Journal of Environmental Sciences Vol. 11, No. 3, pp. 284—289, 1999

ISSN 1001—0742
CN 11—2629/X

Eco-county construction in China

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Abstract—The county is recognized as a basic unit for implementation of the strategy for sustainable development. A campaign for construction of eco-county has been developed all over China since the 1990s. It is aimed to enhance sustainable development capacity of the county by establishing ecologically sound production system and management mechanism through eco-engineering, eco-planning and eco-management. It is a complicated systems engineering and a combination of multi-disciplinary and needs the most extensive participation of decision makers, technicians, and farmers. Construction of eco-county consists of many important works such as survey, systems diagnosis, planning, demonstration, implementation and assessment. In this paper, we will try to summarize the current status, main models in different regions, procedure of construction, and introduce the eco-agriculture county construction in detail by taking Dazu County of Sichuan Province as an example.

Keywords: eco-county, eco-agriculture county, sustainable development, Dazu County.

1 Introduction

In China, county is the most elementary unit in administration. It has the relatively independent authorization in policy making and administrative management. In general, a county has a land area of 1000—4000 km^2 with a population of 0.2—0.8 million. Since the 1990s, county is recognized as a basic unit for implementation of the strategy for sustainable development. A campaign for construction of eco-county has been developed throughout China. Eco-county construction is aimed to enhance sustainable development capacity of the county by establishing ecologically sound production system and management mechanism through eco-engineering, eco-planning and eco-management. It is a complicated systems engineering and a combination of multi-disciplinary and needs the most extensive participation of decision-makers, technicians, and farmers and consists of many important works like survey, systems diagnosis, planning, demonstration, implementation and assessment (Li, 1995; Shi, 1991; 1993).

In order to promote the development of construction of eco-county, a leading group was jointly organized by the Ministry of Agriculture and other ministries. Based on the successful experiences in different physio-geographical and economic conditions, it combines development of models with demonstration and extension. 51 counties with a total area of 120000 km^2 were chosen as pilot sites for trail eco-county construction in 1993. According to the development plan, by the year of 2000 and 2010, about 200 and 1000 eco-agriculture counties will be constructed respectively. In addition, there are many other demonstration and experiment sites constructed by other ministries or various local governments throughout China. For example, recently two other projects have been launched. One is the construction of experimental sustainable community granted by the Ministry of Science and Technology together with other ministries and the other is the construction of ecological demonstration county organized by the State Environmental Protection Administration.

Although eco-county construction is in the primary stage, it has been playing, and will play an important role in realizing the goal of sustainable development.

2 Main development stresses in different regions

Based on the experiences gained in the pilot counties, different models should be developed and implemented in accordance with various physical and economic conditions. It can be summarized as follows (Li, 1994).

2.1 Eastern coast region

This region includes central-eastern part of Liaoning, Beijing-Tianjin-Tanggu area, eastern part of Shandong, Jiangsu, Zhejiang, Fujian and the delta of the Pearl River basin. Conservation of land resources should be the first priority in this region. The agriculture featured with high quality, high efficiency and high yield should be developed. The linkage between rural and urban ecosystems should be strengthened. The input of chemical fertilizer should be limited to a certain amount and rational exploitation of marsh land should be made in the coastal zone.

2.2 Songnen Plain region

Located in northeastern China, this region involves Heilongjiang, Jilin, the northern part of Liaoning and a small part of the Inner Mongolia. It is one of the most important bases of commercial grains and cash crops (e. g. soybeans, sugar beets etc.) as well as timber and petroleum-producing area in China. Special attention should be paid to developing agroforestry systems to strengthen the function of commercial grain base. Though the northern part of the region was only exploited in the later period, there is still a potentiality for further reclamation. The area has expanses of marshlands, which should be paid special attention during eco-county construction.

2.3 Loess Plateau region

The most distinguishing feature in the northern China is the extensive distribution of loess and loess-like deposits. Such deposits are distributed widely through Shanxi, Shaan'xi and Gansu provinces, to form famous Loess Plateau. Lack of rain, high temperature, low humidity and dry winds during crop growing season greatly affect crop yields. In addition, soil erosion is a serious problem constraining the development in this region. The main task for eco-county construction is to take measures to control soil erosion and prevent degradation of grassland along with development of production. The water-saving agriculture system should be established in the course of eco-county construction.

