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Organic farming and the sustainability of agricultural systems

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Abstract

The desire for a sustainable agriculture is universal, yet agreement on how to progress towards it remains elusive. The extent to which the concept of sustainable agriculture has any operational meaning is discussed. Sustainability is considered in relation to organic farming — a sector growing rapidly in many countries. The role of regulation and the use of synthetic agrochemicals, the desired degree of self reliance of agricultural systems, and the scale of production and trade in agricultural goods are all considered in the context of this discussion of sustainability. © 2001 Elsevier Science Ltd. All rights reserved.

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The concept of sustainability lies at the heart of the debates that currently exist over the use of the planet's natural resources, yet there is no consensus on its meaning despite its intuitive appeal (Park and Seaton, 1996). This paper focuses on sustainable agriculture, although there is still no consensus on this more specific aspect of sustainability.

Some have argued that, for example, organic farming and sustainable agriculture are synonymous, others regard them as separate concepts that should not be equated. The relationship between organic agricultural systems and agricultural sustainability is therefore examined in this paper.

The reason for the focus on organic agriculture is the rapid development of the organic sector in Europe and North America. This development has resulted in an

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EU average of 2.2% of agricultural land as organic, while in countries such as Austria and Sweden the figure is over 10% (Lampkin quoted in Soil Association, 2000). USDA estimates that in the USA the value of retail sales of organic foods in 1999 was approximately $6 billion, while the number of organic farmers is increasing at a rate of about 12% per year (USDA, 2000). The area of organic and in-conversion land in the UK doubled between 1999 and 2000. Organic farming, as is discussed below, has a long history but its sudden elevation from relative obscurity merits a consideration of its development and nature. As noted above, the focus of the paper is predominantly European and North American, which is not to devalue the significance of developments in the Southern Hemisphere but rather to keep the paper reasonably focussed.

As the figures above on the development of the organic market indicate, the growth in consumer demand for environmentally friendly, "green" or chemical-free food products has led to an expansion in Europe and North America of organic registration schemes. These schemes are seen to guarantee that products are produced in a certain way, with a range of agricultural inputs prohibited. The effects of these schemes on producers, and the implications of an expansion of the world market in such goods are also discussed in the context of agricultural sustainability. This raises issues regarding the scale, productivity and organisation of a future sustainable agriculture.

The paper is structured thus: Section 1 reviews the development and meaning of sustainable agriculture, while Section 2 is concerned with the history and nature of organic farming. Issues regarding organic standards, regulation and the relationship between input use and sustainability are discussed in Section 3. Sections 4 and 5 concern the degree of isolation of sustainable systems and issues of scale and productivity respectively. Section 6 concludes the paper, focussing on some of the key issues in the debates about the organisation of a sustainable agriculture.

1. What is meant by sustainable agriculture?

Some of the developments in modern agriculture that have led to doubts regarding the long-term viability of current production systems are summed up by Hodge:

> Agriculture has come to draw the inputs which it uses from more distant sources, both spatially and sectorally, to derive an increasing proportion of its energy supplies from non-renewable sources, to depend upon a more narrow genetic base and to have an increasing impact on the environment. This is particularly reflected in its heavy reliance on chemical fertilisers and pesticides, its dependence upon subsidies and price support and its external costs such as threats to other species, environmental pollution, habitat destruction and risks to human health and welfare. (Hodge, 1993, p. 3)

The word sustainable is derived from the Latin, *sustinere*, meaning to keep in existence, implying permanence or long-term support. In the context of agricultural

production, Ikerd (1993) defines a sustainable agriculture as "capable of maintaining its productivity and usefulness to society over the long run. ...it must be environmentally-sound, resource-conserving, economically viable and socially supportive, commercially competitive, and environmentally sound" (p. 30).

Attempting to arrive at a more precise, operational definition of sustainable agriculture is extremely problematic, partly because there is such a range and number of parties involved in the debate. This is not surprising, as there would appear to be little point in advocating a non-sustainable agriculture, and so all relevant groups are fighting it out in the sustainable camp (Francis, 1990). Even the chemical companies can claim that farmers should purchase their agrochemical products to improve their financial sustainability (Buttel, 1993; Whitby and Adger, 1996). Therefore the debate over how to achieve sustainability is plagued by fundamental disputes and disagreements over which elements of production are acceptable and which are not.

The complex nature of the interrelationships between agricultural production and the natural environment means that we are far from knowing which methods and systems in different locations will lead to sustainability (Youngberg and Harwood, 1989). This seems to be a crucial issue in the debate, and leads one to ask, how long should an agrosystem behave sustainably to be considered sustainable, and how should sustainability be assessed? It is extremely difficult to determine whether certain agricultural practices are sustainable or not. It is only in retrospect that sustainable techniques can be truly identified. The identification of technologies as sustainable today is questionable, since such identification is based on hypotheses regarding the sustainable management of natural resources, maintaining their productive capacity through time. This implies that a constant process of monitoring and reevaluation is required. In fact, there have been few attempts "to characterise the sustainability of specific agricultural systems" (Hansen and Jones, 1996, p. 186).

