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CONSULTANTS REPORT

ON

THE FEASIBILITY OF IMPLEMENTING A NUTRITION STATUS MONITORING SYSTEM:

A PILOT STUDY

I. OBJECTIVES

II. METHODS

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OBJECTIVES

The general objective of this project is to evaluate the feasibility of implementing a nutritional status monitoring system at the village and subdistrict levels. There are specific objectives associated with three general areas of evaluation: I) Operational evaluation, II) Choice of indicators and subgroups for monitoring, and III) Choice of sampling frame. The specific objectives are:

I. Operational Evaluation

1. To evaluate the training of Puskesmas health workers to carry out monitoring activities in the villages.

    a. to evaluate their knowledge of nutritional assessment and interviewing methodologies.

    b. to evaluate their ability to train assistants from the villages to assist in data collection.

    c. to evaluate their ability to implement sampling and measurement protocols.

    d. to evaluate their ability to tabulate, analyze and interpret data for their subdistrict.

    e. to evaluate their ability to transmit data to the district office for further analysis.

2. To evaluate the validity of data collected by Puskesmas and village enumerator.

    a. to determine the reliability of data collected.

    b. to determine the accuracy of data collected.

II. Choice of indicators and subgroups for monitoring.

1. To evaluate the feasibility of using anthropometry, infant mortality and socioeconomic indicators of nutritional status for targetting and monitoring nutrition related programs.

   a. to determine which anthropometric indicators are the most discriminatory to different ecological settings and in areas of high infant mortality.

   b. to determine the best village-level socioeconomic indicators of malnutrition and high infant mortality.

   c. to determine the anthropometric indicators that are least sensitive to seasonal variation.

2. To establish the relationship between anthropometry, infant mortality and socioeconomic indicators across villages and subdistricts.

   a. at the district level to determine the relationship between prevalence of malnutrition and village-level socioeconomic indicators across subdistricts, by rural and urban residence, and according to the quality of the district infrastructure.

   b. to determine the relationship between infant mortality and anthropometric and social indicators for different districts classified according to infrastructure and province.

3. To estimate the effect of seasonal variation in the anthropmetric indicators.

   a. to determine the patterns of seasonal variation at the subdistrict through provincial levels.

   b. to determine the patterns of seasonal variation according to quality of district infrastructure, rural versus urban designation of subdistricts and the socioeconomic characteristics of the subdistrict.

4. To determine, cross-sectionally, the relationship between preschool nutritional status and anthropometry of young children in primary schools.

   a. to determine the relationship between village-level prevalences of preschool malnutrition and school-age malnutrition across different types of villages, subdistricts and districts classified according to socioeconomic, ecologic and infrastructural characteristics.

III. To estimate the cost of implementing various population sampling designs to obtain village-level versus subdistrict-level monitoring data.

METHODS

Study Design

The objectives of this study focus on the infrastructural, ecological and social factors that might influence the ability to implement a nutritional status monitoring system. The major infrastructural characteristics that should be considered as important in this study are transportation into villages, communication lines between village, subdistrict and, district health works, number and level of training of health personnel down to village Kadars, and general quality of government administration. General quality of the infrastructure for health care delivery and monitoring might be reflected in the amount of current malnutrition programs. In order to achieve a maximum contrast in infrastructural quality, two subdistricts within a province will be chosen after consultation with provincial nutrition and health officials. These subdistricts will represent the extremes of infrastructual quality relative to the ability to implement a monitoring system. Hence there will be a "good" and a "poor" district per province.

Ecological characteristics to be considered in the study design are mostly gross catagorizations. The major distinction will be made in choosing provinces which represent the ecological diversity of the country. For this pilot study 3 provinces have been choose; Central Java, which represents much of Java and is more densely populated, West Sumatra, which represents the Western provinces and is less densely populated, and South Sulawesi, which

represents the northern archipelago and is sparsely populated relative to the other two provinces.

An additional ecologic criteria which will be considered is the general classification of rural versus urban. This dichotomy tends to reflect relative proximity to public services, population density and occupational and socioeconomic variation.

