ការចិញ្ចឹមត្រីក្នុងស្រែ ចំរុះនឹងការគ្រប់គ្រងសត្វកកេរ នៅប្រទេសកម្ពុជា

RICE FIELD FISH FARMING INTEGRATED WITH RODENT PEST MANAGEMENT IN CAMBODIA

E.G. Smith[1,3], L. Leung[2], C. Phaloeun[3], U. Sopheap[3]

សង្ខេបអត្ថបទ

ប្រសិទ្ធិភាពនៃការចិញ្ចឹមត្រីក្នុងស្រែ និងការគ្រប់គ្រងពពួកសត្វកកេរ ត្រូវបានធ្វើការសិក្សា។ ការប្រើប្រាស់នូវបច្ចេកទេសក្នុងការចិញ្ចឹមត្រីក្នុងស្រែគួបផ្សំនឹងការគ្រប់គ្រងសត្វកណ្តុរ គឺមានប្រសិទ្ធិភាពខ្ពស់ ក្នុងការទប់ស្កាត់ពីការបំផ្លាញនៃពពួកសត្វកណ្តុរទាំងនោះ។ សត្វកណ្តុរក៏ ជាអាហារដ៏សំខាន់ និងផ្តល់នូវប្រភពប្រូតេអ៊ីន សំរាប់ជាចំណីត្រី។ ការចិញ្ចឹមត្រីបានចូលរួមវិភាគទានដល់កសិករ ដើម្បីរកប្រាក់ចំណូលបន្ថែមព្រមជាមួយគ្នានេះដែរ ត្រីក៏បានផ្តល់នូវប្រភពប្រូតេអ៊ីនដល់ការហូបចុកប្រចាំគ្រួសារ។

ការចិញ្ចឹមត្រីអណ្តែងបង្កាត់រយៈពេលបីខែ បានបង្ហាញអោយឃើញថា បច្ច័យដែលបានផ្តល់ចំណីមានការលូតលាស់ល្បឿនជាងបច្ច័យ ដែលពុំបានផ្តល់ចំណី។ ត្រីនៅក្នុងស្រែដែលផ្តល់ចំណី មានទំងន់ជាមធ្យម ៥១.៥ក្រាម និង មានប្រវែងខ្លួនជាមធ្យម ៧.៨ ស.ម ចំណែកឯត្រីក្នុងស្រែ ដែលមិនផ្តល់ចំណី មានទំងន់ជាមធ្យម ២៦.៤ ក្រាម និងមាន ប្រវែងខ្លួនជាមធ្យម ៤.៥ ស.ម ។

តាមការវាយតំលៃ លើការភ្លក់រសជាតិសំណាកត្រីចំនួនប្រាំ បានបង្ហាញថា ២៤ភាគរយនៃអ្នកភ្លក់ ពេញចិត្តត្រី ដែលផ្តល់ចំណី និង ២១ ភាគរយទៀត ពេញចិត្តត្រី ដែលមិនផ្តល់ចំណី។ នេះបញ្ជាក់ថា ត្រីទាំងពីរប្រភេទ (ផ្តល់ និង មិនផ្តល់ចំណី) មានរសជាតិ គួរអោយទទួលយកបានដូចគ្នា។

តាមការសិក្សា និង ការចុះអង្កេតជាលើកដំបូង នៅខេត្តកំពង់ចាម បានបង្ហាញថា បច្ចេកទេសចិញ្ចឹមត្រីក្នុងស្រែ និង ការគ្រប់គ្រងសត្វកណ្តុរ បានផ្តល់នូវអត្ថប្រយោជន៍យ៉ាងសំខាន់ដល់កសិករ ក្នុងការអនុវត្តន៍ ហើយថែមទាំងផ្តល់ប្រាក់ចំណូលបន្ថែមទៀត ដែលបានមកពីការលក់ត្រី។ មិនតែប៉ុណ្ណោះ ត្រីក៏បានផ្តល់នូវប្រភពប្រូតេអ៊ីនផងដែរ។

