

# Experimental study on eco-environmental effects of Paddy land - drainage – Constructed wetland system

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**Abstract** Through comparing test the paddy land-drainage-constructed wetland system and the traditional paddy land drainage system, the ecological environment effects in the two modes have been analyzed and evaluated in this paper. The results showed that the ecological environment effect of the paddy-drainage-constructed wetland system is obviously better than the traditional systems and the organic matters, NH-N, COD, TN, and TP in outflow water are lower. The paddy-drainage-constructed wetland system mainly generates positive effect for the water body.

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**Keyword** Constructed wetland; paddy land; ecological environmental effects

## 1. INTRODUCTION

Water resources are comparatively scarcity in semiarid area of western Heilongjiang province, but driven by the motive of economic interests and affected by traditional cultivation, there is still a certain quantity of rice fields exist. Paddy field need more irrigation water (relatively than dry farming crops), therefore the more water flow into the paddy field (contains rainfall), besides uptake by rice and the evaporation, large quantity of water lost by soil leakage and surface runoff, finally flow into river or other irrigation area. For improving the yield of crops, farmers apply excess chemical pesticide and fertilizer, thus the great deal of unutilized chemical pesticide enter to environment, directly or indirectly affect the sustainable development of economy and human health, meanwhile have resulted the eutrophication of the lake, which forces people to pay more attention to the environmental effects that drainage water of paddy fields influence surrounding environment.

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From the ecology, wetland is composed by water, matrix of permanent or intermittent saturation state, aquatic plant and microorganism, has high productivity and larger activity, and is complex ecosystem in the area between the dry land and water area (Shihe Wang, 2007). Constructed wetland is a wetland System which is artificial construction, controllable and engineering, which design and construction is an optimum combination of the physical, chemical and biological effect for waste water treatment (Baozhen Wang et al, 2004).

## 2. GENERAL SITUATION OF TEST AREA

Experimental station of paddy irrigation located in Beilin district in central south Suihua city, on the northern bank of Hulan River, subordinate to Xingfu Irrigation irrigation water source is from water Hulan river, supplementary irrigation by well water during the drought occurred. For multi-annual average temperature is 2.3°C. The effective accumulated temperature is 2508.7°C. During rice growth (April to September), the sunshine is 1295.8 hours, the

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precipitation is 471.1mm, evaporation is 1349.9 mm, and frostless period is 114-149 days. The basic fertility: organic matter is 2.01%, TN is 0.101%, available nitrogen is 9.853ppm, available P is 17.3ppm, available K173.6ppm, PH Value of 7.7, saturated water content is 45.3 percent, and soil texture is loam.

**3. RESEARCH METHOD**

**3.1 Experiment design**

The Paddy land - drainage - Constructed wetland system includes a paddy land about 0.3 ha, a constructed wetland 16.0m × 4.0m, and a pool 2.0m × 4.0m. The three parts were connected by drainage channel and pipers. In order to collect drainage water the drainage pipers have been lie in the paddy land and drain the water into wetland and then into the pool. According to the north climatic characteristics, the wetland system is designed impermeable layer in the bottom, planting local reed in wetland. The schematic diagram of the system is shown in figure 1.

**3.2 Observation method**

The determination standard is COD, TN, TP, NH<sub>4</sub><sup>+</sup>-N and PO<sub>4</sub>-P. The determinative instrument is ET99730 that fast water quality measuring instrument of microcomputer and multi-parameter, the ammonia nitrogen determined by salicylic acid method, COD by sulfuric acid method, TN by per sulfate digestion

method, TP and PO<sub>4</sub>-P by molybdate law.

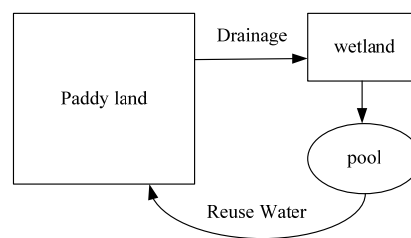


Fig. 1 The paddy – drainage – wetland system

**4. TEST RESULTS AND ANALYSIS**

**4.1 The environmental quality effect of the system**

Because drainage way is different, corresponding different water concentration、pollution loads of rice fields emission , the degree in influencing surrounding water environmental quality is different.

**4.2 Effect of the field drainage water quality**

Field drainage mainly includes seasonal drainage and forcing drainage, such as the drainage in land drying of later tilling stage, “running water” after rice milking as the seasonal drainage, and drainage caused by storm rainfall is belong to forcing drainage.