The approach adopted here rejects an approach to sustainability that focuses on the description and development of sustainable farming practices irrespective of the socio-productive features of the farming systems in which they are used. Thus, sustainability cannot be associated with any particular set of farming practices or methods (Ikerd, 1993), since the ability of a certain technology to behave as sustainable, will mostly depend on the peculiarities of the context in which it is used. Crucially, systems that are sustainable "for one farmer or farm at one point in time may not be sustainable for another farmer or farm at another point in time" (Ikerd, 1993, p. 31). What is a sustainable technique will vary both temporally and spatially.

Despite there being a broad consensus among advocates of sustainable agriculture that the conventional approach to agriculture is inappropriate, there are significant differences regarding the type of farming practices which should be developed in order to approach sustainability. There is a far greater degree of agreement regarding the problems associated with conventional agriculture, than the strategies required to deal with them. Many "alternative" approaches have been developed with respect to issues of sustainability, these include integrated pest management (Caroll and Risch, 1990), integrated crop management (LEAF, 1991), low input agriculture, low input sustainable agriculture (Edwards, 1987), low external

input sustainable agriculture (Reijntjes et al., 1992), agroecology (Altieri, 1995), permaculture (Mollison and Slay, 2000), biodynamic farming (Steiner, 1924) and organic farming (Scofield, 1986). The references provided explain these approaches in more detail as do Rigby and Càceres (1997) and Gold (1994).

The focus here is on organic farming, and particularly its relationship with the concept of sustainability. There are a number of reasons for this emphasis. The first is that organic farming pre-dates all other approaches to "environmentally-friendly" agriculture (Scofield, 1986). Second, it is a rapidly developing agricultural sector in many countries, as the figures cited above for the EU and North America indicated. The reasons for this expansion are numerous and there are variations across countries. Consumer interest has grown in response to repeated food safety scares, animal welfare concerns as well as more general concerns regarding the impact of industrial agriculture on the environment. Producers have also been attracted because of environmental concerns as well as by the potential health impacts of using agrochemicals and, as is discussed in Section 3, by the economics of organic production relative to conventional agriculture. This latter factor has been affected by the fact that many governments, including that of the UK (MAFF, 1999, 2000), are encouraging more producers to adopt organic techniques.

2. Organic farming

There are, as with sustainable agriculture, a variety of definitions of organic farming. Mannion (1995) refers to it as a holistic view of agriculture that aims to reflect the profound interrelationship that exists between farm biota, its production and the overall environment. Scofield (1986) stresses that organic farming does not simply refer to the use of living materials, but emphasises the concept of 'wholeness', implying the "systematic connexion or co-ordination of parts in one whole." (p. 5)

As Scofield points out, the concerns that motivated the early exponents of organic farming are still very much part of the current debate over agricultural sustainability, including issues of soil health and structure, the exhaustible nature of artificial fertilisers, and human health. Northbourne (1940), the person credited with first using the term organic farming, advocated a society made up of small, self-contained units, a view that has a strong role in modern environmental movements, where there is often a rejection of large impersonal units of production, where both people and nature are viewed as being subordinated to the machine or corporate identity. This rejection of the concentration of specialised production in fewer, larger units, was most famously articulated in recent years by Schumacher (1973) in 'Small is Beautiful' (1973) (Scofield, 1986).

As Lampkin points out, contemporary organic farming is based on a number of different approaches which have blended over time to produce the current school of thought. As the above discussion has indicated, seeking to provide *the* definition of any of these approaches is always difficult. A modern definition of organic farming provided by Lampkin (1994), an authoritative source, states that the aim is: "to create integrated, humane, environmentally and economically sustainable

production systems, which maximise reliance on farm-derived renewable resources and the management of ecological and biological processes and interactions, so as to provide acceptable levels of crop, livestock and human nutrition, protection from pests and disease, and an appropriate return to the human and other resources'' (p. 5). One of the most significant expositions of the aims and principles of organic farming is that presented in the International Federation of Organic Agriculture Movements basic standards for production and processing (IFOAM, 1998); these are presented in Table 1. As the this statement makes clear, the scope of the principles extend beyond simple biophysical aspects to matters of justice and responsibility.

