The Sustainability of Agricultural Systems

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1. INTRODUCTION

The concept of sustainability lies at the heart of current debates over the use of the planet's natural resources, yet, despite its intuitive appeal , there is no consensus on its meaning (Gale and Cordray, 1994). Progress in using the sustainability concept to modify policy and management therefore demanads clarification of competing interpretations, and critical evaluation of assumptions which underly them. This paper focuses on sustainable agriculture, for which the absence of a consensus on meaning conforms to the general pattern for "sustainability" issues. As a first step to clarifying implications for agricultural policy and practice, the paper explores the common themes that have emerged from attempts to define sustainable agriculture, and identifies the main streams within the sustainable agriculture movement.

Of particular interest is the relationship between alternative farming methods and the notion of sustainable agriculture. While 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 various alternative agricultural systems and agricultural sustainability is therefore examined, particularly in the context of the use or non-use of synthetic chemical inputs.

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 consumers that the products they buy 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 local organisation of a future sustainable agriculture.

2. WHAT IS MEANT BY SUSTAINABLE AGRICULTURE?

The starting point for the discussion regarding sustainable agriculture is the concern that developments in modern agriculture have led to doubts regarding the long term viability of current production systems. These developments 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)

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 defines sustainability as farming systems that are: "...capable of maintaining their productivity and usefulness to society indefinitely. Such systems... must be resource-conserving, socially supportive, commercially competitive, and environmentally sound" (1993).

Ikerd's definition is one of a vast number that have been offered in the burgeoning literature on the subject of sustainable agriculture, but has the advantage of being relatively clear and concise. Another definition, also quite concise, primarily because it was incorporated in the 1990 Farm Bill in the USA, states that "the term sustainable agriculture means an integrated system of plant and animal production practices having a site-specific application that will, over the long term: (a) satisfy human food and fibre needs; (b) enhance environmental quality and the natural resource base upon which the agricultural economy depends; (c) make the most efficient use of non-renewable sources and on-farm resources and integrate, where appropriate, natural biological sources and controls; (d) sustain the economic viability of farm operations; and (e) enhance the quality of life for farmers and society as a whole."

Pretty (1996) identifies a number of goals of sustainable agriculture, which include:

1. A more thorough incorporation of natural processes.
2. A reduction in the use of off-farm, external and non-renewable resources.
3. More equitable access to resources.
4. Greater productive use of local knowledge and practices.
5. Greater self-reliance for farmers and rural populations.
6. A better match between production practices and climate and landscape.
7. Profitable and efficient production with an emphasis on conservation of the soil, water, energy and biological resources.

Francis and Youngberg (1990) describe the philosophy of sustainable agriculture as being one where concern over long-term impacts on the environment and other species guide the application of prior experience and the latest scientific advances to create "integrated, resource-conserving, equitable farming systems."

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 a long way from knowing just what methods and systems in diverse locations will really 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? With respect to these issues, Monteith (1990) suggests that sustainability can be inferred by examining the trends observed in both farming outputs and inputs (Table 1).

This represents an interesting approach to quantify sustainability, and to observe it as a historical process. There are also weaknesses in the approach. For example, sustainability cannot simply be summarised as a balance between agricultural inputs and outputs. To accept this, would imply an oversimplification of the complex ecological processes upon which farming rests.

Table 1. Sustainability Inference According to Trends in Farming Inputs and Outputs.

	Inputs		
Outputs	Decreasing	Constant	Increasing
Decreasing	*indeterminate*	*unsustainable*	*unsustainable*
Constant	*sustainable*	*sustainable*	*unsustainable*
Increasing	*sustainable*	*sustainable*	*indeterminate*

Source: Monteith, 1990.

Table 1 prompts the question, what is being included in the "outputs" section? Are externalities, whether they be positive, such as improved landscape amenity, or negative, such as water pollution, included in this category? The time frame considered is also critical, for instance, a certain management system that maintains both stable inputs and outputs for five consecutive years could be considered "sustainable" in this approach. There is, however, no guarantee that this system will be sustainable over a longer period, guaranteeing the use of natural resources for coming generations.

This question of the time horizon is critical to understand the concept of sustainability, since many environmental changes become visible only as a result of many years of imperceptible but cumulative processes. Friend (1992), when analysing soil sustainability, argues that soils are formed in time spans of up to 10,000 years. He argues that soil-renewal rates are very slow (about one inch every 150 years) and that in many places soil-losses rates are higher than soil renewal. This implies that an agrosystem which appears sustainable today may be involved in a slow process that will render it unsustainable over a longer period of time.