Therefore, 3 levels of stratification will be necessary to examine the factors that might limit implementation of a nutrition monitoring system. Table 1 presents the sampling design that reflects these 3 levels of stratification. Within each of the 3 provinces there will be 2 districts chosen, representing "good" and "poor" infrastructure, and within each district there will be a further classification of subdistricts according to "rural" or "urban" residence patterns. Once the 2 districts have been chosen, a decision will be made as to how many rural and urban subdistricts are to be selected. There will be 4 subdistricts per district. If the majority (more than 75%) of subdistricts are rural then 3 rural and 1 urban subdistrict will be chosen. If the majority of subdistricts are urban then 3 urban and 1 rural subdistricts will be chosen. If subdistricts are about equally rural and urban then 2 of each will be chosen. The urban subdistricts will be chosen at random from among all the urban subdistricts in the district. And the rural subdistrict(s) will be chosen at random from all the rural subdistricts within the district. In order to continue to have a representative sample of households within the rural and urban stratum, four villages will be chosen at random from among all the villages within a randomly chosen subdistrict. The selection of households within a village will also be random. However, due to the practical difficulty of visiting and measuring truely randomly chosen households of the number sufficient for statistical validity, a cluster sampling design will be employed. In order to show a difference in prevalence of malnutrition of 10 percent between subdistricts at the 5 percent level of probability (z) about a total mean prevalence of 40 percent, a sample of 92 preschool children per subdistrict would have to be chosen. However, given that a cluster sampling design within randomly chosen villages imposes some additional constraints (design effects) on sample size, a larger sample will be required. About 32 clusters per subdistrict are sufficient to insure that the cluster means are normally

Table 1: Sampling Design - Pilot Study

Strata	Province:	West Sumatra				Central Java				South Sulawesi				Totals			
	District:	Good		Poor		Good		Poor		Good		Poor		Rural -Urban Subdistricts		Poor-Good Infrastructure	
	Subdistrict:	U	R	U	R	U	R	U	R	U	R	U	R	Urban	Rural	Good	Poor
R-U weighting factor		x2[a]	x2	x1	x3	x3	x1	x1	x3	x2	x2	x1	x3				
subdistrict																	
A		192[b]	0	192	0	192	0	192	0	192	0	192	0				
B		192	0	0	192	192	0	0	192	192	0	0	192				
C		0	192	0	192	192	0	0	192	0	192	0	192				
D		0	192	0	192	0	192	0	192	0	192	0	192				
Total rural-urban subdistrict		384 (8)	384 (8)	192 (4)	576 (12)	576 (12)	192 (4)	192 (4)	596 (12)	384 (8)	384 (8)	192 (4)	576 (12)	1920 (40)	2688 (56)		
Total good/poor district infrastructure		768 (16)		768 (16)		768 (16)		768 (16)		768 (16)		768 (16)				2304 (48)	2304 (48)
Total Province		1536 (32)				1536 (32)				1536 (32)							
Grand total		4608 (96)															

a. Rural and urban strata weighted to reflect pre-dominant type of subdistrict (hypothetical)
b. Cells contain number of households with number of villages in parentheses.
Households chosen as 48 per village distributed in 8 cluster of 6 households
Average household will have 1.5 preschool (under 5) children
Villages chosen at random with in rural or urban subdistrict stratum;
clusters chosen at random within each village

distributed (Henderson and Sundarsan, 1982). If each cluster contains 6 households, or about 9 preschool children there is sufficient statistical power to provide stable cluster means for this age group. Thus, 192 household would be sampled per subdistrict, resulting in a total sample size calculation of:

3 provinces x 2 districts x 4 subdistricts x 32 clusters x 6 households = 4608 households.

Since the subdistricts are divided into 4 villages, each village will provide 8 clusters of 6 households or 48 households or 72 preschool children. This assumes 1.5 preschool children per household that have at least one child under the age of 6 years.

Additional sample size calculations have to be made to ensure that all the objectives can be tested with the current design. The current sample of 192 households or 288 preschool children per subdistrict, insures a sufficient sample for comparing prevalence of PEM across subdistricts. This sample is determined for practical reasons since targetting of nutrition related programs is done at least down to the subdistrict level. However, if subdistrict health officers need to target specific villages for receipt of programs, then more clusters per village would need to be surveyed. This would amount to about 20 cluster of 7 households (140 HH total) per village if prevalence of PEM is high (50%) or fewer clusters if the prevalence is lower (15 clusters of 6 HH with P=.2). Also, it might be easier to conduct a true random sample at the village level by village Kadars, if feasible. This would greatly reduce the total households and, require that between 40 and 72 households be visited per village to show a difference of 10 percent.

1/ More detailed description of cluster sampling procedures are presented in Appendix 1.

