ALTERNATIVE DESIGNS AND

COMMENTS ON EVALUATING THE NUTRITIONAL CONTRIBUTION OF FISHPONDS

with Reference to the USAID/Panama
Managed Fishpond Project

A REPORT TO THE USDA NUTRITION ECONOMICS GROUP

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This note on research orientation and methodology is an outgrowth of, and a response to, Judith McGuire's consultancy report to the Nutrition Economics Group, USDA/OICD, under contract No. 53-319R-0-45. In the following, familiarity with the project is assumed, and a premium is placed on brevity. (But the paper grew inescapably when budget considerations had to be added.)

I. ASSUMPTIONS

The task is to evaluate the nutritional effects of constructing managed fishponds in 30 small Panamanian villages, averaging perhaps 30 households each. These assumptions are made:

1. The ponds are not viable unless they are economically self-sustaining after start-up costs; an independent financial appraisal will be made.
2. The ponds are co-op run, probably not achieving 100% participation; information from co-op managers can be gotten independently of a household-level survey.
3. The nutritional concern is protein intake, indicated by poor protein quality and quantity in the diet. (The extension to energy is straight-forward.)
4. The nutritional outcome variable is the change in household protein consumption per consumer equivalent, to be established by surveys. The individual is not the focus, but households are asked whether fish is given to children.

II. RESEARCH OBJECTIVES

1. Do fishponds boost total household protein consumption?
2. What household characteristics affect the outcome?
3. What community characteristics affect the outcome?

Objective 2 aimes at discovering:

2A. Which households benefit and why?
2B. Are households having the poorest diets reached?
2C. Are fish substituting for other foods?

The substantial expansion of the questionnaire required for determining indirect effects may or may not be warranted:

2D. Are fish altering diets through price effects on other foods?
2E. Are fish altering diets through income effects from changes in labor allocations or private commercial disposal inside or outside the village?

Objective 3 aimes at discovering (partial list):

3A. Should the project be extended to other communities? What type?
3B. Is total pond output relative to village size adequate to effect a meaningful household-level dietary change?
3C. Is the output distributed to co-op members adequate to effect a change? (Important if some fish are sold by the co-op to meet expenses.)
3D. What are the terms of distribution? Free? Concessional price? According to labor input? According to household size?
3E. Is there co-op distribution to non-members in the village? On what terms and what magnitude?
3F. The extent of co-op participation.
3G. The extent and nature of disposal outside the village by the co-op.

There are differences and overlap between Objectives 2 and 3. The household-level investigation is certainly distinct from a co-op and community inquiry concerned with fishpond operation and output, and community-wide characteristics. But note that objective 3 is really compound. Subquestions 3B-3G hold some interest even if one community is studied and no household survey is conducted. Alternatively, answers to these questions at the co-op level may be demanded to explain a "no consumption effect" result from a household survey.

The important issue of extension of the project, contained in 3A, is another matter. The question <u>necessitates</u> the household survey to arrive at one observation of the community-wide consumption effect. One observation cannot stand alone in this expanded context if community-wide conditions are suspected to vary importantly, so a sample of community effects and characteristics must be analyzed together.

Variations in some of the following conditions might require this approach:

1. Pond size relative to the community size.
2. Type of fishpond feed (commercial, village crops, animal wastes).

3. Access to nets, markets, other disposal channels.
4. Co-op participation, management structure, fish-distribution procedures, or harvest frequency. (Do more fish go to larger households?)
5. Productive potential of the ponds due to sunlight, altitude, climate, harvest schedule, size, etc.
6. Proximity to extension services.
7. Preferences and baseline diet: Will more fish be eaten if rice is dominant?

If these factors are deemed important and variant across villages, then pertinent community data must be collected.

The overlap of Objectives 2 and 3 allows some valuable cross-checking of co-op and household figures for:

1. The extent of membership.
2. Labor inputs.
3. Quantities and frequency of fish distribution to the household.
4. Conditions of distribution to members and nonmembers.

Two important transactions which probably cannot be checked by comparing co-op answers with household answers are gift transfers and resale.

