Practice of Developing Low-carbon Leisure Agriculture in Agricultural Sci-tech Experiment and Demonstration Park: A Case Study of Xinglong Tropical Botanical Park

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Abstract The Agricultural Science and Technology Experiment and Demonstration Park, as a unique tourist scenic spot, is a new model for the development of low-carbon leisure agriculture. In this paper, with Xinglong Tropical Botanical Park as a study case, the practice of developing a model of low-carbon agricultural science and technology tourism in the park is explored. Main measures for developing low-carbon leisure agriculture in Agricultural Science and Technology Experiment and Demonstration Park are summarized, including development of low carbon attractors, construction of low carbon facilities, strengthening low-carbon management, building low-carbon environment and so on, according to analysis on the models for development of low-carbon agricultural science tourism in this park.

Key words Agricultural science, Experiment and Demonstration park, Low-carbon agriculture, Leisure agriculture, Low-carbon tourism, Practice

1 Origin and concept of low-carbon leisure agriculture

Low-carbon agriculture is an important part of low-carbon economy. Since the concept of low-carbon economy was put forward in UK in 2003 for the first time, development of low-carbon economy has become a general consensus of people around the world. Low-carbon agriculture is an agricultural economic model based on low energy consumption, low pollution, low emission and carbon sequestration. In the production process of this agriculture, fertilizer, pesticides and machines should be minimized, and irrational production and living methods shall be changed through the carbon sequestration effects of forest vegetation and plants as well as reduction of non-fossil energy emission of agriculture, so as to reduce greenhouse gas emission. Principle of "efficiency, quality and productivity" shall be followed, and production efficiency and benefits of agriculture shall be improved through science and technology methods as much as possible[1-2]. The leisure agriculture is an emerging industry which organically combines the agriculture with the tourism. It was originated from Europe in the 1930s, and rapidly developed in developed countries such as Japan, America, *etc.*, in the 1970s. In China, the leisure agriculture appeared firstly in Taiwan and Hong Kong areas and emerged in the inland cities in the 1990s such as Beijing and Chengdu, as well as rapidly developed in the beginning of the 2000s. Based on the agriculture resources including rural natural resources, rural landscapes, historic folk customs, farming culture, ecological environment and by combining with agriculture production and operation activities, the leisure agriculture takes the tourism as means and aims at leisure to elaborately create the new agriculture production and operation pattern related to agricultural technology and science and technology exhibition, farming experience and farmer life, rural tourism and leisure entertainment, ecological culture and health preserving, increases in agriculture output and farmers incomes[3-4]. Low-carbon tourism was in conformance with development of low-carbon economy, with its first concept officially proposed in the report "foray into low-carbon tourism" of the World Economic Forum held May 2009[5]. In December 2009, "advocating of low-carbon tourism pattern" was specified in the *Comments on Acceleration of Development of Tourism* issued by the State Council[6]. The low-carbon tourism is a kind of new sustainable tourism development pattern which makes use of low-carbon technology, implements the carbon sequestration mechanism and advocates the low-carbon tourism consumption during the tourism development to achieve a higher tourism experience quality and greater tourism economical, social and environmental benefits[7]. The low-carbon tourism is, in fact, the tourism response towards the development of low-carbon economy under the global climate change. It is the green travel based on low energy consumption and low pollution and advocates reducing the carbon and carbon dioxide emissions as much as possible during traveling[8]. As a product of the modern agriculture at a certain stage, the low-carbon leisure agriculture is the important expression for the modern agriculture and also the result of the low-carbon agriculture, leisure agriculture and low-carbon tourism to a certain stage upon mutual penetration and integration. By combining with the concepts of low-carbon agriculture, leisure agriculture and low-carbon tourism, the low-carbon leisure agriculture can be interpreted to be leisure-targeted, which is based on agriculture resources including rural natural resources, rural landscapes, folk customs, farming culture and ecological environment and centers on a series of agricultural production steps and the processes of tourism landscape, sales, logistic, service, *etc.* It makes use of low-carbon technology, implements the carbon sequestration mechanism and

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advocates the low-carbon tourism consumption to elaborately create the new agricultural operation pattern which is integrated with technology study and education, participation experience and farmer life, rural tourism and leisure entertainment, ecological culture and health preserving and rural prosperity and to allow the tourists to obtain psychological experience of pleasure and spiritual fulfillment when relaxed, promoting the harmony of the human being and the nature.