Therefore, for the purpose of this pilot study 48 households per village is sufficient to test the capabilities of the local health systems to undertake nutritional status monitoring at the village and subdistrict levels. In other words, it reflects the approximate number of households needed if a true random sample is identified within a village and if a cluster sampling procedure is employed for representative data at the subdistrict level.

The sample sizes needed to test the specific study objectives can be calculated after a brief description of the nature of the analysis to be undertaken relative to each objective (numbers refer to objectives listed on p2-4).

I.1 The first objectives deal with evaluation of the operation of the monitoring system. This involves testing enumerators after they have been put through a training course. The design calls for 24 subdistricts each of which will be the focus of sampling, data collection, data tabulation and reporting to the district nutrition office. This is the smallest sample of quantitative observations to be made in the operational evaluation. Tests of the performance of each subdistrict monitoring team will have to be developed before sample size can be computed. If one divides the subdistricts into 12 from "good" districts and 12 form "poor" districts, there should be enough power to show reasonably large difference in test performance (in the order of a difference of 1.7 times the standard deviation of the performance test score). Examples of Tables to be completed and statistics to be generated to achieve these operational objectives are presented in table 2.

I.2 The other operational evaluation tests the reliability and accurancy of the data collected. The reliability testing requires that each enumerator team reinterview and remeasure a 10 percent subsample of the households in their subdistrict. Test-retest statistics to be used will be 1) estimates of variance around the mean difference between 2 observations, 2) estimates of test-retest correlation coefficients 3) estimates of intraclass correlation with enumerators as classes and ecologic and infrastructural characteristics as source of variation among classes (Snedecor and Cochran, 1980: 243-244). A 10% subsample, or 20 household (and 30 preschool children) per subdistrict team is sufficient to analysis for the reliability in anthropometry. An

Table 2: Sample of Breakdown and 3 way ANOVA to Achieve Objective I-1: Evaluation of Training and Implemenation.

Province:	West Sumatra				Central Java				South Sulanesi				Results
Type of District:	Good		Poor		Good		Poor		Good		Poor		ANOVA
Type of Subdistrict: R=Rural; U=Urban	R	U	R	U	R	U	R	U	R	U	R	U	
OBJECTIVE:													
1a. Competency Test Scores of village enumerators (x±sd) n = 96 enumerators 8/cell													3 Way ANOVA
1b. Evaluation Test Scores of the ability of subdistrict personnel to train village enumerators: n = 24 trainers (x±sd) 2/cell													1 + 2 Way ANOVA
1c. Evaulation Test Scores of ability of subdistrict personnel to conduct sampling and implement measurement protocols: n = 24 (x±sd) 2/cell													1 + 2 Way ANOVA
1d. Evaluation Test Scores of the ability of subdistrict personnel to analyze and interpret data: n = 24 (x±sd)													1 + 2 Way ANOVA
1e. Time required to transmit data from village to subdistrict n = 96 (x±sd)													3 Way ANOVA

example of the analysis to achieve this objective is shown in table 3 for objective 2a.

Accuracy of the measurements to be made by each subdistrict team will be determined by comparing their measurements with those made by a "trained" teams from the district nutrition office (6 teams). These trained teams will include a staff member from the district office and the best enumerator/ anthropometrist to be trained at the district level. They will conduct a survey of 4 villages within their district (one village per surveyed subdistrict) remeasuring 6 of the 8 clusters previously measured in that village. This will yield a subsample of 36 households per subdistrict (18.4%) or 288 household per provinced (see Appendix II for description of sub-sampling procedure). The same statistics employed in the reliability analysis will be used in this analysis. Since the estimation of accuracy employs more households than the estimation of reliability, there will be sufficient sample size to conduct the accuracy analysis. An example of the analysis of accuracy is shown in table 3 under objective 2b.

II. 1-2 The choice of indicators for monitoring the nutrition situation will be undertaken at all levels from the village to the province. The feasibility of specific anthropometric indicators will be determined for specific ecological settings by determining if any of the indicators, weight-for-age, height-for-age, weight-for-height or mid-upperarm circumference, distinguish one province from the other, or "good" from "poor" districts, or rural from urban subdistricts (table 4:1 and 4:2). Also the relationship (correlation) between anthropometric indicators will be analyzed according to type of province, district and subdistrict (table 4:3). Anthropometric indicators will also be compared in a similar fashion between districts with high and low infant mortality.

