A Preliminary Experiment to Observe the Effects of Two Feeds on Pond Production of *Macrobrachium rosenbergii* in St. Lucia, W. I.

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ABSTRACT

The preliminary results of a study comparing a sardine diet with a locally produced commercial chicken feed diet on the production of *Macrobrachium rosenbergii* grown in semi-stagnant water systems are presented. The experiment took place at the government-owned Beausejour Prawn Farm (the BPF), Vieux-Fort, St. Lucia. The results of the experiment indicate that for shrimp culture in ponds with a non-continuous water flow system, limited water exchange and no artificial aeration, chicken feed was more economic and productive than sardines.

INTRODUCTION

St. Lucia, a small island of 238 square miles, is located between the islands of Martinique to the north and St.Vincent to the south. In St. Lucia, like many other smaller islands in the Caribbean, large expanses of flat land are limited, rivers are heavily impacted by agriculture, and the per capita income is low. In some instances, electricity is not available in rural areas.

Chicken feed and sardines are two sources of feed that have been used by farmers in aquaculture. A feed mill on the island produced chicken feed (19% protein, 4% fat, 4% fibre, 0.81% calcium, 0.64% phosphorous, 0.2% sodium) until 1992. Sardines or "sprats" are caught by local fishermen often in large quantities (200 -1,000 pounds at a time).

From as early as the late 1950s, interest in aquaculture has been growing in St. Lucia. However, it was not until 1988 that shrimp culture took off with the construction of the island's first shrimp hatchery. This was built by the Taiwanese who also provided a technician to produce the juvenile shrimp needed for pond stocks. The species of shrimp chosen for culture was the freshwater prawn *Macrobrachium rosenbergii*, a popular choice in both the Asian countries and the Western World. This prawn has a life history of egg, larvae, post-larvae, juvenile and adult. It takes about six to eight months to go through this cycle and needs water temperatures of 26 - 28°C for maximum growth (Ling, 1969). The shrimp grows well in dirt ponds and is omnivorous, feeding readily on aquatic worms and insects, molluscs and crustaceans, fish offal, seeds, grains and fruits (Ling, 1969).

Shrimp are normally harvested 6 months after stocking in ponds. Production levels in dirt ponds can range from 2,500 - 5,000 kg/ha/yr (New 1990 for

Thailand) and around 3,000 - 4,000 kg/ha/yr for Trinidad. (Gabbadon and de Souza, 1989). The rearing of the prawns has proved commercially viable in many countries (Shang and Fujimara, 1979; Shang, 1981).

The number of shrimp farmers in St. Lucia is about thirteen (as of December, 1993). Altogether there are less than ten acres of land in ponds. The demand for feed is insufficient to make production of a high protein shrimp feed economically feasible. The experiment attempts to determine which of the two available feeds is more economical for use by small, subsistence level, aquaculture farmers in the Caribbean. An integral part of the study was to examine shrimp production under non-ideal conditions and not just to determine the best foods for freshwater shrimp culture. The latter has been researched in some great detail already (Ling, 1969 and several others).

Whilst attempts are always being made to choose production sites where water is available by gravity flow, many instances arrive in St. Lucia where water can only be obtained by pumping. The breakdown of pumps is frequent and the inability to get replacement parts also quite common. Low production in ponds is often suspected to be caused by poor water exchange exasperated by feeding with non water stable foods. The need, therefore, to identify production maximizing feeds for ponds where water conditions may often be less than ideal is of high priority in St. Lucia.

PROCEDURE

The test areas were two 600 square metre rectangular dirt ponds at the Government shrimp station, the BPF. The water source was the Vieux-Fort river 45m away and 6m below ground level. Water by gravity flow is not possible. Water has to be pumped from the river to the ponds. During the experiment, attempts were made to pump water every three to four days as is often recommended to farmers. However, quite often pump breakdowns delayed water exchange, sometimes by several days. Ponds, however, always received water at least once every ten days and always at the same time. About a 20% water exchange was achieved during pumping.

At the start of the experiment, both ponds had just been filled. Approximately 6,500 two week old post larval shrimp (PLs) were placed into each pond. For the next five months the shrimp in one pond (A1) were fed exclusively on a processed chicken feed whilst shrimp in the second pond (A2) were fed exclusively on ground sardines. At the start of the sixth month problems started to arise in obtaining sardines for A2 and so the experiment was stopped.

Feeding

Feeding rates were based on recommendations from the FAO manual on shrimp and prawn farming (Table 1).

Table 1. Feed Programme Used for A1 and A2.

Size of shrimp/grams	% body weight fed
< 1	100
1	40 - 50
1 - 5	20 - 40
5 - 10	10 - 20
> 10	5 - 8

Shrimp were fed twice per day, at 6:30 am and 5:00 pm, with equal amounts given at each feeding.

