

ROTHAMSTED OPEN INNOVATION FORUM



18th – 20th
January 2017

WHITE PAPER

The Rothamsted Open Innovation Forum was designed to accelerate collaboration for the development of game-changing innovations addressing global food and nutrition security challenges. 250 high-level industry experts came together at Rothamsted Research in January 2017 to work collaboratively on cutting-edge solutions to issues spanning the entire agricultural ecosystem, from pre-farm gate to consumers' plates.

Rothamsted Open Innovation Forum

FOREWORD: The global Agri-Food industry faces considerable demands and opportunities in the years and decades ahead. By 2050, the global population is predicted to reach 9 billion and to keep up with that growth **we need to produce more food in the next 50 years than we have in the past 10,000 years combined.**

That's quite a challenge, given the fact that every second we lose a soccer field of farmland to desertification, urbanisation and degradation. But it's a challenge that we can meet, providing researchers, industry and farming communities work collaboratively.

The Rothamsted Open Innovation Forum (ROIF) is designed to bring industry leaders together to help find where there are gaps in our research, how different stakeholders can work together to the benefit of all, and how to put practical solutions into place.

Organised by the Rothamsted Research and Rothamsted Centre for Research and Enterprise (RoCRE), the inaugural ROIF took place from 18th to 20th January 2017 at Harpenden, Hertfordshire, UK.

With generous support from Syngenta, Bayer, the Wellcome Trust, BBSRC and the International Fertiliser Association (IFA), as well as media support from AgFunder, the event attracted around 250 delegates representing over 135 different organisations from around the world.

Drawing on the best thinking from leading European markets and from as far afield as Pakistan, Australia, South Africa, Singapore and America, the forum sought to use Open Innovation to inspire key global security solutions. It included a series of workshops to help solve some of the main problems identified by industry leaders, and the resulting projects will be taken forward into making a real difference on the ground.

The new collaborations formed will be provided with ongoing support by Rothamsted, including the opportunity to become part of AgRIA, the new pre-competitive ideas innovation accelerator based in the Lawes Open Innovation Hub on the Harpenden Campus.

ROIF 2018 will examine the success of each project, explore lessons learned, and consider new challenges to address going forward. We hope you can join us there.



Professor Achim Dobermann, Director & Chief Executive, Rothamsted Research

Day 1 – Young Innovators: Inspiring the next generation

Key message: The secret to entrepreneurial success is determination, adaptability and passion, not just investment.

Chaired by Charlotte Smith, BBC Radio 4's Farming Today

Delegates on day one were treated to a quick-fire succession of presentations from new entrepreneurs about the secrets to success and the barriers to development. Speakers included Aponic's Jason Hawkins-Row who has developed a soil-less growing system for fruit and vegetables and Miha Pipan from Entomics who has found a way to turn food waste into animal feed by farming insects.

Will Wells from Hummingbird explained how he had recruited staff from casinos to develop algorithms for use in predicting crop diseases, while John Prewer from Airponix discussed how he had found common print heads from printers produced the best type of water droplets for hydroponic systems.

Other speakers included Berwyn Clarke from PBD Biotech, Veena Adityan from Smartbell, Siobhan Gardiner from HEROTECH8, Angelo Montiero from Mothive, and Graeme Lister from Ceravision.

The future of Agri-Food workshops

Delegates were invited to suggest the key challenges they would like to see addressed, with 22% voting for tackling resistance to pesticides and antibiotics; 15% for soil health, 14% for data and how to use it, and 12% for how to grow more food and protect the environment. Splitting into informal and energised focus groups, researchers, scientists and farmers brainstormed how to solve such major issues.

It was clear from the day that **adaptability and drive are requisite attributes for successful innovation**, but there are also barriers to development including lack of investment, an over-restrictive regulatory framework, and in some cases, poor public acceptance and understanding of new technology.

The day was rounded off with cocktails and networking at the 17th Century Rothamsted Manor, former family home to the founder of Rothamsted Research, Sir John Bennet Lawes.