The best socioeconomic indicators of preschool malnutrition will be evaluated at all levels from villages within subdistricts to provincial differences. Similar analysis will also be done at the district and provincial levels to identify indicators best associated with high versus low infant mortality. This analysis will be dependent upon the characteristics of the socioeconomic variables; whether discrete or continuous in their

Table 3: Sample of Breakdown and 3-way ANOVA to achieve objective I2: Validity of length measurements taken by village enumerators. (Repeat this for all quantitative variables)

OBJECTIVE 2a: Test-retest reliability of village enumerators for measuring height (length). 10% Subsample of preschoolers or 20 replicates/enumerator with 96 enumerators.

Province:	West Sumatra				Central Java				South Sulanesi				Results
Type of District:	Good		Poor		Good		Poor		Good		Poor		ANOVA
Type of Subdistrict: R=Rural, U=Urban	R	U	R	U	R	U	R	U	R	U	R	U	
Parameters to be computed: 1. $d = (x_1 - x_2)/n$													3-Way ANOVA
2. $^2diff = d^2/2n$													
3. r^2: x_1 vs x_2													
4. % d ± 1 cm													

Where, x_1 = 1st Measurement, x_2 = 2nd measurement

Table 3 (con't): Sample of Breakdown and 3-way ANOVA to achieve objective I2: Validity of length measurements taken by village enumerators. (Repeat this for all quantitative variables)

OBJECTIVE 2b: Validity of village enumerators versus "expert" enumerators in measuring height (length). 18.4% subsample of pre-schoolers measured by both enumerators-1 cluster of 6 households/village with 6 "expert" enumerators or 1/district.

Province:	West Sumatra				Central Java				South Sulanesi				Results
Type of District:	Good		Poor		Good		Poor		Good		Poor		ANOVA
Type of Subdistrict: R=Rural, U=Urban	R	U	R	U	R	U	R	U	R	U	R	U	
Parameters to be computed: 1. $d = (x_v - x_e)/n$													3-Way ANOVA
2. $^2diff = d^2/2n$													
3. r^2: x_v vs. x_e													
4. % d ± 1 cm													

where, x_v = village enumerator value, x_e = Expert enumerator value

Table 4: Rural-urban, infrastructural and Mortality relationships to various anthropometric indicators (to achieve objective II-1a)

	Population Density		Provincial Infrastructure		District Infant Mortality	
	Rural	Urban	Poor	Good	Low	High
Quantitative data mean ± standard deviation	x±sd	x±sd	x±sd	x±sd	x±sd	x±sd
1. a. Percent of standard weight-for-age (%) height-for-age (%) weight-for-height (%)						
b. Z-score age adjustment weight-for-age (z) height-for-age (z) weight-for-age (z) MUAC (cm)* MUAC-for-height (z)* [Oneway ANOVA or T-test] Sample size (individuals: 1.5 household; see table 1) *no age adjustment	N = 2980	N = 4032	N = 3456	N = 3456	N = 3456	N = 3456
2. Catagorical data number effected; %	N %	N %	N %	N %	N %	N %
% malnourished (WT/A <75%) % stunted (HT/A <90%) % wasted (WT/HT < 80%) % PEM (MUAC < 13cm) [chi-square; Se + Sp] Total N (individual children @1.5/hh.)	2980	4032	3456	3456	3456	3456

(Cont'd) Table 4: Rural-urban, infrastructural and Mortality relationships to various anthropometric indicators (to achieve objective II-1a)

	Population Density				Provincial Infrastructure				District Infant Mortality			
	Rural		Urban		Poor		Good		Low		High	
3. Correlation analysis N, Correlation coefficent	N	r	N	r	N	r	N	r	N	r	N	r
a. correlation of individual values weight with height, age controlled MUAC with weight, age controlled MUAC with height, age controlled Sample size: individuals[a]	2980		4032		3456		3456		3456		3456	
b. correlation of village valves % stunting with % wasting % PEM with % wasting % stunting with PEM % malnourished with % wasting % malnourished with % stunting Sample size: villages[a]	40		56		48		48		48		48	

[a] hypothetical, based on Table 1

distribution, whether collected and aggregated at the village or subdistrict levels or across ecological and infrastructural levels. For example, individual anthropometry within households would have to be aggregated at the village level and compared to the specific village socioeconomic indicator(s). This can be done across any level of strata from the subdistrict type up to the entire sample. However, the best inference might be made between rural and urban subdistricts. Sensitivity and specificity analysis (see original proposal p. 27 for an example) can be applied to specific village socioeconomic indicators as they identify specific categories of malnutrition (stunting, wasting etc).

