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Nonpoint source nutrient load from a subcatchment with a rice cultivation and multipond system

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Abstract — A small subwatershed of Chaohu Lake was chosen for research on the relationships of landuse, nonpoint source pollution and its prevention. The distributions of nitrogen and phosphorus in the different land use types were shown by monitoring N and P in water samples from rainfall, surface runoff, ponds, a stream and the lake, and in soil samples from rice fields, nonirrigated land and mountain forests. A multi-pond agroecosystem was found to prevent the nonpoint source pollutants and sediment loading to eutrophic Chaohu Lake from its catchment area, because this multi-pond system can effectively keep water and nutrients inside the catchment area and be reused to irrigate the rice field. It requires only a small investment and energy consumption, and that is suitable for this large under-development agricultural watershed.

Keywords: nonpoint source pollution; land use; lake eutrophication; agroecosystem.

INTRODUCTION

Lake eutrophication is one of the most important environmental problems. The restoration methods of eutrophic lake are focused on nutrient load control within the watershed. But nonpoint source pollution from agricultural land use is quite difficult to reduce. There are three types of nonpoint source pollution controlling approaches: (1) Source control measures including zoning and erosion control practices; (2) Pollutant delivery reduction, pollutant collection and removal; (3) Physical, chemical and biological treatment.

In comparing these three methods, the first one can prevent non-point source pollutants from leaving the source area and requires low capital investment. The other two methods require engineering struction as well as high technology and much more financial support is needed. According to the economic situation in China, a suitable and practical nonpoint source pollution controlling method can only be found from optional agricultural land use and watershed management. During the researches on Chaohu Lake eutrophication, it was found that a multipond-rice field agroecosystem can efficiently trap the N, P nutrients and sediments, and meanwhile maintaining agricultural development.

AGROECOSYSTEM IN LIUCHAHE SUBWATERSHED

1. Structure of the agroecosystem

Liuchahe subwatershed is chosen as a case study. It is located near Zhongmiao Village at the northern bank of Chaohu Lake. This sub-watershed has an area of 732 hectares and resident population of about 3000 distributed in 16 small villages.

There are lower mountains, hillocks and plains connected by a canal to Chaohu Lake. The highest elevation in this subwatershed is 174.2 m. According to the Digital Relief Model (DRM), the landform is classified into types: Chaohu Lake water level with elevation of 5.5m, lower plain 5.5 – 10, higher plain 10 – 20, lower hillocks 20 – 35, higher hillocks 35 – 50, lower mountains 50 – 100, higher mountains 100 – 200.

The exist five soil groups in Liuchahe subwatershed. Burozen is distributed in rocky hill areas; yellow-brown earth in hillocks and mounds; paddy soil in the saddle part of two mounds, alluvial, fluvial and lake sedimentary plains. Because of soil erosion and the influence of parent materials, two types of lithological soil, limestone soil and purple soil, appear in this subwatershed with a small distribution area. Yellow-brown earth is the main soil type and its parent material belongs to a kind of loessal deposit which was formed in the late Quaternary Period (system)-Pleistocene Epoch (Series). The characteristics of these parent materials are shown in Table 1.

Table 1 Characteristics of soil parent materials

Parent materials	Texture	pH	TN, %	TP, %	TK, %	OM, %
Lake sediment	Loam	7.3	0.0063	0.022	1.60	0.92
Loessal deposit	Clay	6.9	0.062	0.024	1.75	0.76
Fluvial deposit	Clay	7.6	0.055	0.046	1.63	0.55
Alluvial from limestone hill	Loam	7.3	0.095	0.076	2.10	1.08
Purple sandstone deposit	Silty loam	6.0	0.031	0.017	1.10	0.04

Table 2 Land use composition in Liuchahe watershed

Type	Area, ha	Percentage, %
Village	52.24	7.14
Pond	35.54	4.86
Forest	131.02	17.89
Nonirrigated land	228.92	31.27
Rice field	284.28	38.84
Total	732.00	100.00

The agroecosystem is composed of five types of land use in the Liuchahe watershed. The distribution and composition of these land use types are shown in Fig. 1 and Table 2. The structure of land use is strongly influenced by geomorphological and hydrological conditions. The forestry area is on a low mountain; the nonirrigated farmland is situated on mounds; the villages are normally around the top of mounds; the rice fields and ponds are located on the plain or in the saddle part between two mounds.

