Diversity in Food Systems: The Case of Stockfree Organic

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Abstract

This paper argues that organic growing is associated with high levels of agricultural and ecological diversity, and should be understood as 'complex systems of culture' compared to conventional farming. The objective of this paper is to use a framework of complexity theory to investigate the ability of organic systems to meet the contemporary challenges of uncertainty and change in food production, by testing for the properties of resilience, adaptivity and innovation. We present a case study of Stockfree Organic Services (SOS), a committee of organic growers who are trying to promote a new 'higher' standard of organic production called 'Stockfree Organic' (SO) in which the farms and commercial gardens are free of all animal inputs.

Introduction

This paper argues that organic growing is associated with high levels of agricultural and ecological diversity, and should be understood as 'complex systems of culture' compared to conventional farming. Organic production requires a systems-based approach using all beneficial practices and not being selective. Diversity, both in terms of diversity of management strategies and in terms of biodiversity, can create the neccessary opportunities for promoting efficiency and sustainability of the system.

1. Sustainability - as part of a more 'holistic'[1] system of agriculture, organic methods reduce the reliance upon off-farm products such as artificial fertility and chemical pest and disease controls. Thus they promote more careful management of environmental resources. A system to which we refer as a 'sustainable' one is therefore in line with the more traditional definition of 'sustainable development', mainstreamed into the common language by the Brundtland Commission's report - Our Common Future. In other words, organic methods in agriculture are more likely to be sustainable in the sense that they are more likely to guarantee the rights of future generations to use natural resources.

2. Efficiency - contrary to the economic definition of efficiency in agriculture, in which output of a specific crop is measured per unit of labour and capital invested, here by efficiency we mean the production of food from a given area. Various studies have shown that small farms, using high levels of labour input, local knowledge and management skills and usually complex polycultural systems, are more efficient (Tansey 2000). From an environmental point of view, it is also relevant to consider the use of external resources, which could be measured in terms of energy supplied. It is interesting to note that some organic systems can be treated as nearly-closed systems, in that they minimise the use of external resources.

If organic farms have greater internal diversity, then they are better placed to cope with uncertainty and change caused by external factors. They may be more resilient to environmental changes such as, for example, the reduction in the effectiveness of pest controls, and less vulnerable to the economic risk of failure of specific crops (i.e. by always having a range of alternatives available). Organic farms may also be more responsive to changes in the socio-cultural environment (for example, new legislation, new technology of production, emerging markets etc.).

[1] We refer to the concept of holism as discussed in Dabbert et al.(2004:pg.xx)

Pioneer complexity scientists like Ashby (theorem of requisite variety) and Fisher (theorem on genetic diversity and adaptability) first argued that the capability of adaptation of a system is related to its degree of internal diversity. Related to this is the notion of the system's ability to generate novelty and to stimulate creativity and exploration. In terms of organisational forms, diversity may lead to the development of new and innovative practices. Interconnectiveness within an organic network could promote the uptake of such innovations and help the system become more adaptive to the external environment. However, diversity also presents difficulties in terms of the problem of integrating different perspectives and approaches inorder to achieve social cohesion. Standards, certification, and labelling are the regulatory instruments that facilitate development of the organic farming sector, and they are crucial in determining future outcomes.

The objective of this paper is to use a framework of complexity theory to investigate the ability of organic systems to meet the contemporary challenges of uncertainty and change in food production, by testing for the properties of resilience, adaptivity and innovation. We present a case study of Stockfree Organic Services (SOS), a committee of organic growers who are trying to promote a new 'higher' standard of organic production called 'Stockfree Organic' (SO) in which the farms and commercial gardens are free of all animal inputs. SO are the first vegan-inspired standards in the world, and currently it is the only alternative to the established 'Organic' standards in the UK. SO introduces a new set of agricultural techniques which have been formally established only since November 2004 but which date back through many years of experiment and innovation.