Ordinary least square regression and logistic regression can also be used for this analysis. Logistic regression models can be developed to include all the criteria for stratification (province, type of district, rural-urban) as well as relevant socioeconomic indicators and interactions, to predict risk of a village being categorized as malnourished or not. Three way analysis of variance can also be conducted with specific nutritional anthropometry classification as the dependent variable and various stratification and socioeconomic criteria as the treatments. These analyses would permit the objectives under II.1.b to be achieved.

Analysis of village level characteristics can be done as shown in figure 1. In this case, prevalence of stunting (or wasting) within a village is compared across different levels of socioeconomic status for the various villages in the sample. This relationship can also be analyzed to compare rural versus urban villages or those from "good versus "poor" districts as stated in objective II.2.a.

Objective II.2.b will be addressed by logistic regression with risk of death at the district level as the dependent variable and the anthropometric and social indicators, as well as type of district as independent variables.

II.3 Objectives II.3 a-b require a second survey to be conducted approximately six months after the first survey. This second survey will be conducted on the same subsample of villages and households which is to be examined in the analysis of measurement accuracy. The same team of trained

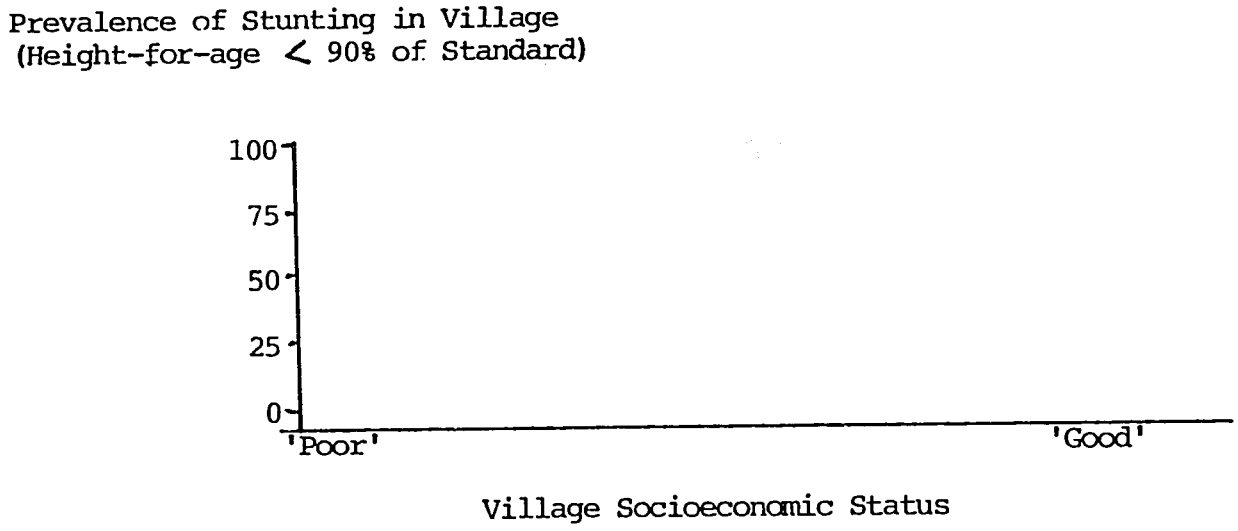


Figure 1: Prevalence of stunting versus socioeconomic status of villages

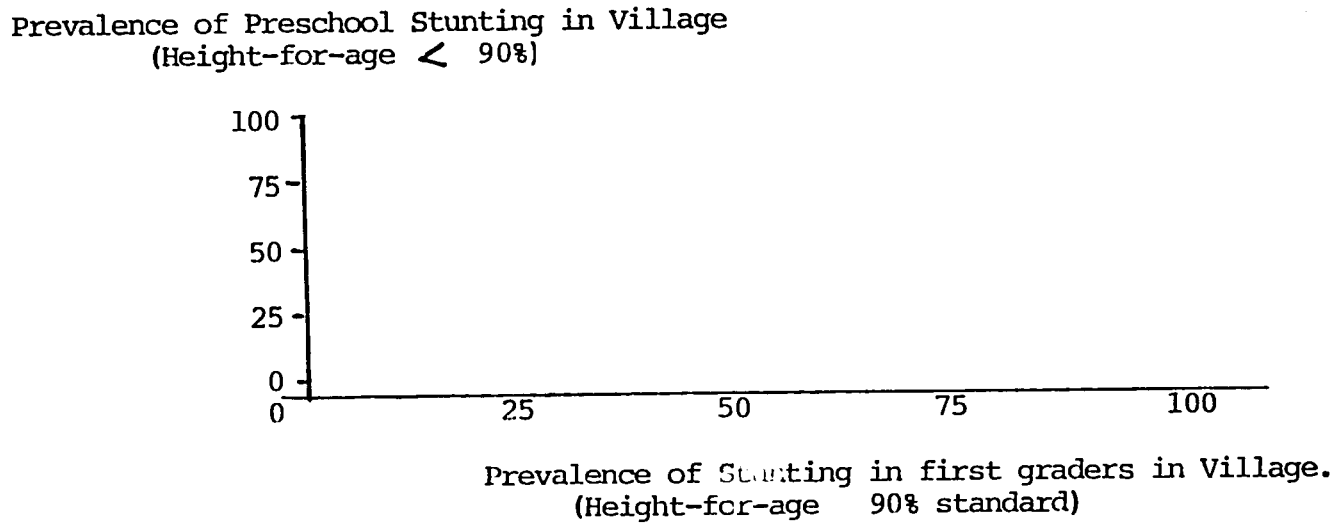


Figure 2: Within village relationship of stunting between preschool age children and first graders.

enumerators from the district nutrition offices who measured the previous subsample will also remeasure them. Only the anthropometry will be remeasured. The analysis for seasonal variation will employ intraclass correlations described above for the reliability and accuracy analysis. Those indicators that deviate most in the expected direction from the first to second survey will be considered as potentially most useful for short term monitoring of nutritional status. One would expect that weight-for-age and weight-for-height will decrease from the post harvest survey in May-June to the preplanting survey in November-December. Those indicators that change the least may be the most practical to use for provincial level nutrition planning, especially where timing of data collection is not consistant across subdistricts.

