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NUTRITIONAL EFFECTS OF RURAL DEVELOPMENT: AN ASSESSMENT AS PART OF THE PLANNING OF A LARGE-SCALE DEVELOPMENT PROJECT IN PALAWAN, PHILIPPINES

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INTRODUCTION

A concern for ensuring that agricultural and rural development projects have beneficial effects on nutrition, and other basic needs, has led to a search for ways of assessing ex ante likely nutritional effects in order to influence project design development. These investigations have been conducted by international agencies in cooperation with a number of governments of developing countries. In 1977, FAO began research to this end and in 1978 proposed a methodological framework through the Sub-Committee on Nutrition of the UN Administrative Committee on Coordination (ACC-SCN 1978). This framework was first presented as a set of guidelines for field testing (FAO 1978), as described in more detail in FAO (1979). A review on the subject was also instigated by the World Bank in 1980, and published in 1981 (Pinstrup-Andersen 1981). The FAO guidelines formed the basis of several field-studies, supported by FAO in cooperation with the Swedish International Development Authority (SIDA), (FAO 1981). This paper reports the results of detailed analyses of data collected in one of these studies, carried out on the island of Palawan in the Philippines. It summarizes the procedures adopted and the findings, and lays out the implications for design of the Palawan Integrated Area Development Project (PIADP).

The government of the Philippines has given priority for many years to a wide range of programs to alleviate and prevent malnutrition. In 1977, one of the first attempts at ex ante nutritional assessment of a rural development project was carried out by a team led by the National Nutrition Council, also in collaboration with FAO, in relation to the Samar Integrated Rural Development Project (NNC 1979). The present study originated from an agreement between FAO, the National Nutrition Council, and the National Council for Integrated Area Development to field-test proposed methods and hence contribute a nutrition-orientation to the design of the project, which is co-financed by the Asian Development Bank and the government of the Philippines. A sum of about 80 million dollars was initially earmarked for investment in a range of mainly production-oriented activities in Palawan.

The Province of Palawan consists of one large island and a number of smaller islands, with a total area of approximately 15,000 square kilometers and

an estimated (1975) population of 300,000 people. Palawan is the most western island of the Philippines. This is a largely underdeveloped area, as is readily apparent from any of a number of different indicators. Fully 80% of the workers are employed in the agricultural sector, and a majority of the population fall below the nationally-established poverty line. However, only about 18% of the potentially cultivable land is being farmed (most of it in the southern portion of the main island and much of it for rice) and yields for all crops are low in comparison to national averages. Shifting cultivation patterns are common in the upland areas, and some areas are already severely degraded. Infrastructural development is limited; roads are inadequate and poorly maintained, sanitation and water supply facilities are poor except in the larger towns, and education and health services are inadequate. There are high incidences of malaria and gastroenteritis, largely attributable to poor sanitation and the warm, humid climate which create ideal conditions for the spread of such diseases.

The last decade has seen a pattern of uneven and unbalanced economic development in the province, which has serious implications for long term progress. The rate of exploitation of the rich natural resources (mining, logging and corporate farming) has increased greatly, resulting in considerable migration of indigenous populations to narrow strips of upland territory, where they practice marginal farming activities. This only serves to exacerbate an already serious set of social and ecological problems.

The PIADP was initiated by the National Council for Integrated Area Development, an agency of the Government of the Philippines. In early 1979 a project outline was put forward, and co-financing agreed upon in principle with the Asian Development Bank. In October 1979, agreement was reached between the National Council for Integrated Area Development, the National Nutrition Council, and the Asian Development Bank to include considerations of likely nutritional effects in the project design, so that improving nutrition in Palawan would become one objective of the project. In cooperation with FAO, work on nutritional aspects of the project began with an initial assessment in November 1979, followed by a nutrition survey in April to July 1980. A report giving recommendations based on a first analysis of the data was made available in November 1980. The feasibility studies for the project as a whole were carried out during this same period.

The project is multi-sectoral in nature, and was formulated with the goals of integrated development in mind. That is, the directly productive sectors (agriculture, livestock, forestry and fishing) were to be backed up with attention to the requisite infrastructure (feeder roads, ports and irrigation) and support services (extension, health, credit and water supply). There were essentially eleven major components to the first phase of the program. These were: lowland agriculture, upland agriculture, livestock projects, fishery, forestry, rural and cottage industries, roads, irrigation, ports, village water supply, and health (particularly malaria eradication).

The procedure for ex ante assessment of nutritional effects (FAO 1979) envisaged two stages: an initial assessment to identify issues and data gaps, followed by in-depth studies to collect fresh data collection if needed. The priority issues essentially concerned targetting of project activities towards those most in need, and then assessing the likely effects on the nutrition of those targetted for project participation.

The following steps were therefore undertaken:

1. The initial assessment was carried out in late 1979, and resulted in a number of tentative conclusions about the nature and scope of malnutrition on Palawan, as well as preliminary recommendations on targetting and project design. These preliminary findings and recommendations laid the groundwork for later analysis.
2. A sample survey of about a thousand households was conducted. Initial analysis was carried out in the Philippines, and the further analyses reported here were undertaken at Cornell University.
3. Results and recommendations were included as part of the report of the feasibility studies, and are elaborated in the Discussion section below.

METHODS

The Initial Assessment

In planning for the nutritional aspects of the PIADP, an initial assessment was carried out in November 1979 under the auspices of the National Nutrition Council and FAO. Its goal was to reach preliminary conclusions on problems of of malnutrition in Palawan, based on existing data, and to recommend tentatively both particular policies with regard to nutrition and ways in which

those policies could be integrated into the design of PIADP. This served at least two important purposes: it allowed the key nutrition issues for planning purposes to be defined, and it pinpointed what data should be collected for more detailed analysis and evaluation.

The existing data drawn upon included the following:

(a) Results from a previous food consumption and nutrition survey for the island, carried out by the Food and Nutrition Research Institute in 1977-78. The sample size for the island from this survey was 138, which allowed limited disaggregation by four occupational groups, but not by municipality.

(b) Results from a community weighing program for pre-school children (Operation Timbang) for 1978, giving percentages of the children weighed of less than 75% weight-for-age, by municipality.

(c) Agricultural production statistics for rice, available by municipality for 1971.

(d) Statistics on population density, road density, literacy and sanitation, derived from economic planning reports which had been compiled from local government statistics and census (1970) results; these again were available by municipality.

In addition, discussions with local officials and brief visits to rural areas were used to gain further information.

Survey Methods and Definition of Variables

While the project may eventually cover the entire island of Palawan, the planned investments were concentrated in the central and southern regions of the island. For this reason, six municipalities in this area were selected for the survey. These are Puerto Princesa (the provincial capital), Brooke's Point, Aborlan, Narra, Quezon and Bataraza, (see Figure 1). Taken together, they account for around 75% of the provincial population. Within each of the six muncipalities, a two-stage sampling process was employed. Out of the total of 125 barangays, 21 were selected randomly. The poblacions (capitals) of 4 municipalities were also included to give a total of 25 sample villages (locally called barangays). Within each of these villages, 40 households were then randomly selected for inclusion in the sample. This sample is not self-weighting,

and population figures were not available to assign weights. For analytical purposes weights have been ignored. The sample is thus not representative of the population in the area. Inferences may be validly drawn for the villages sampled, but cannot be extrapolated to the population of the area. The findings are thus strictly speaking a case-study of the villages selected.

The data collected were structured conceptually in three types: village characteristics, household characteristics, and outcome indicators. A list of the data collected is given in Table 1. Two sets of questionnaires were administered. The first of these was designed to collect information about the villages themselves, and was generally completed by the barangay (village) captain. This included data covering topography, agro-economic context, infrastructure and availability of services. Since this sort of information is applicable to all households in a given municipality, this procedure saved time and money. A household-level questionnaire was also developed and administered to each household in the sample. Interviews were carried out by 32 field staff who were selected from a pool of 52 candidates. They were divided into two teams of enumerators, each of which had two supervisors. All enumerators were residents of Palawan, and spoke at least two of the local dialects. Survey operations were under the supervision of the survey team leader, an economist, and he received assistance from a nutritionist, an urban-regional planner and a sociologist.

A total of 1034 households were surveyed. After data cleaning conducted in the Philippines on a UNIVAC-1100/10 computer using SPSS, the edited filed consisted of 969 households, from six municipalities and 25 villages. The first analyses consisted of tabulation of indicators by relevant grouping - mainly area and occupation - and were used for formulating recommendations in the report issued in November 1980 (NNC/FAO 1980). The subsequent analyses at Cornell, which provide the majority of the findings reported here, have been conducted on an IBM 370/168 computer using SAS (Statistical Analysis System).

Initially, all children with outlying values on the Harvard standards of WA (less than 50% and more than 140%) were excluded (see below). Additionally, all households which had no children were excluded from the sample. Finally, the experience with the sampling and surveying process showed that the selection of villages from the municipality of Quezon was probably seriously biased. Speci-

fically, the barangays surveyed were in close proximity to one another, if not contiguous, considering the physical size of the municipality. For these reasons, the three barangays in Quezon municipality were excluded. This left an effective sample size of 650 households for the analyses and results presented here.

The following variables were collected and used in the analyses reported here.