2 Agricultural science and technology experiment and demonstration park and low-carbon leisure agriculture

The agricultural science and technology experiment and demonstration park is a kind of comprehensive demonstration base with agricultural high-tech research and display, agriculture technology training and popularization and agricultural high-tech products conversion. Such park achieves diffusion effects via agricultural research, agricultural exhibition, technology training and results conversion, and radiates and drives the expansion of modern agricultural application to a wide range. They can promote the overall development of the entire rural areas and agriculture technology while improving the ecological environment quality and leisure entertainment quality[9]. As a kind of unique tourist scenic spot, the agricultural science and technology experiment and demonstration park is a new model for development of low-carbon leisure agriculture. The park can further enrich the meaning of leisure agriculture via development of low-carbon agriculture and promote the integration of technology, culture, tourism, zoology, economic and agriculture to expand the multifunctionity of the agriculture, improve the efficiency of leisure agriculture and promote increases in agricultural output and farmer incomes.

Established in 1957, Chinese Academy of Tropical Agricultural Sciences is located in Wanning City in southeastern region of Hainan province, covers an area of 44.3 hm^2 in agricultural science and technology demonstration bases and maintains 2 300 varieties of tropical crops (plants) resources. Since 1997, the academy has deepened the technology reform and persisted in the integration of "scientific research, product development, and science and technology demonstration". In order to create its own brands and execute the services, it named the agricultural science and technology demonstration base as "Xinglong tropical botanical park". In order to provide a better model to Hainan low-carbon leisure agriculture and ecological tourism, the academy has proposed the acceleration of development of competitive eco-industries since 2005 according to *Hainan Ecological Province Construction Plan* and combined its own characteristic to explore the low-carbon agricultural technology, which took the Xinglong tropical botanical park as the platform, the tourism as the guide, the agriculture as the basis, the technology as the support and the low-carbon economy as the major feature[10]. The academy is intended to form an agricultural experiment and demonstration park which is integrated with germplasm resources conservation, R&D, experiment, demonstration, science popularization, tourism and ecology. The park is divided into five functional zones, namely agricultural research zone, agricultural germplasm resources zones, agricultural science and technology pilot zone, agricultural science and technology exhibition zone and ecological agriculture leisure zone. Such zones are mainly designed to carry out activities including experiment and demonstration of new technology and new variety, processing pilot and development of agricultural product, technology product exhibition and sales, meeting exchanges and technology training, science and technology investigation and education, agriculture tourism and leisure, ecological culture and health preserving.

By taking the Xinglong tropical botanical park as the demonstration platform, China's unique tropical agricultural tourism brand has been formed, completing the blank space between domestic tropical agricultural technology tourism and leisure agriculture, expanding new functions and development space of unique agriculture, driving the rapid development of Hainan modern tropical agriculture and green tourism industry, promoting the close connection between the low-carbon leisure agriculture and Hainan international tourism island Hainan ecological province construction and providing a demonstration window for creation of low-carbon Hainan, ecological Hainan and leisure Hainan. Xinglong tropical botanical park receives more than 1 million tourists every year with the annual tourism revenue of above 50 million yuan. The park has been successively awarded as "National Science Popularization Education Base", "National Youth Education base", "National Rural Science Popularization Demonstration Base", "National Tourist Scenic Spot of Class AAAA", "National Agriculture Tourism Demonstration Site", "National Youth Agricultural Science Popularization Demonstration Base, *etc*[11].

3 Major measures for development of low-carbon leisure agriculture in agricultural technology experiment and demonstration park

3.1 To create low-carbon attractions and improve the attractive power of the low-carbon leisure agriculture The agriculture technology experiment and demonstration park attraction is the core for low-carbon leisure agricultural development. In order to improve the attractive power of the low-carbon leisure agriculture, the development model of tourist scenic spot shall be innovatively applied, with the natural high carbon sequestration resources including crops (plants) in such park fully excavated to improve the quality of natural tourism attraction. Meanwhile, low-carbon leisure agricultural activities which focus on low energy consumption and low loss shall be planned to create the comprehensive low-carbon tourism attraction which combines the nature with the labor.

