COMMENTARY

Ecological agriculture in China: bridging the gap between rhetoric and practice of sustainability ¹

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Abstract

This paper provides a perspective on the potential of Chinese ecological agriculture to address sustainable human–environmental interactions. As Chinese agriculture is increasingly challenged by the constraints of population, resources and environment emerging from its modern development, it is imperative to explore a sustainable agricultural paradigm that could accommodate economic and socio-cultural needs within an already stressed natural resource base. The rise of ecological agriculture is suggested as a workable alternative that has the potential to mitigate negative impacts of modern conventional agriculture and at the same time, to overcome limitations of traditional agriculture in meeting the needs of China’s growing population. Ecological agriculture represents a site-specific manifestation of the application of ecological economics, among others, to agricultural practices. Some challenges being experienced in translating this rhetoric into practice are identified and discussed. Highlighted is the view that sustainable agricultural development is meaningful only when it is tailored to specific ecological, economic, political and socio-cultural settings. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Ecological agriculture; China; Traditional agriculture; Ecological economics; Sustainability

1. Introduction

Agricultural sustainability is now a central focus for agricultural researchers, government leaders and policy makers throughout the world. Many of them have criticised modern conventional agriculture, which is based on high use of chemical and technological inputs and oriented to maximising returns and profits, as often being detrimental and nonviable when considered from social and ecological perspectives (Cai and Smit, 1994a; Pretty, 1995; Dragun et al., 1999). In order to meet increased demands created by growing populations and rising incomes, sustainable agricultural development emphasises the need to enhance agricultural productivity in a manner that provides affordable, efficient and healthy diets to all at the lowest environmental cost (UNCED, 1992). This approach represents not only a new way of thinking about agricultural production but

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also a potential alternative to conventional resource management. As the evolution of an agricultural system is a biophysical phenomenon and socio-cultural construct, ‘[n]o single blueprint of sustainability will be found, as economic and social systems and ecological conditions differ widely among countries. Each nation will have to work out its own concrete policy implications’ (WCED, 1987, p. 40). In China, ecological agriculture has been advocated as a potentially viable alternative to the conventional way of developing agriculture (Ma, 1988; Ye, 1988; Han, 1989; Wu et al., 1989; Luo and Han, 1990; Cheng et al., 1992; Wen et al., 1992; Jiang and Shu, 1996; Qu et al., 1997; Li and Min, 1999; Shi, 2001). It represents an articulation of China’s sustainable agricultural development agenda and a response to the country’s need to facilitate food security and alleviate resource and environmental problems (Sanders, 2000). In this regard, over 20 years development of ecological agriculture in China has provided a context-specific opportunity to evaluate the interrelated ecological, economic and social dimensions of agricultural sustainability.

2. The rise of ecological agriculture: a shifting eco-philosophy

2.1. Traditional agriculture: humans harmonise with nature

More than 4000 years of traditional agricultural practices have enabled Chinese farmers to evolve various agricultural techniques, e.g. thorough tillage, crop diversification and rotation, animal husbandry, use of organic fertilisers, irrigation, drainage and terracing (Wittwer et al., 1987). These techniques, which were largely shaped by the coevolution of nature and culture, have contributed to the maintenance of soil fertility after thousands of years of cultivation (King, 1911; Bray, 1999). Through recycling organic manures that require little in capital input while applying environmental knowledge accumulated by generations of farmers, traditional agricultural practices were ecologically reasonable and sustainable and adapted to relatively high population densities and different regional conditions throughout history (Needham, 1984; Netting, 1993). Perkins (1969) estimates that China’s per capita food production kept pace with population increase between 1400 and 1800, during which time the population grew from about 60 to 300 million. The underlying eco-philosophy was Taoism, which emphasises community interests and the importance of living in harmony with nature (Cai and Smit, 1994b). This philosophy indicates the essentiality to live with and follow, rather than manipulate or dominate nature, and in this way to achieve sustainability and an adequate food supply while simultaneously keeping agro-ecosystem cycles and processes intact (Bennett, 1990). Traditional agriculture was characterised as a self-sufficient natural agricultural economy oriented to subsistence and the satisfaction of basic needs. It often shows a high degree of stability, reliability, resilience and efficiency, although yields are usually lower and labour demands higher than in modern farming systems (Thurston et al., 1999). In many aspects, traditional agricultural practices provide a strong basis for sustainable agricultural development, although they are challenged by the emerging resource and environmental constraints, and the imperative to produce enough food in meeting the needs of China’s growing population.