III. THE CRUX

Whether the evaluation is successful may turn on the study's ability to penetrate the temporal and household distribution of fish.

1. Temporal Distribution Timing enters three ways: through seasonality, the production cycle, and storability. The expected best and worst seasons can be treated separately. These are seasons with high or low protein intake from non-fish sources. However, there may be seasonality in the pond production levels. Do experts say output is constant? What about seasonality in level of fish feed if it is derived from crop or animal sources? It cannot be assumed that the yearly average protein intake equals the best season/worst season average, yet stratifying by season is probably sufficient to be highly informative.

Within seasons, the timing of the survey with respect to the last fish harvest is critical. McGuire reports that fish "lasts no more than 10 days after it is

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* In other words, are there variations in the complementarity of the existing diet with fish?

harvested (and dried) and most people used up their allotments in 2-4 days." It is argued that weekly harvests are necessary to significantly alter the diet. Even if they are achieved, there is reason to suspect within-week fish consumption cycles. It is not unlikely that some villages will harvest two or three times a month at best. Fish may displace certain foods to other days and thereby raise protein consumption even when fish is not eaten, but the strong expectation remains of several protein consumption peaks and trailing-off periods per month.

The utter uniqueness of studying a phenomenon potentially having such marked periodicity, (high amplitude, short cycle) must be recognized and built into the research design, in my opinion. Two examples follow; others are plausible:

Example 1: One village is under study, before and after the fishpond. The harvest cycles are 10 days, but most households are interviewed in the "after" survey 5 days since the last harvest. The effect is underestimated.

Example 2: Several villages are compared. Villages further away tend to be visited systematically later in the week, as a result of convenience. This corresponds to being surveyed later after harvest. A particular community variable (distance, altitude, certain crops?) shared by the remote villages is statistically related to a fictitiously low protein effect. The recommendation is handed down not to expand the project to villages with that characteristic in the future.

To really handle this problem, it may be necessary to randomize days of observation somewhere along the line, and (not or) include questions pinning down when the last harvest was. Surveying three days in a row does not suffice since a crucial issue at stake is whether there are biases influencing the beginning of the observation period. Validly sampling the cycles presents its own unique administrative burden.

2. Household Distribution It should be relatively easy to obtain total production. The household distribution is more difficult. Where does it all actually go besides into the kettle? Invisible transfers, gifts, sale or re-sale

by households, sale by the co-op, spoilage, unequal distribution, may all bear investigation. If distribution, by design or default, is at a concessional price to co-op members, some households may purchase more than they intend to consume, lowering the village consumption effect if it is re-sold elsewhere.

IV. A PARAMETER

About 40 pounds whole fish per week in a community of 100 consumers supplies 4.4 gm protein per person per day. This is about 10% of the pilot study's observed protein intake, including two villages (out of three) already having ponds. This compares with an average weekly yield of 50-70 pounds at a model site in the village of Buenos Aires, Panama. A 10% gain may not be an unreasonably high target.

V. EVALUATION DESIGN

The stated research objectives require household and community data. Even without the issue of extending the project (3A), community information on the functioning and output of the pond is needed to fully interpret the household effect should no consumption gain be observed. Judging the project's nutritional success in terms of community characteristics entails a further expanded set of village data, as sketched above.

Testing the statistical significance of a protein consumption gain should involve a careful examination of what is the unobserved dimension requiring generatization. Another approach to the same issue is to ask "What is being randomized and sampled?" McGuire advocates surveying all households in the community. If they are all included, there is no need to infer or generalize the result to other community members. There are no unobserved households, and there is no need to randomize a 100% sample. The "significance level", in this context, gauges the

likelihood of the outcome if all observations were included. In this sense it is superfulous.

Likewise, if the universe of interest is all communities in the project, and they are all surveyed, as recommended in McGuire's report, then the question of sampling and significance again does not arise viv-à-vis unobserved project villages. The "universe of interest", however, might be all villages which might become project sites or fishpond sites in the future. Then the question is whether the villages chosen in this project are representative of others that may be of interest.

