Operationalizing Sustainability: An Emerging Eco-Philosophy in Chinese Ecological Agriculture

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ABSTRACT. The sustainable development of agriculture has increasingly become an international trend in recent decades. Although this major theme was originated from developed countries, it also has active responses in developing countries. This paper examines the evolution of the ecological agricultural practices in the People’s Republic of China with a focus on the changing underlying eco-philosophy and the broader socio-cultural settings. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <docdelivery@haworthpress.com> Website: <http://www.HaworthPress.com> © 2004 by The Haworth Press, Inc. All rights reserved.]

KEYWORDS. Conventional agriculture, ecological agriculture, eco-philosophy, human-natural harmony, People’s Republic of China, sustainability

INTRODUCTION

Over the last two decades, the sustainable development of agriculture has received increasing attention among academic researchers, government leaders and policy-makers throughout the world. This paper attempts to provide an overview of the emergence and development of ecological agriculture in...
China as a specific manifestation of this international trend. Chinese ecological agriculture gives priority to increasing food production and food security, while ensuring a balance between goals of self-sufficiency and production for markets. It also promotes rural employment and income generation to alleviate poverty, and natural resource management and environmental protection. The philosophical core of this emerging practice is that economic development and environmental protection could be coordinated.

**INTERNATIONAL SUSTAINABLE AGRICULTURE MOVEMENT**

As a co-evolutionary process among society, culture, and the environment, agricultural development can be viewed as part of an economic and scientific revolution that made humans active partners with nature, instead of being passive dependants on nature (Norgaard, 1984; Gliessman, 1998). From an historical perspective, agricultural change can be broadly described by three systems: subsistence agriculture, commercial agriculture, and sustainable agriculture (Padgitt and Petzelka, 1994). All three systems are associated with certain technologies, worldviews, and social expectation. The term ‘subsistence’ is generally associated with primitive agro-ecosystems, or pre-industrial, traditional agriculture, which has practised the basic techniques and methods of cultivation, irrigation, terracing, crop rotations, manuring, and land management for many centuries. Most traditional societies had low population densities and were based on agricultural strategies and social activities that assured their survival for millennia. Boulding (1966) comments that traditional agriculture has already largely solved the problem of a self-sustaining economy on a permanent basis. Traditional farming systems often show a high degree of stability, reliability, resilience, and efficiency although yields are usually lower and labor demands higher than in modern farming systems (Thurston et al., 1999). In contrast, commercial agriculture has focused on expansion, growth, and dominance over nature, and this mainstream approach to modernizing agriculture has led to dependency on external inputs (Kotschi et al., 1989). This practice has generated serious disruptive effects on traditional rural societies and ecosystems around the world. In recent years, increasing concerns about resource limitations and ecological repercussions of this modern conventional practice have led to a growing awareness of the need for environmentally sound alternatives in agriculture.

Modern conventional agricultural practices have been criticized in terms of: (1) using too many chemical and technological inputs (e.g., synthetic fertilizers and pesticides) which has harmed the ecological balance in soils; (2) the increasing size of farms which has eroded the fabric of rural communities; and (3) farm profits are declining as farmers invest heavily in chemical and techni-
cal inputs (Chapman, 1999). Many critics see these problems as fundamental flaws inherent in the structure, policies, and practices of conventional agriculture. Consequently, a host of alternatives has emerged attempting to replace the dominant conventional agricultural paradigm. These alternatives include: organic farming; biodynamic agriculture; natural farming; ecological agriculture; permaculture; and biological agriculture (Beus and Dunlap, 1990). They share a deep concern about the ecological aspects of agriculture and have the common theme of interconnectedness of humans and environment. Dahlberg (1991, p. 338) points out:

Conceptually, conventional agricultural approaches tend to be reductionist and based on single disciplines. They tend to employ narrow economic or productivity criteria to measure their success. The various alternative approaches are broader and necessarily more interdisciplinary, based on open and evolving systems. They evaluate the health of relevant systems not only in terms of economics, but also in terms of ecology, ethics, and equity.