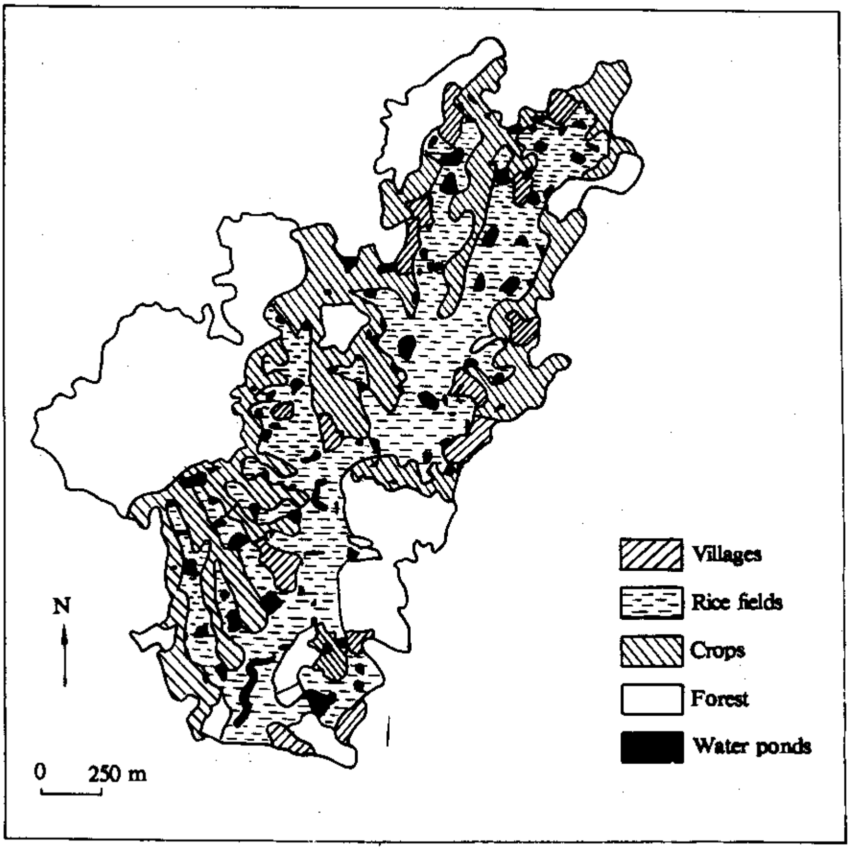

Fig. 1 Land use in Liuchahe subwatershed

2. Characteristics of agroecosystem

There are two characteristics of agroecosystems in this subwatershed. One is small-scale farming and self-sufficient agriculture. Another is rice field-pond cascade irrigation system.

(1) Small scale and self-sufficient agroecosystem

In former times agriculture and fishery coexisted in this area , but nowadays only few families fish in part time because fishery resources decreased rapidly in Chaohu Lake due to various resources such as eutrophication, overfishing and unreasonal hydraulic engineering which control the fish immigration between Chaohu Lake and the Yangtze River by two sluices. Because of unfavorable conditions for fishery and industry in this area, more attention was paid to intensive agricultural land use in the catchment area. In irrigated wet field, a triple cropping system was set up with early rice as the first harvest, late rice as the second and rape (green manure or wheat) as the third. Nonirrigated farmlands were cultivated with wheat, cotton, potato, sweet potato, small parts of corn, soybean and vegetables all year round, one after another without allowing the land to lie fallow. Usually chemical fertilizers, such as NH_4HCO_3, $Ca(H_2PO_4)_2$, and urea are applied in rice fields. Farmyard manure from daily life sewage, domestic livestock and poultry are collected and accumulated for nonirrigated farm land. Since each family has one or two pigs, several chickens, ducks and rabbits, sometimes a day, and two or three families share one cow or a buffalo for plowing and harrowing the fields, manure is readily available. The agroecosystem is shown at Fig. 2.

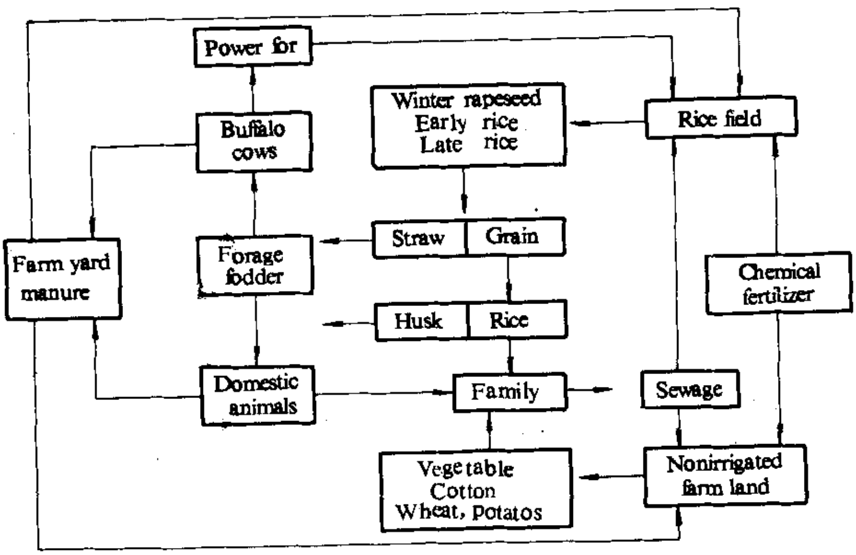

Fig. 2 Small-scale and self-sufficient agroecosystem

(2) The pond-rice field cascade system

Rice is wetland crop which needs irrigation frequently in order to obtain higher yield. Therefore an irrigation network system which is composed of ponds, ditches, reservoirs and canals was created by farmers. In the Liuchahe subwatershed, the rice fields are rainfed and irrigated by water from a series of artificial ponds which were built at suitable positions convenient for terrace irrigation. Rich fields and ponds are formed in cascades along the terrace (Fig. 3). The pond-rice field cascade system is typical for the whole watershed of Chaohu Lake as well as the Liuchahe subwatershed. The natural and social-economic conditions in this subwatershed agroecosystem are typical for the rural area in the whole Chaohu Lake watershed. Agriculture land use structures and characteristics are the dominant factors which influence the nutrients and sediment input from the catchment area to eutrophic Chaohu Lake.

