Progress towards sustainability – a consensual delusion or viable process?

Declan McDonald[A]

[A]Sustainable Land Use Section, Dept of Primary Industries, Parks, Water and Environment, Tasmania, Email declan.mcdonald@dpipew.tas.gov.au

Abstract

Projected demands on soils associated with climate change, growth in population and global affluence over the next 40 years are unprecedented. Adoption of more sustainable agricultural practices continues to be secondary to considerations of yield, consumer expectations for cheap food and optimism regarding technological innovation. A changed research focus is required to support sustainable agricultural development. Sustainable soil management must reflect the needs of an ecological system in terms of management practices and inputs.

Key Words

Sustainability, alternative agriculture, soil biology.

Introduction

Agricultural development post World War II has been characterised by high yields and improvements to farm profit. Availability and affordability of food and fibre has greatly increased, but so also has a range of negative environmental and social side-effects that highlight the unsustainability of current practices (Gliessman 2007). Factors that have contributed to agricultural unsustainability include increasing farm size, purchased inputs, specialisation, mechanisation, pollution, loss of biodiversity, dependence on subsidies, vertical integration and global markets (Hill 1995). Social and economic pressures have resulted in management practices that negatively impact on soil quality and quantity. In the United States, it is estimated that soil loss is proceeding at a rate of 17 times the rate of soil formation (Warshall 2002). Globally, about one tenth of the world's arable area (1.2 billion ha) is affected by serious degradation with about 300m ha now unusable (UNEP 1997). In Australia, a range of evidence tells a similar story (Schoknecht 2009; SoE 2009; Sims and Cotching 2000). Projected demands on soils associated with climate change, growth in population and global affluence over the next 40 years (UNEP 1997) should register deep concern in the context of our poor record of management of this most fundamentally important natural resource.

Discussion

Whilst there is general optimism that with adoption of modern agricultural practices, use of improved crop and livestock varieties, free trade arrangements and more equitable land ownership the challenge of future food security can be met, there is real concern about the capacity of natural systems to sustain the required level of output (Cribb 2006). Much of the increase in agricultural output over the past 40 years has come from an increase in yields per hectare rather than an expansion of area under cultivation (MEA 2005). In his address to the 2006 National Soils Conference in Adelaide, Australia, Professor Julian Cribb asserted that 'If there is to be a second agricultural revolution then it is my belief that it is from the soil – rather than the biotech lab alone – that the next great leap in farm productivity will arise' and the drivers of this revolution will be '...the conservation, manipulation and management of populations of microscopic plants, insects, fungi and bacteria (which) will determine productivity at the surface'.

Given the concern about the capacity of natural systems to sustain the required level of output, and to do so indefinitely, a commitment to sustainability requires research in soil science to focus on the needs of soil as an ecological system. Treatment of the soil as an ecological system will result in management practices that conserve and enhance ecosystem services provided by the soil in ways that reduce negative trade-offs or that provide positive synergies with other ecosystem services (Lavelle *et al.* 2006). Traditionally, soil science has been reductionist, aiming to unlock the complexities of soil processes by analysing their constituent parts and seeking to solve one problem (Stocking 2007). The growing threats to the sustainability of our soil resources requires a change of thinking to one more suited to the dynamic characteristics of soil ecosystems. "If agriculture does move to embrace an ecologically-sympathetic approach, the great scientific challenge for the coming years will be to understand more fully the life in our soils and how it may be better managed for food production and environmental renewal" (Cribb 2006).

1 – 6 August 2010, Brisbane, Australia. Published on DVD.

Within the broad farming community there is a growing awareness of the need to adopt more sustainable land management practices (Oakeshott 2008). In the author's experience, many farmers in Tasmania and New South Wales are looking beyond traditional sources of information because of dissatisfaction with declining outputs and realisation that conventional practices are not building health into their soil resources. Change towards sustainability requires a paradigm shift from a focus on maximising yield and a belief that technological innovation can resolve all problems to one where ecological health is valued. In order to map a path towards sustainability, measures of ecological health that are appropriate to agricultural landscapes, and particularly soil resources, are required. This will involve some conception of the condition we expect in our soils, in 10, 50, 100 or 500 years from now.

