Executive Summary

Development of a Nutrition Intervention Evaluation Methodology for Developing Countries

Prepared for Office of Nutrition,
Bureau of Science & Technology,
Agency for International Development
Under Contract No. AID/DSAN-C-0206
By Abt Associates Inc.
55 Wheeler Street
Cambridge, Massachusetts 02138

September 30, 1982

ABT ASSOCIATES INC.
55 WHEELER STREET, CAMBRIDGE, MASSACHUSETTS 02138
TELEPHONE • AREA 617-492-7100
TELEX: 710-320-1382

AAI No. 82-35

Contract No. AID/DSAN-C-0206

Project Director:
Larry C. Kerpelman, Ph.D.

Principal Report Authors:
Larry C. Kerpelman, Ph.D.
Stephanie Y. Wilson, Ph.D.
Jonathan D. Hodgdon
Paul Oostenbrug
John Himes, Ph.D.
David Poppe
Marian Zeitlin, Ph.D.

EXECUTIVE SUMMARY

Development of a Nutrition Intervention Evaluation Methodology for Developing Countries

September 30, 1982

Prepared for:
Dr. Stewart Blumenfeld
Office of Nutrition, S&T
Agency for International Development
Department of State
Washington, D.C. 20523

Contract Manager	Quality Control Reviewer	Management Reviewer

Abt Associates Inc.
55 Wheeler Street, Cambridge, Massachusetts 02138
Telephone • Area 617-492-7100
TWX: 710-3201382

September 30, 1982

Dr. Stewart Blumenfeld
Office of Nutrition
Agency for International Development
Department of State
Room 306G, SA-18
Washington, D.C. 20523

Re: Contract No. AID/DSAN-C-0206

Dear Dr. Blumenfeld:

I am pleased to enclose five (5) copies of the Final Report for the subject contract. An earlier draft version of this report was sent to, and discussed in person with, our colleagues at the National Nutrition Council of the Philippines in July. A subsequent revised draft documentation was sent to, and discusssed with, you in August. This Final Report has taken account of almost all of the comments provided us as a result of these reviews.

Also enclosed are five (5) copies of an Executive Summary.

The submission of this Final Report represents the completion of all work on the subject contract, and I trust that it meets the needs and expectations of AID.

Sincerely yours,

Larry C. Kerpelman, Ph.D.
Project Director

LCK:bjr
Enclosures

ACKNOWLEDGEMENTS

This Executive Summary provides an overview and summary of a longer, more detailed Final Report of the same date which is the outcome of a contract between the U.S. Agency for International Development and Abt Associates Inc. It describes the process and results of developing an evaluation model for nutrition intervention in developing countries. Everything described here would have been extremely difficult or impossible were it not for the contributions and cooperation of our colleagues at the National Nutrition Council of the Philippines, whose data we examined and used in developing the evaluation methodology. Over the course of the three years of this contract, the Abt Associates team was fortunate to have had close, cordial, and cooperative working arrangements with our National Nutrition Council colleagues. We especially wish to express our appreciation to Mrs. Delfina Aguillon, Acting Executive Director of the Council, for smoothing the way for us. The informed and conscientious work of Mrs. Maria Lourdes Abola-Vega, a Senior Project Evaluation Officer in the Management Information System Division of NNC, Mrs. Asuncion Macalalog, Head of the Management Information System Division, Dr. Sadiri Malapit, Chief of the Management Planning and Information Service of NNC, and the many staff members of the MIS Division helped us find, evaluate, and use much of the data that went into building the model. All of these NNC representatives also helped us considerably in gaining access to persons in other relevant Ministries in the Philippines so that the richness of the Philippine data could be mined. We hope that we have been able to repay the many kindnesses, and considerable effort, extended by the National Nutrition Council of the Philippines by providing them with useful information regarding the nutrition program under their purview and with a viable model for organizing and analyzing their future management information and program data.

The USAID Mission in Manila showed a great and continuing interest in the contract that both inspired the Abt Associates contract team and helped ease our way in dealing with the various Philippine Ministries and agencies that we contacted during the course of this contract. Mr. Anthony Schwarzwalder, Mission Director, Dr. R. W. Engel (now at Virginia Polytechnic Institute), Ms. Maura Mack (now at USAID/Washington),and Mr. Gary Cook all deserve our thanks for their willingness to meet with the contract team and make the numerous arrangements necessary for us to carry out our work. Mrs. Dorothy Santos of the Mission also deserves a note of thanks for helping to make the logistical arrangements for our in-country visits.

The contract team was very fortunate in having extremely competent, industrious, and knowledgeble local subcontractors and consultants to perform some of the in-country work involved in this contract. Market Information and Research Associates, Inc., ably led by Mrs. Carmen Santos, and Ekistics Development Consultants, Inc., creatively directed by Dr. Marito Garcia, provided us with data that would have been much more difficult for the contract team to collect itself. Mr. John Boren

was our able consultant who, calling upon his knowledge of the Philippines and its nutrition programs, performed a very valuable feasibility study for us. It was a distinct pleasure working (and socializing) with all of these individuals over the past three years.

Throughout this project, we have benefited from the informed and steady direction of our AID Project Officer, Dr. Stewart Blumenfeld, of the AID Bureau of Science and Technology, Office of Nutrition. In many ways, the success of this project is his, for he often suggested avenues to explore that, based upon his extensive knowledge of nutrition intervention in developing countries, advanced the project more than it might have without his advice. Always patient, never directing so much as suggesting, Dr. Blumenfeld's gentle guidance was both welcome and appreciated by the contract team throughout the course of the contract. We hope that the final product of our efforts, embodied in the Final Report volume for this contract, shows that the confidence placed in Abt Associates by AID has been fully merited.