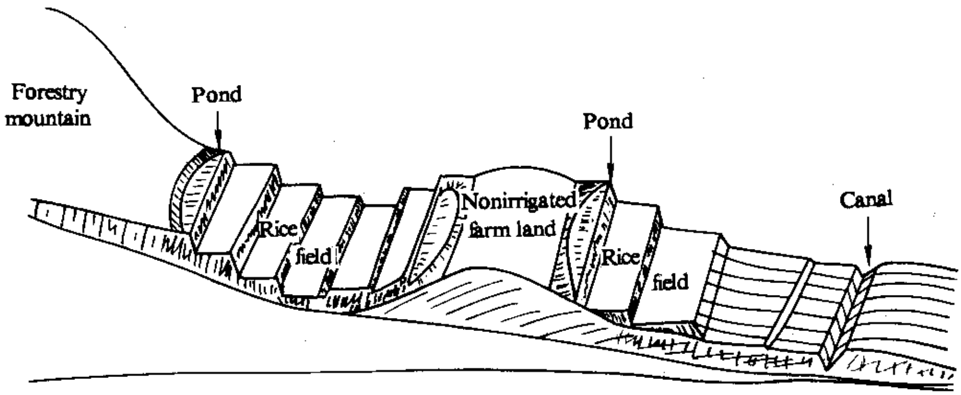

Fig. 3 Pond-rice field cascade system

NONPOINT POLLUTION FROM LAND USE OF AGROECOSYSTEM

1. Land use and nonpoint pollution

As for land use and nonpoint pollution, there are two aspects which must be taken into consideration: (1) type and intensity of land use; (2) generation and quantity of nonpoint pollutants. Therefore, description, diagnosis, identification and estimation of nonpoint source pollutants from different land use type must be known, available prior to the enactment of lake restoration measures as well as to the implementation of nonpoint pollutant controlling approaches. The effort can then be directed to the significant sources and land use types within the watershed.

After one year of monitoring of N, P nutrients in different land use type within the Liuchahe subwatershed, the effects of different land use on nonpoint source pollution were evaluated. From Fig. 4 it is known that:

(1) The rice field is a potential land use type for nonpoint pollution especially in May and August. Therefore are high concentrations of N, P in the water layer of rice fields with TN range from 0.2 – 107 mg/L and TP 0.05 – 0.75 mg/L.

(2) The vegetable field is the second important land use type for nonpoint source pollution. Normally each family has one or two pieces of land to plant vegetables for daily consumption. Liquid household manure, such as dung, is often applied, so that the soil and its surface runoff content is higher in N , P nutrients . Because the vegetable fields occupy only a small

portion of land use area, its involvement on nonpoint source pollution is limited.

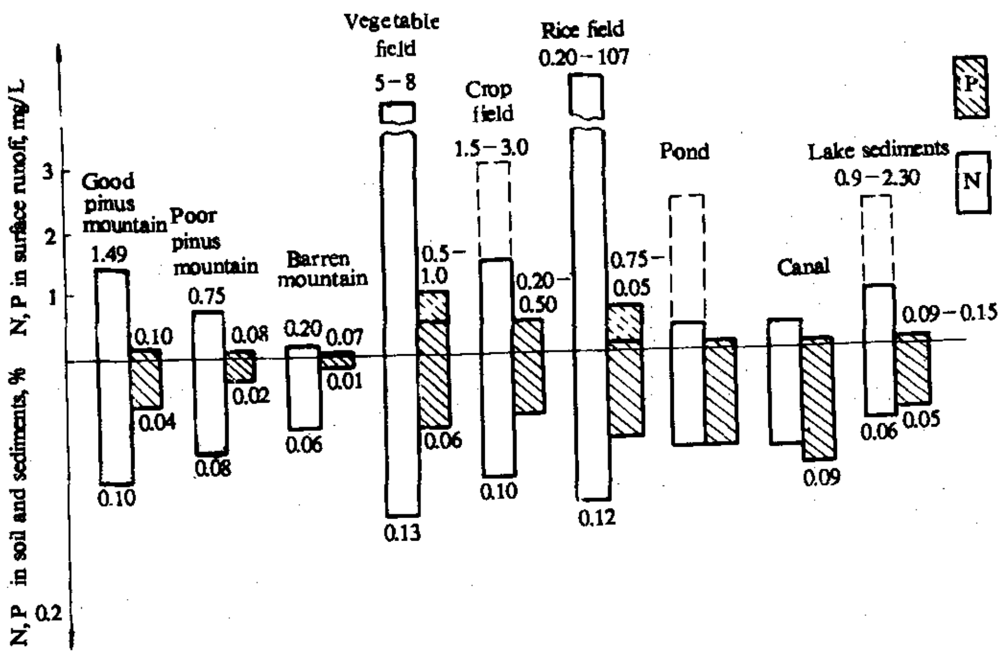

Fig. 4 N, P in different land use types and their effects on nonpoint source pollution

(3) The nonirrigated farmland must be emphasized because it generates most of sediment from soil erosion. The amount of eroded pollutants and sediments is strongly related to fertilizers and crop growth stages. Because farmyard manure is used to fertilize these nonirrigated fields before crop transplanting, the period on the connection and transition between one crop and the next is critical for fertilizer loss.