The other unobserved dimension is consumption by households on days not surveyed. Have they been adequately sampled? The above comments on the periodicity of fish consumption expose the need to avoid biases in the days of observation. Three possibilities are::

1. Some randomization of the days of observation;

2. Weighting the consumption effect of different days according to the time since the last harvest and the number of days at that level represented; This may require prior knowledge of the timing of harvest, and some drop-off-in-consumption estimate. If we knew harvest was on Monday, and consumption (of fish) would tend to be high and constant on Monday and Tuesday, low and constant on Thursday through Sunday, weights of 2 and 4 for observations on Tuesday and Friday might yield a good weekly figure. (Wednesday is assumed to be in between.)

3. Spreading the households surveyed through the harvest cycle. This may give a good community figure (under certain assumptions), but it could present problems for analyzing household characteristics. Since no household by itself has a representative level of fish consumption (if indeed it tapers off after harvest and has marked periodicity), spurious household characteristics might be held accountable for variations. A partial correction might be possible if a question on lapse time since harvest is included.

Perhaps periodicity of intake and the biases of days of observation are not as severe as these reflections imply, but a strong prima facie case can be made that it demands some careful consideration.

Probably all communities should be observed if 1.) one goal of the evaluation

is to decide whether the project should be extended to other villages; 2.) important community-level variables are believed to vary significantly; and 3.) the communities in this project are representative of others, within or outside of Panama, that might become fishpond sites. Even with all villages in the study, N equals 30 communities. This means that at best, maybe one to three characteristics will emerge as important predictors of what type of village a pond is likely to affect nutritionally, assuming some successes and some failures. Discriminant analysis would be possible. If this technique is used, villages would be grouped into "large protein gain" and "small protein gain" categories, and a dummy variable indicating this classification would be the dependent variable. The difference in protein consumption, before and after the pond, at the community level, is used to place villages in categories. The technique is more appropriate if the outcomes are bunched (clear successes and clear failures), but the level of gain that qualifies a village for inclusion into the "large effect" or "success" category can be set arbitrarily or in conjunction with nutritional considerations. An 80-100% household sample within villages is recommended.*

If no extrapolation is required (objective 3A is dropped) and only the present project is being evaluated, then a 100% community sample (all villages) is probably not necessary. Fifteen or twenty villages, chosen at random, should give a good idea of the impact of the project on protein consumption. Sampling no more than half of the households in each, a t-statistic based on a household N of 225 would suffice for the total picture. Each variable in this test would be the household difference (paired), and the SD would have to be computed on the set of household differences.

Any investigation of household characteristics affecting the outcome will probably require merging villages. If regression is used, for example, (there are assumed to be no more than 30 households per village on average) even a 100% sample would allow only one or two explanatory variables to be included if a single village were studied. Regressions might be performed on households merged into two or three

* This approach does not depend on household pairing.

different classes, varying on some important community-wide characteristics, or some community variables (pond area in square meters per co-op member?) might enter a regression of all households combined. In either case, the dependent variable would be the household difference in protein consumption per consumer equivalent.

In conclusion, studying either household characteristics influencing the protein effect, or the total success of the project, may not demand a 100% sample of the villages, nor a 100% sample of households within. Projecting the impact of future fishponds may require a 100% village sample, a nearly complete sample of households within each, and the assumption that the villages the project enters are representative. The ability of the evaluation study to validly represent the short-term cycles in fish consumption that are expected, and to penetrate the distribution of output, will largely determine its utility.

It may be advisable to have a long-term follow-up survey of a few villages providing more than the 18-month perspective afforded by McGuire's suggested design. Since the construction of ponds is phased in over three years, the survey teams will still be operating in some villages long after the first ponds are in operation. This facilitates a later follow-up of the communities where ponds were first introduced.

