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ASSESSING LIKELY EFFECTS OF RURAL DEVELOPMENT DURING PROJECT PLANNING: A TEST OF METHODS IN N. HAITI

By

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INTRODUCTION

Malnutrition is largely caused by poverty, and should therefore be susceptible to prevention by development activities that are designed to alleviate poverty. In rural areas of developing countries, most of the public resources for development are made available through rural development projects; moreover, these resources are orders of magnitude greater than those generally used for direct nutrition intervention programs. For example, the expenditure on nutrition/health programs is typically around $5 per capita per year (Gwatkin et al. 1980), while that in rural development projects, at least when supported by the international development banks, is of the order of $50 per capita per year (see for example Deboeck & Kinsey 1980). These resources devoted to rural development can themselves - albeit as a secondary objective -affect the underlying causes of rural malnutrition and hence bring about long-term improvement in nutritional conditions.

If this improvement in nutrition is an automatic result of rural development activities no special attention needs to be paid to nutritional objectives in planning or monitoring the outcome of such projects. Conversely, if the potential for improving nutrition is not always fulfilled, then alternative program designs with possibly different effects on nutrition need to be considered. There is only scanty historical evidence of the effects of rural development projects on nutrition, but in some well-documented cases (Hernandez et al. 1974, Dewey 1981) nutritional improvement was not found to have followed improvement in economic indicators. There are two basic reasons why rural development may not automatically bring about improved nutrition. The first is simple: the malnourished do not always derive the benefits -primarily increased income - from a project. A second reason is less common, but important: under some conditions, even when household income is increased, food intake may not increase. This has occurred, for example, with some shifts from food crops to cash crops (Dewey 1981; Fleuret & Fleuret 1980). Indirect and intermediate effects of rural development projects, such as migration and changed labour patterns, may also affect nutrition. It is likely therefore that attention to the expected nutritional effects of planned projects could help to ensure that these contribute to alleviating malnutrition. The question is in fact broader: if nutrition is regarded as one measure of level of living, then these

concerns become similar to ensuring that a rural development project has a generally beneficial effect on the level of living in the area.

The concern that rural development projects should realize their potential for alleviating malnutrition has led to some policy committment to this goal on the part of donor agencies and to a search for methods suitable for introducing these concerns into the planning of such projects (ACC-SCN 1978). Two approaches, representing highly different levels of sophistication, have been put forward in some detail, one by FAO (FAO 1979, 1980) and another by the World Bank (Pinstrup-Andersen 1981). The method proposed by FAO is intended to develop procedures that can be applied quickly and inexpensively to a large number of projects. The World Bank's methodology requires more extensive data and analysis and, to begin with, would be applied to a few selected projects. The main differences lie not so much in concept but in the type of data required and the degree of quantification desired.

The study reported here was an early test of the FAO method for introducing nutritional considerations into project planning. The two main questions asked were: how much can the malnourished benefit from the project (mainly in terms of income)?; and is it to be expected that these benefits will improve their nutrition? The answers to these questions could then be used to suggest modifications or additions to the project to enhance its positive effects on nutrition, before the project begins.

The FAO method involved several steps. First, an 'initial assessment' was carried out to obtain preliminary answers and define additional information needs. Second, more detailed data collection and analysis were carried out. The analysis was conducted in two stages - a rapid analysis to elucidate the main effects was followed by a more detailed investigation of the relationship among variables of interest. Third, the conclusions were used to make recommendations on program design.

This paper therefore reports an early application of the methods for project assessment proposed by FAO (1979, 1980). It illustrates how certain conclusions and recommendations on likely project effects can be reached. These conclusions essentially cover:

(a) targetting project activities;

(b) effects of certain production-oriented components on project participants;

(c) identification of a 'nutrition' component.

The Rural Development Project

The planning of the second phase of a rural development project in the north of Haiti was used as a test case for trying out proposed methods of project analysis. A loan agreement between the Government of Haiti and the World Bank/IDA was completed in 1976 for assistance in selected areas of the Departement du Nord. Further financial assistance was provided by French and German bilateral aid, and food assistance was provided by the World Food Programme. The total cost envisioned at the time of appraisal was approximately $13 million. Implementation of the first phase of the project (Projet de Developpement Rural du Nord - Phase I) began in May, 1977. This first phase provided support for infrastructural development, irrigation and soil conservation, village water supplies, credit, extension services, and a number of other components aimed at upgrading argicultural productivity for about 30,000 small farmers. A regional development office, the Organisme du Developpement du Nord (ODN), was established and assigned responsibility for project implementation.

In 1978 it was decided to begin preparation of the second phase of the rural development project, to complete activities begun in the first phase and to extend project activities into other areas of the Departement du Nord. A map showing project areas in the Departement du Nord is given in Figure 1. During the initial stages of planning this second phase it was decided to concentrate on the areas of Limbe, Port Margot and Plaine Du Nord, which are to the west of the areas covered in Phase I. Planning of this second phase of the rural development project was begun well in advance of its intended implementation, despite the fact that the first phase was somewhat behind schedule, in order to ensure that there would be no interruption of activities between the two phases.

The components of the second phase of the project as initially identified were to be credit (20% of expenditure); soil conservation (12%); drainage (12%); fisheries (3%); marketing (6%); feeder roads (14%); social services and infra-

structure (including village water supply and heath/nutrition components), (7%); organization and management (20%); further studies (6%). The proposed budget was $14.5 million.

Although it was decided to concentrate on the areas of Limbe, Port Margot and Plaine du Nord, the precise locations and orientation of the public works and services were subject to feasibility studies during project preparation.

The Project Area

The overall population of the Departement du Nord is about three quarters of a million, approximately 16% of the population of the country.

Some 20,000 households (approx. 120,000 people) are located in the area identified for the second phase of the project. The terrain is rugged, with coastal and inland plains rising through foothills to steep mountains. The population density is extremely high, ranging from 220 to 330 persons per square km in rural areas. This has led to cultivation of many marginal areas with consequent erosion and degradation of the soils. The rainfall averages about 1500 to 2000 mm annually, and is adequately distributed over the year to allow multiple cropping in many areas. Both cereals (rice and maize) and root crops (cassava, taro, yams, sweet potatoes) constitute staple foods; coffee & cocoa are produced as sources of cash income. Mixed cropping predominates throughout the area.

The capital of the Departement is Cap-Haitien, the second largest town in the country with a population of 50,000 people. There are numerous small towns in the department. In the second phase project area these are Port Margot, Limbe and Plaine du Nord. The rural settlement pattern is highly dispersed. No village structure exists. Rural residents are grouped into sections rurales for administrative purposes. These units are, in turn, divided into traditional localities (localites and habitations) based on dominant physical features or the holdings of former landowners. Services and communications in the rural areas are poorly developed, partly because of the difficult terrain and partly as a result of the extreme underdevelopment of the area. Indeed, the extreme poverty of the rural population is everywhere in evidence.

METHODS

The procedure adopted was based on the methods put forward by FAO (1978, 1979) and consisted of the following steps:

1. An **initial assessment** (carried out in June 1979 by one of the authors (JBM)) provided preliminary conclusions on the nutrition situation and on ways in which the second phase of the rural development project could improve nutrition, including proposals for a nutrition component. This step, which took four weeks (two weeks in the field), laid the basis for further study.

2. **Survey and analysis.** A combined agro-economic and nutrition survey of 261 households was carried out between January and April 1980, supervised by two of the authors (THA and IJS). Basic analysis of these data was done in May 1980. A report on these results was issued in June 1980 (Shorr et al. 1980). Further analyses were carried out in 1981-82.

3. **Inputs to project planning.** Recommendations on project design were made from the initial assessment and from basic data analyses. Preparation of the second phase of the project was delayed because of difficulties in phase one and both the location and orientation of the phase II project were subsequently changed. The impact of the recommendations can thus not be evaluated.

Details of these steps are given below.

Initial assessment. The objective of the initial assessment was to use existing statistical data and informal observations to reach preliminary conclusions on: 1) the nutrition situation in terms of food consumption, nutritional status, health; 2) the characteristics of malnourisned households and correlates of malnutrition in terms relevant to the project design; 3) ways in which the rural development project could improve nutrition, both from the effects of project components already identified, and possibly by additional components; and 4) additional information needs.

Information on the nutrition situation was available from reports and publications on: food consumption and nutrition surveys (Sebrell 1959; Jelliffe & Jelliffe 1960, 1961; King et al. 1963, 1968; and Beghin et al. 1970) (of which only one survey (Haiti 1979a & b) covered the project area itself); food balance sheet data for the country as a whole; hospital reports (USDHEW 1972); and a government compilation of these and other data (Haiti 1978). Further information was obtained from discussions with local officials (e.g. in the Health

Dept.and the area development office), and from visits to rural dispensaries and markets.

