to enhance the productivity, sustainability and resilience of crop varieties and agricultural systems.

The DivSeek initiative works to characterize crop diversity and develop a unified, coordinated and cohesive information management platform to provide easy access to genotypic and phenotypic data associated with genebank germplasm.

GIFS is an early member of DivSeek, and will link DivSeek to Canadian universities and university researchers working on agricultural research that relates to this initiative.



Therapeutic Food Products for Malnutrition and Emergency Response

Principal Investigator:

Dr. Michael Nickerson - Associate Professor, Ministry of Agriculture Strategic Research Chair, U of S

This multidisciplinary and multi-institutional team is comprised of researchers from the University of Saskatchewan, University of Manitoba, Mekelle University (Ethiopia), POS Bio-Sciences and the Saskatchewan Food Industry Development Centre, and is funded by GIFS.

The overall goal of this research is to develop innovative therapeutic food products, using pulse and cereal flours/concentrates that are fortified with vitamins and minerals and/or other bioactive constituents (e.g. omega-3 rich oils and fruit phenolics), and include raw materials grown locally in Saskatchewan and Ethiopia (e.g. barley, pea, lentil, chickpea), based on World Food Program specifications. They are shelf-stable for a prolonged duration, economically and commercially viable, and culturally acceptable. These food products are designed for the treatment of moderate to acute malnutrition in high-risk communities.



2015

TIMELINE:

JULY 2015

CFREF of \$37.2M Awarded for Designing Crops for Global Food Security to GIFS and University of Saskatchewan.

Canada 



OCT 2015

Dr. Tim Sharbel joins GIFS to establish GIFS' Seed and Developmental Biology pillar.

GIFS is represented at the Joint International **Conference on Intelligent Agriculture** in Beijing, China.



NOV 2015

Inaugural meeting of the **International Plant Phenotyping Network (IPPN)** in Barcelona, Spain. GIFS is a founding member of the IPPN and is represented on its board of directors.

Plant Phenotyping and Imaging Research Centre (P²IRC) is officially named as part of the CFREF program on Designing Crops for Global Food Security.



DEC 2015

Dr. Leon Kochian agrees to join GIFS as Associate Director.



Dr. Tim Sharbel is awarded a \$369K Agriculture Development Fund (ADF) grant to study Comparative Genomics of Apomictic Plants- Advancing Novel Tools for Niche Breeding.

Scaling up Pulse Innovations for Food and Nutrition Security in Southern Ethiopia

Principal Investigator:

Dr. Carol Henry - Associate Professor, College of Pharmacy and Nutrition, U of S

GIFS is a participant in and co-funder of this project, which is sponsored by Canada's International Development Research Centre (IDRC) and Foreign Affairs, Trade and Development Canada (DFATD).

This project is led by Dr. Carol Henry in close collaboration with researchers at Hawassa University in Ethiopia, and aims to bring higher-yielding, more nutritious chickpea and bean varieties to more than 70,000 households involved in farming in Ethiopia. It will apply a pulse crop-centered strategy to enhance food and nutrition security in southern Ethiopia.

This project will contribute to the Agriculture Growth Program as articulated in Ethiopia's Comprehensive African Agriculture Development Plan (CAADP).



Use of Biofortified Lentils to Remediate Iron Deficiency and Arsenic Poisoning

Principal Investigator:

Dr. Albert Vandenberg - Professor and NSERC Industrial Research Chair, U of S

This project is an international collaboration that explores the potential for lentils grown in Saskatchewan to be used in dietary solutions for iron (Fe) deficiency and arsenic (As) toxicity that can occur as a result of some diets in Bangladesh. The selenium (Se) study, which explores the use of lentil's high natural Se concentration to mitigate arsenic (As) toxicity, has begun in the Shahrasti region of Bangladesh.



2016

JAN 2016

GIFS addresses the **Smart Technologies for Sustainable Agriculture** event in London, UK.



FEB 2016

Dr. Lorne Hepworth becomes Chair of the GIFS Board of Directors.

MAR 2016

P²IRC International Scientific Advisory Committee (ISAC) established.