VI. ALTERNATIVE PROPOSALS

HOUSEHOLD ANALYSIS

Although randomizing the days of observation is the most appealing solution to the periodicity of intake problem from the conceptualization and analysis stand point, the logistical and administrative difficulties may seem insurmountable. A key parameter is the harvest cycle length from which days would be sampled--the longer, the more burdensom. Barring this approach, combining possibilities two and three may be a "second best" solution. Three successive days of observation would be made to overcome day-to-day variations in intake, as under McGuire's Option A. The three-day periods would be spread across the harvest cycle by design, so that some households would be observed during, just after, and long after harvest, and at the midpoint between harvests. Hopefully this will yield a fairly accurate village average intake over the cycle. The problem of spurious household characteristics being held accountable for differences in household level intake, which are actually due to the time factor, remains. However, the questionnaire can obtain information on the time since harvest, the storability of fish, and changes in intake through time. The two most apparent methods of using this information to correct for biases would be either to include the number of days between harvest and the survey as an explanatory variable in a regression analysis, or to estimate a "drop-off in consumption" function and use this to impute average levels of intake over the cycle. The cycle lengths would be expected to vary between villages, and again, this question of periodicity gains importance when the cycle is long. It may not be such a problem if a weekly harvest schedule is actually followed. Without due care, there will be a troublesome tendency to gather information from the households which

only reflects the periodicity issue without being appropriate to use directly in the consumption-effect analysis. The questionnaire must be designed with the specific type of analysis in mind to minimize the amount of less-usable secondary-type data.

It is possible that high protein foods will be displaced by fish in the sense of being consumed later after harvest once the fish has been used up. This will of course mitigate the periodicity of protein intake. However, a working hypothesis is that fish intake at least, and maybe protein intake, may have a quadratic drop-off functional form. So it may be worth pointing out that the time since harvest (number of days) and probably its square, would both be appropriate in a regression

It has been suggested that for evaluating the nutritional impact of the project, something less than a 100% sample of households in villages may suffice. In some cases, it may be cheaper to survey all households than to trace household I.D.s to find a particular sample. For what village size is the trade-off equal? McGuire's report assumes a census of households has been made prior to the survey. I would suggest, as an approximate approach, including all households in villages under 40 in size, and half of the households in larger villages. This should not introduce any new wrinkles in the question of whether to weight observations when households from several villages are combined for analysis. The villages would not be equally represented in McGuires"100% of all villages" recommendation anyway. If some villages are large and households are unweighted, the proposed modification would reduce over-representation as well as cost (presumably).

I am dubious of the merit of collecting income and expenditure data for the purposes at hand. Curtailing the scope of the questionnaire in this respect would also lower cost. Neither this suggestion, nor the recommendation to survey half of the households in large villages are costed out in the budget estimate that follows (after village analysis). A guess as to the cost of

spreading observations throughout the harvest cycle is made. The main cost increases would accrue from more time and more travel.

In the pages that follow, Options C and D are added to McGuire's A and B for survey design. C and D both include the suggestions made above, and it should be kept in mind that some of these modifications will lower costs, although this has not been included in the budget estimates. The main difference between C and D is in reference to the number of villages visited. D is geared to including objective 3A (inferences about future projects) in the design, and therefore requires a larger village sample than needed to just evaluate the one project. The village differences between C and D are elaborated on below. The main reason for not recommending changes in the household sample size, comparing C to D, is the inefficiency of hunting down and sampling large portions of small villages when a 100% sample may be easier.*

Both C and D envisage a long-term follow-up of villages that first had ponds constructed, probably in 1984. This is considered extremely important to realistically evaluate the project's impact. The impact in the first year after construction may not look like the years to follow. Taking only one of many examples, have the ponds silted up without being re-dredged?

* If village sizes ranged from 100 to 200 households (many times larger than in Panama), for example, then it might make sense to sample 30 households from each for the purposes of C, and a larger number for D, or if household analysis within a village (instead of villages combined) were of interest.

VILLAGE ANALYSIS

The following is one possible approach to studying village characteristics as they influence the success of fishponds.

Two questionnaires would be drawn up, called the "Village" and the "Co-op" survey forms. The first would record the more stable features of the village such as location with respect to roads and markets, access to advice from fishpond extension agents, the number of households, the proximity to non-agricultural employment possibilities, e.g. in semi-urban or urban areas, fixed factors that may affect fish pond productivity such as altitude or temperature, the fish pond size, and the like. A physical measurement of the fishpond may be necessary. (Circumference and depth?)