Larry C. Kerpelman
Project Director
September 1982

EXECUTIVE SUMMARY

Development of a Nutrition Intervention Evaluation Methodology for Developing Countries

This Executive Summary describes briefly the results of the three-year-long contract which Abt Associates Inc. (AAI) had with USAID. The purposes of the study were (a) to develop a nutrition intervention evaluation methodology or model, using the nutrition program of the Republic of the Philippines as a basis of examination and model development, and (b) to provide evaluation information useful to the National Nutrition Council of the Philippines. The model development was based upon data about three operating nutrition intervention projects in the Philippines -- the Barangay Nutrition Scholar Program (BNS), the Malnutrition Prevention Project (MPP), and the child feeding portion of the Day Care Service (DCS). This summary also provides guidelines showing how the model developed was applied in the evaluation of these interventions and can be applied in a continuing manner, as well. Tables and figures referred to in this Executive Summary are numbered as they are in the main body of the text of the Final Report to facilitate cross-referencing.

Chronology of the Study

The Abt Associates-AID contract to perform this study was executed on October 1, 1979 and was designed to run for three years to September 30, 1982. In early February, 1980, the initial trip was made to the Philippines by contract staff, accompanied by the AID Project Officer, to discuss the study objectives with our NNC colleagues, discuss the Philippine nutrition programs, and explore, in a preliminary fashion, data sources and availability. After that initial visit, a regular schedule of contract staff visits was implemented, the focus of each trip being one of the evaluation foci or outcome measures (see Table 1-1 for a summary of the trips to the Philippines).

Guidelines for Model Development

Using data from the Philippines, our objectives were to develop a nutrition intervention evaluation model which would:

- Estimate the impact of several nutrition projects on the health of preschool children apart from the influence of socioeconomic factors;
- Provide output carrying policy implications at the national level;
- Be modifiable as needed for ongoing evaluation purposes;

Table 1-1

SUMMARY OF STUDY STAFF TRIPS TO THE PHILIPPINES

DATE	TRIP PURPOSE	STUDY STAFF PARTICIPATING
February 4 - February 13, 1980	Meet Philippine colleagues, develop working relationships and communication protocols, clarify project objectives, discuss nutrition intervention projects.	Project Director; Conceptual Framework and Analysis Task Leader
June 2 - June 20, 1980	Refine study objectives, decide illustrative projects for evaluation, explore nutritional status outcome data, explore household and family characteristics data.	Conceptual Framework and Analysis Task Leader; Household and Family Characteristics Task Leader
August 4 - August 22, 1980	Discuss and explore food policy data, follow-up on initial data gathering/abstracting efforts.	Deputy Project Director and Food Policies Task Leader
September 28 - October 29, 1980	Explore management and planning processes and nutrition education data. Examine data generation from point of origin to final stopping point. Present seminars to NNC staff on management principles and nutrition education evaluation.	Management and Planning Task Leader; Nutrition Education Task Leader
November 15 - December 20, 1980	Explore data processing facilities available in the Philippines for this study. Identify sources of municipal level economic indicators.	Data Base Coordinator
February 18 - March 13, 1981	Select a local Philippine survey research firm to conduct data abstraction. Coordinate data collection activities. Review study status with Philippine colleagues.	Deputy Project Director and Food Policies Task Leader
March 7 - April 13, 1981	Analyze information on existing program data. Finalize data abstraction form. Train subcontracted in-country data abstractors. Monitor Initial field efforts by data abstractors.	Nutrition Education Task Leader and Data Abstraction Coordinator
October 17 - October 30, 1981	Obtain data still missing. Clarify inconsistencies in data obtained. Review study status with Philippine colleagues.	Deputy Project Director and Food Policies Task Leader; Household and Family Characteristics Task Leader
July 19-23, 1982	Review study findings. Discuss draft final report with Philippines colleagues.	Project Director; Household and Family Characteristics Task Leader
August 2-6, 1982	Present study findings to NNC staff and staffs from cooperating agencies.	Deputy Project Director and Food Policies Task Leader

- Be straightforward and manageable in scope and complexity; and

- Be implementable with minimum resources of time, money, labor, and computer support.

Evaluation techniques which employ geographic areas, rather than individuals, as the unit of analysis are commonly referred to as areal analysis or spatial analysis methods. In any country, there exist multiple layers of geopolitical aggregation similar to the following Philippine administrative levels: barangay (village or neighborhood), municipal (district or county), provincial, regional, and national. District-level evaluation may be defined as areal analysis of program effectiveness using data aggregated by district (county, municipality, etc. as the case may be) that are, for the most part, routinely collected for other reporting purposes. The use of multiple regression techniques to analyze such areal data is referred to as multivariate areal analysis.

The selection of an analytical framework for the evaluation model was necessarily dependent upon the type and quality of the data obtainable in the Philippines and the needs and interests of our Philippine colleagues in the National Nutrition Council. The municipality was chosen as the most suitable geographic unit because it had well-defined boundaries, was the lowest level of Philippines census aggregation, represented a satisfactory level of aggregation for dependent variables (nutritional status) and reliable control variables (demographic/socioeconomic factors), and was the highest level of aggregation at which meaningful data could be obtained for treatment variables (nutrition project). Since a major objective of each of the three nutrition intervention projects chosen is to reduce aggregate levels of malnutrition, our selection of this geographic area as the unit of analysis represented to the study team the most appropriate level of analysis. While multivariate areal analysis has been employed in recent years to study the relation of fertility to economic development and to measure the effect of family planning programs on fertility in a given country, to our knowledge, it has not been employed to analyze the effectiveness of nutrition interventions. Central policymakers and administrators frequently have a greater need to know the effectiveness of projects in reducing district-level malnutrition rates than their relationship to malnutrition at the household level: this analytical approach provides them with a tool for this.