2.4 Huang-Huai-Hai Plain region

This region covers Haihe River Plain in the north, the Yellow River basin in the central part and Huaihe River basin in the south. This is one of the most important grain and cotton producing areas in China. The main task for eco-county construction should take integrated manipulation of drought, floods, salinization and alkalization as center through effective utilization of water resources, rational irrigation and drainage; effective use of straw and residues of crops as well as development of agro-animal husbandry co-ecosystem and so on.

2.5 South China red soil hill and low-mountain region

Lying throughout the southern part of the subtropical zone and the lower reaches of the Yangtze River basin, Hunan, Jiangxi, Zhejiang, the northern part of Zhejiang and southern part of Hubei and Anhui provinces belong to this region. The organic matters in soil decompose and leach out rapidly. The main task for construction of eco-county is to develop comprehensive models by the combination of various sectors in order to fully use the natural resources and, at the same

time, protect soil from erosion and mitigate the trends of environmental degradation.

2.6 Southwest China region

This region compromises southeast of Qinghai-Tibetan Plateau, west of Guizhou Plateau, Sichuan basin, almost all of Yunnan Province and southwestern part of Sichuan Province. Influenced by the monsoon from west and east, the weather is warm and clear in winter and the rich rainfall in summer. The main task for eco-county construction is to raise the efficiency of water and land resources through agro-ecological engineering. Special attention should be paid to introduce high value cash crops and strengthen the linkage between agriculture and processing industry so as to increase the value of commercial products.

2.7 Northwestern region

This region consists of the Xinjiang Autonomous Region, the western part of the Inner Mongolia Autonomous Region, the Gansu Corridor, the Qilian Mountains and the Chaidamu Basin in Qinghai Province. For construction of eco-county, the first priority should be given to construction of irrigation system and development of water-saving agriculture. Overall allocation and different types of combination of cereal crops, afforestation and grass-planting is particularly important. Appropriate measures for fixing sand dunesand and controlling salinity should be taken.

2.8 South China tropical region

This region encircles the southern part of Guangdong, Guangxi and Yunnan provinces in mainland, Hainan Island and a part of Taiwan. The region has richest heat and water resource in China. Protecting environment, conserving land resource and developing integrated system with the combination of agriculture, forestry, aquaculture, animal husbandry, are the goals of eco-county construction.

2.9 Qinghai-Tibetan Plateau Region

The Qinghai-Tibetan Plateau is the highest in the world and covers whole Tibetan Autonomous Region, most of Qinghai Province, the western part of Sichuan Province, northwestern part of Yunnan Province, southwestern area of Gansu Province and the southern border area of Xinjiang Uygur Autonomous Region. This region is characterized by its height and vastness with its diversity and fragility in natural conditions. The general aims for construction of eco-county are to develop regional economy through reforming the current crop orienting cultivation to three-dimension-economy by expanding the proportion of animal husbandry and forestry while strengthening natural conservation.

3 Procedure of eco-agriculture county construction

There is no universal formula applicable to all circumstances, each should be carefully examined in the context of the given conditions and prevalent environment. A strategy for the construction of an eco-agriculture county can generally be divided into the following steps: (1) preparatory work, (2) diagnosis, (3) planning and design, (4) implementation, and (5) assessment (Li, 1994; Wu, 1994; Zhang, 1995).