Considering how these themes surrounding complexity, diversity and interconnectedness apply to food production systems, in the following section we review the relevant literature both in terms of the natural and human aspects. Section three introduces the case study of SO and the methodological approach. Section four considers how the concepts of diversity and interconnectivity can be used to analyse the SO system of culture by exploring it in terms of the properties of resilience, adaptivity and innovation, and also looking at the problem of integrating different perspectives. Section five reflects upon these findings and discusses the further research issues.

Literature Review

As well as promoting health and environmental benefits, organic farming has been shown to be economically attractive. Average profits on most organic farms range between 100 and 130 per cent of the profits typical of conventional farms (Offermann and Nieberg 2002). The possibilities are not limited only to organic farms that carry livestock as part of the land use system: organic arable farms

can also produce strong returns (Leake 2001). Whereas the economic and logical arguments for organic methods are very clear, the political will has lagged behind. Only since the 1990s has the development potential been recognised and legislated for by policy makers in government and other institutional agencies. Now that the market for organic products is growing both in size and in complexity, the political aspects are coming to the fore.

Modern organic farming developed out of a set of ideas nurtured within the environmental movement where it was seen as an alternative to mainstream farming businesses (Dabbert et al. 2004). Within environmentalism there are certain limitations perceived of the official organic standards, and because of this the political environment of organic food is still contested, there being several related issues concerning the use of farm animals, the accumulation of 'food miles', the destruction of wildlife habitats (as farms become increasingly large-scale), and provision of fair trade arrangements overseas. Indeed, in many ways the current organic legislation is consistent with globalisation of the food industry, in which *"the thrust of agricultural policies regionally and worldwide is to produce the cheapest product to sell in as wide a market as possible. Despite the growing consumer preference for organic agriculture and local food consumption in the OECD, the trend is still towards ever more intensive agriculture and more long-distance transportation of food."*(Hines, 2000: p60)

Substantial drivers of change in the food industry today are coming from both the supply and the demand sides. Independent growers' are adopting alternative and innovative methods that go beyond current organic legislation. Meanwhile, customers' desires for products and production processes that are health-orientated, environmentally friendly and ethical are generating a market that is very heterogeneous and complex, and to which conventional 'extended' supply channels are maladapted. These factors are creating a situation of change and uncertainty, one in which the benefits that accrue from diversity in organic/holistic methods can no longer be sidelined in the political process.

The conference rationale invites further investigation on the theme of biological diversity, in particular on Ashbys theorem of requisite variety and Fishers theorem on genetic diversity and adaptability, which suggest that the capability of adaptation of a species (or of an organisational form) is related to its degree of internal diversity. Considering how these themes apply to food production systems, in this section we review the relevant literature both in terms of the natural and human aspects.

On the biological side, evidence for ecological diversity in organic systems comes from many studies. For example, a recent report found that *"species abundance and/or richness, across a wide-range of taxa, tend to be higher on organic farms than on locally representative conventional farms ... many of these differences apply to species known to have experienced declines in range and/or abundance as a consequence of past agricultural intensification, a significant num-*

ber of which are now the subject of direct conservation legislation (e.g. skylark, lapwing, greater and lesser horseshoe bat, corn buttercup Ranunculus arvensis and red hemp-nettle are all UK government Biodiversity Action Plan species). These biodiversity benefits are likely to derive from the specific management practices employed within organic systems, which are either absent or only rarely utilized in the majority of conventional systems" English Nature and the Royal Society for the Protection of Birds Report (2004: p25)

Similarly the Soil Association's report (2000) concludes that compared to conventional farms, there are five times as many wild plants in arable fields, 57 per cent more species, and several rare and declining wild arable species found only on the organic farms. Concerning animals there are more birds (25 percent), more arthropods (60 percent), more non-pest butterflies (200 percent more), more spider numbers and different species.

