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UK-India workshop on food-crop production

Introduction

In October 2008, the Royal Society and others held a two-day, multilateral workshop on food crop production at the National Institute for Plant Genome Research, Delhi.[1] This event brought together sixty scientists from the UK, India, Brazil, South Africa and Mozambique to discuss the current and predicted challenges to world food-crop production, scientific possibilities for enhancing food-crop production and barriers to the application of science and technology. The intention was to explore some of the cross-cutting themes which are relevant to scientists working in this area, rather than to serve as an exhaustive review of the state of the science. The discussion at the workshop has fed into the Royal Society's current study into the biological approaches to enhance food-crop production, which is due to be completed in autumn 2009.

Background

Global population is expected to increase significantly over the next thirty years. According to the United Nations, food production must rise by 50% by 2030 if the increased demand caused by rising population is to be met (United Nations, 2008). Despite the developments of the green revolution in the 1940s-1960s, which led to a rise in productivity in certain regions, hundreds of millions of people remain untouched by the resulting technological advances which took place. Agriculture is central to three of the Millennium Development Goals (United Nations, 2000):

- the eradication of poverty and hunger;
- ensuring environmental sustainability; and
- developing a global partnership for development.

[1] The workshop took place on 17th and 18th October 2008, in partnership with the Department for Innovation, Universities and Skills, the British High Commission in India, the UK-India Education and Research Initiative, the Indian Ministry of Science and Technology and the Indian Department of Biotechnology.

Challenges to food-crop production

The workshop attendees discussed the diverse challenges facing food-crop production. Total worldwide energy demands are expected to increase by 45% from 2006 - 2030 (International Energy Agency, 2008). This will put a limit on the energy inputs for agricultural systems, as well as raising questions over land use and the supplanting of food crops by biofuels. Increasing levels of urbanisation result in additional challenges for land use and food distribution. Currently 47% of the world's population live in cities, and this is expected to rise to 60% by 2030. Water scarcity is a growing problem. One in three people worldwide are already facing water shortages, and demand for water is expected to increase still further. Crops need to be protected from pests and disease whilst maintaining biodiversity. 30 – 40% of the major world food crops are lost before harvest due to pests and disease. Increasing levels of ground level ozone have been shown to reduce crop yields. Climate change is placing a significant additional strain on the system. Agricultural systems must adapt to changes in climate, and agriculture must also be carried out in a manner which minimises greenhouse gas emissions.

Key research areas, technologies and policy issues

The attendees at the meeting discussed some of the key research areas that are critical to increasing food-crop production, relevant technologies and the policy issues raised by their implementation. These are outlined in the diagram overleaf. This is not intended as an exhaustive list, but reflects the areas raised by attendees and the discussion at the meeting. It was highlighted that there is no one approach or technology that is appropriate in all circumstances. There may be a range of options for tackling a particular challenge, requiring a combination of different approaches in different circumstances. Many agreed that a holistic view of agricultural systems was the best approach.

In general, the key policy challenges faced by scientists in India were felt to be similar to those in the UK. Of particular concern to delegates at the meeting was an impending skills shortage in agricultural science, across plant breeding, plant pathology, agronomy, crop physiology, agricultural entomology, weed science, post-harvest biology, soil science and agricultural engineering. UK attendees noted the small number of university departments now teaching in these areas. Numbers of students and researchers employed in these areas are falling. The UK national extension service for agriculture, that once existed to link agricultural research to product uptake, no longer exists. Participants from India expressed similar concerns regarding a skills shortage in these areas. Complex regulatory regimes for research on genetically modified crops were also thought to be a challenge to agricultural research.

Summary

Given projections of increasing population, competition for natural resources and climate change, food-crop production must be increased in a sustainable manner. Science has a place in offering a range of potential mechanisms for addressing the problems faced. Investment in agricultural research is essential to determine the effectiveness of these approaches and to translate developments into products or crops which can be used in the field. The skills shortage in agricultural science must be addressed to allow the potential of science and technology in relation to food-crop production to be fulfilled.

References

International Energy Agency (2008) *World energy outlook 2008*. International Energy Agency, Paris.
United Nations (2000) *Millennium development goals*. Available online at http://www.undp.org/mdg/basics.shtml
United Nations (2008) *Remarks made by UN Secretary-General Ban Ki-moon's at a High-Level Conference on World Food Security on 3 June 2008*. See http://www.un.org/News/Press/docs/2008/sgsm11612.doc.htm

Key research areas, technologies and policy issues relevant to food-crop production

Research areas

- Drought tolerance
- Nutrient use efficiency
- Soil management
- Pests and disease
- Nutrient content (of harvested crop)
- Systems approaches to biotic and abiotic stress
- Holistic farming
- Minor crops which are not traded internationally
- Informatics

Technologies

- Irrigation technologies
- Nanotechnology
- Biological control
- Biopesticides
- Engineering to minimise post-harvest loss
- TILLING: the induction of specific mutations for investigating gene function
- In-field diagnostics
- Marker assisted breeding
- Genetic modification
- Hybrid technology
- High throughput phenotyping
- Research integrating farmlands and forest
- Computing power eg large databases for forecasting
- Sequencing power

Policy issues

- Regulation
- Skills shortage
- Extension
- Mobility
- Land use policy
- Intellectual property
- Promotion of translational and collaborational science
- Germplasm exchange