It should also be remembered that environmental changes are not always gradual, piecemeal processes, but are sometimes sudden and abrupt (Conway 1985). Recent ecological findings give a

picture of a complex and dynamic entity, characterised by uncertainties, non-linearities, positive feedbacks, chaos and jump processes (Henning *et al.* 1991). Consequently, within this framework it is extremely difficult to determine whether certain agricultural practices are sustainable or not. Furthermore, 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 a constant process of monitoring and reevaluation is required.

The approach adopted here considers sustainability as a "situated concept" (Caceres 1996), and is at odds with other approaches to sustainability that focus 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). What is a sustainable technique will vary both temporally and spatially.

3. ENVIRONMENTAL IMPLICATIONS OF AGRICULTURAL SUSTAINABILITY

Agricultural sustainability implies a a new way of farming, different from that labelled as "conventional agriculture". Despite the heterogeneity observed in the sustainable agriculture movement, there is an overall agreement that dominant current practices are flawed in terms of their impacts on the environment.

The main concern is to produce healthy food, using more environmentally-friendly techniques which preserve soils and do not generate excessive pollution. This implies a reduction, or elimination, in the use of synthetic chemicals, and the use of farming practices which conserve (or enhance) the quality of soils and water. Soil conservation is one of the main issues addressed by exponents of sustainable agriculture. Although soil erosion and degradation are most acute in

Third World countries, they are a cause for concern world-wide. Mannion (1995) highlights the scale of the problem, pointing out that 11 million hectares of the world's arable land are lost annually as a result of soil erosion. Pollution caused by agrochemicals is contaminating not only soils and water, but has also entered the food chain, posing a more direct threat to human health. Unlike problems of erosion, the pollution generated by agriculture is mainly a problem of developed countries. According to Conway and Pretty (1991), more than 50% of total pesticide spraying occurs in the USA and Western Europe. Taken together, developing countries use a relatively small proportion of the world total, and this use is particularly associated with the production of cash crops. The hazard posed by pesticides lies in their ability to permeate the whole biosphere and to persist actively within ecosystems for long periods. In some cases, the degradation of these toxic substances in the soil produces intermediate products that are just as dangerous as the original pesticide. This is the case with DDT, which, after a certain period in the soil, may break down to form DDE which is toxic, bioaccumulates in tissue and is more stable than DDT (Conway and Pretty, 1991).

These facts point to the need for a more integrated view of farming, one which considers soil as a quite fragile and complex system. This demands moving away from the monitoring of soil quality solely in terms of its capacity to bring about high yields, which leads to a disproportionate emphasis on chemical fertility. To prevent soil erosion and degradation, a broader interpretation of fertility is required, one which considers not only chemical, but also physical and biological fertility.

Soil may be viewed as having an appropriate "chemical" fertility when it contains enough nutrients to fulfil plant requirements, and favourable soil conditions exist for the absorption of these nutrients by crops. For this to occur sustainably, at least two requisites should be met. First, the amount of nutrients removed from the soil through agricultural output (i.e. grain, milk, meat, etc.) and associated processes (eg leaching, volatilisation) should not be higher than the nutrients returned to the agrosystem (i.e. biological fixation of nitrates, green manures, suitable fertilisers, etc.). Second, soil salinisation and alkalisation must be prevented by using suitable watering practices and, most importantly, avoiding the use of poor quality irrigation water.

Preserving the "physical" fertility of soil mainly concerns the maintenance of good soil structure. This allows the adequate circulation of water and air, leading to higher rates of water retention

available for crops and the greater cohesion of soil against erosive processes. Physical fertility can not be achieved by adding chemical fertiliser to the land. Rather, it depends on the incorporation of organic matter into the soil. This matter, once it becomes humus, is the main agent responsible for soil structure.

Maintaining the "biological" fertility of a soil calls for the use of farming practices that consider soil as a living entity, where many micro- and macro- organisms participate in processes indispensable to the achievement of soil health and long term sustainability. This leads to an acknowledgement that chemicals such as chlorine and organo-phosphates should not be used, not only because they contaminate water sources and threaten human health, but also because they interfere with essential biological processes within soil.

Despite there being a broad consensus among advocates of sustainable agriculture that the conventional approach to agriculture is inappropriate, there are significant differences of opinion regarding the type of farming practices which should be developed in order to reach sustainability. There is far greater degree of agreement regarding the problems associated with conventional agriculture, than the strategies required to deal with them. This is not surprising, since it is far easier to identify unsustainable practices than prescribe sustainable farming systems The differences that exist regarding the development of a sustainable agriculture are reflected in the different streams within the "alternative" agriculture movement. Some of the key concepts and movements within this attempt to develop a sustainable agriculture are now discussed, this is followed by a consideration of the relationship between the "theory" of sustainable agriculture and the practice of organic farming.