APR 2016

Dr. Lutz Goedde of McKinsey & Co joins the GIFS Board of Directors.

GIFS presents **Global Perspective on the Future of Cereals Research** at the 2016 Canadian Global Crops Symposium.



JUNE 2016

#GIFSCONF2016: GIFS hosts the first **Emerging Technologies for Global Food Security Conference** in Saskatoon – joined by 341 delegates and 47 global speakers.

GIFS participates in the first **DIVSEEK meeting** held in Canada.

First meeting of the GIFS International Scientific Advisory Panel (ISAP).

JULY 2016

GIFS develops terms for a joint project on developing **Hybrid Mimics** in lentils with **CSIRO** and the **University of Technology Sydney** in Australia.

AUGUST 2016

Dr. Leon Kochian takes on the **Canada Excellence Research Chair (CERC)** in Food Systems and Security.



GIFS hosts the **Inaugural Symposium for the Plant Phenotyping and Imaging Research Centre** August 29-30.





John Pickett
CBE, DSc, FRS – ISAP Chair

Having received his BSc Honours chemistry in 1967 and PhD in organic chemistry synthesis in 1971 from the University of Surrey, John completed his training in organic chemistry with a postdoctoral fellowship at the University of Manchester (then UMIST). He joined the Brewing Industry Research Institute in 1972. In 1976, he joined the Insecticides and Fungicides Department (later the Department of Biological Chemistry) and was appointed Head of Department in 1984 and, concurrently in 2007, Scientific Director of the Rothamsted Centre for Sustainable Pest and Disease Management. In 2010, he relinquished these positions on being awarded the first Michael Elliott Distinguished Research Fellowship at Rothamsted. As well as fulfilling this prestigious new role, he continues to contribute to the Chemical Ecology group and is still very much involved with research activities in the UK and around the world. He has over 515 publications and patents.

John's contributions to the field of chemical ecology have been acknowledged with the 1995 Rank Prize for Nutrition and Crop Husbandry, election to Fellowship of the Royal Society in 1996, Member of the Deutsche Akademie der Naturforscher Leopoldina, 2001, International Society of Chemical Ecology Medal 2002, appointment to CBE for services to Biological Chemistry in 2004, and the Wolf Foundation Prize in Agriculture in 2008, among many others. In June 2014 he became President of the Royal Entomological Society and in April 2014 he was elected Foreign Associate of the National Academy of Sciences (US).



Julia Bailey-Serres
PhD

Julia Bailey-Serres is Professor of Genetics in the Department of Botany and Plant Sciences and Director of the Center for Plant Cell Biology at the University of California, Riverside. She is also Professor of Rice Physiology at Utrecht University, the Netherlands. Her honors include member of the US National Academy of Sciences, fellow of the American Association for the Advancement of Sciences, fellow of the American Society of Plant Biologists and recipient of the USDA National Research Initiatives Discovery Award.

Dr. Bailey-Serres is recognized for the in-depth dissection of the function of SUBMERGENCE 1A gene, responsible for survival of rice plants under prolonged submergence as evidenced by its successful use in breeding programs that has led to stabilizing rice grain yield in flood-prone regions of Asia.



