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# Stipulation of the criteria for the construction of eco-agricultural county in China

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**Abstract:** The criteria for the construction of an eco-agricultural county in China were suggested. The criteria should coordinate social, economic, and environmental effects together. At first, it emphasizes on the social effect input into the system, which includes population control, cultural, scientific, and moral education, technical training and so on. Secondly, economic criteria are mainly those of the increase of gross national product(GNP) and income per capita every year. Finally, the technical criteria consist of not only the grain yield, commodity percentage of the agricultural product, cultivated output/input, animal husbandry production value/total agricultural production value and other agricultural criteria, but also environmental criteria, such as the percentage of forest and grass cover, degenerated land under control, recycling of organic waste, recommended fertilization, integrated pest management, treatment of discharged wastes and others. In an eco-agricultural system, the realization of these criteria by three different development steps were recommended too.

**Key words:** criteria of eco-agriculture; indicator system of eco-agriculture; eco-agricultural indexes for assessment

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## Introduction

Now we all concern ourselves with the contemporary problems of over-population, resource exploitation, environmental pollution and ecological deterioration. Agriculture is, and always has been, an activity involving a close interaction with the environment. Ecological agriculture seems to be the key way to solve the environmental issues in agriculture. The concept of eco-agriculture implies that the agriculture system is to be conceived of and dealt with as a whole. Eco-agriculture focuses on the ecology of the whole agricultural system very broadly, encompassing agronomy, forestry, animal husbandry, sideline, fishery and much more; for example, township enterprises, mainly the rural industries. Thus, it should be classified as a branch of agriculture, focussing on more applied ecological principles.

Until now, we do not give a very clear and exact definition on eco-agriculture. The Chinese people do prefer to use the term “eco-agriculture”, rather than “agro-ecology”, as many literature concerned in western world(Lawrence, 1984; Altieri, 1987; Gliessman, 1990; Tivy, 1990). However, it can be defined in detail, as Chinese authority recommended (The Ministry of Agriculture of China, 1994; Wang, 1995), that it is a synergic blend of the modern scientific techniques and the essence of traditional agriculture in line with the local condition. It allows full play to the resource superiority of the district, in accordance with the economic development level and the principle of “entirety, coordination, cycling and renewal”. By the use of system engineering, agricultural production should be wholly programmed and rationally organized with the purpose of achieving high yield, best quality, high efficiency of the agricultural production for the sustainable development to reach benign cycling of both ecology and economy. In short, it is of primary importance that eco-agriculture should coordinate social, economic, and ecological effects together.

Eco-agriculture has been practiced in China since 1980. Many patterns have been developed in

the households, villages, countryside, farms and so on. A number of multi-type eco-agricultural experiment bases have been initially established. There have been fifty counties all over China which were confirmed by the Ministry of Agriculture of China, and other six Chinese authorities as the demonstration pilots in 1993. There are thirty-four provinces and nationality autonomous districts in China (Table 1). Every province or nationality autonomous district has 1—3 counties as demonstration pilots in the country wide, not including Tibet and Taiwan. Actually, every province has its own demonstration pilots, with 3—6 counties, in province wide (not shown in Table 1).

In China, counties are the most elementary units in the local system of administration. It has a land of about 1000—4000 km<sup>2</sup> and a population of about 0.2—0.8 millions.

At present, the development of eco-agriculture construction in China is going to proceed with vigor and flourish. There is an urgent need for methods to assess a sound eco-agricultural system. In the following contents, we will explore how this more holistic perspective can serve as the basis on eco-agricultural system and suggests the main determinants for assessment. It concerns the agriculture system very much on its ecological structure and function, its energy and material flow (including organic waste cycle), its economic efficiency, and environmental impact.

In China, Deng and Li (Deng, 1984) recommended three subsystems, namely physical, ecological, and social ones as the indicator system for assessment of eco-agriculture. Sun (Sun, 1985) suggested a comprehensive index group which consists of 22 indexes. The utilization of eco-agriculture index, including the primary, secondary, and processing production for assessment was suggested by Wang *et al.* (Wang, 1990). As a result on site research, Zhang (Zhang, 1993) summarized different comprehensive methods of assessment in four counties.