Collectively, these alternative approaches fall under the ‘sustainable agriculture’ rubric. Sustainable agriculture provides not only a philosophical change, but also a set of agricultural practices that involve the intersection of three key areas: farm profits, agro-ecosystems, and local communities (Chapman, 1999). Its primary goal is to develop farming systems that promote each of these areas equally, rather than solely one or the other. It implies the consideration of trade-offs between them. This has challenged the core values of economic growth and the domination of nature which are basic tenets of conventional agriculture. A fundamental contribution of the sustainable agriculture agenda is to explicitly recognize the linkages of agricultural production to the environment and society (D’Souza and Gebremedhin, 1998). From an ecological economics perspective, sustainable agricultural practices might provide profitable alternatives to farmers who are increasingly asked by society to reduce negative impacts on the environment. Although it is much too early to predict whether the alternative agricultural paradigm will significantly modify or even replace the conventional paradigm, it represents the first stage of a ‘paradigm shift’ occurring within agriculture (Beus and Dunlap, 1990).

The Unsustainability of Modern Conventional Agriculture

Increasing problems associated with modern conventional agriculture have brought the sustainability of such systems into question. Conventional agriculture is fundamentally an industrial development model that ascribes to the assumption that a high quality of life can be derived from increases in income and consumption of goods and services (Ikerd, 1993b). The philosophy be-
hind it in regard to efficiency criteria is equivalent to that of mainstream economics with its simplistic ideas about allocative efficiency, profits, and gross margins in monetary terms (Söderbaum, 1985). Conventional agricultural systems have relied primarily on specialization and mechanization to achieve physical and economic efficiencies through large-scale production, but these have also generated numerous negative side effects. The agro-ecosystems produced and maintained in conventional agriculture frequently bear little resemblance to the natural system in terms of structure, function, and nutrient cycling (Jansson et al., 1994). Mitchell (1984) has pointed out the differences in technology and ecological scale between traditional and modern agro-ecosystems. Modern agro-ecosystems maximize the production of marketable outputs, and their link with consumers is unidirectional. By contrast, in traditional subsistence agro-ecosystems, farm families are the major consumer and the link between agro-ecosystems and consumers is bi-directional (i.e., agricultural and other wastes are recycled within the system). As a result, there is a growing worldwide perception that the present means of agricultural production are socio-economically and environmentally unsustainable (Tisdell, 2000).

This is also illustrated by the fact that the modernization of agricultural techniques is causing the separation of farming communities from their original culture. The spread of energy-intensive agriculture has brought in its wake a multitude of negative environmental impacts not associated with traditional agriculture. As Conway (1987) argues, modern agricultural systems are less sustainable than traditional ones. One interpretation of this would be that traditional agriculture, as with natural ecosystems, was well organized for the capture of the solar low-entropy flux, but that intensive agriculture expands apparent carrying capacity at the expense of polluting the environment with high-entropy waste products. In many locations, relatively ecologically stable land-use systems have been turned into exploitative systems: machines and fossil fuels have replaced animal and human labor; chemical fertilizers have replaced natural cycles of soil fertility; monocultures have replaced complex polycultures; and commercial chemicals have dominated weed and pest control. As the drawbacks of modern industrial-intensive agriculture become more and more apparent, researchers are beginning to look at traditional agricultural systems in order to understand how agro-ecosystems, management techniques, and cultures can co-evolve sustainably (e.g., Thurston et al., 1999).

Since Western society and agricultural science have become dominated by scientism, a reductionist way of regarding nature and the physical world has led to profoundly anti-ecological attitudes. Modern human societies are lured into mechanization, intensification, and specialization by the linear thinking of quick monetary gains and the materialistic security implied by industrialization. Meanwhile, neoclassical economists do not regard natural resources and environment as being a significant constraint on economic growth because they believe that man-made capital can easily substitute for the func-
tions and services provided by natural systems (Dragun and Tisdell, 1999). As a result, Western society and agriculture have been separated from nature and this has led to the abuse of resources. Consequently, soil fertility and the sustainability of agricultural production, in general, have been threatened (Smil, 2000). These problems are the result of historical processes determined by global political and economic decisions that affect the management of natural resources (Meadows et al., 1992). Over the past 200 years, agriculture in the developed countries has evolved from a largely self-contained, organically and biologically based, labor-intensive pattern to one that is chemically and mechanically based, labor-saving, and market-oriented (Norgaard, 1994; Vosti and Reardon, 1997). However, the rapid progress and application of science and technology in Western agricultural practices did not ease the constraints of overpopulation, resources shrinkage, and environmental degradation—in fact, they were deepened in a more extensive ecological, economic, and social context (Rasmussen et al., 1998).

