UNIVERSITI PUTRA MALAYSIA

IMPACT OF SILVER BARB *(BARBODES GONIONOTUS)* REARING ON THE BENTHIC COMMUNITY AND NUTRIENT LEVELS OF RICE FIELDS AT SG. MANIK, TELUK INTAN, PERAK, MALAYSIA

SUN CHAMRAUN

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By

SUN CHAMRAUN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Master of Science

October 2006

DEDICATION

To My memory of My grandfathers and grandmothers who are no longer with me this moment

To My Beloved Parents,

SUN SAMBAN and KENG CHOUR,

who have always inspired and encouraged me to achieve my goal

To My Both Sisters,

Sun Sambath and Sun Sambo,

who have provided me with love and encouragement

To All My Uncles and Aunties

who provided me advices and encouragement

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Master of Science

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Chairman: Professor Jambari Hj. Ali, PhD

Faculty: Science

The aims of this study are to investigate the impact of silver barb fishes *(Barbodes gonionotus)* reared in rice field on the benthic organisms and also its impact onto nutrients level in water, sediment and paddy plant in rice field. The study was carried out at Sungai Manik ricefields, where rice was cultivated in the main and off seasons. Rice was planted by direct casting with paddy variety MR 219 at the sowing rate of 80 kg/ha. The experiments were performed in three growing seasons (July - November 2003, February - June 2004 and July - November 2004). The experimental plot was divided into subplots measuring 15 x 20 m and partitioned using corrugated zinc sheets. The field was fully flooded two weeks after planting. The water level in the field was maintained at about 20 cm. A trench of about 1 m in depth and about 1 meter in width was dug along the periphery of the plot and water is allowed to flow freely by connecting 4" PVC pipes that were covered with fine mesh net. Three fingerling densities were introduced into the plots at the rate of 4,000, 8,000 and 12,000 fingerlings/ha at 20 days after rice casting. The range of sizes of fingerlings released were 8.78 ± 0.88 to 11.05 ± 1.58 cm. Three replicates were carried out for each treatment arranged in fully randomized designed. There was no

insecticide applied during the growing periods. Herbicide was applied at two weeks before and after sowing. The fish was not given any supplemental food until the harvesting time after 80 days of introduction. Samples of paddy plants, sediments, water and benthic organisms were collected in a stratified random number in six replicates in each treatment at two weeks interval. Benthic organisms were sampled by using core sampler made of PVC pipe of 20 cm in diameter and 500 cm in length. From each treatment, six fishes were taken at 50 days after rice casting for its stomach content analysis. Sampled water was preserved with 2 drops of concentrated hydrochloric acid immediately after sampling. Paddy plants and sediments were dried and weighed before digestion. The paddy plant, sediment and water samples of the last two trials were analyzed for nitrogen-ammonia, phosphorus-phosphate and potassium.

The fish harvested ranged from 960 to 1967 (mean 1,317 ± 448) fishes from the plot 4,000 fishes/ha, 1000 to 2600 (mean 1,883 ± 582) fishes from the plot 8,000 fishes/ha and 3934 to 4400 (mean 4,111 ± 252) fishes from the plot 12,000 fishes/ha. The macrobenthic organisms found in the ricefield were mainly from 3 main groups namely gastropods, annelids and insects. Annelid was found to be the dominant group. There was no sign of remaining tissue of any invertebrate found from the stomach examined. The fishes did not consume macrobenthos thus it gave no negative impact on the population of benthic organisms in the ricefield. Nevertheless, it indicated that the oligochaetae worm benefited from the presence of large number of fish in the ricefield. It was thought that the dropping of the fish might contribute to the increased number of worm in the field.

