Current CSIA funded research:

- Chasing the high-fliers: Aerial sampling and flight capacity of high-flying migrant insect pests in China
- Amelioration of soil acidification from long-term chemical fertilizers combined with organic materials
- Modelling management scenarios for fertiliser input to reduce greenhouse gas emissions and improve soil quality in Chinese upland soils
- An integrative study of water flow, hormone transport and the associated microbial activities and nutrient cycling in soil-root-shoot system under different soil water conditions

CSIA Travel Fellowships:
Kamrun Suravi

Chasing the high-fliers: Aerial sampling and flight capacity of high-flying migrant insect pests in China

**Project Lead(s):** Dr Jason Lim (Rothamsted); Prof Dengfa Cheng (Chinese Academy of Agricultural Sciences).

**Project Members:** Assoc Prof Yunhui Zhang (Chinese Academy of Agricultural Sciences); Mr Philip Gould and Dr Chris Jones (Rothamsted); Assoc Prof Jason Chapman (University of Exeter); Prof Hongqiang Feng (Henan Academy of Agricultural Sciences); Assoc Prof Gao Hu (Nanjing Agricultural University).

**Project start date:** October 2016

**Duration:** (18 months)

**Project Summary:** This project will complement an existing Newton Fund Project which uses remote sensing and modelling approaches to assess the effectiveness of biopesticide control for Oriental migratory locusts. Rothamsted’s component of the project is to investigate the role that vertical-looking entomological radar (VLR) can play in monitoring the effect of regional-scale control measures on aerial insect populations and the possibility that locusts can outbreak from their breeding areas. In autumn 2016 we shall deploy a Rothamsted VLR at the HAAS experimental farm in Zhengzhou, Henan Province in east-central China.

In this new project, we shall carry out high-altitude aerial sampling to determine the exact nature of the aerial insect fauna detected by the radar. This will corroborate radar findings and inform local cropping systems of the potential threat posed by insect pests. In addition, the proposal will deploy field-prepared tethered flight mill systems to analyse the flight behaviour and migratory potential of pest moths caught at the lowest gate of the vertical looking radar (150-200 m). This will be the first time such technology has been used *in situ* to determine the flight capacity of insect pests. Insects caught ‘en route’ will be flown on the flight mills and sampled for downstream molecular analysis to determine the genetic mechanisms of migratory behaviour. By capturing insects during their migration these samples will provide the ideal migratory phenotypes to compare with more sedentary populations of the same species.

Amelioration of soil acidification from long-term chemical fertilizers combined with organic materials

**Project Lead(s):** Dr Tom Misselbrook (Rothamsted); Zejiang Cai (Chinese Academy of Agricultural Sciences).

**Project Members:** Dr Shilin Wen, Assoc Prof Shiwei Zhou and Prof. Minggang Xu (Chinese Academy of Agricultural Sciences); Dr Alison Carswell (Rothamsted); XueJun Liu, Qichao Zhu and Sen Wang (China Agricultural University).
**Project start date:** September 2016  
**Duration:** (24 months)  
**Project Summary:**  
Soil acidification from the long term overuse of chemical nitrogen (N) fertilizers has become a serious global issue for agricultural production that requires the adoption of more sustainable fertilization strategies. Long-term manure applications can prevent or even reverse soil acidification arising from chemical N fertilizers and enhance nitrogen use efficiency (NUE). This has been demonstrated in a 26-year long-term experiment in Qiyang, Hunan province, South China. To date, however, little is known regarding the mechanisms, especially for different types of organic material, by which soil acidification is modified. The goal of this project is to investigate the effects of manure, crop residues, and litter from grass and trees on soil acidity and their relationship with C and N transformations in soil, and to elucidate how organic materials may affect the soil acidification processes arising from chemical N application. Three long-term fertilization experiments (two 7-year and one 26-year) from Qiyang Experiment Station in China and the >100-year-old experiments at Rothamsted Research will be used to collect data from different treatments. Soil pH, exchangeable acidity, exchangeable base cations, pH buffering capacity, and soil organic matter will be measured from all treatments, soil acidification rate will be estimated and all the data will be statistically analyzed for conclusions.