The Green Revolution aimed at universalizing the methods of industrial agriculture. Many farmers in developing countries are using modern inputs to sustain high growth in yields, but such practices threaten the environment and are profoundly ecologically unsustainable. Technical and scientific solutions to agricultural sustainability are unlikely to succeed in the long run if they do not account for the natural, political, economic, and socio-cultural conditions of particular locations (Dragun and Tisdell, 1999). Conventional agriculture may be bountiful and profitable in the short run and in narrow monetary terms, but it is surely not the best way to promote longevity and stability of agro-ecosystems (Smil, 2000). Martinez-Alier (1987, p. 235) points out:

If modern agriculture means ‘farming with petroleum’ (and natural gas), then it could be argued that it cannot be extended to the world at large, at least as a permanent solution. Hence, the argument that labour-intensive agriculture has an important role to play in feeding the world population.

**The Sustainability of Agriculture**

Increasing concerns about the economic, ecological, socio-cultural, and political problems in modern agricultural development have brought the sustainability issue to the fore. Furthermore, the sustainability of agriculture is currently the subject of vigorous debate among both scholars and policy-makers. Actually, agriculture is facing the dilemma of growing food and fiber while turning a profit and protecting the environment.

Solutions that are aimed at helping the environment without helping rural economies to grow and become less poor will, in the end, neither meet environment goals nor be sustainable. (Vosti and Reardon, 1997, p. 15)
Sustainable agricultural development is a process of change in which the utilization of resources, the management of the environment, the orientation of technical development, and institutional change are all directed towards harmonizing and enhancing both current and future potentials to meet human needs and aspirations (WCED, 1987). Its emergence represents a shift in environmental beliefs, values, attitudes, and norms; it is also an evolution of practices, strategies, and ways of thinking that are dependent on the context of the production system. For agriculture to be sustainable, it must be biophysically possible, socio-politically acceptable, and economically feasible (Cai and Smit, 1994). In this sense, it is increasingly necessary to place agricultural sustainability issues in the broader context of achieving food security, reducing malnutrition, and increasing sustainable use of natural resources.

Sustainability offers a general direction rather than a fully defined objective for agricultural development. “[E]veryone assumes that agriculture must be sustainable. But we differ in the interpretation of conditions and assumptions under which this can be made to occur” (Francis and Hildebrand, 1989, p. 8). Sustainable agriculture is an ambiguous phrase and open to many interpretations. Douglass (1984) provided a robust three-fold definition for the concept of agricultural sustainability that includes the dimensions of stewardship, food sufficiency, and community. According to Conway (1987, p. 101), sustainability is an agro-ecosystem property operating over time, which “is defined as the ability of an agroecosystem to maintain productivity when subject to a major disturbing force.” The definition adopted by the American Society of Agronomy is that, over the long-term, sustainability enhances environmental quality and the resource base on which agriculture depends, provides for basic human food and fiber needs, is economically viable, and enhances the quality of life for farmers and society as a whole (Schaller, 1990). According to Parr et al. (1990), agricultural sustainability seeks to optimize the management and use of internal production inputs (i.e., on-farm resources) in ways that provide sustainable crop production yields and livestock production, and result in acceptable income levels. Smit and Smithers (1992) argue that agricultural sustainability refers to the use of resources to produce food and fiber in such a way that the natural resource base is not damaged, and that the basic needs of producers and consumers can be met over the long term. According to Wenz (1999, p. 393), sustainable agriculture involves:

