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Sustainable development of agricultural systems: competing objectives and critical limits

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Abstract

The sustainability of agricultural systems has become a major focus for debates about future human survival. Much of the argument appears to rely on simplistic interpretation of ecological models, and fails adequately to define what sustainability objectives are being sought. We explore the implications of two alternative approaches to agricultural sustainability: the Critical Limits view which would require future farming systems to accept the ecosystem-imposed limits on the number of people in the world and the lifestyle they can enjoy; and the Competing Objectives view would balance agricultural sustainability with economic viability, reduction of environmental harm and fulfilling public demands for food and landscape benefits. The development of farming systems of the future will depend on which of these views is adopted by planners and policy makers.

This paper challenges some of the ecological assumptions underlying the Critical Limits approach and questions the conventional view that extensive farming systems are more sustainable agriculturally than intensive systems. We may be able to deal more effectively with the environmental side effects of intensive farming systems by treating them as unwanted externalities and taking direct action to avoid or remove them rather than attempting to change fundamentally the nature of modern farming systems.

To cope with the increasingly complexity and inter-connectedness of modern farming systems in the context of globalisation and potential perturbations like climate change, we need a pluralistic approach to policy, which can cope with the high levels of uncertainty in these areas and which allows maximum flexibility of response to changing circumstances. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

At a time of predicted climate change, globalisation of commodity food trading systems and rapid technological innovation, accurate assessment of the sustainability of our food production systems could be crucial to our survival, at least in the style to which we have become accustomed.

Questions have been raised about the sustainability of our farming systems since Thomas Malthus' *Essay on the Principles of Population* [1] opened up the question of our ability to produce enough food for an ever-expanding human population. In the aftermath of the oil price shocks of 1972–3 sustainability issues were part of the overall concern about resource depletion [2]. From then until the Brundtland-inspired resurgence of interest in the late 1980s [3] there was little serious discussion of the issue but throughout the 1990s the concept has been at the forefront of European debate and has been incorporated into government policies in the UK and internationally [4–6].

Since 1945 these fluctuations have occurred against a background of increasing crop yields in both *per hectare* and *total* terms [7]. There has been no evidence on a world scale that we are reaching the predicted limits to our capacity to exploit the productivity of the world's croplands [8]. Data for Europe, Australasia, North and South America [9] show almost monotonically increasing total production of food, and slower improvements in per capita food availability. However, the Malthusian spectre has not been entirely banished and in parts of Africa and Asia the picture has continued to look bleak [10].

The areas where agriculture has been most demonstrably unsustainable are often those where it is most marginal — on steep slopes, poor soils or areas of low rainfall. Such extensive farming systems may have existed for centuries at low levels of productivity, only becoming unsustainable when practices are changed in an attempt to improve yields, for example through inappropriate cultivation or over-grazing.

Cultivation *per se* is less likely to undermine the sustainability of intensive, high yielding farming systems on highly fertile soils. There are concerns about soil structure for some of these systems [11] and excessive use of pesticides can lead to a degenerative downward spiral if the supporting ecosystems become so seriously undermined as to threaten the ability to grow crops at all in a particular area [12]. Also, although intensive farming systems may appear sustainable from the narrow perspective of the farm itself, they may have impacts on the wider environment which are perceived as unsustainable or at least unacceptable [13].

This paper takes a critical look at our current understanding of the concepts of sustainability and sustainable development as they relate to different types of farming system and challenges some common assumptions and conclusions.

2. Sustainable development and agriculture — conceptual issues

The concept of sustainable development is social rather than fundamentally scientific. It relates to the management of a natural resource for a human purpose and is

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