1. Weights and ages of pre-school (0-83 months) children were collected. The enumerators were trained in standard nutritional surveying techniques. Weights were measured on a bar scale. Early analyses (Garcia 1980) utilized Philippine growth standards to calculate weight-for-age for children. For the analyses carried out subsequently, Harvard growth standards have been used for ease of analysis, since simple algorithms developed by J. Hitchings are available for computing WA values (Kenya. CBS 1979). Comparisons of mean values and prevalences between the two methods showed that this change produced negligible differences. In the analyses reported here, the WA variable, measured at the child level, was aggregated to the household level for the bulk of the statistical analyses. Two household-level versions of this variable were created. The first is the mean WA of preschool children within each household (MEANWA). A second household-level indicator was created by taking the minimum WA within each household (MINWA). These two indicators are the primary dependent variables in the household-level analysis. Prevalence estimates were also derived at village level, using the % of households with (a) MEANWA 80%, and (b) MINWA 80%. (These prevalence variables are highly correlated at the village level; for example the Spearman rank order correlation between them is 0.86.)
2. Health data. Morbidity and mortality variables were included. The mortality figure used in later analysis was constructed from two questions on the survey. They asked for a 5 year recall on the part of the parents as to (a) how many children had been born during that period and (b) how many of these children had died. Morbidity data consisted of a 3 day recall of incidence of fever, cough or diarrhea in survey children. A morbidity variable was derived, as the proportion of children under age 7 years within

the household who had had a fever within the 3 days previous to the survey (mother's recall). An alternative indicator of morbidity based on reported diarrhea was not used because of the small number of families where positive results were reported.

3. Sanitation data. These included quality of water supply, toilet facilities and type of garbage disposal. For purposes of the analysis, these were generally coded into "good" and "bad" categories, following generally accepted criteria, as spring and rain water vs. piped or well water; and dumping garbage vs. burning or burying it.

4. Wealth data. These included housing information, livestock ownership (see below) and education of children. The housing variables include the number of rooms and the value of the home.

5. Demography. These include family size, sex and age composition. An index was constructed to reflect the structure of the family, as the proportion of children in the family to the number of adults; this is referred to as 'ratio'.

6. Occupation. Respondents were asked their primary and secondary sources of income. Possible categories (eleven altogether) were:
   - Farmers. Rainfed upland, rainfed lowland, irrigated lowland and kaingin (slash and burn) were distinguished. Additionally, estimates were made by interview on hectares cultivated by type of crops (see point 7 below), and tenure status.
   - Fishermen. There were four categories here as well, based on both boat ownership and type of fishing activity. Categories were: Subsistance fishermen/owner, subsistence fishermen/worker, commercial fishermen/owner and commercial fishermen/worker. Other information on motorization of boats and catch retention were also collected, but not used in theses analyses.
   - Service workers. Regular wage earners were distinguished from casual workers or laborers.
   - Self-employed workers.

The following categories (and dummy variables) were used:

a. Irrigated lowland farmer
b. Rainfed upland farmer
c. Rainfed lowland farmer
d. Kaingin farmer (slash and burn)
e. Subsistence fishermen (worker or owner)
f. Commercial fishermen (worker or owner)
g. Regular or casual wage earner
h. Self-employed

7. Area cultivated and crops. Area was recorded categorically in the questionnaire; possible values were: 0.25, 0.75, 1.5, 2.5, 4.0 and 6.0 (approximately equal to hectares under cultivation). This was broken down by the following crops: corn, rice, coconuts, and also coded as total cultivated area.
8. Livestock. Dummy variables were created for the following:
   a. Cattle ownership
   b. Pig ownership
   c. Goat ownership
   d. Poultry ownership.

Statistical Methods

Based on knowledge of the level of development of different areas, and on mapping the prevalence of malnutrition for each municipality and barangay (see Appendix Table 1 and and Figure 1) (referring here to % less than 80% MEANWA), the following geographical breakdown was used:

1. A-Rural. The rural barangays of the municipality of Puerto Princesa.
2. B-Rural. The rural barangays of the municipality of Brooke's Point.
3. C-Rural. The rural barangays of the municipalities of Aborlan, Narra and Bataraza (known to be the least-developed barangays).
4. Poblacions. Four urban barangays of Puerto Princesa, Abortan, Brooke's Point and Narra.

Prevalences were also broken down by variables such as occupation and area cultivated. This preliminary analysis identified the most malnourished

groups, and facilitated the more detailed analysis to follow. A series of cross tabulations was then produced in order to evaluate the relationship of nutritional status to a number of the independent variables, including socio-economic factors, landholding and cropping patterns; morbidity and mortality rates were also investigated in a similar manner. Chi-square statistics for these tables were computed, which allowed identification of significant (uncontrolled) relationships. Analyses of variance were employed to assess the significance of differences in the means of outcome variables between specific groups. Both Pearson Product-Moment and Spearman Rank Order Correlation Coefficients among salient variables were generated. This was done at both the household and village levels. In the latter case, the mean value of each variable of interest for each village was computed, and these were then correlated. (Since the unit of analysis was the village, the N was 22). This aided in assessing the relative strength of the relationship among the variables, and particularly the relationship of the key independent variables to MEANWA.

These techniques allowed a tentative identification of relationships among the variables, not controlling for other factors or partialling out the effects of other independent variables. Therefore a series of stepwise regressions were run, allowing SAS to construct the "best" predictive model out of the independent variables above. These regressions were run for the sample as a whole, using dummy variables for each area, and separately within each area. Finally, full model regressions were run in order to control for as many factors as possible.

Statistical tests are referred to in the text as appropriate; the expression 'significant' refers to p 0.05.

RESULTS

Initial Assessment.

The findings of the initial assessment (based on data available at the time) may be summarized as follows:

1. Calorie deficits were estimated as around 200 to 300 kcals/head/day, (results calculated from FNRI data collected in 1977-1978); this deficit was higher among farmers and fishermen than among other occupational groups, despite the fact that the island exported a small surplus of rice.

2. 27% of the children weighed in the community weighing program fell into second and third degree malnutrition categories, with northern Palawan apparently having higher prevalences than southern Palawan.
3. Malaria, gastroenteritis and tuberculosis were widespread, particularly in the coastal areas (from local health department reports).
4. Municipalities located at higher elevations generally seemed to have higher rates of malnutrition (from analysis of the community weighing results).
5. Production of meat and vegetables was very low, with virtually all such products having to be imported (from agricultural statistics).

Results such as these led to a tentative classification of priority groups, in which the kaingin (slash-and-burn) farmers and the rainfed upland farmers and fishermen in inaccessible areas, were suggested as worst-off; with rainfed lowland farmers, and irrigated farmers in inaccessible areas of next priority (NNC 1979, NNC/FAO 1980).

The preliminary policy recommendations at this stage were: (1) to direct project activities to the most nutritionally-disadvantaged groups (defined as described above); (2) to increase food production of nutritionally important foods; and (3) to strengthen basic services (e.g. water supply) for those with immediate needs.

There was however insufficient data to go beyond this, or to put forward these or more specific recommendations with any confidence. There was a choice of conducting a new nutrition survey or hoping to include nutrition data collection in other surveys planned at that time for purposes of project design. It was decided to opt for a rapid nutrition survey, since the schedule for other surveys was not certain. In the event this proved correct, since no other household sample surveys were in fact conducted in time to produce results for the project plan presented in September 1980.

Survey Findings

The extent to which the findings discussed below can be generalized to the population as a whole is uncertain. Every attempt was made to draw a random sample, given the severe constraints of accessibility within southern Palawan. However, it is likely that some bias was introduced in selection of villages;

moreover, the need to visit a limited number of villages, led to making up the sample size with a large number of interviews within each village. With MEANWA as dependent variable, this has produced a design effect of 2.5 (for discussion of design effects see Kish 1965); this means that the effective sample size is reduced by a factor of 2.5, which would substantially lower the level of significance of the findings discussed if they were to be treated as representative of the population.

Relations among outcome indicators

Three biological outcome indicators were used in the analysis of this survey: weight-for-age (as MEANWA etc.), prevalence of fever, and under five child mortality. The nutritional status indicators were highly correlated with each other at both household and village levels (see Table 2 lines 1 and 2 and Table 3 lines 1-4). Nutritional status variables and the morbidity and mortality variables analyzed at household level were not highly correlated (see Table 2, lines 1 and 2, columns 3 and 4). There was a significant but small correlation between nutritional status and morbidity in the expected direction.

At village level (see Table 3, line 5 column 6), mortality and fever were significantly correlated. Otherwise, except between the anthropometric variables, the outcome indicators were not correlated at village level.

Nutrition and related indicators by location

The prevalences of malnutrition by barangays surveyed are mapped in Figure 1. It is evident that the barangays more remote from the poblacions tend to have a higher prevalence of malnutrition; in fact it appears that the villages more distant, specifically from the two main centers of Puerto Princesa and Brooke's Point, have the higher prevalences. No variable was available for directly measuring the accessibility of different barangays given the varied terrain. Attempts were made to find a pattern with respect to topography, but the main relationship seemed to be simply with accessibility. The argument can be sustained from this map that the more remote barangays appear to be the most affected by malnutrition, although no statistical tests of this are available. A listing of outcome indicators by village is given in Annex Table 1.

Data were then analyzed by the four areas based on geographic location, separating out the urban areas (poblacions). Results by area are shown in Table 4. The area designated C-rural (the rural areas of Aborlan, Bataraza, and Narra) has a significantly higher rate of malnourished households (49%) than the rest of the sample (34%); this difference remains significant for C-rural when account is taken of the design effect. The poblacions by contrast are substantially better off, with an equivalent malnutrition rate of 30%. C-rural has significantly more poor housing (71% of the sample with only one-room housing); a less well developed water supply (23% with unimproved water supply) but, surprisingly, C-rural also has the lowest reported morbidity and mortality recorded in the sample. By contrast A-rural has a lower prevalence of malnutrition but the highest rates of morbidity and mortality in the sample, with significantly higher rates of poor toilets and garbage disposal than the rest of the sample. This finding is in line with the lack of correlation between nutrition and health indicators, but is difficult to interpret.

As well as having the lowest rate of malnourished households in the sample, the poblacions also have about average mortality, high reported morbidity, but the best environment (low rates of poor water supply, poor toilets, lack of garbage disposal, and one-room housing). The indicator values for the area designated B-rural are about average in most cases, the one exception being mortality which is, with C-rural, surprisingly the lowest in the sample. We have no way of checking for underreporting of mortality rates, but for the moment continue to use this as a potentially valid indicator.