This evaluation approach may be applied to large-scale nutrition intervention projects when one has the following sets of data available at the district level for one or more points in time:

- One or more measures of nutritional status (dependent variables);

- A series of characteristics (independent variables) whose influence on nutritional status is to be determined;

- A subset of the independent variables which reflect levels of project activity in terms of manpower, facilities, money, etc. (project variables); and

- A theoretical framework which interrelates these independent and dependent variables.

Compared with individual-level nutrition studies relating project inputs to dietary intake and selected household characteristics, district-level evaluation of nutrition interventions offers the following advantages:

- High policy relevance,

- High potential for ongoing monitoring and evaluation,

- Ability to assess overall program effectiveness as well as individual program effectiveness,

- Ability to assess program effects relative to other non-program effects,

- Ability to test hypothetical project inputs, and

- Methodological stability and simplicity.

Framework of the General Model

To illustrate the basic model from which to begin the evaluation process, let us assume that a given country is interested in estimating the relative contributions of three national nutrition projects (Projects A, B, and C) to reductions in preschool malnutrition from 1975 to 1980. The district-level evaluation model described and tested in this study essentially treats the 1980 level of malnutrition in a particular district as a function of its 1975 level plus characteristics of socioeconomic development and program efforts occurring between 1975 and 1980:

$$\begin{matrix}\text{Nutritional} \\ \text{Status}_{1980}\end{matrix} = f\left(\begin{matrix}\text{Nutritional} \\ \text{Status}_{1975}\end{matrix} + \begin{matrix}\text{Socioeconomic} \\ \text{Development} \\ 1975\text{-}1980\end{matrix} + \begin{matrix}\text{Program} \\ \text{Efforts} \\ 1975\text{-}1980\end{matrix}\right)$$

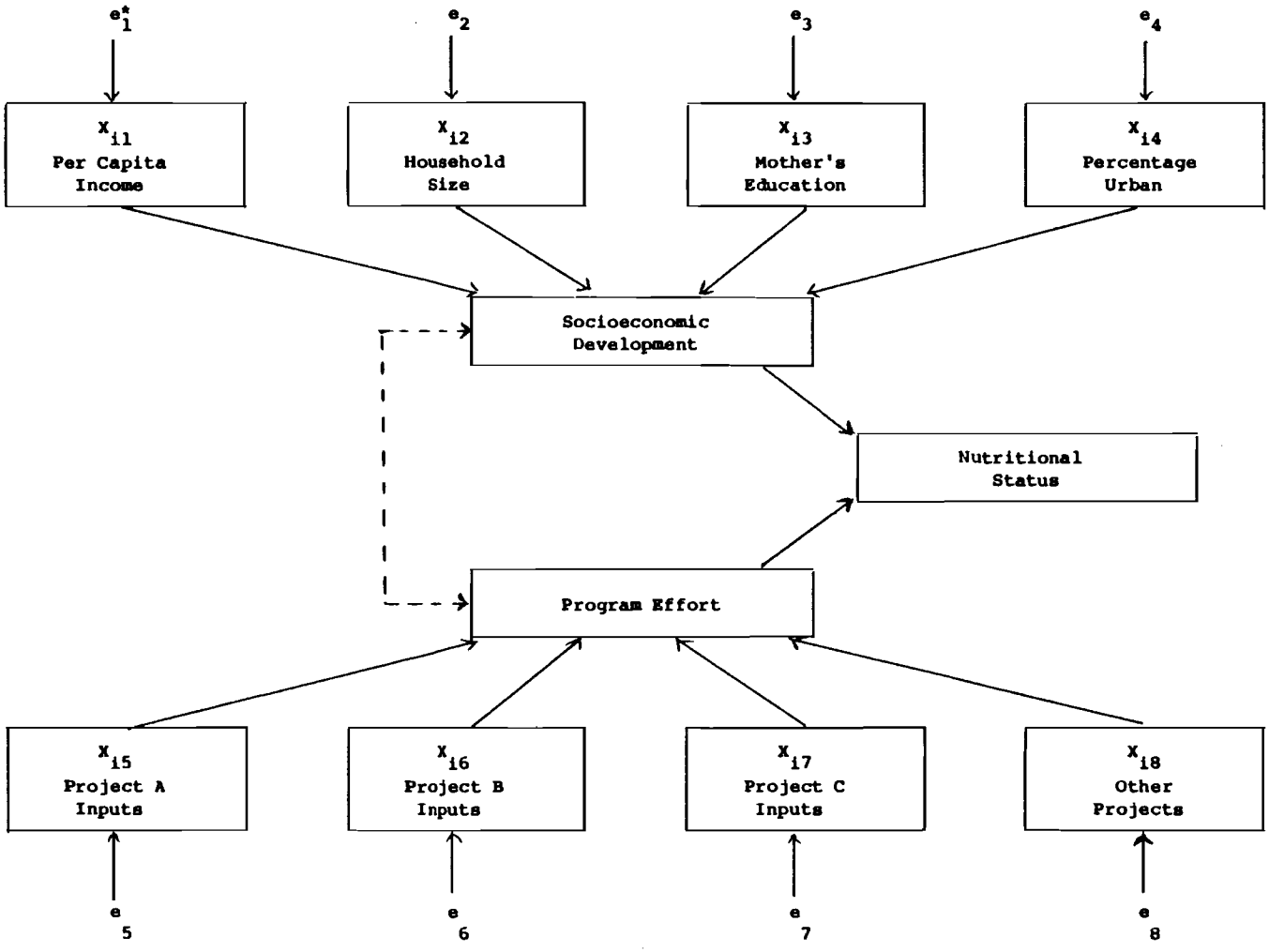
As depicted in Figure 2-1, the evaluation model treats socioeconomic development and program effort as unmeasurable variables represented by multiple indicators.