With respect to biodiversity, an important question centers on the ability of holistic systems to overcome the dangers of environmental upsets. Firstly it is clear that organic methods are aligned with a preventative approach which actually remove some of the conventional dangers relating to 'food scares' involving transgenic viruses, or over-use of pesticides (that cause the appearance of superbugs), for example. Although there is no guarantee that this will not induce other types of dangers, which are as yet unknown, it does remove significant risks. Other dangers like droughts, floods, and fire, however, will remain a serious problem. This is especially true in developing countries and rural areas where holistic systems can potentially be of great benefit by establishing sustainable systems.

Secondly, it is essential to know how stable are organic systems. According to the insurance hypothesis *"if the ecosystem is diverse if it has some species that can tolerate drought, some that are flood-resistant and some that are fire-tolerant, then two scenarios are likely. The ecosystems may show resistance, remaining broadly unchanged, because its many species buffer it against damage. Or it may show resilience: if it is hammered, it may bounce back to its original state quickly because the tolerant species ultimately drive the recovery and compensate for the temporary loss of their less hardy compatriots."*(Naeem, 2002).

The insurance hypothesis may very well apply to holistic systems, given their high level of diversity. On the other hand the question of the relationship between stability and diversity is still contested. Pfisterer and Schmid (2002) found that diverse systems are actually less stable and suggested that this could be due to 'niche complementarity effects'. In this case, *"a community of species whose niches complement one another is more efficient in its use of resources than an equivalent set of monoculture"*(Naeem, 2002) and a sufficient peturbation of the former could lead to dramatic losses in efficiency.

Despite the dangers of 'complexity catastrophy' the general opinion is that *"..diversity probably begets diversity; hence diversity may help beget growth"*(Kauffman, 1995: pg.292). In terms of comprehending the dynamics and consequences of di-

versity, these concepts have been most often explored from within the science of biodiversity. Generally speaking organic farming appears less likely to produce risks. The aforementioned food safety scandals burst out throughout Europe fit perfectly into Becks analysis of modern Risk Society. The author argues that the dangerous consequences of development patterns associated with modernity (including also the agricultural revolution) can no longer be limited in time and space (Beck, 1992). In this framework, organic food production represents one reaction to this reality, where technocratic and scientific solutions are being replaced with, literally, more natural ones, based on local knowledge and production systems.

On the human or social side, we consider the implications of the existance of a diverse number of perspectives on the objectives, motivations and methods of organic production, and what can be said about the challenges of trying to integrate them. Concerning trade legislation, globalisation moves further away from people having control over their food economies, and through deregulation and liberalisation there is an increasing concentration of power in corporate hands. Whilst the food industry remains one of the most protected and regulated industries, the current situation is characterised by development patterns that are dominated by one set of interests: corporate interests.

Furthermore, it has been argued that knowledge systems associated with globalisation represent a particular Northern approach to nature where technocratic responses predominate and there is no reflexivity (i.e. the consequences of ones actions are not taken into the due consideration), whereas local systems of knowledge are more likely to ensure that "limits, restraints and responsibilities are always transparent and cannot be externalised or denied" (Mies and Shiva, 1993).

If organic production is to serve diverse interests instead of dominant ones then it needs to admit plurality and find ways of coping with the resulting complexities whilst building upon its strengths. As pointed out by Hines (2000), *"Given the desire to involve people as much as possible a number of new institutional mechanisms are required. These must encourage and maximize citizen's participation in defining development priorities and in planning economic, social and environmental initiatives, especially in local communities."* (Hines, 2000: p128)

Analytical work on diversity of perspectives has been done by Hong and Page (2001) in terms of describing human capital and its application to problem solving in the knowledge economy. The authors find that, in a similar way to biological systems, strong societal performance can result from high diversity among individual perspectives. On the other hand, whilst society may be diversifying in terms of social demands and social choices or strategies, this dynamic can make representation within groups more difficult to achieve because they are less cohesive. This could be a significant drawback expressed through an increased possibility of social conflict. According to Hong and Page, *"Fresh perspectives*

and new ideas provide a basis for many improvements in problem solving contexts"(Hong and Page, 2001: pg.128).