The next step is to attempt to explain these differences, which we begin by examining the effects of occupation category.

Relation between outcome variables and occupation

The sample is composed of 4 main occupational categories: farmers (45%), service workers (33%), fishermen (11%), and the self-employed (10%). The values of nutritional indicators disaggregated by area and occupational group are shown in Table 5.

Farmers as a group are worse off nutritionally than non-farmers (see Table 6): 42% versus 35% prevalence of malnourished households; the difference

between the means of 83.6% vs 85.5% for mean weight-for-age is significant at p = 0.08. Farmers in the sample fall into four types: irrigated lowland (24% of the farmers in the sample), rainfed lowland (45%), rainfed upland (5%), and kaingin (slash-and burn farmers -26%). There are no significant differences in the nutritional indicators between these groups and the other indicators are also similar; the apparent difference in child mortality rates between irrigated farmers and the others is not significant. The indicators disaggregated by area do not alter these conclusions; the full series of indicators in shown in Annex Table 2. Examining the nutritional status indicators as shown in Table 5 shows that most occupations in C-rural are worse off than their counterparts in the rest of the sample; this especially applies to the rainfed lowland and kaingin farmers in area C-rural compared with equivalent groups in area A and B.

These results show however that the kaingin farmers in the sample are in fact no worse off than other farmers. At the same time, the lowland farmers with irrigated agriculture are not significantly better off, either as a group or within different areas. Mean values of the weight-for-age indicator suggests that there is a slight positive effect of irrigation, but the variation within the irrigated farming group tends to be higher. We know that many of the irrigation systems are in poor repair or not functioning, so that this may reflect a positive effect of irrigation in cases where production is raised, but nonetheless the group overall is not significantly benefitting in terms of nutrition.

The rainfed lowland farmers as a group have the highest rate of malnutrition at household level (44%) among farmers (Table 6). This is especially evident in C-rural where the rate is 54% (see Table 5). Within the total rainfed lowland farmer group significant differences in rates of malnutrition were found when the data was disaggregated by total area cultivated, the highest rate being found amongst the small group of households with less than 1 hectare of land cultivated (see Table 7). However, in the total sample there does not appear to be any significant differences in malnutrition prevalence by total cultivated area.

The rainfed upland farmers represent a very small proportion of the sample and no firm conclusions can be drawn for this group because of the small sample size. However, there is not support for the idea that this group may be particularly badly affected, either in terms of nutrition, or by most of the other

indicators shown in Table 6.

Service workers are located primarily in the poblacions and in the area designated A-rural. In the poblacions they make up 71% of the households surveyed. Overall they have a low prevalence of malnutrition calculated at the household level - 32-35% for the sample as a whole, (see Table 5, regular wage earners, and casual workers). As for farmers, the highest rate of malnutrition for this group is in area C-rural (38-50%). There is no substantial difference in prevalences of malnutrition between the regular wage earners and the casual workers, although the casual workers have significantly poorer housing (33% with one room versus 62%, results not shown in the tables, p 0.001).

The self-employed are fairly evenly distributed between the four areas, but the designation "self-employed" may differ. Except in area C, this group is not substantially different from the other groups. In area C however, this group shows a very high prevalence of malnutrition (73%) and a high mortality rate (15.4%). This group has poor housing, poor water, and poor sanitation. The majority (66%) of these households are located in two barangays (called Sagpangan and Panacan). The high child mortality rate is accounted for by four child deaths out of 14 births in Sagpangan. We know that Sagpangan is a remote mountainous barangay about 9 kilometers by trail from the main road. The self-employed group here are those who gather forest products and are mobile, unorganized, and have no permanent livelihood. Sometimes they gather cashew nuts growing wild on the mountain slopes. It seems likely that the sample here picked up a minority group who live outside the mainstream of life on the island. These results demonstrate the need for additional investigations of minority groups, and indicate that particular attention may be needed to these.

The data on fishermen were collected under four categories: subsistence (meaning non-commercialized) fishermen as boat owners or laborers and commercial fishermen as boat owners and laborers; however there were so few commercial fishermen that they are not generally included in the tables. The series of indicators for subsistence fishermen are shown in Table 8; the nutrition indicators disaggregated by area and type of fishing employment are in Table 5. The subsistence fishermen in area A-rural have the highest malnutrition prevalence and mortality indicators in that area, and compared with other subsistence fishermen. 58% of subsistence fishermen surveyed are in area A-

rural; within this area, the majority (61%) are in one barangay where they make up 58% of the households. It has been suggested that fishing villages are in particular difficulties and this may be a reflection of that fact. Overall, subsistance fishermen live in smaller houses and have poor toilet and garbage facilities. The mortality rate among subsistence fishermen is significantly higher than for the rest of the sample (see Table 8).

Relations between outcome indicators, cropping pattern and area cultivated.

Rice was reported as the major crop grown by 92% of those who grew any crop. Most of those growing crops gave their main occupation as farming, as expected, although some 26 households whose main occupation was not given as farming reported growing a major crop - there were 299 households giving farming as the main occupation in the sample, and 315 households who were cultivating some crop. The distributions of main crops grown by area is shown in Table 9. The only major crops other than rice in the sample were corn and coconuts, but these represented only a tiny fraction of the farmers. The effects of growing alternative crops - in effect coconuts - whether or not this was given as the main crop, was investigated as shown in Table 10, and conclusions could also be drawn from the regressions shown in Table 11. In Table 10 the prevalences of malnutrition associated with growing coconuts - defined as a reported area planted to coconuts greater than zero, whether or not rice was the main crop - is shown. In areas A-rural and B-rural, where most of the coconut growers in the sample were found, coconut growing was associated with a somewhat lower prevalence of malnutrition (p 0.1). Controlling for other factors in area B-rural significantly associated with weight-for-age (by stepwise regression, see Table 11, line 2), a significant association of area planted to coconuts with improved nutrition was found; again this should be treated with caution since the coconut growers are such a small group. Nonetheless, this result does indicate that growing the higher value crop of coconuts was probably associated with improved nutrition at least at the time of the survey. Since that time there has been a dramatic fall in the price of copra (the commercial product from coconuts), which may well have had a negative effect on nutrition. Nonetheless, this finding indicates that higher value non-food crops may be advantageous to nutrition compared to rice, even though coconuts may not be

the best alternative due to instability of world prices.

A negative association of corn cultivation was found in area A-rural (see Table 11), although this only represented 6 farmers; nonetheless, it was expected that corn growing, which is associated with the poorest farmers, would be associated with malnutrition.

The area of rice cultivated was positively associated with better nutritional status in area C, when controlling for other factors (see Table 11 line 3), as might be expected. The relationship is quite strong, the regression coefficient for rice area with weight-for-age indicating a 2.2% difference in mean weight-for-age per hectare difference in rice area cultivated (approximately equivalent to 10% difference in prevalence per hectare of cultivated area). In area B, and in areas A and B combined, there was a negative association of nutrition with rice area for the whole sample in the areas (Table 11 lines 2 and 5). This probably reflected the fact that those growing <u>any</u> rice, certainly in area B, tended to be worse off anyway; when the regression was run for rice farmers only, in areas A-rural and B-rural, rice area was not significantly related to nutritional status (but was not significantly positive). Essentially the same results were found when associations of malnutrition with area cultivated per head (i.e. standardizing for household size) were investigated. In sum, the expected relationship of nutritional status with cultivated area is apparent in area C-rural; in A- and B-rural (the more developed areas) the relation is not significant, but here rice farmers tend to be worse off than non-farmers. The lack of apparent effect of irrigation on nutritional status has been discussed in the previous section.

<u>Relations with livestock ownership.</u>

Associations between livestock ownership and nutritional status were investigated first using stepwise multiple regression (see Table 11). The only significant relationship found was with pig ownership in Brooke's Point and Narra, and this finding led to a number of further inquiries. Part of the population is Moslem, but this community is likely to be poorer than the rest. However, since Moslems are unlikely to own pigs and ownership of pigs was associated with poorer nutritional status, this did not appear to be the answer. It

was also discovered that a scheme for promoting pig production had been in operation in the province: the scheme involved provision of 1 pig to households, which had to be repaid out of the first litter when the pig had bred. We investigated the relationship between pig ownership controlling for wealth and environmental factors. Using a crowding index (numbers per room). It was found that a combination of ownership of one pig with crowded housing was significantly associated with a higher prevalence of malnutrition (see Table 12). Whether this indicates an environmental effect or whether in some other way it is related to the pig dispersal scheme cannot be determined from these data. It remains an intriguing finding, and perhaps indicates that a closer look at the pig dispersal scheme might be worthwhile.

Relation between outcome variables and environmental factors.

Quality of water supply and toilet facilities are significantly associated with malnutrition. The factors as measured appear to have approximately equal effects, with no interaction, on mean household weight-for-age values (see Table 13a). Different results are obtained using the prevalences of households with mean weight-for-age values below 80%, as shown in Table 13b. These results indicate that the existence of significant malnutrition (e.g. less than 80% weight-for-age) is apparently more related to water supply than to toilets. This could be because polluted river or spring water is often drunk by many people whereas a latrine is primarily used by the people of the household in which it is located. These findings are not in line with morbidity data, but reported prevalences of diarrhea were extremely low for the sample. We could tentatively conclude that a water supply intervention, which need only apply to relatively few households with unimproved water (14% of the sample) might be more effective than an intervention to improve latrines. The effects of water supply and toilet remain significant when controlling for the other factors significantly associated with malnutrition in the overall sample, when the full regression model is run at household level (Table 11, line 10).

Means of garbage disposal is also associated with malnutrition in the overall sample and in area C-rural (see Table 11). The association indicates that dumping of garbage is either itself contributing to poor environmental hygiene or is a proxy for some other negative influence on nutrition. In any event, the

association is much as expected, and is significant when controlling for other environmental factors; it is also associated in the expected way with housing, water supply, and toilet facilities indicators (see Table 2 line 9).