During the practices of creating low-carbon attractions, the Xinglong tropical botanical park (1) laid emphasis on construction of domestic tropical spice and beverage crops germplasm resources park, collected and preserved the tropical plant germplasm resources park and strengthened the preservation and creative use of genetic resources; (2) constructed the breeding base for good seed of tropical spice and beverage crops, selected and bred the good seed, and strengthened the exhibition and popularization of leading varieties; (3) constructed standardization demonstration base of tropical spice and beverage crops, and strengthened the exhibition and experiment of high quality cultivation pattern, three-dimensional planting pattern, water-saving cultivation pattern, energy cultivation pattern and pollution-free agricultural production pattern for such crops, and promoted the popularization

and application of major technologies; (4) constructed the pilot processing base for tropical spice and beverage crops, made use of new high technology to develop the agricultural products with high value attached, sped up the conversion of technological results, innovated the technologies to reduce the carbon emission in the course of production and preservation of traditional roasted coffee, coconut cake, *etc.*, improved quality and competitiveness of featured agricultural products and promoted the industry update geographical indication product of Xinglong coffee; (5) constructed the tropical tourism agriculture demonstration base and science popularization demonstration base and packaged the agricultural technological experiment and demonstration park to an emerging botanical tourist scenic spot in a bid to enrich the variety of Hainan tourism products; (6) constructed the energy-saving tropical agricultural demonstration base and environmental friendly ecological tourism demonstration base, built the cycle mode of plant industry, processing industry and tourism industry and expanded the ecological protection and culture heritage of agricultural technology demonstration park.

3.2 To build low-carbon facilities and vigorously apply low-carbon technology for leisure agriculture The facilities for agriculture technology experiment and demonstration park are the cores for low-carbon leisure agricultural development. Energy – saving and emission – reduction technologies shall be vigorously applied in the experiment and demonstration park to reduce the use of resources and energies. Renewable energy utilization shall be strengthened to control the input of resources in terms of their sources and reduce the generation of pollutants. The way in which the reconstruction is made based on the low-carbon technology or the construction is carried out by directly using the low-carbon products shall be applied to improve the low-carbon technology contents and the environment quality in the park. In addition, construction of low-carbon tourism transportation, tourist facilities (tourist sanitary facilities and tourist safety facilities), shopping facilities and resources and energy supply facilities shall be highlighted.

During construction of low-carbon facilities in the Xinglong tropical botanical park, (1) the internal low-carbon tourism transportation such as parking lot, battery tour roads, pebbles, quartzite walking paths, *etc.*, have been built and featured transportation including battery tours and bikes have been used to keep the environment quality in the park. (2) There were visitor center, open – air tourist public rest facilities, plant technology exhibition and biomimetic viewing facilities in the park. Low-carbon navigation tools including E-commerce, voice guide system and ecological boot logo have been used to display and interpret the traditional culture. (3)Travel sanity facilities have been constructed in the park and sewage treatment systems including oxidation ponds have been applied to achieve the recycling of surface water; there were waste collection devices to solve the problems about agriculture and tourism wastes and to promote the recycling of the wastes; ecological toilets and garbage cans, *etc.*, have been used in the park and low-carbon technology devices have been fully used. (4) There were low-carbon tourist safety facilities in the park and the high-tech electronic monitoring systems have been used to monitor each kind of safety problems and remove safety risks; the high-tech information warning and pre-warning systems have been used to control the number of tourists to avoid the negative impact on the park. (5) Low-carbon tourism shopping facilities have been constructed in the park, where its self-produced low-carbon foods and health products including Xinglong coffee, pepper, vanilla, Ilex, cocoa , *etc.*, are sold, with plastic bags replaced by reusable shopping bags to reduce the carbon consumption and waste discharge during the goods transport. (6) There were new low-carbon tourism resources and energy supply facilities in the park, such as solar water heater used to provide hot water, solar insecticidal light used for physical prevention from pest, biogas used for lighting and other renewable energy technologies to reduce the energy consumption. (7) Low-carbon resources supply facilities have been constructed, *e. g.* blackwater horsefly and microorganisms used for disposing animal feces, versatile microbial fertilizer or high-protein animal feed. Meanwhile, biogas slurry and residue have been used to provide organic fertilizers, achieving the eco-development of the park.

