Functional Biodiversity

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The reduction in biodiversity in commodity-orientated, intensive conventional production means that this form of production cannot be maintained without oil-dependent inputs: it is fundamentally non-sustainable. Natural ecosystems, on the other hand, maintain high levels of biodiversity, and receive no inputs except for light, water, air and some fertility from migrating animals and man-made pollution: they are fundamentally sustainable.

Some farmers, agriculturalists and scientists have recognised this difference for a long time, leading to a wide range of alternatives developing out of conventional agriculture from Integrated Crop Management through Organic and Biodynamic Agriculture to Permaculture. Indeed, at the extreme, the Permaculture view is to take natural ecosystems as the starting-point and to develop sustainable food systems from them.

Organic systems, from their inception, have recognised the inter-relationships among soils, plants, animals and man which became manifest, for example, in the use of rotations, legumes and composts or manures. These basic approaches were developed largely on the basis of accumulated practical experience and a limited range of broad principles. However, the blossoming of many offshoots of ecological sciences means that there is now the opportunity to develop the science and practice of organic agriculture in ways that were unimaginable to the pioneers of only half a century ago.

Crop plants and animals, like all other organisms, need systems in place for uptake and metabolism of nutrients and water together with protection against pests, diseases and competition and the ability to cope with environmental variability. These services are provided fundamentally by the genetic make-up of the organism itself, supplemented by the interactions of the organism with others in the adjacent space. In conventional agriculture, these interactions are often replaced by synthetic inputs and the varieties of crop and animal are selected to maximise these artificial interactions.

For this latter reason, the varieties of crops and animals currently available in agriculture are often not well suited even to present-day forms of organic agriculture. If we are to capitalise more fully on accumulating knowledge in the many relevant facets of ecological sciences, then an accelerated and larger scale development of appropriate varieties of crops and animals will be needed. One example is our current project on the development of wheat populations in collaboration with the John Innes Centre. This project will, incidentally, help to demonstrate a number of valuable ways in which molecular biology can help to provide insights into crop variability and its dynamics, without recourse to the use of GMOs.

Integrated with relevant work on breeding and selection to provide appropriate crop and animal genotypes, one of the most important concerns is to improve our understanding and application of the potential for a wider range of spatial and temporal arrangements of crops and animals so that different components within the arrangement can contribute different services. Such examples include clover/vegetable inter-cropping systems where the legume component can provide nitrogen and encourage mycorrhizal phosphate uptake, the beet components help to release potassium and glucosinolates released from Brassicas help to control soil-borne pathogens. In this sense, we need to look critically at conventional rotations which, although they provide specific benefits in terms of weed and disease control, nevertheless, by their nature, limit within-field diversity. We believe there is a strong argument for simultaneous use of different crop and animal components at different levels of organisation from simple variety mixtures within a single crop through to complex systems of agroforestry.

Some of the broad principles that we need to follow can be summarised:

- To develop understanding of the "whole ecosystem" concept, which treats agriculture as one component in a complex and highly interdependent ecosystem encompassing all aspects of nature.
- To broaden the use of genetic diversity to protect crops against pest and weather problems by using multiple genetic systems that can cope with biotic and abiotic stress.
- To support studies that investigate and compare new and improved procedures for effective deployment of biodiversity in the farming system.
- To support studies that investigate ways to utilize and maintain biodiversity more effectively in animal production systems.
- To support studies that demonstrate the interactions of agriculture with the other parts of the "whole ecosystem," including improvement of the contribution of agricultural systems in a locality to the whole landscape.

Development of biodiverse systems has at least two major benefits outside the production system itself. The first is in provision of a wider range of employment potential within the system compared with conventional systems. The second is the potential for a much wider range of produce and products from the system, further increasing the local employment potential and support for the rural sector. Moreover, diversity of outputs, in an analogous way to diversity within the production system, provides buffering against the external environment.

In summary, development towards greater use of biodiversity services is essential if organic agriculture is to fulfil its promise and move from a minor role to centre stage. Furthermore, comprehensive sustainability requires not only wider and fuller applications of ecological sciences to the practice of food production, but also the application of similar and related principles to the sustainability of the whole organic food chain.

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