Agri-Tech, Agriculture and Plant Sciences at the University of Cambridge

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The University of Cambridge

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Please click the image to watch the video: ‘Agritech and the future of farming in the East of England.’
Operations, technology adoption and behavioural economics perspectives in industrial policy implementation and the role of technology intermediaries.

Agricultural burning, or the burning of crop residues before or after harvest, is currently a great hindrance to sustainable development especially in the global south. The practice releases GHG and black carbon, which has 460-1500 times stronger global warming impact than CO2 per unit of mass, and smallholder farmers have difficulties following regulations imposed on burning. This presentation gives an overview of the issue and of my research which aspires to study how agricultural burning can be solved by understanding the farmer's behavioural limitations hindering technology adoption, as well as the different methods of technology transfer.

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Participating Projects

Operations, technology adoption and behavioural economics perspectives in industrial policy implementation and the role of technology intermediaries

A study on technology transfer for agricultural burning reduction in the agri-food supply chain

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Dr. Mukesh Kumar
Dr. Eoin O'Sullivan
Institute for Manufacturing, Department of Engineering, University of Cambridge

Please click the image to watch the video.
Enhancing Growth in a Roof Top Garden with Indoor CO2 from Human Respiration

“CO2 was measured in air inside classrooms and being emitted from the exhaust vents on the roof of a school to find increased concentrations averaging over 1000 ppm during the day when people were present. Crops were grown in a rooftop garden next to these exhaust vents and the plants were found to grow larger with the application of indoor air.”

Researcher
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Participating Projects

ENHANCING GROWTH IN A ROOF TOP GARDEN WITH INDOOR CO₂ FROM HUMAN RESPIRATION

Authors: Elizabeth Buckles, Rebecca Nigalase, Matthew Phillips

Background
A rising population, expected to occur mostly in cities, will require increased food production (BP, 2002). Climate change is another crucial challenge facing humanity over the next century. Both of these issues will place more stress on already crowded urban environments. To mitigate the effects, solutions should be designed to be sustainable and address climate change at the same time.

One potential approach is to construct rooftop gardens. These can provide many environmental, social, and health benefits (Oriani et al. 2016, Ahmed et al. 2017). A challenge facing rooftop gardens is decreased growth due to more extreme environmental conditions such as higher wind and temperatures, heightened solar radiation, and limited soil moisture content. Human breath has high concentrations of CO₂, which builds up in indoor spaces. Exhaled CO₂ can increase performance of plants, but can cause a CO₂ fertilization effect in plants, which can limit growth. This project aims to enhance growth in rooftop gardens by transpiring waste CO₂ from inside all buildings from human respiration.

Abstract
Climate change will increase storm intensity, heat waves, and more. Rooftop gardens provide both a source of food in urban environments and a means to combat climate change by increasing carbon dioxide. Decreasing urban heat, food, and helping manage stormwater in cities. We enhanced growth in rooftop gardens by transpiring waste carbon dioxide (CO₂) from inside buildings produced by human respiration. We first determined the amount of CO₂ emitted and emitted from exhaust vents and the buildings and then set up a rooftop garden at the end of an exhaust vent to test for the effect of applied CO₂.

Results
Growth was significantly higher in the gardens exposed to vent air, which contained higher concentrations of CO₂. The potential for more rooftop greenhouses could encourage the construction of more gardens in cities.

Methods
CO₂ sensors (Gorend Hele-MV-102) were placed in 12 classrooms inside Bedford University for one week. Sensors were also placed on a rooftop exhaust vents at the Bedford University Academy. The first two weeks were taken and the second week was taken. Sensor plants were planted and planted at several spots in September. The garden next to the vents connected to the city air and then circulating air into the rooftop garden.

System and Results

Contact Information: REAP2021@cam.ac.uk
www.carbonfarm.net
The Peas’n Chips Project

The Peas’n Chips Project aims to rehabilitate a forgotten African crop, the African Yam Bean (*Spehenostylis stenocarpa*) in Nigeria. This crop can be consumed for both beans and tubers, and has very high protein content due to its ability to fix atmospheric nitrogen. Therefore, this crop has high potential as an alternative and sustainable crop of the future.