4. MAIN STREAMS WITHIN THE SUSTAINABLE AGRICULTURE MOVEMENT

Part of the confusion that surrounds the definition of sustainable agriculture results from uncertainty regarding the large number of alternative agricultural systems that are associated with it. In order to allow a better understanding of sustainable agriculture, and to identify some of the different approaches to it, a description of some of the main streams within the sustainable agriculture movement now follows. This section draws on the work of Gold (1994). It should be noted that

attempting to provide precise definitions for all of these approaches is difficult since some are more coherent, philosophically-based, schools of thought than others.

Integrated Pest Management (IPM)

IPM is an ecologically based approach to pest control, utilising knowledge of pest/crop relationships, establishment of acceptable economic thresholds for pest populations, and constant field monitoring for potential problems (Gold, 1994). This approach to agriculture stresses the co-ordinated integration of chemical, cultural, and biological control practices in particular ecological and socio-productive settings (Carroll and Risch 1990). Management techniques include "the use of resistant varieties; crop rotation; cultural practices; optimal use of biological control organisms; certified seed; protective seed treatments; disease-free transplants or root stock; timeliness of crop cultivation; improved timing of pesticide applications; removal of infested plant material" (Waldron, 1989).

The difficulty in defining these schools of alternative agricultural thought is well illustrated by the case of IPM. Some argue that the original meaning of IPM, focusing on ecosystems-based strategies, has been distorted. Dahlberg (1991) states that IPM had "...great potential to restructure important parts of agriculture, but the combined power of the dominant production paradigm and the resistance of the chemical industry has largely transformed integrated pest management into integrated pesticide management."

Low Input Agriculture

These farming systems "seek to optimise the management and use of internal production inputs (i.e. on farm resources)... and to minimise the use of external production inputs..., such as purchased fertiliser and pesticides, wherever and whenever feasible and practical, to lower production costs, to avoid pollution of surface and ground water, to reduce pesticide residues in food, to reduce a farmers overall risk, and to increase both short- and long-term farm profitability (Parr *et al.*, 1990).

Low Input Sustainable Agriculture (LISA) & Low External Input Sustainable Agriculture (LEISA)

LISA was the United States Department of Agriculture's research and education grants programme, organised and directed by the Cooperative State Research Service (CSRS). and Extension Service. This programme was expanded through the 1990 Farm Bill, becoming the Sustainable Agriculture Research and Education (SARE) programme. The approach was referred to as LEISA in some European countries. Reijntjes *et al*. define LEISA as "agriculture which makes optimal use of locally available natural and human resources (such as soil, water, vegetation, local plants and animals, and human labour, knowledge and skills) and which is economically feasible, ecologically sound, culturally adapted and socially just. The use of external inputs is not excluded but is seen as complementary to the use of local resources and has to meet the above mentioned criteria" (1992).

Schaller (1993) notes that adoption of the term "low input" had an effect rather different from that originally intended. The term was chosen to try to correct the view held by some agricultural groups that sustainable agriculture was just another name for chemical-free or organic farming. However, Schaller suggests that the impact was, for some, to encourage the notion that sustainable agriculture implied a general lowering of all inputs currently used, and a return to "hoes, hard labour, lower yields, and lower farm income." This one example gives some indication of the care that has to be taken when discussing the terminology of "sustainable agriculture".

Agroecology

This is an approach to farming that heavily incorporates ecological concepts into the design and management of agrosystems. Agroecology has been proposed as a new scientific discipline that defines, classifies and studies agricultural systems from an ecological and socio-economic perspective (Altieri, 1995). Dahlberg (1991) adds that this approach seeks an understanding of how traditional and indigenous agricultural systems have adapted socially, economically and technologically, to local conditions. According to Hecht (1987), agroecology is a loosely defined concept that "incorporates ideas about a more environmentally and socially sensitive approach to agriculture, one that focuses not only on production, but also on the ecological sustainability of the productive system".

Biological Dynamic (Biodynamic) Farming

Biodynamics owes its origin to the spiritual insights and perceptions of the Austrian philosopher Dr Rudolf Steiner, and represents the first form of alternative agriculture in Europe (Kirchmann, 1994). Steiner was concerned by the increasing degeneration of seed-strains and cultivated plants (Scofield, 1986), and focused on many of the forces within nature, outlining how he felt one could work in harmony with them, through the use of specific techniques and preparations. In particular, "central to the biodynamic methods...are certain herbal preparations that guide the decomposition processes in manures and composts." (Kimberton, 1985-86).

The biodynamic approach to agriculture is holistic, working with what it views as the spiritual dimension of the earth's environment. To some of its critics, however, biodynamics represents an approach based on "subjective insights" and a "spiritualistic point of view". As a result, Kirchmann (1994) considers that Steiner's writings are "occult and dogmatic and cannot contribute to the development of alternative or sustainable agriculture."