ពាក្យគន្លឹះ: *Clarias batrachus*, *Clarias macrocephalus*, *ការគ្រប់គ្រងសត្វកកេរ. ដំណាំស្រូវចំរុះ*

ABSTRACT

The effect of integrating rice field fish culture with rodent pest management was examined. The use of rodent pest management was effective for controlling rodent pests as well as containing fish within the rice field while potentially providing a free source of dietary protein (captured rats) to feed fish. The growth of fed (captured rats or dried fish) walking catfish hybrids (*Clarias batrachus* ♀ x *Clarias macrocephalus* ♂) in the rice field over 3 months was significantly higher (51.5g, 7.8cm) than a treatment of unfed walking catfish hybrids (26.4g, 4.5cm) in the same rice fields. Fish culture was shown to contribute to a farmer's income (68,800 Riel) and provided a source of protein for the family's consumption. Both the fed and unfed products were found to be palatable and accepted by a test group with 24% of the test group selecting fed fish and 21% selecting unfed fish as their first choice from 5 fish products. This pilot study and a preliminary survey in Kampong Cham province indicate that this technology will be useful for farmers to improve rodent management practices while supplementing income through fish sale and providing a high protein diet for their families.

Keywords; *Clarias batrachus*, *Clarias macrocephalus*, rodent management, integrated rice field fish culture, carnivorous, hybrid

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INTRODUCTION

Wild fisheries provide the farm household in Cambodia with a free source of dietary protein, equivalent to more than 35% of animal protein consumption (Subasinghe, *et al*., 1998), and are a simple alternative to culturing fish. However in some areas the supply of wild rice field fishes has been degraded to the extent that fish culture is the only alternative for a sustainable fish supply (Bunra and Gregory, 1995). The demise of this natural resource has come about largely because of the intensification of agriculture, population growth, over-harvesting and the use of destructive fishing gear. These problems are likely to worsen with rapidly increasing population (Sihapitakgial, 2000) and increased fish demand for local and export markets (Gregory, 1997).

Rice field fish culture is not a new concept and has been widely trialed and used throughout Cambodia. Not only does the fish harvest add to the rice farmer's income, it provides a source of dietary protein. Dual cropping, rice and fish, helps manage economic uncertainty better, fish are believed to manage insect pests and accelerate nutrient recycling and the simple fact that farmers frequent the rice field more often to manage fish results in improved rice husbandry (Gregory, 1997). Despite these benefits there are many problems that have and continue to inhibit the success of rice field fish culture. The most common problems reported are that natural flooding and drought can result in the loss of an entire fish crop and that fish predators such as carnivorous wild fish can significantly reduce the harvest (Gregory, 1997).

These problems are currently being addressed by CARDI through a novel approach to introduce rice field fish culture to rural Cambodia. This pilot project has been designed to value-add work on the ACIAR funded Farmer-based Adaptive Rodent Management, Extension and Research System (FARMERS) project by linking rice field fish culture with rodent pest management. Implementation of a community-based project has been secured from the AusAID funded Community Development Fund and will be initiated in March 2002.

MATERIALS AND METHODS

Field design for rice fish culture with rodent pest management

The design of the Trap and Barrier System (TBS) is similar to that used for rodent pest management in the FARMERS project. The trap crop is a 20 x 20m rice plot with a bund and a fence placed around the perimeter. In addition for fish culture, a small pond (4 x 4 m x 1m deep) was incorporated into the corner of the rice field. This was to offer fish a localized site for supplementary feeding and refuge from heat and drought. This study made comparisons between the rates of growth of fish fed a supplementary diet (rats that are trapped or dried fish if no rodents are captured) and those that feed only on what is available in the rice field. To achieve this a division was incorporated into the rice field, rats trapped in the field were euthanised and minced with rice bran to feed fish on one side of the division (Appendix 1). For reproducibility of results two project sites were developed at CARDI. The project was implemented on 1st October 2001 when rice (IR66) was transplanted and hybrids of the walking catfish (average weight 10.93g ± 0.5, average total-length 10.95cm ± 1.52) were released into the rice field on the 22nd October at 1.25 m^{-2}. The catfish had previously been held in a harpa (holding cage) for 7 weeks