...practices that preserve indefinitely agriculture’s ecosystem base. Such practices use minimal amounts of herbicides, fungicides, insecticides, and petroleum-based fertilizers...it is relatively labor intensive and relies heavily on local inputs,...it is not capital intensive and involves less national and international monetary exchange than does industrial agriculture...it lends itself to regional self-sufficiency,...poor people can more easily practice sustainable agriculture for their own sustenance.
However, sustainability implies no clear intellectual framework and offers no rules to guide researchers and policy-makers. The sustainability literature, therefore, tends to gloss over certain types of problems: human values (e.g., economics, aesthetics, biocentrism versus anthropocentrism); scale (e.g., farms, regions, nations); and dimension or discipline (e.g., environmental, socio-economic). Instead, it should accentuate and solve them (Waltner-Toews, 1996).

The differences between conventional and sustainable paradigms of agriculture are evident much more in philosophy than in practice (Ikerd, 1993a). Some adherents considered sustainable agriculture to be only a set of substitute technologies for commercial agriculture practices; others regarded sustainable agriculture as an alternative belief system to that underlying commercial agriculture (D’Souza and Gebremedhin, 1998). Conventional and sustainable agriculture are points on a continuum of agricultural practices. The substitution of economic for ecological sustainability captures a fundamentally different view between conventional and alternative agriculture (Beus and Dunlap, 1990). In general, sustainable agriculture refers to those practices that have, to a greater or lesser degree, been removed from the conventional, large-scale, industrial model of farming. It can be classified as an information-rich, rather than strictly technology-based form of farming (Lockeretz, 1991). The sustainability of agricultural systems depends mainly on the positive interactions between socio-economic systems and ecosystems, which are interrelated by numerous feedback mechanisms to create modalities of co-evolution (Farshad and Zinck, 1993). Gliessman (1998, p. 13) outlines the following as the essence of sustainable agriculture using systems that:

- have minimal negative effects on the environment and release no toxic or damaging substance into the atmosphere, surface water, or groundwater;
- preserve and rebuild soil fertility, prevent soil erosion, and maintain the soil’s ecological health;
- use water in a way that allows aquifers to be recharged and the water needs of the environment and people to be met;
- rely mainly on resources within the agro-ecosystem, including nearby communities, by replacing external inputs with nutrient cycling, better conservation, and an expanded base of ecological knowledge;
- work to value and conserve biological diversity, both in the wild and domesticated landscapes; and
- guarantee equality of access to appropriate agricultural practices, knowledge, and technologies, and enable local control of agricultural resources.

Moving Towards Ecologically Sustainable Agriculture

Although sustainability means various things to different people, there is a general agreement concerning the importance of ecological sustainability.
Ecological economists (e.g., Norgaard, 1984; Martinez-Alier, 1987) have argued that agricultural production must be viewed in the context of biophysical limits on carrying capacity. Some (e.g., Smil, 2000) even argue that biophysical limits have already circumscribed the world’s food production capacity. Therefore, a new way must be proposed with regard to the complex social, economic, and ecological issues associated with current agricultural practice (Waltner-Toews, 1996). However, it is extremely difficult to determine whether certain agricultural practices are sustainable or not. It is only in retrospect that sustainable techniques can be truly identified (Rigby and Cáceres, 2001). In this regard, traditional agro-ecosystems with long histories of sustainable management are the only time-tested examples of sustainable agriculture today that are essential in the search for ecologically sustainable agriculture (Ellis and Wang, 1997). Barkin (2001, p. 3597) commented:

...a series of allied disciplines attempting to integrate indigenous knowledge with scientific advances in our understanding of the ability of local communities to implement effective programs of ecosystem management have demonstrated the potential for increasing output without occasioning the environmental and social devastation observed in commercial monocropping systems.