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. Henning *et al*. (1991), adapting the work of MacRae *et al*. 1990, argue that organic agriculture "is designed to work with natural processes to conserve resources, encourage self-regulation through diversity, minimise waste and environmental impact, whilst preserving farm profitability." 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."

Due to the growing importance of this method of agricultural production in the UK, mainland Europe and the USA, a more detailed discussion of organic farming, and its relationship to sustainable agriculture, now follows.

According to Scofield (1986), the term "organic farming" pre-dates all other labels of an environmentally-aware approach to agriculture. The work of Rudolf Steiner (1924), and the agricultural methods employed by his anthroposophic followers, represent the origin of organic farming today. As explained above, although Steiner's work is the basis of organic farming, he is more commonly associated with the term *biodynamic farming*.

It was a follower of biodynamic agriculture, Lord Northbourne, who is credited with first using the term "organic farming" (Harwood, 1983). In his work 'Look to the Land' (1940), Northbourne outlines his preferred concept of the farm unit as "a sustainable, ecologically stable, self-contained unit, biologically complete and balanced - a dynamic living organic whole" (Scofield, 1986).

As Scofield points out, the concerns that motivated Northbourne 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 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' (Scofield, 1986).

A strong element in the early writings on organic farming, is an opposition to the ideas of the financial and economic sectors. Their role, argued Northbourne, would be to lead to the long-term loss of the fertility of the soil: “Farming cannot be treated as a mixture of chemistry and cost accountancy, nor can it be pulled into conformity with the exigencies of modern business, in which speed, cheapness, and standardising count most....While true fertility is accompanied by productivity, productivity alone is not a measure of true fertility unless it is both independent of outside assistance in the form of manures and feeding stuffs not produced on the land concerned, and provided that it is measured qualitatively as well as quantitatively.”

As Lampkin (1994) 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. An authoritative modern definition of organic farming provided by Lampkin (1994) 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."

Another definition, one which spells out more clearly some of the operational aspects of organic production, is provided by a USDA Study Team which reported that organic farming: "avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators, and livestock feed additives. To the maximum extent feasible, organic farming systems rely upon crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, mechanical cultivation, mineral-bearing rocks, and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients, and to control weeds, insects and other pests." (USDA, 1980)

One of the aspects of organic production which separates it from many of the other "alternative" agricultural movements discussed above, is that it has a history of regulation. Tate 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." (1994) 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.

When considering the relationship between sustainable agriculture and organic agriculture, this is extremely useful. While discussion of the former is diverse and contains many, often contradictory notions, the latter has a more precise, often legally designated, interpretation. It is this issue, how sustainable agriculture and organic farming are related that is now discussed. As will be seen, there

is a wide disparity of views on this subject, often from people who may agree on much else in this area.

5. ORGANIC FARMING AND SUSTAINABLE AGRICULTURE

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.

Many definitions and discussions of organic farming focus specifically on the issue of sustainability. 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." This characterisation of the relationship between organic and sustainable farming is repeated in Lampkin and Measure's 1995/96 Organic Farm Management Handbook (1995). 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'". Rodale even suggested that "sustainable was just a polite word for organic farming" (York, 1991).

One conclusion which may be drawn from the vast literature produced on the issues of sustainable and organic farming is that researchers seem less concerned with producing new definitions of organic farming than they are of sustainable agriculture. Indeed, there exist so many competing definitions of sustainability and sustainable development, that some have questioned whether the concept has any real substance, since it means so many different things to different people (see Jacobs, 1995).

This does not appear to be the case with organic farming, on which, despite varying definitions, there seems to be a far greater degree of consensus. This is partly a result of the history of regulation referred to above. As 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 complete set of certification procedures governs organic farming, from the soil to the dining table."

The existence of these clear and strict standards, laid down by various organic bodies, does appear to be a major difference between organic and sustainable farming. The International Federation of Organic Agricultural Movements (IFOAM) is making efforts to co-ordinate various national organic certifying schemes, and has laid down minimum standards for primary organic producers. These were used as the basis for the current European Community (EC) scheme which came into effect as a result of EC Council Regulation 2092/91 (Tate, 1994). This regulation came into force on July 22nd 1991, specifying rules with respect to the production, inspection and labelling of organic products.