3. Organic farming, regulation and sustainability

One of the aspects of organic production which separates it from many of the other alternative agricultural movements identified above, is that it has a history of regulation. Tate (1994) explains that this is necessary ''to maintain the high ethical standards of the organic movement, to retain consumer confidence in produce, to encourage and support genuine organic farmers, and...to provide a basis for traffic in organic produce across frontiers'' (p. 15). MacCormack (1995) notes, ''unlike 'sustainable' farming practices, organic farming practices are well-defined — in fact, organic farming practices are unique, for they are the only ones codified as law. A

Table 1
The principle aims of organic production and processing[a]

To produce food of high quality in sufficient quantity.
To interact in a constructive and life-enhancing way with natural systems and cycles.
To consider the wider social and ecological impact of the organic production and processing system.
To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals.
To develop a valuable and sustainable aquatic ecosystem.
To maintain and increase long term fertility of soils.
To maintain the genetic diversity of the production system and its surroundings, including the protection of plant and wildlife habitats.
To promote the healthy use and proper care of water, water resources and all life therein.
To use, as far as possible, renewable resources in locally organised production systems.
To create a harmonious balance between crop production and animal husbandry.
To give all livestock conditions of life with due consideration for the basic aspects of their innate behaviour.
To minimise all forms of pollution.
To process organic products using renewable resources.
To produce fully biodegradable organic products.
To produce textiles which are long-lasting and of good quality.
To allow everyone involved in organic production and processing a quality of life which meets their basic needs and allows an adequate return and satisfaction from their work, including a safe working environment.
To progress toward an entire production, processing and distribution chain which is both socially just and ecologically responsible.

[a] Source: IFOAM, 1998.

complete set of certification procedures governs organic farming, from the soil to the dining table'' (MacCormack, 1995, p. 60). This history of regulation makes a discussion of what organic agriculture actually is considerably easier, since there exist published standards which producers must comply with. Although there are differences in these standards between various organic bodies and across national boundaries, these clearly defined standards represent a foundation on which debate can be based.

There is no real dispute that sustainable agriculture and organic farming are closely related terms. There is however disagreement on the exact nature of this relationship. For some, the two are synonymous, for others, equating them is misleading. Lampkin's definition of organic farming, quoted above, talks of sustainable production systems. Having provided his definition, he goes on to state: ''...sustainability lies at the heart of organic farming and is one of the major factors determining the acceptability or otherwise of specific production practices'' (Lampkin, 1994, p. 5). Similarly, Henning et al. (1991) precede their definition of organic farming, quoted above, by claiming that ''it could serve equally well as a definition of 'sustainable agriculture''' (p. 877). Rodale even suggested that ''sustainable was just a polite word for organic farming'' (York, 1991, p. 1254).

Despite the variety of definitions of organic farming, the general agreements regarding what is necessary to produce organically are in stark contrast to the debates and arguments that rage regarding the nature of agricultural sustainability. However, as Ikerd (1993) notes, ''mention 'sustainable agriculture' and many people will think you are talking about organic farming. Some organic farmers will agree. They think that organic farming is the only system that can sustain agricultural production over the long run'' (p. 30). This view of an extremely close if not synonymous relationship between organic farming and sustainability is not universal, and it should of course be noted that the elusive nature of sustainability's definition and meaning imply that equating it to anything is a rather bold step.

Hodge argues against those like Bowler (1992), who view organic farming as the only truly sustainable type of agriculture, contending that this is only true if non-sustainability is identified through the use of non-renewable resources, especially inorganic chemicals. In opposition to this position he states that: ''...it must be questionable as to whether organic farming, as currently practised, can reasonably be regarded as sustainable'' (Hodge, 1993, p. 4). Factors that Hodge uses to support his argument include uncertainty regarding nitrate losses from conventional and organic farming, particularly in light of the difficulty in controlling nutrient applications from organic manures. Concerns over the long-term maintenance of potassium levels in soils, especially on dairy farms, and the issue of soil erosion are also cited. The conclusion drawn is that ''it is thus a mistake to equate 'sustainable' agricultural systems with 'organic' ones. A restriction on the use of inorganic chemicals is not a sufficient condition for sustainability, but it may not even be a necessary condition'' (Hodge, 1993, p. 4).

Pretty (1995, p. 9) argues that although ''organic agriculture is generally a form of sustainable agriculture'', it can also have negative environmental effects. These include the leaching of nitrates from field under legumes, the volatilisation of

ammonia from livestock waste and the accumulation of heavy metals in soil following the application of Bordeaux mixture.

Some of the research that has been carried out regarding the historical relationship between agricultural systems and the sustainability of the societies they support, illustrates the point that a farming system need not be modern, mechanised, and using synthetic chemicals to be profoundly unsustainable. Carter and Dale (1974), in a historical review of the relationship between the soil, agricultural systems and the civilisations they have supported, explain how the fertility of large areas of Greece, Lebanon, Crete and North Africa was destroyed by low input, chemical-free unsustainable agricultural practices. The farmers whose agricultural practices contributed to this erosion and desolation were undoubtedly organic producers in terms of the inputs used, but they were 'organic by neglect'.