2.2. Conventional agriculture: humans conquer nature

Realizing the importance of food security to political stability and social development, the Chinese government carried out a series of industrialised agricultural reforms from 1949 to 1979, adopting higher yielding, greater external-inputs and petrochemical-based agricultural technologies and measures to replace traditional organic agricultural practices (Cheng et al., 1992). These Maoist era agricultural practices were greatly influenced by the Soviet model, in which the underlying eco-philosophy was derived from the Western Enlightenment tradition that regards nature as an instrument to serve human ends, that focuses on human mastery over nature, and that forsakes the core of traditional culture that sanctifies nature (Wallace et al., 1996). Since production was
granted as an absolute human priority in socialist political thinking, agriculture was viewed as another type of industry that can increase output by increasing inputs. This mastery of nature mentality was most dramatically evident in the period of Great Leap Forward (1958–60), which emphasised increased economic growth and food output with little resource and environmental concerns. Moreover, the Maoist leadership, owing to its top-down nature, often implemented its policy initiatives on a national basis without reference to local and regional specificities (Blecher and Wang, 1994). In many cases, this adopted Western anthropocentric philosophy prescribed a quite different set of economic-social-cultural orientations from those that underpinned traditional agriculture.

2.3. Ecological agriculture: re-establishing human-natural harmony

Over the past decades China has managed to feed its people (22% of the world’s population) with only 6.5% of the world’s arable land. However, much of this has been achieved by the mining of ecological and communal capital (Muldavin, 1996), especially in areas that have undergone agricultural modernisation relying on extensive external inputs. Conventional agricultural practices in China have demonstrated the limitation of Western industrialised agriculture as a directly transferable model to fit within the specific settings of Chinese society and environment (Luo and Han, 1990). Ensuing problems have promoted the exploration of alternative practices, especially towards establishing agro-ecosystems that require a lower rate of external chemical inputs (Han, 1989). Ecological agriculture is viewed as a complex, co-evolutionary ecological-economic-social system and employs a holistic approach in agricultural production and resource management. The final goal is to attain the integrated effects of the whole system, not the effects of its individual components (Li and Min, 1999). Luo and Han (1990) identify three principal objectives of Chinese ecological agriculture: protect and conserve natural resources and the environment as the foundation for sustainable agricultural productivity; co-ordinate agro-ecosystem relationships with the needs and characteristics of the socio-economic environment; and facilitate the recycling of agricultural resources to reduce adverse environmental impacts and to lower production costs. As an integrated agricultural production system, ecological agriculture encompasses cropping, forestry, animal husbandry, aquaculture and processing industries, and emphasises the co-ordination of relationships between agriculture and the natural environment, biodiversity, agricultural technology, economic results and ecological integrity (Jiang and Shu, 1996). It attempts to redefine and design a new development pattern, which moves beyond a growth-dependent mentality towards a socially just and ecologically viable future. This approach replaces the dominant reductionist and mechanistic model of nature as a resource to be exploited with a systemic and biological model that emphasises the goal of ecosystem viability and integrity (Gale, 2000). To some extent, ecological agriculture intends to produce a human-natural co-operative community that advocates the development of human potential while respecting the non-human world.

3. The rhetoric of ecological agriculture

3.1. Ecological economics as the theoretical core

Emerging ecological agricultural practices were largely motivated by the development of ecological economics in China in the past two decades. Ecological agriculture and ecological economics share a common theme that economic development and environmental protection can be co-ordinated (Shi, 2002). Chinese scholars (Ma, 1988; Jiang and Shu, 1996; Qu et al., 1997; Shi, 2001) have characterised ecological agriculture as a comprehensive agro-ecological-economic system, in which agricultural production and development are directed, organised and managed in the light of ecological economic theory and a systems engineering approach. Based on a holistic point of view that humans are within the biosphere and dependent on scarce natural resources, ecological
agriculture emphasises the explicit examination of human-environmental interactions. Ma (1988) has identified four ecological economic principles—holism, harmony, recycling and regeneration—in the construction of Chinese ecological agriculture. This promotes the idea of developing agro-ecosystems with a minimum dependency on agrochemical inputs and energy, emphasising interactions and synergism among the many biological components of agro-ecosystems to enhance recycling and biological control, thus improving overall ecological efficiency and environmental protection (for examples of ecological agriculture production systems, see Luo and Han, 1990; Sun, 1993; Jiang and Shu, 1996). In order to achieve integrated economic, ecological and social effectiveness, ecological agriculture is required to conduct cross-sectoral cooperation and multidisciplinary effort with due consideration of biophysical, socio-economic, cultural and political aspects (Li and Min, 1999). In this regard, ecological agriculture is a particular manifestation of applying ecological economic rationality in Chinese agricultural practices (Shi, 2001).