Day 2 - Defining what Open Innovation means for Agri-Food

Key message: The opportunity for innovation in the global Agri-Food sector has never been so great or compelling, and collaboration is the only way to succeed.

Chaired by Bianca Forte, Alliance Manager at Rothamsted Research

George Freeman MP provided the first key note speech on day two, highlighting how Brexit offered an ideal opportunity for the UK to create a legislative framework which could pave the way for a new Victorian age of applied science with global impact. “We need global inward investment to our science base to drive out exports of food and technology,” he explained.

By opening its doors to global innovators, the UK could once more nurture beneficial technologies and roll them out across the world to help developed and developing countries alike. “We won’t build a 21st Century economy unless we’re open to the science that we need, and we can’t build a global Britain on a narrow, isolationist platform.”

Mr Freeman said the government had invested heavily in the new Agri-Tech Strategy. In addition to sponsoring key sectors, it was committed to a broader programme, opening up new models of innovation, finance and infrastructure, he added. **“It is my passionate belief that this country needs to produce more for less: globally we need to double food production on the same land area using half as much water. That’s a big challenge, but it’s perfectly do-able. This (forum) has exactly the expertise and cluster of talent we need to be convening.”**

Dr Christian Witt from the Bill and Melinda Gates Foundation explored how technology could be used to help farmers in developing nations to produce more food more sustainably. Smart phones, the internet and open access to data could all be used to speed up technological development and help nations move from subsistence farming to more productive, profitable systems, he said. “We want farmers to be empowered with the knowledge, tools and technologies to improve their livelihoods and lift themselves out of poverty.”

Collaboration has become a key way to foster innovative thinking and drive commercial success. But there are also risks: the danger of sharing sensitive data, patenting of intellectual property, and dilution of ultimate profits.

In his presentation, Wim van Haverbeke, Professor of Strategy and Innovation Management at Hasselt University in Belgium and author of over a dozen publications on Open Innovation, argued that **a founding principle of successful collaboration should be to have**

complementary partners, rather than competitive ones. “And separate commercial activities from theme development.”

When it came to data, the potential to drive efficiencies and speed up scientific development was tremendous, said Dr Jeni Tennison, CEO of the Open Data Institute. **“Our economy is becoming driven by data: information is the founding point on which all other things can be built.”** Setting the framework of how data could be used and shared was vital though, to protect sensitive information while still sharing as openly as possible to benefit the wider industry.

During his session, Roland Harwood of 100% Open brought energy and pragmatic ways in which people could make connections in everyday life through audience participation. “We are just one conversation away from pretty much everything and anything,” he said.

Roland Harwood, founder of 100% Open’s top tips for making collaborative Open Innovation work

1. Start with an interesting question followed by intense bursts of activity
2. Ensure that diverse perspectives are equally represented and heard; seek new ideas from the periphery
3. Curate a programme with an equal mix of online and offline engagement
4. Combine qualitative and quantitative analysis in feedback loops
5. There is no substitute for bold ambition and sheer hard graft

After lunch, Belinda Clark of Agri-Tech East chaired a lively panel discussion on the *Challenges of Working in an Open Innovation Environment*. It soon became clear that Agri-Tech giants like Bayer were embracing Open Innovation, both within their own businesses and throughout the wider industry.

“It is a big mindset change,” admitted Adrian Percy, Global Head of Research and Development at Bayer Crop Science. “But it is such an exciting time to be in Agri-Tech: **Open Innovation is being driven by an explosion in science.** And we’re moving from delivering products to delivering systems and solutions to growers, so there is more need to work with other businesses.”

It was also important to agree a policy on treatment of Intellectual Property, explained Simon O'Brien, patent attorney at DYoung & Co. Working with mutual trust and benefit was the key to successful joint innovation, backed up with ultimate commercial success for both parties.