Fundamentally, we regard the eco-agricultural system as a comprehensive one. Thus, it is a complex far-ranging discipline which belongs not only to natural science and technology, but also to social science as well. In this paper, the assessment criteria are classified into three groups, i. e. social, economical, and technical criteria.

**Table 1 51 demonstration counties for the construction of the ecological agriculture in China (1994—1999)**

Provinces & main cities	Demonstration counties
Beijing	Daxing, Miyun
Tianjin	Baodi
Shanghai	Chongming
Hebei	Qianan, Guyuan
Shanxi	Hequ, Wenxi, Zhongyang
Inner Mongolia	Wengniuteqi, Hellingeer, Kelaqingi
Liaoning	Dawa, Changtu
Jilin	Fuyu, Sub. Jilin, Dehui
Heilongjiang	Baiquan, Mulan
Shandong	Linzi, Wulian, Linqu
Anhui	Shexian, Quanjiao
Jiangsu	Jiangdu, Dafeng
Zhejiang	Deqing
Jiangxi	Wuyuan
Fujian	Dongshan
Guangdong	Dongguan, Chaoan
Guangxi	Wuming, Dahua
Hunan	Cili, Changsha
Hubei	Jingshan, Honghu, Yicheng
Henan	Lankao
Shaanxi	Yanan
Gansu	Jingchuan
Ningxia	Guyuan
Sichuan	Meishan, Hongya, Dazu
Yunnan	Simao, Lufeng
Guizhou	Sinan
Xinjiang	Shawan
Hainan	Wenchang
Qinghai	Huangyuan

# 1 Social criterion

## 1.1 Population control

The population are frequently regarded as the origin of all environmental problems. Therefore, it is clear that the task will still be at hand to control the population, especially in China. At present, each family is allocated a grant for each child in big and middle cities in China, but not in countryside, minority nationalities and outlying districts. A sound eco-agricultural county must control the growth rate of the population, with not greater than 11.5% (an average in whole China, 1993).

## 1.2 Education

Giving priority to education and improving the quality of the Chinese people are the key to achieve eco-agricultural construction. A Chinese statistical material(Qu, 1992) showed that there had been about 15.9% illiteracy of the whole people(above 15 years old) and compulsory education people(primary and middle school, 9 years) about only 33% in 1990. Unfortunately, the high growth rate of the population is always associated with backward, low income, low living standard and less educated people.

Since 1978, the economic development has made great success, but not in the field of ideology and morality. It is much to be regretted that many officials and researchers put more emphasis on inputs to eco-agricultural systems, such as energy, material(in the form of capital), labor and information but not in the education, morality, including ecological ethics. The phenomena of

money worship and eager for quick success and instant benefit are prevalent. Anti-corruption and anti-degeneration still have a long way to go. Furthermore, people do not have ideas of ecological ethics(Wang, 1995). Therefore, the education means not only cultural and scientific contents, but also spiritual, disciplinary, moral and eco-ethical ones.

Criteria, including the contents just mentioned above, are of primary significance. We suggested that the construction of eco-agricultural county count about 15 years. It includes three

**Table 2 Social criteria for the construction of eco-agri cultural county in China**

	First stage, %	Second stage, %	Third stage, %
Population growth rate			
East coastal district	< 11.5*	< 1.05	< 0.95
West inland district	< 1.20	< 1.15	< 1.05
Diminish illiteracy			
East coastal district	< 10	< 8	< 5
West inland district	< 20	< 15	< 10
Compulsory education			
East coastal district	> 50%	> 70	> 90
West inland district	> 30	> 50	> 70
Occupational training and moral education			
East coastal district	> 50	> 70	> 90
West inland district	> 30	> 50	> 70

\* 1.15%, an average population growth rate in China(1993); 1.055%(1995)

stages, and each stage is about 5 year. Table 2 shows the social criteria. We have mentioned that there are many differences between the east coastal district and west inland. The economic development in east coastal district is much better than west inland. Therefore, two indexes were suggested in most of the criteria.