II.4 The validation of school entry anthropometry will require data to be collected from primary schools in the same villages where the household surveys are to be done. The procedure for collecting these school data should be similar to that recommended by the Centre for Research and Development in Nutrition CRDN for the national survey of school entry heights. That is, school teachers take the heights of all first graders. In addition, it will be desirable to determine the validity and feasibility of using other anthropometry. Therefore, weight should be taken as well. Moreover, considering the broad range of variation in first graders and the potential bias this creates for interpretation of school data (see original proposal, p. 16-17), schools should be represented by all 6,7 and 8 year olds, just the first graders. Thus, it will be possible to determine whether the sampling frame in schools should be first-graders or a specific age group irrespective of grade.

The analysis of the school sample will require that prevalences of various types of malnutrition be estimated separately for preschool and primary school children (for first graders, then again for 6 year olds, 7 year olds and 8 year olds). Intraclass correlations of these prevalences will then be calculated with villages serving as classes and various village characteristics as criteria for analysis of factors that influence concordance between the two age group (see figure 2).

III. Cost analysis to determine the most appropriate sampling strategies, training procedures and enumerator selection will have to consider the time involved in alternate strategies of data collection. The major differences in sampling strategies will be between an approach which obtains representative data for subdistrict by sampling 32 or more clusters of household irrespective of village and one that samples fewer clusters within all villages of the subdistrict. It is obvious that the latter is more costly in terms of "in field" time. But the training and analytical costs are not known and the quality of the data is uncertain. More work needs to be done on this component of the project.

Appendix 1: Sampling Methods

Households will be selected according to a stratified multistage sampling procedure. The 3 strata are Provine, District infrastructure and rural-urban classification of sub-districts. Three provinces have already been identified (West Sumatra, Central Java, South Sulawesi). Two districts within each province will be chosen after consultation with provincial authorities. One district will represent the best infrastructure in terms of communications, government administration, success of previous health and nutrition programs and low rates of malnutrition. This district is referred to as "good". The other district within the province will fall at the other end of this classification scheme and is referred to as "poor".

Within each of the 6 districts there will be a final stratification according to population density. All rural subdistricts (low population density) will be identified and given a number. All urban subdistricts will also be identified and assigned a number for randomization of selection.