Similarly, it is thought that technological innovation benefits from diversity of ideas (Mokyr, 1990). This is particularly apparent within geographical regions where there are lots of small companies interacting, they can often be seen to generate positive network externalities of innovation and economic growth.

The food sector has always been regarded as a low technology industry, having been associated with low-tech transformation of agricultural products. In comparison with other major industrial sectors, research and development activities in the food industry are of minor weight. All the same, the dramatic changes the food industry has gone through during the past few decades did bring about a change of winds. First, the food industry, as most of the manufacturing sector, experiences increased competition both on the domestic and on the international markets. Second, it has been losing the confidence of the general public due to a series of severe food safety shocks like the mad cow (BSE) or Foot and Mouth diseases in the UK or the dioxin in chicken crisis in Belgium. Finally, environmental and cultural concerns have entered the food debate, directing consumers attention towards issues of long term ecological sustainability as well as animal rights (Boudouropoulos and Arvanitoyannis 2000).

In response to these changes, the food industry found itself in a situation where it was forced to introduce innovations as a response to rising pressures from two fronts. On the one hand, food enterprises needed to keep up with stricter regulation covering food safety, food quality and environmental standards. On the other hand, pressure also arrived from various stakeholders (e.g. environmental NGOs or the general public) to go beyond these statutory regulations. As a result, food standards and labels (such as organic food) were developed in order to identify companies that have implemented a strategy that goes in this direction.

Avermaete and Viaeneon identified three innovative strategies which are often adopted as a response to the transformation the food industry goes through: (1) food safety and quality systems, (2) environmental management strategies and (3) labelling. In contrast with conventional innovation, these strategies are based on innovations for which the procedures are set by an external party. At the same time, the strategies go far beyond technological innovations. Information, communication and networking play a key role for successful implementation of the three mentioned strategies (Avermaete and Viaeneon, 2001: 3).

Hence, switching to organic production is in itself an innovation which results in the production of an output that better responds to changes in consumers tastes. However, once switched to organic productions, firms will constantly have to comply with externally defined standards and product characteristics. In turn, this will require a constant innovating and learning capability. All these considerations demonstrate the complexity of organic systems and the need for adaptation, innovation and sustainable development.

Stockfree Organic

"Stockfree as a term was introduced in 2000. It is a description of an organic method of growing food without the use of animal inputs. It is an adaptation of the word "stockless" commonly used by organisations like the independent Elm Farm Research Centre (EFRC) based in Newbury, Berkshire, to denote all arable farming."(Hall and Tolhurst, 2005:pg.1)

SO incorporates 27 additional regulations (requirements, restrictions and prohibitions) above the Soil Association standards for their 'Organic' label[2]. Currently the SO standards have been successfully applied by a number of small-scale growers, i.e. family-sized firms, all of which place an emphasis upon local production and distribution. There is much uncertainty as to what might happen if and when the application of stockfree methods expands. Firstly, there is little evidence available on whether or not the methods are scaleable to large agricultural businesses. Moreover, the role of the multiple retailer, which in the U.K. exerts a lot of influence, is unknown. Finally, it is not known how big the market for organic food may become, and to what extent it will support differentiation based upon multiple standards or systems.

Much, it seems, depends upon the response of consumer groups and the general public. Up until now the standards have remained largely out of view of the public, except for a few scattered groups of individuals who are reached directly by existing food distribution schemes or through the parent organisation of SOS, the Vegan Organic Network(VON). The VON is organised principally through personal contact via meetings and through the postal service by which it distributes newsletters; however, it is also represented through a web site (http://www.veganorganic.net).