## 2 Total economic criterion

In measuring an economic status, two economic indexes most often used are gross national product(GNP) and income per capita in each year. GNP is the sum of the money values of all final goods and service produced by the economy during a specified period, usually one year. Therefore, GNP is a far better measure of changes in national product in a county too. World Bank promulgates its statistical GNP data of the most countries all over the world every year. Table 3 shows the suggestions of the total economic criteria for the construction of eco-agricultural county in China. However, the further detailed statistical economic indexes will be shown latter and associated with the agricultural and ecological indexes together.

## 3 Technical criterion

The technical criteria mainly include the agricultural and ecological contents, though few of them are associated with the economic efficiency together. In the whole China, big environmental problems have mainly focused on the soil erosion(water, soil loss and desertation), and a shortage of water resource in northern and inland area. For example, severe soil erosion has occurred on many deforested watersheds in Huanghe River(Yellow River) basin through thousand years and Changjiang River(Yangtze River) basin in these recent hundred years. The comprehensive harness of small watersheds have been succeeded in many Chinese regions. The percentage of grass and forest cover and degenerated land under control were suggested for assessment.

Most recently, the weather has become drier and drier in northern and inland China. Since the removal rate of ground water is faster than replenishment, ground water is being over-exploited. Waste-saving agriculture promises to be the key way to solve the shortage of water resource. It includes dry or rainfed farming, breeding drought tolerance crops, using advanced irrigation techniques, e.g. drip or sprinkler, rather than flood irrigation and so on. However, we do not have a good index for this assessment in the mean time.

The agriculture technical and ecological criteria are shown in Table 3. There are some brief discussions as follows.

### 3.1 Recycling organic waste

Fig.1 illustrates the recycling of organic waste in ecological farms in China. The system is an open one, with external sources of materials being required to ensure its continued cyclic operation. In reality, each ecological farm practices only two to three steps in the foregoing recycling system, nevertheless, they provide an

ecologically sound alternative for waste management. For example, chicken excrement after processing(occupied $\approx$ 20%) is mixed with new blended feed( $\approx$ 80%) to raise pig. Pig or cattle excrements is mixed with crop stalk to produce biogas(Fig. 1).

### 3.2 Fertilizer application

**Table 3 Total economic criterion for the construction of eco-agricultural county in China(per capita, one year, in US dollars)**

	First stage	Second stage	Third stage
Gross national product			
East coastal district	>320*	>500	>1000
West inland district	>230	>300	>500
Income			
East coastal district	>250	>360	>720
West inland district	>170	>250	>360

\* GNP 320; income 250 were an average in whole China, 1993(Almanac of China's Economy, 1994); GNP 578, 1995(Li, 1996)

Chemical fertilizer application is the key factor in the high crop yield obtained in modern intensive agriculture. However, this practice permits many losses of nitrogen from agrosystems, primary as nitrates in runoff and seepage. It contaminates surface and ground water and creates problems of eutrophication in fresh water and coastal marine areas.

Eco-agriculture focuses attention on the application of organic fertilizer, but do not refuse absolutely chemical inorganic fertilizer. Long term studies of fertilizer practice suggest the recommended fertilization. On a basis of soil test, the recommended fertilization involves: (1) a reasonable ratio of N:P:K; (2) a reasonable ratio of organic and chemical inorganic fertilizer; (3) trace elements needed; (4) crops and environment are not contaminated. In addition, it is necessary to maintain the cultivated land at a nutrient balance in accordance with different crop species, varieties, and yields needed.