Two indicators were investigated to represent quality of housing: first, to divide households into those with one-room housing, as opposed to houses with more than one room; second, to standardize for household size, using the variable number of people per room. Both variables showed similar associations with nutritional status: for example mean WA of 85.6 for less crowded (4.8 people/room) vs. 83.1 for the more crowded group (4.8 people/room); 86.6 for those with greater than 1 room vs. 83.8 for 1 room housing. The main differences were in area A-rural and the poblacions, see Table 14.

Relations of Nutritional Status with family size.

The effects of family size were investigated using a variable derived from the number of children in the household expressed as a proportion of the number of adults (the variable is called "ratio" in the tables). In the sample, the values of this variable range from 0.17 to 6.0. The stepwise regressions show that as ratio increases, (i.e. more children/adult) the mean weight-for-age decreases significantly (see Table 11, line 10). The coefficient is significant for the overall sample (in fact is the variable most significantly correlated with nutritional status) but is not significant for the regressions run by area. The values of weight-for-age by category of ratio are shown in Table 15. Above a ratio value of 1, there is little further effect of increasing numbers of children. Below 1, the mean WA rises sharply to 89.3% from 82-84%, with an associated decrease in malnutrition prevelance from around 40% to 30%.

DISCUSSION

The results of this study (including both initial assessment and the survey) were needed first to identify priority population groups, in terms of nutrition, for participation in the area development project; and second to indicate what design features of the project would be likely to benefit nutrition. Nutritional status and associated indicators were used to assess relative need between different areas and groups. Conclusions on how to improve nutrition and level of living, and the likely effects of different project components, were also drawn by

comparing these conditions between different groups, and by examining associations between factors that could be influenced by the project (e.g. cropping pattern) and nutritional conditions. This assumes, as is inevitable with cross-sectional data, that the change in outcome associated with a given policy can be predicted by examining the situation of those who have in fact already experienced this change in the normal course of events: for example it is assumed that an association of malnutrition with poor water supply, when controlling for other factors, is evidence that a water supply intervention is likely to be beneficial to nutrition. Nonetheless, additional evidence would usually be needed before adopting this intervention: the results indicate where to look, but by themselves are not always enough to confidently recommend any particular action.

The results showed that certain areas and population groups in southern Palawan had substantially higher prevalences of malnutrition, and related indicators (such as housing) help to confirm that there were significant differences in welfare and level of living. The situation of different population groups, by areas and occupation, are discussed below with respect to their relative priority for attention in the project; and in relation to certain activities feasible within the context of the project, needed to improve their situation. In general, we are trying to answer the questions: (a) who needs to benefit from the project? (b) was the project as then conceived - which would primarily develop agricultural production, and provide infrastructure and certain services -be likely to benefit the participants' nutrition or should certain alternative policies be adopted? and (c) were additional components indicated to attack specific causes of malnutrition?

Priority Areas.

Parts of southern Palawan were at a higher level of development than others. The municipalities of Puerto Princesa and Brooke's Point had received substantial agricultural inputs in the past; moreover, the town of Puerto Princesa is the island's capital, and the surrounding areas in the municipality differ from other areas as a result. The three other municipalities (see map in Figure 1) were more backward. Finally, the urban centers of each municipality (the poblacions) again have different characteristics. The area was therefore divided

into four: rural Puerto Princesa (A rural); rural Brooke's Point (B rural); the rural areas of the municipalities of Aborlan, Bataraza, and Narra (C rural); and the poblacions. Part of all the rural areas were targetted by the development project, but precisely where within these had not been decided at the time of the survey.

The indicators by area defined in this way confirmed that C rural was worse off in most respects (Table 4). For example, the prevalence of malnutrition was 1.7 times that in the poblacions, 1.4 times that in the other rural areas. Nearly 40% of total households with stunted children were in this area. Housing was worse, 71% of the families having only one-room housing, and water supply less developed. For a start, it is clear that project benefits need to be substantially focussed on the rural areas of Aborlan, Bataraza, and Narra if the project is to succeed in reaching the more needy households in southern Palawan.

Mapping the prevalences of malnutrition by village (barangay) indicates, additionally, that those villages at greatest distance from the poblacions tend to have higher prevalences of malnutrition (Figure 1). These more remote villages presumably have least access to services, are at a disadvantage for sale of agricultural produce, and perhaps for purchase of food and other goods. Project outreach to remote areas, and development of infrastructure and services, are likely to be important for improving nutrition.

Fishermen.

Many coastal communities in Palawan depend on fishing for their livelihood. Fishing households are often part-subsistence, owning a small boat and making a living by small-scale inshore fishing for their own food, as well as for local trading. In some areas fishing is more commercial, with larger boats whose owners hire labor. It had long been suspected that the small fishermen had a particularly low standard of living, and preliminary evidence from the initial assessment tended to confirm this, at least in terms of calorie consumption. About 10% of the sample were small fishermen. This may be an underestimate of the overall dependence on fishing of the population, since in the south fishing villages are inaccessible by land and may have been under-sampled; moreover the more accessible fishing villages reached may

underestimate the nutritional problem. In this sample, over half the fishing households were in the more accessible area A.

The results indicated that the prevalence of malnutrition in small fishermen was not substantially higher than for the rest of the sample -somewhat higher for boat owners than laborers. The difference was significant at the 10% level between the subsistence fishermen in A rural and the other occupations in A rural. The indicator showing the major difference for fishermen is the child mortality indicator: the indicator value of 12.3% is more than double that estimated for the rest of the sample (5.4%, p 0.01). Estimates of kcal consumption given by Garcia et al. (1980) from a food consumption recall module of this survey indicated a significantly lower kcal consumption for the fishermen (the only group found to be significantly different from any other with respect to kcal consumption).

The condition of the subsistence fishermen is not easy to diagnose from these data. It is likely that their kcal consumption is indeed inadequate, and while this may be related to an elevated child mortality, it is not reflected in a higher prevalence of underweight children. Their diet presumably contains a lot of fish; since protein deficiency is unlikely in the rest of the population, the energy density of the diet rather than it's protein content is a more likely explanation for why there is not a higher prevalence of underweight among children (it could be postulated that children get relatively more kcals from the family food if less constrained by bulk, or for other reasons). There is no way for the present data to explain the relatively good - or at least not bad - nutritional status of children in this group. Unfortunately, we have no data on access to health services. However, there seems sufficient reason from the child mortality data, from other estimates of household food consumption, and from a priori concerns about the subsistence fishermen to identify this group as priority for intervention.

Farmers.

A major concern before the survey was that the traditional kaingin (slash-and-burn) farmers had particularly poor living conditions and should receive priority for settlement and other benefits from the project. This was one conclusion, for example, from the initial assessment. The survey results do not

tend to support this view. None of the indicators show the kaingin farmers to be worst off, in nutrition or other terms in the area as a whole (Table 6), nor (except for the housing indicator in area A) within areas (Annex Table 2). The rainfed lowland rice farmers (certainly in area C) were themselves not well-off in nutritional and other terms, and since project participation of the kaingin farmers may well tend to bring them into this group, there is some reason for concern that the project may actually not benefit the kaingineros. In fact, this is not surprising if the kaingineros are presently more subsistence-oriented than other farmers - there is good reason from elsewhere to be concerned that moving away from subsistence agriculture is sometimes associated with more malnutrition, (Fleuret and Fleuret 1980).

By far the major crop grown is rice, and the rural development project is likely both to aim to intensify rice production, as well as to diversify the cropping pattern. There is evidence that both diversification and intensification of rice production may be beneficial. The small group of farmers growing coconuts (the only other crop substantially represented in the sample) are clearly doing better than the others (Table 10). The higher monetary value of coconuts may have more than compensated for any loss of subsistence consumption from rice-growing. The association of rice area cultivated with improved nutrition is weak, although overall the expected correlation between total land cultivated and better nutrition is found at least in the poorest area (C rural) (Table 7). In areas A and B there is in fact a negative correlation between rice area and nutrition; this seems to reflect the fact that farmers are worse off as a group in this area, compared with other occupations. The negative coefficient disappears when the regression is run for the rice farmers alone in this area; it is not however significantly positive. In area C the coefficient is significant and positive, indicating that nutrition is improved with increased rice area cultivated, hence presumably with increased rice production. The direct comparison between irrigated and rainfed lowland farmers in the whole sample and in each area showed that the mean nutritional status was somewhat better for irrigated farmers, although the difference was not significant. In the overall sample, and in areas A and B, irrigation was also associated with somewhat better housing, but this is not so in area C.

To summarize, in the more developed areas (A and B) rainfed rice farming is associated with more malnutrition. Irrigation - mainly for rice - and coconut cultivation are both possibly associated with better nutrition. In the less developed area (C) where rice is virtually the only main crop, increased cultivated area for rice is associated with better nutrition. It can be tentatively concluded that intensification of rice production is likely to benefit nutrition in Area C, and possibly in other areas through irrigation. However, certainly in areas A and B, diversification to higher value crops may be a better bet: there is no significant effect of increased rice area here, and coconut growing was clearly beneficial.

Finally, these results on the farming community emphasize the need to reach the small farmer, particularly the relatively small group with a total cultivated area of less than 1 hectare (11% of our sample).

Other occupation groups.

Households whose main income source was from wage labor (regular or casual) or from self-employment tended to be better off in terms of nutrition in most areas. The important implication is that development of off farm rural employment opportunities are likely to benefit nutrition. The main exception was the group defined as self-employed in C rural, most of whom were in two villages in Narra and Aborlan. This group was badly off by most indicators; nutritional status was low; child mortality (probably) elevated; housing, water supply, and toilet facilities poor. In one of these villages, Sagpangan, these results are consistent with their remote mountainous location and their uncertain livelihood. Little is known about the other village, Panacan, and without additional information no further conclusions can be drawn at present.