Dr Andrew Spencer, Head of Knowledge Exchange and Commercialisation at Rothamsted Research, said patenting was not a barrier to Open Innovation. "In some ways it can help. **Collaborating with industry partners means you can develop ways of working to achieve your objectives.**"

The forum then explored the funder's perspective on Open Innovation in a session moderated by Louisa Burwood-Taylor, Editor of AgFunder, USA. Three main options were discussed: crowdfunding, equity investment, and debt. Each had pros and cons, so it was important to find the right solution for the developer and the investor, explained Katrin Burt, Managing Director of Syngenta Ventures. **"You need to get connected with the right people; it's a marriage rather than a date and you need to have trust and respect among the people you're working with."**

The formalities for the day were completed by Malcolm Skingle, Director of Academic Liaison at GlaxoSmithKline, which is using Open Innovation to tackle the big challenges in the medical industry, like malaria and Tuberculosis in African countries. "These are hard questions, and we have to do to it in collaboration," he stressed. "It is also the right thing to do."

A relaxed and informal local ale and curry night provided sustenance to networking into the evening, but not before Prof Angela Karp, Director of Science Innovation, Engagement and Partnership at Rothamsted Research urged all to: *"Take the clear innovative thinking they may have in the shower,"* into the next day's Challenge Workshop.



Day 3 – Addressing pre-competitive challenges together

Key message: International Agri-Businesses, scientists and researchers committed to working together to answer some of the biggest challenges facing global food security.

Chaired by Chris Dunkley, CEO of the Rothamsted Centre for Research and Enterprise

The final day of the forum was all about finding answers to the big questions, with delegates focusing on five key challenges identified by industry leaders.

Project one: Boosting sustainable food production in Africa

Leading this project on African food production at Rothamsted Research is Prof Steve McGrath, Head of Sustainable Agriculture Sciences. Partners include the Bill and Melinda Gates Foundation and the aim is to identify suitable areas on which to intensify agriculture and support local farmers in raising productivity.

Although the project has its roots in the Africa Soil Information Service (AfSIS), ROIF sparked a number of new collaborations which are now going forward. “Representatives from Nestlé joined our workshop and are very interested in our approach, using technology throughout the whole food chain to improve the sustainability of their producers in West Africa,” says Prof McGrath.

“Such companies are interested in the well-being of their farmers; looking at what they eat and whether they can grow sufficient nutritional food – as that affects the sustainability of the cash crop. They also want to show they’re not damaging soil health, but ideally improving it.”

Traditional wet chemistry cannot be used in Africa due to lack of resources, so the AfSIS lab network, using dry spectral analysis, has been set up in 10 African countries. These can be used to analyse soils, manures, fertilisers, crops and end products, enabling advisers to make more informed decisions and ensuring quality control throughout the food chain.

Following ROIF, Prof McGrath has applied for further funding from the Gates Foundation and BBSRC, and the project has also joined forces with communications and technology specialist Barefoot Lightning to create a PhD post. The International Fertiliser Association is also in discussion about a Rothamsted Innovation Accelerator programme for plant nutrition and fertilisers.

“We’re hoping to use these dry spectral techniques in the UK and South Africa to help governments, food and fertiliser manufacturers: by selling these services we can invest further into research projects in poorer areas,” says Prof McGrath.

By mapping African soil quality, it’s possible to target the most productive areas on which to focus food production, he explains. “We’re also working with fertiliser companies to help blend specific products for the particular soil, climate and type of crop to be grown. **It’s all about long-term health and sustainability.**”

Having met such a variety of potential stakeholders at ROIF, Prof McGrath is excited about all the ways in which the project might develop in future. “There are lots of potential offshoots – rolling out in different geographical areas, or developing the next generation of devices; smaller, less expensive techniques which could be used in the field, for example. The opportunities are endless.”

Project two: Sharing agricultural data to boost global biodiversity

Data sharing could yield considerable benefits across the agricultural sector, but there are technical barriers to success. Jon Timmis, Professor of Intelligent and Adaptive Systems at York University, and Dr Sarah Targett, Data Collaborations Lead at Syngenta, aim to overcome those barriers in this project to boost biodiversity. Through computer modelling and data sharing they hope to better co-ordinate activities to connect biodiverse areas and generate cumulative benefits.