The "Co-op" form would be administered to the fishpond managers asking about co-op participation from the village (How many households?), the fish feed inputs to the pond, harvest frequency, yield, distribution schemes, labor inputs, nets, etc.

Under Option C, Confined to a project evaluation, the Village Form would be used 30 times: all 10 of the first series of villages would be surveyed at the time of the Winter Post Test (Household) Survey; 5 of the second-series villages and 5 of the third-series villages would be surveyed at the time of their Winter Post Test Surveys; and the first 10 villages would have a repeat visit in January and February of 1984 for a long term follow-up.

The reasoning for this suggestion is:

a.) Without extending the total length of the evaluation, only the first villages in which ponds are constructed are candidates for a long-term follow-up. Since there are so few of these, all 10 should be included. This means using the form in 5 first-series villages from which no household information is sought under Option C, at the beginning, and late into the project.

b.) The village characteristics of interest are not likely to change seasonally, so this form does not need to be completed in both seasons; however, they may change by the time of the long-term follow-up, so it is repeated then. Access to markets is one such characteristic that may change.

c.) The Village Form cannot be given during the pre-test survey since the pond size, and perhaps depth, if this is not standard, are being treated as village characteristics.

The Co-op Form would be given whenever the Village form is given. In addition, it would be given in the second season during the Summer Post Test Household Survey. However, it would only be given once during the long-term follow-up, since the household long-term follow-up surveys are only given once. It is assumed that in general, output, participation, and distribution information from the co-op will be of interest in both seasons.

Under Option D Option D requires all villages to be included so that the sample is large enough at the village level to extrapolate from to other possible fish projects. The protocols for the Village and Co-op Forms would be the same, but would be applied to all second and third series communities.

A reproduction of McGuire's Timetable, found on the next page, conveys the overview in simpler terms than the narrative approach above. "V" has been written in for the Village Forms, and "C" for the Co-op survey. The long-term surveys have been added under 1984. However, the timetable does not distinguish between Options C and D with respect to whether half or all of the second and third series villages enter the analysis.

Timetable for Expanded Survey Design

V = Village Characteristics Survey
C = Co-op and Pond Operation Survey
(A long-term follow-up household survey has been added.)

	1980	1981	1982	1983	1984
	M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
POND SERIES I	Summer Pre Test Survey I	Install 10 Fish Ponds → NEED ALL FOR LONG-TERM FOLLOW-UP. / Winter Pre Test Survey I	Winter Post Test Survey I / V+C / Summer Post Test Survey I / C	(V+C) →	ADDED: ↓ Preparation of Final Report / Long-Term Follow-Up Household Village, and Co-Op Surveys, 10 Villages. One season, determined by review of earlier returns.
POND SERIES II		Summer Pre Test Survey II	Install 10 Ponds / Winter Pre Test Survey II	Winter Post-Test Survey II / V+C / Summer Post-Test Survey II / C	
POND SERIES III			Summer Pre Test Survey III	Install 10 Ponds / Winter Pre-Test Survey III	Winter Post Test Survey III / V+C / Summer Post Test Survey III / C

Assumes prior census in each villagd with enumeration (1980) or concurrent census & enumeration with first pre-test survey in each village.
Assumes Fish ponds can be dug only in January-March.
Assumes 10 fish ponds will be built each year for 3 years starting January 1981.
Assumes Fish ponds require 3-4 months to reach capacity production (minimum requirement for post-test is weekly fish harvests)

VII. BUDGET

A. Notes on McGuire's Budget

A partial budget is given on p. 34 of McGuire's report. The interview and coding cost for her Option A is given as $43,500 and for Option B, $20,800. The author states these figures are exclusive of expenses for cars, gasoline, and fixed costs, which she does not attempt to estimate. Fixed costs include training for interviewers, analysis, report preparation, the project director's salary (full time for four years), etc. It is unstated in the report, but she has figured all labor at $7.50/day, including drivers, per diem's at $7.50/day, and equipment at $50.00/set. Coders do not receive per diems. Her calculations assume 25 households per village, and the census costs are external. It should be noted that no costs are included for questionnaire preparation or testing. There will be a significant amount of manual or computer matching of household questionnaires which will add to the cost of analysis.