(4) The nonpoint source pollution from mountain forests is determined by forest coverage. The mountain with good pines coverage has lower N, P concentrations in the surface runoff than the bareen one.

(5) Quite lower N, P concentrations appear in pond and canal runoff, even lower than the N, P concentrations in Chaohu Lake.

2. The rice and its influence on nonpoint source pollution

The triple cropping system has existed in rice fields since the 1970s with period of early rice (from early May to late July) —late rice (from early August to early November) —rape (from late November to late April). Because of intensive cultivation, increasingly more chemical fertilizers such as NH_4HCO_3, $Ca(H_2PO_4)_2$ and urea are being applied to rice fields with 60−90 kg/ha N-fertilizer; 24−36 kg/ha P-fertilizer for early rice and 120−180 kg/ha N-fertilizer, 46−72 kg/ha P-fertilizer for late rice. Manure is only applied to early rice.

(1) Early rice

All of the farmyard manures and chemical fertilizers were applied and incorporated in paddy soil while the fields were plowed and harrowed one or two days before early rice seedling transplantation. The highest nutrient concentrations of TN 30−107 mg/L and TP 0.2−0.75 mg/L appears in surface water layer of rice fields during this time. If the fertilizer is urea, the highest concentration of TN appear 2−3 days later. If $(NH_4)HCO_3$ or $(NH_4)_2SO_4$ is applied, the highest concentration happen at the same day of fertilizer application. After one week, assimilation of N and P by rice takes place while the transplanted rice seedling turns green. After the end of the booting and tillering stages in late May, TN is about 0.8−1.5 mg/L and TP 0.1−0.2 mg/L. From the middle of June to early July it is time for the heading and flowering stages. During this period, a lot of nutrients are needed and the TN is about 0.5−0.8 mg/L while the TP is 0.03−0.08 mg/L. At the manure stage after the middle of July, the nutrient requirement of early rice decrease. But during this time the higher temperature and lower water layer contribute more nutrient mineralization. Therefore TN rises to 1.1−2.3 mg/L and TP to 0.1−0.15 mg/L (Fig. 5 and Fig. 6).

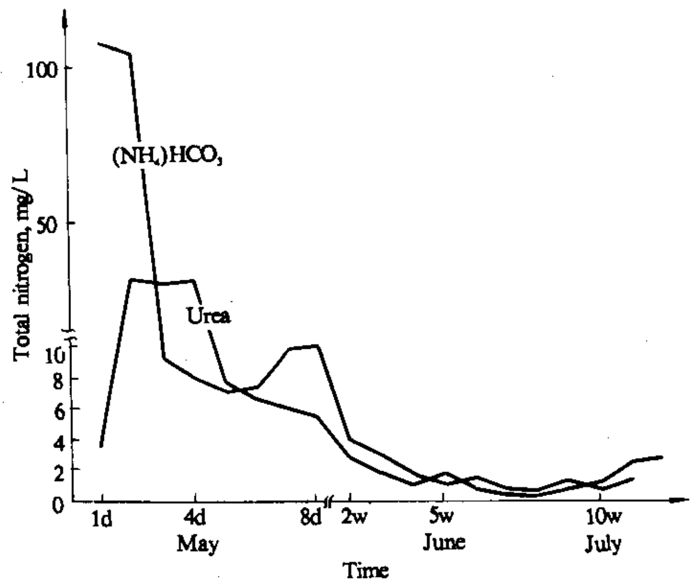

Fig. 5 Total nitrogen (TN) in flooding water layer of rice field

(2) Late rice

Only chemical fertilizers are applied to late rice during or several days after late rice seedling transplantation. Normally 375 kg/ha $(NH_4)HCO_3$ and 375 kg/ha $Ca(H_2PO_4)_2$ or only 150 kg/ha urea are applied so that the concentrations of TN and TP are as high as TN 40–50 mg/L and TP 0.4–0.6 mg/L in the surface water layer. But after one week the TN decreases to 4–5 mg/L and TP to 0.2–0.4 mg/L. From middle to late August when the late rice