From this conceptual framework, the model is extended to the generalized multiple regression equation below:

$$Y_i = B_0 + B_1X_1 + \sum_{j=2}^{m} B_jX_{ij} + \sum_{k=m+1}^{n} B_kX_{ik} + u_i$$

Figure 2-1

SCHEMATIC REPRESENTATION OF A DISTRICT-LEVEL
NUTRITION INTERVENTION EVALUATION MODEL



Note: The individual error terms, e_i, are represented in the general equation (see previous page) by the single disturbance term, u_i.

where Y_i = nutritional status of the i^{th} district in 1980

X_i = nutritional status of the i^{th} district in 1975

X_{ij} = indicator of socioeconomic development from 1975 to 1980

X_{ik} = indicator of project inputs from 1975 to 1980

m = number of socioeconomic variables

n = number of project input variables

u_i = error term representing all unmeasured influences on nutritional status.

Once the specific variables are defined, this model allows one to estimate the proportion of the variance in 1980 malnutrition across districts attributable to each of the nutrition interventions, as well as the proportion of variance attributable to demographic or socioeconomic factors. With the previous level of malnutrition included as an independent variable (to remove pre-existing district variations in malnutrition), the above analytic model performs the multiple regression equivalent of analysis of covariance. Without this important independent variable, the estimates of project impact would be confounded by effects due to the nonrandom assignment of project resources to districts (especially where projects are targeted to high malnutrition areas), resulting in less negative or even positive project coefficients.

The remainder of this Executive Summary discusses the results found by the study team using data obtained on a sample of 60 municipalities in the Philippines. The model was developed and tested by Abt Associates Inc. and the National Nutrition Council in an iterative fashion, with the AAI/NNC study team making necessary adaptations as required.

Results Part One: The BNS and MPP Projects

Our first set of analyses focused upon the two intervention projects for which more detailed information was gathered -- the Barangay Nutrition Scholar Program and the Malnutrition Prevention Project -- and on two dependent measures that were reliably and consistently reported -- the percentage of preschoolers in each municipality reported to be second- and third-degree malnourished in 1980 and the percentage decline in second- and third-degree malnutrition from 1977 to 1980 (1977 was used instead of 1975 because the 1977 data were more consistently collected and complete than similar 1975 data).

Table 6-4 defines and summarizes the 14 variables included in one or more of the multivariate analyses, excluding interaction variables. The first two variables are estimates for 1980 and 1977, respectively, of

Table 6-4

VARIABLE DEFINITIONS AND DESCRIPTIONS

VARIABLE NAME	DEFINITION	SOURCE	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM
OPT.1980	The percentage of preschoolers in the municipality who are second- or third-degree malnourished in mid-1980 as determined by Operation Timbang weighings.	1	27.56	7.57	14.80	45.90
OPT.1977	The percentage of preschoolers in the municipality who are second- or third-degree malnourished in mid-1977 as determined by Operation Timbang weighings.	1	30.78	9.44	13.40	57.60
%DECLINE	Percentage decline in malnutrition from 1977 to 1980 computed as % DECLINE = (OPT.1977-OPT.1980) x 100/OPT.1977. Negative values indicate percentage increases.	1	6.11	24.87	-53.46	65.42
ADJINCF	Municipal income (revenues in pesos) per capita in 1980 adjusted for (divided by) the local 1980 price of the least expensive fish (galungong).	2	3.20	2.61	0.05	19.16
MHOUSESZ	Mean household size computed as a ratio of total municipal population to the total number of households in the municipality in 1975.	3	5.71	0.39	4.41	6.91
%FEMHSG+	The percentage of females age 6 years and over who have completed at least four years of high school education in 1975.	3	10.78	4.11	4.96	24.29
BNS	Dummy variable indicating the presence (1) or absence (0) of the Barangay Nutrition Scholar Project in the municipality as of January 1980.	1	0.75	0.43	0	1.00
BNS/1000	The number of Barangay Nutrition Scholars per 1000 preschoolers in the municipality as of January 1980.	1	2.16	2.89	0	15.45
BNS.%B	The percentage of barangays in the municipality with at least one Barangay Nutrition Scholar as of January 1980.	1	24.77	29.37	0	100.0
BNS.BMOS	The cumulative number of months of BNS service across barangays from 1977 to 1980 as a ratio of all barangays.	1	4.84	6.13	0	27.86
MPP	Dummy variable indicating the presence (1) or absence (0) of the Malnutrition Prevention Project in the municipality as of January 1980.	4	0.74	0.44	0	1.00
MPP/1000	The number of Home Management Technicians per 1000 preschoolers in the municipality as of January 1980.	4	0.31	0.26	0	1.02
MPP.%B	The percentage of barangays covered by the MPP project in the municipality as of January 1980.	4	13.77	12.51	0	60.00
MPP.BMOS	The cumulative number of months of MPP service across barangays from 1977 to 1980 as a ratio of all barangays.	4	0.57	0.56	0	2.21

Sources: 1. National Nutrition Council; 2. Ministry of Human Settlements, Bureau of Agricultural Commodities; 3. National Census and Statistics Office; 4. Bureau of Agricultural Extension.

the percentage of preschoolers malnourished as determined by Operation Timbang (OPT) weighings conducted in all barangays in the municipality. The data presented in all of the tables in this first set of analyses are based on 57, rather than 60, municipalities. One municipality was dropped from the analysis due to an absence of either estimate of the percentage of preschoolers malnourished in 1980, and two were dropped due to suspected reporting errors causing incompatibilities between the 1977 and 1980 estimates (i.e., outlier muncipalities).