SO aims to uphold the 9th principle of the International Federation of Organic Agricultural Movements (IFOAM) to use decentralised systems for processing, distribution and marketing of products. To do so it has suggested the use of box-schemes, which operate on a local scale. Although it is not a part of the SO regulations, all of the current adopters of the standards distribute exclusively by these schemes.

If the focus upon such *local* systems of food production and consumption systems can be maintained during further adoption of the standards then there are positive externalities associated with these changes. Improving local self-sufficiency in agriculture can help to rebuild local economies and infrastructure by bringing job security and more equal income distribution to rural areas. Moreover, opportunities for innovation in this sector are currently very strong. From a long term perspective, achieving sustainable regional economic growth and lower

[2]The inspection function of the SO Standards has been contracted out to SA Cert Ltd, the certification wing of the Soil Association, although the SO standards do not represent the views of the Soil Association.

environmental destruction are two factors that could bring intervention in the form of state subsidies and strategic placement of institutions into a more supporting role.

In Hall and Tolhurst (2005) the SO concept of sustainability is described as follows:

"Sustainability depends upon three things: perpetuity, reproducibility and information dissemination. A practice needs to have the ability to continue forever, to apply in different situations and to be easily copied and the information has to be accessible to many."(Hall and Tolhurst, 2005: pg.1)

On the one hand many of the techniques are traditional because they are based on practices that preceeded the mass-industrialisation of farming. On the other hand the growers have become innovators by experimenting in the use of ecosystems, crop rotations and other alternatives (discussed below). Also, stockless farming has never before had the support of an organised and well-informed collective like the VON. The trustees of the network encourage cooperation and sharing of information. However, a lot of technical knowledge is invested in a small number of experienced growers. The small-scale and local aspect of operations, compounded by the difficulty of obtaining funding to disseminate more widely, will probably result in a slow uptake of the new standards. The VON trustees are working on several initiatives to create access points for information on organic horticulture: a book (Hall and Tolhurst, 2005), SO demonstration films, HNC/HND college courses in organic horticulture at a SO certified farm, and eventually, a training centre.

They have longstanding links with similar organisations in other EU countries, and legislative and operational support from the main UK organic certification agency, the Soil Association. This relationship with the SA is somewhat ambivalent because on the one hand the SA actively promotes livestock farming, on the other hand they have been a great asset in getting the organic movement underway in the U.K.

The methodology for the case study involved working directly with members of VON who were initially interviewed (April and May), and then provided feedback on the findings (July) as well as access to internal documentation about the development of the standards (August).

Analysis

We investigate both the natural and social aspects of the SO system of culture in relation to the concepts of diversity, inter-connectivity and sustainability. In agriculture the human system is integrated with the natural system in a way such that it can be difficult to separate and analyse individual components only in terms of either the natural or social processes. However the issues raised below

span the range of phenomena, beginning from the ecological and then moving on to the managerial aspects of SO. Some of these points are quite difficult to quantify because the systems discussed here are recent departures in organics: as yet there are few farms that have converted to SO, there is scarce research underway and there is little empirical evidence available. This article draws together current knowledge about the emerging standards and discusses these points and the interconnections among the various concepts identified in the diversity dynamics forum in a broad and interdisciplinary way.

Biodiversity of ecosystems

SO is concerned with the development of ecosystems to provide a diverse natural habitat for many different species of wildlife. These ecosystems contain many natural predators be they insects (ladybirds, hoverflies, beetles, parasitic wasps) or creatures (frogs, toads, newst, birds, bats, slow worm), which are useful for pest control. Used in conjunction with the installation of physical barriers (covers, nets, fences, electric fences etc.) this systems-based approach has been very successful on several holdings(ref: HDRA study).

The importance of ecological principles is illustrated by the Welsh College of Horticulture which has a 'biodiversity plan' associated with Stockfree-organic growing, which encompasses areas designated for wetlands, woodland and wildlife.

