A BRIEF REVIEW OF THE 'FUTURE OF FOOD AND FARMING FORESIGHT REPORT', JANUARY 2011, by Chris Finney, Agricultural Economist, April 2011.

1. Background

This major report is one of the series of Foresight reports published by the UK Government Office of Science. It was prepared under the Foresight Project on Global Food and Farming Futures, under the chairmanship of Sir John Beddington, Chief Scientific Adviser to the Government. It is a massive report, comprising an Executive Summary, a Final Report and an Action Plan, supported by an Evidence Base of 13 Synthesis Reports, 22 Driver Reviews, seven Regional Reviews, five Additional Reviews, three Working Papers, six Workshop Reports and 41 State of Science Reviews. The report was probably completed in less than two years, although no dates are given. It can be found on http://www.bis.gov.uk

A similarly massive team was involved in its preparation, comprising a Project Lead Expert Group of nine, all but two of whom were Professors, a High-Level Stakeholder Group of 40, 169 Authors and Contributors to the Evidence Base, 30 Project Advisory Group members, 15 Economics Advisory Group members and the Foresight Project Team of 17, including administrative staff. Management of such a large number of contributors would certainly have been challenging!

Most of those involved were from the public sector (DFID, DEFRA and many other organisations) and academia. As was the case with the preparation of the January 2010 All-Party Parliamentary Group (APPG) on Agriculture and Food for Development Inquiry report entitled "Why No Thought for Food?", there were no witnesses from ICID (UK) or the Tropical Agricultural Association (Chris Garforth, the TAA Chairman, was a contributor but is listed as from the University of Reading rather than as a TAA representative). There also appeared to have been no one from the overseas development consultancy industry, either through British Expertise, the successor organisation to the British Consultants Bureau, or as individual consultants. Clearly, we are not making our presence felt.

As expressed in the Executive Summary, the Project aim is *"to explore the pressures on the global food system between now and 2050 and identify the decisions that policy makers need to take today, and in the years ahead, to ensure that a global population rising to nine million or more can be fed sustainably and equitably"*. This suggests that there is considerable overlap between the coverage of the Foresight study and the APPG work. I did not, however, see any mention in the Foresight report of the existing APPG report or its current follow-up Inquiry, which seems surprising.

2. Some brief comments on the Foresight Report

In his email of 24/01/2011 Geoff Pearce of HR Wallingford drew attention to the Foresight report and commented adversely on its apparent lack of attention to irrigation and other water-related aspects of agriculture, as did other ICID (UK) members. This stimulated me to have a look at the report itself. Rather than attempt the impossible task (in terms of time) of reviewing the overall report in general, I had a look at just the following reports which were of particular interest to me:

- The Executive Summary, and the part of the Action Plan relating to DfID.

- In view of the importance of accelerating the growth of agricultural output in Sub-Saharan Africa, Synthesis Report C9: 'Sustainable Intensification in African Agriculture – Analysis of Cases and Common Lessons'

- In view of the critical need to raise agricultural productivity, especially crop yields, Driver Review 5a: Production Possibilities: Crops, and Driver Report 8: Agricultural Investment, Research, Extension and Development.

Given the concern about the inadequate emphasis given to irrigation, I also glanced briefly at one or two of the 56 State of Science Reviews to see whether there was any significant coverage of irrigation. I did not find any.

(a) The Executive Summary

The Sunday Times edition of April 3rd summarised the report's basic findings rather well. In a major public meeting a few days ago to discuss the report it *"was welcomed for stating common sense truths: that hunger is already a problem for a billion people; that farmers need roads and land rights as well as new farming technology; that wasted food represents an enormous resource that should be easy to tap"*. The Foresight team concluded that *"a redesign of the food system to bring sustainability to the fore"* and *"a sustainable intensification of agriculture"* is required.

Although this recommendation is hardly original its validity still stands. The problem, of course, is how to achieve such an aim in practice. Without going into the depths of the report in detail the degree to which that problem is satisfactorily addressed cannot be judged.

The Summary is well written and argued and seems to make good sense but, following on from the above cautionary note, would benefit from more emphasis on the practicalities, with some boxed examples from real life. The high priority given to research and development and the vital need to improve crop yields is welcome, as is the view expressed in Box 1.2 that new technologies such as GM and the use of cloned livestock should not be excluded *a priori* on ethical or moral grounds.

Increasing water scarcity is recognised as a major constraint on future food production. In fact, Section 9 states that *"water is the most pressing constraint, with significant effects on regional productivity likely to occur by 2030"*. Section 2.V also notes the increasing pressure on water resources resulting from agricultural growth and estimates that total global water demand could rise by 35-60% between 2000 and 2025.