Table 6-4 shows estimates of the percentage of preschoolers who were malnourished in 1980 (OPT.1980) ranging from about 15 percent to 46 percent, with a mean of about 28 percent. This 30 percentage point range narrowed considerably from the 45 point range observed in 1977 (OPT. 1977), and, overall, these estimates represent a 6 percent decline in malnutrition since 1977 (%DECLINE). Note that negative values on the variable %DECLINE indicate a percentage increase in malnutrition in those municipalities since 1977. Three demographic and economic variables employed in this analysis are the municipal per capita income in 1980 adjusted for the local 1980 price of fish (ADJINCF), the mean household size in 1975 (MHOUSESZ), and the percentage of females age 6 years and over with at least four years of high school education in 1975 (%FEMHSG+).[1]

Four measures of project inputs as of January 1980 were derived for both the BNS and MPP projects, as shown in Table 6-4: a dummy variable indicating the presence or absence of the program in the municipality, the ratio of nutrition program workers to preschoolers, the percentage of barangays covered by the project, and the cumulative barangay months of project coverage since 1977 averaged over the total number of barangays in the municipality. Overall (not shown in Table 6-4), both BNS and MPP are present in 33 of the 57 municipalities, BNS but no MPP in 10 of the municipalities, MPP but no BNS in another 9, and neither project in 5 municipalities. Each equation includes an interaction term calculated as the product of the BNS and MPP project measures, to test for effects (on nutritional status) of having BNS and MPP located in the same areas.

The output from this first series of regressons indicates that as more elaborate measures of project input are employed, the strength and significance of the project coefficients improve. In all the regressions, over half (55 percent) of the variance in either 1980 malnutrition levels or the percentage decline in malnutrition from 1977 to 1980 can be explained by the four nonproject variables: OPT.1977, ADJINCF, MHOUSESZ, and %FEMHSG+. The direction and significance of the coefficients associated with these variables are consistent with findings from household-level Philippines nutrition studies, thus providing support to the validity of the OPT data. For most regressions, the coefficients for the MPP input measure are at least four times stronger than the corresponding BNS measure, reflecting, no doubt, the amplification of effect provided to each Home Management Technician in an MPP municipality by numerous

---

[1] Most 1980 Philippine Census data were not yet available at the time this study was undertaken. Therefore, 1975 levels were substituted for several socioeconomic variables.

Rural Improvement Club members in conducting monthly weighings, convening mothers' classes, and surveying new or pregnant mothers.

Table 6-12 and Table 6-13 show the regression results obtained when the fourth, and most elaborate, measure of project input is employed, the cumulative barangay-months of project coverage between 1977 and 1980 averaged over all barangays in the municipality. As indicated by the B values next to MHOUSESZ in Tables 6-12 and 6-13, a municipality with a mean household size of six is likely to have a 1980 level of malnutrition which is 4.86 percentage points higher and a decline in malnutrition from 1977 which is 12.72 percentage points lower than a municipality with a mean household size of five. The column of standardized beta coefficients indicates that adjusted municipal per capita income is an even more important predictor of changes in nutritional status, with high income (1980) municipalities reporting lower 1980 malnutrition levels than expected based on their 1977 nutritional status. With 1980 malnutrition levels as the dependent variable (Table 6-12), significant BNS and MPP effects are found at the 95 percent confidence level. With the percentage decline in malnutrition from 1977 to 1980 as the dependent variable (Table 6-13), significant BNS effects at the 99.9 percent confidence level and MPP effects at the 99 percent confidence level are detected. For both regression equations "g" and "h", the MPP effect appears about nine times stronger than the BNS effect, with each additional month of MPP coverage per barangay reducing the predicted 1980 percentage malnourished by 2.97 percentage points and increasing the percentage decline in malnutrition since 1977 by 10.92 percentage points. Because of the much wider variation in BNS project months per barangay among our sample municipalities when compared with MPP project months per barangay (see Table 6-4), however, the significant but weaker BNS effects explain a greater proportion of the variance in preschooler nutritional status than the MPP effects. The 6 percent of the variance in OPT.1980 and 8 percent of the variance in %DECLINE explained by these two project measures (exclusive of interaction effects) is greater than the corresponding values obtained from the previous regressions employing any of the other three measures of project input.

This first series of analyses represent what we believe is a logical and conservative approach to evaluating two nutrition intervention projects. With the 1977 malnutrition level, three socioeconomic indicators, and two project input measures in our analysis, we have explained nearly two-thirds of the variance in 1980 levels of, or reductions in, malnutrition among our sample municipalities in the Philippines. Significant BNS and MPP program effects were detected at the 95 percent confidence level or greater, after partialling out the major portions of the variance in 1980 nutritional status accountable by the 1977 covariate and the socioeconomic indicators and despite the relatively small sample size. Not reflected in the tables shown here is the fact that several other socioeconomic indicators -- the percentage of the population which is urban, the percentage of males employed in agriculture, and the percentage of the population which is under age 5 -- were also tested with no significant additional impact in any of the regressions on either nutritional status or program effects. The detection of strong