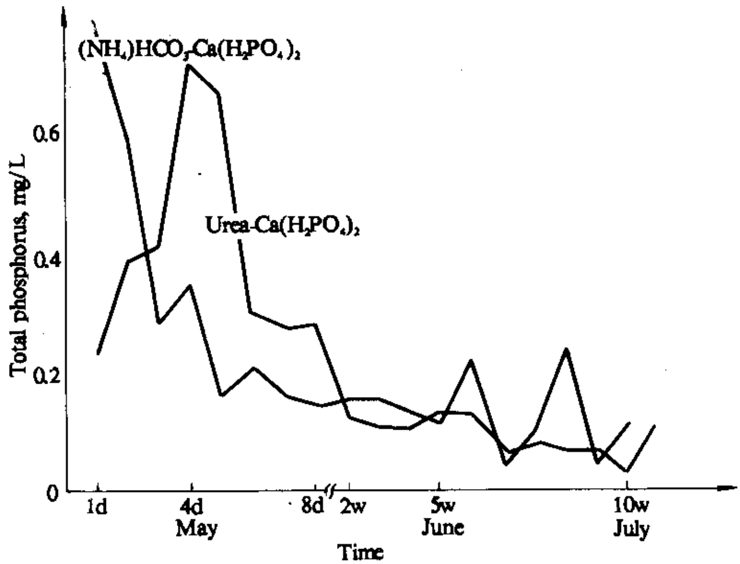

Fig. 6 Total phosphorus (TP) in flooding water layer of rice field

is at its booting and tillery stages, assimilation is great. If there is no top-dressing fertilizers, then the TN decreases to 2 mg/L and the TP to 0.2 mg/L. If the fertilizer is sufficient, 75–170 kg/ha of chemical fertilizers is used for top-dressing, then the TN is raised to 6–15 mg/L and TP 0.2–0.5 mg/L. After the heading and flowering in September the TN is again lower than 2 mg/L and the TP under 0.1 mg/L.

From the N, P nutrient dynamic changes, it is evident that fertilizing is the most important factor which influences the N, P nutrient concentrations in the flood water layer of a rice field. It is certain that these high concentrations may cause heavy nonpoint source pollution through ammonia volatilization, denitrification, surface runoff and percolation. It is indicated that to apply fertilizers in suitable quantities and with appropriate methods at proper times is still the best way to enhance the fertilizer utilization ratio and increase the rice grain yield economically, and at the same time to lower the nutrient concentrations in flood water layers, decrease the nutrient loss and nonpoint source pollution by discharge, percolation, volatilization and denitrification from the surface water layer of rice fields.

3. Groundwater pollution and land use

Becase there is no sewage system in the village, every family collects its own and farmyard refuses as organic fertilizers and return them to the fields. Only a small part of these refuses are washed away from village and discharged into nearby agricultural fields during rainfall. The concentrations of total nitrogen and total phosphorus in surface runoff from villages are about 5.0 – 37.0 mg/L and 0.2 – 2.5 mg/L, respectively. The main environmental problems are bad odor and groundwater pollution. Fig. 7 shows the concentrations of nitrogen in water samples from different wells. The highest TN concentration measured reaches 16.42 mg/L.

The rainfall from Sept. 8 – 9 was 30 mm, from Sept. 13 – 14 was 18.8 mm and Sept. 22 – 23 was 17.3 mm. These rainfall caused the increase of nitrogen concentration in the groundwater.

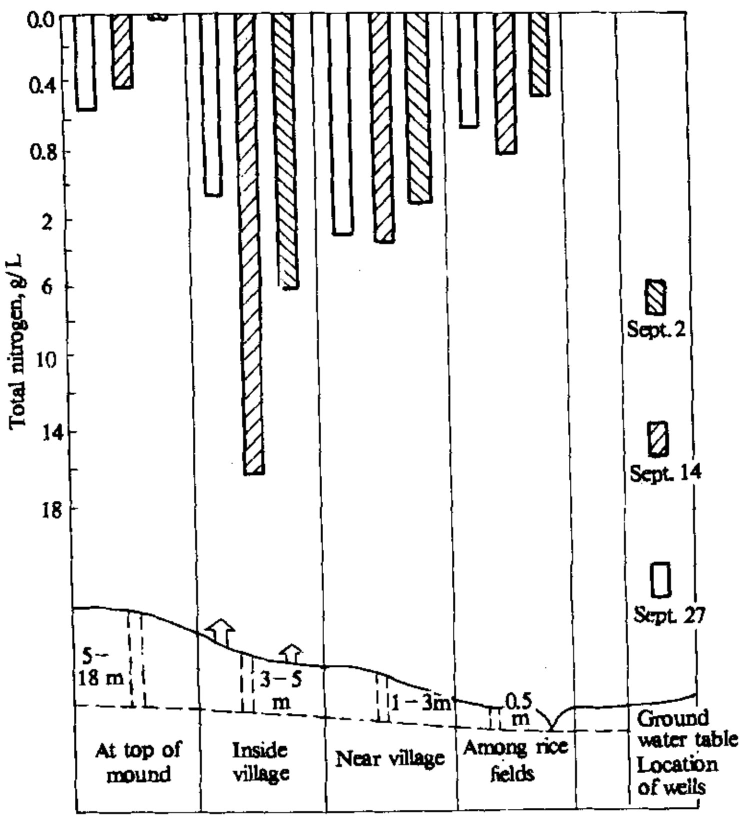

Fig. 7 Groundwater pollution and land use

NONPOINT SOURCE POLLUTION CONTROLLED BY MULTI-POND AGROECOSYSTEM

There are 150 artificial ponds inside this small watershed with a surface area of 35.54

hectares which is 4.86% of the whole catchment area. The function of all these ponds is to store rainfall and to irrigate the rice fields. One or two ponds near the village are mainly used for washing. Only a few ponds are especially for fishery.