Proponents of alternative agriculture (biological, organic and agroecosystem farming) are motivated by a belief in the sustainability of an ecological approach. However, opponents of alternative agriculture claim that only conventional, high production agriculture can feed the world (e.g. former US Secretary of Agriculture Earl Butz in Beus and Dunlap 1990) and that alternative agriculture should be dismissed as merely a new theory, a philosophy and not based on science (Wynen 1996). A substantial body of scientific research now shows that alternative agriculture is economically viable and has the capacity to meet much of the world's needs for food and fibre (e.g. UNEP 2008; Pimentel *et al.* 2005; Ashley *et al.* 2003; Ching 2002; Wynen 1996). However, a wholesale shift to organic agriculture, particularly in developed countries is not regarded as immediately practical, partly due to a predominance of negative perceptions among farmers, researchers and agri-business and partly due to the lack of extension capacity to guide changes in management practices. In addition, the decline in numbers of farmers with complex knowledge of natural systems is also a major limitation (Halweil 2000).

The development of agro-ecology as a discipline recognises the potential advantages of working with, and mimicking natural systems for sustainable production outcomes and protection of biodiversity (Gliessman 2007). However, wholesale adoption of agro-ecosystem principles and practices in the developed world is also unrealistic in the short-term as it shares many of the same impediments to adoption as identified above for organics, not least of which are the knowledge and commitment required for successful implementation. Time and research effort is needed to overcome these impediments. Of the alternative systems of production, biological agriculture has the greatest potential to contribute to agricultural sustainability in the short- to medium-term. Biological (or eco-) farming is rapidly growing in Australia, the United States, New Zealand, South Africa and Europe. It is a recognised hybrid system that aims to take the best from conventional and organic systems, promote biological health and maintain yields with judicious use of inputs. Biological farming represents a practical and positive development in view of its: improved ecological focus; improved focus on soil management; broad compatibility with existing production systems; compatibility with technological innovation; focus on system health; and focus on quality outputs (Zimmer 2000; Wheeler and Ward 1998).

A biological approach differs from conventional approaches in subtle but important ways. For example, nutrient management is not wholly based on the 'sufficiency level of available nutrient' concept which aims to supply nutrients to a 'critical level' at which point there is little or no crop response to further additions of that nutrient (Zimmer 2000). Rather, inputs are provided to maximise the growing potential and pest / disease resistance of crops. For example, Fitzgerald *et al.* (2003) showed that the pH and calcium required for optimal plant health in bananas was higher than that required for optimum yield but resulted in a significant reduction in Sigatoka pressure and the need for fungicide applications. Similarly, Zimmer (2000) reported significant reduction in leaf hopper pressure on potatoes with increased application of soluble calcium. Such responses to pest and disease pressures can contribute to improve biological functioning of soils, improved plant health and improved product quality (Zimmer 2000). This approach requires fundamentally different thinking to the control of pests and diseases with pesticides but ironically, it does not require a major change in the tools used. Research is needed to further examine the costs and benefits of this kind of response to pest / disease pressure with regard to the efficacy of treatments, relationship with soil biological function and soil condition, and product quality. Given that biological agriculture is largely compatible with current agricultural practices and supports the use of most conventional inputs, albeit in a way that protects and enhances ecological processes, it stands that a more biologically / ecologically sympathetic RD&E program that is multidisciplinary and holistic can deliver substantial improvements in our understanding of how to manage our natural resources, and particularly our soils, sustainably.