As the sustainability of agriculture is not wholly consistent with existing norms and values, or the previous experiences and current needs of farmers, it requires the development of new conceptual frameworks and modes of operation. Meadows et al. (1972) argue that it is possible to alter the conventional growth trends and to establish a condition of ecological and economic stability that is sustainable far into the future. This is a social learning process which requires one to focus particular attention to how the learning process can be facilitated and enhanced through appropriate institutional frameworks and policy contexts (Röling and Wagemakers, 1998). There are two different views regarding agricultural sustainability: fine-tuning of conventional agriculture (e.g., more careful and efficient farming with sensitive technologies), which will reduce or eliminate many undesirable effects of conventional agriculture; and fundamental changes in agriculture, which require a major transformation of social values. The adherents of the former opinion argue that sustainable agriculture is inherently unprofitable. If widely adopted, it would not feed the world’s expanding population as well as conventional agriculture. The adherents of the latter opinion believe that sustainable agriculture, on the contrary, can be even more profitable than the conventional, especially when the calculation of profit counts all of the benefits and costs of farming (Schaller, 1993). Ecological agriculture is regarded as being highly productive over the long
term, and its practice is advocated in the Declaration of the International Movement for Ecological Agriculture (DIMEA, 1990, p. 107):

"By undermining ecologically sound systems of agriculture, many of them with ancient traditions, environmental degradation has been aggravated to the point where the capacity of many regions to grow food is now seriously threatened . . . A radically different approach is required: one that seeks the regeneration of ecosystems through ecological agriculture, and which brings the wider social, economic and political changes necessary to ensure food security and social justice for all."

Ecological agriculture aims to produce crops using methods that are more closely based on the functioning of natural systems and the use of ecological processes, as opposed to a large-scale manipulation of nature and high inputs of energy. It starts off with an ecologically oriented understanding and, thus, a restricted interpretation of sustainability. Some common characteristics of ecological agriculture are outlined in DIMEA (1990):

- wide range of crop varieties adapted to differing conditions, maintain genetic diversity, and facilitate farmers against the vagaries of the weather, etc;
- through the use of poly-culture, reduce the vulnerability of crops to pest infestations and disease;
- be prudent and efficient in the use of energy, water, and other resources;
- minimize the use of toxic substances;
- maintain, and in some cases improve, soil fertility through such practices as fallowing, terracing, crop rotation, etc;
- provide efficient and non-toxic methods of food storage;
- grow a wide range of crops and provide a great diversity of food for consumption; and
- provide fodder, fuel, fiber, and fertilizer as an integral part of the agricultural system.

**ECOLOGICAL AGRICULTURE IN CHINA**

The continual use of natural resources and improvement of the ecological environment are prerequisites to the sustainable development of agriculture. Given China’s diversity, heterogeneity and complexity nature, Chinese agriculture is characterized by a combination of subsistence farming and market-oriented production. With increasing population, environmental stress and resource depletion, the potential role of Chinese agriculture in the future has attracted special attention, both internationally and domestically (Brown, 1995). The pressure to increase yields is in conflict with the requirements of
long-term sustainability. Chinese agriculture is challenged to develop models of sustainable agro-ecosystems, which balance yield requirements with ecological constraints. It has been demonstrated that the model of using large external inputs for agricultural modernization, as in most developed countries, is unrealistic and inappropriate for China (Luo and Han, 1990). Furthermore, China does not have the comparative advantages (e.g., per capita natural resource endowment) that most developed countries enjoyed during their period of industrialization (Yang and Tyers, 1989). Therefore, it is urgent to improve the resource utilization rate, to transform agricultural production methods, and especially, to establish agro-ecosystems that require a lower rate of external chemical inputs (Han, 1989).

Grounded in traditional ecological philosophy and practice, ecological agriculture in China seeks to find an alternative way to realize sustainable agricultural development. Parallel to and partially within the mainstream approach in agricultural development, efforts have long been made to promote practices that efficiently use locally available resources. From the late 1970s, many alternative agricultural ideas were introduced into China, which had a substantial influence on the specific Chinese articulation of sustainable agriculture. However, those alternative concepts were based mainly on the experiences and norms of Western industrial nations and, therefore, are not appropriate for China. Chinese ecological agriculture is a modern type of agriculture that combines aspects of current Western science and technology with traditional agricultural practices which have been followed by Chinese farmers for 40 centuries (King, 1911; Cheng et al., 1992). It attempts to rediscover traditional farming wisdom and incorporate it into new practices. This process involves alternatives to current conventional farming techniques and its concept and practice are quite different from the counterparts in the West. Chinese ecological agriculture promotes more ecologically rational and sustainable agricultural practices by developing technologies that substitute renewable for non-renewable resources and adapt to local ecological and cultural conditions, linking the productive processes through the use of complementary activities, and recycling by-products and residues (Shi, 2002a, b).

