On-Farm Production Trials with Nile Tilapia in Fertilized Ponds in Highland and Lowland Areas of the Philippines

Interim Work Plan, Philippines Studies 1 and 3

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Introduction

Production of particle-feeding fishes, such as the now commonly-cultured Nile tilapia (*Oreochromis niloticus*) in fertilized ponds has been reasonably well-researched and demonstrated in technical terms. Actual farmer practices in developing countries, and their amenability to modification by research-derived fertilization guidelines, have been documented and analyzed (Molnar et al., 1994). In general, use of new guidelines requires little modification of basic practices, involving, rather, use of different materials as inputs and reliable and quantitative attention to input schedules and pond appearance. The potential benefits include greatly increased yields per unit pond area and per unit input cost.

On-farm trials of such guidelines have been conducted in several countries by component projects of the Pond Dynamics/Aquaculture Collaborative Research Support Program (PD/A CRSP), including those based in Thailand, Honduras, and Rwanda. In the Philippines, small-scale farmers commonly have more than one pond, and grow two crops per year of Nile tilapia using inputs including manure and inorganic fertilizers. The PD/A CRSP guidelines represent, as noted above, only small modification of the routine practices (Molnar et al., 1994).

We report here the results of three trials, each conducted during a coherent production period of four to six months on Luzon island in the Philippines. Two of the trials took place in lowland areas of Central Luzon, Nueva Ecija province; the third was conducted at elevations of 1000 to 1700 m in Mountain province. The objectives of the lowland trials were to demonstrate on-farm feasibility of fertilization guidelines and to quantify yield parameters. The objective of the high-elevation trial was to complete the examination of high-elevation (mainly temperature) effects on farm outcomes which was begun in Rwanda (Seim et al., 1993), but left incomplete by the tragic upheavals there. This trial compared outcomes at different stocking densities at two ranges of elevation.

Table 1. Structure of on-farm production trials for *Oreochromis niloticus* in fertilized ponds in Central and Northern Luzon, Philippines.

Characteristic	Mountain Province		Nueva Ecija Province	
	Barlig Town	*Sagada Town*	*Various Towns*	*Lupao Town*
Elevation (m)	1000 to 1400	1400 to 1700	0 to 100	0 to 100
Period	Mar to Jul	Mar to Jul	Aug to Feb	Oct to Feb
Number of Farms	20	13	11	10
Pond Sizes (m^2)	25 to 136	25 to 200	976 to 5865	135 to 1000
Stocking Density (no./m^2)	1, 2, or 3	1,2, or 3	2	2 or 2.19
Nitrogen Inputs (kg N/ha/d)*	4	4	4	2 or 4

* N:P ratio of nutrient inputs = 5.

Materials and Methods

Three field trials were conducted between March 1994 and February 1996. Farmers were enlisted from Mountain province, a highland region, and the lowland Nueva Ecija province, to manage one of their ponds through one growout cycle of Nile tilapia (*Oreochromis niloticus*) using specified stocking and fertilization protocols. Fingerlings were grown to market size, taking approximately four months in most cases. The highland region consisted of two elevation ranges, 1000 m to 1400 m above MSL, and 1400 m to 1700 m.

Fingerling *O. niloticus* of approximate weight 4 g/fish for initial stocking, and fertilizers for weekly addition to ponds, were given to the farmers; sampling of fish and water was done monthly by the senior author and local project personnel, who also assisted farmers with the initial fertilizer application. Cost-free provision of fingerlings was considered a necessary incentive in these early trials because the local costs are significant, approximately \$0.005 to \$0.020 depending on size, although some communal ponds may receive free stock from government hatcheries.

Table 1 details the structure of these trials in terms of location, numbers of participants, and intended comparisons of parameters, including elevation ranges (1000 m-1400 m and 1400 m-1700 m), different stocking densities (1, 2, and 3 fish/m^2) in the high-elevation trial and two levels of fertilizer input (4 and 2 kg nitrogen/ha/d, at an N:P ratio of 5:1, as diammonium phosphate and urea) in one of the low-elevation trials. The higher fertilization rate was standard for the other trials. The other low-elevation trial involved several different strains of *O. niloticus*, but was not designed as a formal comparison.

Monthly sampling and analyses consisted of:

1) sampling of at least 25 fish, randomly selected from a seine haul, for total length (TL) and bulk weight;
2) near-surface water samples for analysis of total alkalinity (TA), total ammonia, soluble reactive phosphorus (SRP), pH, dissolved oxygen (DO) and temperature; and
3) measurement of pond depth.

In addition, in the second lowland trial DO and temperature were measured at top, middle, and bottom depths when possible, and Secchi disc depths were recorded.

Ponds were harvested after approximately four months (longer in some cases) by seining and complete draining. Fish were weighed and measured as above and left to the farmers, who consumed, bartered, or re-stocked them for further growout.

Water analyses were performed according to standard protocols (Lind, 1974; Boyd 1979). Dissolved oxygen was measured in the field by polarographic probe; pH was determined in the laboratory by gel-filled combination electrode; total ammonia was determined by the indophenol method; total alkalinity was determined by titration to the methyl orange end point; and

Table 2. Tilapia yields (kg/ha/yr) from on-farm fertilization trials.