Each pond was sampled once per month with a one-eighth inch mesh seine net that was dragged once through the pond. Records of the sample size and the average weights and lengths of the shrimp were made. Body lengths were taken from the tip of the rostrum to the tip of the telson. Average body weights were calculated by first determining the total weight of the sample and then doing the necessary division. Total weight was found by wrapping the shrimp in a small piece of damp cloth which was attached to a hanging scale balance. The same balance was used to weigh the rations of chicken feed and sardines used in the ponds. Based on these results and the guides from Table 1, daily feed rations were calculated. A survival rate of 50% was assumed and this was based on recorded averages for St. Lucia in 1990 and 1991. At the end of the 5th month, shrimp were harvested by completely draining the ponds. The total production per pond and feed cost was determined. Oxygen levels were taken twice daily, at 6:00 am and 6:00 pm. Average values, including minimum and maximum, are provided. More experiment details are shown in Table 2.

RESULTS

The results from the monthly samples, feed calculations and harvests are shown in the following tables.

Final production figures by May : A1 = 78 kg = 83 pounds
A2 = 18 kg = 40 pounds

Value of crop A1 = $1245 (market price is $15 per pound)
A2 = $600

Estimated survival = 25% (A1) and 12% (A2).

Table 2. Stocking and Management Data.

Activity	A1	A2
Stocking date	30/12/91	30/12/91
No. stocked	6500	6500
Age of PLs	2 weeks	2 weeks
Total weight of PLs	0.77kg	0.78kg
Feed used	chicken feed	sardines
Cost of feed	$0.64/lb	$0.75/lb

Table 3. Results from Pond Sampling of A1 and A2.

Samples dates	sample no.		Av. length/cm		Av. weight/gms	
	A1	A2	A1	A2	A1	A2
January	162	61	3.2	4.3	0.8	1.1
February	86	162	5.2	6.3	1.1	2.6
March	42	141	7.8	8.8	4.6	6.0
April	121	123	10.5	9.8	11.8	9.7
May	327	105	12.5	10.1	18.0	11.0

Table 4. Feeding Data for Ponds A1 and A2.

Dates	daily feed/kg		total feedpermonth/kg	
	A1	A2	A1	A2
January	1.5	1.5	46.5	46.5
February	3.0	3.5	84.0	98.0
March	4.0	4.0	124.0	124.0
Apri	4.0	4.0	120.0	120.0
May	4.0	3.0	120.0	93.0
Total feed used/kg			494.5	481.5
Total feed used/pounds			1090	1061
Costs of feed			$697.6	$795.75

Net Profit
A1 = $547.4
A2 = -$195.75

Table 5. Dissolved Oxygen Data mg/l for Ponds A1 and A2

	Months				
	Jan.	Feb.	Mar.	April	May
A1					
Min. O2 am	3.4	3.2	3.6	4.2	3.2
Max. O2 am	6.4	8.2	8.7	7.6	6.1
Min. O2 pm	5.7	6.6	5.4	5.9	6.6
Max. O2 pm	12.3	11.9	10.0	10.6	10.2
A2					
Min. O2 am	3.9	4.1	2.0	2.6	3.0
Max. O2 am	8.0	8.3	9.7	9.8	9.0
Min. O2 pm	5.5	6.7	6.8	6.2	5.8
Max. O2 pm	12.0	11.5	9.5	10.4	9.8

OBSERVATIONS

Productivity was greater in A1 than in A2 (Figure 1) where negative monetary returns were obtained. Production in both ponds were found to be lower than expected compared to that normally obtained from similar sized ponds on the island (Figure 2). Mortality was obviously far greater than 50% and growth rates were low. This was more so in pond A2 than in A1 despite the observation that initial growth rates (during January – March) were greater in A2 (Table 3). Water was observed to foul more easily in A2 than in A1. This was indicated by the bad smell that sometimes developed in A2. Water fouling could have caused critical oxygen levels to occur. That low oxygen levels did exist in A2 is indicated by metre readings (Table 5). Unusually low oxygen levels in A2 were also suspected by the observations of shrimp jumping at the water's surface along the edges of A2 during early morning hours. Similar activities were not observed in A1.