Initially focusing on the UK, if the project is successful, it could be rolled out across the globe. “There are three questions: How can you co-ordinate activities so they have a cumulative effect, how can you measure the connectivity between biodiverse rich areas and what role will computer modelling play in that?” says Prof Timmis.

Syngenta has already published open data covering biodiversity projects in over 30 countries and covering 1.6m ha, and is trying to collate more data for even greater environmental benefit. “We need to discover what needs to be in place to share that data easily,” explains Dr Targett. **“In future, more research is going to rely on data that hasn’t been produced by your own company; the real value is building engagement around the data, not just publishing it.”**

Examples include the RSPB’s Big Garden Bird Watch and the Great British Bee Count: by integrating data from different sources it is possible to build a picture of biodiversity in different areas. “The better connectivity you have between biodiverse areas, the more resilience the plants and animals have to disease, bad weather and long term environmental change,” says Dr Targett. “The problem is that the data comes from so many different sources, of varying quality, that integrating it is difficult.”

Alongside Professor Richard Tiffin from the Agri-Tech Centre, Agrimetrics and a group of ecology experts, the project hopes to create a list of indicator species to measure biodiversity and a list of proxies if data on those species isn’t available. “We can then look at ‘noisy’ data – which previously could not be understood and interpreted correctly – and mine it for information,” explains Dr Targett.

“We want to use this proof of concept work to show that noisy data can be mined and thus demonstrate the value of bringing biodiversity data of various qualities together. In this way we hope to inspire others to use data to enable biodiversity to flourish.”

Project three: Improve data sharing between farmers and related industries

Syngenta is also involved in a second data-sharing project which ultimately could benefit farmers, their advisers, researchers – the whole food chain. The aim of the project is to create virtual data lockers, which contain farmers’ information and which they can choose to share with anyone they like. “It will give farmers the ability to take control of their data,” says Syngenta’s Science and Technology Fellow Derek Scuffell, who is leading the project.

“Boosting farmer confidence in security and data management will be critical to unlocking the potential that technology holds,” he explains. “But we also need to work out how to make data shareable in a way that its ownership remains legally defined.”

There are two main aspects to the project: unifying data from different sources and building a consistent framework for describing it, and identifying the areas in which it could be used. “One of the lowest risk options to begin with is research, perhaps into blackgrass,” says Mr Scuffell. “There is an appetite for sorting out blackgrass in both the farming and research communities. If farmers have data that would be of use to researchers, and vice versa, they could share it via the data lockers.”

In this way, research findings could be rolled out more quickly to deliver real benefits on the ground, he explains. “At the moment researchers only really have split or trial plot data – there’s not enough real farm data. **By improving information sharing, we can power research to bring in new farm solutions.**”

Dr Paul Neve, a weed biologist at Rothamsted Research, has already helped establish a network of 71 farmers who are sharing management data as part of the Blackgrass Resistance Initiative (BGRI). “In our experience, farmers have been happy to share data, particularly where they see a benefit in dealing with a major agronomic issue on their farm,” he says. “Every field with blackgrass can be viewed as an ‘experiment’ in blackgrass management and there are large benefits to ‘crowdsourcing’ farmer data to understand how farm management is impacting efforts to control herbicide resistant blackgrass.”

The data locker could also reduce form-filling for farmers: rather than manually entering the information for different farm assurance schemes or Defra surveys, they could simply choose to share that data, he adds.

“The next step is to get the core project team to meet again at Rothamsted, define the project parameters, and secure some funding.” Partners who have expressed interest at this stage include Rothamsted which will carry out the data research, Craigmore Farming representing the farmer’s views, and Syngenta on data integration. “This idea will naturally need technology and service design thinking, from a group such as the Agri-Tech centre, Agrimetrics, which would also be involved,” says Mr Scuffell.