Preparatory work mainly includes collection of data. Data required for diagnosis and planning can generally be categorized as follows:

Physiographical data including location, elevation, soils, geology, land forms, slopes, drainage patterns, and so on; land use and cover types including forest, grass range land, cultivated lands, orchards, wildlife reservations, recreation areas, water bodies, areas under heavy erosion, and their productivity or quality, and so on; climate and hydrology including precipitation, wind, temperature, evaporation, surface runoff, streamflow, sedimentation, and so

on; socio-economic data including data about demography, land tenure, farming systems, educational infrastructures and level, human resources, farm enterprises, rural employment, production, income, marketing, traffic and transportation, credits, and so on; institutional and cultural data including policy and administration, legislation, extension services, farmer's organizations, community and private groups, traditions, religions, cultural practices, acceptance of innovations, group actions, and so on; traditional knowledge and existing models of integrated farming. Their potential and limits are particularly important for the diagnostic and design of an ecological farming system; and management-oriented data including environmental impacts, land management techniques, treatment needs, infrastructure requirements, research and training needs, unit cost, sectorial cost, cash flows, work schedule, financial arrangements, expected benefits and results, and so on.

At the diagnostic stage we shall look at how well the co-ecosystem works, its limits, problem generating syndromes and leverage points.

Physiographical problems (e.g., steep slopes, heavy rains, excessive run-off, problem soils, etc.); resource use problems (e.g., shifting cultivation, deforestation, and fire, overgrazing, uncontrolled mining, poor road construction, etc.); end problems (e.g., erosion, sedimentation, flood, water pollution, water shortage, etc.); and socio-economic and other problems (e.g., illiteracy, low acceptance of innovation, labor shortage, land tenure, poor infrastructure, etc.).

Based on the results of the diagnosis of the current production system, resources and environment status, and socio-economic conditions of the county, a planning with both meso-and long-term and short-term goals use should be made in accordance with the objectives, guidelines, hypotheses, available resources and people's acceptance, and so on. The following points should be considered in the design:

Characteristic features of the prototypes; the best overall development strategy for the development or population of the system; problems and potential to be addressed by the design; separate or combined execution of functions; locations within the landscape where these functions should be performed; species and their combinations best suited for the desired functions; number of each of the above components required to achieve the objectives of the design; precise arrangement of the plant and animal components envisaged (in space and/or in time); and management steps necessary to achieve the objectives.

Next, implementation is the very key step. In order to ensure successfully implementation of the planning, some measures are necessary which includes: to set up an authority institution which is responsible to manage and regulate the construction; to organize a effective team which should include decision makers, technicians, and farmers; to give a stress to the pilot work so that some available experiences can be summarized and popularized; and to pay attention to the capacity building by training and guiding in time.

The last step is to assess or evaluate the effectiveness of the construction that will be the basis for perfecting the original planning and making the further construction and development. Generally the assessment should abide some principles which are: (1) Integrity: Combining organically the economic benefit, ecological and social benefits will be helpful to assure the enhancing ceaselessly of agro-economic benefit, the improving continuously of agricultural ecological environment, the development of stable society, and the integrated development of farming, forestry, livestock breeding, fishery and side-line production. (2) Regionality: It means that one should assess the construction according to the local natural, economic and social conditions. (3) Dynamics: With the development the eco-county and its environment change from

time to time, so in order to evaluate effectively, the intensity, types and conditions of limiting factors of the system should be determined. Hence, the stable, harmonious, and sustainable development of the system can be achieved by adding inputs in a wise way and compensating the insufficiency of certain ecological factors.

4 A case study: Eco-county construction of Dazu County

4.1 Background

Dazu County is located in the southeastern part of Sichuan Province. It covers an area of 1390 km^2, among which 6.9 % is mountain area, 55.7 % is low hilly area and 37.4 % is middle hilly area. The population of the county is 890000. 90% of whom live in rural areas and labor forces are about 404000. The climate of the area belongs to subtropical monsoon climate with an annual accumulation temperature (>10℃) 6366℃, annual precipitation 1006 mm. The arable land of the county totals 45333 hm^2 with the average per capita 0.06 hm^2. The soil of the area is predominated by purple soil, which is relative fertile and suitable for cultivation of different kinds of crops. However, due to the soaring growth of population and irrational utilization of natural resources, the development of the county falls into a virtual circle.

In the early 1980s, an integrated survey for diagnosis and design of eco-county was carried out. It was discovered that a series of disasters were dominated in the country. These include the degradation of forest resources; increased soil erosion; degradation of soil fertility; worsening of local climate, shortage of rural energy and backward in economic development and so on.