DISCUSSION

Poor production in both ponds was most likely due to insufficient water exchange and the absence of any other form of aeration. Water exchange always occurred at the same time and to the same degree in each pond, therefore it is the conclusion here that some factor, in addition to poor water exchange, was responsible for the significant difference in production levels obtained in ponds A1 and A2. Decomposing sardines may have caused poorer water quality in A2 thus contributing significantly to high shrimp mortalities. This conclusion is somewhat supported by New and Singholka (1985), who suggest that trash fish could be a greater pollution hazard than the more stable compounded chicken feeds. That decomposing food could be dangerous in a pond environment is

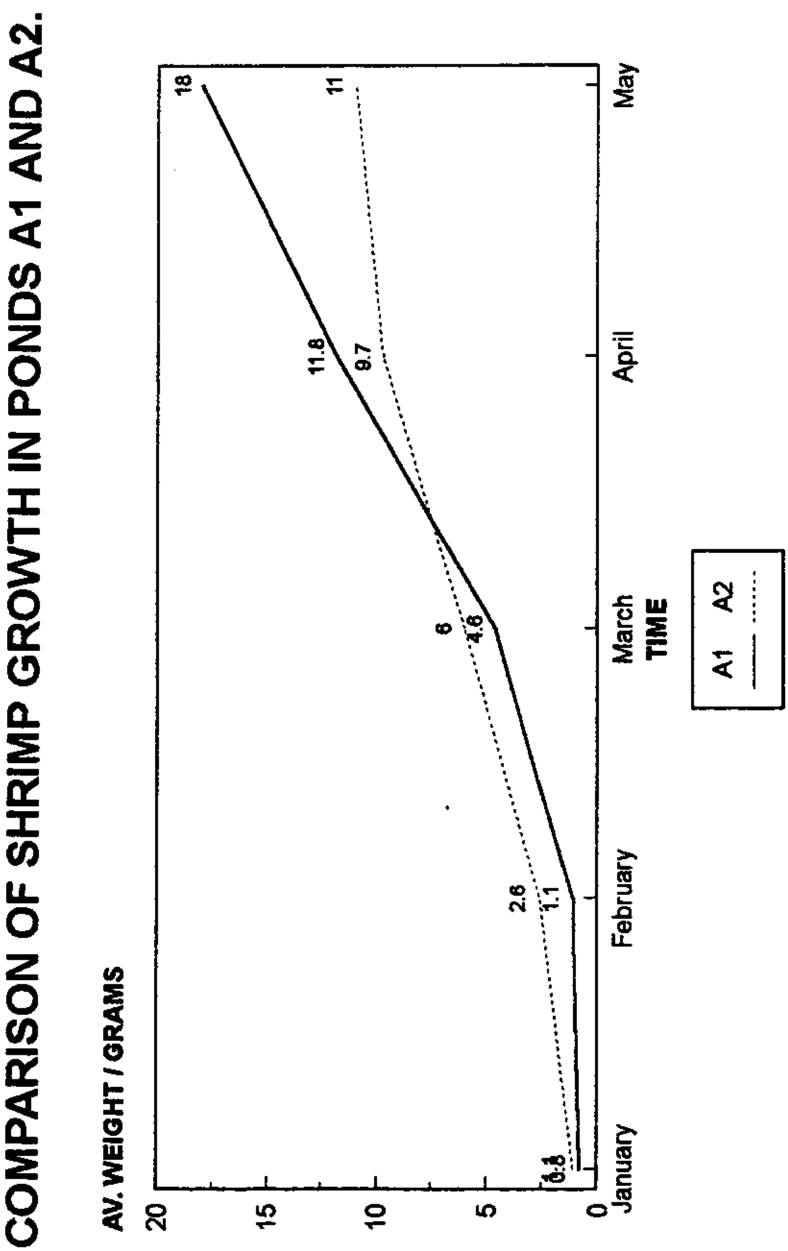

Figure 1. Comparison of shrimp growth in ponds A1 and A2.