Traditional Agriculture: Achievements and Constraints

Chinese traditional agriculture was characterized by an intensive use of natural resources with twin objectives: achieving high short-term food production levels; and nurturing the natural resources so as not to impair the long-term production capacity (Cheng et al., 1992). Mainly due to the use of organic manures to improve soil structure and increase nourishment retention, the soil fertility has been sustained during thousands of years of cultivation (King, 1911; Wittwer et al., 1987; Netting, 1993). These kinds of practices are
still used in China today, but to a limited extent. The fact that traditional agricultural production systems have survived is a testimony to their ecological appropriateness and superiority for the conservation of fossil fuels (Needham, 1984; Martinez-Alier, 1987).

Traditional agriculture, adapted to certain social productive forces, has played an important role in the exploitation and utilization of natural resources and in the development of societies and economies. Traditional farmers have applied, though unconsciously, tenets of ecological economy and sustainable development. Bray (1992) comments that those concerned with sustainability will be struck by the system’s flexibility, and its long-term technical and political stability that accommodated steady population growth, while maintaining rural prosperity and a flowering of inter-regional commerce. Many traditional farming systems can allow for the satisfaction of local needs while also contributing to food demands on the regional or national level. Production taking place in this way is concerned more with the long-term sustainability of the system rather than solely on maximizing yield and profit (Gliessman, 1998).

Traditional agricultural practices associated with smallholder systems are an adaptation to great population pressure and scarce land resources. Farmers work small plots intensively with family labor and cannot afford to degrade the soils (Netting, 1993). However, increased population pressure on land resources, increased dependency on a commercial economy, and demand for cash incomes have brought about environmentally destructive changes in Chinese agriculture. The assumption of socio-economic and environmental equilibrium in traditional agricultural society is gradually becoming a misplaced notion. Although the expansion and further improvement of traditional agricultural practices present a real hope for sustainability, it 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 (Gliessman, 1998). It would be naive to think that traditional agriculture could be maintained or recreated in the modern era which has been dominated by specialized commodity production and a huge increase in population. In addition, traditional tools and techniques are strongly cultural-based and require an understanding of local conditions and ways of managing local energy and materials, so they are not easy to duplicate.

**Agriculture at the Crossroads: An Eco-Philosophical Retrospect**

Over the last 50 years there have been dramatic changes in Chinese agriculture. The population almost doubled between 1949 and 1976 and, consequently, the amount of cultivated land was halved on a per capita basis. In 1995, the Chinese population reached 1.2 billion, while the per capita area of cultivated land is only 0.085 ha (Zhong, 1999). In terms of water resources, there are less than 2,474 m$^3$ of river runoff for each Chinese person every year,
which is only a quarter of the world’s average. In addition, the water resources are unevenly distributed on regional and seasonal bases. Increasing chemical inputs in agriculture, coupled with recent pollutants from the rapid development of township and village enterprises, have disturbed the biophysical agro-ecosystems and in some cases reduced yields (Ash and Edmonds, 1998). Huang and Rozelle (1995) estimate that erosion, salinization, and losses of farmland may have cost China six million tonnes of grain a year. Although China has managed to feed its people (22% of the world’s population) with only 6.5% of the world’s arable land, much of this has been achieved by relying on extensive external inputs at the expense of the long-term integrity of natural resources and environment. An historical retrospect is, therefore, necessary for understanding the reasons why ecological agriculture is proposed and its relationships with traditional and conventional agriculture in China.