The main focus of the study was on farming opportunities rather than off-farm employment, so that the data are not available for further comment on this aspect.

Environmental factors.

Water source and toilet facilities were highly correlated with malnutrition. The associations with mean values of weight-for-age were similar for both factors (with no interaction). These associations remain significant when controlling for other variables significantly associated with weight-for-age, in the total sample. However, using prevalences below an 80% weight-for-age cutoff most of the effect appeared to be due to water supply. This means that if the objective is specifically to reduce the occurrence of underweight children then a water supply intervention alone is worth considering. Since only 14% of the sample have an unimproved water supply (as opposed to 43% without reasonable toilet facilities), there is the opportunity for focussing a water supply intervention on a relatively small group.

Housing is, as expected, related to nutrition in the overall sample. This is a reflection of wealth, although affecting the environment, and improving housing itself is unlikely to be a feasible objective of a direct intervention, in contrast to water supply.

Family size.

The lower the ratio of children to adults, the better the nutritional status of the children; this seems to be non-linear, with the difference occurring below a ratio of 1 child/adult. The association is significant alone, and when other factors significantly correlated with nutritional status are controlled for. A large number of children in the household is thus disadvantageous to nutrition, presumably both because of such factors as family spacing, and since available resources have to be shared among more non-producing family members. It may indicate that the first child in the family is better-nourished than subsequent children. This finding also supports the view that the population programs could, if effective, benefit child nutrition, and thus is a further argument in their favor.

Summary of recommendations for program design.

The priority target groups should be as follows: in the more remote areas of Aborlan, Bataraza, and Narra; rice farmers without irrigation and relatively small land-holdings (certainly below 1 hectare, probably less than 3 hectares

would be a reasonable definition); kaingin farmers; and subsistence fishermen. By contrast, certain groups merit less priority in terms of nutrition: the urban and accessible rural areas in Puerto Princesa and Brooke's Point; wage earners and laborers. The group defined as self-employed, particularly in Aborlan and Narra, is particularly badly off, and requires further investigation.

The production-oriented components of the rural development project are likely to improve nutrition, insofar as they reach the priority groups defined above. That is to say, there is little reason to suppose that increased income will not improve nutrition. There are indications that diversification of cropping pattern - already part of the project design - will be beneficial, and certainly in the more developed areas diversification may be a policy more advantageous to nutrition than intensification of rice production; however, we would also expect increased real income from increased rice production to benefit nutrition in the poorer areas. Development of infrastructure and services to remote areas is again likely to be beneficial to nutrition in these areas. The data here do not give indications of the interventions needed to improve the poor conditions of the subsistence fishermen: we can say that this is of priority, but further studies would be needed to identify which precise interventions are needed. Finally, there is evidence that an intervention specifically to improve water supply could be important and probably cost-effective in improving nutrition - only a relatively small proportion of the population requires this, and the association with malnutrition is quite strong.

Priorities for Nutritional Surveillance.

The data discussed here provide an excellent baseline for surveillance of nutritional conditions in the future, and for linking these to project activities. This could ultimately allow, if correctly designed, an assessment of the nutritional impact of the project in practice. We can now identify the groups whose nutrition conditions need in particular to be monitored, being the same as those identified as priority for the project. Surveillance should not only follow changes in their nutrition, but monitor the extent to which these groups participate in the project. The indicators used in this study would also be suitable to monitor nutritional outcome.

Two means of obtaining the necessary information for nutritional surveillance suggest themselves. First, a nutritional - primarily anthropometric -module could be built into the monitoring and evaluation system which has already been suggested as part of the project implementation. This system is to be based partly on interviews of sample households at regular intervals, periodic weighing of the children in these households, for example every one to two years, could provide vital information. Secondly, efforts could be made to use existing data sources - including the weighing program (Operation Timbang) and using clinics in the area as a source of anthropometric data. Resources for capturing, tallying, and reporting on these data could be focussed on priority areas and groups. It is important to get data from remote areas, in particular those with small rice farmers, kaingin farmers, and subsistence fishermen. Such data should identify the occupational grouping of the households from which the children measured come.

Finally, it is essential that both these baseline data, and information obtained from future surveillance, be used to make decisions on project design and implementation. A mechanism needs to be established within the project management to review changes in nutrition, and their possible relation to project implementation, and tc use this information to make decisions on future directions for project implementation to benefit not only nutrition, but the level of living of the poor sections of the community in Palawan. Nutritional status provides one useful indicator of these living conditions.

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FIGURE 1

Malnutrition in Palawan
by Barangay

KEY

% households with WAS 1 < 80% = > 40 - ●

% households with WAS 1 < 80% = 30-40 - ◑

% households with WAS 1 < 80% = < 30 - ○

Poblacions - ◁

Barangay Code - 23

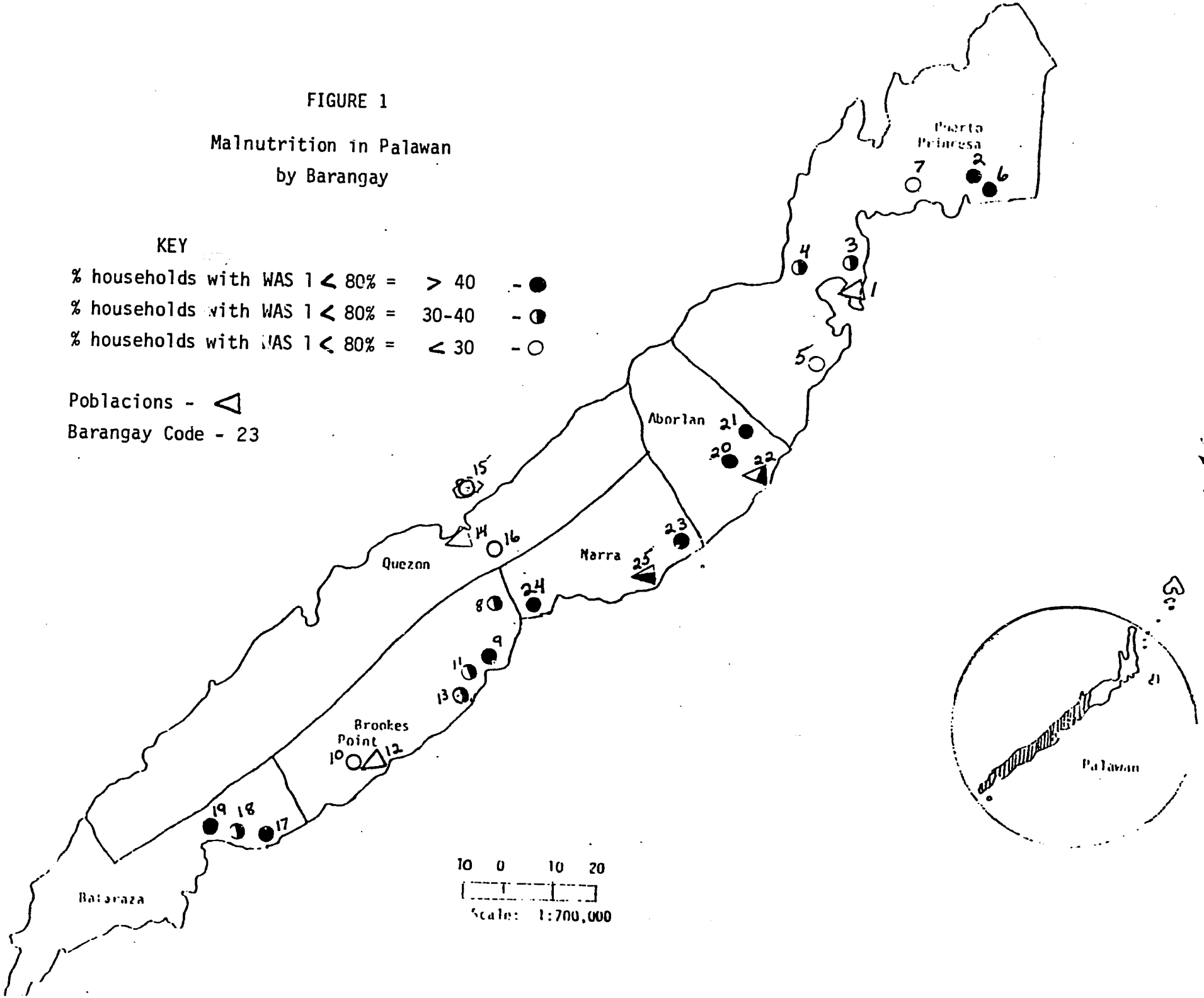

TABLE 1

VARIABLES COLLECTED

VILLAGE

Topography: lowland, coastal, upland, mountainous
Agro-economic zone: fishing, agricultural, both
Agro-economic zone: production pattern
Distance to poblacion
Distance to health service: with barangay, poblacion
Barangay irrigation system: none, wet season only, year round
Electricity - yes or none
Malaria prevalence (% pop) 0 to >20%

HOUSEHOLD

Source of Income (main & secondary):

Farmers: irrigated lowland, rainfed upland, rainfed lowland, kaingin (slash and burn)
Fishermen: subsistance boat owners and workers, commercial boat owners and workers
Service workers: regular wage earners, casual wage earners
Self employed

Farmers
Size of land: by 3-hectare groupings (0-3, 3-6, 6-12, >12)
Size of cultivated area of rice, corn, coconut, vegetables, others
Major crop produced: rice, corn, coconut, fruits, vegetables, root crops, casuy
Farm ownership: landlord, tenant-worker, squatter
Production technology/yield per hectare: irrigated; rainfed; kaingin
Number of hired workers
Percent of production retained for home consumption

Fishermen
Boat Owners
No. of boats: <3 ton, motorized; <3 ton, non-motorized; >3 tons
No. employees/workers
Type of fishing activity

Share Fishermen
Type: commercial worker; municipal worker
Average daily share
No. fishing trips per: day, week, month
Average catch per day (per expedition) per boat (kg)
Proportion of catch retained for home consumption

Service Worker
Days worked per week, weeks/month, months/year

Self-employed
Income: net and gross

Indicators

Demography: # hh members, adults, school-age children (≥ 7 y/o), preschoolers (0-83 mo.); infants (< 12 m/o?)