This point is not merely of historical interest, examples of the organic by neglect approach are still witnessed today. Hall, an organic inspector with the Organic Crop Improvement Association[1] (OCIA) in the USA, states that this idea that a crop is organic because 'nothing has been put on it' is all too common. This, he argues, is not a sustainable approach and "does a major disservice to the majority of organic farmers who are making excellent progress in developing healthy and naturally resilient whole farm systems" (Hall, 1996).[2]

These points support the view that focusing on particular inputs or tools in the identification of sustainable agricultural systems is insufficient. In response it might be argued that inputs and tillage methods are only one part of the picture, that organic production goes beyond these narrow production issues. Lampkin and Measures (1995, p. 3) write that "the term 'sustainable' is used in its widest sense, to encompass not just conservation of non-renewable resources (soil, energy, minerals) but also issues of environmental, economic and social sustainability." The IFOAM aims in Table 1 refer to the need "to interact in a constructive and life-enhancing way with natural systems and cycles...to consider the wider social and ecological impact of the organic production and processing system...to encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals...to progress toward an entire production, processing and distribution chain which is both socially just and ecologically responsible" (IFOAM, 1998, p. 3). Clearly, the standards do not exist in a vacuum they represent an attempt to move from general principles, such as these from IFOAM, to specific practices and inputs, whether recommended or prohibited.

The difficulty is that incorporating these wider concerns into definitions of, and standards for, organic farming is problematical. Standards are far more able to refer to prohibited inputs than to deal with precise criteria for the assessment of whether producers and processors are acting in a manner which is "socially just" or "ecologically responsible". The significance of this increases when one considers the

[1] The OCIA is the world's largest organic certification agency.

[2] From Sanet-Mg, a sustainable agriculture network discussion list. Details of its history, purpose and how to subscribe to it are available at: http://www.sare.org/htdocs/hypermail. There was an extensive debate among subscibers on the relationship between organic farming and sustainable agriculture in the first half of 1996.

massive expansion of the organic sector currently underway in many countries, where the motivations of newly converting organic producers may well be different from the 'traditional' organic producer who associated closely with these broader principles.

This issue of the range of motives that people may have for adopting organic techniques must be carefully considered. While many adopting organic practices are doing so for lifestyle and more holistic reasons, the issue of higher market prices for organic goods can not be ignored. Lampkin and Measures (1995) report, for example, organic prices in the UK between 50 and 100% above conventional prices for cereals and vegetables. It seems highly probable that these economic factors are driving the conversion decision for many new organic producers in contrast to the past. In the UK, this changing profile of the new organic producer is a result of the number of established conventional producers who are now converting to organic production, something which the number of calls to the Organic Conversion Information Service (OCIS) reflects. In the context of the prolonged crisis in large sections of British agriculture the possibility must therefore exist of producers becoming organic to pursue these premiums; their motive may not be sustainability in its broadest sense, but marketing at its most strategic.

A greater understanding of the range of motives for adopting organic techniques is needed, and the implications of this range of motives for any discussion of the relationship between organic and sustainable farming practices must be considered. Weymes (1990) found that 9% of the Canadian organic farmers surveyed stated that profitability was their primary reason for adopting organic farming (see Blobaum, 1983; Kramer, 1984; MacRae et al., 1990; Padel, 1994; Padel and Lampkin, 1994; Rigby et al., 2000a; for more on the motives of alternative farmers). Fairweather and Campbell (1996) found that over a third of the organic farmers they interviewed would switch to conventional production if premiums decreased, and on the basis of an analysis of these organic producers distinguished between "pragmatic organic" and "committed organic" farmers.

Part of the difficulty here is that these organic schemes must focus on prohibiting or encouraging the use of particular inputs or tools, whereas it is the use of these things that determines a system's sustainability. Stolze et al. (2000) argue that organic farming uses two methods to obtain environmental results: "the regulation of the use of inputs" and "the requirement of specific measures to be applied or, in some cases, of the outcome of environmental or resource use". The authors confirm the emphasis on the regulation of inputs explaining that "the first method is more important and the second is more a supplement" (2000, p. ii).

This orientation on specific inputs is hardly surprising since these schemes require producers to either be registered or not; there can be no grey areas, the produce is sold either with the organic symbol, or without. The criteria must therefore be clear, well-defined and open to inspection. Objectives such as the sustainability of farm families, farm workers and rural communities, which are frequently espoused by organic groups, are simply not amenable to this type of regulation. Individual producers may be committed to such goals, but most standards do not include them, and it is difficult to see how they could.

Hall (1996), an OCIA inspector, states "the best, most sustainable farms that I have ever been on have all been organic-truly inspirational stuff. I have also been on so-called organic farms with 1050 acres of soybeans out of 1100 acres total...Others have even less rotation than many conventional farms. The sustainability of organic farms runs across the entire range of sustainability, just like it does for conventional farms."

An obvious example of the need to have clear-cut standards is the prohibition of synthetic chemical which is one of the defining properties of organic farming systems. Two of the basic characteristics of organic systems are "the avoidance of fertilisers in the form of soluble mineral salts" and "the prohibition of agro-chemical pesticides" (Soil Association, 1992, p. 13). There are problems with this grouping together of synthetic chemical inputs. Putting mineral fertilisers in the same category as synthetic pesticides may be as much a result of an antipathy towards science and the industrialisation of agriculture, as it is of scientific categorisation. For example, fertilisers supply the same nutrients as organic manure, but in a more soluble form, whereas many pesticides are biocides which have no natural equivalent. Regarding both types of chemical inputs as equally unsuitable for sustainable farming is therefore extremely debatable.

