



Research on the Construction of the Urban Wetland Park Environment based on Resource Saving and Environment Friendliness

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ABSTRACT

Wetland park is one of the city's major ecological infrastructures, undertaking the dual functions of improving the ecological environment and providing recreational places. Studying the reasonable construction methods of the wetland park is very important for its sustainable development. In this paper, a wetland park with an area of 173.5 hectares located in Zhangzhou City, Fujian Province, China is taken as an example to show how to apply the concepts and measures of resource saving and environment friendliness to the three development phases of planning, construction and management of the park. Measures of resource saving include land conservation, water resource conservation, energy conservation, vegetation optimization, application of low carbon construction techniques, indigenous materials and intelligent technologies used in management. Environment friendly measures include development intensity control, man-made wetland construction, friendly materials adoption, fibre resource using wooden plank, road building on stilts, topsoil and native vegetation protection during construction, noise control, pesticide usage reduction in management, bio-safety disposal of garbage and tourists capacity control. Resource saving and environment friendly wetland park construction can effectively promote the sustainable development of the park.

INTRODUCTION

The wetland areas in China reduce sharply due to the expansion of cities (Sun et al. 2015). This phenomenon has aroused wide concern of society, and both the government and society have reached the consensus of strengthening the protection of wetland. The wetland is known as "the kidney of the earth", which has the ecological functions of water conservation, absorbing pollutants, maintaining biological diversity, etc. It is an important ecological infrastructure of the city. There are many modes in the wetland protection. Generally, wetlands in the periphery of cities are defined as wetland reserves, which serves the main function of protecting the ecological environment in wetlands and conserving biodiversity (Bai et al. 2008). Scientific research and expedition are the main activities; most of the wetlands in the city are designated as wetland parks, in which, besides the function of the ecosystem maintenance, there are also social service functions like relaxation, recreation (Duan et al. 2011). According to the data released by the Ministry of Housing and Urban-Rural Development, up to 2013, China had owned 298 national wetland parks, which are the important components of the city ecosystem and also the important nodes of the city recreation system. The wetland is a transitional zone between the terrestrial ecological system

and aquatic ecological system, which is a unique and multifunctional ecological system (Bassi et al. 2014). The environment of the urban wetland park is sensitive; it can cause many problems if it is improperly constructed. The excessive tourism development can have a serious impact on the wetland ecological environment because of the improper function position; because of the inappropriate wetland structure construction, the water environment of wetland is hard to maintain. And because of low management efficiency, it needs to consume a lot of labour, material and finance in the management of the wetland environment (Wang et al. 2012). In order to make the construction of urban wetland park more reasonable, Chinese State Ministry of Housing and Urban-Rural Construction has made the "Planning and Design Guidelines of Urban Wetland Park" to guide the construction of urban wetland park, and some results have already been gained. However, the guide rule lacks the attention on resource saving and environment friendliness.

Resource saving and environment friendliness are the important rules to promote the social sustainable development, which are extensively applied to production, construction, circulation and consumption in every field (Wang & Huang 2011, Dong et al. 2015, Obata et al. 2006, Jing et al. 2014).

By effectively protecting and reasonably using all sorts of resources, this rule improves the utilization efficiency of resources, in order to acquire the maximum economic benefits and social benefits with the minimum resource consumption as much as possible. Resource saving aims to achieve economic, social and ecologically sustainable development through efficient utilization, rational allocation and effective protection of resources. Environment friendliness is to perfect the recycle system of renewable resources, to comprehensively promote clean production and to form an increase mode with low input, low consumption, low discharge and high efficiency according to the rules of reducing the quantization, recycle and resource.

The urban system can be divided into artificial construction system and urban ecological green space system. Resource saving and environment friendly methods are widely used in the fields such as the building construction and the municipal engineering. In wetland park construction, resource saving and environment friendliness also have a vast application prospect. This study tries to apply resource saving and environment friendly methods for the construction of urban wetland park, so as to promote the sustainable development of wetland parks.

PLANNING AREA AND PLANNING METHOD

Planning area: The wetland park is located in Huaan Economic Development Zone at Zhangzhou City, Fujian Province, China. And the project zone covers a total area of 173.5 hectares. The general objective of the wetland park construction is to effectively protect the decreasing urban wetland resources, to take full advantage of the wetland ecological function and science education function, and to improve the urban ecological environment through the wetland park construction (Fig. 1).