Characteristic	Mountain Province		Nueva Ecija Province	
	Barlig Town	*Sagada Town*	*Various Towns*	*Lupao Town*
Elevation (m)	1000 to 1400	1400 to 1700	0 to 100	0 to 100
Number of Farms	20	11	11	8
Average Yield	1259	2215	2309	2217
Minimum Yield	538	981	859	1109
Maximum Yield	2195	3524	3293	3920

Note: The two farms using feeds had yields of 9356 and 10,933 kg/ha/yr.

soluble reactive phosphorus (SRP) was determined by the molybdate method. Statistical analyses were performed using Statmost and Cricket Graph.

Results and Discussion

Data were collected from 52 of the 54 farms stocked. The other two ponds were lost to a dike collapse and poaching. Fifty of the farms reported that they had used the PD/A CRSP fertilizer regime. Two of the farms used feed instead.

Extrapolated fish yields were extremely variable and ranged from 538 to 3920 kg/ha/yr (Table 2). The yields from Barlig town in Nueva Ecija had lower yields than either Sagada or the lowland ponds. It appears that this is related to survival. In Barlig, 60% of the farms had survival of less than 51%. In Sagada, only 18% of the farms had such poor survival.

A direct examination of the effects of stocking density on yields was impossible because of the variability in survival rates. As most mortality occurs early in an experiment, harvest density was used as an indicator of fish density during the experiment. Fish density accounted for 69% of the variability in yields (Figure 1). The reasons for the variability in density have not yet been identified, but could be attributed to a range of factors from stocking stress to poaching.

Comparison of the lowland trials to the highland trials was complicated not just by variable survival, but by the seasons as well. Given the availability of project facilities and staff, it was impossible to conduct the trials simultaneously. The highland trials started in early spring and ran into the summer. The lowland trials started in late summer and ran into the winter. Low water temperatures, slightly below 20°C, were measured in both the highlands and lowlands. However, based on reliable information, winter temperatures in the highlands can be much lower than this. Thus, our extrapolation of yields to an annual basis is probably invalid for the highlands. Although multiple crops per year are possible in lowland areas, probably only a single tilapia crop per year is possible in the Mountain Province.

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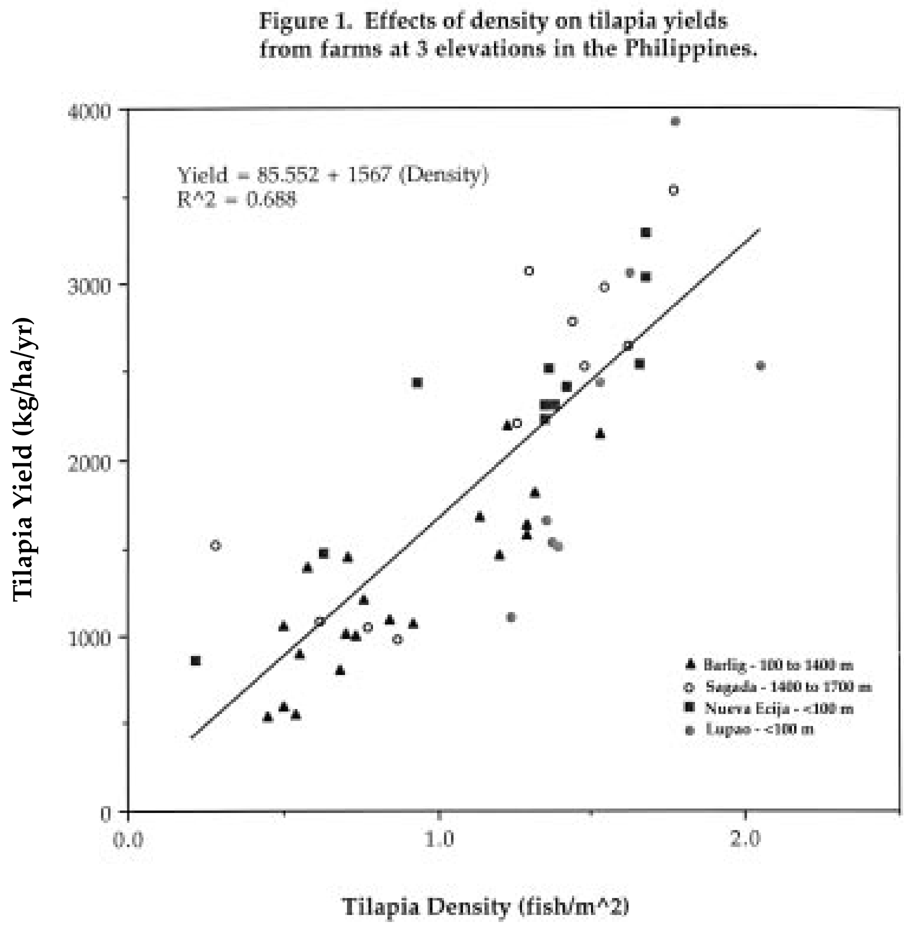

Figure 1. Effects of density on tilapia yields from farms at 3 elevations in the Philippines.