**Modelling management scenarios for fertiliser input to reduce greenhouse gas emissions and improve soil quality in Chinese upland soils**

**Project Lead(s):** Dr Lianhai Wu (Rothamsted); Prof Nan Sun (Chinese Academy of Agricultural Sciences); Xubo Zhang (Chinese Academy of Sciences).  
**Project Members:** Prof Yinghua Duan, Fengling Ren, Prof Minggang Xu, Prof Wenju Zhang (Chinese Academy of Agricultural Sciences); Dr Kate Gongadze (Rothamsted), Prof Chunsheng Hu (Chinese Academy of Sciences).  
**Project start date:** January 2017  
**Duration:** (12 months)  
**Project Summary:**  
Different fertilization strategies together with climate change will alter soil carbon (C) and nitrogen (N) cycling. Great uncertainty still remains in identifying soil C and N turnover and distribution in soils under different fertilization strategies and climate conditions. We will use a process-based model to quantify soil C and N cycling and crop yield under the environmental change and with different fertilisation strategies. The SPACSYS model developed by Wu is chosen for the study because it is a process-based, field scale, weather-driven and daily-time-step dynamic model that can simulate plant growth, N and C cycling in multiple fields simultaneously. The aims of the proposed research are:  
- to validate the SPACSYS model using the dataset collected from the long-term experiments in China under different fertilization strategies and climate;  
- to predict dynamics of soil C and N pools and the GHG emissions under various fertilization practices and future climate scenarios;  
- to provide suitable fertilization strategies to alleviate the negative impacts from climate change on soil fertility and environmental services.

Data and modelling are brought together to help deliver sustainable soil fertility while minimise negative impacts on ecosystem services in various climatic zones. The study will enrich and improve the understanding in control factors and mechanisms of both nutrients and climate impact on soil carbon and nitrogen turnover under various climatic and soil conditions and different fertilisation strategies, and provide scientific guidance for increasing soil fertility and sustaining agroecosystem services.
An integrative study of water flow, hormone transport and the associated microbial activities and nutrient cycling in soil-root-shoot system under different soil water conditions

**Project Lead(s):** Dr. Xiaoxian Zhang (Rothamsted), Dr. Jingsheng Sun (Chinese Academy of Agricultural Sciences)  
**Project Members:** Dr. Yang Gao, Dr. Yuan Liu, Dr. Hezhou Wang (Chinese Academy of Agricultural Sciences); Dr. Andrew Neal and Dr. Marc Redmile-Gordon (Rothamsted); Dr. Junli Liu (Durham University); Dr. Zhenjun Yang (Zhejiang University)  
**Project start date:** November 2016  
**Duration:** (24 months)  
**Project Summary:**  
One challenge in constructing sustainable agriculture is to improve resource use efficiency and effectively manage the wastes produced in agricultural production. The purpose of this project and the following-on activities are to 1) systematically investigate and model water flow and hormone transport in soil-root-shoot system and their associated impact on microbial activities and nutrient cycling in soils, 2) movement and transformation of antibiotics and metabolism flow in soil.  

For the soil-root-shoot system, we have developed systematic models to describe the cross-talk of hormones (auxin, cytokinin, ethylene and ABA) and their spatial distributions at cellular scale in a single root. We also developed methods to determine the dynamic change of rhizosphere hydraulic property due to root growth. This project is to scale-up this single-root model for water flow and hormone synthesis and transport to a whole plant by explicitly resolving the rhizosphere, the root and shoot architectures. We will also analyse the microbial communities and develop model to describe hormone transfer between the microbes and the root. Success in these will fundamentally improve the ways we model soil-root interaction as currently, most root models are phenomenal, ignoring the role of hormones in coordinating root growth and responding to change in soil environments.

In parallel with the above work, we will also investigate the movement and transformation of antibiotics and antibiotics genes in soils. In particular, we will analyse the metagenomics of soil organisms under different conditions and establish genome-scale metabolic network models to systematically analyse how metabolism transfer in soils under different environments.

**CSIA Travel Fellowship: Mrs Kamrun Suravi, PhD student**

**Purpose of funding:** To allow Kamrun Suravi to spend three months in the laboratory of Prof. Tusheng Ren (Dept of Soil and Water, China Agriculture University) to conduct thermogravimetric (TG) measurements and to fund Dr. Whalley to visit for one week to ensure that the project is proceeding smoothly.  
**Expected outputs:** In the short term, a joint paper in a high impact soil science journal. In the longer term we expect that the use of thermogravimetric (TG) measurements and related approaches will gain traction in their application at interpreting the effects of soil organic carbon (SOM) on soil physical and other properties.