In order to select 4 subdistricts within the district that represent the approximate balance between rural and urban subdistricts, the following selection procedure will be implemented:

a) If more than 3/4 of the subdistricts are rural then 3 rural and one urban subdistricts will be chosen.

b) If more than 3/4 of the subdistricts are urban then 3 urban and one rural subdistricts will be chosen.

c) If neither a nor b apply then 2 rural and 2 urban subdistricts will be chosen.

Choice of subdistricts within the rural or urban stratum will be by random selection from all subdistricts within the stratum. There will be 24 subdistricts chosen.

Within each subdistrict 4 villages will be selected at random from a list of all villages in the respective subdistrict. There will be 96 villages chosen.

Households within each village will be chosen according to a cluster sampling design described by Henderson and Sundaresan (1982). In order to identify 48 households per village it will be necessary to sample 8 cluster of 6 households. Each cluster will be identified as follows:

a. All households in the village will be given a number.

b. Eight households will be chosen at random from the list of numbers.

c. These eight households are "cluster centers" and will be the first households visited by the enumerator team for that cluster.

d. If the households has at least one preschool child (under 6 years old) the household is accepted into the sample and all children under 6 are measured. The enumerator team then moves on to the next nearest neighbor.

e. If the household does not have a preschool child it is not included into the sample and the enumerator team moves to the next neighbor.

f. If the neighboring household has a preschool child, repeat as in d. If not, repeat as in e.

g. Continue until 6 households with at least one preschool child are found and measured.

h. When 6 households are found the cluster is complete. Go on to the next cluster center and repeat the process c to g.

It is anticipated that not all households will have a preschool child. Also, that some households will have more than one preschooler. The important criteria is that only households with at least one preschooler be included, and that all children under 6 years be measured.

Appendix II: Sub-sample Selection

Objection 1.2a, 1.2b and 11.3 require that random subsamples be chosen from the total sample of 4608 households. Also, objective 11.4 requires an independent sample of children age 6-8 years to be chosen from primary schools. Figure 3 presents the various samples and subsamples to be examined in the study. Also presented are the objectives which are to be tested by comparison of the various samples. The sample selection is as follows:

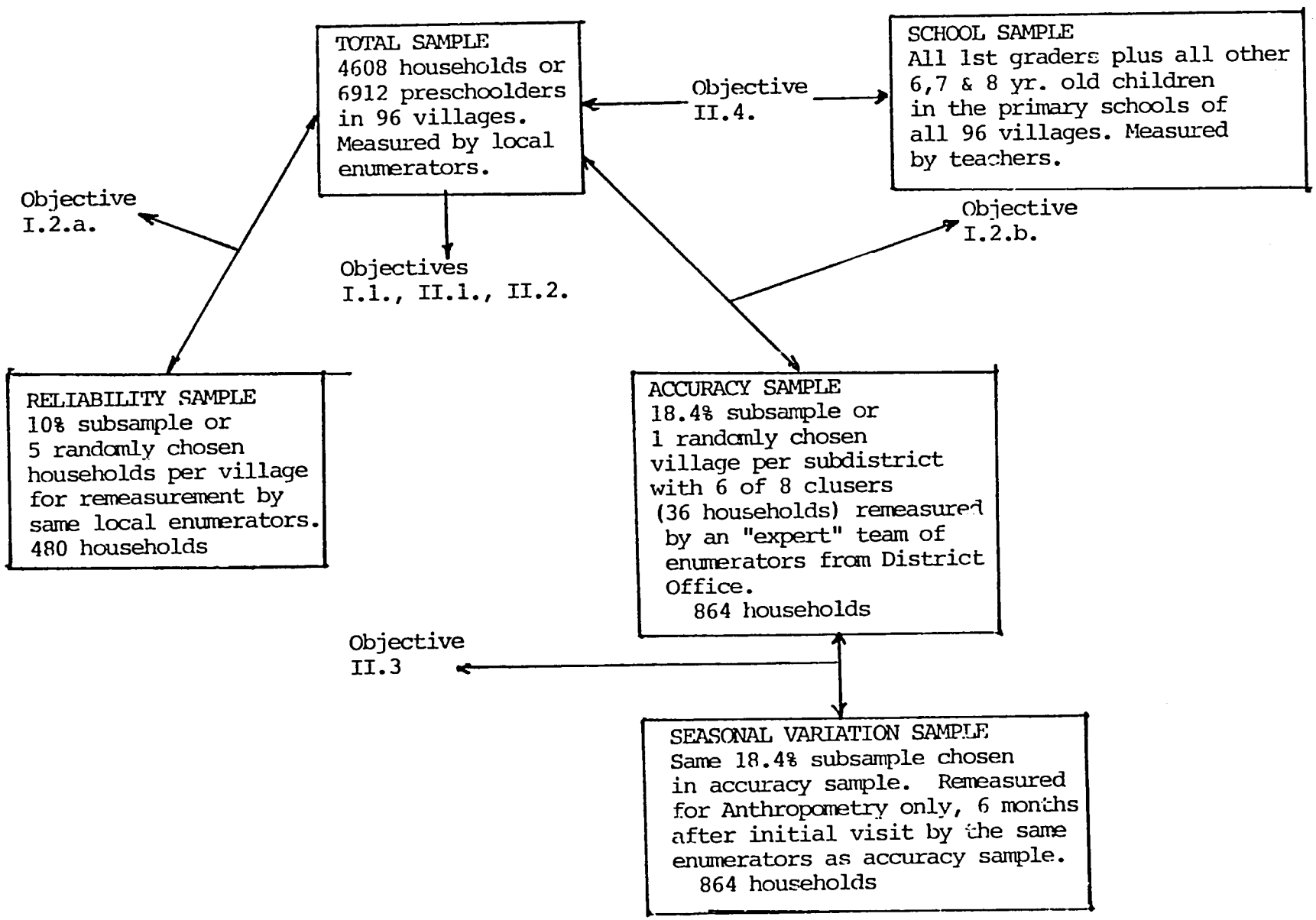
a. Total sample of 4608 households as described in Appendix 1.