Survey Methods

Several options were considered for obtaining further data. An agro-economic survey was to be undertaken as part of the feasibility studies for the project. It was decided to include nutrition and related measurements in this survey - which was carried out in January-April 1980. The survey was primarily of agricultural and economic factors, and these descriptive results have been reported separately (see Ahlers 1980). The design was therefore dependent mainly on the needs of the agro-economic study, with the nutrition module being added into the survey.

Sample Design. The second phase of the project was to focus on three watersheds -- Port Margot, Limbe and Plaine du Nord. Eight sub-watersheds had been identified from a previous study as the key areas for project intervention. The survey covered these eight sub-watersheds. For analytical purposes the Limbe watershed was divided into upper and lower parts which correspond roughly to the mountains and plains/foothills of the watershed.

The sample was selected by a two stage procedure. For the first stage a sample of 40 primary sampling units was judged the maximum feasible with the available time, funds and personnel. Localites, the smallest identifiable area units, were chosen as the primary sampling unit. A lower limit of 60-80 households per cell was considered necessary for analysis of the agro-economic variables. Estimates for up to four strata (i.e. watersheds) were needed. Allowing for non-response and non-farm households and elimination of questionable data a total sample size of 560, or a mean of 12.5 households per localite was required. Estimated numbers of households per localite were obtained from local records (from the malaria eradication service) for each of 694 localites in the survey area (total 20,016 households). 40 sample localites were selected with probabilities proportional to their size (number of households). In order to avoid applying variable weights to the data each household in the project area was given an equal chance of selection. Within each sample localite, households were thus selected with a probability inversely

proportional to that of the clusters being selected. This was based on a new listing of the households obtained in each selected localite. This procedure yielded a total of 499 sample households. Interviews were successfully completed in 462 households, and children aged 1-6 were found and measured in 261 of these.

Selection of variables for nutrition assessment.

It was decided to restrict the indicators of nutritional and related conditions to a few measurements of current 'status', and specifically not to attempt estimates of food consumption. This was for both theoretical and practical reasons. We considered that reliable food consumption estimates could not be obtained given the available resources. Moreover, even if attempts were made to obtain such measurements, the associated data on pre-project income, as well as estimates of expected income changes due to the project, would not have permitted valid projections of food consumption to be made. It was therefore decided to collect 'diagnostic' data on the nutrition situation (anthropometric measurements on children, estimates of child mortality and morbidity, and household sanitation and wealth indicators) and to concentrate on relating these to factors important for targetting the project, and for assessing possible effects of agricultural and other components.

Questionnaires. Ten questionnaire forms were constructed in the local language (Creole), nine for the agro-economic survey and one for the nutrition module. These were field tested during enumerator training. Certain descriptive variables for the nutrition analysis were extracted from the agro-economic survey questionnaires.

Field methods. A total of seven enumerators and two supervisors were employed for the agro-economic survey. For the nutrition module, eight additional enumerators were trained in anthropometric measurements, and formed into four teams. Strict attention was given to training and to standardization tests for quality control. A total of twelve standardization tests to ensure competence in anthropometric measurement and oedema assessment were administered at three separate intervals: during training, mid-way through the survey and during the last week of data collection. After the second week of

data collection, two days were spent reviewing age assessment methods with the enumerators. Each day during data collection a programmable calculator was used to calculate height-for-age and weight-for-height of the sampled children to identify dubious results. Forms were identified with questionable age and/or anthropometric results. Most of these data were checked by repeat visits. In addition, teams revisited selected localites to remeasure and redetermine ages of a sub-sample of children. These remeasurements showed no consistent difference from the original data.

Weight was measured with Salter hanging scales (25 kg limit) borrowed from the Haiti Bureau of Nutrition and USAID/Port-au-Prince. Height and length were measured using custom-made height/length measuring boards, previously used in the 1978 National Nutrition Status Survey, borrowed from the Haiti Bureau of Nutrition. Scales and measuring boards were standardized for reliability and validity (i.e. to check that each scale and board produced the same results as on previous standardization tests) before the training began, mid-way through the survey and during the last week of data collection. A test for oedema, as a clinical sign of kwashiorkor, was done on every child. The criterion used for identifying oedema was the occurrence of pitting as a result of thumb pressure on the dorsum of both feet. Age was determined from a child's documentation (e.g. baptismal certificate, birth certificate, or clinic card) or, in the absence of these, using an events calendar.

A small subsample of fields operated by the survey households were also measured. Areas were calculated for 44 fields using a compass, rangefinder, and programmable calculator. The results indicated that areas reported by farmers were not very closely correlated with measured areas, and tended to overestimate actual sizes. For the purposes of the nutrition analyses, in which broad categories of holding size are used, this discrepancy is probably not serious and has not been taken into account.

Analysis of survey data

The data collected by anthropometric measurement and from the nutrition questionnaire were combined with certain variables extracted from the agro-economic questionnaires. These data are shown in Table 1, with the variables names quoted in later tables.

Basic Analysis. The objective of this analysis was to produce a rapid description of the main factors associated with different nutritional conditions. The output was a series of indicators by population group.

The data were entered directly from the nutrition questionnaire, and from a print-out of some agro-economic variables, into a Commodore 3032 (32K) microprocessor, using software specially developed by FAO (Nimrod/FAO, 1980). In the 277 households in which children were measured, a full data set was available for 261 households. The 16 households with missing household data were omitted. In the 261 households, nutritional data were obtained on 427 children aged 1-6.

Weights, heights, and ages of children were converted to weight-for-age, height-for-age and weight-for-height. The procedure used is described in Jelliffe (1966) and involves expressing the height (or weight) as a percentage of the standard height (or weight) for a child of that age (or height). An algorithm modelling the weight-for-age, weight-for-height, and height-for-age curves was used to calculate the standard values (developed by J. Hitchings, see Kenya CBS, 1979). The analytical procedure on the Commodore 3032 system involved selecting characteristics of households, and aggregating indicators by groups so defined. Mean values and prevalences of the nutrition indicators were presented in tabular form for different sub-groups of the sample.

The anthropometric indicators were aggregated over children, i.e. prevalence and mean values for a group were obtained by aggregating the values for all children in that group. The Commodore software assigned the value of household variables to each child in the household, in effect weighting households by the number of children they contained. Morbidity variables (sick yesterday, sick last week) were also aggregated to household level to derive a score between 0 and 1; for example, if one of two children were sick, the score was 0.5. The mortality variable was aggregated at household level by totaling the

children reported to have died, divided by total born, for one or more mothers in the household. Subsequent analysis revealed that this procedure of treating the child rather than the household as the unit of analysis did not significantly affect the results. This variable was used for regression analysis, discussed below. However, for the tabulations by population group (i.e. in tables 7,9, 10, 11, 12, 16) the indicator gives the reported total children died in that group divided by the reported total born.

Further Analyses. After the results of the basic analysis had been reported (Shorr et al. 1980 and Mason, 1980), it was decided to use more advanced statistical techniques - including analyses of variance and ordinary least squares regression analysis - to further investigate the results. The data were printed out and reentered onto the Cornell University IBM 370 (this proved quicker than setting up the necessary links, to read the data directly from the Commodore System onto the IBM 370), and further analysis was done using the Statistical Analysis System program package (SAS Institute Inc. 1979).

Four nutritional status indicators are selected for the major part of these analyses (see Table 1). All four refer to a household as the unit of analysis rather than a child. MEANHA refers to the average of height-for-age values for sample children in each household. It is a score assigned to each sample household and is used to measure average nutritional status of a household. A mean of these household scores is taken when a summary statistic for a group of households is needed. The proportion or percentage of households in a group whose MEANHA scores fall below the cut-off of 90% provides another indicator of nutritional status, equivalent to prevalence. Indicators based on weight-for-height are defined in exactly the same way (referred to as MEANWH), with 80% as the cut-off point to express prevalences. Similar indicators of weight-for-age are derived but are not used extensively. The averaging process involved in assigning household scores alters prevalences only slightly compared with using child values, as discussed below. Alternative household scores are also constructed by assigning the minimum of weight-for-age, height-for-age, or weight-for-height of the sample children in a household to that household. These are referred to as MINWA, MINHA, and MINWH respectively.

Locality and household characteristics have been used to group sample households in order to describe and compare their nutritional situation, to identify potential target groups, and to investigate which characteristics are most closely associated with malnutrition. Analyses of variance and X^2 tests have been occasionally used to test for statistical significance of differences in means and prevalence(s) across groups respectively. Possible associations among various indicators of nutritional status, morbidity and mortality are examined through correlation analysis. Similarly correlation analysis and X^2 tests have been employed to detect possible associations among various child-, household- and locality-level characteristics as well as among these and nutritional status.

Regression analysis allows estimation of the effect of one variable on another while other factors are held constant. Household level nutritional status, mortality and morbidity indicators have been treated as dependent variables. The household socio-economic characteristics used as independent variables were chosen based on previous results and theoretical expectations. The household characteristics used in the regressions are shown in Table 1.