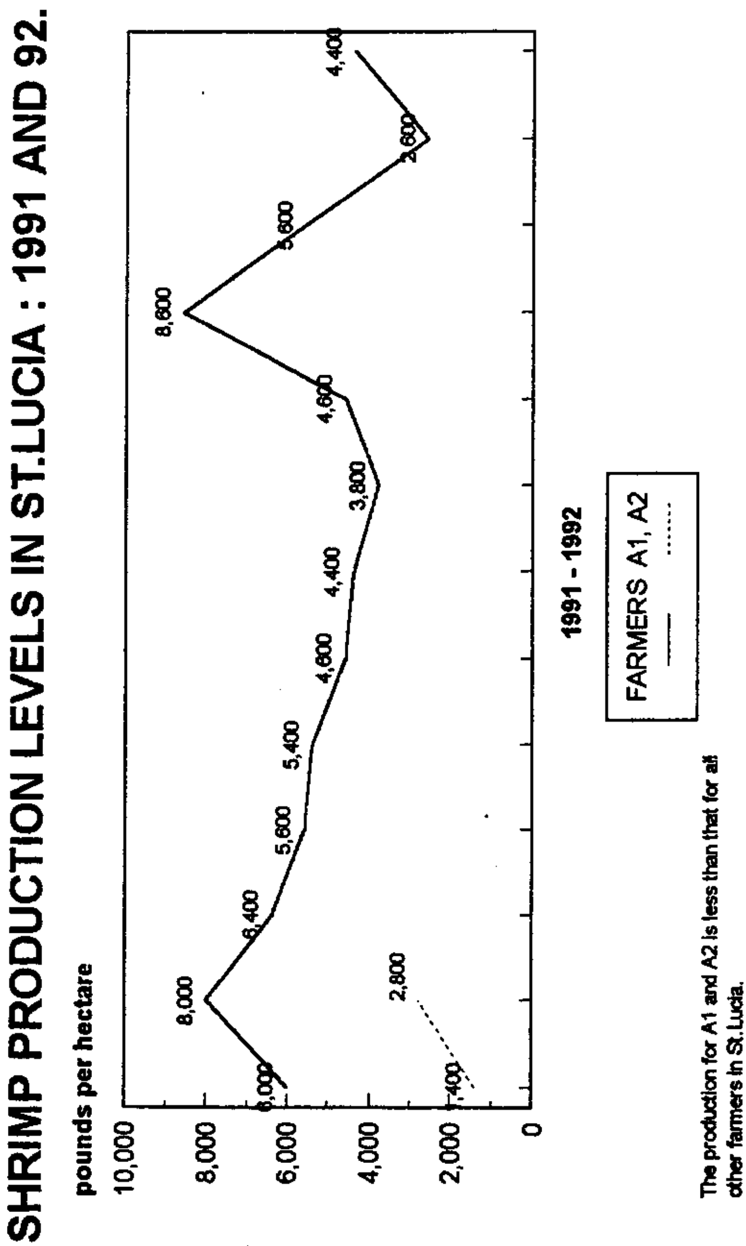

Figure 2. Shrimp production levels in St. Lucia : 1991 and 1992.

further supported by Chamberlain (1988) when he proposed that as much as 50% of the feed delivered to a pond becomes part of the decomposing organic material which, if allowed to accumulate, leads to low oxygen levels. As a matter of interest, it can be noted that Dr. Shigueno (1975) conducted an experiment in shrimp ponds in Japan where he found that shrimp avoided areas in the pond where low oxygen levels existed but readily returned to these areas once conditions improved (*i.e.*, oxygen levels rose).

Pond productivity is clearly influenced by multiple factors. Feed quality is an obvious one. When all other factors are normal, high protein feeds given in the right amounts will produce fast growth. When water quality is less than good however, care must be taken both to prevent overfeeding so that there is little spoilage and secondly, to choose a food type which degrades rapidly. Based on the results from Table 3 (from January – March), it is likely that under higher water exchange rates, sardines may most likely be a better feed. Although the results are not conclusive, (repeat trials are needed to confirm the findings) they do provide helpful information for farmers. A farmer with pond conditions such as those in the trials, may be advised to feed with chicken feed rather than with sardines despite the latter's higher protein level and thus better potential for tissue growth. Unlike sardines, however, chicken feed is easily broken down and absorbed into the substrate leaving little decaying material behind. Uneaten sardines remain at the bottom of the pond for a long time where decay is slow and anaerobic conditions are allowed to develop. Low oxygen levels are inevitable and with poor water exchange this can lead to high mortalities.

Production was far lower in both ponds than normal (normal being 100 – 150 pounds per pond when paddlewheel aerators are used and water exchange is more frequent). The results have helped emphasize the benefits of artificial aeration and frequent water exchange in ponds with non-continuous water flow. These observations have helped aquaculture officers in St. Lucia assess land for aquaculture. This has been especially relevant over the last couple of years.

CONCLUSION

Interest in aquaculture, more so shrimp culture, has grown significantly. Several persons in St. Lucia have expressed a desire to culture freshwater shrimp. Unfortunately, some of them are unable to access water by gravity flow and thus, rely on pumps. Some areas do not have electricity services available and so installing aerators is not easy. Due to the close down of the St. Lucia feed mill in 1992, processed feeds are imported which has increased their costs. Farmers have thus started to use more local products such as sardines and other wet feeds. The pond conditions tested in the trial are thus not far fetched but actually exist on the island. The results from this preliminary study have helped aquaculture officers recommend the following to farmers with the above conditions:

i. use a dry, processed feed if possible or use sardines sparingly, being careful not to overfeed;

ii. do partial water exchange at least every three to four days;

iii. where pumps may be unreliable, introduce generator operated paddlewheels or injection aerators;

iv. carefully monitor ponds especially after overcast days. Water exchange should be more frequent on these days;

v. if oxygen levels cannot be improved, it may be better to harvest the crop and sell at a lower price and thus cut further losses. In fact, this has already been tried and some farmers have actually found it profitable to grow shrimp for 4 months, sell them at a lower price of $12 per pound and avoid the risk of high mortalities at the larger size.

With the above guidelines, several farmers have been able to run successful shrimp ponds without continuous water flow and with locally available food materials.

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