Effects of Pond Size

Work Plan 5, Thailand Study 9

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Introduction

Having studied the relationship of pond depth to fish production and other parameters of ecosystem response to fertilization (Szyper et al., 1991; Szyper and Hopkins, 1993), the Thailand component next investigated the effects of pond surface area. Extrapolation, particularly scaling upward the results of trials in small impoundments to production scale ponds is a classical and unsolved problem in aquaculture. There are numerous cases of impractical, high areal production rates observed in research scale water bodies (Colman and Edwards, 1987). Our interest here was not in "solving" the larger problem, but rather to examine earthen ponds of available different sizes for potential effects on CRSP experimental results at the Asian Institute of Technology (AIT). The results should have more general applicability because the relatively small ponds used (areas of 200 to 1400 m^2) are similar to those used by farmers in Thailand, the Philippines, and elsewhere, though farmers' ponds range to much greater areas.

Materials and Methods

A five-month experiment was conducted in 11 earthen ponds of four different surfaces areas (approximately 200,380,610, and 1390 m^2) with triplicate ponds of each size, at AIT. Ponds were stocked with sex-reversed fingerlings of Nile tilapia, *Oreochromis niloticus*, at 2 fish per m^2, maintained weekly to depth of 1.0 m, and fertilized weekly with chicken manure at 250 kg dry matter / ha / wk supplement with urea and TSP to attain rates of 35 kg N / ha / wk and 7 kg P / ha / wk. Water sampling and analysis were performed according to standard protocols, with detailed water sampling / analyses conducted every month.

Results and Discussion

Extrapolated yields ranged from 1,921 to 8,631 kg / ha / yr (Table 1). Single-factor ANOVA showed no significant relationship between yield and pond size. A plot of yield as a function of pond size (Figure 1), although positive, was also not significant.

Table 1. Extrapolated Fish Yields (kg / ha / tr)

	Pond Size (m^2)			
	200	380	610	1390
Replicate 1	4,918	6,905	7,709	8,631
Replicate 2	3,520	1,921	4,896	4,670
Replicate 3	3,923	5,277	6,714	
Mean	4,120	4,701	6,440	6,651
Standard Error	416	1,467	824	1,981

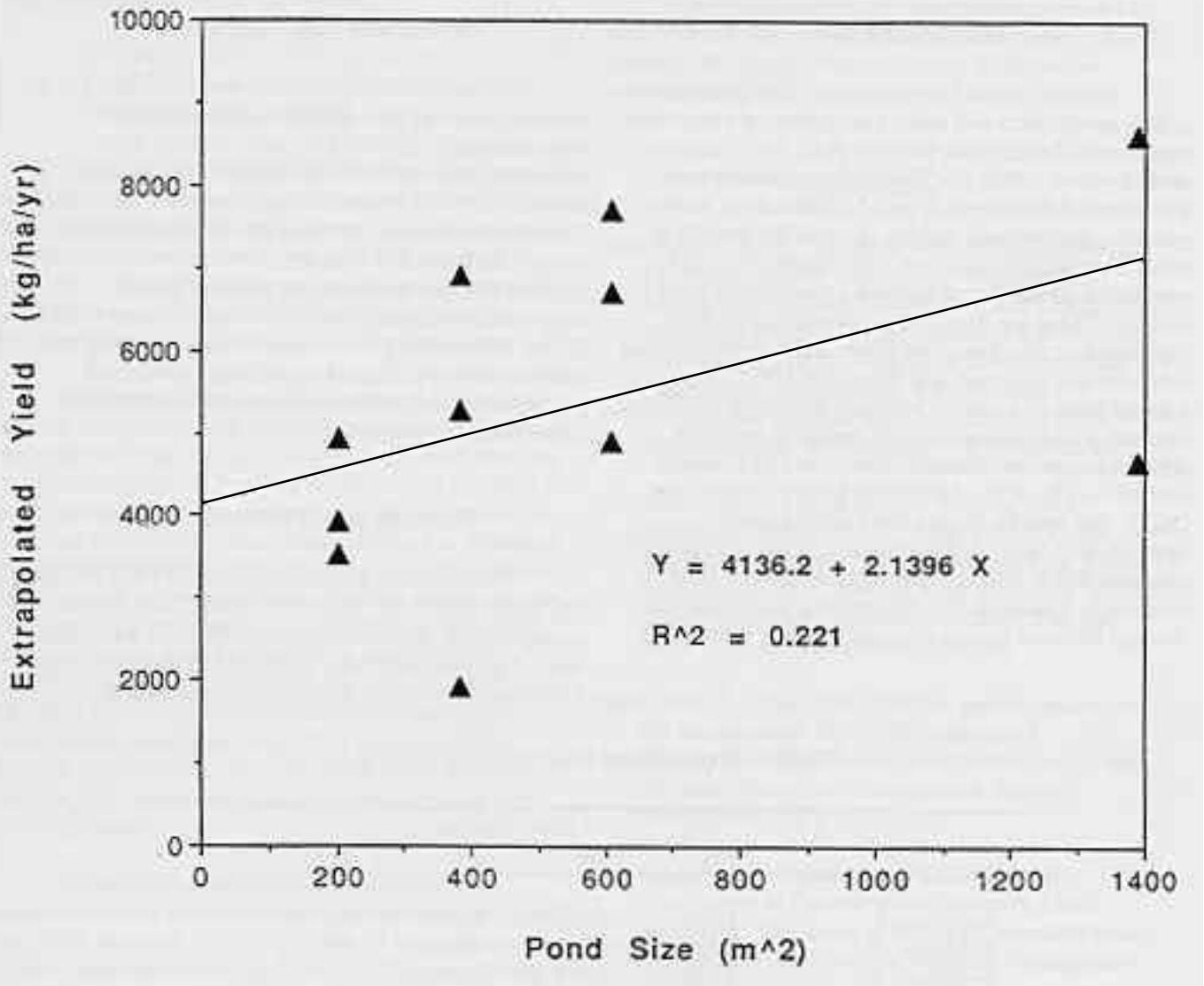

Figure 1. Relationship between pond size and yield.