Based on the current situations and agro-ecological principles, the county government made a general framework and concrete measures for construction of eco-county and developed some eco-agricultural models. In order to implement the development plan, some measures are essential which cover organizing a leading group and special working office, establishing experimental sites and so on.

4.2 Major models of eco-agriculture

In order to use the local natural resources and improve the ecological and economic development, many eco-agricultural models have been created and practiced. Among which are paddy rice-fish model (Fig.1), paddy rice-vegetable-vegetable/strawberry model (Fig.2) and planting-breeding-biogas model (Fig.3).

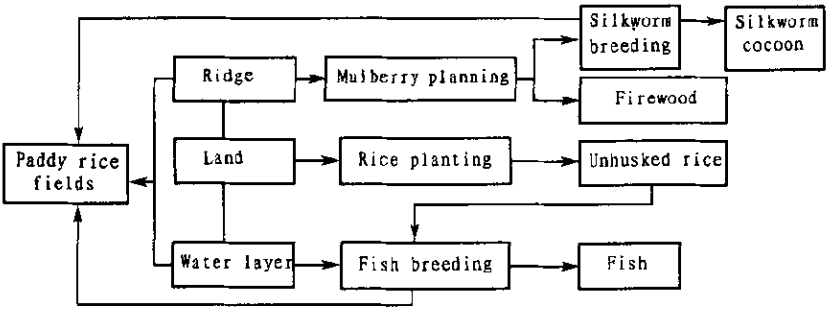

Fig.1 The model of rice-mulberry-fish ecosystem

4.3 Benefit analysis

In the process of eco-agriculture construction,. remarkable ecological, economic and social benefits were achieved.

4.3.1 Ecological benefits

Through the construction of eco-agriculture county, forest coverage was raised from 5.7% in

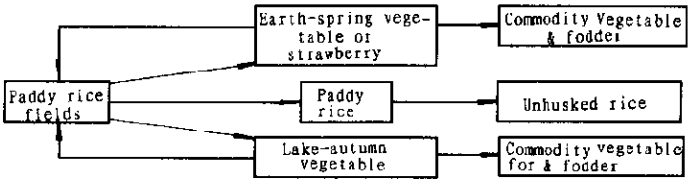

Fig. 2 The model of rice vegetable vegetable/strawberry ecosystem

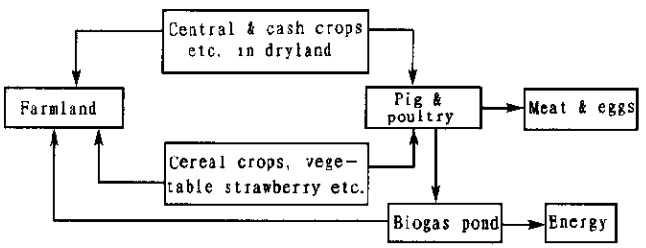

Fig. 3 The frame of planting-breeding-biogas ecosystem

1983 to 19.6% in 1993 and, thus, the atmospheric quality was also ameliorated greatly. Soil erosion was under control, sources of drinking water were managed and improved, and agricultural disaster weather is decreased.

4.3.2 Economic benefits

From 1984 to 1993, a great progress of agro-economy in Dazu County has been made. The county financial income in 1993 is about 2.5 times that of 1983. The total income of countryside's was raised as much as 5.7 times during this period. In 1993, the total production of food, fish, fruit and tung oil were increased by 22.7%, 2.7 times, 2.7 times, 9.7 times more than that of 1983, respectively.

4.3.3 Social benefits

Dazu was awarded the honor of the advanced unit of agro-environmental protection by the Ministry of Agriculture of China and was approved as one of 51 eco-agriculture counties. Many organizations and people, including many professors, specialist and students coming from over ten countries, gave their appreciation to the achievements. In addition, the construction of eco-agriculture county accelerates the exploitation of agricultural natural resources and the development of other sectors than agriculture. The ecological idea, consciousness of environmental protection is further strengthened so that the degree of scientific decision in agriculture is improved (NEPA, 1995).

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