Table 6-12

REGRESSION "g" RESULTS: DEPENDENT VARIABLE - 1980 OPT % 2^{O} + 3^{O}
PROGRAM MEASURE - MONTHS OF COVERAGE PER BARANGAY

Multiple R_2	.78
R^2	.61
Adjusted R^2	.56
Std.Error	5.05

Analysis of Variance	DF	Sum of Squares	Mean Square	Value of F	Level of Significance
Regression	7	1956.68	279.53	10.94	.001
Residual	49	1252.47	25.56		

Independent Variables	B	Beta	Std.Error of B	Value of F	Level of Significance	R^2	ΔR^2	Simple R
OPT.1977	.4631	.5776	.0743	38.80	.001	.29	.29	.54
ADJINCF	-1.0325	-.3562	.3102	11.08	.001	.44	.15	-.31
MHOUSESZ	4.8606	.2522	1.8244	7.10	.001	.54	.10	.20
%FEMHSG+	-.2366	-.1286	.1827	1.68	ns*	.55	.01	-.21
BNS.BMOS	-.3495	-.2832	.2089	2.80	.05	.59	.04	-.34
MPP.BMOS	-2.9729	-.2208	1.8334	2.63	.05	.61	.02	-.25
BNSxMPP4	.1738	.1866	.1939	0.80	ns	.61	.00	-.23
Constant	-5.8578							

*ns indicates F value is not statistically significant at the .05 level.

Table 6-13

REGRESSION "h" RESULTS: DEPENDENT VARIABLE - PERCENTAGE DECLINE IN MALNUTRITION 1977 TO 1980
PROGRAM MEASURE - MONTHS OF COVERAGE PER BARANGAY

Multiple R_2	.80
R^2	.63
Adjusted R^2	.58
Std.Error	16.07

Analysis of Variance	DF	Sum of Squares	Mean Square	Value of F	Level of Significance
Regression	7	21981.41	3140.20	12.17	.001
Residual	49	12648.56	258.13		

Independent Variables	B	Beta	Std.Error of B	Value of F	Level of Significance	R^2	ΔR^2	Simple R
OPT.1977	1.5565	.5911	.2362	43.41	.001	.34	.34	.58
ADJINCF	2.1812	.2290	.9856	4.90	.001	.42	.08	.37
MHOUSESZ	-12.7160	-.2008	5.7976	4.81	.001	.49	.07	-.27
%FEMHSG+	1.5433	.2553	.5807	7.06	.001	.55	.06	.14
BNS.BMOS	1.4425	.3558	.6639	4.72	.001	.61	.06	.29
MPP.BMOS	10.9154	.2468	5.8264	3.51	.01	.63	.02	.22
BNSxMPP4	-.7047	-.2302	.6161	1.31	ns*	.63	.00	.19
Constant	-3.4116							

*ns indicates F value is not statistically significant at the .05 level.

MPP effects despite much lower intensities of MPP activity in our sample municipalities relative to BNS is an especially promising phenomenon which suggests that MPP might be capable of explaining a much higher proportion of the variation in municipal-level malnutrition indices if it were to cover more than the three barangays per municipality to which, until recently, it has been limited.

Results Part Two: Other Projects, Socioeconomic Indicators and Outcome Measures

Less detailed information was collected and analyzed for four other nutrition projects in the Philippines, four additional socioeconomic variables, and four alternative outcome measures. In this part of the analysis, we employed a single measure of project input, the percentage of barangays covered by the project in 1980, to test for possible impacts on nutritional status associated with Day Care Service, the Targeted Maternal and Child Health Project (TMCH), Nutribus Service, and the Rural Improvement Club (RIC) Homemaker's Classes. Forward stepwise regression procedures were employed to assist in the variable selection process, and no tests for project interactions were performed due to the reduced number of degrees of freedom available. Results from these analyses must therefore be viewed as very preliminary looks into the impacts of the BNS and MPP projects relative to other ongoing projects and into potential project impacts on district-level infant mortality and morbidity rates.

Table 6-14 summarizes and describes the new variables considered at this analysis phase. The first four variables are demographic or socioeconomic measures taken directly from the national Census volumes. The percentage of dwelling units with aluminum roofs is taken as a proxy for income or perhaps degree of urbanization; it has been substituted in previous studies in developing countries where income statistics were unavailable. The other three demographic variables all relate to nutritional status in ways similar to mean household size, i.e., we postulate a direct, rather than inverse, association with the percentage of preschoolers malnourished. The second four variables measure new project inputs based on data provided by each respective agency or ministry. A glance at the mean percentages of barangay coverage indicates that the Day Care and TMCH projects exhibit a heavier presence in the 59 municipalities than the Nutribus or RIC Homemaker's Class projects. The final four (pairs of) variables shown in Table 6-14 are the 1980 and 1977 infant mortality, gastroenteritis, pneumonia, and influenza rates. To adjust for the skewed distributions of these mortality and morbidity rates (as well as for population density), the natural logarithm of each rate was used as the dependent variable in the analyses. Table 6-14 presents the means and standard deviations, however, for the untransformed rates.