Two methodological questions arose in data analysis which are best dealt with here. The first concerns the effect of the two-stage sampling procedure, and the second, the accuracy of age reporting.

The statistical tests assume a simple random sample of households although the sample is in fact selected in 2 stages. Tests of the effect of the two-stage design (Kish 1965, p. 257-259) lead to the conclusion that for height-for-age and mortality at the household level the assumption of simple random sampling is justified and the design effect is not significant (Table 2). The design effect is, however, significant for household mean weight-for-height and for individual child height-for-age and weight-for-height. For these variables the effective sample size is only about two thirds of the actual sample size. All results reported as statistically significant in this paper remain so when the design effect is accounted for, unless otherwise stated.

Another factor which must be considered is the reliability of age-dependent indicators. The recorded age of a child is likely to be more accurate when copied from documents than when estimated from an events calendar. Our results indicate that the prevalence of stunting, the mean height-for-age and its standard deviation among children whose age was documented are virtually

identical to those for children whose age was estimated (Table 3). There also did not appear to have been much rounding of the reported ages among undocumented children, from frequency distributions of estimated ages. This result is the same as that found in a similar survey in Kenya, in which no systematic error was indicated on similar grounds to those used here by lack of age documentation (Kenya, Central Bureau of Statistics 1977).

RESULTS

Initial Assessment.

As described in "Methods", the initial assessment was based on existing data and from on-the-spot observations and discussions. The results reported in this section are condensed from the report written at the time (July 1979), and are not modified by hindsight.

Description of nutrition problems. No nutritional status data existed for the project area itself. The National Nutrition Status Survey of 1978 (Haiti 1979a & b) and other data indicated that, however, the prevalence of stunting was higher in the Departement du Nord (33%) than in any other Department and that the the prevalence of wasting (6.8%), and that of anemia were higher in only one other department. Estimates of the prevalence of oedema, the key clinical sign of kwashiorkor, range from 9% to 16%, which is high both in comparison with national data and with the prevalence in other countries of similar ecology. From these and other data (Sebrell 1959; Jelliffe & Jelliffe 1960, 1961; King et al. 1963, 1968; Beghin et al. 1970; USDHEW 1972; May and McLellan 1973; World Bank 1976; and Haiti 1978, 1979a & b.) as well as from local discussions and observation, the nutritional status of the population in general was summarized as follows. Malnutrition in young children was widespread, showing characteristics both of inadequacy of total food intake, and of a high starch/low protein diet. The prevalence of malnutrition (wasting and kwashiorkor) probably varied seasonally, with the worst period being April to July. Children showed more effects of chronic malnutrition and marginal protein deficiency than of acute malnutrition. There was little information on the nutritional status of adults.

The food consumption surveys (approximately 12, none national, for details see Shorr et al. 1980; King et al. 1968; Beghin et al. 1970; and Haiti 1978) carried out since 1958 all showed a very substantial deficit in both calorie and protein intakes. A synthesis of these results indicated an energy deficit of around 300-500 kcals/person/day which is 14 to 23% of requirement. A figure of 1700 kcals/person/day seemed to represent the most common estimate (77% of requirement). The protein-energy proportion in the diet was also low, at about 8.5 to 9.5%. The estimated kcal availability for 1974 (from the Food Balance Sheet) was 1900 kcals, as compared with an estimate of 1700 kcals from consumption data. Seasonal variation in food consumption had only been studied in one survey, which showed substantial changes, e.g. from 55% energy sufficiency in March to 100% in June.

A small socio-economic survey had been carried out in February 1979 in several communities in the proposed project area. Recalculation of certain results from this study led to the following tentative conclusions. Only about 40-65% of food consumed appeared to be produced in the area. On the average there was sufficient income from sale of cash crops (coffee, and cocoa) to allow for food purchases, presumably from outside the area, to make up the difference (assuming 65% of income was spent on food as indicated in previous surveys). However, for the households with small landholdings (0.5 ha) it seemed very likely that a substantial deficit must exist in food availability. Even for the food crops, about 60-90% of production passed through the market; a considerable proportion (e.g. cassava) probably left the area.

Major causes of morbidity, as obtained from health records (Haiti 1975) were intestinal parasites, malaria, gastroenteritis and tuberculosis. These were all potentially open to improvement through project activities both indirectly and directly.

Characteristics of those affected by malnutrition. Apart from the reasonable assumption that the biologically vulnerable groups - infants, pre-school children, pregnant and lactating mothers - were most affected, there was little direct evidence to identify the malnourished in socio-economic terms. The factors considered likely to be important for the farming population in the project area were: size of land holding; land tenure; altitude, particularly in relation to

malaria; access to potable water; access to health services; communications - roads, transport. No data were available to relate nutrition to these factors. Nonetheless it was considered likely that the households most affected by malnutrition were those with the smallest landholdings (for comparison with existing data, less than 0.5 ha), particularly those not owning land; those in areas with the worst water control, particularly in the lowlands; and those furthest from roads, health services, and without potable water.

Correlates of malnutrition. The causes of malnutrition were considered primarily from the point of view of those that were relevant to possible project activities. Those tentatively identified at this stage could be summarized as follows.

The production from holdings was inadequate to support the households dependent on them. This was partly due to inadequate size of holdings, in turn largely due to population pressure on the cultivable land. The present cropping pattern was well-adapted for making food energy available to the household on a year-round basis, given the resource constraints and the crop varieties then available. Thus the farmer was marginally better off planting much of his land to coffee and cocoa, and buying maize or root crops with the revenue, than in growing the maize or root crops himself. However, protein availability was marginal, and nutritionally there was a case for promoting the production and consumption of beans, peas, and, if agronomically feasible, groundnuts.

Environmental health factors - especially potable water, sewage disposal, hygienic habits, and housing - were important factors. Potable water was already to be included in the project and it was mainly a matter of who got access to the improved supply. Sewage disposal and housing could form part of a rural education scheme, and, particularly, use of potable water to improve hygiene could be promoted. Access to existing health services was poor, and the services that existed were inadequately supported. It was estimated that only 10-20% of the children served by one dispensary ever attended.

Project Strategy for Improving Nutrition. Increasing the income of poor households was regarded as the main means of improving nutrition in the project area. The two main issues therefore considered were: how the project could

reach the greatest number of the malnourished, and whether increasing income would in fact improve nutrition, regardless of the income source (including cropping pattern in the definition of income source). The primary consideration was the extent to which the benefits of the project itself could reach those most in need. A further project component was proposed to enhance the impact of project activities on nutrition. The identification of its component was one of the purposes of the initial assessment. The following proposals were tentatively put forward, recognizing that further information was needed.

(1) Increasing nutritional effects of production-oriented activities. These effects could, it was proposed, be enhanced by:

- direction of project activities (public works, agricultural extension) to areas and farm-types on the basis of severity of nutritional problems;
- increasing quantity and quality of food consumed, by: introducing new varieties for local consumption: sweet cassava, peas, beans, possibly groundnuts; promoting oil-bearing crops: groundnuts, oil palms; introducing acquaculture; and developing local maize milling capacity.

(2) Additional nutrition component. Inputs to strengthen the rural extension services (agricultural, health, "animation rurale") appeared to constitute a feasible additional component to increase the project's effects on nutrition. A proposal was made to site rural extension centers in accordance with the following considerations:

- where other project developments (road access, water control, potable water, production credit), and the agro-economic possibility for intensifying/introducing new crops gave the community the potential resources for improving nutrition;
- where malnutrition was particularly prevalent.

This component would provide: physical infrastructure (rural extension centers); additional extension agents with training and logistic support; and demonstration and communication equipment and materials.

Survey Findings

The sample-wide means for height-for-age (HA), weight-for-height (WH), of prevalences of stunting and wasting are shown in Table 4. Table 4 also shows that means and prevalences calculated from child-level data are very similar to those calculated from household level data. Household-level variables have been used for all further results shown in the rest of the tables and figures. Values obtained for the Dept. du Nord in the 1978 National Nutrition Survey are also shown in Table 4, and indicate more wasting and less stunting in the earlier survey. Both surveys show that stunting is far more prevalent than wasting.

Chronic malnutrition is widespread in the area. Nearly half the children are stunted (that is, less than 90% height-for-age). Acute malnutrition is less common, with 3% prevalence of wasting (less than 80% weight-for-height). Given the high risk of mortality for children with kwashiorkor, the 3% prevalence of bitting oedema (the key clinical sign of kwashiorkor) may indicate that this form of malnutrition is contributing to a high child mortality rate. Chronic malnutrition affects many more children, however, and is likely to be a better long-term indicator of the degree of deprivation of households.