The issues discussed above point towards a rejection of the view that organic farming is simply the practical implementation of sustainable agriculture's principles, or indeed that, as has been claimed, it represents the pinnacle of sustainable agriculture. This does not imply that organic agriculture is unsustainable. Rather, the notion of sustainability is such a "site-specific, individualistic, dynamic concept" (Ikerd, 1993, p. 31), that arguing that one particular set of codified production practices are its practical expression seems incorrect and likely to attract unnecessary criticism. In this sense, the sustainability concept may be viewed similarly to appropriate technology, in that the appropriateness of particular technologies will also vary temporally and spatially (McInerney, 1978).

The information that is required to inform this debate further is detailed data regarding the environmental impacts of organic production systems. Such information is sparse, although the increased interest in the sector over recent years has produced a series of initiatives investigating these matters, some of which have reported. Stolze et al. (2000) provide a review of the environmental impacts of organic farming in Europe based on a review of existing literature in national and international sources noting that "as data availability on the subject has not always been satisfying, a qualitative...analysis has been chosen as an approach" (2000, p. ii). The impacts are assessed under seven headings: ecosystem; soil; ground and surface water; climate and air; farm input and output; animal health and welfare; and quality of food produced.

Summarising some of their findings, the authors find that "organic farming clearly performs better than conventional farming in respect to floral and faunal diversity" however "direct measures for wildlife and biotype conservation depend on the individual activities of the farmers" (Stolze et al., 2000, p. ii). In terms of soil it is concluded that "organic farming tends to conserve soil fertility and system stability better than conventional farming systems...no differences between the farming

systems were identified as far as soil structure is concerned'' (p. ii). Regarding water quality the review concluded that ''organic farming results in lower or similar nitrate leaching rates than integrated or conventional agriculture'' (p. iii). Conclusions regarding the impacts on climate and air are hard to draw because of a lack of data and the difference between calculations per unit of land as opposed to per unit of output. Stolze et al. (2000) conclude that nutrient balances on organic farms are often close to zero and that ''energy efficiency...is found to be higher in organic farming than in conventional farming in most cases'' (p. iv).

Work on impact assessment raises the issue of which are the key aspects of a system's performance that should be measured, that is, what are the key aspects of agricultural sustainability and what are the associated indicators that should be monitored. Stolze et al. (2000) adapt the OECD set of environmental indicators, using only those indicators which directly affect the system of organic farming. This issue of indicator development is a rapidly developing area of work which is reviewed by Glen and Pannell (1998); Moxey (1998) and Rigby et al. (1999). Specific examples of work on constructing indicators of agricultural sustainability are to be found in Taylor et al. (1993); Gomez et al. (1996); Swete-Kelly (1996); Bockstaller et al. (1997); Müller (1998) and Rigby et al. (2000b).

Part of the difficulty in assessing the sustainability of agricultural systems, an issue which many of the papers cited above address, is the fact that both the units of measurement and the appropriate scales for measurement differ both within and across the commonly identified economic, biophysical and social dimensions of sustainability. For example, consideration of the effects of organic production on farm margins, soil fertility and rural employment are difficult to combine in an overall measure. Not so problematic if the effects are all in the same direction, but when one starts to consider trade-offs, as one indicator increases and another falls, across different dimensions then this factor becomes more significant. This is an issue which will not be solved simply by greater knowledge of the impacts of different production systems; even with complete information regarding impacts one will still have to consider trade-offs with movement towards targets in some respects accompanied by reverses in others.

Despite this complication of trade-offs and the need for judgements to be made about priorities, the notion of sustainability as a goal, a signpost rather than a destination, is still useful (Ikerd, 1997). Thought of in this way, the convergence to agricultural sustainability may be viewed as an asymptotic process.

Two other issues that complicate the sustainability assessment of agricultural production systems in general, and organic systems in particular are now discussed.

4. The degree of isolation of sustainable systems

The first issue is how broad should the consideration be when one considers the sustainability of farming systems. For example, can a farm on which no synthetic chemicals are used, and which may be considered sustainable in terms of its tillage and rotational practices, be sustainable if it uses electricity generated from fossil

fuels or nuclear power? Standards for organic food production do not deal with the sustainability of energy sources, and it is difficult to see how they could. However, one might argue that concentrating on very specific, on-farm, aspects of crop and livestock production for farming systems which are based on unsustainable energy sources is problematical. Expecting producers who aspire to sustainability to generate their own electricity seems unrealistic (although Amish communities do not connect to electricity power grids, Stinner et al., 1989), but the sustainability of energy sources is an issue worth consideration before any alternative agricultural approach claims that it is sustainable. Issues of energy and thermodynamics have played a central role in the development of ecological economics (Costanza, 1991), with analysis based on entropy (Georgescu-Roegen, 1971, 1976) and emergy (Odum, 1971, 1986) being cases in point (see Martinez-Alier, 1987, for a review of the history of agricultural energetics).