It is found by our experiments that these ponds are important not only for their agricultural use, but also for their interception of runoff, storage nutrients and sedimentation. They evidently decrease and efficiently control the nonpoint source pollution loadings from this catchment area to Chaohu Lake , since the ponds enlarge the watershed water storage and buffer capacity in response to rainfall events.

1. Water and matter dynamic in the multi-pond agroecosystem

The schematic diagram of nutrient flow and cycling is shown in Fig. 8. The runoff water with eroded material first enters the ponds at a higher elevation. This water can be used by surrounding lands for irrigation while drainage water flows back to the pond or to a pond at a lower elevation. Since rice usually needs irrigation frequently, water in the system is reduced several times before it reaches the main river channel.

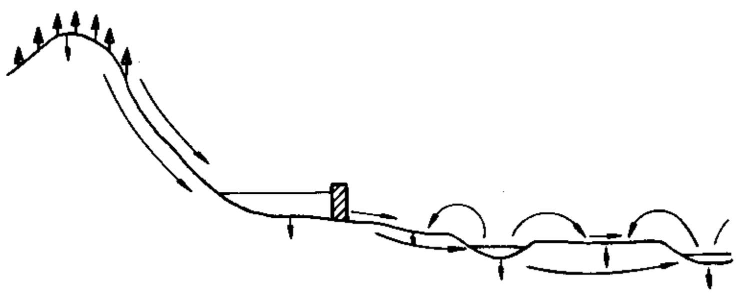

Fig. 8 Water and matter dynamic in multi-pond agroecosystem

In such a flow and recycling process, much of the nutrients can be kept in the terrestrial ecosystem. The following retardative mechanism are suggested:

(1) Particulate nutrient in runoff and drainage water deposits to pond bottom by gravity and flocculation. It is then often dredged by farmers and applied to surrounding land as fertilizer and the pond keeps its volume;

(2) Dissolved nutrient is adsorbed by soil particle surface;

(3) Nutrients are taken by aquatic organisms and crops in spring and summer;

(4) Nutrient loss is reduced by keeping water in the terrestrial ecosystem.

2. Effects of multi-pond on nonpoint pollution

(1) Water storage

The watershed water storage capacity could be estimated by the precipitation before the first canal flow occurred. During 1988, the first flow with 17330 m^3 runoff appeared on March 15 after three days rainfall (4.7 mm on March 13, 19.8 mm on March 14 and 14.23 mm on March

15). Until that time, there were about 174 mm of precipitation including 126.9 mm snowfall in Jan. and Feb., and 47.5 mm of rainfall in the first half of March. So the watershed water storage capacity is estimated about 174 mm precipitation.

The pond water storage capacity is calculated by multiplying the surface area and the depth of the pond. It has a total volume of 710800 m^3. If it is completely empty it can store as much water as 97 mm rainfall falling to the whole 732 hectares catchment area. This is 55.7% of the whole watershed water storage capacity.

There was no runoff during April of 1988 because the whole month's precipitation was only 27.2 mm. According to the record of the last 24 years, the average rainfall amount is 104.0 mm in April. The first half of May is the time for ploughing, harrowing rice fields, and for transplanting early rice seedling after rape harvest. Usually about 20 cm depth of water is needed for preparing each piece of rice field. There are 2842800 m^2 rice fields which consumed 568560 m^3 water which is 80% of total pond storage water.

From May 15 to June 29, there was 163.9 mm of rainfall but the second canal discharge of 9930 m^3 flow into Chaohu Lake occurred only after three days rainfall (6.3 mm on June 27, 55.5 mm on June 28 and 2.1 mm on June 29). Because the enclosed boundary banks of rice fields can store 5 – 10 cm depth of water inside the fields and each sunny day 0.7 – 1.0 cm depth of field water was consumed by evaporation, transpiration and percolation and so on, the watershed storage capacity was enlarged and the runoff decreased in comparison with the first canal discharge on March 15.

In July of 1988, there were only 52.7 mm rainfall with 20 mm on July 24 and 24.8 mm on July 25 which caused no runoff. Normally July has the highest rainfall with an average of 161.4 mm. Because of drought in 1988, about 117900 m^3 water was pumped from Chaohu Lake into this catchment area by irrigation networks to ponds and rice fields during July.

Early rice was harvested at the end of July and late rice seedling was transplanted in early August. Obviously, large amounts of water are needed. Despite the 121.4 mm total rainfall with 35.6 mm on August 8, 22.1 mm on August 19 and 14.9 mm on August 20; 21.8 mm on August 25 and 25.3 mm on August 26, there were no canal discharges during August.

On September 9, after rice fields were drained and let dry to make the paddy soil moisture condition good for winter rape growth, the third canal discharge appeared with 480 m_3 flow after two days rainfall (25.6 mm on Sept. 8 and 4.4 mm on Sept. 9). And the last 370 m^3 flow happened on Sept. 14 after 18.8 mm of rainfall. These two small canal runoffs mainly came from rice fields near the cannal because the closed boundary banks had been opened during the drained period.