Before describing the characteristics of those in need, and possible determinants of this need, the association among nutrition and health indicators, and among locality characteristics are reported. These associations influenced the choice of variables used in the analysis.

Relations among nutrition and health indicators. The correlations between anthropometric, morbidity and mortality indicators are shown in Table 5. MEANWA (MINWA) is highly correlated with both MEANHA (MINHA) and MEANWH (MINWH). The correlation of MEANHA and MEANWH is not significantly different from zero and MINHA and MINWH are only weakly correlated. These two indicators measure different aspects of malnutrition and are both used in the present analysis. Weight-for-age was not used further in this analysis as an indicator since it adds little to the results obtained with the use of height-for-age and weight-for-height alone, and its omission simplifies interpretation. Mean and minimum methods lead to household scores which are highly correlated: with all three indicators (HA, WA and WH), the mean and minimum variables have a correlation coefficient that exceeds 0.9.

Mortality rate is significantly negatively correlated with both MEANHA and MINHA. In other words, households with higher mortality scores have lower anthropometric scores - as might be expected if malnutrition is related to mortality. Similarly one of the morbidity measure (sick yesterday) is weakly correlated with MEANWH and MINWH in the expected direction although the coefficients are statistically barely significant. The two indicators of morbidity are not correlated with height-for-age, but have a highly significant correlation with each other. Mortality rate is not correlated with either measure of morbidity. Its positive correlation with MINWH is somewhat surprising although barely significant.

Relations of nutrition and health indicators with housing and distance-to-water. Type of housing and whether or not there are any beds in the household were included to act as proxies for wealth. The two are highly associated (Table 6), and only housing type was used in most of the further analyses. The only variable available for measuring environmental sanitation was the distance to water supply. Other measures, such as type of water supply or toilet, showed no variation between households. The distance-to-water variable is not associated with either wealth variable (Table 6). As possible factors in the determination of nutritional status housing and sanitation are important and their lack of association, though somewhat surprising, makes statistical procedures easier.

Height-for-age (mean values at household level) is significantly associated with the quality of housing, in the expected direction (see Table 7). Mortality rates show the same effect. Morbidity indicators however show a trend in the unexpected direction, with households with better housing reporting a higher sickness rate. In general when the morbidity variables show associations with socio-economic indicators these are frequently in the direction of higher sickness with higher socio-economic status: this may be due to a reporting artifact (e.g. better-off families have less stringent criteria for considering their children sick), or may be a genuine result for which there is no ready interpretation.

The distance-to-water variable had no significant association by itself with anthropometric, mortality and morbidity indicators.

Relations among locality level variables. The correlations between certain characteristics of the 36 localities in the sample are given in Table 8. The variables measuring distance to town and to road are indicators of accessibility to services, markets, etc. and are, as expected, highly correlated with one another (coefficient of 0.8). Altitude is less strongly correlated with distance variables - there were some remote lowland clusters and some accessible upland clusters in the varied terrain - but the relationship is significant. This high degree of correlation meant that no more than one of these variables could be used at a time in multiple regression. The variable for distance-to-road was found to be most closely associated with the nutrition and health indicators, and was used in most of the regression analyses.

Nutrition and related indicators by location. The values of nutritional, health, and wealth indicators for each watershed area are given in Table 9. The areas, with the exception of Lower Limbe (mountain area), have similar values for all the indicators. Lower Limbe has a much lower prevalence of malnutrition, a somewhat lower value of the child mortality indicator. Otherwise the malnourished are quite evenly distributed geographically. Nutrition and health indicators are tabulated by distance-to-road categories in Table 10. Distance of a village to a road is likely to be the primary determinant of access to markets and services. Chronic malnutrition increases with increasing distance to road (Table 10): for example the proportion of households with MEANHA 90% is substantially higher for those living farthest from a road than for those living nearest to the road. This means that any intervention can succeed in affecting malnutrition only given adequate outreach to remote areas. A particular effort to reach the malnourished may be warranted despite higher costs. Mortality and housing indicators generally show a similar trend to nutritional status indicators. In this case, the morbidity indicator for children sick last week also shows a trend in the expected direction.

Similar results were obtained by category of distance-to-town, (which is strongly correlated with distance-to-road), and these were consistent within all four of the main watersheds (Port Margot, Limbe Lower, Limbe Upper, Plaine du Nord). A rough re-analysis of the 1978 data from the National Nutrition Survey, relating nutrition status to distance from Cap Haitien, showed a similar negative

relationship for the Dept. du Nord as a whole. The distance-to-dispensary variable showed no consistent effects of any of the nutrition and health variables.

Nutrition indicators by landholding area and tenure status. Landholding area is associated with nutrition, both for the overall population and on a more disaggregated basis. Table 11 gives results by category. For the population of the area, farmers with 0.2 to 1.0 Cx (1 Cx = 1 carreau = 1.29 hectares) were significantly worse off than those with 1.0 to 5.0 Cx, in terms of malnutrition, child mortality, and housing. Households with very small landholdings (less than 0.2 Cx), who usually had off-farm employment, tended to have intermediate values on the indicators used.

Disaggregation by distance to road category shows similar results by landholding area (see Table 12). For stunting, this shows that the effect of landholding is only important in the closer-to-road households, and this interaction between landholding and distance is significant. On the other hand, distance is always associated with malnutrition, independently of holding size. For the mortality and housing indicators, both holding size and distance are important.

No effect of tenure status on nutrition was detected for the population as a whole, nor within distance-to-town categories. For example, the percentage of stunted children was much the same whether the household head is a landowner or not, although housing is better for landowners and those with a pre-inheritance grant (26-32% unimproved housing) than for tenants and sharecroppers (44-52%). The probably reflects the lack of variation in tenure status and problems created by classifying households according to major tenure status even though most households operate land under a variety of tenurial arrangements.

Relation between nutrition & health indicators and agricultural variables. The main effects of agricultural and geographic factors on nutrition and health variables were found in the initial analysis - distance-to-town or road, and area cultivated. Regression analysis was used to investigate the effects of these and

other factors, such as land tenure status and cropping pattern, in the presence of each other.

The anthropometric measures were regressed on the cropping pattern, tenure status, distance to road and area cultivated. Cropping pattern and tenure status were not significant (Table 13). These regressions were run on farm households. The regression with MEANHA as dependent variable is the only equation which is significant, and the adjusted R^2 values are low in all cases. Both MEANHA and MINWA are again significantly associated with distance to road, and the first is positively associated with the amount of land held, as might be expected from Table 12. However, the main point is that (based upon these results) the effects of cropping pattern are minor if they exist at all.

There are indications of a possible association between coffee growing and MINWH, although this is not a significant result. The problem, which results in difficulty of interpretation, is that the bulk of coffee producing households also own land (DTEN1). DCOFF was highly significant (p= .022) when DTEN 1 is not in the model, but when the dummy variables DTEN1-DTEN4 are included, neither DCOFF nor DTEN 1 are significant.

Table 14 is constructed to shed some light on this result, by disaggregating the distance to road into four categories. Each cell of the table gives the average of MINWH. Without taking distance to road into consideration, coffee producers have significantly better MINWH than the rest of the sample (mean of 91.6% vs. 93.9%). Within each category coffee producers fare better, except for the second category (which includes few coffee growers). The analysis of variance indicates that when interaction is ignored both factors are significant regardless of which one enters first and remain so even when an interaction term is introduced. The interaction terms itself is significant. This indicates that the effect of coffee production on MINWH is somewhat different depending on how far from a road a household is located.

Regressions of prevalence or mean of anthropometric variables, mortality and morbidity measures at the cluster level on distance variables confirmed that distance to road was a significant explanatory factor accounting for changes in height-for-age. Altitude is somewhat associated with wasting and morbidity. In general, however, no additional information on effects of these variables, and others such as cropping pattern, were found.

Relations of nutrition indicators with housing, water supply, and family size

Associations of certain household characteristics with nutritional status were examined, allowing for the effects already detected by location and landholding area. These were studies using multiple regression analysis with anthropometric and mortality indicators as the dependent variables. The results are shown in Table 15. The analysis was carried out on the full sample, that is including the 25 households whose main occupation was not farming. Two variables were used to measure the effect of the number of children in the household: firstly the number of children as a ratio to the rest of the members of the household (DPROP), and secondly the number of children itself (NOKIDS).

The most significant associations for height-for-age indicators are distance to roads, housing type, and the number of children in the household. These factors are significantly related to height-for-age when the effects of the others are controlled for. Thus for example the number of children affects nutritional status irrespective of distance from road. The relation with housing was also shown in Table 7. The association with landholding is not significant in this regression, both because it is not significant by itself for the full sample, and because it is not significant in the presence of the distance-to-road variable alone when cropping pattern is not controlled for (i.e. as opposed to Table 13).