This issue of sustainable energy sources highlights a more general point about the extent to which sustainable farming systems should attempt to isolate themselves from the rest of 'unsustainable' society. For example, given that many alternative agricultural philosophies espouse a return to the land, and a rejection of large-scale, market-orientated production in the cities, to what extent is contact, and more specifically trade, with this sector acceptable. The use on farms of agricultural machinery, powered by fossil fuels, to produce goods to sell back to 'unsustainable' society may be viewed as compromising such farming systems' sustainability.

MacCormack (1995) focuses on the degree to which farming systems are closed when distinguishing between organic and sustainable agriculture. He argues that sustainability ''implies a goal of 'closed system' farming, meaning that farms approach self-sufficiency and require little outside input''. It is on this basis that he claims that ''many organic producers wonder whether any farm system can ever be sustainable in the pure sense. After all, organic systems still require cultivation, soil management inputs, processing, shipping, trucks, air freight,...all of which use oil, not usually produced on farms'' (MacCormack, 1995, p. 61).

The issue of trade in respect of agricultural sustainability assessment is becoming increasingly important with respect to organic farming. As the demand for organic food grows (the UK currently imports 70% of its organic fruit and vegetables), so the international trade in organic products expands. A simple inspection of the organic produce range in a British supermarket indicates that organic vegetables are being flown to the UK from east and southern Africa and elsewhere in the southern hemisphere. Even if the practices used on-farm were accepted as exemplary, the implications in terms of energy use and emissions of global warming gases are extremely significant. This highlights another issue of importance when it comes to sustainability assessments which is the appropriate level of measurement (farm plot, farm household, watershed, region etc.). An assessment at the plot and farm household level of the production system used to produce organic vegetables in Kenya, for example, may indicate an extremely sustainable production system. An assessment of the food miles (the distance products travel between producer and consumer) and energy use once these have been flown to the UK for sale is likely to provide very different insights.

5. The scale and productivity of sustainable systems

At one level, there is little doubt that some farming systems like, for example, those of the Amish are sustainable at the farm level, since they "sustained their culture for hundreds if not thousands of years" (Stinner et al., 1989, p. 77; Zook, 1994). Does such a form of agricultural production represent a path to sustainability that can be followed by others? If one strips away the specifics of the religious and cultural aspects of these communities and focuses on the production system, then the issue that seems to prevent this being a widespread interpretation is the level of productivity. If one is considering the sustainability of farming systems then this issue of productivity is worth some attention. The question is how to design sustainable farming systems that have productivity rates high enough to maintain current demographic trends in developing countries, which sees the population becoming increasingly urbanised and divorced from agricultural production. The ability of a farming system to sustain those people who work within it indefinitely, need not be the sole test of sustainability. The issue of providing food and fibre for the non-agricultural population needs also to be addressed. If sustainable agriculture necessarily implies small-scale, more labour-intensive farming, then does this require a large-scale return to the land, and an end to much of today's industrial and manufacturing production as such large urban populations could not be maintained in the context of this form of agricultural production?

The answer here is uncertain, but it is undoubtedly mistaken to simply equate sustainable agriculture with low-yield farming. However, this issue of productivity and sustainability features heavily in the literature, Zilberman et al. (1997) comment "While organic farming and traditional crop rotations may have a significant role in a sustainable future, we do not believe that the keys to sustainability are the technologies of the past...we cannot turn the clock back and still feed the current human population" (p. 65). Avery, a former agricultural analyst for the US Department of State, is one of the most forceful proponents of this view. His report 'Saving the Planet with Pesticides and Plastic: The Environmental Triumph of High-Yield Farming' (Avery, 1981) counterposes "high-yield farming" with organic farming, where the latter represents a serious threat to biodiversity because, in his view, the lower yields it generates would cause large areas of species-rich wildlife habitats to be lost to cultivation: "the public has been told that the organic approach to farming is kinder to the environment. The public has not been told that its low yields would force us to destroy millions of square miles of additional wildlands" (Avery quoted in BCPC, 1997)

There may be many definitions of sustainable agriculture, but very many of them stress that such a system must be able to "provide for the food and fiber needs of society, must meet the needs of the current generation,...must be capable of maintaining its productivity and value to human society" (Ikerd, 1993, p. 30). In industrialised countries conversion to, for example, organic farming is commonly associated with lower yields than with conventional agriculture. Even if one accepts this for the developed world, the situation in developing countries is rather different, with many producers farming at relatively low levels of intensity. In this situation,

organic techniques can lead to yields increased threefold and more (la Prairie, 1996), and the possible generation of agricultural surplus for trade. Some people's vision of a sustainable agriculture may entail a "patchwork" countryside of small holdings and a greatly increased rural population. Sustainable agriculture is not viewed in this way by others, and so the issue of productivity and how these food and fibre needs are to be met, is one of the great issues of debate in the area.