Catfish hybrid

The species of fish to be grown is a hybrid of two native catfish species, the walking catfish (*C. batrachus*) and the broad head catfish (*C. macrocephalus*). These fish are a highly regarded table-fish in Cambodia, reaching market prices of 4000 - 5000 Riel kg^{-1} (US$1- 1.25 kg^{-1}). This group of catfish is very suitable for coupling with the TBS as they are resistant to desiccation, can breath atmospheric air, are highly carnivorous, have fast growth rates (200g in 3 months) and the hybrid has been shown to grow 20% faster (Dunham, *et al*., 1990). Another characteristic of these catfish species is their ability to move across land with their pectoral spines (Pillay, 1990). In the past the mobility of this species has proven to be a problem for rice field culture, however the TBS will act as a barrier to contain these mobile fish. The hybrid cross used for this project was *C. batrachus* ♀ x *C. macrocephalus* ♂. Tarnchalanukit (1986) found that this hybrid cross produces a 5% higher fertilization rate and surviving larvae than the inverse cross. Fish were stocked at 1.25 m^{-2}, or 500 per 400m^2 trap plot.

Product evaluation

The final issue to be addressed by this study is taste and marketability of the fish product. Preliminary surveys identified that Cambodian's have a preference for wild caught fish compared to cultured fish. Whether this is due to the taste of the fish or common perception that cultured fish are raised on low quality diets in poor water and previous experiences from bad quality products needs to be tested. To test whether there is a difference in taste, a taste test and product evaluation was conducted with CARDI staff to quantify their responses to wild caught versus cultured fish and different catfish species. Staff were asked to sample 5 different fish

(wild *C. macrocephalus*, wild *C. batrachus*, fed CARDI hybrid, un-fed CARDI hybrid and hybrid catfish from another farm) and given a survey to record their response to each product.

Project potential

A community project with farmers in the Som Rong Commune, Kampong Cham will be undertaken in March 2002 to further develop the fish culture technique and help scientists target the research to farmers' requirements. The community-based project will be implemented with the arrival of an Australian Youth Ambassador (AYA), Morgan Edwards, and financial support from the AusAID funded Community Development Fund (CDF). To identify the appropriateness of this technology to the community, a preliminary survey of 105 people in the Som Rong Commune and 105 people in Lvea commune, both in Kampong Cham province, was conducted.

RESULTS

Fish production

Hybrid catfish (average weight 1.38g ± 0.1; average length 5.58cm ± 0.1) were raised in a harpa for 7 weeks and reached an average weight of 10.93g ± 0.5 and average total-length of 10.95cm ± 1.52 before being released to the rice field. The average FCR for catfish during this holding period was 2.5.

Fish were on grown in the rice field for a total of 86 days (22nd October - 15th January 2002). Fish were fed on a mixed diet of dried fish and rice bran (30% crude protein), as rodent capture was low due to extensive flooding at CARDI on 15th October. The total volume of fish harvested from the four study sites was 17.2kg. The two study sites (east and west) produced 7.2 and 2.6kg of fed fish respectively. Production of unfed fish from both study sites (east and west) was 1.4 and 2.9kg respectively. A further 2.3kg of wild fish was harvested from both the east and west fed ponds and 0.9kg from the east and west unfed ponds. Wild fish were primarily made up of by Snakehead (Trey raws), Climbing Perch (Trey crang) and minor contributions from Trey chloin, Trey codjoh and Trey changwa. By the end of the culture period the fed fish were significantly larger (62.4g ±3.1, 18.8cm ±0.3) than the unfed group (37.4g ±2.7, 15.5cm ±0.3). The rate of survival was low in both treatments with 31% survival from the fed group and 22% survival from the un-fed group.