Number of children in the household has an effect on mean height-for-age, such that mean height-for-age is decreased when there are more children in the household. This association does not exist for MEAN WH. The effect of numbers of children in the household is substantially stronger in its association with the minimum height-for-age (MINHA). Part of this effect on the minimum indicator could be due to the fact that for a given probability of a child being malnourished, the minimum value will tend to decrease with constant mean and increasing number of children. These results are shown in Table 16. This displays the decline in mean height-for-age with increasing household size, despite the fact that larger households tend to have better housing. The mortality indicator also seems to decline with increasing number of children, but the direction of causality in this case is not clear.

None of the factors investigated were significantly associated with weight-for-height. The observation that the dummy for landholding becomes significant in this case (compared with Table 13) appears to be due to inclusion

of the 25 non-farming households in the sample. Mortality is only associated with distance to road, when controlling for other factors.

DISCUSSION

The initial assessment, survey and analysis were intended to lead to conclusions on ways in which the rural development project, at that time in the planning stage, could have a beneficial effect on malnutrition in the project area. The first issue concerned targetting: was there sufficient difference in nutritional conditions that targetting was important? and if so who was most in need, defined in terms relevant to planning? Since project activities were designed to increase income among participants, the second issue was whether increases in income would be expected to improve nutrition, and whether there was evidence that different crops, as the main source of income, would have different effects. Third, there was the question of whether additional components were indicated for nutritional reasons. Finally. the relative importance of these issues was considered.

Implications for design of the rural development project

The ability of the project to bring benefits to the population most isolated from roads and towns is likely to be the main factor governing its effect on nutritional conditions in the area. As far as we can tell, physical outreach itself seems to be important: the finding that more isolated areas have higher malnutrition prevalences is not due to differences in, for example, cropping patterns or landholding areas. Half the population, and that portion most affected by malnutrition, lives at a distance more than 100 minutes from a road (or town) (Table 10). From several points of view strong emphasis should be put on outreach, by improving communications through infrastructure development and delivering services to isolated communities.

The reasons for this strong effect of isolation can only be guessed at. One possibility is that the better-off may move towards more accessible areas and towns; this is unlikely to account for all of the differences observed and would not alter the conclusion that outreach is crucial. Presumably the effects are related to poor access to markets, both for selling farm produce and for buying household goods, particularly food. The cost of transportation is high, so that

the more isolated farmer is faced with lower farm-gate prices than those closer to roads. The effect on nutritional status of children is probably not explicable by access to health services, since the distance-to-dispensary variable by itself was not associated with malnutrition.

The second factor important for project targetting with regard to malnutrition is landholding area. In general, farming households with less than 1.0 Cx (1.3 hectares) had about 50% more malnutrition than larger farmers (prevalence of households with mean HA 90% was 51% for households with less than 1.3 ha and 34% for those with more than 1.3 ha see Table 11). Mortality and housing indicators show a similar relationship with farm size. Moreover, the small farmer (1.3 hectares) accounted for 75% of the population, and 82% of the malnutrition (calculated at household level). Again, there is a clear case for both targetting small farmers for project benefits, and for devising project components that can effectively induce participation of this group in the project. The latter is a major constraint, at least from experience in the first phase of the project, when major difficulties were encountered in setting up credit schemes (through promoting small mutual guarantee groups) for the small landholder.

The issue of targetting the small landholder is in fact more relevant for the accessible farmers, since the association of malnutrition with landholding is stronger in the less distant (from road) areas (Table 12). Nonetheless, nutritional impact would depend subtantially on the success of bringing in the small, isolated farmers who constitute about 40% of the population and account for nearly 50% of the malnutrition.

Little association was found between tenure status and malnutrition. This implies that sharing of existing food resources is not greatly inhibited by tenure conditions. Depending on how production inputs are made available to the small farmer (whether landowner or tenant), it might be expected from these results that increased resources would benefit the household even when the land is not owned by that household. This should however be evaluated during project implementation.

No pronounced effects of different cropping patterns on nutritional indicators were found (see Table 13). The exception was that coffee (and cocoa) growing was associated with somewhat better nutrition in terms of wasting (see

Table 14). In general, income is therefore likely to be positively associated with nutrition, independently of which crops are grown. There is evidence from these data that income and wealth are associated with better nutrition. First, improved quality of housing is quite strongly associated with less stunting, both alone (see Table 7) and controlling for other variables (see Table 15). Second, landholding area - which is likely to be associated with income, and is known to be associated with housing (see Table [illegible]) - is positively related to nutritional status.

The targetting of project activities could be guided by nutritional conditions expressed in various ways, the two most obvious of which are: (a) by prevalence alone and, (b) by proportion of total malnourished represented by a target group. Expression (b) is the population-weighted derivative of (a). For example, a group that only represented 5% of the population might not take priority even if its' prevalence of malnutrition were verv high. Evidently, such calculations would best be made if cost estimates for delivering project benefits to different population groups were available. These estimates are not available, but some points can be illustrated. Essentially the calculation will differ depending on whether costs are fixed per household, or per area (as extremes). An example of the former is home visits or credit; of the latter, building a road. For per household costs, relative prevalences (taking account of differential costs of reaching different households) would be the appropriate measure (option (a) above): for instance, those with the smallest land-holdings. On the other hand, for fixed costs per area, relative proportions of total malnourished (option (b) above) would be more appropriate: in this case the most distant areas are an example.

In sum, the recommendations for the development components of the project are:

- physical outreach is crucial;
- ways of including the small landholder (1.3 hectares) and increasing his production should be identified;
- there is no obvious advantage in any particular cropping pattern in the area in terms of nutrition - emphasis should be on increasing real income;

- real income improvement is likely to lead to nutrition improvement.

Implications for additional interventions

How to design additional components was a problem: evidently the need was enormous, but resources were far from sufficient to cover the whole area. It was proposed that (a) additional interventions be designed to capitalize on developments brought about by the project - for example, where a road was built additional resources could then ensure that this road was used to bring services to the previously isolated population; and (b) that additional interventions should be based on need - e.g. prevalence of malnutrition - within the project area.

The project will yield a number of benefits such as increased income, piped water, and better access to services. The best use of limited additional resources (approximately 4% of the planned project costs in this case) would be to ensure that the population served by the project was (a) informed of how to get access to these benefits: to health services, and water improvements, for example; and (b) to provide additional facilities for existing services to make use of the new infrastructure to reach more remote localities: i.e. staffing, transport and logistic support for the health services and agricultural extension. The original proposal from the initial assessment to create and support rural extension centers in development areas seems justified by the new data. However, the exact function of these would require additional study.

Conclusions on methods used

The procedure tested was designed within strict constraints of time and fund availability. It needed to be developed into a procedure that could be practically applied to a substantial number of projects. It needed to be compatible with the timing of the overall project planning cycle - mainly with the preparation phase in which feasibility studies are carried out, usually within a 6 to 12 month time period. Finally, it needed to be feasible with a tight budget. Up to $500,000 might be available for preparation of a project such as this, and realistically nutrition considerations would be unlikely to warrant more than 10% of this expenditure at most. The primary objective was to assess the likely nutritional effects of the overall project components -infrastructure, production inputs, etc. - and how these might be improved. The degree of

quantification and certainty of conclusions and recommendations required was not specified, but could be guided by that required for decision-making on other design issues. Generally, most of these design decisions are made on a semi-quantitative basis - due to similar constraints of data and analytical time.

The procedures tested fall into three distinctive phases. The initial assessment was, as intended, relatively cheap and rapid. About one person - month was needed, with other costs, perhaps equivalent to $8,000. The survey and basic data analysis took approximately six months. Part of the costs were absorbed by the broader agro-economic survey. The cost of the nutritional data collection and analysis was around $50,000. Finally, the advanced data analysis took about 6 months additional time (although this could have been compressed), and was equivalent to perhaps $10,000. Recommendations were formulated within each phase. In assessing these three phases, it is of interest to examine how conclusions and recommendations changed.

The initial assessment report (FAO 1979) identified outreach as a crucial factor, and proposed measures of this and other factors likely to distinguish population groups with different prevalences of malnutrition. These included distance measures, altitude, cropping patttern, land-tenure status, etc. -the variables in fact collected in the survey. It was not possible initially to reach conclusions on which of these were likely to be important. The recommendation on outreach was made, and it was tentatively concluded that cash crops were unlikely to have a detrimental effect. Tenure status was thought to be important. Effects of other factors were not known. There was virtually no quantified supporting evidence for these recommendations. In sum, the initial assessment conclusions were generally not wrong, but they could not go very far. The data were not of good enough quality to be presented with conviction as a basis for planning the project.

The results from the basic analysis of the survey picked up most of the findings in the data. The importance of isolation and landholding area, the lack of association with cropping pattern, relations with housing, and other effects were identified. These results were produced by simple tabulation of indicators by group, with few statistical tests - tables 7-12 are virtually the same as those given in the reports of the basic analysis, although they have been checked subsequently.