Table 6-15 summarizes the output from the first stepwise regression with the 1980 percentage of preschoolers malnourished as the dependent variable. A hierarchical inclusion option in SPSS prevents project variables from entering the model ahead of socioeconomic variables. As

Table 6-14

DESCRIPTION OF OTHER SOCIOECONOMIC, PROJECT, AND OUTCOME VARIABLES

NAME	DESCRIPTION	SOURCE*	MEAN	STD.DEV.
%RFSALUM	Percentage of dwelling units in 1970 with aluminum roofs	1	32.7	20.9
%POPLT5	Percentage of the population less than age 5 in 1975	1	15.3	1.5
POPDEN	Persons per square kilometer in 1975 in the municipality	1	29.3	58.4
AGR75.80	Annual geometric growth rate of the municipal population from 1975 to 1980	1	1.7	1.5
DCS.%B	Percentage of barangays covered by Day Care Service as of January 1980	2	16.1	20.5
TMCH.%B	Percentage of barangays covered by Targeted Maternal and Child Health as of January 1980	3,4	19.8	29.3
NBUS.%B	Percentage of barangays covered by Nutribus Service as of January 1980	5	7.0	21.5
RICHM.%B	Percentage of barangays with RIC homemakers classes as of January 1980	6	8.1	16.4
IMR.1980 IMR.1977	1977 and 1980 infant mortality rates per 1,000 live births	7	49.4 49.2	36.4 26.1
GER.1980 GER.1977	1977 and 1980 gastroenteritis and colitis rates per 1,000 preschoolers	7	18.8 14.8	21.3 18.5
PNM.1980 PNM.1977	1977 and 1980 pneumonia rates per 1,000 preschoolers	7	9.9 7.0	15.2 7.4
FLU.1980 FLU.1977	1977 and 1980 influenza rates per 1,000 preschoolers	7	15.9 14.9	26.9 23.1

*Sources: 1. National Census and Statistics Office; 2) Ministry of Social Services and Development; 3) Catholic Relief Services; 4) CARE; 5) Nutrition Center of the Philippines; 6) Ministry of Agriculture, Bureau of Agricultural Extension; and 7) Ministry of Health, Provincial Health Offices.

Table 6-15

FORWARD STEPWISE REGRESSION "i" RESULTS:
DEPENDENT VARIABLE - 1980 OPT %2^{O} + 3^{O}

Multiple R_2	.85	Analysis of Variance	DF	Sum of Squares	Mean Square	Value of F	Level of Significance
R^2	.73	Regression	9	2149.95	238.88	13.60	.001
Adjusted R^2	.67	Residual	49	860.72	17.56		
Std.Error	4.13						

Independent Variables*	B	Beta	Std.Error of B	Value of F	Level of Significance	R^2	ΔR^2	Simple R
OPT.1977	.3794	.4903	.0684	30.70	.001	.28	.28	.53
ADJINCF	-.8179	-.3004	.2298	12.67	.001	.35	.07	-.28
MHOUSESZ	3.9948	.2150	2.0483	3.80	.01	.41	.06	.22
%POPLT5	.9592	.2035	.4590	4.37	.001	.45	.04	.28
%RFSALUM	-.0601	-.1745	.0310	3.76	.01	.48	.03	-.33
BNS.%B	-.0519	-.2098	.0230	5.12	.001	.61	.13	-.43
TMCH.%B	.0978	.3975	.0220	19.95	.001	.65	.04	.27
MPP.%B	-.1451	-.2527	.0515	7.93	.001	.71	.06	-.23
NBUS.%B	-.0414	-.1239	.0270	2.35	.05	.73	.02	-.20
Constant	-18.7912							

*Variables not selected for inclusion: %FEMHSG+, POPDEN, AGR75.80, DCS.%B, RICHM.%B.

this table indicates, the overall explained variance in 1980 municipal malnutrition increases from 0.63 (in a prior regression) to 0.73, with statistically significant associations detected for two new socioeconomic variables, %RFSALUM and %POPLT5, and two new project variables, TMCH.%B and NBUS.%B. The presence of both mean household size and the percentage of the municipal population who are preschoolers in the model is indicative of the primary importance of family size and composition to nutritional well-being. The only unexpected coefficient in this regression is the strong positive association between the presence of TMCH and high malnutrition levels. One plausible interpretation of this strong, but undesirable, TMCH effect is that this project, more than any other, is targeted to areas of high malnutrition, and the 1977 covariate cannot remove completely the masking effect caused by targeting. Another interpretation might be that better identification of 2^{o} + 3^{o} preschoolers occurred in 1980 than in 1977 for municipalities with heavy TMCH presence causing "instrumentation effects" in these areas. If the latter interpretation is accurate, this unexpected association should disappear when other outcome measures are tested.

Table 6-21 summarizes the malnutrition regression model described above, along with the remaining stepwise regression models which were tested for project effects on alternative indicators of nutritional status. Using the reported 1980 municipal infant mortality rate as the dependent variable, only one project variable, TMCH.%B, and one socioeconomic variable, POPDEN, are included with IMR.1977 in the equation, with a total explained variance of 0.40. Because of the high degree of variability in infant mortality rates reported for our sample municipalities (note the high standard deviation associated with IMR.1980 in Table 6-14), it is not surprising that the total variance explained in this model would be low relative to our malnutrition models. In sparsely populated municipalities with heavy TMCH coverage, the 1980 infant mortality rates are significantly lower than one would expect based on the corresponding 1977 rates. How can TMCH show strong reductions in infant mortality yet strong increases in malnutrition (as indicated by Table 6-15) in our sample municipalities?

We know that TMCH, more than any other nutrition project, is targeted to the areas in the Philippines with the most severe malnutrition problems. We also know that reductions in infant mortality in a region are likely to cause increases in malnutrition rates in that region since there are more surviving infants to feed. A logical conclusion therefore is that the TMCH project, operating in areas of greatest poverty, has made considerable progress in reducing infant deaths from 1977 to 1980, an impact which leads to increased numbers of second- and third-degree malnourished children over the same time period in those municipalities. Because of the interrelationship between infant mortality and preschool malnutrition, recursive path analysis techniques are better suited to such nutrition models which include infant mortality measures.