The fed treatment was fed at 10% biomass per day for the first 62 days however this was reduced to 5% per day as water quality deteriorated while the other group was not fed for the culture period. Figure 1 shows average weight increase and Figure 2 shows the average length increase of fish fed and unfed in the rice field. The fed fish consumed a total of 32.7kg of supplementary feed in the rice field resulting in an FCR of 1.9.

Water quality deteriorated in the fed ponds over the culture period resulting in an average final pH of 5.93 compared to the unfed ponds that had an average final pH of 6.62.

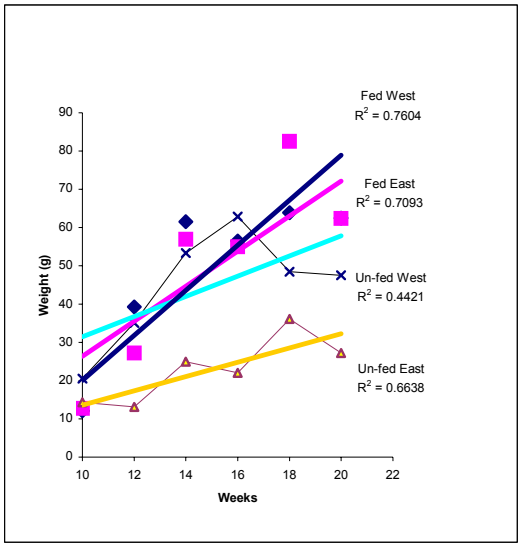

Figure 1: Average weight gain of fed and unfed walking catfish hybrids from two rice field culture sites (east and west).

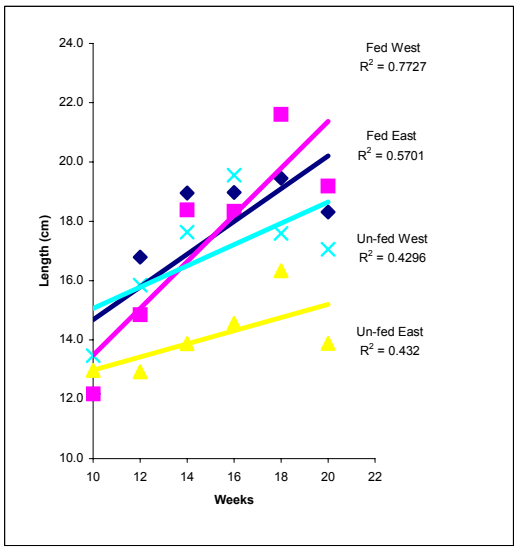

Figure 2: Average length gain of fed and unfed walking catfish hybrids from two rice field culture sites (east and west).

Product taste and acceptability

From a survey of 35 people, 31% selected *C. macrocephalus* as their first choice of fish for overall taste and fish characteristics, 24% of the survey group selected the fed CARDI hybrid as their first

choice for taste and fish characteristics, third was the unfed CARDI hybrid (21%), fourth was *C. batrachus* (14%) and the final choice was a hybrid from another farm (10%).

From the survey, 59% of the test group identified that the most desired catfish are light in colour, 36% identified that medium sizes of 200g are preferred and 44% identified that fat fish are preferred (Figure 3).

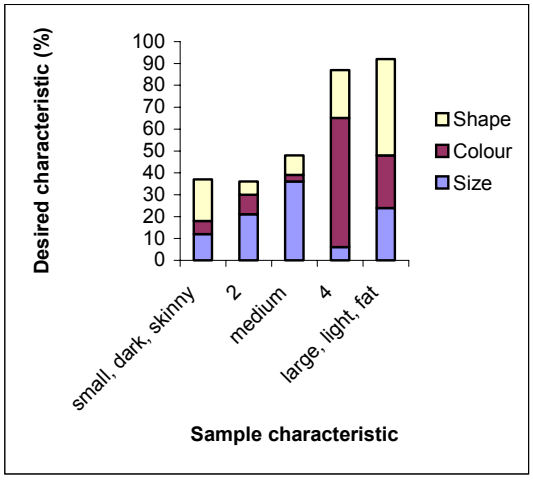

Figure 3: Desired characteristics of catfish identified through a survey of 35 CARDI staff members.