The economic benefits of biodiversity of ecosystems are greater crop yields. The social benefits are the environmental improvements due to the reduced reliance of off-farm inputs and greater efficiency of land-use compared to stocked systems. In contrast, in conventional organic systems conventional thinking dominates i.e. growers often reach for the biological controls or permitted pesticides without giving a thought for providing the habitat for natural predators. They are also less likely to consider the overall impact upon the environment.

Aside from economic and social benefits, also important are the personal benefits, where the growers emphasised the 'enormous sense of wellbeing and satisfaction knowing that you have brought wildlife back and improved the soil biology e.g the grower can see increased earthworm populations.' Such considerations can, to some extent, explain the motivations and incentives for adopting SO systems of horticulture.

Diversity of agricultural or horticultural strategies

SO growing strategies are underpinned by highly complex crop rotations that typically involve about 50 different crops. Agricultural diversity is seen as a virtue of the system and is actually planned for in a highly methodical way, through the development of specific rotations. In the view of Hall and Tolhurst(2005), diversity brings the benefits of stabilising the fertility systems on the holding:

"Rotations are based on the principle that diversity and complexity provide stability. There is always diversity in 'natural' ecosystems with harmony depending on the balance between competition and co-operation among component parts." (Hall and Tolhurst, 2005: pg.111)

Following the imperative for maintaining fertility levels, a second reason for diversity is that it provides a way to spread economic risk i.e. if one crop fails it does not lead to economic disaster. Thirdly, crop diversity is important for engaging in certain types of direct selling (see subsection below).

Whereas conventional organic systems can sustain monoculture and thus produce food for wholesale markets, SO Standards restrict the use of biological insecticides and encourage polyculture. In terms of crop rotations, this means that they often have more 'courses' (i.e. years) in order to provide space for each of the different vegetable families (and obtain all-year-round harvests). Compared to standard four-course rotations recommended for conventional organic systems, SO rotations may have seven or eight courses (see Table 1). Indeed in the SO regulations, rotations that involve alliums (onions and leeks), brassicas (cabbage family) or potatoes returning to the same plot of land within a 48 month period are prohibited.

- insert Table 1 about here -

Whilst innovators in SO farming have demonstrated that complex rotations can be used to grow a variety of crops in a sustainable and economic way, there are relatively few working examples so far. The intention is that adopters of the new standard will not be presented with one prescribed strategy, but will be advised in developing their own rotations according to and in harmony with the site of their holding and other factors. Moreover, strategies are meant to be constantly tweaked and changed as growers learn about new techniques and new vegetable fashions (e.g. the rise of the salad bag).

Whilst diversity among different SO rotations may not yet be a measurable phenomenon, it is possible to analyse the complexity of rotations such as that presented in Table 1.

As with many small enterprises, commercial SO growers have to operate within fairly tight economic margins, and it is therefore important to have a good knowledge of the effect of different crop rotation systems on yields. Given that the growers are using highly complex rotations and other diverse methods, this can be a difficult task. It requires careful planning, monitoring and evaluating. Compared to conventional farming (organic and non-organic) the results are likely to be more unpredictable and indeterminate (there being a wide range of available strategies).

For example, Hall and Tolhurst (2005: pg.112) propose a list of eight different factors which could determine the specific rotations. In contrast, conventional

farmers often just follow the advice of the chemical input companies and are unwilling to try new things (even if a crop or livestock product is making a loss). They are willing to give control of their sector to advisors, input and machinery companies whereas SO growers firmly keep every part of the growing system within their remit. It is likely that experimentation does not often occur in conventional farming because the yield could be a relatively simple and predictable function of a small number of factors (for example soil type, climate and availability of fertiliser).