From January to september there were 676.0 mm precipitation which caused only 28110 m^3 flow to Chaohu Lake. It was only 0.55% of total the rainfall falling to this catchment area and 24 % of the pumped water from Chaohu Lake.

(2) Sediment and nutrient trap

Sediments and water samples were collected from five types of ponds according to their locations at different land use areas during 1987–1988. Table 3 is the total nitrogen and total phosphorus, organic matter and particle composition in pond sediments and in the canal bed.

Table 3 TN, TP, OM and particle composition in pond sediments and canal bed

Type of pond sediment	TN, %	TP, %	OM, %	Particles composite, % 1–0.25	–0.05	–0.01	–0.005	–0.001	< 0.001
Pond on hillfoot	0.054	0.036	1.67	17.7	16.8	26.8	8.0	9.5	21.2
Inside dry farmland	0.053	0.113	2.83	33.6	31.9	9.5	3.5	7.5	14.0
Among rice fields	0.078	0.078	1.70	2.8	7.6	29.3	13.7	14.0	37.6
Near the villages	0.127	0.085	2.37	1.4	3.6	24.5	18.3	16.2	36.0
On canal near villages	0.110	0.100	2.07	2.7	2.8	23.5	13.5	15.0	35.5
Canal bed sediment	0.077	0.090	1.43	1.4	8.2	24.5	21.9	16.1	27.9

Ponds at foothills have the lowest nutrient but higher sandy and gravel content in their sediments because there is no fertilizer application to these sandstone hills where pine three coverage is about 15%.

Villages have more influence on the pond sediment nutrients, because of the P-detergents are used to wash clothes and the overgrowth of plankton enriching the organic matter in sediments.

Ponds surrounded by nonirrigated fields have higher sediment organic matter (OM) and total P content because most of the farmyard manure is applied to nonirrigated fields. The highest gravel content is due to soil erosion during rainfall.

Ponds among rice fields have more clay in the sediment, because the runoff from rice fields can only transfer small particles.

The canal bed has deposits of loam clay which can be transferred to Chaohu Lake during the canal discharge. That is the reason why the sediment of Chaohu Lake has a clay content.

(3) TN and TP changes in the water of ponds, canal and lake

Water samples were collected from ponds, canal discharges and Chaohu Lake during 1988. Table 4 reflects the nitrogen and phosphorus concentrations in the different ponds, canal discharge and lake in different time of a year.

The concentrations of TN and TP in ponds are lower in winter and spring (from Oct. to April), higher in summer (from May to July) and highest in autumn (from Aug. to Sept.).

Ponds which are surrounded by nonirrigated farmland and ponds which are located at foothills have the highest TN and TP concentrations.

Ponds among rice fields have two peaks of TN and TP concentrations: one in early May because of the early rice seedling transplantation; the other in the middle of Sept. When rice fields are drained to sun drying.

Table 4 TN, TP concentration change in ponds and canal runoff

TN/TP, mg/L	On hill foot	Among rice fields	Near village	Near village canal	Among dry land	Canal runoff	Chaohu Lake
Feb. 22–25							2.320/0.155
Apr. 20	0.234/0.064	0.272/0.058	0.527/0.066	0.195/0.062	0.393/0.094	0.223/0.054	
May 5 8–10*		0.667/0.099				0.552/0.035	1.700/0.144
May 14		0.430/0.037	0.763/0.168	0.481/0.100			
June 3		0.333/0.052		0.310/0.028		0.685/0.018	
July 1	0.613/0.135	0.416/0.051	0.313/0.018	0.343/0.055	0.971/0.102	0.422/0.072	
Aug. 6–10*							0.910/0.097
Sept. 11	3.553/0.128	1.191/0.044	0.925/0.050	0.891/0.042	4.902/0.094	0.754/0.056	
Sept. 29	2.284/0.097	0.880/0.025	0.652/0.044	0.584/0.035	3.297/0.116		
Oct. 15 Nov. 3–6*	0.288/0.135		0.369/0.213	0.189/0.020		0.214/0.085	1.580/0.114
Average	1.394/0.112	0.598/0.052	0.592/0.093	0.426/0.049	2.391/0.102	0.475/0.053	1.680/0.127

* Sampling date in lake

Compared to the concentrations of TN and TP in other rivers and in Chaohu Lake, this catchment area has lower TN and TP concentrations in its canal discharges. TN in other rivers' runoff is 1.0 mg/L . This means that the Liuchahe watershed has little influence on Chaohu Lake pollution and eutrophication.

(4) Pond on canal

There are several ponds in the small canal of the Liuchahe catchment area. These ponds have the lowest nutrient concentrations with TN 0.426 mg /L and TP 0.049 mg/L. This result reflects that the interception, absorption and decomposition of the nutrients in surface runoff in a series of ponds are quite noticeable. The nutrient changes in canal ponds also reflect the agricultural activities in the catchment area, rainfall and their possible influences on canal discharges and nonpoint pollution to Chaohu Lake. The canal ponds become the integrated mirrors used to reflect the effects of this multi-pond agroecosystem on nonpoint source pollution and its annual changes. Fig. 9 gives the TN and TP changes in these canal ponds during different periods.