The point is that when the discussion of sustainable agricultural production occurs, some clarity regarding the scale of productivity involved, and how closed or open the system should be, in terms of energy and markets for example, would be helpful. To some advocates of, for example, organic and biodynamic farming, a return to small-scale production, small communities and a return to some form of spiritual link between farmer and the soil is precisely what they advocate. To others who utterly reject such notions such a considerable reorganisation of production is not envisaged at all, rather sustainable agricultural systems much more similar to today's are imagined. This relates directly to the often neglected aspect of sustainable agriculture: its social organisation.

It seems that although sustainable farming systems are now advocated almost-universally, there is great disagreement regarding even the basis on which systems should be judged. Whether farms should be self-sufficient, the degree to which they should trade with the rest of society, the question of energy sources and whether sustainability requires a return to small-scale, labour-intensive agricultural production.

There seems to be little benefit in the followers of various alternative agricultural schools of thought claiming that they represent the true path to sustainability. This is primarily because the view that sustainable agriculture varies in both time and space, is only capable of being identified in retrospect, over an uncertain time period, leads to sustainability being viewed as a process. This lack of certainty now about whether practices and process are indeed sustainable should not be seen as a sanctioning of passivity or complacency. Ikerd (1997) comments that "what we can do is make logical, informed judgements concerning the 'likelihood' that something will or will not be sustainable." Rather than asserting, or denying, whether certain agricultural movements are *the* approach to sustainable agriculture, the question must be: are producers moving in the right direction? Given local conditions, and the agricultural and ecological history of an area, are the agricultural systems operating there becoming more sustainable, are they coming closer to achieving a goal that is constantly being refined and redefined as knowledge and attitudes change?

6. Conclusions

This paper has focused on agricultural sustainability, and its relationship to various alternative agricultural approaches. It has, quite deliberately, not offered any new definitions of sustainability or sustainable agriculture. Sustainable practices will vary both temporally and spatially and can only truly be identified in retrospect. It is not simply a question of tools and inputs, but the context in which they are used.

This raises the possibility of sustainability being considered so vague a concept that it has little meaning and should be discarded. This issue is considered in a more general form by Jacobs (1995). Noting that there are at least 386 definitions of sustainable development, and that both Mrs. Thatcher and Friends of the Earth have signed up to it, he asks if it is meaningless. Jacobs answers 'no' because: "...this is to mistake what it means for a political principle to be meaningful. There are far more than 386 definitions of democracy, but that doesn't mean the concept is meaningless. Nor does the fact that different people disagree on what counts as democracy. Key political principles like democracy...are contestable-they are open to different interpretations- but they carry a core meaning...which is substantive and important." (p. 9). Agricultural sustainability may be considered in the same way.

The notion that agricultural sustainability should be regarded as a process rather than as a prescribed set of practices, and that it has a generalised core meaning, may pose problems when one wishes to assess the sustainability of systems. Pretty (1995) argues that: "At the farm or community level, it is possible for actors to weigh up, trade off and agree on these criteria for measuring trends in sustainability. But as we move to higher levels...to districts, regions and countries, it becomes increasingly difficult to do this in any meaningful way" (p. 11).

It has been noted that the use or non-use of synthetic chemicals is not a particularly rigorous scientific basis on which to determine a system's sustainability, however this dichotomy has been used in the discussion because of the prohibition of synthetic chemical inputs in organic farming. Rather than attempting to categorise certain farming methods as sustainable, which would contradict the view of sustainability expressed above, some issues that merit attention have been highlighted.

The extent to which any farming system which is intended to be sustainable should be linked to an unsustainable society is one such issue. These links may take the form of purchased inputs, including energy, or the sale of farm output. Clearly no farming system can entirely seal itself off from the rest of the planet, but there are important questions as to whether sustainable farming systems should aspire to as great a degree of self-sufficiency and self reliance as possible and at what level should sustainability assessments be made.

It has been noted that the lack of consensus regarding exactly what organic farming and agricultural sustainability mean, is a problem when discussing the relationship between them. The existence of published standards for organic production is a great advance in this respect. In an area of research plagued by different definitions, interpretations and meanings, these standards offer a firm basis for discussion and debate. The problem that subsequently arises, is that one may simply try to reduce organic production to what is contained in these standards, whereas for many involved, organic production goes far beyond this. Organic farming may therefore be viewed as being pulled in two different directions. On the one hand, greater regulation is required for the reasons Tate (1994) gives above, and yet this regulation can not cover the full range of motives and aspirations of organic farmers.

Duesing, (1995) in an article entitled "Is Organic Enough?" deals with this divergence between some of the more spiritual aspects of organic farming and the greater standardisation associated with regulation. He notes that pre-regulation organic

farming meant many different things to many different people: "its lack of specific definition allowed many of us to associate it with certain important characteristics of scale, locality, control, knowledge, nutrition, social justice, participation, grower/eater relationships and the connections with schools and communities." Duesing goes on to contrast this with the current situation. He argues that "these desirable food system characteristics seem threatened as the definition of organic farming and food is narrowed to a set of standards which deal with growing and processing methods exclusively" (p. 24).