3.3 To enhance the low-carbon management and improve development capacity of low-carbon leisure agriculture The agriculture technology experiment and demonstration park management is the guarantee for low-carbon leisure agricultural development. In order to enrich the tourism products with resources, features, culture and services and improve the tourists' satisfactions, the park has to improve its management and lay emphasis on quality and efficiency. The park has to standardize and implement relevant national low-carbon agriculture and low-carbon tourism policies, construct low-carbon leisure agriculture management, assessment, and popularization education mechanisms, and enhance the management of the park to improve the entire quality and sustainable development ability of the staff. During enhancement of management of low-carbon Xinglong tropical botanical park, the park (1) made clear development orientation and carried out optimization configuration, scientific planning against the tourism resources based on the eco-environment and resources to create the low-carbon agriculture leisure brand and improved the brand awareness; (2) implemented ISO9001 quality and management system and ISO14001 environmental management system standard to enhance the production and service process quality management and environmental management, improve the product (service) quality, reduce the pollution against the environment, reduce energy and resources consumption and promote the sustainable development of the park; (3) conscientiously implemented *Guidance on Further Promoting Tourism Industry Energy – Saving and Emission Reduction and* 300 *Energy – Saving and Emission Reduction Items for Scenery Sport Class A*, vigorously conducted water and electricity saving activities of high performance and soaked the energy saving and emission reduction into each aspect of operation[12]; (4) made use of guider, promotional materials, books, signs, radio, website *etc.*, publicize the concept of environmental protection, conduct low-carbon tourism education and strengthen the tourists' ecological awareness and environmental protection awareness; (5) established resource and environmental consulting feedback comments and complaints system of tourists and residents around, tried best to create low-carbon tourism atmosphere and formed conscious low-carbon travel behavior; (6) built energy saving and e-

mission reduction performance evaluation system of each departments in the parks, strengthened the follow – up check for objective responsibility and work progress to guarantee an good ecological environment in the park.

3.4 To foster low-carbon environment and advocate the consumption pattern of low-carbon leisure agriculture During fostering of the low-carbon environment, the Xinglong tropical botanical park (1) continuously enhanced introduction of professionals in the fields of agricultural biotechnology, ecology, *etc.*, and increased the eco-park control capital investment and advocated sustainable development concept; (2) developed internal low-carbon tourism transportation, reduced pollutant discharge and advocated the simple and comfortable tourism pattern of nature; (3) established pipeline direct drinking water system to achieve the direct supply of the drinking water; advocated the low-carbon travel mode without mineral water carried; (4) applied the new energy – saving environmental-friendly building materials and energy saving equipments and advocated the green building concept; (5) established shopping mode of "the park is located in front of the shops" and advocated the green foods and ecological foods which were integrated with "production, processing and sales"; (6) conducted low-carbon healthy tourism experience activities including tropical crops cultivation technique, making of flower bonsai, national fishing championship, *etc.*, and advocated the low-carbon leisure tourism; (7) used the decontaminated wastewater by aquatic plants for crops irrigation and landscape stream recycling, the leaves of turf trimmed and remainings of products processed for fish farming, the crushed dead twigs and coconut shell and waste residue from production and drinking of tea and coffee for corps production coverage, *etc.*, to advocate the waste low carbonization; (8) applied high-tech means such as low-carbon temperature and humidity control intelligent greenhouse system and pest prevention pre – warning system, *etc.*, and advocated the concept of promoting agriculture and tourism development by the modern technologies.

4 Conclusions

The development model of low-carbon leisure agriculture in Xinglong tropical botanical park provides a useful exploration in the development of low-carbon leisure agriculture in agricultural science and technology experiment and demonstration park and has an important reference significance on the development of China's low-carbon leisure agriculture. As a kind of system engineering, promotion of agricultural science and technology experiment and demonstration park to develop low-carbon leisure agriculture should seek appropriate development models based on the actual situations of the park, enhance the relation among related industries such as tourism, agro-forestry, *etc.*, speed up formation of low-carbon technology cluster and popularize the low-carbon tourism theory to better develop the demonstration model of low-carbon leisure agriculture and improve the overall competitiveness of the leisure agriculture all over the world.

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