There is, however, little, if any, discussion of irrigation *per se*, either here or in other parts of the report which I visited. On the other hand, much of the discussion concerning crop production (e.g. development of new varieties and improvements in crop management) is applicable to irrigated crops as much as unirrigated crops. Taking account of this factor and the emphasis given to the water resource constraint in the report, maybe the authors did not consider discussion of irrigation as a separate

topic to be necessary. Given that irrigation consumes some 70% of the world's water, occupies 18% of the world crop area and produces some 40% of the world's food, however, this omission seems regrettable.

Section 3.1: Improving Productivity Sustainably Using Existing Knowledge, states that the application of existing knowledge and technology could raise average yields two- to threefold in many parts of Africa and twofold in the Russian Federation. Bearing in mind all the constraints involved, this seems somewhat over-optimistic. Four classes of intervention to achieve this improvement are identified, namely:

- Revitalisation of extension services.
- Improving the functioning of markets and providing market access, particularly in low income countries.
- Strengthening rights to land and natural resources, including water.
- Improving physical infrastructure in low and middle income countries. Irrigation projects are one of the several categories specifically mentioned.

As its title implies, the following Section, 3: New Research and Technology To Raise The Limits Of Sustainable Production And Address New Threats, makes a strong and very welcome case for *"a reversal of the low priority accorded to research on agriculture, fisheries and the food system in most countries"*. The Foresight Project commissioned a series of reviews, including the two Driver Reviews listed above and various others, to support this part of its work. As explained in the comments given below on the two Driver Reviews, these supporting reports contain some really interesting information.

Attention is drawn to the decline in investment in agricultural development in recent decades resulting from changing donor fashions (in Section 5.4) and smallholder farming is stated to have been long neglected (Section 5.2). (Though not mentioned, in Sub-Saharan Africa the same is in fact true of large-scale commercial farming and plantations – in some countries, such as Mozambique, Tanzania and Zambia, there is considerable potential for the output from this sector).

As part of its proposals to remedy the situation described above and to increase agricultural production, the Action Plan calls for major support from DfID, with eight specific actions listed. The APPG on Agriculture and Food has made similar recommendations for an increased agricultural effort by DfID. Amongst the eight specific actions, investment in the development of *"new agriculture products" (new crop and livestock varieties, farming systems)* and support for the implementation of the African Union Comprehensive African Agriculture Development Programmes are proposed.

(b) Synthesis Report C9: 'Sustainable Intensification in African Agriculture – Analysis of Cases and Common Lessons'

One weakness of this Synthesis report is that in most respects it does not distinguish clearly between Sub-Saharan Africa (SSA) and the rest of the continent – basically, North Africa. This weakness seems to be common to many reports concerning African development. Most of the North African countries are middle income rather than low income countries and much, if not most, of their agriculture is irrigated

rather than rainfed. In contrast, SSA generally comprises low income countries, including some of the poorest in the world, and its agriculture is predominantly rainfed. In recent decades its agricultural output per head has tended to stagnate. From the agricultural viewpoint the two regions are very different and should be discussed separately. Despite its title, this report in practice seems to concern mainly SSA instead of the continent as a whole.

To provide information and ideas on means of improving the region's agriculture the Foresight project commissioned reviews and analyses of 40 existing projects and programmes where sustainable intensification has been successfully developed in the 2000s (some with antecedents in the 1990s). All these examples were from SSA countries. This work has produced a mine of useful information. The types of projects/programmes assessed were as follows:-

Type	Number of examples
Crop variety & system improvements	9
Integrated pest management	8
Livestock and fodder crops	6
Agroforestry & soil conservation	5
Conservation agriculture	4
Horticulture & very small-scale agriculture	2
Aquaculture	5
Novel regional & national partnerships & policies	8

Since only successful projects/programmes were included in the sample, their achievements cannot be taken as representative of what has been or might be achieved on a larger scale. Nevertheless, the results were encouraging. It was estimated that over the 12.8 million hectares covered by the projects crop yields rose by an average of 113% (i.e. more than doubled) over periods varying from three to ten years. According to Table C9.2 in the report, the increases were remarkably consistent between the five types of project for which yield increases were quantified, ranging from 96% for agroforestry and soil conservation to between 118% and 124% for crop variety and system improvements, conservation agriculture and integrated pest management. Section C9.5 of he Synthesis Report describes in detail the results for each of the project types.