Clearly this relationship between greater regulation and the diverse motivations and practices of organic farmers poses a dilemma for the organic movement. If consumers are to be certain that the products they buy are genuinely organic, and are to be able to find out exactly what this means, then unless they know the producer directly, greater standardisation seems inevitable. There appear therefore to be contradictory pressures on the organic movement, from outside and within. Some producers wish to retain small, local organic markets where "food miles" are minimised, while others look to greater national and international co-ordination of standards and production methods.

As organic standards become established in an increasing number of countries, and as these standards become more co-ordinated and integrated, the degree to which the organic producer and organic consumer may be geographically separated grows. Furthermore, the trade in organic farm inputs may also grow, with organic producers having the option of buying in mulch or organic fertilisers from distant sources. There may be doubts regarding the sustainability of the systems which have generated these purchased inputs. In addition, organic producers may be sceptical of such developments because they farm in this way to escape from many aspects of the global trade in foodstuffs, and aim to produce for local markets because of concern regarding the energy efficiency implications of such a trade in organic products.

These are not hypothetical issues. Duesing (1995) cites a report in Organic Food Business News revealing that the Dole food multinational brought Argentinian producers to the USA to learn organic techniques which could then be used to produce vegetables for export from South to North America. Duesing also refers to North Californian organic farms using manure from South Californian dairy enterprises, which themselves use feedgrain from the Midwest. The energy efficiency implications of such arrangements, particularly if the resulting organic produce is then shipped to the East Coast, are worthy of consideration. Duesing, an organic farmer in North America, also reports having been approached with offers of organic compost from Brazil and peat moss substitutes from the Philippines.

This relates to the earlier point regarding the different vision that different parties have of a future sustainable agriculture. The arguments being raised by Duesing appear to fit with the vision of farms producing for local consumers. For organic producers with this philosophy, the greater involvement of government and certifying bodies, whom they have to fund, can be a source of discontent. There can be resentment of this perceived interference, and a sense of the farmer's sovereignty being weakened, both of which contradict the desire for the food system to be "local and organic" (Duesing, 1995). Patrick Madden, President of the World Sustainable

Agriculture Association, also expresses concern regarding the development of international standards and the trade they permit. He writes "I am frankly alarmed by the trend of globalisation of trade (especially in agriculture)." Madden (1996) continues:

> I am very concerned that the establishment of national and international certification standards will draw huge multinational organisations into that segment of agriculture, and that countless family farms will become extinct, and many rural communities will be devastated, and food security will be worsened in very many places.

The attempt to produce overly prescriptive descriptions of sustainable agriculture may be of little use, but the general vision one has for such systems should be explicit. Disagreements between actors and organisations over how a more sustainable agriculture can be developed may be the result of, for example, differing opinions regarding local production versus greater trade, or greater regulation versus greater producer autonomy. If there is a contradiction between the sustainability ethos of alternative farming, which some may associate with a rejection of consumerism, and the realities of standardised, high-volume modern food markets, then it needs to be addressed to aid the debate regarding sustainable agriculture.

In addition to the issue of food miles and energy efficiency, another aspect of the debate which requires clarification concerns the scale of production possible, or desirable, in sustainable systems. This concerns the environmental effects of the trend towards larger farm sizes in Europe and North America, and the consequences of this trend for food production levels. Some regard larger farm sizes as generally implying greater environmental costs. A recent survey in the UK[3] found that 54% of conventional, and 80% of organic, horticultural producers thought that the trend toward larger farm sizes was a bad thing in environmental terms. As a result, people may view sustainable agriculture in terms of smaller enterprises, hence Duesing's view of "small scale, local eating". Some, like Pretty (1995, p. 12) argue that "sustainable farming can be compatible with small or large farms". For others, discussion of sustainability is bound up with ideas of small units, family farms, — a patchwork countryside of small producers producing for local markets.

The issue of the scale of production in a future sustainable agriculture is closely connected with the issue of productivity. As capital has been substituted for labour in industrialised agriculture, the majority of the population has become urbanised and separated from food production. Whether a transition to, for example, organic agriculture could maintain this predominately non-agricultural population is a matter of debate. The same survey of horticultural producers in the UK indicated that although 75% of conventional producers believed that organic farming methods were better for the environment, only 13% thought that such techniques could

[3] These data were collected as part of ESRC project "Adoption of Sustainable Agricultural Technologies" at the University of Manchester in 1996.

produce sufficient food and fibre for society. Indeed, only 73% of the organic horticulturalists interviewed believed that the necessary food and fibre could be produced.

For those who do not see sustainable agriculture as necessarily implying the end of large-scale farming, who envisage the sector continuing to produce food for an urban population which has little or no contact with agricultural producers, then greater regulation and policing of standards is crucial. In this scenario producers and consumers will continue to be geographically separate, and the certification and inspection process will provide the link between organic producer and consumer. For those who seek a closing of the gap between producer and consumer, and between the population and the processes by which food is generated, falling into "the same patterns of scale, distance and control as the conventional food system" (Duesing, 1995, p. 24) poses major problems.

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