Conclusion

There is a slow shift towards development of a national Soils Policy in Australia and most regional Catchment Management Authority strategic plans have soil condition targets. However, at this time, most plans and policies still lack a clear articulation of the need for, and a path to sustainability. Unfortunately the reduction of government-sponsored extension could not have come at a worse time. The popular idea that the market will meet the needs of business does not hold for considerations of sustainability. Without appropriate extension to support a transition to more ecologically-focused soil management existing paradigms will hold fast. In the face of economic, market, consumer, peer and institutional pressures, farmers can not make this change alone. The change to sustainable management of our soil resources requires the support and commitment of Governments, universities, agricultural (and soil) science communities, agri-business and consumers. The reality is that (under current timeframes) we are effectively dealing with a non-renewable resource. Investment in sustainable soil management is an investment in our collective future.

References

Ashley R, Bishop A, Dennis J (2003) 'Integrated Development of Intensive Organic Vegetable Production Systems'. (Rural Industries Research and Development Corporation: Canberra).

Beus CE, Dunlap RE (1990) Conventional versus alternative agriculture: the paradigmatic roots of the debate. *Rural Sociology* **55**, 590-616.

Ching LL (2002) Turning the table on common organic misconceptions. *Australian Organic Journal* **52**, Summer 2002-03.

Cribb J (2006) Can Australian Soil Science Save The World? In 'Keynote address at the ASSSI-ASPAC-ACMS National Soils Conference, Adelaide'.

Fitzgerald SM, White SD, Dickinson, AA, Goldman B (2003) A survey of Sigatoka leaf disease (*Mycosphaerella musicola* Leach) of banana and soil calcium levels in North Queensland. *Australian Journal of Experimental Agriculture* **43**, 1157-1161.

Gliessman SR (2007) 'Agroecology: the ecology of sustainable food systems'. (CRC Press: USA).

Halweil B (2000) 'Where have all the farmers gone?' World Watch, September/October, pp. 12-28

Hill S (1995) Learning land stewardship. In 'The Queensland Annual Landcare Conference, Longreach, June, 1995'.

Lavelle P, Decaens T, Aubert M, Barot S, Blouin M, Bureau F, Margerie P, Mora P, Rossi JP (2006) Soil invertebrates and ecosystem services. *European Journal of Soil Biolog* .**42**, S3-S15.

Millennium Ecosystem Assessment (2005) 'Ecosystems and Human Well-being: Synthesis'. (Island Press: Washington, DC).

Oakeshott G (2008) 'Nature – an answer to climate change could be right under our feet, About the House, September'. (Parliament House: Canberra).

Pimentel D, Hepperly P, Hanson J, Seidel R, Douds D (2005) Organic and Conventional Farming Systems: Environmental and Economic Issues, ecommons.cornell.edu/bitstream/1813/2101/1/pimentel_report_05-1.pdf viewed 15th November 2009

Schoknecht N (2009) Managing Australia's Soils – public consultation outcomes. In 'Natural Resources Policies & Programs Committee, May 2009'.

Sims CC, Cotching WE (2000) Erosion and water quality: Turbidity and sediment loads from selected catchments in north west Tasmania. *Natural Resource Management* **3**, 8-14.

State of the Environment (SoE) Tasmania (2009) Dept of Justice, Tasmania http://soer.justice.tas.gov.au/2009/

Stocking M (2007) A Global Systems Approach for Healthy Soils. In 'Proceedings of the International Forum Celebrating the Centenary of Conservation and Restoration of Soil and Vegetation in Iceland, 31 August – 4 September 2007, (Selfoss, Iceland'.

UNEP (1997) Global Environmental Outlook, ch.4 Looking to the future, http://www.unep.org/Geo/geo1/ch/ch4_11.htm

Warshall P (2002) Tilth and Technology: the Industrial Redesign of our Nation's Soils. In 'The Fatal Harvest Reader' (Ed Andrew Kimbrell) (Island Press: Washington).

Wheeler PA, Ward RB (1998) 'The Non-Toxic Farming Handbook'. (Acres: USA).

Wynen E (1996) 'Research implications of a paradigm shift in agriculture: the case of organic farming'. (Centre for Resource and Environmental Studies: ANU, Canberra).

Zimmer GF (2000) 'The Biological Farmer'. (Acres: USA).