The project is an interdisciplinary research collaboration between scientists from University of Cambridge (UK), and the International Institute of Tropical Agriculture (IITA, Nigeria). They are a group of plant biologists and sustainable innovation academics working together with a passion for African Yam Bean. They work with Nigerian farmers to understand their real-world challenges and needs and make informed decisions in translating our scientific findings to the field. The initiative will pave the way to better food security in Nigeria and Sub-Saharan Africa.

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Participating Projects

The IITA and University of Cambridge
(funded by Global Challenges Research Fund)

Peas’n Chips Entrepreneurs:
Rehabilitating African Yam Bean for Food Resilience
and Soil Health in Nigeria (Bean-preneurs)

Please click the image to watch the video.
Peas’n Chips: Sustainable tubers and beans on one plant, African Yam Bean

- Scientific name: *Sphenostylis stenocarpa*
- Originates from Ethiopia and used to be grown all over Africa
- Both beans and tubers are edible: eaten for beans (West Africa) or tubers (East and Central Africa)
- High protein in beans and tubers - alleviate malnourishment in Nigerian Civil War (1967-1970)
- Higher seed yield per unit land with up to 3000 kg/ha
- Drought-resistant
- Nitrogen-fixing nodules – enrich soil with nitrogen, good for intercropping
- Grown by old farmers – acreage is declining
Participating Projects

AFRICAN YAM BEAN WORKSHOP COMMUNIQUÈ

A stakeholders’ “Prioritization Workshop on African Yam Bean” was held on 18 May 2021 at the International Institute of Tropical Agriculture (IITA), Ibadan, physically and online through Microsoft Teams. The workshop was under the auspices of the Global Challenges Research Fund (GCRF, Bean_preneurs) and the Cambridge-ALBORADA-supported projects: ‘Peas’n Chips Entrepreneurs: Rehabilitating African Yam Bean for Food Resilience and Soil Health in Nigeria’ and ‘Characterizing Tuber Development in African Yam Bean’, respectively. The multidisciplinary projects are a partnership among IITA, the University of Cambridge, and University of Ibadan, Nigeria.

Participants at the workshop were drawn from academia, farmers’ communities, hospitality industry, non-governmental organizations, private seed companies, and government agencies and ministries at federal and state levels. The workshop presented an opportunity for discussion on prospects for resuscitation of the African yam bean value chain.

The participants included representatives from the University of Ibadan, University of Cambridge, IITA, hospitality outfits, Federal Ministry of Agriculture and Rural Development personnel, Agricultural Development Program officers, technical and extension experts, selected farmers and their spouses from Oyo, Osun, Ekiti, and Delta states of Nigeria, current and potential entrepreneurs, and environmental scientists.

Please click the image to access the full document.
Recipes from
African Yam Bean

Ingredients
- 1 cup bean
- 1 cup sweet corn
- 2 spoons palm oil
- 1 tomato
- 1 scotch bonnet rodo (pepper)
- 1 big onion sliced
- Handful dried crayfish
- 1 Knorr cube
- Salt to taste

Method
- Blend the bell pepper, tomato and scotch bonnet to a smooth paste and set aside
- Pick and wash beans
- Soak the beans for 24 hours with hot water to avoid cooking for too long; this helps to soften it prior to the cooking process and reduces the flatulence.
- Boil in ordinary or pressure pot
- Make your sauce by frying the pepper in palm oil
- Check the beans when it is half done; add the sliced onion and salt
- Continue to cook till tender
- When tender, add fried stew then stir
- Add the fresh corn and cook for 10 minutes
- Add crayfish
- Leave to cook for 5 minutes
- Serve hot

Please click the image to access the full document.
The **Department of Plant Sciences** is made up of 24 research groups whose long-term aim is to contribute to global food security, growing a sustainable bioeconomy and protecting the environment.

**Contact details:** [https://www.plantsci.cam.ac.uk/](https://www.plantsci.cam.ac.uk/)
Strategic links both within Cambridge, as well as across the East of England and further afield, allow the Department to make the best use of its science.