Planning method: The building period of urban wetland park usually consists of three stages: planning, construction and management, and every stage can be divided into

several sectors in details. Combine resource saving and environment friendly measures with construction stages together, and promote the sustainable development through integrating with the construction cycle in the whole journey. The frame of resource saving and environment friendly methods with the construction of urban wetland park are given in Table 1, which include 8 resource saving measures and 10 environment friendly measures. These measures will take effect through direct or indirect ways.

CASE STUDY

Construction Scheme

Construction goals: Effectively protect and restore wetland resources and improve ecological functions of wetlands through wetland park construction. The number of wildlife resources, especially waterfowl population will increase year by year through improving the bird habitat, protecting the biodiversity effectively. Enhance the stability, anti-interference and self-healing capabilities of the wetland ecosystem, and form the protection network system and monitoring system of the wetland. Play the ecological, economic and social benefits of the wetland parks and make a coordinated development of ecological system between the wetland and city.

Sectorization: The urban wetland park formed a layout structure of two lines and five districts on the whole (Fig. 2). Two lines: A closed main road line throughout the park and a two-meter-high elevated boardwalk line; five areas: wetland ecological conservation area, wetland science popularization education area, wetland utilizing and viewing area, wetland ecological art area and management service area.

Wetland ecological conservation area (WECA): Wetland ecological conservation area is the core area of the wetland park, which is located at both northern and southern side of the park. This area is mainly composed of vast broad waters, shallow shoals and habitat islands. This area is mainly aimed at ecological protection and cultivation of wetland, facilitating improvement of biological diversity and functional

Table 1: The construction framework of resource saving and environment friendliness of urban wetland park.

Construction phase	Resource saving measures	Environment friendly measures
Planning Phase	Construction circle coordination Land conservation Water resource conservation Energy conservation Vegetation optimization	Development intensity control Construct the man-made wetland Choosing friendly materials Using the photovoltaic resources Adopting the wooden plank road building on stilts
Construction Phase	Using low-carbon construction technology Choose local materials	Topsoil and native vegetation protection Noise control
Management Phase	Using intelligent technology	Reducing the use of pesticides Bio-safety disposal of garbage Tourists capacity control

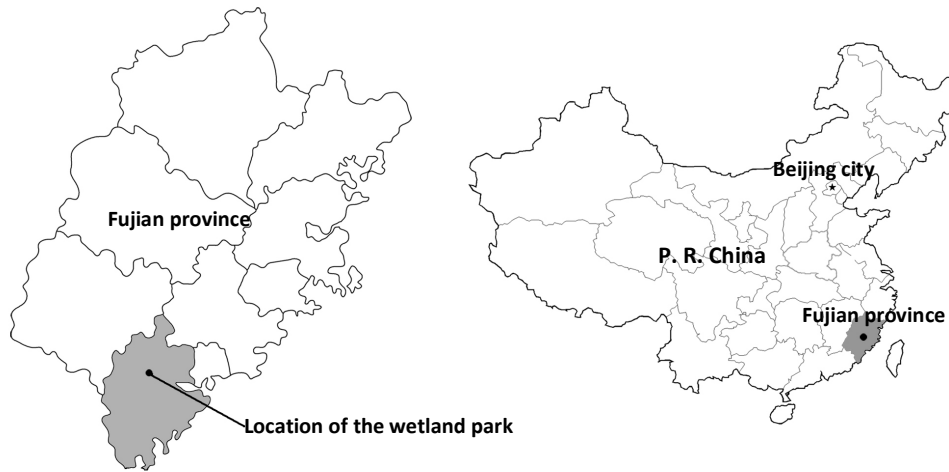


Fig. 1: The location map of the wetland park.



Fig. 2: The sectorization and general layout of wetland park.

recovery of wetland. Considering the biological habitat requirements, only those kinds of work including scientific research, protection and observation on wetland are allowed in this area.