This is not to imply that there are no differences or disagreements regarding what is, and is not, acceptable for organic farming. For example, EC Regulation 2092/91 made the previously voluntary UK Register of Organic Food Standards (UKROFS) a designated inspection authority, responsible for administering and policing the scheme. The Soil Association, an approved Sector Body under this scheme, is the largest organic producer group in the UK. Its standards include all those necessary for UKROFS approval, but also include additional standards that its members are required to meet. The implication of these additional requirements, must surely be that the Soil Association considers the UKROFS standards alone, to be insufficient, that they do not specify high enough standards for organic producers.

This aside, a large measure of agreement exists regarding what is necessary to produce organically. 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." This claim that organic farming and sustainable farming are synonymous divides many of these working in the field of sustainable agriculture (Sanet-MG, 1996). One immediate reason to doubt the claim that they are one and the same thing, is the fact that there exists no unique definition of either, therefore equating them appears a rather bold step.

Hodge (1993) 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." 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."

Pretty (1995) argues that although "organic agriculture s 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 loss of so much of, for example, Palestine's fertile soil is "a sad commentary on man's stewardship of the earth" (Lowdermilk, 1944). Carter and Dale, again referring to Palestine, explain how, over the last 3000 years, soil has been washed off half the area of the hill lands. This soil was deposited in the Mediterranean and on former alluvial plains, creating marshes where malaria became rife and depopulation became increasingly severe. 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". Such "organic

by neglect" farming practices have historically helped turn large areas of once fertile soil into dustbowls, and this was clearly unsustainable.

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, 1996a)

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), for example, when explaining their view of the relationship between organic farming and sustainability, 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 difficulty is that incorporating these wider concerns into definitions of, and standards for, organic farming is problematical. The range of motives that people may have for adopting organic techniques must therefore be carefully considered. While many adopting organic practices are doing so for lifestyle and more holistic reasons, the issue of market premiums for organic goods can not be ignored. The existence and extent of these premiums varies between countries and across commodities, but Lampkin and Measures (1995) report, for example, premiums in the UK of between 50% and 100% above conventional prices for cereals and vegetables. The possibility must therefore exist of producers becoming organic to pursue these premiums; their motive may not be sustainability in its widest sense, but marketing at its most strategic. The implication of this is that if premiums were to fall, the growth of the organic sector could be slowed or even reversed.

[1] The OCIA is the largest of five nationwide certifying agencies in the USA, it certifies about 20% of the 5000 registered producers (Anton and Frazao, 1993).

The danger of raising this issue is that it is prone to being caricatured as simply "organic-bashing", that what is being claimed is that organic producers have simply altered production methods for no other reason than to secure profits, as public awareness and policy priorities change. This is not the claim here. Nevertheless a greater understanding of the range of motives for adopting organic techniques is urgently 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, and MacRae *et al*., 1990, 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 this basis distinguished between "pragmatic organic" and "committed organic" farmers.

It is likely that even the most elaborate set of production standards could not rule out the possibility of one or more complying farmer having an unsustainable aspect to their production system. Certainly organic organisations are continually striving to ensure their standards are as effective as possible, and the process of inspection serves to inform them of possible oversights and weaknesses in existing standards. Part of the problem is that these organic schemes must focus on prohibiting or encouraging the use of particular inputs or tools, whereas it is not only the use of these things that determines a system's sustainability (see Hodge, 1993). 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. This is not a criticism, simply a factor that should be borne in mind when considering the organic-sustainable relationship.

The limited contact with organic inspectors possible during this research[2] indicates that a common feeling could be summed up in the view of Hall (1996b), an OCIA inspector, when he says: "The

[2] This ESRC-funded research project has been concerned with the adoption of sustainable agricultural techniques. The starting point in identifying such adopters has been existing organic registration schemes.

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.". Hall also describes how, in 1994, he inspected several similar farms (heavy, continuous soya production) seeking OCIA certification. On his recommendation they were refused certification, but were subsequently registered with another organic organisation.

The risk when considering cases such as these, is that one may be viewed as simply undermining the case for organic production or registration, just as those with economic or political interests in industrial or chemical agriculture are prone to do. This can cause particular frustration amongst organic producers when these criticisms are seen to emanate from academics interested in the sustainability issue, but who are not themselves actually involved in farming. Organic producers, often with good reason, may feel that while they are struggling to put notions of sustainability into practice, the sustainability "experts" are doing no more than sniping from the sidelines. Critically discussing the relationship between various alternative agricultural approaches and the concept of sustainability, without appearing to simply indulge in destructive criticism, is a difficult balance to achieve.

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), 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 (see McInerney, 1978).

6. SYNTHETIC CHEMICALS, ORGANIC FARMING AND SUSTAINABILITY

Ikerd (1993) arguing against the view that any farming system can be definitely identified as sustainable now, asserts that organic farming and sustainable agriculture should be seen "as two related, but distinctly different, concepts." The diagrammatic representation used in his paper to illustrate this point is of the form shown in Figure 1. This implies that organic farming accounts for some sustainable agriculture and some non-sustainable, while sustainable agriculture is also contributed to by some non-organic farming methods.