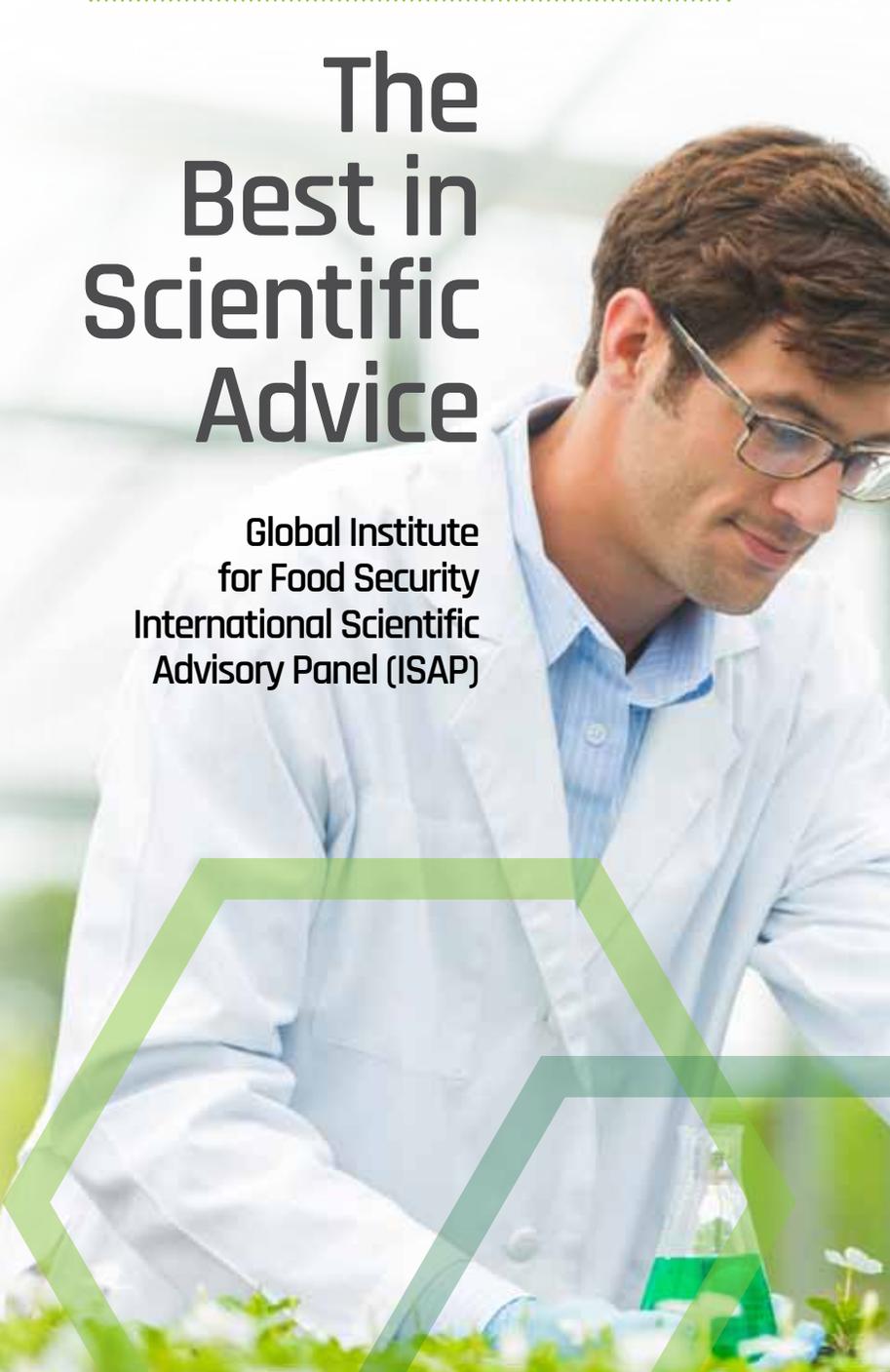
Richard (Dick) Flavell
PhD, DSc, CBE, FRS

Dr. Flavell received his PhD and DSc from the University of East Anglia in the UK and has been a Fellow of European Molecular Biology Organization since 1990 and of The Royal Society of London since 1998.

From 1987 to 1998, Dr. Flavell was the Director of the John Innes Centre in Norwich, England, a premier plant and microbial research institute. He joined Ceres in 1998 and served as Chief Scientific Officer from 1998 to October 2012, overseeing a large gene discovery program and the breeding of improved bioenergy crops. He has published over 220 scientific articles, lectured widely, and contributed significantly to the development of modern biotechnology in agriculture. In 1999, Dr. Flavell was named a Commander of the British Empire for his contributions to plant and microbial sciences.

The Best in Scientific Advice

**Global Institute
for Food Security
International Scientific
Advisory Panel (ISAP)**





Margaret Gadsby
MSc, PAg

With degrees from McMaster University and the University of British Columbia, Margaret Gadsby worked in the Agribusiness industry for 31 years based in Canada and the United States. The first part of her career focused on environmental characteristics and impacts, mitigation approaches and regulatory approvals for pesticides in Canada.