The more detailed analysis added to previous results in two ways. First, it checked that the previous findings were not the result of associations among different explanatory factors - for example that the distance findings were not due to differences in cropping pattern. Secondly, it provided a check that no other important effects were being missed, for example that cropping pattern was not important even if one controlled for farm size. The main outcome was to increase confidence in the results of the basic analysis. Given the low degree of correlation among the explanatory variables, it is not surprising that such associations as exist were found in the basic analysis. Most of the information to be obtained from the survey data was thus extracted by the first analysis.

Certain lessons have been learned for future application of this procedure. The most obvious is that the procedure needs to be much more closely related to the project planning itself. This is a policy rather than a scientific matter. It is certainly possible technically to arrive at conclusions that could be incorporated in decisions on project design, and which would be likely to influence the nutritional outcome of the project. These conclusions are unlikely to offer easy ways to tackle malnutrition; and they may raise fundamental questions about who benefits, and how, from rural development. However, they are only worth the time and money involved if there is a policy decision, which is implemented, to include these considerations from an early stage in project planning.

The procedure itself should become cheaper and quicker as experience accumulates. If the initial assessment procedure can be developed to the point where recommendations can be made with reasonable confidence, then it is clearly the most cost-effective. At the present state of knowledge, it is usually going to be necessary to collect additional data, unless (as is occasionally so) a suitable set of data already exists for the project area. With more experience, conclusions from an initial assessment may be drawn with more confidence. It is now important to apply a procedure such as this to several more projects, and ensure that findings are compared and where possible generalized. In due course, the survey and analysis phase could occasionally be dropped. On the other hand, when surveys are included it will usually be worthwhile to continue the analysis as was done here, although this need not be in the time-frame necessary for

making recommendations for project design. The further analysis can act as a check on initial findings, and help to provide an information base that can eventually be generalized.

Finally, the proof of the pudding is in the eating. It is essential to set up evaluation and monitoring procedures that can measure the actual effects of project implementation on nutrition. Methods for such "nutritional surveillance" for ongoing evaluation of programs have been put forward, for example, in Mason et al. 1982. This knowledge of the outcome would greatly improve the procedures for assessment in the planning stage. Studies such as the one reported here provide essential baseline data - both against which to measure change, and to define the indicators and groups that need to be monitored.

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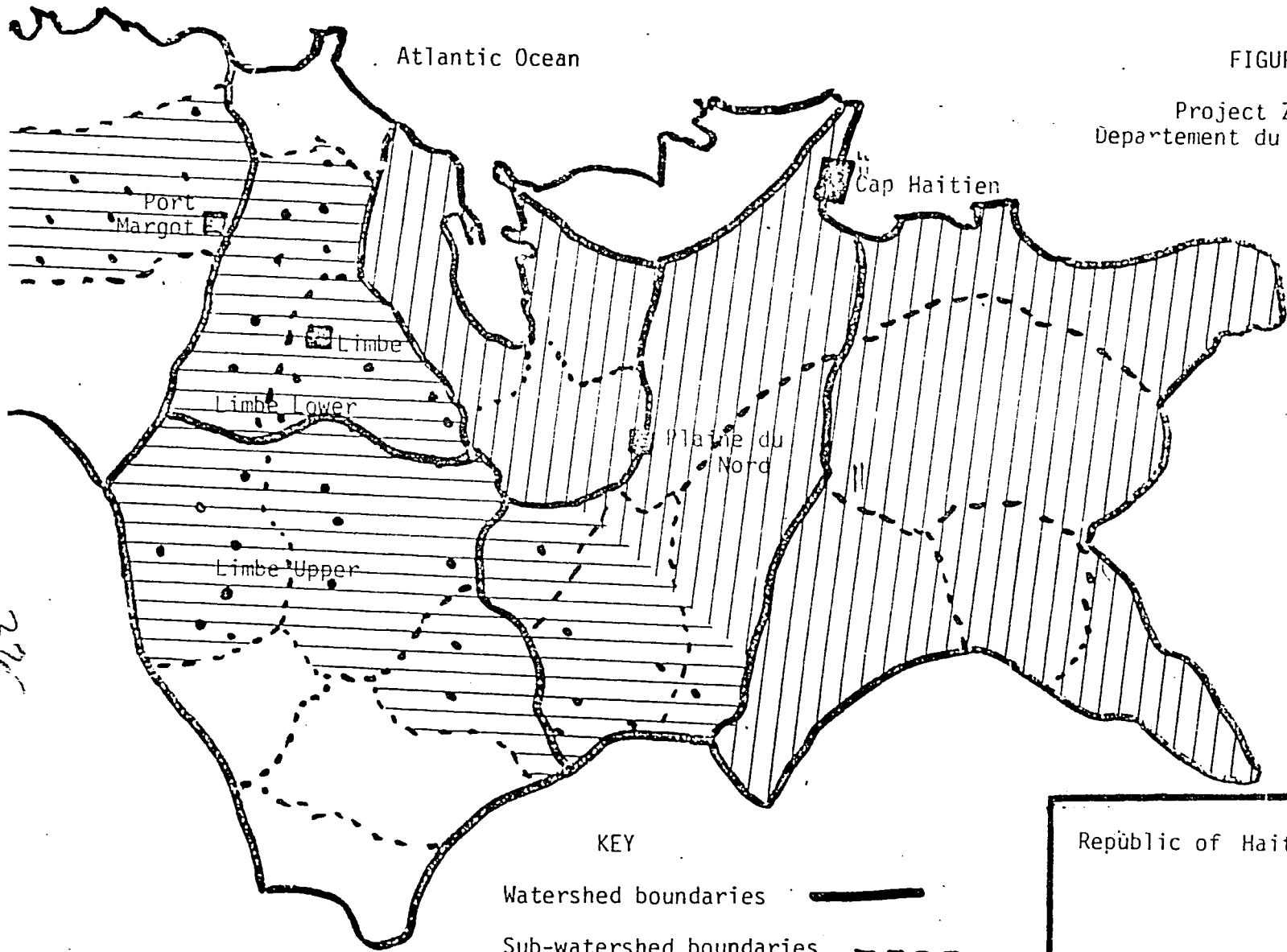
FIGURE I

Project Zones
Departement du Nord, Haiti



KEY

Watershed boundaries

Sub-watershed boundaries

Localite' in first stage sample

Major City

Phase I Area

Phase II Area (Proposed)

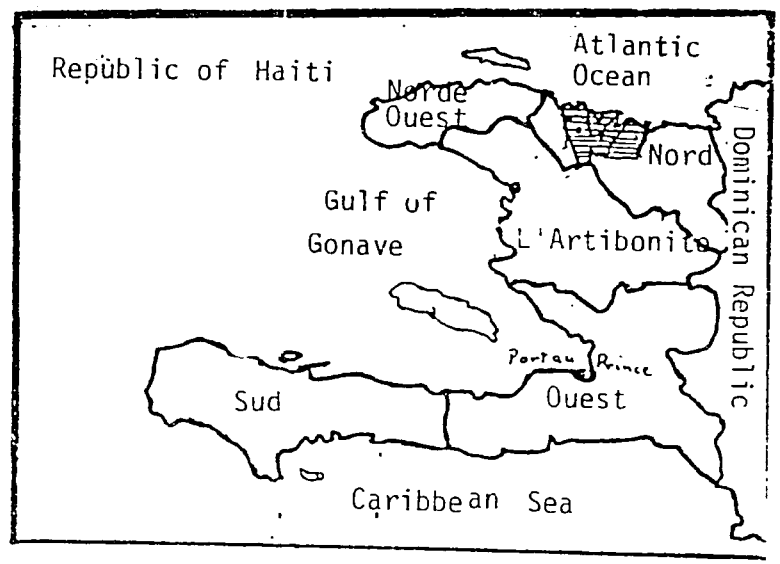


TABLE 1

DEFINITION OF VARIABLES USED FOR ANALYSIS

Area Characteristics

WSHED	Watershed code 1. Port Margot 2. Lower Limbe 3. Upper Limbe 4. Plaine Du Nord
ECOZONE	Agro-zone: plains or mountain
TOWN	Distance to nearest town (mins. of walking) 1: 0-50 mins. 2: 50-100 mins. 3: 100-200 mins. 4: 200 mins.
ROAD	Distance to nearest road (mins. of walking)
DISPENS	Distance to dispensary (in mins. of walking)
ALT1	Altitude in meters

Household Characteristics

MAINOCC	Main income source = farming, cash employment, non-agricultural self-employed
SECOCC	Secondary income source = faming, cash employment, self-employed
DLAND	1: if cultivated land is 1.0 C_x (carreau = 1.29 hectares)
	Predominant Tenure **status**
DTEN1	1: if owner
DTEN2	1: if renter
DTEN3	1: is sharecropper
DTEN4	1: if pre-inheritance grant
DTEN5	1: if squatter
	Cropping pattern
DCOFF	1: if grows coffee
DCERL	1: if grows cereals but not any coffee
DROOT	1: others
	Demography
DPROP	Proportion of children younger than 6 years old to all member in household