Figure 1. Ikerd's View of Organic Farming and Sustainable Agriculture as Two Related, But Distinctly Different Concepts.

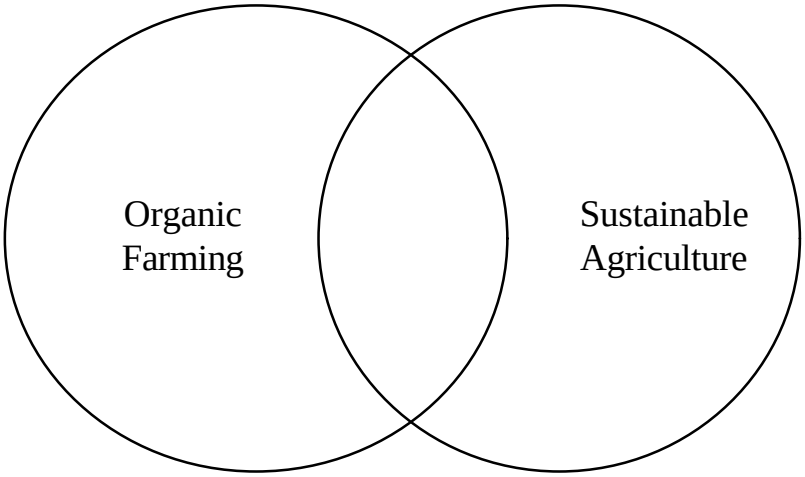

Figure 2. Graphical Representation of Possible Relationship between a Number of Approaches to Agricultural Production.

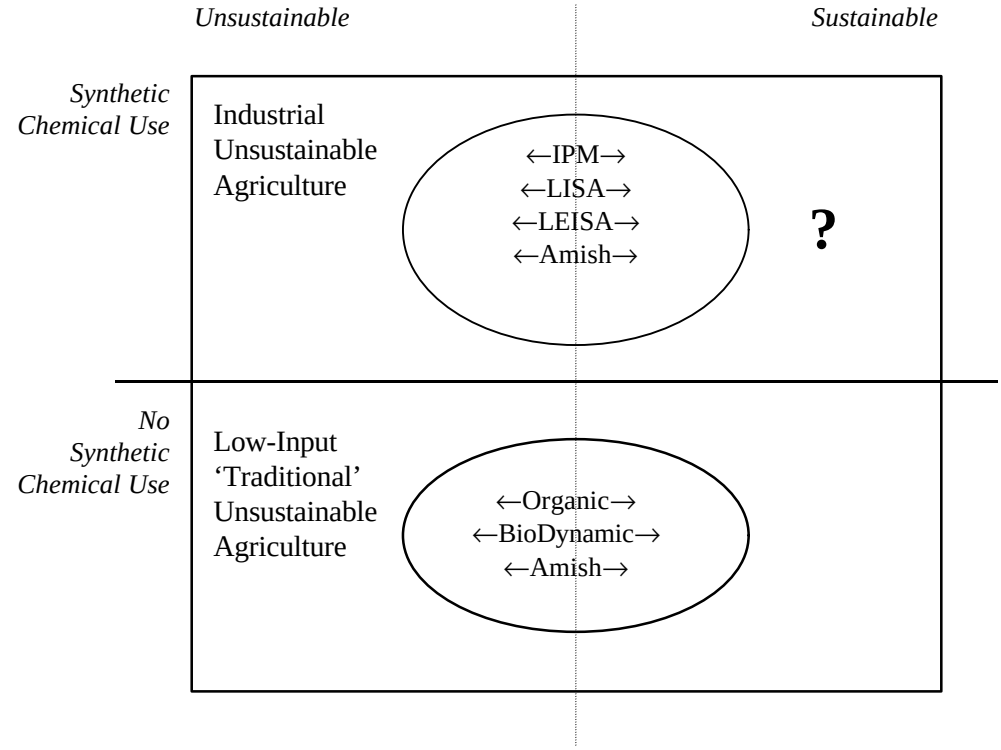

Figure 2. attempts to locate some of the agricultural systems discussed, in terms of (un)sustainability and also in terms of the use of synthetic chemicals. This generates four quadrants of classification: Chemical Unsustainable (CU), Chemical Sustainable (CS), Non-Chemical Sustainable (NS), Non-Chemical Unsustainable (NU).

The choice of synthetic chemical use as a category here is to some extent arbitrary, although the prohibition of such inputs 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). 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. 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. However, given that the use or prohibition of such inputs distinguishes many farming systems, they are used here.