Results of nutrient analysis in water showed the ammonia content was in the range of 0.76 to 1.94 mg/litre throughout the growing periods. Statistical analysis showed the concentration of water ammonia did not differ significantly between fish treatments. The soluble phosphate was in the range of 0.007 to 0.022 mg/litre, where the concentrations were high at the early of growing period, but it decreased slightly at the end of growing period. Statistical analysis showed the soluble phosphate in the water differed significantly between fish treatments. The potassium content was in the range of 1.16 to 12.33 mg/litre, the concentrations were higher at the early of growing period, but there was a decreasing trend toward the end of the growing period. However, statistical analysis showed there was no significant different of the potassium content between fish treatments. In the sediment, the total nitrogen content was in the range of 3.70 to 4.68 mg/g DW, the statistical analysis showed there was a significant different between fish treatments only at the 65^{th} day of the growing period. The total phosphorus content in the sediment was in the range of 0.15 to 0.39 mg/g DW. Statistical analysis showed no significant different of phosphorus content between fish treatments. The potassium content in the sediment was in the range of 14.66 to 26.33 mg/g DW, where the statistical analysis showed there was a significant different between fish treatments at the early of growing period. In this study, total nitrogen, total phosphorus and potassium content of the stem and root were analyzed separately. The total nitrogen content in the stem was in the range of 7.22 to 32.04 mg/g DW and 7.57 to 17.50 mg/g DW in the root. The total phosphorus content in the stem was in the range of 0.35 to 2.93 mg/g DW and 0.29 to 2.10 mg/g DW in the root. The potassium content in the stem was in the range of 21.83 to 36.33 mg/g DW and 12.50 to 25.33 mg/g DW in the root throughout the growing periods. The results of statistical analysis showed there was no significant different of the

total nitrogen, phosphorus and potassium in the stem and root of paddy plant between plots with fish at difference densities during the growing periods.

It is concluded that based on the results of this study, the impact of fish on benthic community and nutrient levels in water, sediment and rice plant were not significant. The feeding behavior of fish introduced, which are not bottoming feeder, have no effect on the community of benthic organisms and it did not also enhance better condition of sediment water interface for a better plant growth.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PEMELIHARAAN LAMPAM JAWA *(BARBODES GONIONOTUS)* KE ATAS KOMUNITI BENTIK DAN KANDUNGAN NUTRIEN DI SAWAH SG. MANIK, TELUK INTAN, PERAK, MALAYSIA

Oleh

SUN CHAMRAUN

Oktober 2006

Pengerusi: Professor Jambari Hj. Ali, PhD

Fakulti: Sains

Kajian ini dilakukan untuk menyelidik kesan pemeliharaan ikan lampan jawa *(Barbodes gonionotus)* di sawah ke atas organisma bentik dan kandungan nutrien air, sedimen dan tumbuhan padi di sawah. Kajian ini dijalankan di sawah Sungai Manik, di mana padi ditanam di dalam dan di luar musim. Padi ditanam secara tabur terus dengan varieti MR 219 pada kadar semaian 80 kg/ha. Kajian dijalankan selama tiga musim (Julai – November 2003, Febuari – Jun 2004 dan Julai – November 2004). Plot kajian dibahagikan kepada sub-plot berukuran 15 x 20 m dan diasingkan menggunakan kepingan zink. Sawah dibanjiri air pada minggu kedua selepas penyemaian. Air dikawal dengan kedalaman pada kira kira 20 cm. Satu parit berukuran 1 m dalam dan 1 m lebar digali sepanjang tepi plot. Air dibenarkan mengalir bebas diantara plot melalui paip PVC 4" yang ditutup dengan jaring halus. Benih ikan dilepaskan ke dalam sawah pada kadar 4,000, 8,000 dan 12,000 ekor/ha selepas 20 hari penyemaian. Saiz anak ikan semasa dilepaskan berukuran diantara 8 ke 12 cm. Setiap rawatan dijalankan dengan tiga replikat direka secara rawak penuh. Tiada racun serangga digunakan. Herbisida digunakan 2 minggu sebelum dan setelah penyemaian. Ikan tidak diberi makanan tambahan sehingga hari penuaian pada hari

ke 80. Sampel pokok padi, sedimen, air dan organisma bentik diambil secara rawak dalam enam replikat setiap rawatan pada jarak masa 2 minggu. Organisma bentik disampel dengan menggunakan pensempel kor yang diperbuat daripada paip PVC berukuran diameter 20 cm dan panjang 500 cm. Air diawet dengan 2 titik asid hidroklorik sebaik selepas penyempelan. Dari setiap plot percubaan 6 ekor ikan disampel untuk diperiksa kandungan perutnya. Tumbuhan padi dan sedimen dikeringkan dan ditimbang sebelum melalui penguraian berasid. Tumbuhan padi, sedimen dan air daripada dua percubaan terakhir dianalisis untuk nitrogen-ammonia, fosforus-fosfat dan potassium.

