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What can Research deliver for Organic Farming?

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Summary

The research needs of any applied subject are always influenced by three major groups of criteria. These are the economic/political, the societal/ethical and the technical/scientific. This is especially the case for Organic Farming which explicitly sets out to present a positively value based approach to agriculture, an activity, which has commonly become dominated by the commercial economics of an industrial society. To maintain this ethical stance Organic Farming must challenge some of the tenets of conventional economics and politics and must work within the particular societal context. Its scientific needs are then driven either by the need to increase its role in terms of market share or the need to achieve its aims more effectively in respect of product quality and/or delivery of environmental goods. In this paper I examine the current opportunities for Organic Farming in relation to the present state of farming economics and the current expectations of society, considering both food production and the delivery of environmental services which are paid from the public purse, e.g. via the Common Agricultural Policy (CAP). I use these criteria to analyse what are the current primary research needs in relation to the science and ethical base of Organic Agriculture.

Keywords: CAP, bioethics, post-modernism, clustering, arbuscular mycorrhizal fungi, ecology.

Introduction

The Current economic and political climate

Agricultural economics in the UK and the whole European Union are dominated by the CAP (Common Agricultural Policy). For the UK, the CAP replaced an existing subsidy system, the Deficiency Payment Mechanism, which was in place from 1945 until 1973. Thus for the past 60 years UK agriculture has received support from the public purse. However, the rules governing this support and the proportion of costs covered have varied. Pre-1973 support covered the difference between the cost of production and the prevailing market price. Between 1973 and 1993 an intervention mechanism achieved a similar effect. Post-1993 (following the McSharry Reforms) support payments were divided into restricted intervention support plus some direct payments (Pillar 1) plus some support given as Rural Development Aid (Pillar 2). A major revision of CAP which came into effect in 2005 introduced single farm payments which are largely independent of the particular commodity or level of production on the farm.

It is important to ask whether the CAP regime has worked. From the standpoint of the consumer, who now spends the lowest proportion ever of their average income on food (<10%) it could be argued “Yes”. From the standpoint of the supermarkets, whose profits remain at record levels, it could be argued again “Yes”. Large scale farming units might well have a similar view. However from the standpoint of the average Scottish or other small farmer in the UK, it is more difficult to argue that CAP has worked. For most of the period from 1997 until the introduction of the single farm payment, income from farming activities represented around one third of the total farm income. The power of the supermarkets meant that for the majority of major food types farm gate receipts were less than the cost of production. Milk which cost 19–20p L^{-1} to produce sold at 18p. Beef which cost £2 kg $^{L-1}$ to produce sold at £1.90. A tonne of oats which cost £100 to produce sold at £70. Income from CAP was thus the greatest element of income in the farm budget. Farming’s predominant customer was the CAP and the predominant customer requirement the rules of the CAP. However, there were other problems. In this same period, increasing health problems especially in relation to obesity and heart related problems were observed. There were also environmental problems and significant reductions in biodiversity linked directly to agriculture. Pretty *et al*. (2000) estimated that during the 1990s agriculture generated external costs of £2.3 billion, equivalent to around 90% of net farm income and represented a cost of £208 ha^{-1} for all arable land and grassland in the UK. Chemical inputs to agriculture were responsible for many of the estimated externalities.

The change in “Agricultural Support” in 2005 represents a real paradigm shift. Funding for agriculture no longer represents a deficiency payment; instead it gives real freedom to farm. At he same time, the EU Commissioner for Agriculture speaking at the 2006 Highland Show set out priorities for farming, which include an increased emphasis on quality production, more production aimed at local markets, improved animal welfare rules and a much increased emphasis on environmental care and rural development. These economic and political changes would seem to provide real market opportunities for Organic Farming provided that it can be shown to provide quality food, environmental goods and to contribute to sustainable rural development. Research is needed to support the development of the farming systems described above. Identifying and developing real indicators of quality is also an important research need. The history of food and the value placed upon it in relation to society and social structure indicates that any assessment of “quality” must go beyond analysis of major mineral elements and nutrient groups, e.g. protein content. Similarly environmental and sociological indicators must relate to longer term objectives such as the retention of nutrients within the farming system, and the retention of energy (including those used in the manufacture of pesticides and fertilisers) from inputs into final product.

The societal and ethical climate

We now live in a post-modernist society. As a result the views of the professional or of the expert are no longer simply accepted without challenge. While the fact that all views are considered to have some credibility may be difficult to manage; in technical areas, discussion has opened up to a wider range of views and approaches. The recent and continuing discussions on genetically modified (GM) farm crops and on the meaning of food quality are relevant examples of this shift in thinking. The GM debate has been characterised by the scientific establishment defending the safety of these crops and their products and the need for them as a step in developing means of feeding an increasing world population. In contrast those in opposition questioned whether the form of agriculture on which a GM approach depended was what was needed and whether, taken overall, this approach was an appropriate way of valuing creation. Clearly these approaches are not opposites. They represent alternate sets of values. The co-existence of the alternates is only possible in a post-modernist world.