Since 1992, her emphasis has been on the development of science-based regulatory systems and stewardship approaches as well as the pursuit of regulatory approvals for products of biotechnology globally. She led the team that earned the approval of the first LibertyLink™ canola in Canada and has since been involved in development of more than 30 products of agricultural biotechnology including corn, cotton, soybeans, and rice. She served for five years as the Global Head of Stewardship and a further nine years as Global Head of Regulatory Affairs for the Bayer CropScience, Seeds Business.



Kiran Sharma
PhD

Dr. Kiran Sharma is the Principal Scientist (Cell & Molecular Biology) at ICRISAT, a non-profit organization that conducts agricultural research for development in Asia and sub-Saharan Africa. Dr. Sharma earned a Master's degree in plant physiology from the CCS Haryana Agricultural University, Hisar in India and a PhD from the University of Delhi. During his postdoctoral work at the University of Calgary in Canada, Dr. Sharma worked on various aspects of cell and developmental biology and biotechnology.

In 1991, he joined ICRISAT to develop transformation systems for ICRISAT's mandate legume crops, as well as providing group leadership for transformation work and the development of strategies for collaborative research in the semi-arid tropics. Dr. Sharma has been involved in developing an Agri-Business Incubator (ABI) at ICRISAT, as well as the recently established Platform for the Translational Research on Transgenic Crops (PTTC).



Bill Lucas
PhD, DSc

Bill Lucas is Distinguished Professor and Chair of the Department of Plant Biology at the University of California, Davis. He also currently holds academic positions as Chair Professor at

National Chung-Hsing University in Taiwan and Distinguished Guest Professor at Shanghai Jiao Tong University, China. Dr. Lucas received his BSc (Hons) in 1971, his PhD in 1975 and his DSc in 1990, from the University of Adelaide. He was appointed to the faculty at UC Davis in 1977 where his research team has made seminal contributions to the field of plant biology.

Dr. Lucas has co-authored over 250 articles and has served as senior editor for *The Plant Cell* and *Journal of Integrative Plant Biology* and Associate Editor for the *Journal of Theoretical Biology*. He is a Highly Cited Researcher (Original Member), has been awarded the ASPB Gibbs Medal and the Belgian Francqui Medal, and is a foreign member of the French National Academy of Sciences, a Fellow of the American Association for the Advancement of Sciences, an Inaugural Fellow of the American Society of Plant Biologists (ASPB), and Honorary Life Member of the Australian Society of Plant Scientists.



Joerg Bohlmann
PhD

Joerg Bohlmann is a Professor and Distinguished University Scholar in the Michael Smith Laboratories at the University of British Columbia, Vancouver, Canada. He is co-director

of the UBC Genome Science and Technology Graduate Program. He is a Fellow of the Royal Society of Canada, Fellow of the American Association for the Advancement of Science (AAAS), E.W.R. Steacie Memorial Fellow of the Natural Sciences and Engineering Research Council (NSERC) of Canada, Feodor Lynen Fellow of the Alexander von Humboldt Foundation, and Fellow of the German Scholarship Foundation. He received his PhD from the Technical University Braunschweig, Germany, and was a postdoctoral fellow at Washington State University and group leader at the Max Planck Institute for Chemical Ecology.



Gijs van Rooijen
PhD

Gijs van Rooijen graduated with an MSc in Molecular Sciences from the Agricultural University in Wageningen in 1989 and a PhD

in Plant Molecular Biology from the University of Calgary in 1993. Dr. van Rooijen joined SemBioSys Genetics in 1995 where he advanced to Director of Cellular and Molecular Biology. In January 2003, Dr. van Rooijen assumed the position of Chief Scientific Officer with Genome Prairie, and in 2006 became Chief Scientific Officer for Genome Alberta. Dr. van Rooijen is (co)author of numerous reviewed publications and an (co)inventor on 25 issued US patents.