TABLE 1 (cont'd)

DEFINITION OF VARIABLES USED FOR ANALYSIS

Indicators	
	Nutritional status
MEANHA	Mean height for age values for sample children in household
MEANWA	Mean weight for age values for sample children in household
MEANWH	Mean weight for height values for sample children in household
MINHA	Minimum of height for age values for sample children in household
MINWA	Minimum of weight for age values for sample children in household
MINWH	Minimum of weight for height values for sample children in household
	Mortality
MORT	Proportion of children born no longer alive (asked of mothers with children under five years)
	Morbidity
SICKYT	Proportion of children in household who were sick yesterday
SICKLW	Proportion of children in household who were sick last week
	Household sanitation
	Distance to water supply (in mins. of walking)
DWAT1	1: if 0-5
DWAT2	1: if 5-30
DWAT3	1: if 30-60
DWAT4	1: if 60
	Wealth
	Type of housing
DHOUSE1	1: if dirt floor, straw roof
DHOUSE2	1: if dirt floor, tin roof
DHOUSE3	1: if cement floor, tin roof
	Possession of bed
DOWNBED	1: if yes

TABLE 2

ANOVA TESTS FOR PRESENCE OF DESIGN EFFECT

Dependent Variable	Level	No. of Cases	No. of Clusters	F	p	Interclass Corr. Coeff.	Design* Effect
HA	Child	428	36	1.57	0.024	0.046	1.50
WH	Child	428	36	1.80	0.004	0.063	1.69
MEANHA	Household	261	36	1.14	0.282	----	----
MEANWH	Household	261	36	1.76	0.008	0.095	1.60
MORT	Household	261	36	1.19	0.230	----	----

* Factor by which the sample size should be divided to give the "effective" sample size.

TABLE 3

PREVALENCE OF STUNTING BY SOURCE OF AGE DATA

	AGE DOCUMENTED n = 235	AGE ESTIMATED n = 192
% Stunted	47.2[1/]	47.9[1/]
Mean HA	90.8	89.8
St. Dev.	6.9	6.1

[1/] Chi-square = 0.02

d.f. = 1

prob. = 0.8883

TABLE 4

MEANS AND PREVALENCES FOR NUTRITIONAL STATUS INDICATORS, FOR CHILD AND HOUSEHOLD-LEVEL VARIABLES, AND COMPARED WITH 1978 SURVEY

A.	Mean HA (Children)	90.5
	% children with HA 90%	47.0%
	Mean of household HA scores (MEANHA)	90.7
	% households with MEANHA 90%	46.7%
	% children 90% HA in 1978 survey for Dept. du Nord	33.4%
B.	Mean WH (Children)	93.9
	% Children 80% WH	3.3%
	Mean of household WH score (MEANWH)	94.0
	% households with MEANWH 80%	1.9%
	% Children 80% WH in 1978 survey for Dept. du Nord	6.8%

TABLE 5

CORRELATION COEFFICIENTS BETWEEN OUTCOME INDICATORS

(N = 261)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. MEANHA	1.00	0.76**	-0.04	0.92**	0.71**	0.02	-0.18**	0.01	-0.02
2. MEANWA	0.76**	1.00	0.60**	0.71**	0.92**	0.61**	-0.08	-0.06	-0.05
3. MEANWH	-0.04	0.60**	1.00	-0.02	0.55**	0.92**	0.09	-0.12	-0.03
4. MINHA	0.92**	0.71**	-0.02	1.00	0.79**	0.14	-0.12*	-0.02	-0.01
5. MINWA	0.71**	0.92**	0.55**	0.79**	1.00	0.66**	-0.04	-0.06	-0.03
6. MINWH	0.02	0.61**	0.92**	0.14	0.66**	1.00	0.12*	-0.11	-0.03
7. MORT	-0.18**	-0.08	0.09	-0.12*	-0.04	0.12*	1.00	0.02	-0.07
8. SICKYT	0.01	-0.06	-0.12	-0.02	-0.06	-0.11	0.02	1.00	0.28**
9. SICKLW	-0.02	-0.05	-0.03	-0.01	-0.03	-0.03	-0.07	0.28**	1.00

* 0.01 p 0.05

** p 0.01

TABLE 6

TESTS OF ASSOCIATION BETWEEN TYPE OF HOUSING OWNING BED AND DISTANCE TO WATER SUPPLY

	X^2	df	p	Phi
Type of housing by whether or not there is any bed	26.2	2	0.01	0.32
Distance to water supply category by whether or not there is any bed	4.1	2	0.13	0.13
Type of housing by distance to water supply category	2.4	4	0.66	0.10

TABLE 7

NUTRITIONAL AND HEALTH INDICATORS BY TYPE OF HOUSING

	(1) Un-improved	(2) Inter-mediate	(3) Improved	TOTAL	ANOVA Test F	ANOVA Test p	X^2 Test X^2	X^2 Test p
1. No. of households (hh's) in sample	79	159	23	261				
2. No. of children in sample	123	273	32	428				
3. Estimated no. of hh's in population	6050	12,180	1760	20,000				
4. % of population in this group	30.3	60.9	8.8	100				
5. Mean of hh HA scores (MEANHA)	89.6	90.8	93.8	90.7	4.8	0.009		
6. Mean of hh WH scores (MEANWH)	93.8	94.3	93.1	94.0	0.26	0.77		
7. % of hh's with MEANHA 90%	54.4	45.3	30.4	46.7			4.5	0.11
8. % of all hh's with MEANHA 90% in this group	35.2	59.0	5.7	100				
9. Mortality rate: % of children born and died	18.1	16.7	9.0	16.5				
10. Morbidity rate: % of children sick yesterday	18.7	22.0	34.4	22.0				
11. Morbidity rate: % of children sick last week	47.2	56.0	65.6	54.2				

(1) Dirt floor, straw roof

(2) Dirt floor, tin roof

(3) Cement floor, tin roof

TABLE 8

CORRELATION COEFFICIENTS BETWEEN VILLAGE-LEVEL VARIABLES

(N = 36)

	(1)	(2)	(3)
1. TOWN	1.000	.83**	.50**
2. ROAD	0.83**	1.00	.31
3. ALTI	0.50**	0.31	1.00

* 0.01 p 0.05

** p 0.01

TABLE 9

NUTRITIONAL AND HEALTH INDICATORS BY ADMINISTRATIVE AREA (WATERSHED)

	(1) Port Margot	(2) Limbe Lower	(3) Limbe Upper	(4) Plaine du Nord	TOTAL
1. No. of households (hh's) in sample	45	75	69	72	261
2. No. of children in sample	79	127	106	116	428
3. Estimated no. of hh's in population	3440	5760	5290	5500	20,000
4. % of population in this group	17.2	28.8	26.4	27.5	100
5. Mean of hh HA scores (MEANHA)	90.4	92.2	90.6	89.5	90.7
6. Mean of hh WH scores (MEANWH)	93.6	93.6	93.9	94.8	94.0
7. % of hh's with MEANHA 90%	48.9	36.0	49.3	54.2	46.7
8. % of hh's with MEANWH 80%	2.2	1.0	4.4	0.0	1.9
9. % of all hh's with MEANHA 90% in this group	18.0	22.1	27.9	32.0	100
10. Mortality rate: % of children born and died	15.7	13.4	18.4	17.8	16.5
11. Morbidity rate: % of children sick yesterday	17.7	15.0	33.0	22.4	22.0
12. Morbidity rate: % of children sick last week	50.6	48.0	61.3	56.9	54.2
13. Wealth: % of hh's with unimproved housing	35.6	30.7	26.1	30.6	30.3

TABLE 10

NUTRITION AND HEALTH INDICATORS BY DISTANCE TO ROAD CATEGORY (IN MINS.)