3.2. Combining traditional and modern agricultural practices

Supported with modern science and technology, ecological agriculture is not only an evolution of traditional, biological and organically based agricultural production systems but also a recently developed alternative to decades of conventional agricultural practices in China (Wu et al., 1989; Cheng et al., 1992). Cleveland et al. (2001) suggest that to understand problems and explore workable solutions requires the contextual, experiential and, in some cases, traditional or indigenous knowledge of local people and practitioners. The primitive philosophy and techniques for the implementation of ecological agriculture in the past two decades can be traced back in ancient China. Traditional agricultural knowledge and techniques, once regarded as ‘primitive’, reflected local adaptations and were the only time-tested examples of sustainable agriculture that are essential in today’s search for ecologically sustainable agriculture (Ellis and Wang, 1997). According to the precautionary principle, traditional forms of resource use must be preserved until proven superior forms of resource use have been developed. In this sense, indigenous farming practices and environmental knowledge are under-utilised resources crucial to ecological agricultural development. Traditional agriculture cannot produce enough food to meet the needs of increasing population and global marketing because of its focus on meeting local and small-scale needs (Cai and Smit, 1994b). However, the overall production of traditional agricultural systems could be further increased with a small input of industrial energy (Netting, 1993). Recognising the need to promote adjustments in both traditional and conventional agricultural practices, ecological agriculture utilises scientific knowledge for the development of appropriate technology and advances traditional farming practices that are applicable in site-specific situations (Wen et al., 1992). In contrast to conventional agricultural practices, ecological agriculture is heavily reliant on organic fertilisers and manure to maintain land productivity for long-term use (Wittwer et al., 1987).

3.3. Consistency with Chinese social, economic and ecological settings

It would be naïve to think that traditional agriculture could be maintained or recreated in modern China, which is dominated by specialised commodity production and a huge population. Among other viewpoints, Zilberman et al. (1997, p. 65) argue, “While organic farming and traditional crop rotations may have a significant role in a sustainable future, we do not believe that the keys to sustainability are the technologies of the past. …we cannot turn the clock back and still feed the current human population.” It is instructive to view agriculture not only as existing in the natural environment, but also as comprising three dynamic and interrelated technological, socio-organisational, and ideological systems (Padgitt and Petrzelka, 1994). For agriculture to be sustainable it must be biophysically possible, socio-politically acceptable, and economically feasible (Cai and Smit, 1994a). In China, agricultural systems must
have high productivity without causing degradation of natural resources and the environment to fulfill the needs of a growing society (Wu et al., 1989; Cheng et al., 1992). Ecological agriculture is suggested to be the most promising alternative that has a sound track record of adapting safely to the higher population (Wu et al., 1989). This can be achieved when it is incorporated into the national sustainable development framework and is based on established conditions of China (Li and Min, 1999). Ecological agriculture takes advantage of a big population to overcome the disadvantage of relatively small resources per capita, and makes up the deficit in scientific expertise and capital with the rich experience of traditional agriculture (Laird, 1992). It advocates technological pluralism, more labour-intensive modes of production, and small-scale enterprise adapted to local resources for high agricultural productivity, better conversion efficiency and sound ecological circulation (Ma, 1988; Shi, 2001). It is likely to be even more site-specific than conventional agriculture because it relies more on management of on-farm resources and less on purchased commercial inputs. By focusing on an intensive labour force with considerable technical skills and local knowledge, this knowledge-based farming system could reduce many of the existing capital constraints while maintaining the potential of natural resources and the environment. Owing to the impossibility to feed, even at subsistence levels, 1.3 billion Chinese without large chemical inputs in agricultural production, ecological agriculture has justified the minimal use of chemical fertilisers on the grounds that the social costs (e.g. the instability resulting from reduced food production) might far outweigh the ecological benefits of non-chemical input in agriculture.

4. Ecological agriculture in practice: achievements and constraints

4.1. Successful outcomes

As an important approach to realise the co-ordinated development of environment and economy, Chinese ecological agriculture has had significant effects on agricultural environment and rural development since its implementation in the early 1980s (Qu et al., 1997). Preliminary results from ecological agricultural projects include: (1) higher productivity and commodity output with less cost; (2) higher stability of the farm system during disasters; (3) more concern with the environment and ecosystem; (4) harmony among farmers and agricultural administrators; and (5) improved rural landscapes (Han, 1989). In 1993, the Chinese government selected 51 counties as pilot sites to practise ecological agriculture methods. As a result, these 51 counties have had a favourable environmental improvement, e.g. forest coverage is 3.7% higher than before, and soil erosion and the expansion of deserts are under control. The gross domestic product (GDP) and the annual growth of rural residents' net incomes of these 51 counties is 2.2 and 1.5 percentage points higher than that of the national average, respectively (China Daily, 2001). The achievements of ecological agricultural practices have also been highly praised internationally. Since 1984, seven ecological agricultural villages and small towns have received UNEP's Global 500 Awards (Laird, 1992). The experience of Chinese ecological agriculture is suggested as being apposite for developing countries that have a high population density, small per capita agricultural land and complex geographic conditions (Jiang and Shu, 1996).