Other uses of the data locker include benchmarking for farmers and more consistent provenance for consumers. “By adopting the same vocabulary, we could unify quality assurance schemes,” he explains. Agricultural supply companies and advisers could also use the locker to deliver farm-specific services in one place. “We’re not changing what they’re doing, just using common data locker language,” says Mr Scuffell. “It also improves portability: if farmers want to change from one provider to another, they can do so and just take their data with them. Rather than being locked in, the farmer is back in control.”

Project four: Securing social acceptance for crop protection technologies

Agri-Science is moving on apace, but never before has there been such a disconnect between the general public and farming. There is gross misunderstanding about how food is produced and serious mistrust of farming practices, modern genetics and agro-chemicals. It is therefore essential to improve consumer understanding of new technological improvements and the benefits it can bring to wider society.

“There is a public recognition of the link between science and medicine but not between science and agriculture,” says Bernard Leroux, project leader and Head of R&D Portfolio Management at Bayer. “We need to address that; as more agricultural science will be needed in the future.”

Over the past 40 years, the industry has been very successful in producing more food, of higher quality, and at an affordable price, than ever before. But over that time it has lost public support and understanding, which is something that now needs to be redressed. **“We need to talk to people about what we do and what’s required in the future: we have to make our science more transparent and understandable, and create a common vision for where we want to go,”** explains Mr Leroux.

The biggest challenge is deciding who takes responsibility for communicating those messages – and from the brainstorming session it appeared there were lots of potential routes. “We need to talk to politicians to avoid ever more constraints and raise money for research and development,” says Mr Leroux. “We need better understanding throughout the food chain, and we have to tackle the criticism levelled by non-governmental organisations. But this can’t all come from the industry itself.”

Science and agriculture are both under-represented in the media, and delegates suggested the appointment of a public influencer to champion agricultural science, perhaps creating a television show melding food and science gurus like Jamie Oliver and Brian Cox. “The key is to be telling stories, engaging the public with emotion backed up by science, rather than just facts alone,” says Mr Leroux.

Modern farming is increasingly sensitive to the environment, and cutting edge science can help with that, he explains. “You cannot disconnect the two – you have to consider the whole picture, and we need people who can translate the story into something the public can understand and engage with, to build together a better future, not mourning the past.”

Mr Leroux is hoping to reconvene the group to take some of these ideas forward, and may seek collaboration with computer developers to create a new online farming game. “Many people play farming games on their phones – perhaps there is scope to get our messages across the younger generation in a new and innovative way.”

Project five: Develop understanding of the plant microbiome, leading to enhanced crop health and productivity

Scientific understanding of plant biology has advanced tremendously in recent years, as has awareness of the inter-relationship with other organisms that comprise the microbiome. Soil and plant health is all about the interaction between these different organisms, and, by further improving our understanding of these relationships, the Agri-Tech industry can develop new products and advice to sustainably boost agricultural productivity.

Dr Matthew Ryan, Curator of the Genetic Resource Collection at the Centre for Agriculture and Biosciences (CABI) is bringing together an international team to tackle this subject. “The plant microbiome is hugely important. We want to collaborate with global microbiome networks and co-ordinate the research alongside academics and the wider industry to generate innovative projects,” he says.

One of the main challenges in this relatively new field is that there are many disparate groups working in silos – the key is to bring them all together. “We have already scheduled a meeting with about 30 stakeholders, with a view to creating a secretariat, and have three other potential collaborative projects to develop, with others in the pipeline,” explains Dr Ryan.

The first is a project focussing on the microbiome in wheat and maize crops, the second covers collation and sharing of data, and the third is about developing new technologies to help researchers find the solutions they need.

“In the same way that understanding the human microbiome is unlocking treatment solutions for humans, the same opportunities exist with the plant microbiome to improve plant and crop viability for the ultimate benefit of human and animal health and environmental sustainability,” he adds.

Dr Penny Hirsch, Soil and Plant Microbiologist at Rothamsted, says gene sequencing is opening up new opportunities for plant health and productivity. “It’s very exciting. We don’t

know how all of these microbes interact, but a complex group could, for example, protect plants from a particular pathogen. By understanding what drives the maintenance of a healthy microbiome we can exploit that knowledge to reduce reliance on conventional crop chemistry, or at the very least learn how to use it synergistically without damaging the beneficial bacteria.”