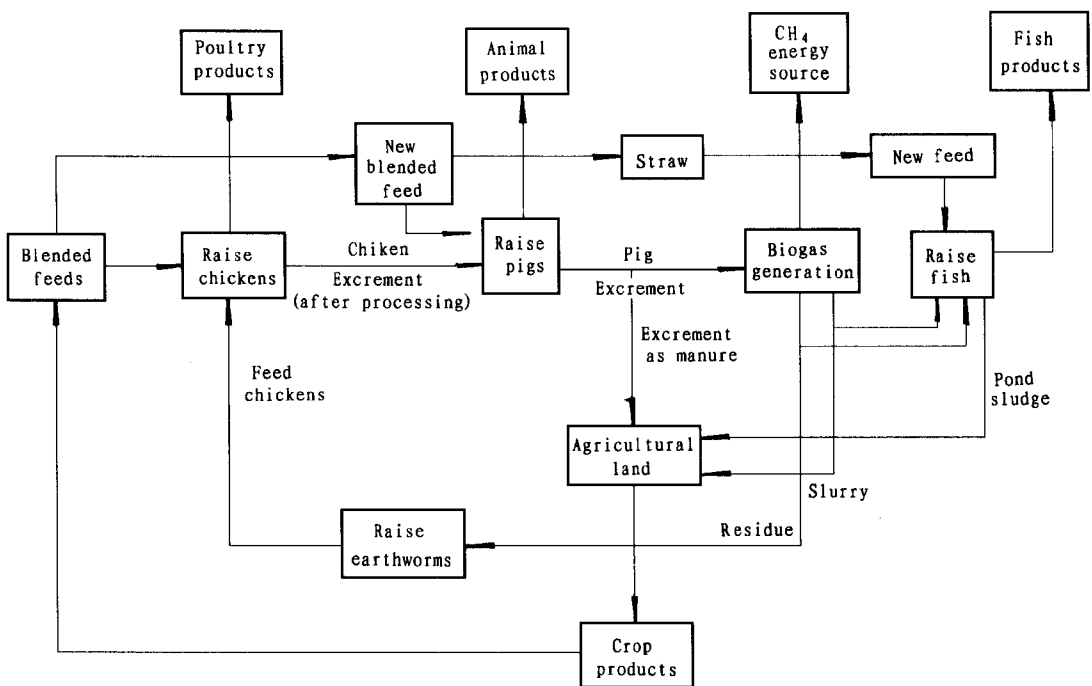


Fig.1 Recycling of organic waste in ecological farm

### 3.3 Pest control

Eco-agriculture recommends the integrated pest management(IPM). IPM stresses that it is a combination of all suitable techniques for pest control. Eco-agriculture differs from organic farming in western countries that it advocates biological control, but do not absolutely exclude the use of chemical pesticides. The value of chemicals in pest control is clearly established and it is also clear that the use of chemicals should be substantially reduced whenever possible. Obviously, it must obey the standards for safe use and regulations for safe use of pesticides. The pesticide residues in edible portion of crops should not exceed the public health criteria.

### 3.4 Animal husbandry production

Animal husbandry plays an important role in agriculture. Livestock and poultry excrements are utilized as manure for cultivation in crop fields. Thus, chemical fertilizer application can be reduced. Recycling of organic waste, including animal excrements, is traditional in China. It is

much better to have an animal production criterion. In 1993, the Chinese animal husbandry production value reached 30% of the total value of cultivation, forestry, animal husbandry, and fishery (Editorial Board of China Agricultural Yearbook, 1994). It is promising for further development to be reached a value of >50%.

### 3.5 Waste treatment

The waste treatment has been very backward in China. In 1993, the treatment percentage of waste gas, waste water (industrial and municipal) and waste solid reached 80.2%, 68.6%, 18.5% and 23.5%, respectively. The percentage of waste treatment in an eco-agricultural county should also includes the township enterprises, mainly rural industries. The percentage of waste treatment must reach, at least, or greater than average level of whole China in 1993. According to the development plan for the Ninth Five-Year Plan (1996—2000), the percentage of three wastes treatment will reach 86%, 83%, 25% and 50%, respectively (the Chinese State Planning Commission, 1994; Li, 1995). On the basis of all these, we suggest the technical criteria in Table 4.