4.2. The inadequacy of institutional arrangements

In the past 20 years, Chinese agriculture has retreated from Mao's focus upon self-reliance and collective egalitarian ideals to Deng's pragmatism that favours short-term individual profit and more freedom of choice in agricultural production. In particular, the adoption of the household responsibility system (HRS) has revitalised traditional households as the basic unit of production and released farmers from a rigid planning regime (Han, 1989). HRS can be viewed as an institutional arrangement that uses
economic instruments to stimulate agriculture production in response to market demands, which, to a large extent, has overcome the former difficulties in creating incentives and initiatives under Maoist collectives (Netting, 1993; Muldavin, 1996). But on the other hand, HRS no longer forced farmers to conserve soil and water, and the dispersed and small-scale land units limit the creation of a rational economic structure and public action necessary for resource conservation and ecological projects (Qu et al., 1997). For example, ecologically sound practices, such as integrated pest management and biogas production for rural energy and organic manures, were weakened mainly because communes that provided a better scale of operation to maintain these techniques disappeared (Edmonds, 1994).

The stagnation of China’s agriculture in the late 1980s indicated HRS had exhausted the potential of traditional farming methods, while the necessary conditions for modern agriculture had yet to be established (Wang, 1989). Moreover, the uncertainty about land tenure has further encouraged short-term profit maximisation and exploitation of land at the expense of sustainable agricultural production. This is evident in the rapid conversion of agricultural land to non-agricultural use, such as rural industrialisation, urbanisation, road construction and house building. These negative influences have made the exploration of alternative institutional arrangements imperative. At present, the weakest link is the lack of managerial and institutional capacities to promote ecological agricultural practices beyond farm household level. The necessary political economic setting that can continuously provide incentives to farmers to practise ecological agriculture using their own initiatives has yet to be developed. A paradox is that real functioning alternative systems (e.g. organic agricultural practices at experimental sites) work well, but the conversion from conventional to sustainable agriculture has failed so far (Vandermeer, 1995). This is mainly because adopting new elements into what remains structurally a conventional farming framework demands very complex transformation processes.

4.3. Limits of the market economy

To maintain political and macroeconomic stability, China’s pursuit of market efficiency in agriculture has been gradual. Policy makers avoided large-scale reform experiments by experimenting on a small scale at the local level (e.g. village or county), and only after the experiment was deemed successful would a transformation policy be introduced over a broad geographic area. However, the intensification of a market-oriented economy creates pressures to use natural resources at a faster rate for immediate financial gain. The rising opportunity cost of labour has also motivated farmers to substitute purchased external inputs (e.g. chemical fertilisers) for organic fertilisers and other time-consuming, labour-intensive traditional practices (Edmonds, 1994). These potential dangers of a more fully developed market economy in relation to ecological agriculture should be explicitly recognised and resisted. While market liberalisation is a necessary condition to encourage farmers to operate efficiently, it is far from a sufficient condition for sound environmental management. ‘As long as the ecological costs of modern agriculture can be externalised to the future or other sectors, we must conclude that the market fails to ensure the widespread adoption of ecologically sound practices, and that alternative measures must be taken to offset this ‘market failure’” (Röling et al., 1998, pp. 291–292).

4.4. Trade-offs between policy objectives: sustainability versus productivity

Munasinghe (1993) suggests that when sustainability for development is an ultimate goal, it requires the balancing of environmental, social and economic systems. In agriculture, policy makers are generally concerned with goals for the maintenance or enhancement of the natural environment, provision of human food needs, economic viability and social welfare (Smith and McDonald, 1998). At any given time, however, trade-offs between policy goals of productivity and sustainability are difficult to operationalise. This means that no matter how technically feasi-
ble and potentially ecologically beneficial a new agricultural practice may be, it will not be adopted if it does not fit into extant political relations and promise considerable economic rewards. Current mainstream agricultural practices in China are so heavily dependent on conventional inputs that a quick move away from them would almost inevitably lead to immediate production reductions, thus representing a major quandary to policy makers (Cheng et al., 1992). Although ecological agriculture was set as a key project for achieving sustainable agricultural development in China’s Agenda 21, this required political process implies official recognition of the necessary tradeoffs between short-term productivity and long-term sustainability. Even though in the long term more sustainable production systems are likely to provide the best outcomes, China may be forced in the immediate term to give greater weight to achieving a productive rather than an environmental goal; otherwise social instability would emerge (Cheng et al., 1992). Thus, rhetorically adopted sustainable agricultural development has been confined and compromised within the prevailing macroeconomic policies and institutions that favour productivity. In this sense, the practice does not match the rhetoric.