The type of agriculture that dominates the first quadrant, CU, may be described as high-input, modern or industrial agriculture. This is the system that is prevalent in Western Europe and the USA, is associated with cash-cropping in many developing countries, and which has prompted much of the concern and debate over agricultural sustainability. The problems associated with these techniques include water and air pollution, soil erosion and depletion of soil fertility.

The type of agriculture typically identified as Non-Chemical Unsustainable (NU) is the low-input agriculture which is seen in many poorer non-industrialised countries. The use of inappropriate techniques in these cases is not usually associated with agrochemical use, but the overexploitation of natural resources through traditional, low-capital methods. This excessive exploitation of resources is often linked to poverty and strong socio-economic pressures which lead to greater environmental costs as the drive to achieve subsistence production levels dominates environmental concerns. The environmental externalities commonly related to these methods include both water and wind erosion, leading to degradation and depletion of the soil.

Characterising the agricultural approaches in the final two quadrants is more controversial, as one would expect, since the labelling of certain techniques as unsustainable is always likely to be less controversial than the positive identification of others as sustainable. Consequently the dividing line drawn between the unsustainable and sustainable halves of the diagram has been marked less starkly than the dividing line between chemical and non-chemical agriculture, which is better defined and less open to question.

When attempting to describe the agricultural strategies that may be located in the Chemical Sustainable quadrant it must first be acknowledged that some would argue that this quadrant is empty, that it is a null set since the concepts of synthetic chemical use and agricultural sustainability are mutually exclusive, hence the '?' here. This would result in the location of the LISA, LEISA and IPM approaches in the CU sector. Amish farms where synthetical chemicals are used might also be located here (Amish farming systems receive more attention later in this paper). Given the focus on the site-specific use of inputs and tools already advocated in this paper, this view is rejected. Therefore the possibility of some of these LISA/LEISA/IPM strategies being situated in the CS sector is not ruled out. This is not to argue that these approaches are always sustainable, and so this group of approaches is located in both the CU and the CS sectors, there is an overlap. Whether particular farming systems based on these approaches should be characterised as CU or CS depends on the specifics of each case, and ultimately on one's opinions.

Any attempt at characterising the final sector, the NS quadrant, is again extremely open to debate. The alternative agricultural approaches identified here are often associated with a more fundamental break from conventional techniques and values. For many farmers involved, these approaches are viewed as qualitatively different from conventional agriculture, rather than modifications of it.

Agricultural practices that may be placed in this sector include forms of organic and biodynamic farming. Another set of farming systems which, it might be argued, could be located here is that belonging to those Amish who do not use synthetic agrochemicals, since their low-input techniques have sustained their communities for over 300 years (see Hostetler, 1980, Stinner *et al*., 1989, Zook, 1994). In this context, the Amish may be viewed as a useful representative of a wide range of traditional farming approaches, because their religious beliefs have led to their agricultural philosophy and practices being relatively well-documented. Organic, biodynamic and Amish

agricultural approaches have been grouped together, with the possibility that farming systems based on them may be interpreted as either sustainable or unsustainable. Some may argue that such farming systems are generally sustainable, others may be less convinced. Given the earlier discussion, organic, biodynamic and non-chemical Amish systems are characterised as overlapping the NU and NS sectors in Figure 2. These approaches are shown as equally distributed between these two sectors, this is an arbitrary distribution, designed to indicate that the extent of this overlap is very much open to discussion. Rather than attempting to allocate each of the approaches, it is worth highlighting two issues which are relevant to how they are viewed.

The first concerns how broad the consideration is, 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.

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. The Amish, for example, use horses instead of tractors, but although Amish communities are close-knit their insulation from the rest of society is not as great as one might imagine. The use of chemical fertilisers, pesticides and insecticides is permitted on Amish farms, and petrol and diesel powered engines are also used where they were rarely seen thirty years ago (Stinner *et al.*, 1989, Zook, 1994). This is instructive

because the Amish are a well-defined group of agriculturalists, with clear socio-religious rules, who have rejected many of society's developments in the last 200-300 years and they are in many ways separate from 'mainstream' society, and yet the links are still evident. The use of chemical farm inputs and internal combustion engine indicate that their farming practices are greatly affected by changes in the outside world.

MacCormack 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" (1995). It is on this basis that he claims that "many organic farmers 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." (1995).

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). Does such a form of agricultural production represent a path to sustainability that can be followed by others? The issue that seems to prevent this being a widespread interpretation may concern productivity levels. If one is considering the sustainability of farming systems then this issue of productivity is worth some attention. The question is whether it is possible to design sustainable farming systems that have productivity rates high enough to maintain current demographic trends in developing countries, which see the proportion of the population working in agriculture decline, as the population becomes 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 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. 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, 1996). 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, such a considerable reorganisation of production is not envisaged at all, rather sustainable agricultural systems much more similar to today's are imagined

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. This discussion highlights why simply equating certain codified agricultural practices with agricultural sustainability is mistaken.