Wetland science popularization education area (WSPEA): Wetland science popularization education area is the major place where visitors accept the science popular education. This area, through protecting or constructing the typical wetland landscape and demonstrating the wetland function and environment in the wetland museum specimens, wetland science museum and so on, makes the public understand the wetland deeply, and improves protection consciousness of the wetland and ecological environment. This area also takes on some works of the wetland research and scien-

tific experiment, of which main construction contents include wetland ecological research laboratory, waterfowl multiplying farm, the study base of ecological change rule observation and research. In this area, the activities of tourists are limited.

Wetland utilizing and viewing area (WUVA): The emphasis of wetland utilizing and viewing area is to show the water purification function, biological diversities and wetland natural landscapes of the wetland ecosystem. This area is the main area of the wetland park to reveal the wetland landscape, and it is the main place for leisure visitors, where human activities are concentrated.

Wetland ecological art area (WEAA): Wetland park construction should be coordinated with the community devel-

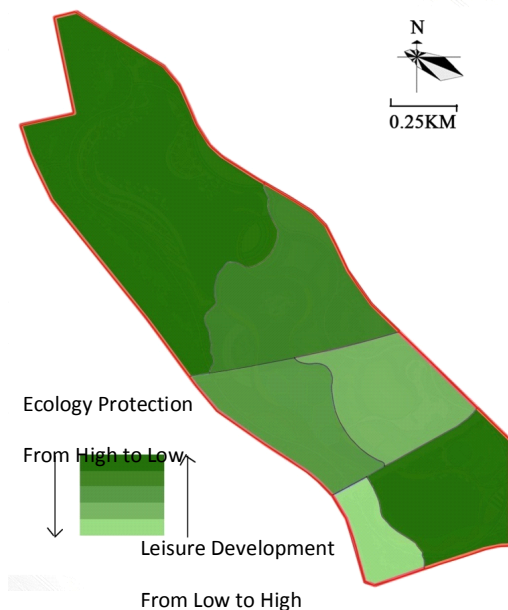


Fig. 3: Sketch map of the development intensity.

opment. This area uses the original villages to develop wetland ecological and cultural tourism. Wetland ecological art area mainly includes artist hotel, picture gallery, art gallery and other art creation places.

Management service area (MSA): The management service area is the management and reception service centre of the park and at the same time it can be used for the venue of scientific cooperation of wetlands, scientific communication, education and training and scientific studies for social, government and folk organizations. The purpose of this area is to find out problems of various kinds happening in the park on time and deal with them, as well as to promote the tourists' security and matters needing attention during the tour in the wetlands.

THE RESOURCE SAVING CONSTRUCTION IN WETLAND PARK

Land conservation planning: Land conservation planning is mainly manifested as improving the utilization of the land. Compared to the ordinary city green space, the wetland park has a higher green capacity rate and green looking rate in a same land area (Zhao et al. 2011). The green capacity rate means the total green capacity of plants in unit land area of the wetland park land. The service function and value of the ecological system can be improved by increasing the green capacity. Green looking rate means the rate of green plants among all the objects that are seen by people's eyes. Increasing green vision rate within the limited space of the wetland park can enhance the visual effect of tridimensional landscape.

Water conservation planning: Water conservation planning realizes the goal of saving water through the method which includes terrain regulation and the improvement of ground mulching. Through the terrain processing, the wetland park forms the terrain which is high on all sides and low in the middle, which collects the rainwater into the wetland to supplement the water loss of the wetland surface caused by evaporation. The earth's surface is covered with ground covers and dead leaves, which will add more rainwater infiltration as well as diminish the earth's surface water runoff, thereby fully preserving the rainwater resources (Li et al. 2012).

Energy conservation planning: Energy conservation planning plans to make full use of solar energy. All the buildings and road lighting in the park use solar energy, in order to reduce the consumption of coal and oil as well as reduce carbon emissions.

Vegetation optimization: Choose the native plants which are suitable for local growth and form wetland community system through the optimization design of vegetation structure. Through the vegetation transition from xerophytes, mesophytes, hygrophyte to aquatic plants, the ecological and aesthetic features of plant communities form.

Resource saving construction and management: Saving the resource and energy in the construction by adopting low-carbon technologies. Local construction materials, such as plant seedling and fabrications are used so as to reduce the carbon emission caused by long distance transportation, thus protecting the environment. Apply intellectual technologies to the management of wetland parks. The application of a new generation of information technologies such as internet and cloud computing as well as other tools like wiki, social networks and meta-synthesis method helps to realize comprehensive and thorough perception. Broadband-connected internet, intellectually integrated application and sustainable innovation characterized by user innovation, open innovation, mass innovation and collaborative innovation (Mattoni et al. 2015).

