

Ensuring Sustainable and Responsible Production of Healthy Food from Healthy Animals

This programme addresses the Global Challenge: Adapting to Climate Change with the immediate strategic objective of safeguarding food security for the growing human population predicted to reach 9 billion by 2050. The analogy to a 'perfect storm' of predicted increased demands for food, water and energy given by UK chief scientist John Beddington is well known; during a recent presentation at the University of Bristol (1 May 2012), he highlighted the role of sustainable livestock farming as part of the solution, pointing out that large areas of agricultural land are unsuited to other purposes and that consumers in growing populations would continue to eat meat. The significant contribution of livestock to greenhouse gas production and environmental degradation, as highlighted in FAO's seminal report 'Livestock's Long Shadow' (2006), represents a major opportunity for improvement, especially with grazing ruminants, for the development of 'carbon sensitive agriculture' in an appropriate ecosystem services framework.

A recent UK Government Report "*The Future of Food and Farming*" (2011) highlighted in key conclusions for policy makers that global population is predicted to surpass nine billion by 2050, putting intense pressure on the global food system, including competition for land, water and energy. Continuing globalisation and imperatives to reduce greenhouse gas emissions and adapt to the uncertainties of a changing climate while maintaining biodiversity and ecosystem services, will expose the food system to novel economic and political pressures, including demand for a more varied, high-quality diet from a burgeoning wealthier sector of society.

Livestock products comprise an important component of human diet, and their production is likely to continue for the foreseeable future as the only practical option on a large proportion of the world's agricultural land, especially seasonal or permanent pasture suitable only for grazing. While meat consumption varies globally from over 120kg per capita year in the USA to just 3kg per capita year in India, protein malnutrition (kwashiorkor) is a common problem in developing countries, especially in South Asia, causing stunted growth and threatens to increase unless food production keeps pace with global population growth. Meat and dairy products are excellent sources of first class protein, containing all essential amino acids, although excessive consumption is linked to a number of health problems, such as heart disease and cancer.

Our objective is to research '*future farming*' systems, sustainable and responsible production of healthy food from healthy animals, supporting a vision where people in all regions can enjoy the benefits of appropriately moderate consumption of high quality animal products with net health benefit. These integrated farming systems consider nutrient cycling so that animal waste products are used to the maximum potential, minimising both greenhouse gas emission and use of artificial fertilisers. The research considers not only livestock rearing *per se*, but also mixed crop-livestock systems in which human inedible crop residues such as cereal crop straws or stovers, sugar cane, grain sorghum, soybean and

vegetables may be fed to livestock, themselves producing manure for fertilizing crops. Optimisation of livestock feeds will focus on pasture utilization of polyphenol oxidase-containing red clover (*Trifolium pretense*), which as well as fixing nitrogen has the potential to increase levels of N-3 (omega-3) fatty acids in meat of grazing animals with resultant health benefit to both animal and consumer. Similar effects may be obtained by addition of plant extract supplements such as *Echium* oil to cattle feed.

Another aspect of this programme focuses on 'One Health', i.e. interactions among human, animal and ecosystem health. Improved nutrition of livestock may lead to direct health benefit for animals, improving their welfare, and also indirectly to benefit for consumers. Dairy cattle in intensive production systems, commonly suffer from metabolic diseases with underlying nutritional aetiology, conditions which predispose animals to infectious disease and a wider range of ailments, including infertility, lameness and welfare problems. The majority of human infectious diseases have their origins in animals, and many important zoonotic diseases in livestock not only adversely affect productivity and welfare, but may also be transmitted to man either directly or via animal products and the environment. Sustainable future farming systems must mitigate against risks such as avian influenza, Q-fever, *E. coli* O157, bovine tuberculosis, and various helminthiasis.

In an influential report to DEFRA, John McNerney (2004) described the relationship between levels of livestock productivity, i.e. human benefit, and welfare levels, i.e. animal benefit, and suggested that excessive intensification is to the detriment of both. This concept can be extended to the relationships between levels of intensification and health and between intensification and food quality. Many zoonotic infections are exacerbated by intensification which therefore has implications in the One Health context, while food quality of animal products, in terms of both nutritional value and palatability, may be improved in appropriately grazed rather than intensively reared, cereal-fed animals.

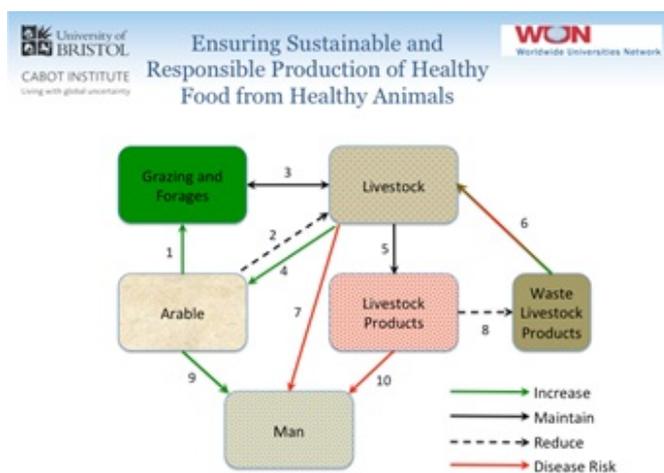


Figure 1

The programme we are proposing aims to capture these effects in a '*systems framework*' that considers food-producing animals in the broader context of their grazing environment and the wider agricultural setting, including ecosystem services such as water and waste management. Figure 1 considers the following elements: (1) increased usage of forages and crop residues in animal feeds; (2) reduced reliance on cereal crops in animal feed, increasing availability for human food and lessening adverse health effects of concentrate feeding; (3) livestock primarily raised on grazing land; improved nutritional quality of grazing; recycling of animal manure directly on grazing land; (4) increased use of animal manures as fertilizer; (5) improved quality of livestock products through improved nutrition and disease management; (6) revisit utilisation of waste livestock products in animal feed (after stringent disease risk assessment); (7) mitigation of direct zoonotic disease risk through contact with livestock (e.g. farm workers, vets, abattoir workers); (8) reduced wastage of livestock products, so-called 'post-harvest losses'; (9) increased proportion of arable produce for human consumption, rather than animal feed; (10) mitigation of indirect zoonotic disease risk through contact with animal products (consumers, food industry workers).

The programme will benefit from three unique and visionary research farms. Rothamsted Research's North Wyke Farm Platform is a globally unique facility with a range of *in situ* instrumentation in hydrologically isolated fields and farmlets to research key issues in sustainable beef and sheep production. Future Farm 2050, is a multidisciplinary project based on a 1600-hectare farm near Pingelly, Western Australia with the mission to develop a profitable mixed-enterprise operation at the cutting edge of practical technology for cropping, animal, environmental footprint, and ecosystem and biodiversity management. Finally, at an earlier stage of its development and with possibilities for exchange and collaboration, Thiruvazhankunnu Farm (Silent Valley) in Kerala, owned and operated by KVASU has emphasis on the effects of climate change on animal production. By comparison and contrast of these three farm platforms in disparate locations and ecosystems, the researchers will begin to compile a global assemblage of data, analyses and ideas that will inform best practice for ensuring sustainable and responsible production of healthy food from healthy animals.

References

- FAO (2006). *Livestock's Long Shadow: Environmental Issues and Options*.
Foresight. *The Future of Food and Farming* (2011). Final Project Report. The Government Office for Science, London.
- McInerney, J. (2004). *Economics and Policy: Report on a study undertaken for the Farm & Animal Health Economics Division of Defra*.