Recent discoveries include:
- Disorder in nanoscale ridges on petals has evolved repeatedly to help attract pollinators
- The smoke receptor in plants conditions recognition of symbiotic fungi
- Potent greenhouse gas production from lakes is influenced by neighboring vegetation
- Standardisation of DNA parts for use in plant synthetic biology
- Principles underlying the spread of disease in plant communities and crops
- Identification of molecular partners that allow circadian rhythms to be controlled by sugars
- Using chronoculture in agriculture and crop breeding for higher yields
- First visualisation of the colonisation of plant roots by fungi arbuscular mycorrhiza in real time
Some of the Department of Plant Science’s recent research:

New research shows chronoculture could make food production more sustainable.

Researchers visualise for the first time the colonisation of plant roots by fungi in real time.

European lakes potential hotspots of microplastic pollution.

Researchers discover ancient protein domain.
The **Crop Science Centre** combines the diverse skills and expertise of the University and NIAB, providing an environment for research excellence, with the capability to apply discoveries to crop improvement in the field. The Centre focuses around three key pillars of research activity: Crop Nutrition, Pests and Diseases, and Improving Photosynthesis.

**Contact details:** [https://www.cropsciencecentre.org/](https://www.cropsciencecentre.org/)
The Sainsbury Laboratory Cambridge University (SLCU) is a research institute funded by the Gatsby Charitable Foundation. The aim of the Laboratory is to elucidate the regulatory systems underlying plant growth and development.

Contact details: [https://www.slcu.cam.ac.uk/](https://www.slcu.cam.ac.uk/)
The **Algal Innovation Centre (AIC)** is a Centre for Excellence with test and scale-up facilities. It connects the entire pipeline of algal research from strain selection and improvement, through harvesting and processing, to development of underpinning technology and engineering solutions.

**Contact details:** [https://www.cambplants.group.cam.ac.uk/cambridge-bioenergy-initiative/AIC](https://www.cambplants.group.cam.ac.uk/cambridge-bioenergy-initiative/AIC)

Centre manager: Dr Payam Mehrshahi, pm579@cam.ac.uk
The laboratory is a secure, research grade glasshouse on a sealed foundation with gross floor area of 164 sq. meters. It has laboratory grade benching, RO water supply, environmental data collection, access to autoclaving, centrifugation and a wide range of algae reactors. The AIC is open for academic and industrial research collaborations.

Some of the AIC’s recent research:

- Exploring the Impact of Terminators on Transgene Expression in *Chlamydomonas reinhardtii* with a Synthetic Biology Approach.

- Synthetic algal-bacteria consortia for space-efficient microalgal growth in a simple hydrogel system.

A heterogeneous microbial consortium producing short-chain fatty acids from lignocellulose.

Development of Novel Riboswitches for Synthetic Biology in the Green Alga Chlamydomonas.

Responses of a Newly Evolved Auxotroph of Chlamydomonas to B12 Deprivation.

Bionic 3D printed corals.

Snow algae communities in Antarctica: metabolic and taxonomic composition.
The IfM’s research aims to help:
Companies develop life-changing products and services, build better businesses, create meaningful jobs, and improve the environment for the future.
Governments foster innovation and enterprise to deliver social and economic benefits.

Contact details: https://www.ifm.eng.cam.ac.uk/

Some relevant articles and editorials:
Global supply chains

Improving food allergen management in food manufacturing: An incentive-based approach
The Synthetic Biology Interdisciplinary Research Centre provides a hub for anyone interested in Synthetic Biology at the University of Cambridge and beyond. We promote interdisciplinary exchange at the intersection of biology, engineering, computing and design.

- Talks, seminars and webinars
- Networking events
- Training for researchers
- Funding for interdisciplinary projects
- Building and sharing open tools and technologies

www.synbio.cam.ac.uk
The Cambridge Global Food Security IRC is a virtual network of researchers across the University, from crop scientists and engineers to specialists in policy, economics and public health. It promotes interaction and knowledge sharing, and supports collaborative research to address the issues surrounding food security at local, national and international scales.

Contact details: [https://www.globalfood.cam.ac.uk/](https://www.globalfood.cam.ac.uk/)
TIGR2ESS is a large-scale project drawing together partners from research, industry, government and NGOs in the UK and India.

Objectives:
To define the requirements and set the policy agenda for a 'second Green Revolution' in India, framed by demographic changes affecting rural communities and feminisation of smallholder farming systems.