**Table 1 the analysis of drainage water quality (mg/L)**

	I (July 2—July 8)							II (July 2—July 8)						
NH <sub>4</sub> -N	2.25	1.9	4.9	3.0	8.2	12	3.8	3.9	3.8	7	5.4	11	14	6.2
COD	105	69	111	40	23	12	11	156	141	135	98	83	92	46
TN	3.45	4.1	11	6.9	10	15	4.3	7.2	11	14	14	15	20	8.6
TP	0.8	0.4	0.8	0.9	0.6	1.5	1.3	1.2	2.5	2.9	2.6	4.9	1.8	2.3

I—the “Paddy field - drainage - constructed wetland system”

II—the traditional paddy field drainage system

From Table 1 we can see that, the drainage concentration of the “paddy land - drainage - constructed wetland” system is far lower than traditional paddy field drainage system.

The constructed wetland system reduces the emission concentration of nitrogen, phosphorus, which removes organic compounds mainly depends on ammonification, nitrification and de-nitrification, on absorption and evapor-transpiration of plants, on absorption, filtration, and precipitation of matrix and volatilization of ammonia.

#### 4.3 Effect of field Emission pollution load

Field emission pollution load can immediately reflect effect of water environment quality in two emission models. The load value of nitrogen, phosphorus and organic compound is shown in table 2. The analysis shows that discharge load of II is more than I.

#### 4.4 Effect of the net load of field emission pollutant

The net loads of field emission pollutants are different between field emission and irrigation input. When the net load is a positive, it shows that the fields contribute contaminant to water, therefore, the higher level of the net load is, the more serious pollution degree of surrounding water is. If the value is negative, it presents the fields absorb the contaminant; therefore the system exerts the effects of purification ability (Shizong Zheng et al, 2006).

The results show that the net load of TN, TP, phosphate, and COD emitted from the “paddy land - drainage - constructed wetland system is positive. This means that the water from the system cause pollution. The results showed that TN, TP, phosphate and COD for vicinal water in the “paddy land - drainage - constructed wetland” system of field. By contrast with paddy field, the net load of paddy field is higher than the “paddy land - drainage - constructed wetland” system. Therefore the results present that direct drainage caused more pollution degree to surrounding water, as table 2.

**Table 2 the discharge load of pollutants in paddy drainage**

Time	NH <sub>4</sub> -N			COD			TN		
	I	II	Ratio	I	II	Ratio	I	II	Ratio
	g/hm <sup>2</sup>			g/hm <sup>2</sup>			g/hm <sup>2</sup>		
July 2	3149.3	5460	1.7	146966	218400	1.5	4828.6	10077	2.1
July 3	2659.4	5320	2.0	96577	197400	2.0	5738.4	15396	2.7
July 4	6858.4	9800	1.4	155364	189000	1.2	15395	19594	1.3
July 5	4199.0	7560	1.8	55987	137200	2.5	9657.4	19594	2.0
July 6	11477.3	15400	1.3	32192	116200	3.6	13996	20994	1.5
July 7	16796.2	19600	1.2	16796	128800	7.7	20994	27992	1.3
July 8	5318.8	8680	1.6	15396	64400	4.2	6018.3	12037	2.0
total	50458.4	57680	1.1	519278	1051400	2.0	766277	125684	2.1

Continued table

Time	TP			PO <sub>4</sub> -P		
	I	II	Ratio	I	II	Ratio
	g/hm <sup>2</sup>			g/hm <sup>2</sup>		
July 2	1119.8	1680	1.5	4199	8398	2.0
July 3	555.5	3500	6.3	4199	6366	1.5
July 4	1119.8	4060	3.6	2799	3919	1.4
July 5	1259.7	3640	2.9	2799	5878	2.15
July 6	839.8	6860	8.2	1819	2659	1.5
July 7	2099	2520	1.2	1679	2099	1.3
July 8	1819.6	3220	1.8	1399	1959	1.4
total	8813.2	25480	2.9	18893	31278	1.7

## 5. CONCLUSIONS

The research result shows that, the discharge from paddy field was purified by the “paddy land - drainage – constructed wetland” system, the concentration of nitrogen, phosphorus and organic pollutant decrease significantly, while the emission load and pollution degree of TN, TP, phosphate and COD are all less than in only paddy field.

Therefore, the eco-environmental effect of the “paddy land - drainage – constructed wetland” system is mainly positive.

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