Treating crops with beneficial microbes can also help improve root growth as well as protect against disease, explains Dr Hirsch. “The healthier the soil and plants, the more resilient they are to adverse conditions.” The research therefore stands to benefit sustainable crop production both in the developed and developing world. “Using Open Innovation will help us to better understand what the industry needs, and therefore the areas of research on which we need to focus.”



Conclusion

We are living in a golden era of advances in science and technology, and Adrian Percy, Global Head of Research and Development at Bayer Crop Science, believes the importance of cross-industry collaboration will continue to grow.

“Industry and academic collaborations are often instrumental in putting new inventions and technologies into the hands of those who need and use them,” he says. Enabled by digitalisation, many technological areas are currently colliding which will allow the development of completely new types of applications and solutions, including the integrated use of drones, precision farming and self-driving tractors, for example.

These types of advances in agriculture technology are essential, adds Dr Percy. **“There is a clear need to both increase and improve food production in a sustainable manner if we are to ensure the availability of healthy and nutritious food for all.”**

“To meet this grand challenge, we need effective collaboration both across industries and with universities and research institutions, as it is clear no one entity can do this important work on its own in this fast-paced and complex environment,” he explains. “The ability of academia to pave the way for critical scientific breakthroughs and the capabilities of small, medium and large companies to deliver impactful products to end users will be the winning combination that we need.”

This innovation ‘ecosystem’ was in full evidence at ROIF 2017, says Dr Percy. “The atmosphere was electric and reflective of similar efforts that we are seeing in all corners of the planet. Innovation isn’t just one person in a lab creating a solution for one particular challenge. Open Innovation, partnerships, peer reviews and collaborations are just some of the ways new innovations will come to our fast-paced world.”

Unlike conventional conferences, the Rothamsted Open Innovation Forum was aimed at helping to take the key challenges identified forward into multi partner collaborations that really deliver in practice, says Bianca Forte, Alliance Manager at Rothamsted Research. “We are offering our conferencing facilities free of charge to those teams, and hope to nurture any resulting business start-ups or research ventures on-site under our Agritech Research Innovation Accelerator Programme (AgRIA).”

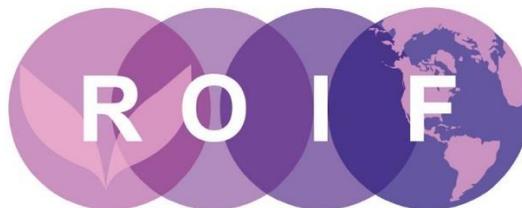
Saskia Heijnen, portfolio lead on Our Planet, Our Health at the Wellcome Trust, which partnered the event, says it is vital to find a sustainable balance between global food systems and environmental health. “Natural systems that we rely on – from clean air to fresh water, biodiversity to a stable climate – are under threat,” she says. “As researchers discover more links between our health and the environment, we become better equipped to come up with ways to reduce these threats. There are already opportunities for change, but more research and action is needed.”

Angela Karp, Director of Science Innovation, Engagement and Partnerships at Rothamsted Research adds: **“Open Innovation is all about partnerships. There is a real need for us to pull together to tackle some of these big issues. We need a strategy and an action plan, and we are delighted that ROIF has helped to facilitate this.”**

“Did we achieve what we set out to do?” reflected Chris Dunkley CEO of ROCRE and the ROIF Programme Director. “By all accounts, yes, we sought to define what Open Innovation really meant for the Agri-Food sector and demonstrated this immediately by helping form a number of collaborative communities around key challenges. There is overwhelming support for a repeat event next year so it looks like our delegates saw value in an ongoing programme.”

Rothamsted is working to enable further innovation through investment into an innovation campus; delivering events that change the way in which research scientists work together including ROIF, and the development of a unique innovation programme for development of pre-competitive ideas, the **AgriTech Research Innovation Accelerator, AgRIA**. For more information, visit roif.co.uk.

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inspiring global food security solutions