B. Alternative Budgets

Using the same set of assumptions, wage rates, and limitations, a very rough idea of the interview costs of other alternatives, Options C and D, can be worked out. In both C and D, it is planned to interview households for three consecutive days per season, as in McGuire's Option A. This is probably necessary to overcome day-to-day variation in intake. Both C and D envision Village and Co-op surveys, and a long-term follow-up in ten villages including a one season repeat household survey. Option C considers only five out of ten of the second and third series villages. This reduces the total number of surveyed villages by a third. Option D, recommended for analysis extrapolating beyond simple project evaluation to find village characteristics conducive to

success at other fishpond sites, would survey all the villages. The suggestion to drop detailed income and expenditure portions of the household survey is partially off-set by requiring more information about the use and disposal of fish and the timing of the last harvest. Some budget savings may result, but the recommendation follows from the belief that given the intake data and the purposes of the evaluation, it is unnecessary. There will be a savings in terms of coding and analysis from its omission, again partially off-set by the additional village and co-op data that I am recommending be collected. Is it really the intent of the evaluation to perform thorough economic analysis of expenditure patterns and income?

The follow-up of the first series of villages in 1984 may cost about $3,500 for the interviews. This is similar to the 1980 expense of the first visit to this group of ten communities. Spreading the interviews through a harvest cycle is going to mean more time and transportation. As a guess, this may escalate costs 30-50%. Let's pick 40%. Two partial budgets for interviews would be:

Partial Costs of Interviewing and Coding

Option C

	$43,500	McGuire's Option A figure
	- 14,500	Dropping 10 Villages (One third)
	29,000	
	+ 11,600	(40% added on for spreading interviews throughout fish harvest cycle)
	+ 3,500	Long-term-follow up of first 10 villages, Household Form
	+ 1,300	Village and Co-op Surveys (See Below)
TOTAL	$ 45,400	

Option D

	$ 43,500	McGuire's Option A Figure
	+ 17,400	Spreading the Interviews adds 40% (assume)
	+ 3,500	Long-Term Follow-Up
	+ 1,800	Co-Op and Village Surveys (see Below)
TOTAL	$ 66,200	

Assumptions underlying Co-op and Village Survey Costs (Interviews Only):

Option C: 20 villages + 10 repeats = 30 Village Forms filled out
50 Co-op Forms (More since seasons)

40 Interviewer days
40 Driver days
10 Coder days
80 Per Diems

Assume one village and one co-op questionnaire per day. When doing seasonal co-op forms, assume two per day.

Option D: 30 villages + 10 repeats = 40 Village Forms
70 Co-op Forms

55 Interviewer days
55 Driver days
15 Coder days
110 Per Diems

It is expected that compared with the household level survey, a substantial amount of village characteristic and co-op data can be collected at low cost. Whether co-op records of pond output are kept may be critically important. Distance wheels or some other equipment may be needed to figure out pond area (the area can be found from the circumference if round). There are no additional equipment costs in the budget.

These interview budget guidelines have made some heavy assumptions and are totally dependent on McGuires figures and additional assumptions. Are they

informative or believable?

The consultant believes $7.50/day (50-80% above agricultural work) is reasonable for interviewers. Whatever does apply, it should probably be above the rate for drivers (McGuire has assumed the same wage). Only a pre-test will tell if six household interviews per person per day is reasonable. One village and one co-op form per day is a less strenuous pace. The 40% added on for spreading the timing of the household survey is pure speculation. There is no contingency allowance in the budget, nor additional time for repeat visits to locate missing respondents.

NOTE: Before launching into an evaluation of the protein impact of the project, in my opinion, there should be a clear demonstration that protein is a distinct, widespread (in target villages) and important nutritional constraint. The apparent heavy reliance on tubers is suggestive.

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