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# The Construction and Practice of Ecological Villages and Aquatic Biological Systems

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**Abstract** This paper selects Xiaowangliu Village, Banquan Town, Junan County, Linyi City as the test point to explore the construction of he ecological village. The ecological village is divided into two sub-systems: land and waters. The water resource of the ecological village is divided into the village water source, village water system, village pond wetland and water resource output sub-systems. The organic waste in villages is related to the industrialization of insect resources.

**Key words** Ecological village, Water system, Biological system, Insect resource, Industrialization

## 1 Introduction

On February 5, 2017, the CPC Central Committee and the State Council released *A Number of Opinions on Further Promoting the Structural Reform of the Agricultural Supply Side and Accelerating the Cultivation of New Momentum for Rural Development*[1]. It is the 19th Central No. 1 Document with issues concerning agriculture, countryside and farmers as the theme since the reform and opening up. Since 2004, the Central No. 1 Document has focused on the issues concerning agriculture, countryside and farmers for 14 consecutive years. The construction of "three parks and one complex" is mentioned. The "three parks" refer to the agricultural industry park, science and technology park, high-tech business incubator; "one complex" refers to the pastoral complex[2]. The Central No. 1 Document stresses that the focus is to cultivate the livable characteristic villages and towns to facilitate the employment and entrepreneurship for people. Around the distinctive and promising industries with foundation, we will construct a number of characteristic villages and towns integrating agriculture, culture and tourism, improving production, living and ecology in sync, and deeply linking primary, secondary and tertiary industries.

In the arid area of north China, the water resource is an important factor restricting the sustainable development of "three parks and one complex" construction. On Earth, the oceans account for 70% of the Earth, and the sea accounts for 96% of the Earth's total water; and there is water, accounting for 3% of the total water, frozen in the south and north poles and alpine glaciers covered with snow and ice, not for direct human use; about 50% of the lakes on Earth are lagoons; the rest of the freshwater that can be used for human is only 0.5% of the total water, part of which is very difficult to develop and really use[3]. In fact, the freshwater resources that can be directly used by humans account for only 0.3% of the Earth's total water. China's total water resource volume is about 280 million $m^3$, second only to Brazil, Russia, Canada and the United States, ranking fifth in the world[4]. However, China's per capita water resources are less than one fourth of the world average, and the spatial distribution and time distribution of water resources are uneven. This shows that the shortage of China's water resources is very serious.

In order to practise the exploration of "pastoral complex", Xiaowangliu Village (Banquan Town, Junan County, Linyi City, Shandong Province) is chosen to carry out the study on the ecological village construction and aquatic biological system, in order to find the ways to solve the problems about the construction of ecological village and the use of water resource in the northern arid areas.

## 2 Overview of the village

Xiaowangliu Village, Banquan Town, is located 15 km in the west of Junan County, adjacent to Linshu County in the south, west and across the river from Hedong District. The land area is about 100 ha, and it has 326 households, 1 189 residents.

## 3 Zoning of the ecological village

In this study, the ecological village is divided into three types: living area, production area and leisure area. The living area refers to the residential area for the villagers, the production area refers to the area used for large-scale agricultural production activities, and the leisure area refers to the collective area used for public events in the living area.

In the villages, the household rubbish is divided into ternary and secondary categories[5]. The dry rubbish enters the renewable resource system, the wet rubbish and pond wetland plants are mixed and pulped to prepare insect feed (Fig. 1). After drying, physical crushing and microbial decomposing agent pretreatment, the organic waste from the production is processed into insect feed.

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Wet rubbish (wet, organic, perishable) → Environmental biological systems → Insect industry
Dry rubbish (anhydrous, inorganic, non-perishable) → Renewable pesource system → Misplaced resources
Special rubbish (toxic, harmful, easy to pollute) → Professional recycling → Harmless disposal

**Fig. 1 The ternary and secondary categories of household rubbish**

## 4 The water resource cycle system of ecological village

The water resource cycle system of ecological village is composed of the village water source, the village water network, and pond wetlands. The village water source is mainly the domestic tap water system, followed by rainwater, and the underground deep well water is used for farmland irrigation. The village water network is divided into the household garden micro-watercourse, secondary street watercourse, primary street watercourse, and the confluent watercourse linking the village watercourse and pond wetlands. The terminal consists of pond wetlands, and the waters biological system is established in the pond, and interacts with the biological system of wetlands. The terminals are large and medium-sized fast-growing aquatic plants.