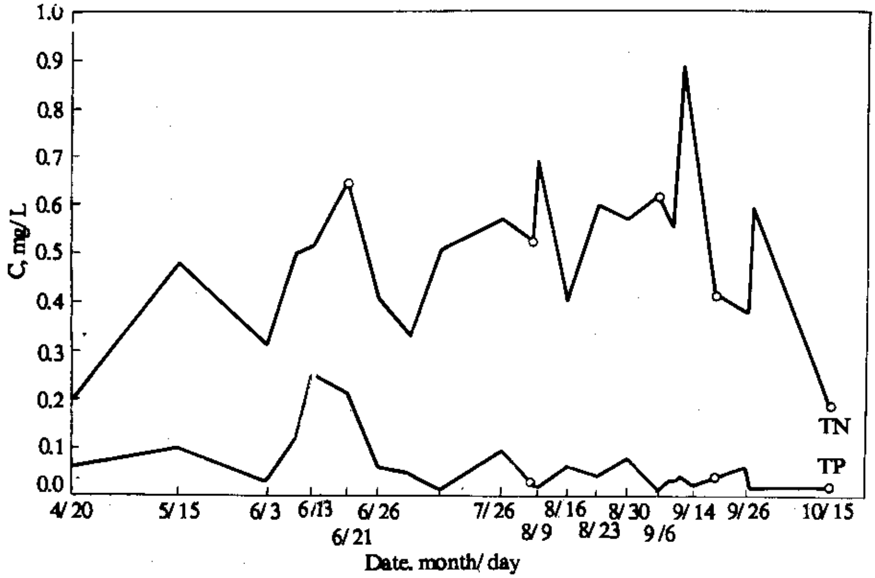

Fig. 9 Total nitrogen (TN), total phosphorus (TP) concentrations in canal pond

From early May to mid May, a series of agricultural activities such as plowing and harrowing rice fields, fertilizing, and early rice seedling transplantation take place in the catchment area. Runoff from these activities increase the nutrient concentrations in the canal ponds.

From mid May to June 10, there was not much more nutrient input from cultivated fields during rainfall (44.2 mm on May 18). Surface runoff diluted the nutrient concentrations.

From June 10 to 20 with the temperature rise, the nutrients were released from the sediment which slowly increased the TN and TP in the canal ponds.

From June 20 to July 10, plants in the ponds grew rapidly and absorbed the nutrients. TN and TP in the water layer of rice fields were lower because most nutrients were absorbed by rice. The 61.8 mm of rainfall (6.3 mm on June 27; 55.5 mm on June 28 and 2.1 mm on June 29) only lowered the nutrient concentrations in the canal ponds.

From July 10 to Sept. 15, early rice is harvested, late rice is transplanted after field preparation and fertilizing, the high temperatures and low water level raise the nutrient concentrations.

After Sept. 15, autumn comes with lower temperatures and less nutrient input from rice fields, so the TN and TP concentrations decreased.

(5) Nonpoint source pollution controlled by multi-pond agroecosystem

Before the surface runoff discharge flows to Chaohu Lake from the Liuchahe catchment area, it should flow through a series of ponds which are located at foothills, among the nonirrigated farmland and rice fields, and finally flows by the small canal to Chaohu Lake. After flowing through many/all the ponds, almost all of the sediments, nutrients and water from surface runoff during rainfall are intercepted and stored inside the watershed. These water and nutrients can easily be reused for irrigation of rice fields. To build the multi-pond agroecosystem requires a small labor investment and only needs some areas. Little money and no electric power is needed to run and manage this system. From this research we can conclude that a well designed multi-pond agroecosystem depends on the following factors: annual rainfall amount and its distribution; watershed water storage capacity; land use types, their locations and their water consumptions. All these can be used to control the nonpoint source pollution from catchment area of Chaohu Lake.

CONCLUSION

The rice field is the main agricultural land use type in the watershed of eutrophic Chaohu Lake. The high concentrations of total nitrogen (TN) and total phosphorus (TP) with TN 0.2 – 107 mg/L and TP 0.05 – 0.75 mg/L in the flood water layer of rice fields are the main and potential nonpoint source pollution which is responsible for Chaohu Lake eutrophication. A multi-pond agroecosystem has been developed. It can effectively control the nonpoint pollution from rice field and other land use by intercepting and storing the sediment and surface runoff, absorbing and decomposing the nutrients and organic matters. It is a good method to recycle the water and matter inside the agroecosystem with little capital investment while reducing the canal runoff and its N, P concentrations (TN 0.48 mg/L and TP 0.05 mg/L) which is much lower than the N, P concentrations in Chaohu Lake (TN 0.9 – 2.3 mg/L, TP 0.09 – 0.15 mg/L). A well designed multi-pond rice field cascade agroecosystem and optional fertilization at suitable times, with appropriate quantity and method (in the rice field) would result in a most effective controlling of nonpoint pollution and Chaohu Lake eutrophication.

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