FOOD SECURITY, INNOVATION AND INDUSTRY

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The global demand for food is increasing because of growth of consumption in our increasingly large global population. This, combined with increasing competition for land, water, energy, other limited resources, and the impact of climate change, is creating a major challenge for governments and the agro-industry to ensure we can provide both the necessary quantity and quality of food on the table for everyone, without further damage to our environment. This is a challenge of unprecedented proportions because it requires innovation and change in many aspects of our way of life – which is why John Beddington, the Government Chief Scientific Adviser, refers to it as the "Perfect Storm".

Innovation and subsequent development of appropriate technologies that are safe, affordable, rely less on our limited natural resources for their manufacture (such as gas and oil), assist in mitigation of greenhouse gases, cause less environmental degradation and reduce the rate of loss of biodiversity are seen as key components of a global strategy for food security. In addition to all this, technologies that meet these criteria must be available sooner rather than later – 15 or 20 years to develop new technologies may be too late. Sadly, few traditional agricultural inputs meet these criteria and even new agri-biotechnological solutions are considered by many as unsafe and themselves a threat to sustainability. Also development times and regulatory requirements for many GM crop introductions preclude them from providing more immediate solutions even if UK research, field trials and commercialisation geared up to this end from this point in time.

A 2009 report entitled *Agrochemicals: Working for the future*, based on a House of Lords discussion sponsored by Plant Impact plc in November 2008, concluded that the regulatory demands and the fury of the negative consumer lobby against technology in agriculture was out of all proportion to the risk that attends its use, and that innovation in agriculture had suffered as a consequence. The participants from government, academia and industry considered innovation to be crucial to our ability to address existing and key future issues that will arise due to climate change.

Innovation is certainly necessary to ensure global food security and while innovation can arise in many forms, the development of new technologies is largely dependent on our research capability in academia, national institutes and industry. One of the frustrations with UK science and how it is supported, however, is that we too readily focus on the latest state of the art techniques, always looking here first for the magic bullet or as a panacea when solutions are needed to our most challenging problems. This is part of the explanation for why GM crops are emphasised as a solution to our current food security needs. Within agriculture, biotechnology and transgenic crops have been largely seen as an alternative to conventional development and use of agrochemicals. Despite the disadvantages of a poor public perception to many of these GM products, they have the potential to be safer and in some ways more environmentally friendly than many conventional agrochemicals. It is clear that transgenic crops are going to be part of the armoury of technologies necessary if the world is to feed its growing population. Innovation, however, takes many guises other than the latest methodological approaches, such as GM crops, and it is perhaps here that we will find the solutions in the short to medium term to address some of our most pressing needs.

Sir James Dyson, one of our country's leading inventors and entrepreneurs, has forcefully argued that there is always a need to "Ignore the perceived wisdom of the era …" and talks about the need for "entrepreneurial" and "creative rule breakers" and "inventive engineers". Britain has a long tradition in such creative engineering – which goes back centuries. However, the ability to develop something to meet a specific market need has sadly been relegated to the lower divisions of scientific endeavour because it is considered less sexy, less high tech – not at the forefront of the latest panacea. Much of UK science is carried out as if we were trying to build a bridge across a ravine for which we have no dimensions or understanding of load bearing requirements – we all too rarely define the market before we embark on science to develop a technology – in ways that are second nature to engineers.

Designing products fit for purpose, ie scientific innovation for the market place, as opposed to science to research a problem, is the approach pioneered by Sir James Dyson in the household appliance market. He looks at the market and decides what it is that really meets customers' needs and then designs products to meet those needs. The approach involves two elements – firstly understanding the market and secondly being able intelligently to design a product. In this context 'design' is not about how something looks but rather how something works – good design evolves from function.

For agricultural inputs, intelligent product design means developing technologies which assist mitigation and our adaptation to climate change, and are sustainable, safe, economic and environmentally effective – by design – right from the outset. This is the market in which we now have to exist and this has to be the whole basis on which products now and in the future will need to be developed.