As early as the industrial revolution in the mid-19th century, the rivers and lakes were polluted in the developed countries due to the discharge of waste water by factories, and some biologists began to study the impact of water pollution on aquatic organisms, followed by the study on biological monitoring and biological treatment of water pollution. In 1902, Kolkwitz and Marsson classified the micro-organisms in water, and proposed the concept of "wastewater biological systems"[6-7].

**4.1 The self-purification effect of water body** The phenomenon of naturally returning contaminated water to original water is called self-purification. If there is a pollutant discharge point for a water system, when a large number of organic pollutants enter the water system and flow down with the water, the changes as shown in Fig. 2 will occur.

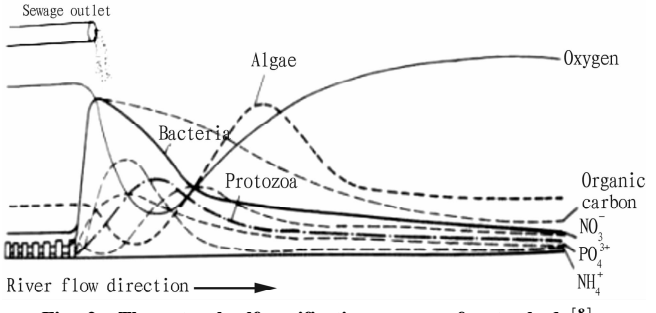


**Fig. 2 The natural self-purification process of water body[8]**

This process of change shows the following characteristics: (i) The concentration of organic pollutants changes from high to low. (ii) There are a series of changes in the biological phase of water. Firstly, the heterotrophic bacteria rapidly oxidize and decompose the organic pollutants and thus proliferate in a large number to reach the peak; then the number of protozoan with bacteria as food reach the peak; due to the mineralization of organic matter, it is conducive to the growth of algae, and the algae growth peak appears. (iii) The dissolved oxygen concentration is greatly reduced along with organic matter oxidative decomposition by the microorganisms, and soon drops to the lowest point; subsequently, due to the inorganic process of organic pollutants, the algae photosynthesis and the decrease in the number of other aerobic microorganisms, the dissolved oxygen is gradually restored to the original level.

In this way, after leaving a considerable distance from the source of pollution, the number of various microorganisms in the water, and the content of organic matter and inorganic matter, all drop to the lowest point. As a result, the water returns to its original state. This is the self-purification of water that exists in nature.

**4.2 The ability of water hyacinth to purify sewage** It is reported that NASA once explored the ability of water hyacinth to purify sewage, to solve the problem of drinking water in the U. S. space base-San Diego, California, where there was a shortage of water sources, especially with the development of large industries, the shortage of drinking water became increasingly serious, and 90% of drinking water relied on the supply of other regions. Later, people found the ability of water hyacinth to purify the sewage, and built a water hyacinth sewage purification system. The "sewage—water hyacinth—aquatic organism—water microecology" mode is established, and the system consists of six pools of 12 m long, 5 m wide and 1 – 2 m deep. A few centimeters thick pool mud is laid at the bottom of the pool for planting water hyacinth. The waste water is first filtered through the traditional filter, then one after another through six pools with lush water hyacinth and a little duckweed. Water hyacinth can not only absorb nutrient salts, nitrates, phosphates, *etc.*, but also absorb the toxic heavy metals in the water such as lead, mercury and cadmium. After the sewage as the nutritional agent is absorbed and utilized by the water hyacinth, from the fourth pool, in addition to water hyacinth in each pool, there are also aquatic animals—snails, crawfish, mosquito fish, *etc.*, which further purify the sewage by eating the organic substances in the water environment. The water from this purification system is 3 to 4 times cleaner than the water treated by the traditional purifier. This kind of water can be used for irrigation after it is filtered through the sand bed, and can be supplied to urban residents for drinking after further treatment.

## 5 The industrialization of insect resources

The saprophagous insects are selected as the production targets, to form the micro-livestock emerging industries. The types having been under large-scale production and breeding include flour weevil and *Potosia brevitarsis*. The wet rubbish in the village domestic rubbish and pond wetland plants are mixed and pulped to prepare insect feed. The flour weevil and *Potosia brevitarsis* are bred, and the perfect insect and frass are screened. After microwave drying, the insect is processed into dry insect, and the frass is prepared into the frass-based soil. In this way, driven by the industrialization of the terminal insect resource, it reversely activates the aquatic

plants, duckweed, algae—inorganic matter—organic matter—microorganisms—bacteria—organic pollutant system, thereby realizing the system from the organic pollutants to the aquatic plants, eventually to the frass transformation, and insect resource industrialization.

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and medium-sized enterprises and micro-enterprises as non-leading enterprises, attach great importance to the brand effect of the finished products in the food processing industry, carry out the brand promotion and create the brand value[14].

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