**Table 4 Technical criterion for the construction of eco-agricultural county in China**

	First stage	Second stage	Third stage
Crop average yield, kg/hm <sup>2</sup>			
East coastal district	5000	6000	7000
West inland district	3000	4000	5000
Commercial percentage of agr. product, %	>60	>70	>80
Output/input (cultivation)	>1.6	>1.8	>1.9
Animal husbandry value/gross agr. product value*, %	>30	>40	>50
Percentage of degenerated land under control, %	>50	>70	>90
Percentage of forest & grass cover, %	>70	>80	>90
Percentage of recycling of organic waste, %	>30	>40	>50
Recommended fertilization, %	>50	>60	>80
Integrated pest management, %	>30	>50	>80
Percentage of treatment, %			
Waste gas	>80	>85	>90
Industrial waste water	>70	>80	>90
Municipal waste water	>20	>25	>30
Waste solid	>20	>50	>70

\* Gross agr. output value includes crop farming, forestry, animal husbandry and fishery output values together

## 4 Conclusion

We attempt to follow a path of scientific inquisition into how the natural system function, explore the past influences, present problems and future prospects for people and the environment. Our ultimate goal is to propose a systemic approach to the management of both on agriculture and environment with a view of improving the quality of life.

Now, we understood that the environmental problems is not only the scientific and technical, but also social and moral. Further economic development is still of great importance in developing country, but it must be sustainable.

Eco-agriculture is a comprehensive new system engineering, because it covers many topics and

makes many inter-disciplinary connections which are not generally brought out in traditional works. Research conducted over the last 15 years in China has created a reservoir of professional expertise upon which the assessment and the resolution concerns on the basis of fact. Sound eco-agricultural practices are a prerequisite in order to give assurance that further agricultural development can be accomplished without sacrifice the environment. We hope that it may prove as useful to others and that it may play some role in helping to solve our environmental problems.

## References:

- Altieri M A, 1987. *Agroecology*[M], US: Westview Press Inc.
- Deng H H, S J Li, 1984. *Environ Sci in China*[J], 4(5):37—41.
- Editorial Board of China Agricultural Yearbook, 1994. *China agricultural yearbook, 1993*[M]. Beijing: Agr Publ House.
- Gliessman S R, 1990. *Agroecology*[M], N. Y.: Springer-Verlag.
- Li P, 1996. Outline of China's Ninth-Five-Year Plan(1996—2000) for national economy and social development and long range goal to the year of 2010[N]. Beijing: People's daily, April 19:1.
- Lawrence R, B R Stinner, G J House, 1984. *Agricultural ecosystems*[M]. N. Y.: John Wiley & Sons.
- Ministry of Agriculture of China, 1994. The technical criteria for the construction of eco-agricultural demonstration pilot[S](Trial implementation). Beijing: Agr Environ & Energy Bureau, No. 3.
- Qu G P, J C Li, 1992. *Population and environment in China*[M]. Beijing: Chinese Environ Sci Publ.
- State Planning Commission of China, 1994. *China's 21 century agenda*[M]. Beijing: Chinese Environ Sci Publ.
- Sun H L, 1985. *Rural Ecological Agr*[J], 1(2):17—1.
- The Compilatory Committee of Almanac of China's Economy, 1994. *Almanac of China's Economy*[M], Beijing: Almanac of China's Economy Press.
- Wang H K, 1995. *Eco-Agr Research*[J], 3(4):13—16.
- Wang F X, Y Z Wang, W Z Xu, 1990. A study on the indicator system and method for the evaluation of eco-agricultural[M]. Beijing: Agr Publ.
- Zang S W, J J Wen, F T Qu, 1993. The theories and methods of eco-agriculture[M](Ed. by Sun H L). Jinan: Shandong Sci & Tech Publ. 253—312.

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