This is the approach which Plant Impact plc has adopted and the following examples demonstrate how it is possible to use product design to address key issues for food security. If, for example, we wish to increase the nutritional value of harvestable crop products while decreasing wastage in storage and improving the ability of the crop to withstand drought stress and a whole range of

physiological disorders whilst growing in the field, then some may consider it necessary to breed a super crop plant. The alternative, however, is much more innovative and involves simply improving plant cell integrity through delivery of a calcium input formulated in such a way that the nutrient is able to reach all of the key parts of the plant while it is growing – something we have consistently failed to do with calcium inputs since their first use.

CaT is Plant Impact's calcium technology which is uniquely formulated with an analogue of a plant hormone which draws the calcium into the plant and moves the nutrient from cell to cell within the plant – CaT is the world's first calcium input to achieve this. It is more effective than current calcium options moving calcium 20-25 times faster and in doing so creates higher calcium content of key food products, healthier, higher yielding crops, tolerant to abiotic and biotic stresses while retaining their quality in storage as well as lower farmer operating costs and improved profitability.

Nitrogen fertilisers are another area desperately crying out for innovation. The way we use nitrogen is like using a sledgehammer to crack a nut and sadly nothing has changed in 50 years. The cost of production of nitrogen is linked to natural gas production and hence costs fluctuate in line with gas costs. Also the means by

which nitrogen is delivered to the plant is incredibly inefficient leading to release of the greenhouse gas, nitrous oxide, and leaching of nitrates which contaminate our waterways and oceans. Plant Impact's PiNT is a unique controlled nitrogen release system that ensures that nitrogen is taken up by the plant in its most useful form as amines and ammonia and reduces the amounts released as nitrous oxide and converted to nitrates by soil micro-organisms to leach and contaminate waterways. PiNT improves plant growth, produces higher yields and is environmentally sustainable; a nitrogen product that is innovative and designed for our 21st century needs in agriculture.

Effective safe chemical pesticides – those that are safe for the user to apply, safe for the environment and for the consumer are rare and yet there is an increasing need for such products that can make a contribution to sustainable agriculture, maintaining biodiversity and not damaging human health. Bug Oil, another of Plant Impact's range of products, is based on a novel mix of harmless plant oils which when combined make a highly effective (equal to its chemical pesticide equivalent) and incredibly safe green pesticide that controls some of the world's most harmful insect pest species on our most important crops – whiteflies, aphids and thrips through both a preventative and curative action.

These examples illustrate that we do not have to seek the magic bullet or methodological panacea, but through the use of the James Dyson approach – the intelligent design of products – it is possible to develop technologies from scratch, based on a sound knowledge of the market and the plant and animal physiology that do not have political, public or environmental drawbacks and can be developed in a time frame relevant to our current pressing needs. However, as the House of Lords discussion on the future of agrochemicals highlighted, if companies such as Plant Impact plc are to make a full and proper contribution to addressing food security in an era of climate change and declining natural resources, then governments need to have a key role in enabling and facilitating that involvement. Specifically, there is a need for a faster track for registration of products (not a lesser process but a faster one) so that technologies which clearly address mitigation, adaptation to climate change and improved sustainability are prioritised for evaluation and processed quicker – not least because many of such new technologies are coming from small companies who cannot afford, in cash flow terms, to wait three years for a registration.

There is also a need for a re-prioritisation of research funding with greater emphasis on market-led innovation, rather than our outmoded commitment to serendipity, ad hoc processes for commercialisation and a fear of near market research, in short a commitment to a new age of UK innovation through design in support of our most innovative companies.

Food security as an issue also has to be prioritised throughout government, for example through a commitment to ensure that companies with innovative technologies which address food security and climate change are prioritised for export support. There is also a need for greater involvement of the agricultural industry in initiatives such as the Defra Sustainable Development Dialogues.

UK companies have a crucial role to play in addressing global food security but will only be able to deliver properly through co-operation and partnership with government, academia, the media and the public to ensure that innovation through design is part of the equation, and companies developing such technologies are given the opportunity to make them globally available.