Child Mortality: # live births in past 5 years; # children deceased who were born alive; deaths due to sickness and accidents.

Nutritional Status: preschool child's: name, birthdate, age in months, wt. in kg.

Morbidity: disease in preschool child in last 3 days: fever, diarrhea, cough, other

Sanitation: type of water supply: rain, well, river, pipe.
distance to water
type of toilet: none, open pit, closed pit, antipolo
type of garbage disposal: dump, burn/collect/bury

Wealth: type of house: on stilts or flat ground; 1, 1½ or 2 stories
number of rooms: 1 - 5
housing material: sawali/bamboo/Nipa; wood; semi-concrete; concrete
livestock ownership (# heads): cattle/carabao; pigs, goats, poultry
cost of house: <10,000 ₱→ 50,000 ₱ +
school-age children not in school

Food Consumption Survey

Food recall: food item, description, amount, leftover, net, price
List of persons eating from family pot by age, sex and # of meals

TABLE 2: HOUSEHOLD LEVEL CORRELATIONS

	1 MEANWA	2 MINWA	3 Fever	4 Mortality	5 Ratio	6 Water	7 Toilet	8 Garbage	9 Room	10 Pig
1. MEANWA	1.00	0.90***	-0.09*	0.02	-0.14***	-0.13***	-0.12**	-0.12**	-0.07	-0.07
2. MINWA	0.90***	1.00	-0.07	0.06	-0.25***	-0.11**	-0.07	-0.10*	-0.06	-0.09*
3. Fever	-0.09*	-0.07	1.00	0.04	-0.02	0.02	0.02	0.03	-0.06	0.07
4. Mortality	0.02	0.06	0.04	1.00	-0.03	-0.02	0.09*	0.05	0.05	0.00
5. Ratio	-0.14***	-0.25***	-0.02	-0.03	1.00	-0.06	-0.04	-0.08*	-0.15***	0.10**
6. Water	-0.13***	-0.11**	0.02	-0.02	-0.06	1.00	0.15***	0.13***	0.13***	-0.06
7. Toilet	-0.12**	-0.07	0.02	0.09*	-0.04	0.15***	1.00	0.42***	0.13**	-0.13***
8. Garbage	-0.12**	-0.10*	0.03	0.05	-0.08*	0.13***	0.42***	1.00	0.11**	-0.08*
9. Room	-0.07	-0.06	-0.06	0.05	-0.15***	0.13***	0.13**	0.11**	1.00	-0.15***
10. Pig	-0.07	-0.09*	0.07	0.00	0.10**	-0.06	-0.13***	-0.08*	-0.15***	1.00

* $P \leq 0.05$
** $P \leq 0.01$
*** $p \leq 0.001$

N= 650, 602 for mortality

Coding of Variables:

MEANWA, MINWA	- continuous values of means.
Fever	- continuous values of means.
Mortality	- continuous
Ratio	- continuous values of proportion of nonadults/adults
Water	- 1= river water, spring water
Toilet	- 1= none or open pit
Garbage	- 1= dump
Room	- 1= 1 room
Pig	- 1= owns pigs

TABLE 3: VILLAGE LEVEL CORRELATIONS

	1 MEANWA < 80%	2 MEANWA < 75%	3 MINWA < 80%	4 MINWA < 75%	5 Fever	6 Mortality
1. MEANWA < 80%	1.00	0.81***	0.80***	0.81***	-0.24	0.13
2. MEANWA < 75%	0.81***	1.00	0.78***	0.82***	-0.16	0.12
3. MINWA < 80%	0.80***	0.78***	1.00	0.93***	-0.27	0.14
4. MINWA < 75%	0.81***	0.82***	0.93***	1.00	-0.13	0.13
5. Fever	-0.24	-0.16	-0.27	-0.13	1.00	0.43*
6. Mortality	0.13	0.12	0.14	0.13	0.43*	1.00

*** $p \leq 0.001$
** $p \leq 0.01$
* $p \leq 0.05$

N = 22

Coding of Variables: MEANWA, MINWA - proportion of hh < cutoff value
Fever - continuous values of means
Mortality - continuous

TABLE 4. INDICATORS BY AREA

	A rural	B rural	C rural	Poblacions	Total	X^2	p	Adjusted X^2	p
# hh in sample	181	153	194	122	650				
% sample	27.8	23.5	29.8	18.8	100.0				
Est.No. people	47,260	39,950	50,660	31,960	170,000				
MEANWA[a]	85.3	85.7	79.8	86.8	84.6				
% hh with MEANWA<80%	34.8	35.3	49.0[b]	29.5[c]	38.2	15.11	<0.01	5.87	<0.20
% of all PEM in grp.	25.4	21.8	38.3	14.5	100.0				
Fever	18.4	9.6	7.5	17.6	13.3				
Child mortality*	9.5	4.7	4.7	5.4	6.1	8.65	<0.05		
Poor water	11.6	13.1	23.2	4.1	14.0	24.58	0.001	9.454	0.025
No toilet	59.7	45.1	36.6	23.0	42.5	44.01	0.001	16.961	0.001
No garbage disposal	32.6	26.1	25.4	16.4	25.9	10.27	0.025	3.948	0.20
1 Room housing	49.7	59.2	71.4	37.7	56.1	39.35	0.001	15.133	0.01

* # hh with this variable are: A rural - 159; B rural - 142; C rural - 183; Poblacions - 118; Sample - 602.

[a] ANOVA on means shows $p = 0.005$; $F = 4.41$

[b] C rural vs. A, B rural & Poblacions: $X^2 = 13.71$, $p < 0.001$; with design effect $X^2 = 5.27$, $p < 0.025$.

[c] Poblacions vs. A, B, C rural: $X^2 = 3.46$, $p < 0.01$; with design effect $X^2 = 1.33$, $p < 0.30$.

TABLE 5: HOUSEHOLD NUTRITIONAL STATUS BY AREA & OCCUPATION

		Irrig. Lowld	Rainfed Lowld	Rainfed Upld	Kaingin	Sub. Fish	Com'l Fish	Reg. Wage	Casual Worker	Self Empl.	Total
A Rural	Mean	89.1	86.4	(92.4)	85.3	82.4	--	87.4	84.5	85.7	85.3
	Prev.	30.8	18.2	(50.0)	36.8	47.4	--	33.3	33.3	21.1	34.8
	n	13	11	2	38	38	0	24	36	19	181
B Rural	Mean	83.8	82.4	(89.8)	84.9	86.0	--	(80.0)	96.6	88.5	85.7
	Prev.	45.0	35.7	(28.6)	35.0	33.3	--	(33.3)	29.4	33.3	35.3
	n	20	56	7	20	9	0	6	17	18	153
C Rural	Mean	83.1	81.6	(92.4)	80.0	84.6	(79.7)	77.0	84.9	75.7	79.8
	Prev.	45.9	54.1	(25.0)	47.4	27.3	(75.0)	50.0	37.9	73.3	49.0
	n	37	61	4	19	11	4	14	29	15	194
Pobl	Mean	(77.8)	(83.7)	(78.0)	(89.0)	(86.6)	(82.2)	86.3	87.2	92.1	86.8
	Prev.	(33.3)	(66.7)	(100.0)	(0.0)	(37.5)	(0.0)	25.9	36.4	7.1	29.5
	n	3	6	1	1	8	2	54	33	14	122
Total	Mean	84.2[a]	82.4[a]	90.1	84.0	83.8	80.5	84.9	87.2	85.6	84.6
	Prev.	42.5	44.0	35.7	38.0	40.9	(50.0)	31.6	34.8	33.3	83.2
	n	73	134	14	78	66	6	98	115	66	650
Rural	Mean	84.4[b]	82.4[b]	91.0	83.9	83.4	79.7	83.1	87.2	83.8	83.4
	Prev.	42.8	43.0	30.8	39.0	41.4	75.0	38.6	34.1	40.4	40.2
	n	70	128	13	77	58	4	44	82	52	528

[a]t-test= 0.87; p=0.39,NS

[b]t-test= 0.94; p>0.20,NS

TABLE 6: INDICATORS BY TYPE OF FARMING

	Irrig. Lowland	Rainfed Lowland	Rainfed Upland	Kaingin	All Farmers	Non Farmers	Total Sample
#hh in sample	73	134	14	78	299	351	650
%hh in sample	11.2	20.6	2.2	12.0	46.0	54.0	100.0
Lt. population	19,040	35,020	3740	20,400	78,200	91,800	170,0
MEANWA	84.2*	82.4*	(90.1)	84.0	83.6[e]	85.5[e]	84.
%hh with MEANWA <80%	42.5[b]c	44.0[b]c	(35.7)	38.5[b]	41.8[a]	35.1[a]	38.
% all PEM in this grp.	12.5	23.8	2.0	12.1	50.4	49.6	100.
% with fever	6.6	8.9	(14.3)	22.1	12.1	14.4	13.
Child Mortality	10.0[d]	4.3[d]	(0.0)[d]	7.8[d]	6.5	5.9	6.
%hh with poor water	16.4	18.7	(14.3)	21.8	18.7	10.0	14.
%hh with poor toilet	39.7	44.0	(42.9)	46.2	43.5	41.7	42.
%hh with no garb.disp.	20.5	27.8	(55.6)	23.1	25.2	26.6	25.
%hh with only 1 room	60.3	65.9	(57.1)	62.8	63.3	50.1	56.