ENVIRONMENT FRIENDLY CONSTRUCTION OF THE WETLAND PARK

Development intensity control: The ecological environment of the wetland park is sensitive. The construction targets are protecting the wetland and promoting the public cognition to the environment of the wetland through popular science education. Therefore, it is necessary for the wetland park to control the development intensity strictly, and to control the residents' casual activities in a certain range (Fig. 3).

The construction of man-made wetlands: This wetland park adopts vertical underflow wetland to process the waste

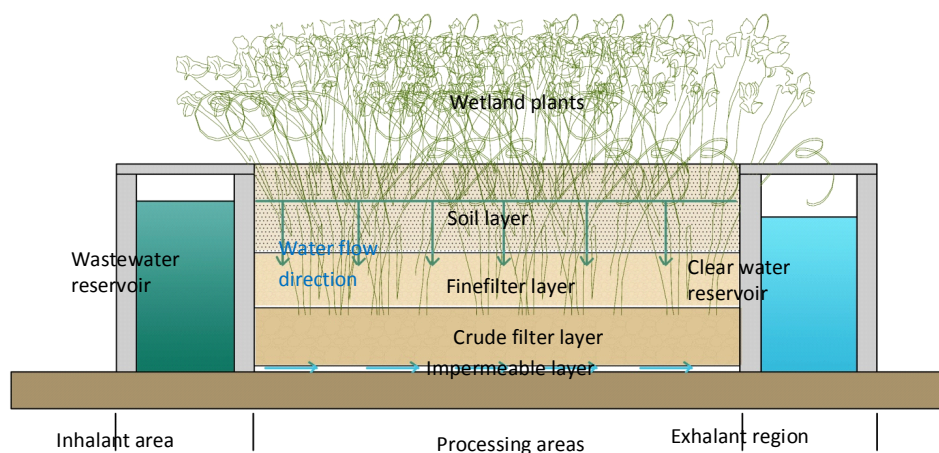


Fig. 4: Schematic diagram of vertical subsurface flow constructed wetland.

water which has been processed by the waste water process station of the surrounding industrial park (Tong et al. 2011). The system is mainly composed of inhalant region, process region, and exhalant region. The inhalant region is composed of the underground intake chamber, the water distribution system and the padding, and it is the water distribution and the primary sedimentation area of the processing system. It is mainly used to remove the suspended substances of larger particles, and has a considerable biochemical effect; the processing area was the main bed frame of the processing system. Bottom and sides are lined with PVC impervious membrane or other impervious material, the bed body is filled with cobble and gravel; the water outlet area: consisting of underground water chamber and a water outlet system (Fig. 4).

Environment friendly construction: It mainly displays in three aspects: reducing noise, and reducing the effects on wildlife, especially to birds; preserving and utilizing the native vegetation in the area as much as possible; topsoil contains microbes and nutrients needed by plant growth. Focus on stacking the topsoil and re-covering it on the surface of the earth after the completion of construction would help plant growth.

Environment friendly management: Mainly manifested in the following two aspects: conduct the pest control through biological controlling methods and minimize the use of chemical pesticides; draw up strict standards to control visitor capacity, and adopt the method of dynamic or seasonal adjustment according to the environmental change. Seasonal adjustment and control measures include the adjustment and control of the touring area, touring line, touring way and so on as well as all the other adjustments and control methods which are beneficial to protection. For ex-

ample, during the breeding period of birds, prohibit visitors' approaching to reduce the impact on birds' habitats through signs and management approaches.

The urban wetland park takes the protection and utilization of wetland as the major objective, bringing the functions of protection, recover, utilization, research, education, view and so on together, and is the important ecological infrastructure in the city. The rationality of the construction of urban wetland park has significant impact upon its sustainable development. The pack construction consists of three phases which are planning, construction and management, which lasts for a long time. Therefore, assimilating the resource saving and environment friendly conception and measures into the whole process of the wetland park construction will be beneficial in increasing the utilizing efficiency of lands, resources and energy and reducing carbon emission and environmental pollution, thus to promote the sustainable development of the wetland park.

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