With the 1980 municipal rate of gastroenteritis and colitis as the dependent measure, a total of 63 percent of its variation across the 32 municipalities with valid cases is explained by the model. More than

Table 6-21

PHILIPPINE NUTRITION EVALUATION SUMMARY TABLE:
MALNUTRITION, MORTALITY, AND MORBIDITY MODELS

Variance Explained By:	Y =	1980 Percentage $2^{o} + 3^{o}$	1980 Log_{e} Infant Mortality	1980 Log_{e} Gastroenteritis	1980 Log_{e} Pneumonia	1980 Log_{e} Influenza
1977 covariate rate		.28	.18	.39	.32	.41
Nonproject variables		.20	.11	.19	.28	.32
Project variables		.25	.11	.05	.11	.02
Total explained variance	R^2 =	.73	.40	.63	.71	.75
Total municipalities	N =	59	40	32	31	32
Significant Variables ($p < .05$)						
1977 covariate rate		+	+	+	+	+
ADJINCF		-			-	-
MHOUSESZ		+		+		+
%FEMHSG+		-				
%RFSALUM		-		+	+	+
POPDEN			+		+	
%POPLT5		+				
AGR75.80				+	+	+
BNS.%B		-			-	-
MPP.%B		-				
TMCH.%B		+	-			
RICHM.%B		-		-		
NBUS.%B		-				

NOTE: A "+" sign means that, in municipalities where the independent variable (in the left column of the table) is high, the 1980 level of the dependent variable (across the top of the table) is higher than expected based on the 1977 level of the dependent variable. A "-" sign means that, in municipalities where the independent variable is high, the 1980 level of the dependent varible is lower than expected.

half of this explained variance is picked up by the 1977 covariate level; however, statistically significant effects associated with RIC Homemakers' Classes were detected as well as effects associated with mean household size, prevalence of aluminum roofs, and annual population growth rate in the municipality. In fast-growing municipalities with above-average household sizes and percentages of dwelling units with aluminum roofs, the 1980 gastroenteritis rates are significantly higher than would be expected based solely on the corresponding 1977 rates.

The second morbidity regression model predicts the 1980 preschool pneumonia rate in a given municipality from the 1977 rate, adjusted municipal income, percentage of houses with aluminum roofs, annual growth rate, and presence of the BNS project. After one-third of the variance in 1980 pneumonia rates is explained by the 1977 levels, an additional 11 percent is associated with the presence of the BNS project. No other project effects on pneumonia rates were detected at the 95 percent confidence level. Pneumonia rates are higher in densely populated, lower-income municipalities.

The last stepwise regression model summarized in Table 6-21 used the 1980 preschooler influenza rate as the dependent variable. Three-fourths of the variance in this outcome across municipalities is accounted for by the independent variables, of which only 0.02 is associated with project inputs. Once again, however, the BNS Program shows a statisically significant (albeit weak) deterrent effect on influenza rates, with no other project effects apparent. In urban municipalities with above-average household sizes and below-average income levels, the 1980 influenza rates are significantly higher than might be expected based on the corresponding 1977 rate.

Conclusions

Across each of the malnutrition mortality and morbidity models tested in this study, significant impacts of selected nutrition interventions were detected. Project variables contribute most to reductions in malnutrition (25 percent of the variance in Y, but bearing in mind the undesirable direction of the TMCH coefficient) and least to reductions in influenza rates (2 percent of the variance in Y). Strong single-project impacts (11 percent of the variance in Y) were observed for TMCH on infant mortality and for BNS on pneumonia rates. Demographic characteristics relating to the household (size and composition) and the municipality population (density and growth rate) appear to be more important predictor variables than other socioeconomic characterisics, with the exception of adjusted income. Significant effects in at least one model iteration were detected for independent variables, with the exception of Day Care Service coverage. Since nutritional well-being is a secondary, as opposed to primary, goal of the Day Care Service, and since not all Day Care Centers provide the same supplemental feeding component, more detailed information on this project would probably be necessary in order to conduct a valid assessment of its nutritional impacts. The BNS is the only project tested which yielded significant impacts on three of the

five outcome measures; however, the strength of the MPP coefficients suggests a greater potential for cost-effective nutrition intervention using the MPP (and Rural Improvement Club) approach. Given the small, nonrepresentative sample sizes and stepwise selection of variables, however, these results should be interpreted as suggestive of future evaluation directions rather than as definitive findings concerning the Philippine Nutrition Program.

This application of an areal model, using secondary data for the evaluation of nutrition intervention is, to our knowledge, unique. We have found that such an approach is both feasible and valuable. Central planners have a growing need to know the effectiveness of projects in reducing district-level malnutrition rates as distinct from malnutrition at the household level. Also, secondary data of the type in this evaluation are collected routinely in many countries. In the absence of appropriate analysis models, it is extremely difficult to use such secondary data for decision making. The district-level analytical approach developed for this study provides a way to develop models which can be simplified for routine use by staff to monitor nutritional status across districts over time. The success of the effort is also reflective of the joint cooperation and collaboration between Abt Associates and the National Nutrition Council during each phase of the study.

The results of this approach applied to the evaluation of Philippine nutrition projects are encouraging. Significant project effects have been found, modernization effects are accounted for, and pockets of malnutrition are identifiable. Using this approach, policymakers can monitor districts periodically without additional data collection efforts. Had these results been obtained on a larger nationally representative sample of municipalities, some of the policy implications of the model might be to suggest a major increase in coverage for the MPP project as well as increased proportionate allocation of resources to BNS, Nutribus, TMCH, Rural Improvement Club, and any family planning activities (given the significance of family size and growth rates). The model remains to be validated for a larger sample or in other countries; however, we hope this initial attempt will encourage other attempts to explore and expand the potential of this approach.