*t-test on means = 0.87 p <0.4 NS

a difference significant @ 10%

b No significant difference

c No significant difference

d No significant difference

e t-test = 1.77; p <0.08

TABLE 7: HOUSEHOLD MALNUTRITION FOR RAINFED LOWLAND FARMERS BY TOTAL CULTIVATED AREA

	MEANWA	% hh MEANWA < 80%	N
<1.0 hec.	79.8	73.3	15
1-3 hec.	82.8	42.4	85
> 3 hec.	82.5	35.3	34
Total	82.4	44.0	134

t - test = 0.53 χ^2 = 5.41, 2 df; χ^2 = 5.88, 1 df (<1 vs ≥1 hec.)

p > 0.20, NS p < 0.10 p < 0.025

TABLE 8. INDICATORS FOR SUBSISTENCE FISHERMEN

	Owners	Workers	Total Sub Fish	S F in A Rural	Other S F	Other Occup. A Rural
#hh in sample	41	25	66	38	28	143
% hh in sample	6.3	3.8	10.1	5.8	4.3	22.0
Est. population	10,720	6,540	17,260	9,940	7,320	37,400
MEANWA	82.4	86.1	83.8	82.4	85.7	86.1
% hh with MEANWA<80%	46.3	32.0	40.9	47.4	32.1	31.5
% all PEM in this grp.	7.7	3.2	10.9	7.3	3.6	18.1
% with fever	7.9	25.3	14.5	20.4	6.5	17.5
Child Mortality	11.8	13.0	12.3*	16.4[c]	6.4	7.5[c]
% hh with poor water	0.0	4.0	1.5	2.6	0.0	14.0
% hh with poor toilet	75.6	48.0	65.2	78.9[ad]	46.4[a]	54.5[d]
% hh with no garb.disp.	46.3	40.0	43.9	60.5[be]	17.8[b]	25.2[e]
% hh with only 1 room	42.5	80.0	56.0	55.3	59.3	48.3

*14 deaths in 114 live births in S_2F families compared with 52 deaths from 960 live births from rest of sample gives $X^2 = 8.32$ $p < 0.01$.

[a] difference significant at 0.8%

[b] difference significant at 0.1%

[c] difference significant at 5.0%

[d] difference significant at 1.0%

[e] difference significant at 0.1%

Table 9 . Percent Households With MEANWA< 80% by Major Crop and Area.

	A Rural	B Rural	C Rural	Poblacions	Crop Total	Percent Distribution
Rice	33.8	40.7	51.2	50.0	43.8	
n	68	91	121	10	290	92.1
Corn	--	(0.0)	(0.0)	(50.0)	11.1	
n		5	2	2	9	2.9
Coconuts	(25.0)	(14.3)			20.0	
n	8	7	--	--	15	4.8
Fruit	(0.0)				(0.0)	
n	1	--	--	--	1	.3
Growers Total	32.5	36.9	50.4	50.0	41.6	
n	77	103	123	12	315	100.1
						(48.5)
Non-Growers	36.5	32.0	46.5	27.3	34.9	
n	104	50	71	110	335	(51.5)
Area Total	34.8	35.3	49.0	29.5	38.2	
n	181	153	194	122	650	(100.0)

Table 10. Percent Households with MEANWA < 80% by Coconut Growing and Area.

	A Rural	B Rural	C Rural	Poblacions	Total
Coconut > 0	23.1	15.4	(100.0)	(100.0)	30.0[a]
n	13	13	3	1	30
Coconut = 0	35.7	37.1	48.2	28.9	38.5[a]
n	168	140	191	121	620
Total	34.8	35.3	49.0	29.5	38.2
	181	153	194	122	650

	A-Rural + B-Rural
Coconut	19.2[b]
n	26
No Cocunut	36.4[b]
n	308
Total	35.0
	334

a $X^2 = 0.89$, $p < 0.50$, NS

b $X^2 = 26.8$, $p < .001$

TABLE 11

Stepwise Regression Results with MEANWA as Dependent Variable

Parameters		Total Sample	A Rural	B Rural	C Rural	Pobla-cions	A+B Rural	A+B Rice Growers	Aborlan	Narra	Bataraza	Full Model
# households		648	181	152	193	122	333	159	54	57	82	649
Area C Rural	B	-3.35										
	t	2.91**										
Irrig. Lowland Farmers	B											-1.00
	t											0.29
Rainfed Lowland Farmers	B			-4.19			-5.94	-4.06				-3.72
	t			1.74			2.76*	1.05				1.14
Rainfed Upland Farmers	B	5.95										
	t	1.69										
Kaingin	B											-2.36
	t											0.70
Subsistenc- Fishermen	B						-4.06					-3.69
	t						1.85					1.05
Service Workers	B				7.05							-2.66
	t				2.75							0.82
Self Employed	B									-9.66		-0.55
	t									1.64		0.16
Water Source	B	-3.43		-8.05			-5.03		-6.12			-4.39
	t	2.23*		2.46*			2.26*		1.98			2.82**
Type of Toilet	B	-2.70	-3.31	-3.41			-4.50	-5.35			-5.97	-2.44
	t	2 32*	1.75	1.49			3.08**	2.96**			1.67	2.07*
Garbage Disposal	B	-2.47			-6.17						Excluded	-2.26
	t	1.91			2.73**							1.70
Own Farm	B						3.76					
	t						1.79					
# Rooms in house	B		-3.99		4.49			-3.24				-1.01
	t		2.17*		2.08*			1.76				0.94
Ratio	B	-1.94	-1.75			-2.63	-1.73	-2.24				-2.15
	t	3.31**	1.65			1.92	2.11*	2.09*				3.62**
Poultry	B			-3.78								
	t			1.58								
Pig	B	-2.50		-4.75		-4.06	-3.82			-6.12		-2.57
	t	2.40*		2.40*		1.66	2.63*			2.04*		2.38*
Cattle	B		4.82	-3.79	3.07	-7.16						
	t		1.96	1.56	1.57	1.66						
Goat	B		-9.91									
	t		1.63									
Cult Rice	B			-1.45	2.17		-1.58					-0.73
	t			1.71	2.10*		2.30*					1.26
Cult Coconut	B			3.40			2.69					1.88
	t			2.27*			2.53*					1.89
Cult Corn	B		-5.74					-4.08				-0.29
	t		2.09*					1.90				0.24
Intercept		86.91	91.31	97.60	66.62	92.53	94.61	93.15	82.47	84.87	86.30	90.27
R^2		0.076	0.125	0.236	0.060	0.091	0.129	0.142	0.070	0.101	0.033	0.079
$\bar{R}^2$		0.066	0.095	0.193	0.045	0.068	0.105	0.114	0.052	0.068	0.021	0.057
F		7.53**	4.14**	5.52**	3.99**	3.94*	5.33**	5.05**	3.91	3.04	2.76	3.59**

* 0.01 p 0.05
** p 0.01

Table 12: Malnutrition by Pig Ownership and Crowding

Crowding[a]		No Pigs	1 Pig	>1 Pig	Total
≤ Average	MEANWA	86.1	85.8	83.9	85.6
	Prevalence[b]	37.9	29.6	36.1	35.5
	N	211	98	83	392
> Average	MEANWA	84.6	80.0[c]	83.5	83.1
	Prevalence	38.5	53.6	37.3	42.2
	N				
Total	MEANWA	85.6	83.4	83.7	84.6
	Prevalence	38.1	39.5	36.6	38.2
	N	341	167	142	650

[a] Crowding = # people/room: Overall average 4.5.

[b] Prevalence = % of households with MEANWA <80.

[c] Comparison of these households (greater than average crowding and own 1 pig) with the rest of the sample showed a significantly greater degree of malnutrition (Chi-square = 7.83, sig. .01).

Table 13A. MEANWA by Water and Toilet

Toilet	Water Supply: River/Spring	Water Supply: Piped/Well	Total
Pit/None	79.1	83.7	82.8
n	55	221	276
Closed pit, Antipolo, Flush	83.1	86.4	86.1
n	35	338	373
Total	80.7	85.3	84.7
n	90	559	649

ANOVA Results on Sanitation Categories
(Dependent Variable: MEANWA)

Independent Variable	Type I SS F	Type I SS P	Type IV SS F	Type IV SS P
Water	9.36	.0023	6.33	.0121
Toilet	7.16	.0076	4.64	.0317
Water*Toilet Interaction	0.18	.6712	.18	.6712

Overall Model: $F = 5.57$
$p = .0010$
$R^2 = .0252$

Table 13B. Percent Households with MEANWA< 80% by Water and Toilet.