**Traditional Agriculture: Humans Harmonize with Nature**

Before 1949, Chinese society and economy were dominated by traditional agriculture. Almost all production was on a household scale and the small family farm occupied 84 percent of agricultural land in the 1930s (Netting, 1993, p. 210). Because food self-sufficiency has always been a priority in China, 90 percent of farm area was devoted to food grains, with only 1.1 percent being set aside for pasture (Buck, 1964, p. 268). Traditional agriculture ecosystems were solar-dominated, in that about seven times more biomass energy than other forms of energy were utilized (Martinez-Alier, 1987). Traditional agriculture was characterized as a self-sufficient natural agricultural economy oriented to subsistence and the satisfaction of basic needs. It implies the replacement of short-term self-interest with the long-term interests or welfare of society as a whole. In this process, the conviction of human-nature oneness (i.e., humans must maintain the intrinsic harmony of the natural system and conduct their affairs in respect for and cooperation with nature) played an important role.

**Conventional Agriculture: Humans Conquer Nature**

The main political ideologies of conventional agriculture have been economic development and Marxism (often with an emphasis on economic growth). As a result, higher-yielding measures, with greater external-inputs and petrochemical-based agricultural technologies, were adopted from the West to replace traditional organic agricultural practices (Cheng et al., 1992). In addition, the subordination of villages and the agricultural sector to the requirements of the urban-industrial sector results in a general disregard of local concerns. Many concrete, individual situations are reduced to one nationally or provincially average level. These new forms of social, economic, and insti-
tutional relations have ultimately altered the human-environmental relations in Chinese agriculture.

Realizing the importance of food security to political stability and social development, the Chinese government carried out a series of industrialized agricultural reforms from 1949 to 1979: the Land Reform (1949-52); the Agricultural Co-Operative Movement (1954-57); the Great Leap Forward (1958-60); and the People’s Communes (1958-79). All these policy imperatives manifested a planned economy paradigm in which the state dominates the means of production and distribution. The Chinese government collectivized agriculture. Its goals were to rationalize, mechanize, and thereby increase agrarian production; to get rid of the capitalist inequality that came from private property; and to provide more efficiently the basic social services of welfare, medical care and education (Netting, 1993). The introduction of collective agriculture permitted substantial labor investments for stabilizing and intensifying agricultural production. Traditional organic agricultural practices were steadily abandoned as chemically intensive cultivation and husbandry took over. This institutional arrangement was derived from a profoundly political conviction that equity in conjunction with higher production could not be met under systems of private property and small-scale non-mechanized farms (Hinton, 1983). Collective agriculture in China achieved better medical care, education, and some mechanization of agriculture and field consolidation, but the expected economies of scale in land use and labor mobilization, modernization of the means of production, and greater social equality did not materialize. Over the long term, China’s collective farms were unable to raise rural labor productivity or to achieve any growth in output per person for the whole Chinese population (Nolan, 1988). As Wong (1982, p. 6) argues that the decision to establish collective Chinese agriculture could only be rationalized on macroeconomic and ideological grounds.

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 dramatically contradictory to the Taoist-based production systems of the past. For example, the mechanical application of the Dazhai model in situations with inappropriate local ecological conditions was an expression of ‘dogmatic uniformity’ or an attempt to ‘cut everything with one slice of the knife’ (yi dao qie) (Shapiro, 2001). Socio-political power and the over-exploitation of the environment have a tendency to co-vary. The technological mastery combined with political domination had undermined traditional customs and cultures and had a destructive impact on the environment, which was dramatically evident during the Great Leap Forward period (1958-60).
Agriculture in Reform: Households Replace Collectives

Since 1978, Deng's pragmatism that favors short-term individual profit has gained ground. Chinese agriculture has retreated from Mao's focus upon self-reliance and collective egalitarian ideals to agricultural reforms in terms of freeing markets for outputs, abolishing collective community farming, and reintroducing family farming through the household responsibility system (HRS). These measures provided incentives to farmers to raise output and stimulated diversification away from the traditional food grains. Instead of requiring local self-sufficiency in grain, the regime allowed diverse, regionally specialized commodity production in response to market demands. In particular, the HRS restored the Chinese traditional household as the unit of surplus extraction for the state (Netting, 1993). This has, to some extent, overcome the former difficulties in creating incentives and initiatives at all levels of agriculture under Maoist collectives.