Assuming that the above assessment was deliberately confined to SSA rather than the continent as a whole, the omission of any irrigation examples from the sample of 40 is perhaps understandable. In the majority of SSA irrigated agriculture is much less important than in most other regions of the world and the land and water resource base generally does not favour a major expansion of profitable (economically viable) irrigation in at least the near-term and medium-term future.

Omission of any examples of successful SSA large-scale commercial agriculture from the sample is less understandable. Despite its title, Section C9.7:Emergent Private Sectors, which is anyway only four paragraphs long, does not cover it. The sample of 40 could easily have been expanded to take in a few relevant examples of recent successful commercial agriculture developments in SSA. Taking Mozambique as an example, for instance, the rapid expansion of tobacco growing in Manica Province instigated by white farmers who have migrated from Zimbabwe, encouraged by the

favourable 'enabling environment' which the Government has created for private investment in agriculture, and the successful development of several large private irrigated sugar estates, could have been included. Expansion of large-scale mixed farming in central Zambia is another possible example.

(c) Driver Review 5a: Production Possibilities: Crops, and Driver Report 8: Agricultural Investment, Research, Extension and Development.

These two documents are two papers published by the Royal Society in 2010. Driver Review 5a is "Possible Changes to Arable Crop Yields by 2050", by Keith Jaggard, Aiming Qi and Eric Ober of Rothamsted Research, UK and Driver Report 8 is "Review: Agricultural Research and Development, Technology and Productivity", by J.Piesse and C.Thirtle of Bournemouth University, Stellenbosch University and Imperial College. Both contain a variety of interesting data on historic and projected trends relating to crop production. Some of these are summarised below.

- Yield growth rates: Figure 2 in DR 8, which is taken from the World Bank 2008 World Development Report, shows a serious decline in the yield growth rates of major cereals (maize, rice and wheat) in developing countries between 1963 and 2003. In the 1960s and 1970s annual growth rates were typically in the 2% to 4% range, whereas by the 1995-2003 period these had fallen to a 1% to 1.5% range. According to Section 6 of DR 5a, the current world yield growth is only around 1%. Clearly, this is very worrying.

  Some of the projections discussed in DR 5a, however, paint a less negative picture for the future. CO_2 enrichment is considered likely to increase yields of most crops by approximately 13% by 2050, although this will be balanced to some degree by the predicted 5% decrease resulting from higher ozone concentrations. It is not clear to what extent these figures consider the enrichment impacts in isolation or whether they also take full account of the effects of climate change on rainfall, temperatures and other factors affecting crop growth. Carbon enrichment was expected to reduce crop water consumption, although this positive effect would be cancelled out by the impact of increased temperatures on evaporation rates.

  One interesting observation made was that the yield response to CO_2 enrichment will be enhanced or at least unchanged where the N (nitrogen) amount is inadequate. This situation would be typical of much smallholder farming in developing countries. To quote: *"In future, if for financial or environmental reasons N fertiliser use is further restricted, the enriched CO_2 atmosphere should help to limit the negative effect on crop yields"*.

  Data presented in Section 5 of DR 5a underline the critical importance of plant breeding as a contributor to crop yield growth. The papers quoted calculated that the proportions of historic yield growth attributable to plant breeding were 47% for wheat and 55% for barley in the UK, 58% for maize in Minnesota and 50% for the USA as a whole. Similarly, although increased tubewell irrigation and fertiliser use made major contributions, the basic drivers of the Green Revolution Asia in the 1960s and 1970s were the new short-strawed rice and

wheat varieties. Plant breeding clearly merits a very high priority in the future improvement of yields, for both rainfed and irrigated crops.

Another study quoted in DR 5a (Section 4) concluded that, in the absence of the CO_2 effect on growth, by 2050 crop yields in low latitudes (i.e. many of the developing countries) are likely to decrease, owing mainly to increased temperatures, whereas at higher latitudes yields are likely to increase slightly as warmer weather allows longer growing seasons.

Total world crop area: Another climate change-related paper quoted in the same section estimated that by 2080 an additional 320 million ha would be cropped in the Northern Hemisphere. Considering the likely loss of cropland due to desertification brought about rainfall and temperature changes, this seems surprisingly high. Nevertheless, climate change can certainly be expected to open up new areas for cropping in the more northerly regions of Russia, Canada and Scandinavia.

Irrigation: Under Section 7: Unanswered Questions, DR 5a noted several major issues which were not addressed in the review. The two most important, both of which could seriously constrain future production, were the future availability of water for irrigation, and declining soil quality resulting from degradation of the land resource (nutrient loss, soil erosion, salinisation etc). Irrigation has thus not been completely ignored in the review.