Rat trapping

Rat trapping was very low during the fish culture period due to floods driving rat populations out of the area in mid October. However at the end of December as the rice crop matured rat trapping was more frequent. During the period of fish culture, 22nd October - 15th January, 25 rats were caught. In this period traps also collected a number of snakes and frogs. Rodent capture was still being achieved at the end of the fish culture period and was maintained.

Rice yield

Rice yield was expected to be low due to extensive floods at CARDI 15 days post transplant. Rice did not recover from this early damage and as a result the average yield was 920 kg ha^{-1}. Rice yield from the $200m^2$ treatment sites was significantly higher for both east and west fed treatments (26kg and 21.5kg respectively) compared to the east and west unfed treatments (14.5kg and 11.5kg respectively).

Gross margin

Total costs and potential sales for rice and fish are recorded in Table 1.

Table 1: Cost and profit statement related to rice field fish culture.

Item	Unit	Unit price (Riel)	Gross Margin (Riel)
Fingerling	1,000 head	50	-50,000
Fish Food	32.7 kg	1,000	-32,700
Fish	17.2 kg	4,000	+68,800
Rice	73.5 kg	500	+36,750

Preliminary survey

From the 210 people surveyed in Kampong Cham, it was found that 17.6% are growing fish in ponds with an average production of 185kg $year^{-1}$. The main species being cultured is the shark catfish, *Pangasianodon hypophthalmus*, local name Trey Pra. Farmers that were not growing fish clearly indicated that they would like to be able to but are primarily restricted by lack of technology and capital (Table 2).

Table 2: Main problems facing farmers that are not growing fish but would like to be able to. Data presented as a mean percentage of farmers.

Restriction	Som Rong	Lvea
Low protein diet	5.2	0.5
Lack of technology	17.7	15.2
Lack of capital	18.2	23.8
Water restrictions	4.8	4.2
Disease	5.2	1.4
Low market price	3.5	0.0
Other	21.6	27.1

DISCUSSION

1. *Fish production*

FCR of 1.9 is comparable to figures presented by Pillay (1990) of 2.

Water quality was poor in one of the fed ponds therefore the feeding rate was reduced from 10% biomass per day to 5% biomass per day. Water pH was lower in the fed ponds. Fed ponds showed high amount of algal growth while unfed contained little. Future projects will integrate herbivorous species to utilize primary production.

2. *Product taste and acceptability*

The taste test suggests that consumers have a dislike for farmed fish due to inconsistent products reaching the market place as the farmed fish from CARDI were selected as the consumers second preference. The data also identified that consumers are after catfish of a medium size (200g), of light colour and that are fat.

3. Rat trapping

Rodent capture did not begin until late stages of the rice maturity. It is postulated that surrounding crops provided food for the rats but as they were harvested the rats moved into the TBS crop.

4. *Rice yield*

Floods at CARDI on the 15th October caused considerable damage to newly transplanted rice as well as driving out the rodent population. It is estimated that rice yield was affected by 50%. In one case dogs also attacked trap with rats, flattened $2m^2$ of rice.

The agronomic crop benefited from fish culture due to the increased nutrient load to the soil from accumulation of excrement and unconsumed feeds during the fish culture period.

5. Gross margin

This pilot project has identified a new technology that will not only increase the farmer's income and nutritional diversity but will improve rice yield through rodent pest management and nutrient influx from fish culture.

6. Preliminary survey

Farmers identified that lack of capital and technology were the major constraints for them to adapt fish culture.

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Appendix 1

Integrated rice / fish farming with rodent pest management
System layout