On the other hand, the HRS no longer forced farmers to conserve soil and water. Much of agricultural progress experienced after 1980 has been achieved by the mining of ecological and communal capital (Muldavin, 1996), especially in areas that have undergone agricultural modernization relying on extensive external inputs. The stagnation of China’s agriculture in the late 1980s indicated that the HRS had exhausted the potential of traditional farming methods, while the necessary conditions for modern agriculture had yet to be established (Wang, 1989). The Chinese government after 1949 emphasized increased economic growth and food output with few resource and environmental concerns. Environmental protection and conservation have continued to have a lower priority than political stability and economic growth, which resulted in long-term damage to the resource base, economy, and society. These negative influences, together with the constraints in the transition from traditional to modern agricultural practices, have made the exploration of alternative approaches imperative.

Re-Establishing Human-Natural Harmony

Chinese ecological agriculture is based on a core of traditional organic agriculture and supported by advances in modern agricultural science and technology. It emphasizes both the quality and yields of the farm products and is expected to contribute to economic development while protecting the environment (Jiang and Shu, 1996). Ecological agriculture advocates a production system with minimal agro-chemical inputs, using a range of local, natural, and social capital. It is the most promising alternative that has a sound track record for adapting safely to the increased population (Wu et al., 1989). Ecological agriculture represents an alternative practice by which ecological economics and sustainable development can be realized at the grass-roots level. It is regarded as a creative biological and living
process rather than a mechanistic technological and industrial one. In this regard, ecological agriculture systems and techniques have been developed on the basis of a holistic view of humans within the biosphere and the awareness of humans' dependence on scarce natural resources. This ecological approach to agriculture pursues a broader goal than just the economic one and pays more attention to cost reduction and efficiency.

The emphasis of traditional agriculture on sustainability and resource management, and of conventional agriculture on productivity should be combined. To some extent, ecological agriculture is not an invention of the future but a rediscovery of the past. Ecological agriculture is a synthesis of biological-organic agriculture and chemical agriculture (Ma, 1988). It is regarded as a complex and interconnected ecological economic system, so the development of the economy and the conservation of biodiversity and resources should be coordinated. As the natural ecological processes increasingly substitute for external inputs in agricultural production, its negative impacts on the environment are reduced. In addition to the full use of natural productivity in the agricultural production process, social productivity (e.g., modern science, technology, and management skill) should also be emphasised. Ecological agriculture utilizes scientific knowledge for the development of appropriate technologies (e.g., cooking with solar collectors, producing biogas from dung) and advances traditional farming practices that are applicable in site-specific situations (Wen et al., 1992). This knowledge-based farming system could reduce, if not eliminate, many of the existing capital constraints to future agricultural productivity while conserving the natural resource base and protecting the environment. To achieve effective agro-ecosystem management, human factors should be treated as integral parts of the ecosystems and their interactions given explicit consideration.

As a compound ecological-economic-social system, ecological agriculture emphasizes the coordination of relationships between agriculture and the natural environment, biodiversity, agricultural technology, economic results, and ecological integrity (Jiang and Shu, 1996). The aims of ecological agricultural systems are to promote the all-round development of farming, forestry, animal husbandry, fishery, and agro-processing industries in harmonized relationships, and they must adapted to local resources for high agricultural productivity, better conversion efficiency and sound ecological circulation. Ecological agriculture is proposed to promote integrated ecological-economic benefits for all society (Jiang and Shu, 1996; Shi, 2002b). Luo and Han (1990) identify three main objectives of 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.

CONCLUSION

If ecological economics represents the synergy of several different disciplines in the theoretical area, ecological agriculture can be considered as one example of its practical application. It requires cross-sectoral cooperation and a multidisciplinary effort, with due consideration of biophysical, socio-economic, cultural and political aspects to better understand the system’s behaviour. Chinese scholars have characterized ecological agriculture as an integrated ecological-economic-social system, designed on ecological economic principles and managed with a systems engineering approach. The application of advanced science and technology to traditional farming practice is oriented to achieve higher agricultural yields, lower production costs, and the unity of the economic, ecological and social effectiveness of agriculture.

REFERENCES


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