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. 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? In this way, the convergence to agricultural sustainability may be viewed as an asymptotic process.

One may ask whether these issues are important, whether they have practical implications for the pressing need to deal with the problems currently being experienced because of agricultural production systems. Current research, of which this paper is a part, entails large scale, cross-country analysis of the determinants of the decision to adopt sustainable agricultural techniques. To carry out such empirical analysis, one is forced to confront, very directly, the issues of what is a "sustainable technique", and what is the nature of the relationship between farms registered with various alternative bodies, and agricultural sustainability. Failure to consider these factors carefully can result in the wrong questions being asked of the wrong people about the wrong issues.

7. ISSUES AND PERSPECTIVES ON SUSTAINABLE AGRICULTURE

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. This has been a result of accepting the view that sustainable agriculture should be viewed as a process, rather than as a rigid set of production practices. As Pretty (1995) notes, "precise and absolute definitions of sustainability, and therefore of sustainable agriculture, are impossible. Sustainability itself is a complex and contested concept." 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. Nigh (1996), writing on the relationship between organic and sustainable agriculture, argues that 'sustainable' agriculture was "invented by those who are more comfortable with or have a vested interest in vague terms." 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." (1995). 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. However, a set of goals, such as those outlined by Pretty (1996) and listed in Section 1, serve as a starting point for such an evaluation. Given the degree of debate regarding sustainability, explicitness is required regarding the criteria used when these evaluations are conducted. Furthermore, a set of criteria that may be applicable at one location are unlikely to be appropriate at another. Pretty 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."

A consequence of this understanding of agricultural sustainability is that there appears to be little to be gained from producing yet more abstract definitions of the concept. A preferred option for many has been to go about implementing their concept of a more sustainable agriculture. Although agricultural production does not exist in isolation from the rest of society, there is scope to control a great deal of the system, to be able to change many aspects of it, and to attempt to put one's vision of agricultural sustainability into practice.

A number of the different schools of "alternative" agricultural thought have been outlined. All of them have been conceived, to varying degrees, with the concept of sustainability in mind. They have developed and grown not simply because people wished to implement their notion of sustainability, but because there has been a general growth in awareness of environmental issues, and food safety in particular. Organic farming is the largest of these schools of thought.

These alternative agricultural methods have been discussed in terms of sustainability, and also with respect to the use of synthetic chemical inputs. It has been noted that synthetic chemical use or non-use 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 the question is whether sustainable farming systems should aspire to as great a degree of self-sufficiency and self reliance as possible.

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. These motives range from those who see the issue in very personal terms and are concerned with sustainability in its very broadest sense, to those for whom organic production is a more narrow, marketing-based approach. Fairweather and Campbell (1996) were able to

distinguish two groups of organic farmers among the sample they interviewed which they characterised as “committed organic” and “pragmatic organic”, for whom the role of organic premiums was critical.

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”.

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” (the distance products travel between producer and consumer) 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 point raised earlier 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 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."* (1996)

The purpose here is not to assert whether either of these trends, towards greater regulation and trade or toward smaller local agricultural markets, represents a move towards a sustainable agriculture. Instead it is to highlight that the discussion and development of a more sustainable agriculture requires clarity regarding what it is that one is trying to achieve. Although the attempt to produce overly prescriptive descriptions of sustainable agriculture may be of little use, the general vision that one considers desirable 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[2] 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".

It should be noted that concern over the environmental effects of growing farm sizes need not imply a general rejection of larger farms, but only the manner in which this process is currently occurring. Attempting to prescribe the preferred size for sustainable farms clearly contradicts the notion of sustainable agriculture as a process rather than a set of tools or techniques. However, openness in the sustainability debate regarding perceptions of enterprise scale would be helpful. Some, like Pretty (1995) 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 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. The literature regarding comparative yields between conventional and alternative farming continues to grow (see Lampkin and Padel, 1994, and Pretty, 1995), but if one views sustainable agriculture in terms of small, family farms then the question of the requirements of the urban population must be addressed. It must be addressed in terms of whether such smaller family farms could generate the necessary surplus, and in terms of who is going to be producing on such farms. If one advocates such a system of production, the implications need to be addressed in full.

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, then falling into "the same patterns of scale, distance and control as the conventional food system" (Duesing, 1995) poses major problems.

[2] These data were collected as part of ESRC Project L320253235 at the University of Manchester in 1996.

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