5. Prospects toward sustainable agricultural development

Ecological agriculture is generally more environmentally benign than most petrochemical-based practices and offers a potential mechanism for sustaining output and at the same time maintaining the agricultural ecological foundation. To balance the economic imperatives with the need to preserve the fabric of rural communities, ecological agriculture extends the spectrum of production from concentrating on crop production to sideline industries and rural enterprises. Agriculture of this kind might generate greater employment opportunities to retain farmers in rural areas and, thus, mitigate urban problems. However, until and unless ecological agriculture has a much more immediate and widespread adoption, the possibility of it contributing significantly to China’s sustainable agricultural development is fairly bleak (Sanders, 2000).

5.1. Challenging the dominant position of conventional agriculture

The development of ecological agriculture means much more than just practising environmentally sound agriculture; it should embrace the capacity building for practices to spread far beyond the project level. Owing to the coexisting of conventional and ecological agricultural practices, it is difficult to determine the extent of adopting ecological agriculture in China. Each is significant in contributing to agricultural sustainability and each is inseparably bound up with the other. Developing ecological agriculture is essentially a process of altering, where necessary, current mainstream agricultural practices. To the extent that ecological agriculture is seen as a potential solution, it will increasingly challenge, if not replace, conventional agriculture. However, within current development paradigms that are driven more by economic rather than environmental concern, ecological agriculture only involves a small part (5%) of rural labour force compared with the dominant conventional practices in China (Sun, 1993). Nevertheless, ecological agriculture has challenged conventional agriculture by identifying policies (e.g. eco-labelling products of ecological agriculture to reward farmers for adopting this pro-environmental practice) that facilitate an actual transition towards sustainable agricultural development. Such a transition is not immediate, and the implementation of pro-sustainability policies involves an iterative procedure with necessary economic, technological, institutional and ecological changes over time. During this process, indigenous cultural heritage and traditional farming knowledge need to be increasingly emphasised despite of the dominant conventional economic and political interests.

5.2. Reconciling the conflicts between economic and ecological objectives

The exploitation of natural resources and environment at a rate that over-stresses its natural
resilience and exceeds its capacity for self-renewal has already threatened the long-term sustainability of agricultural production. For example, water is scarce in most of China, water tables are falling alarmingly and many rivers no longer reach the ocean. Therefore, increasing attention should be paid to alternative production systems that strive for both high production and environmental quality. From an ecological economic perspective, environmental and economic developments are complementary rather than conflicting goals. Ecological agriculture seeks to balance the long-term costs of farm production against the short-term profits of goods sold at market, and this approach is able to contribute to income generation at the farm household level as well as food security and ecological objectives at the national or regional level (Qu et al., 1997). In this sense, it can help forge a consensus or commitment that ultimately leads to environmentally sound and economically acceptable agricultural practices.

6. Conclusions

Chinese ecological agriculture is an alternative paradigm derived from reconsidering the environmental impacts of conventional agricultural practices and the limitations of traditional agriculture in providing enough food to a growing population. It offers a good opportunity to help alleviate poverty and solve the needs of many people (mainly by producing affordable, healthy and efficient grain-based diets rather than beef and milk), to establish ecological balance, and to put sustainable agricultural development on a sound ecological and social basis. These activities are inextricably bound up with China’s political, economic and social systems and are not transferable in isolation from them. Since a universal plan for sustainability does not exist, the development of ecological agriculture, therefore, requires a bottom-up farmer participation strategy, sensitivity to local socio-cultural values, and tailoring to specific biophysical, economic and political situations (e.g. the ratio of population to land, the level and manner of agricultural production, the living standard of farmers, the phase of rural transformation and the available resources). In this sense, the economic feasibility, social effects and institutional capacity of ecological agriculture in relation to the environment and rural development need to be further explored. Given a well-designed agro-ecological-economic system must be integrated and interactive with its natural and social environment, a deeper understanding of traditional ideas and historical experiences is valuable for both present and future sustainable agricultural development. Needless to say, there is still a long way to go for Chinese agriculture to bridge the gap between rhetoric and practice of sustainability.

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References