On the other hand, it is important to point out the limits of complexity within SO strategies:

"In a rotational system there is interaction among crops but the interaction is limited to the relationship between the amount and range of living and dead organic matter left by each crop in turn."(Hall and Tolhurst, 2005: pg.121)

Within rotations, further interaction can be promoted by crop interspersing, i.e. placing different crops on the same strip of land (also known as companion planting). In this way, it is thought that agricultural or horticultural designs could become more like ecosystems (further experimentation is taking place through several farm trials). There being relatively few working examples, it is difficult to compare and measure the diversity and complexity in terms of agricultural or horticultural strategies. However it is clear that the few innovators for which data are available have made large steps towards bringing SO further along the scale from monoculture towards polyculture.

Diverse management strategies

This section considers what kind of business strategies are economic and can support different rural livelihoods. Most SO growers either rent or have bought a small bit of land and so they are not in the financial position to diversify because they have not inherited their farm. Most rural diversification schemes tend towards taking farmers out of farming whereas the stockfree-organic sector has the opposite goal: to get people farming in the most efficient and environmental way possible (where efficiency is measured as suggested in the introduction).

If at the moment the focus is on farming, there could be potential diversification strategies that combine core farming activities with, for example, education, (eco-)tourism, and conservation schemes. Many stockfree-organic holdings already have an educational role and encourage visitors, growers and customers to the holding to observe it first-hand. In terms of conservation work, currently SO growers do take advantage of conservation subsidies. This could be an area into which they could further diversify. Tourism, where run by family-sized firms, could bring money into local economies and hence benefit the rural communities. However this would be a relatively specialised type of eco-tourism that would in the long run probably only generate a small revenue.

Marketing activities largely concern the creation of channels for direct selling, which allow SO farmers to obtain the best prices. Wholesale selling is not recommended for the small companies that grow SO food because they are in a relatively weak negotiating position. More direct selling, e.g. through farmers markets, farm-gate sales and box schemes are more economically suitable, and they all satisfy the initiative for providing food to local markets. Hall and Tolhurst (2005: pgs. 322-324) consider the advantages and disadvantages of each type of direct selling. The main drawback for direct marketing is that it consists of a lot of work to set up these various schemes (involvement of the grower is high) and they also have to develop the required marketing skills.

Nevertheless, most SO growers have put in place box schemes and other methods of direct selling, which allow them to get the best price. Shared schemes are collective enterprises in which growers may pool their resources. These considerations are very important because for the system to be economic they have to be able to fill the boxes in sufficient quantity, and provide consistency of service as well as variety. If growers do not secure sufficient market outlets, then the businesses may be at risk.

In summary, this section has argued that SO has some potential to diversify the rural economy, although we cannot say that it is diverse in the current situation.

Capacity to innovate new sustainable farming techniques

Innovation and innovation potential are key to the success of the organic movement because systems that imply more restrictions (in the form of the additional regulations) must respond by developing their own alternatives. SO farming is a good example of that (for example, development of ecosystems, complex crop rotations, green manures for fertility, initiation of box-schemes and other direct selling techniques - see the analysis of the previous subsections). These new techniques are based on the work of a number of different innovators in the vegan-organic growers' movement, and the outcomes demonstrate that high diversity can promote learning and innovation in organic food systems.

Moreover, the SO Standards themselves can be regarded as a legislative innovation. Consulting on the standards incorporated ideas from different members - this is discussed in the following subsection. The networking activities lead to a process by which the set of regulations and guidelines are continually updated and improved in accordance with the needs and wishes of the growers. In other words, the sector has to be innovative.

As mentioned earlier, SO farmers are very willing to experiment upon new ideas and to become innovators. One of the most important innovations has been in the production of green manure for fertility. This thought to be a crucially important component because of the difficulty of obtaining animal manures in

many parts of the UK. Green manures could offer an alternative solution for arable farms wishing to convert to organic production (where the development of new infrastructure for keeping livestock would not be economically viable).