b. Reliability subsample. This about a 10% subsample of the total sample. Five households per village will be chosen at random after the village has been surveyed and 48 households are measured. These 5 households will be remeasured by the same enumerator team. There will be 20 such households per subdistrict and 480 in the entry study.

c. Accuracy subsample. This is an 18.4% subsample of the total sample. It will be selected after the original study sample has been measured. One village will be selected at random from the 4 originally identified for each subdistrict. From the 8 original clusters for each of these 24 villages, 6 will be chosen at random for remeasurement (and reinterview) by a especially trained "expert" enumeration team. This team will be composed of the district nutrition officer and a well trained anthropometrist from the subdistrict or village being subsample. The remeasurements should be made within 2 weeks of the original measurements. This will provide a subsample of 865 households for validation.

d. Seasonal variation subsample. This is the same subsample identified under "e" above. It will be remeasured for a third time approximately six months after the first measurement when a maximum contrast in nutritional status is expected. The same "expert" enumerators who remeasured for the accuracy analysis under c will perform these measurements. Only anthropometry will be repeated.

Figure 3: Relationship among subsamples (in boxes) to test study objectives. Two way arrows indicate sample comparisons. See text for details of objectives by number.



e. School sample. Each of the 96 villages will have 3-5 primary schools. School teachers will be trained to do weighing and measure heights. All first graders will be measured plus all 6, 7 and 8 year old children not in the first grade. This should yield about 200 children per village.

References:

Haas, J.D.: Consultant's report on assessment of nutritional status in Indonesia. Cornell Nutritional Surveillance Program, June 11, 1984.

Henderson, R.H. and T. Sundaresan. Cluster sampling to assess immunization coverage: a review of experience with a simplified sampling method: Bull. World Health Org., 60:253-260, 1982.

Snedecor, G.W. and W.G. Cockran: Statistical Methods (4th ed). The Iowa State University Press, Ames, Iowa, 1980.

TERMS OF REFERENCE

Geoff Marks

1. Assist the Nutrition Academy to develop the data collection protocol, evaluate training manuals and procedures, and prepare procedures for data analysis.

2. Train the Nutrition Academy staff in computer operation and analytical methods applied to the nutritional status monitoring system pilot project.

3. Supervise management and analysis of pilot projects data.

4. Assist the Nutrition Academy and Nutrition Directorate in developing data analysis methods to be used by subdistrict, district and provincial authorities for nutritional status monitoring.

5. Assist the Nutrition Academy and Nutrition Directorate in ongoing and final evaluation of the pilot project, especially regarding sampling design and data analysis, and computer operations and statistics.

6. Assist the Nutrition Academy in preparation of study reports.