Ikan telah dituai dari plot 4,000 ikan/ha sebanyak 960 ke 1967 (purata 1,317 ± 448), 1,000 ke 2,600 (purata 1,883 ± 582) daripada plot 8,000 ikan/ha dan 3934 ke 4400 (purata 4,111 ± 252) daripada plot 12,000 ikan/ha. Organisma makrobentik yang terdapat di sawah kajian adalah dari 3 kumpulan iaitu Gastropoda, Annelida, dan Insekta. Annelida adalah kumpulan dominan di sawah. Tiada tanda-tanda sisa invertebrata dalam usus dan perut ikan yang diperiksa. Ikan lampam jawa tidak memakan organisma benthos, oleh itu ikan ini tiada memberi kesan kepada populasi makro bentos, walau bagaimanapun cacing oligochaeta mendapat keuntungan dari najis ikan yang dihasilkan.

Keputusan analisis nutrient air menunjukkan kandungan ammonia dalam jumlah 0.76- 1.94 mg/liter disepangjang musim penanaman. Analisis statistik menunjukkan kandungan ammonia air tidak berbeza dengan signifikan diantara rawatan. Fosfat larut air dalam berjumlah 0.007 ke 0.022 mg/liter, dimana kepekatan adalah tinggi diawal musim penanaman, tetapi kepekatan berkurangan diakhir musim penanaman.

Analisis statistik menunjukkan kandungan fosfat terlarut berbeza dengan signifikan diantara rawatan kepadatan ikan. Potassium air dalam julat 1.16 ke 12.33 mg/liter, kepekatannya adalah tinggi diawal musim penanaman, tetapi kepekatannya menunjukkan corak yang menurun di akhir musim menanam. Walau bagaimanapun, analisis statistik menunjukkan tiada perbezaan yang signifikan bagi kandungan potassium diantara rawatan kepadatan ikan. Dalam sedimen, kandungan nitrogen keseluruhan adalah dalam julat 3.7 ke 4.68 mg/g DW, analisis statistik menunjukkan perbezaan yang signifikan kandungan nitrogen dengan rawatan pada pensampelan hari ke 65 musim pertumbuhan. Kandungan fosforus keseluruhan di sediment adalah dalam julat 0.15 ke 0.39 mg/g DW. Analisis statistik menunjukkan tiada perbezaan signifikan kandungan fosforus diantara rawatan kepadatan ikan. Kandungan potassium dalam sedimen adalah dalam julat 14.66 ke 26.33 mg/g DW, dimana analisis statistik menunjukkan adanya perbezaan signifikan diawal penanaman. Dalam kajian ini, kandungan total nitrogen, total fosforus dan potassium batang dan akar dianalisis secara berasingan. Kandungan nitrogen keseluruhan di batang adalah dalam julat 7.22 ke 32.04 mg/g DW dan 7.57 ke 17.50 mg/g DW di akar. Kandungan fosforus keseluruhan dalam batang dalam julat 0.35 ke 2.93 mg/g DW dan 0.29 ke 2.10 mg/g DW di akar. Kandungan potassium di batang dalam julat 21.83 ke 36.33 mg/g DW dan 12.5 ke 25.33 mg/g DW di akar di sepanjang musim pertumbuhan. Keputusan-keputusan analisis statistik menunjukkan tiada perbezaan yang signifikan kandungan nitrogen keseluruhan, fosforus keseluruhan dan potassium keseluruhan di batang dan akar pokok padi diantara plot dengan rawatan kepadatan ikan yang berbeza di sepanjang musim pertumbuhan.