Interconnectivity in defining standards

Since the VON was first established as an informal network back in 1996, much discussion has taken place and thought gone into developing the standards. The main underlying motives range from the concern for welfare of farm animals, preference for more rational, sustainable, and economic methods, and the frustration with the destructiveness, wastefulness and innefficiency of modern agricultural production. These have led to the wish to actively support social change in food systems from the 'grassroots' of small, independent, horticultural growers by firmly establishing an alternative.

The network consists of small growers and amateur gardeners interested in the principles of vegan organic growing. As well as a magazine, local meetings, and an annual conference, information is provided through the VON Web site, which represents a great resource for the network. There are two fora: one providing advice about gardening methods and the other carrying all correspondence among the commercial growers. Over these communicative networks, online, offline, and face-to-face, SOS diffuse knowledge and solicit the views of the members.

The standards were devised after canvassing world-wide opinions of over 100 persons involved in organic growing. This was a long process, taking several years during which time more than 12 drafts were produced. Interconnectivity was high, and although this approach resulted in a lot of work to broker compromise, it turned out to be very inclusive. Only about three people withdrew their support and there were few conflicts. Indeed, most are happy with the outcome and it is viewed as a great success. One reason could be that it was approached as a pragmatic enterprise that aimed for realistic outcomes supporting plurality of perspectives.

This is illustrated by the fact that one of the discussion points concerned the naming of the standard, it being eventually changed from 'vegan-organic' to 'stockfree-organic'. The committee decided to use the term stockfree in order to avoid communicating in a way that might impose perceived cultural barriers. In particular they wanted to use terminology that would resonate with the farming community, being both similar to the traditional 'stockless' and yet having a 'positive' connotation.

Perhaps the largest conflicts were about whether to allow animals during the process of conversion, whether to allow 'trapping' of animals, and about keeping pets on the holding.

As discussed earlier, information is shared. SO growers are the complete opposite to conventional farmers in that they are constantly experimenting and

sharing their information for free to try and promote the sector. Sharing of information implies cooperative relations - this tendency could be explained by the fact that the network started off as an informal network of friends, and that the culture of sharing and recipriocity still dominates and is encouraged.

The experience of SOS suggests that that for workable standards to be achieved there must be a process of discussion that invites a wide range of different views. That so much effort and discussion has gone into the standards, which are now well-liked by nearly everybody, demonstrates that interconnectivity can help to avoid lock-in to sub-optimal standards. However the network must continue to provide flexibility to respond to ongoing changes in the organic sector.

Discussion

Out of the five areas in which the concepts of diversity and interconnectivity were investigated, in four areas diversity was shown to be an important strength of the SO system. Thus the analysis has provided some useful indicators that the system has good credentials to withstand the changing and uncertain food sector, as it appears to have the potential for resilience, innovation as well as adaptability.

The SO experience suggests that a pragmatic approach must be taken to dealing with internal diversity of perspectives, and concentration upon the difficult task of establishing processes that are inclusive and democratic, but that can eventually succeed. Reflecting on the future direction of SO, it is clear that it is aiming to become a mass movement for progressive change in food systems, based upon bottom-up growth from small growers connecting directly with consumers into local systems. Developing a new set of standards is an empowering step that allows the growers to establish and cooperatively manage their own niche.

This research aims to track the development of the SO standard, to analyse it as a complex adaptive system, and to be useful to those stakeholders at SO by providing research findings based on a critical analysis using multidisciplinary techniques. In this article we have seen that Complexity theory is an appropriate framework to understand and draw out the themes of organic growing.

To take this further it was suggested that an agent-based modelling (ABM) approach, combined with social network analysis (SNA) would be chosen as tools of further investigation. Combined with in-depth case study research, these methods will allow the best available insight into dynamic social processes and complexity. Therefore the following phase of investigation will use the findings of the SO study to inform the development of an agent-based model of certification, standards and labelling. One objective of the modelling is to investigate how social networks can be important for determining producers' implementation and buyers' acceptance of standards, and the emergence of logos and labels to support

the development of new markets.

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