Toilet	Water Supply: River/Spring	Water Supply: Piped Well	Total
Pit/None	56.4	38.0	47.7
n	55	221	276
Closed pit, Antipolo, Flush	51.4	33.7	35.4
n	35	338	373
Total	54.4	35.4	38.1
n	90	559	649
	14%	86%	

$X^2 = 6.857$
$p < 0.01$

TABLE 14: HOUSEHOLD MALNUTRITION BY # ROOMS AND AREA

		A Rural	B Rural	C Rural	Poblacions	Total
1 Room	mean	82.7	85.7	82.7	85.4	83.8
	prev.	41.1	35.6	49.6	34.8	42.1
	n	90	90	137	46	363
>1 Room	mean	87.9	85.6	79.7	87.6	86.6
	prev.	28.6	34.9	47.4	26.3	33.1
	n	91	63	57	76	284
Total	mean	85.3	85.7	79.8	86.8	84.6
	prev.	34.8	35.5	49.0	29.5	38.2
	n	181	153	194	122	647
	X^2	3.14	0.00	0.09	0.99	5.53
	$p <$	0.10	99.9	0.80	0.50	0.03
	t-test	2.86	0.03	1.59	0.91	2.61
	$p <$	0.005	0.97	0.11	0.36	0.01

Overall $X^2 = 10.13$

$df = 3$

$p < 0.025$

TABLE 15: NUTRITIONAL STATUS BY RATIO CATEGORY

	<1	1-1.4	1.5-2	>2	Total
#hh in sample	156	182	117	195	650
%hh in sample	24	28	18	30	100
Est. population	40,800	47,600	30,600	51,000	170,000
MEANWA	89.3	83.2	84.3	82.4	84.6
%hh with MEANWA <80%	30.1[a,b]	40.7[a]	35.0[a]	44.1[a]	38.2
% all PEM in this grp.	19.0	29.9	16.5	34.7	100

Significance tests:

a $X^2 = 8.8$; 3df; $p < 0.05$

b <1 vs. ≥1 $X^2 = 5.6$; $p < 0.025$

ANNEX TABLE 1

INDICATORS BY BARANGAY

Code		Barangay	MEANWA	% hh MEANWA <80%	% hh MINWA <80%	% Fever	CMR	Number Born Alive	% River Water	% No/Pit Toilet	% No Disposal Garbage	% One Room	N	% Dist.
Pobl.	1	Puerto Princesa	89.4	22.2	27.8	24.5	4.6	63	0	16.7	8.3	22.2	36	4.9
A	2	San Rafael	81.3	50.0	73.1	16.0	8.3	44	7.7	30.8	19.2	42.3	26	3.6
A	3	Tagburos	87.4	35.5	54.8	14.0	14.3	63	0	35.5	6.5	51.6	31	4.3
A	4	Mabuhay	83.9	37.5	40.0	18.1	5.6	53	0	92.5	97.5	55.0	40	5.1
A	5	Inagawan	88.6	16.2	40.5	8.1	4.8	62	2.7	48.7	10.8	27.0	37	5.1
A	6	Langogan	84.2	48.2	51.9	22.8	9.8	39	33.3	59.3	11.5	59.3	27	3.7
A	7	Binduyan	85.3	23.8	42.9	41.3	15.2	33	42.9	85.7	28.6	71.4	21	2.9
B	8	Isumbo	81.2	36.4	66.7	15.2	9.5	63	6.1	60.6	39.4	69.7	33	4.5
B	9	Labog	81.9	48.2	55.6	13.9	9.1	50	11.1	22.2	7.4	46.2	27	3.7
B	10	Oring-oring	94.7	23.3	30.0	10.8	0.0	41	20.0	70.0	33.3	66.7	30	4.1
B	11	Inaray	83.6	37.0	59.3	1.9	2.0	46	22.2	25.9	18.5	59.3	27	3.7
Pobl.	12	Brookes Point	87.7	30.8	53.9	13.1	8.8	52	0	30.8	26.9	38.5	26	3.6
B	13	Maasim	86.7	33.3	47.2	6.0	0.0	57	8.3	41.7	27.8	52.8	36	4.9
	14	Quezon	88.0	16.1	35.5	3.8	0	49	12.9	58.1	35.5	45.2	31	4.3
	15	Panitian	86.6	30.4	52.2	16.3	10.6	47	4.4	30.4	30.4	47.8	23	3.2
	16	Pinaglabanan	89.7	29.2	37.5	9.7	0	32	54.2	41.7	12.5	79.2	24	3.3
C	17	Inogbong	78.8	61.8	67.7	3.9	11.8	51	20.6	88.2	64.7	91.2	34	4.7
C	18	Marangas	89.1	36.7	53.3	1.1	2.0	50	3.3	13.3	0	80.0	30	4.1
C	19	Bono-bono	83.6	44.4	61.1	5.6	0	25	72.2	16.7	22.2	76.5	18	2.5
C	20	Cabigaan	78.5	53.9	76.9	3.8	5.0	40	38.5	26.9	15.4	57.7	26	3.6
C	21	Sagpangan	80.8	44.8	75.9	5.2	8.3	48	37.9	55.2	37.9	75.9	29	4.0
Pobl.	22	Aborlan	85.8	31.0	44.8	19.0	2.4	41	13.8	6.9	10.3	44.8	29	4.0
C	23	Panacan	82.2	45.2	58.1	8.6	1.8	56	9.7	19.4	12.9	66.7	31	4.3
C	24	Aramaywan	80.0	53.9	80.8	26.0	2.1	48	0	19.2	16.0	46.2	26	3.6
Pobl.	25	Narra	83.9	35.5	58.1	12.1	4.1	49	3.2	38.7	25.8	48.4	31	4.3
		Sample $\bar{x}$	84.6	36.6	53.1	12.8	5.9	1202	15.0	42.7	26.0	56.1	729	100.4

ANNEX TABLE 2: INDICATORS BY FARMING TYPE & AREA.

A RURAL	Irrig Lowld	Rainfed Lowld	Rainfed Upland	Kaingin	All Farmers	Non Farmers	Total
# hh in sample	13	11	2	38	64	117	181
% hh in sample	2.0	1.7	0.3	5.8	9.8	18.0	27.8
Est. population	3400	2880	520	9940	16,740	30,600	47,340
MEANWA	89.1	86.4	(92.5)	85.3	86.5	84.6	85.3
% hh with MEAN WA<80%	30.8 [a]	18.2[a]	(50.0)[a]	36.8[a]	32.8[b]	35.9[b]	34.8
% all PEM in this grp.	1.6	0.8	0.4	5.6	8.5	16.9	25.4
% with fever	7.7	4.5	0.0	30.9	20.7	17.1	18.4
Child Mortality	8.7	0.0	0.0	15.6	11.7	8.4	9.5
% hh with poor water	15.4	9.1	0.0	21.1	17.2	8.5	11.6
% hh with poor toilet	53.9	27.3	(50.0)	63.2	54.7	62.4	59.7
% hh with no garb. disp.	15.4	0.0	0	23.7	17.2	41.0	32.6
% hh with only 1 room	23.1	36.4	0	60.5	46.9	51.3	49.7

a X^2 = 1.68, p 0.7,NS
b X^2 = 0.17, p 0.7,NS

B RURAL							
# hh in sample	20	56	7	20	103	50	153
% hh in sample	3.1	8.6	1.1	3.1	15.8	7.7	23.5
Est. population	5230	14,650	1830	5230	26,940	13,080	40,020
MEANWA	83.8	82.4	89.8	84.9	83.7	89.8	85.7
% hh with MEAN WA<80%	45.0[a]c	35.7[a]c	28.6[a]	35.0[a]	36.9[b]	32.0[b]	35.3
% all PEM in this grp.	3.6	8.1	0.8	2.8	15.3	6.5	21.8
% with fever	14.2	10.3	25.0	5.0	11.0	6.7	9.6
Child Mortality	9.5	8.6	0.0	0.0	6.4	0.0	4.7
% hh with poor water	0.0	19.6	14.3	20.0	15.5	8.0	13.1
% hh with poor toilet	45.0	51.8	42.9	35.0	46.6	42.0	45.1
% hh with no garb. disp.	20.0	37.5	57.1	5.0	29.1	20.0	26.1
% hh with only 1 room	50.0	73.2	71.4	65.0	67.0	42.0	59.2

a X^2 = 1.54 p<0.7 NS
b X^2 = 0.35 p<0.7 NS
c X^2 = 0.54 p<0.5 NS

ANNEX TABLE 2 (Continued)

C RURAL	Irrig Lowld	Rainfed Lowld	Rainfed Upland	Kaingin	All Farmers	Non Farmers	Total
# hh in sample	37	61	4	19	121	73	194
% hh in sample	5.7	9.4	0.6	2.9	18.6	11.2	29.8
Est. population	9680	15,950	1050	4970	31,650	19,090	50,740
MEANWA	83.1	81.6	(92.4)	80.0	82.2	75.8	79.8
% hh with MEAN WA<80%	45.9[a]	54.1[a]	(25.0)[a]	47.4[a]	49.6[b]	48.0[b]	49.0
% all PEM in this grp.	6.7	13.3	0.4	3.6	24.2	14.1	38.3
% with fever	2.7	9.3	(6.3)	18.4	8.6	5.7	7.5
Child Mortality	10.3	1.0	(0.0)	0.0	3.7	6.2	4.7
% hh with poor water	27.0	20.0	(25.0)	26.3	23.3	23.3	23.2
% hh with poor toilet	35.1	41.7	(50.0)	26.3	37.5	35.6	36.6
% hh with no garb. disp.	24.3	23.3	(25.0)	42.1	26.7	23.3	25.4
% hh with only 1 room	78.4	65.0	(75.0)	63.2	69.2	74.0	71.4
a	X^2 =	1.70	p< 0.7	NS.			
b	X^2 =	0.05	p< 0.9	NS			
c	X^2 =	0.61	p< 0.5	NS			

Poblacions	Farmers	Non Farmers	Pobl.	Total Sample Farmers	Non Farmers	Total
# hh in sample	11	111	122	299	351	650
% hh in sample	1.7	17.1	18.8	46.0	54.0	100.0
Est. population	2880	29,030	31,910	78,200	91,800	170,000
MEANWA	82.1	87.3	86.8	83.6[c]	85.5[c]	84.6
% hh with MEAN WA<80%	54.5[a]	27.0[a]	29.5	41.8[b]	35.1[b]	38.2
% all PEM in this grp.	2.4	12.1	14.5	50.4	49.6	100.0
% with fever	9.1	18.4	17.6	12.1	14.4	13.3
Child Mortality	6.3	5.3	5.4	6.5	5.9	6.1
% hh with poor water	0.0	4.5	4.1	18.7	10.0	14.0
% hh with poor toilet	18.2	23.5	23.0	43.5	41.7	42.5
% hh with no garb. disp.	18.2	16.2	16.4	25.2	26.6	25.9
% hh with only 1 room	45.5	36.9	37.7	63.3	50.1	56.1
a	X^2 =	3.64	p<0.1	b	X^2 =	3.13	p<0.1
				c	t-test = 1.77	p 0.08	

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