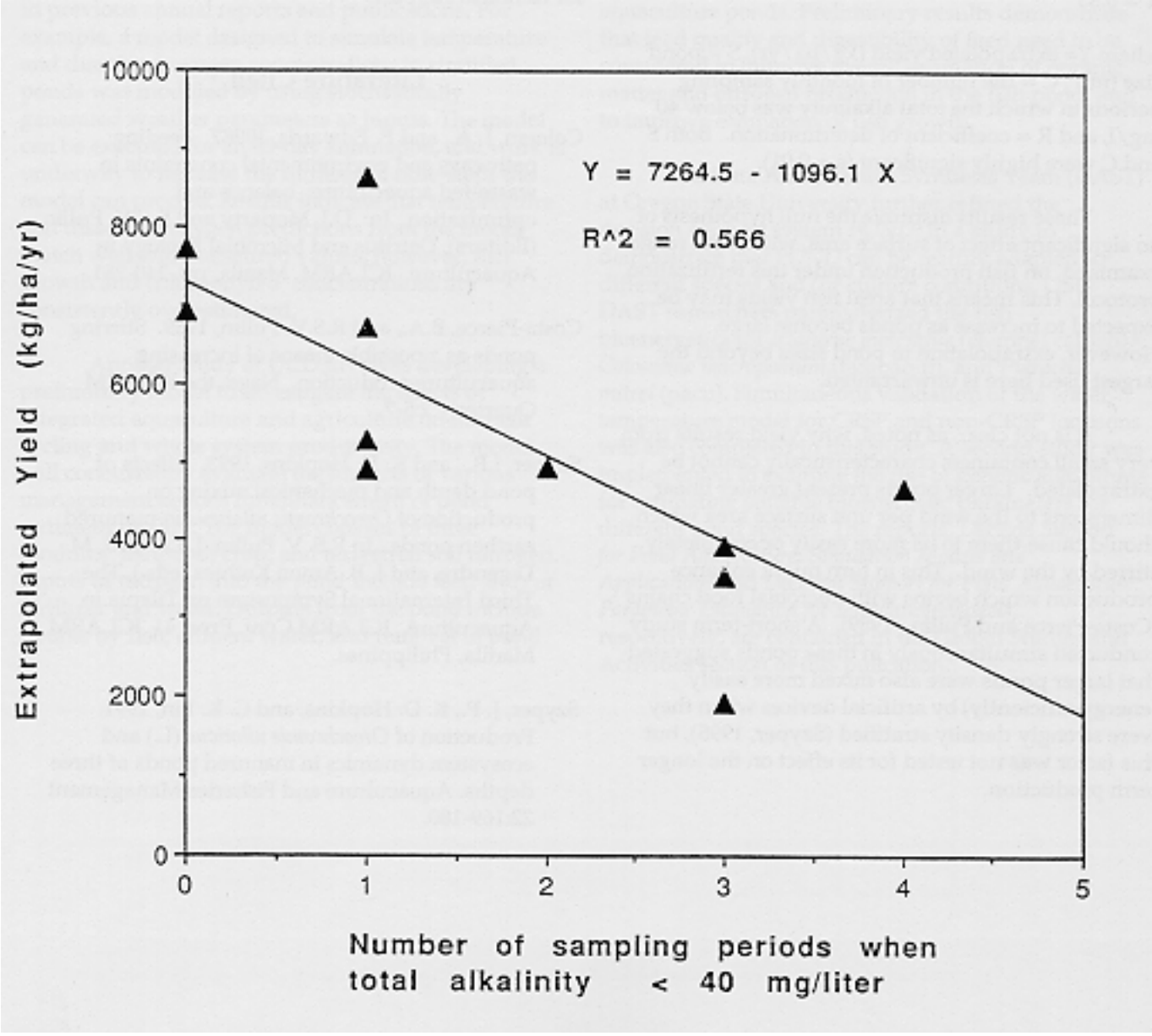

Figure 2. Relationship between alkalinity and yield.

However, further analysis indicated low alkalinity (Figure 2). Computing a multiple regression relating pond size and low total alkalinity to fish yield produced the following equation:

$Y = 5988 + 2.34\ S - 1137\ C$
$R^2 = 0.83$

where Y= extrapolated yield (kg / ha / yr), S = pond size (m^2) , C = the number of monthly sampling periods in which the total alkalinity was below 40 mg / l, and R = coefficient of determination. Both S and C were highly significant (a = 0.01).

These results disprove the null hypothesis of no significant effect of surface area, within the range examined, on fish production under this fertilization protocol. This means that areal fish yields may be expected to increase as ponds become large. However, extrapolation to pond sizes beyond the largest used here is unwarranted.

It is not clear, as noted, why yield results from very small containers characteristically cannot be extrapolated. Larger ponds present greater linear dimensions to the wind per unit surface area which should cause them to be more easily or completely stirred by the wind. This in turn might enhance production which begins with microbial food chains (Costa-Pierce and Pullin, 1989). A short-term study conducted simultaneously in these ponds suggested that larger ponds were also mixed more easily (energy-efficiently) by artificial devices when they were strongly density stratified (Szyper, 1995), but this factor was not tested for its effect on the longer term production.

Acknowledgments

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