To develop and strengthen alliances across a carefully selected network of UK and Indian experts, to build a collaborative, long-term research partnership in sustainable agriculture that will set India on the path to a second Green Revolution.

Contact details: https://tigr2ess.globalfood.cam.ac.uk/
Please click the image to watch the video: ‘TIGR2ESS - Shaping the Future of Indian Farming.’
Numerous research papers have been produced, with a selection below:

From cotton to paddy: Political crops in the Indian Punjab

Stomatal responses to light, CO2 and mesophyll tissue in Vicia faba and Kalanchoë fedtschenkoi

Aegilops umbellulata introgression carrying leaf rust and stripe rust resistance genes Lr76 and Yr70 located to 9.47-Mb region on 5DS telomeric end through a combination of chromosome sorting and sequencing

Lipid residues in pottery from the Indus Civilisation in northwest India

Digital supply network design: a Circular Economy 4.0 decision-making system for real-world challenges

Rural women entrepreneurship: a systematic literature review and beyond
MillNETi (Millets and Nutritional Enhancement Traits for Iron bioavailability) aims to improve the iron nutrition status of people living in Ethiopia and The Gambia by assessing, and suggesting ways to optimise, the bioavailability of iron from biofortified pearl millet and local finger millets.

Contact details: [https://www.niab.com/research/agricultural-crop-research/research-projects/millneti](https://www.niab.com/research/agricultural-crop-research/research-projects/millneti)
Please click the image to watch the video: ‘The MillNETi project’
‘Agriforwards’ is the world's first EPSRC Centre for Doctoral Training (CDT) in Agri-Food Robotics. **Agriforwards CDT** has been established by the University of Lincoln in collaboration with the University of Cambridge and University of East Anglia.

Agriforwards CDT provides a unique blend of technical expertise, outstanding research environment and, most important, integral industry collaboration in Agri-food Robotics.

Main website - [https://agriforwards-cdt.blogs.lincoln.ac.uk/](https://agriforwards-cdt.blogs.lincoln.ac.uk/)

University of Cambridge - [https://agriforwards.eng.cam.ac.uk/](https://agriforwards.eng.cam.ac.uk/)
Selected recent research:

- Improving Robotic Cooking using Batch Bayesian Optimization
- A field-tested robotic harvesting system for iceberg lettuce
- Non-Destructive Robotic Assessment of Mango Ripeness via Multi-Point Soft Haptics
- Achieving Robotically Peeled Lettuce

Robot uses machine learning to harvest lettuce

209 views • 7 months ago

(Video and text courtesy of the University of Cambridge Press office)

Crops such as potatoes and wheat have been harvested mechanically at scale for decades, but many other crops have to date resisted automation. Iceberg lettuce is one such crop. Although it is the most common type of lettuce grown in the UK, iceberg is easily damaged and grows relatively flat to the ground.

Please click the image to watch the video to access AgriFoRwArds CDT YouTube Channel
Informing consumers about the food system and how we can make it healthier and more reliable.

As a partner in #AnnualFoodAgenda, the University of Cambridge organises public events and out-reach activities in schools that address the project’s four themes.

Sustainable Agriculture
Circular Food Systems
Targeted Nutrition
Alternative Proteins

#AnnualFoodAgenda is funded by EIT Food, the main European food innovation initiative. EIT Food is a consortium of key industry players, start-ups, research centres and universities from across Europe.
Sustainable Agriculture

Click on the titles to watch:

How new technology is making agriculture more sustainable from Grupo AN.

Three University of Cambridge Sustainable Agriculture Research Projects explained.

Land sharing or land sparing: What’s the best way of farming for nature?

Circular Food Systems

Click on the titles to watch:

Why we should feed pigs on food waste (event recording).

Plastic in the food chain – the pros and cons.

Recirculation technologies used in aquaculture to reduce CO2 emissions and water usage.
Alternative Proteins
Click on the titles to watch:

Cellular Agriculture an introduction from VTT in Finland

The proteins of the future, by iMDEA in Spain

Targeted Nutrition
Click on the titles to watch:

What makes it difficult to eat a healthy diet?

How can we change our diets to make them more environmentally friendly?
Please direct any enquiries to:

CambPlants

A networking organisation for plants-related research and impact.

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