Independent Auditor's Report

July 25, 2016

To the Board of Directors of the Global Institute for Food Security

We have audited the accompanying financial statements of Global Institute for Food Security, which comprise the statement of financial position as at April 30, 2016 and the statements of operations and unrestricted net assets and cash flows for the year then ended, and the related notes which comprise a summary of significant accounting policies and other explanatory information.

Management's responsibility for the financial statements

Management is responsible for the preparation and fair presentation of these financial statements in accordance with Canadian accounting standards for not-for-profit organizations, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Opinion

In our opinion, the financial statements present fairly, in all material respects, the financial position of Global Institute for Food Security as at April 30, 2016 and the results of its operations and its cash flows for the year then ended in accordance with Canadian accounting standards for not-for-profit organizations.

PricewaterhouseCoopers LLP

Chartered Professional Accountants

PricewaterhouseCoopers LLP

128 4th Avenue South, Suite 600, Saskatoon,
Saskatchewan, Canada S7K 1M8

T: +1 306 668 5900, F: +1 306 652 1315

"PwC" refers to PricewaterhouseCoopers LLP, an Ontario limited liability partnership.

Statement of Financial Position

As at April 30, 2016

	2016 \$	2015 \$
Assets		
Current assets		
Cash held by University of Saskatchewan (note 3)	32,434,548	19,407,318
Liabilities		
Current liabilities		
Accounts payable and accrued liabilities	57,170	121,718
Unrestricted net assets	32,377,378	19,285,600
	32,434,548	19,407,318

Economic dependence (note 1)

Commitments (note 5)

Approved by the Board of Directors



Lorne Hepworth, Board Chair



Alanna Koch, Director

The accompanying notes are an integral part of these financial statements.

Statement of Operations and Unrestricted Net Assets

For the year ended April 30, 2016

	2016 \$	2015 \$
Revenue		
Contributions from founding partners (note 4)	17,000,000	8,000,000
Interest income (note 3)	376,591	386,588
	17,376,591	8,386,588
Expenditures		
Administration		
Salaries and benefits	695,819	558,730
Occupancy costs	184,434	108,680
Communications and marketing	151,466	191,521
Travel and recruitment	144,438	164,867
Office operations (note 3)	104,455	138,218
Consulting fees	-	34,155
	1,280,612	1,196,171
Research and education		
Grants and awards (notes 3 and 6)	2,761,225	998,700
External science advisory	204,043	90,010
Salaries and benefits	38,933	39,044
Scholarships	-	19,640
	3,004,201	1,147,394
	4,284,813	2,343,565
Excess of revenue over expenditures	13,091,778	6,043,023
Unrestricted net assets – Beginning of year	19,285,600	13,242,577
Unrestricted net assets – End of year	32,377,378	19,285,600

Statement of Cash Flows

For the year ended April 30, 2016

	2016	2015
Cash provided by (used in)		
Operating activities		
Excess of revenue over expenditures for the year	13,091,778	6,043,023
Changes in non-cash working capital items		
Cash held by University of Saskatchewan	(13,027,230)	(5,753,042)
Accounts payable and accrued liabilities	(64,548)	(289,981)
	(13,091,778)	(6,043,023)
Net change in cash	-	-
Cash – Beginning of year	-	-
Cash – End of year	-	-

The accompanying notes are an integral part of these financial statements.

1] Nature of business

The Global Institute for Food Security (the “institute” or “GIFS”) was established by a Memorandum of Agreement (the “agreement”) dated November 19, 2012 between the University of Saskatchewan, the Government of Saskatchewan, and Potash Corporation of Saskatchewan.

The institute is a Type B Centre of the University of Saskatchewan (the “university”). The mandate of the institute is to place Saskatchewan among global leaders in food security research and policy development.

The operation of the institute is economically dependent on the funding from Potash Corporation of Saskatchewan and the Government of Saskatchewan (note 4).