Berdasarkan keputusan kajian ini, kesan peliharaan ikan ke atas komuniti bentik, kandungan nutrien air, sedimen dan tumbuhan padi adalah tidak signifikan. Ikan dipelihara, iaitu bukanlah jenis ikan yang memakan didasar, tidak memberi kesan kepada komuniti organisma bentik dan tidak juga menyumbang kepada perubahan keadaan interfasa sedimen air yang boleh membantu pertumbahan pokok yang lebih baik.

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I certify that an Examination Committee has met on 12th October 2006 to conduct the final examination of Sun Chamraun on his Master of Science thesis entitled "Impact of Silver Barb *(Barbodes gonionotus)* Rearing on the Benthic Community and Nutrient Levels of Rice Fields at Sg. Manik, Teluk Intan, Perak, Malaysia" in accordance with Universiti Petanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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Date: 22 NOVEMBER 2006

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science.
The members of the Supervisory Committee are as follows:

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Date: 14 DECEMBER 2006

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutes.

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SUN CHAMRAUN

Date: 2nd November 2006

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
°C	Degree celsius (Centigrade temperature)
CARDI	Cambodia Agriculture Research and Development Institute
cm	centimeter(s), (0.01 m)
DO	Dissolved oxygen
DOA	Department of Agriculture (Malaysia)
DOF	Department of Fisheries (Malaysia)
fishes/ha	fishes per hectare
g	gram (hence also mg, kg, etc.)
ha	hectare(s) (10^4 m^2)
H_2O_2	Hydrogen peroxide
H_2SO_4	Sulphuric acid
HYV	High-Yielding Variety
IADP	Integrated Agriculture Development Project
i.e.	that is
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
K	Potassium
KADA	Kemubu Agriculture Development Authority
KCl	Potassium chloride
KH_2PO_4	Potassium hydrogen phosphate
kg	kilogram(s)
kg/ha	kilogram per hectare
m	meter (hence also cm, mm, etc.)

m^2	square meter
MADA	Muda Agriculture Development Authority
MANCID	Malaysian National Committee on Irrigation and Drainage
mg	milligram(s), (0.001 g)
mg/g	milligram per gram
mg/g DW	milligram per gram Dry Weight
mg/litre	milligram per litre
ml	milliliter(s)
mm	millimeter
N	Nitrogen
NaOH	Sodium hydroxide
NH_4Cl	Ammonium chloride
nm	nanometers
NPK	Nitrogen-Phosphorus-Potassium
P	Phosphorus
p	probability
PBLS	Project Barat Laut Selangor
pH	Potential Hydrogen (-log10 hydrogen ion concentration)
PKSM	Project Kerian Sugai Manik
ppm	part per million
P.P.P.B.P Pinang	Project Pengembangan Pertanian Bersepadu Pulau Pinang
PVC	Poly Vinyl Chloride
S.D	Standard deviation
Sg.	Sungai (River)

CHAPTER I

GENERAL INTRODUCTION

Many countries in Asia can be called “rice-fish societies” in the sense that rice is the staple crop for basic subsistence, while fish is the main source of animal protein. The availability of rice and fish has long been associated with prosperity and food security. The cultivation of most rice crops in irrigated, rainfed and deepwater systems offers a suitable environment for fish and other aquatic organisms. Traditionally a good deal of the fish for household consumption was caught from the paddy fields. In the past, these were often wild fish entered the flooded rice field naturally. In more recent times, this natural association of rice and fish has been threatened in many countries due to reduce stocks of wild fish through increased population pressure, fish disease and degradation of water resources caused by deforestation and the toxic effects of agricultural chemical in use.

Rice-fish culture is not widely practiced around the world. Most information comes from Asian countries where traditional rice farming methods have been refined over centuries. Rice is the economically important primary crop. The additional of fish culture to rice production is an additional management consideration for farmers. In many cases, there may not be sufficient economic justification for this extra management. Some how fish culture in rice field may be practiced at several management levels because rice-fish culture is a low-input, low-risk technology which can help to maximize the agricultural production from a given area of land.