	(1) 0-50	(2) 50-100	(3) 100-200	(4) 200	TOTAL	ANOVA Test F	ANOVA Test p	X^2 Test X^2	X^2 Test p
1. No. of households hh's in sample	77	51	114	19	261				
2. No. of children in sample	120	88	187	33	428				
3. Estimated no. of households in population	5900	3910	8740	1460	20,000				
4. % of population in this group	29.5	19.5	43.7	7.3	100				
5. Mean of hh HA scores (MEANHA)	92.4	91.2	89.8	88.2	90.7	4.6	0.004		
6. Mean of hh WH scores (MEANWH)	95.7	91.7	94.0	93.5	94.0	2.7	0.04		
7. % of hh's with MEANHA 90%	37.7	43.1	50.9	68.4	46.7			7.2	0.07
8. % of all hh's with MEANHA 90% in this group	23.8	18.0	47.5	10.7	100				
9. Mortality rate: % of children born and died	15.3	12.3	17.3	25.4	16.5				
10. Morbidity rate: % of children sick yesterday	19.2	28.4	21.4	18.2	22.0				
11. Morbidity rate: % of children sick last week	45.8	51.1	56.7	78.8	54.2				
12. Wealth: % of hh's with unimproved housing	20.8	27.5	39.5	21.1	30.3			17.1	0.0001

TABLE 11

NUTRITIONAL AND HEALTH INDICATORS BY LANDHOLDING SIZE

(In Cx; 1 Cx = 1.29 Ha)

	(1) 0.1	(2) 0.1-0.2	(3) 0.2-1.0	(4) 1.0	TOTAL
1. No. of households (hh's) in sample	25	27	145	64	261
2. No. of children in sample	38	39	241	110	428
3. Estimated no. of households in population	1920	2070	11,110	4900	20,000
4. % of population in this group	9.6	10.3	55.6	24.5	100
5. Mean of hh HA scores (MEANHA)	89.7	91.1	90.2	92.2	90.7
6. Mean of hh WH scores (MEANWH)	91.6	93.4	93.7	95.9	94.0
7. % of hh's with MEANHA 90%	52.0	48.1	51.0[1]	34.4[1]	46.7
8. % of all hh's with MEANHA 90% in this group	10.7	10.7	60.7	18.0	100
9. Mortality rate: % of children born and died	14.5	21.6	17.3[2]	13.3[2]	16.5
10. Morbidity rate: % of children sick yesterday	15.8	23.1	17.8	32.7	22.0
11. Morbidity rate: % of children sick last week	55.3	59.0	49.4	62.7	54.2
12. Wealth: % of hh's with unimproved housing	24.0	40.7	37.2[3]	12.5[3]	30.3
13. % with off-farm employment	68	81	71	67	71

Significance Tests:

1/ $X^2 = 4.96$, df = 1, significant at 5%

2/ $X^2 = 2.85$, df = 1, not significant at 5%

3/ $X^2 = 13.0$, df = 1, significant at 1%

TABLE 12

NUTRITION AND HEALTH INDICATORS BY LANDHOLDING SIZE WITHIN

DISTANCE TO ROAD CATEGORY (IN MINS.)

	(1)	(2)	(3)	(4)	(5)	(6)	
	Distance to Road (in mins.)						
	100			100			
	Holding (Cx)			Holding (Cx)			
	0.2	0.2-1.0	1.0	0.2	0.2-1.0	1.0	TOTAL
1. No. of households hh's in sample	31	60	37	21	85	27	261
2. No. of children in sample	46	103	59	31	138	51	428
3. Estimated no. of households in population	2380	4600	2840	1610	6510	2070	20,000
4. % of population in this group	11.9	23.0	14.2	8.0	32.6	10.3	100
5. Mean of hh HA scores (MEANHA)	91.1	91.5	93.4	89.5	89.3	90.5	90.7
6. Mean of hh WH scores (MEANWH)	92.4	93.7	96.2	92.7	93.8	95.6	94.0
7. % of hh's with MEANHA 90%	45.2	48.3	21.6	57.1	52.9	51.9	46.7
8. % of all hh's with MEANHA 90% in this group	11.5	23.8	6.6	9.8	36.9	11.5	100.1
9. Mortality rate: % of children born and died	12.3	17.0	9.7	26.9	17.6	16.3	16.5
10. Morbidity rate: % of children sick yesterday	19.6	20.4	30.5	19.4	15.9	35.3	22.0
11. Morbidity rate: % of children sick last week	52.8	38.8	61.0	64.5	57.2	64.7	54.2
12. Wealth: % of hh's with unimproved housing	29.0	30.0	8.1	38.1	42.4	18.5	30.3

1/ ANOVA : Overall F = 5.09, p = .002. Road class: F = 11.31, p = .0009. Landholding: F = 1.99, p = .139.

TABLE 13: REGRESSIONS ON AGRICULTURAL DETERMINANTS

(N = 236)

Dependent to Variable	(1) Intercept	(2) ROAD	(3) DCOFF	(4) DCERL	(5) DTEN1	(6) DTEN2	(7) DTEN3	(8) DTEN4	(9) DLAND	(10) R^2	(11) R^2	(12) F
1. MEANHA	91.43** (30.26)	-0.0134* (2.25)	-0.23 (0.23)	0.75 (0.79)	-3.7 (0.13)	0.82 (0.25)	0.22 (0.07)	2.04 (0.66)	1.87* (2.09)	0.072	0.039	2.19*
2. MEANAH	90.51 (21.92)	-0.0104 (1.28)	1.09 (0.83)	-1.03 (0.79)	4.69 (1.17)	3.72 (0.84)	5.05 (1.18)	2.91 (0.69)	1.59 (1.30)	0.043	0.009	1.26
3. MINHA	90.98** (26.49)	-0.0178* (2.64)	0.29 (0.26)	1.20 (1.11)	-1.17 (0.35)	-0.11 (0.03)	-0.92 (0.26)	0.78 (0.22)	1.42 (1.40)	0.061	0.028	1.84
4. MINAH	88.17** (19.86)	-0.0148 (1.69)	1.68 (1.19)	-0.69 (0.50)	5.60 (1.30)	4.37 (0.91)	5.12 (1.12)	3.12 (0.69)	0.93 (0.71)	0.048	0.014	1.42

Note = t-ratios in parentheses

* 0.01 p 0.05

** p 0.01

TABLE 14

MINIMUM WEIGHT-FOR-HEIGHT BY DISTANCE TO ROAD AND COFFEE PRODUCTION*

Distance to Road (in mins.)	Coffee Producer No	Coffee Producer Yes	TOTALS
0-50	54 93.0	19 96.6	73 94.0
50-100	32 91.7	7 84.7	39 90.5
100-200	77 91.0	30 93.9	107 91.8
200	11 88.7	6 96.3	17 91.4
TOTALS	174 91.6	62 93.9	236 92.2

* Values in the cells are:
Number of cases
Mean of minimum weight-for-height (MINWH)

ANOVA: Overall F = 1.61, p = .173. Road Class: F = .42, p = .740.
DCOFF: F = 5.16, p = .024

TABLE 15: REGRESSIONS ON PROXIMAL FACTORS

(N = 261)

Dependent Variable	Intercept	ROAD	DWAT1	DWAT2	DWAT3	DLAND	HOUSE1	HOUSE2	DPROP	NOKIDS	R^2	R^2%	F
1. MEANHA	96.13 (38.20)	-0.01* (2.54)	-0.46 (.213)	-0.63 (.304)	-2.53 (.930)	1.07 (1.25)	-3.06*	-1.95		-0.58*	.085	.055	2.90*
2. MEANWH	93.02 (26.89)	-0.01 (1.27)	-1.84 (.624)	-1.33 (.463)	-2.82 (.754)	2.65* (2.65)	2.17 (1.12)	2.08 (1.16)		0.36 (.886)	.36	.005	1.16
3. MINHA	95.89 (34.86)	-0.02** (2.94)	1.31 (.557)	0.76 (.335)	-1.31 (.441)	0.62 (.658)	-3.39* (2.19)	-2.28 (1.60)		-1.38** (4.34)	.135	.107	4.90*
4. MINWH	94.43 (25.72)	-0.01 (1.78)	-1.92 (.613)	-0.99 (.326)	-3.80 (.956)	2.05 (1.64)	1.68 (.812)	1.79 (.942)		-0.71 (1.66)	.042	.011	1.38
5. MORT	-.008 (.106)	.00047** (2.68)	0.08 (1.24)	0.08 (1.3)	-0.05 (.645)	-0.01 (.252)	0.07 (1.67)	0.05 (1.37)		-0.01 (1.67)	.085	.056	2.93*

Note: t-ratios in parentheses under coefficients

* .05 sig.
** .01 sig.

TABLE 16

NUTRITION AND HEALTH INDICATORS BY NUMBER OF CHILDREN IN HOUSEHOLD

	(1) 1	(2) 2	(3) 3	(4) 4	(5) 4	Total	ANOVA Test F	ANOVA Test p
1. No. of households (hh's) in sample	51	97	66	29	18	261		
2. No. of children in sample	51	143	121	68	45	428		
3. Mean of hh HA scores (MEANHA)	91.8	90.9	90.9	88.7	89.6	90.7	1.5	0.20
4. Mean of min. hh HA scores (MINHA)	91.8	89.7	88.6	85.2	86.6	89.1	6.1	0.0001
5. Mean of hh WH scores (MEANWH)	92.5	94.6	94.3	93.3	95.4	94.0	0.81	0.52
6. Mean of min. hh WH scores (MINWH)	92.5	93.0	91.6	88.7	91.5	92.0	1.6	0.17

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