A comment on papers by Gregory *et al.*[2] and Guishen *et al.*[3]

Two papers in this Issue concern world food resources from entirely different angles.

Previously in this Journal Cook and Frape[1] examined the potential regional food production and related this to Man's minimum nutrient requirements.

They found that global food production at present was adequate when considered only as sources to meet the minimum dietary requirements for energy and protein, although there was a marginal deficiency of the limiting amino acid, lysine. They also estimated that with a vegetable based diet, including some milk products, production would be sufficient to support the estimated global population of 9 billion in 2050.

This conclusion however, rested on the adequacy of distribution, the avoidance of wastage and of disaster in world harvests. It assumed present day average output of regionally adapted crops. The findings raised a number of questions including whether governments could enforce such restricted diets upon their populations.

Current diets often incorporate large quantities of meat products which require relatively inefficient land use. Some of the crops currently diverted to animal feed could then be used directly for human consumption. Moreover, ruminant livestock belch large quantities of methane, a very potent greenhouse gas.

In this Issue Gregory *et al.*[2] indicate that human health may be improved by micronutrients present in minor crops. These crops could also increase local biodiversity and most are grown in small local areas, often as traditional foods, excluded from large scale agriculture. This exclusion may be a result of the production and marketing difficulties such crops present.

Moreover, the relative ease of cultivation of the higher yielding major crops, such as maize, wheat and rice and the relative ease with which they can be manipulated to produce improved strains, make them more profitable. This presents a considerable obstacle to the minor crops. Hence, the three cereals have become staples to provide sources of energy and protein/amino acids to the bulk of the world's population.

Guishen *et al.*[3] reach a similar conclusion by assessing the Ecological Footprint (EF) of China and of the World to compare the overall sustainability of various communities. They conclude that the exploitation of finite resources both globally and by China must be curtailed and replaced by resources which may be renewed. This will eventually become essential if food production systems are to be sustainable.

Greater biodiversity of production is a mandatory characteristic of all revised systems. Biodiversity in its broadest sense includes genetic diversity of species as well as ecological community and landscape, each of which is important to reduce the EF. They cite an example in which the genetic diversity of rice is used to control the fungal rice blast disease in South China by using mixtures of susceptible and resistant cultivars. Similar approaches have been used in Europe, for example, to control powdery mildew diseases in cereals.

However, although effective in reducing disease without recourse to fungicides and increasing yield the approach is rarely used in practice as each cultivar will have different properties and the resulting produce does not have sufficient homogeneity to be marketable.

Both papers raise key questions about the role of local small scale production in enhancing the sustainability of food production. They imply a refocusing away from intensive production, based on non-renewable resources, to more sustainable systems using more renewable inputs. Theoretically, therefore reduced use of non-renewable resources is the pivotal measure to promote the sustainability of agro-ecosystems.

A number of interesting questions arise from this conclusion. We could reduce the global EF with a lower population and reduced consumption. More sustainable agro-systems must reduce external inputs per unit of production and to be

effective, consumption per capita should not increase; a requirement which may be difficult to achieve given the increasing demand associated with the rise of living standards of many societies. Furthermore, as pointed out by Guishen, the EF of a region may be manipulated depending on whether nutritional requirements rely on locally produced food.

Importing food has been a consistent fact of life, either for densely populated countries, or for areas unable to grow sufficient crops. It has also been used as an economic strategy to maintain low domestic food prices, as has happened in the past in the UK.

To many, however, this may be seen as simply exporting the environmental damage associated with agriculture; in this case the EF deficit, to give the impression that the consuming nation is reducing its own EF. Some might view such a policy as hypocritical unless there are efforts to make the remote production as environmentally benign as possible. But reliable data for estimating a revised EF would be scarce.

That is the challenge. Agriculture, by definition, changes biological production of land so that produce and thus energy is removed for external consumption. This reduces sustainability, as it deprives the land area of the return of resources at harvest.

It is a dilemma the 'organic' movement hope to have managed, although overall crop yields are generally reduced and remain dependent upon a return of plant nutrients, some of which must be obtained from animals. Absence of these animals and thus of these nutrients also needs to be addressed by those who would promulgate the vegan life style.

Technology is likely to be a key component of the ways in which this challenge can be rectified for crop and livestock improvement and biodiversity management. Novel food production systems, such as artificial meat or meat substitutes also need to be considered as the consequent reduction of animal populations might even allow man to return areas currently used for production to a natural habitat and actually enhance the world's biodiversity. Globally that would be a significant achievement.

References

1. Robert Cook and Dr David Frape (2014) World Food Production – will it be adequate in 2050? **World Agriculture** #1407
2. Gregory, Professor, Peter, Susan Azam-Ali and Sayed Azam-Ali (2017) Crop Diversity for Human Nutrition and Health Benefits. **World Agriculture** #1720
3. Zhao Guishen,Liang Long and Li Li (2017) Methods for Increasing Sustainability of Agro-ecosystems Based on the Ecological Footprint in China **World Agriculture** #1719

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Dr David Frape,

Robert Cook

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Comments