2] Summary of significant accounting policies

a) Basis of presentation

These financial statements include the accounts of the institute and are presented in accordance with Canadian accounting standards for not-for-profit organizations (“ASNPO”).

b) Use of estimates

The preparation of financial statements in conformity with ASNPO requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amount of revenue and expenditures during the reporting period. Actual results could differ from these estimates.

c) Revenue recognition

The institute follows the deferral method of accounting for contributions which includes funding from the Government of Saskatchewan and Potash Corporation of Saskatchewan as well as other funding sources.

Unrestricted contributions are recognized as revenue when received or receivable if the amount to be received can be reasonably estimated and collection is reasonably assured. Restricted contributions for expenses of the current period are recognized as revenue in the current period and restricted contributions for expenses of one or more future periods are deferred and recognized as revenue in the same period or periods as the related expenses are recognized.

Investment income earned on the cash held by University of Saskatchewan is recognized as revenue when the university can measure and transfer the income to the institute.

Contributions of materials and services are recognized only when a fair value can be reasonably estimated and when the materials and services are used in the normal course of the institute’s operations and would otherwise have been purchased.

d) Financial instruments

Financial assets and financial liabilities, consisting of cash held by University of Saskatchewan and accounts payable and accrued liabilities, are initially recognized at fair value and subsequent measurement is at amortized cost. The institute does not consider itself to have significant exposure to credit risk, currency risk, interest rate risk, liquidity risk, market risk or other price risk.

2] Related party transactions

During the year, the institute entered into various transactions with the university. The institute purchased goods and services from the university in the amount of \$20,046 (2015 – \$144,322), which are

included in expenditures. Of the grants made during the year by the institute, \$2,761,225 (2015 – \$998,700) were made to the university, including individuals or entities related to or employed by the university.

During the year, the university provided the institute with access to facilities, phones, computer networks and financial administrative systems needed to support the operational needs of the institute.

All funds received by the institute are held in, and payments to vendors of the institute are made from, bank accounts administered by the university, which are included on the statement of financial position as “Cash held by University of Saskatchewan”. The average monthly balance earned a rate of 1.5% during the year (2015 – 2.5%) and interest income of \$376,591 (2015 – \$386,588) was received from the university during the year.

4] Contributions from founding partners

The agreement features a funding commitment of \$15 million from the Government of Saskatchewan over seven years ending April 30, 2020 and a provisional donation to the institute of a contribution of up to \$35 million by Potash Corporation of Saskatchewan over seven years, subject to an annual review of the institute including certain reporting requirements being met and satisfactory performance against certain objectives and metrics. The contribution from Potash Corporation of Saskatchewan may be structured such that funds are provided evenly over the seven year period, or proportionally matched with the growth of the institute, or by some other agreed upon manner. Potash Corporation of Saskatchewan will determine on an annual basis whether or not to make a contribution during any fiscal year.

5] Commitments

a) Funding awards

One of the core activities of GIFS is to provide grants to eligible scientific investigators for the purpose of research in a wide range of issues related to food production and food security. As of April 30, 2016, funding commitments have been made toward eight projects with multi-year grants. The total maximum commitment on these projects is \$12,138,800, of which \$2,761,225 was funded during the year (2015 - \$958,700) and of which \$4,146,925 has been funded in total as of April 30, 2016.

Based on the above, total anticipated maximum commitments over the next four years are as follows:

	\$
2017	3,342,125
2018	1,761,375
2019	1,888,375
2020	1,000,000

b) The university is party to a “License to Occupy Premises at the National Research Council” on behalf of the institute for office space. The minimum future commitments under the agreement are as follows:

	\$
2017	162,668
2018	188,918
2019	215,168

The institute has the opportunity to reduce the total cost of the lease payments by the amount of leasehold improvements (approximately \$250,000) provided by the landlord through the development of mutually agreed collaborations during the term of the agreement.



Growing science for life

GIFS | GLOBAL INSTITUTE
FOR FOOD SECURITY

PotashCorp - a Founding Partner

110 Gymnasium Place, University of Saskatchewan, Saskatoon, SK Canada S7N 4J8

PH 1-306-966-3701 | EMAIL info@gifs.ca | WEB www.gifs.ca