Similarly debates in relation to food quality have seen the Food Standards Agency (and others) strongly identifying quality in terms of chemical and bacteriological analysis; others have emphasised traditional values both inherent in foods, such as taste and provenance, and those associated with them, such as the importance of the family meal. In addition those who are concerned to identify links between diet and health are becoming increasingly aware of clustering of values within individuals and groups which make it difficult to draw out simple cause and effect relationships or traditional linear connections. For example, it is clear that those in the population who consume substantial amounts of organic food are in general healthier than those who do not. However, whether this is because of the properties inherent in organic food or because of greater consumption of fruit and vegetables, the taking of more exercise, reduced levels of smoking and/or the interaction of a range of other life style factors is unclear. The need to reduce health care costs and to develop the delivery of positive health care in the community suggests that the use of appropriate statistical and other modelling techniques to understand these clusters is essential. Such understanding might also help focus the aims of husbandry programmes for organic production. Similarly a better understanding of societal values will help to identify the real range of options for future food production systems. The outcome of the GM debate, without them being analysed in this way, has suggested that systems which are inherently supported by the majority of the public are those which promote biodiversity and environmental care and which minimise the use of non-renewable resources and the generation of greenhouse gases.

The scientific and technical challenges

Organic Farming is often characterised in terms of what it does not do. It is therefore described as a system which produces food without the use of fertilisers, pesticides or pharmaceuticals. More correctly Organic Farming should be regarded as a system which is designed in order to minimise the need for external inputs of nutrients, crop protection aids and preventative medicines. As a result it is not associated with many of the externalities identified by Pretty *et al*. (2000). This more accurate definition explains the existence of a list of last resort measures which are available for use when the checks and balances of the normally balanced system have failed (reluctantly and only with appropriate safeguards). These two elements of the philosophy are critical to understanding research needs at a technical and scientific level. The elements in the definitions remind us that all agricultural systems, both organic and those which are most easily described as conventional, require mechanisms to appropriately regulate a balance in resource capture between the crop and other vegetation, micro-organisms and invertebrates and the provision of a range of mineral nutrients for crop growth. In a conventional system these are provided largely through inputs of externally generated materials. The research needs of conventional farming systems have therefore dominantly related to the efficient use of external materials and the design of appropriate inputs. In an organic system the system requirements are provided primarily through recycling within the total system. Consequently the research needs of Organic Farming have been rather different, such that only the most basic of results from many studies, e.g. information on soil chemistry, have been directly of relevance to organic systems. To be true to the underlying values of the approach, advances must relate to a sustainable management of natural cycles and take a holistic rather than a reductionist viewpoint. In doing this Organic Farming can learn much from the ecological approach to understanding ecosystems and from recent approaches to the management of natural and semi-natural vegetation. Essentially Organic Farming is about recycling within the rotational system. As such it can learn from attempts to better understand soil biological processes, especially those which evolution has refined as appropriate means of meeting plant needs for the provision of nutrients, recycling materials between plants and animals and other organisms.

It is appropriate to ask whether yields from organic agriculture can be increased and if so how. This involves identifying the major limitations to crop production and devising means of reducing these limitations but doing this within the context of a recycling system. Such an approach needs information on the quantification of basic soil biological processes but it also needs applied studies on how to manage such processes. Atkinson *et al*. (2005) assessed the key limits to production systems, which had been devised to place greater reliance on the use of recycled soil resources, they concluded that there was scope to improve both the availability and efficiency with which elements were recycled in the soil, particularly in relation to nitrogen and the ability of the plant to capture soil resources. This will lead to an increased emphasis on the management of micro-organisms such as mycorrhizal fungi which were critical to the ability of plants to successfully colonise land 0.5 billion years ago. The ways in which mycorrhizal fungi (AMF) may aid plants in nutrient capture have recently been reviewed by Atkinson (2006). AMF are able to help to optimise the capture of resources, by improving plant health they enhance resistance to disease but perhaps most importantly they seem able to provide the plant with information about the soil environment especially its water status. Just as information has replaced resource provision as an economic attribute, an increased emphasis on the provision of information to plants would seem valuable especially in organic systems. Basic scientific research is thus needed to support a better functional understanding of plant roots and their associated micro-organisms. Such approaches would not only benefit crop production but would also aid the prevention of soil erosion. Improved links between crop and animal production are also needed so allowing the waste materials of animal production systems which are currently identified as a significant disposal problem to become a valued resource.

The question whether Organic Farming can feed the world is commonly asked. This assumes that food supply is the greatest limitation to maintaining current and projected future world populations. This seems unlikely to be the case. The available of quality water supplies and the maintenance of social structures both currently and in the future seem more likely to act as limits. It could also be argued that the success of conventional approaches to agriculture in producing large volumes of food can be directly related to the magnitude of the research effort employed, especially that in the commercial agro-chemical industries. If Organic Farming is to become a major contributor to the world's food supply then it will also need significant research input. However it is important not to think of food as the only product of Organic Farming. Explicitly Organic Farming is designed to deliver a range of environmental and social services e.g. improved soil structure and water use, rural development goals. It is for this reason that trials which aim to compare production levels with organic and conventional treatments are fundamentally flawed. Conventional Agriculture benefited from over a quarter of a century of focussed research on it science base and technology. Organic agriculture needs a parallel approach focussed on its key needs.

Conclusions

The research needs of Organic Farming go far beyond mere science and require research to re-evaluate current economics-based values and social systems. Coming to this conclusion represents a developmental point on my journey through food production and its study. This has taught me to appreciate the importance of elements such as ethics in assessing what scientific developments are real advances, rather than simply repairs to the previous generation's legacy of technical problems. The science need will best be met by exploring the contributions which modern ecology can make to understand these agro-ecosystems and especially the management of soil processes and cycles. With this focus, I come full circle to the ecological approaches of my initial research career.

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