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RATIONALE AND METHODOLOGY FOR INCLUDING NUTRITIONAL AND DIETARY ASSESSMENT IN FARMING SYSTEMS RESEARCH/EXTENSION *

Carolyn E. Campbell
Department of International Nutrition
Cornell University
Ithaca, New York

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Rationale and Methodology for Including Nutritional and Dietary Assessment in Farming Systems Research-Extension

ABSTRACT

Improvements in nutritional status and/or the quality of life are frequently cited as motivations for undertaking technological interventions and development projects in rural areas of the Third World. In the past, many projects have failed in these goals with or without an increase in per capita income in the project region. Farming Systems Research came into being in part as an answer to this problem. By thoroughly understanding the agricultural system and its human and environmental ecology, it was thought that the errors of the past could be avoided. However, if technological interventions continue to include improvements in nutritional status and quality of life as principal goals of projects, in the absence of rigorous, well-planned nutritional and dietary studies within the realm of FSR-E, FSR-E trials and in the intervention phase itself, the same disappointing results of past interventions are not only possible, they are probable. This paper presents a rationale and condensed methodology for the inclusion of nutritional and dietary assessment in FSR-E.

Rationale and Methodology for Including Nutritional and Dietary Assessment in Farming Systems Research-Extension*

Introduction

Farming systems research-extension is a methodology the aim of which is to provide a means to gather sufficient information about a given agricultural system so that the implementation of an intervention will have a greater likelihood of fulfilling the stated aims of the program. While any intervention will have a well-defined set of goals, the reality is that in the recent past, the outcomes of many agricultural interventions were neither contemplated nor desired. (1) While FSR-E may be considered an end in itself, it is usually undertaken as a preliminary to technological intervention.

Because it is the study of a system in its totality, farming systems research is of necessity multi-disciplinary involving agronomists, plant and soil scientists, entomologists, animal scientists, hyrologists, economists, sociologists, anthropologists, etc. (2) More recently, nutritionists and other health oriented professionals have been included in certain FSR-E teams but their participation has not been a regular feature of FSR-E programs. This paper will present 1) a rationale for the regular inclusion of nutritionists in FSR-E teams; and 2) a methodology for incorporating nutrition into FSR-E.

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*This piece has been written for an audience with little to no training in nutritional sciences.

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It is hard to imagine any Third World agricultural intervention project med at peasants and/or small holders which does not include some mention improving yields not only for the purpose of increasing household income t also to increase the food available for consumption in farming households ith the aim of improving the nutritional status of farm families and, on a rger scale as the development project progresses, the community in general.

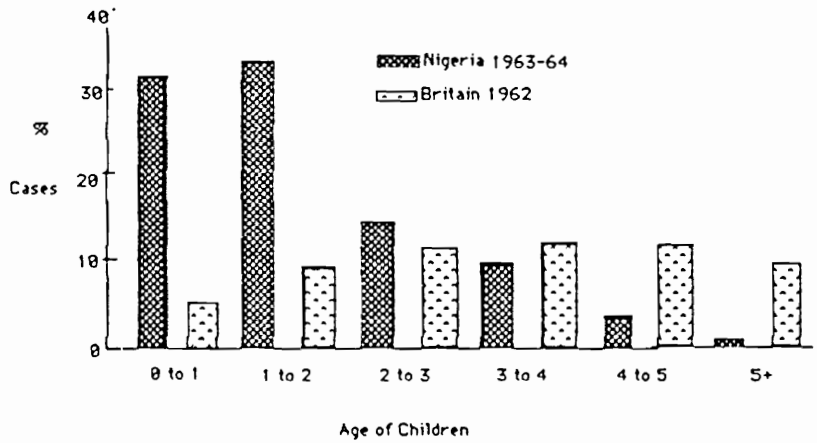
Furthermore, most agricultural intervention projects state, either rectly or indirectly, that an aim of the project is to improve the quality of e (QOL) of the farmers targetted in the project. QOL may be measured, for ample, by comparing a complete or sub set of the following indices of velopment: infant mortality rate; young child (under five years of age) ortality rate; number of doctors per thousand population; access to potable ater; access to electricity; adult literacy rate; educational attainment of e population; unemployment rate; life expectancy; access to and efficacy of mmunization programs; sewage and/or sanitation access; nutritional status.

Nutritional status is one of the most important QOL indicators and it is easurable at the individual, community, regional and national levels. In dition, nutritional status is related either directly or indirectly to several the other indicators. For example, it is directly and indirectly related to e infant and young child mortality rates. Malnutrition may lead directly to fant or young child death, the actual cause of death being starvation or fection, or malnutrition may be secondarily caused by infection, rticularly diarrheal disease, which may lead rapidly to death from either alnutrition itself or dehydration. Gastrointestinal illness is the most evalent cause of infant and young child mortality in the Third World (4) and

prevalent cause of infant and young child mortality in the Third World (4) and it is directly related to feeding, environmental hygiene and sanitation.

Furthermore, good nutritional status prevents unnecessary fatalities from common childhood diseases such as measles, whooping cough and viral infections. In a malnourished population measles, as an example, strikes children under two years of age and often precipitates serious protein-energy malnutrition. Many children die or become so seriously ill that hospitalization is necessary. In a well nourished population measles peaks after two years of age and rarely causes complications. (5, 6) This comparison of morbidity profiles between the developed and less developed countries is graphically shown in Figure 1 and demonstrates the synergism between nutrition and infection.

Figure 1. Measles occurrence among mal and well nourished populations (7)



Low birth weight is another outcome of poor nutrition and low birth weight infants are at greater risk of mortality than are normal birthweight infants. Poor nutrition during pregnancy is a principal cause of low birth

weight and contributes not only to the infant's high risk health status but also damages the mother whose reserves are overtaxed with repeated pregnancies in the absence of adequate nutrition to support them. (8)

In addition, the malnourished child is a poor learner because of decreased inquisitive behavior (9) and this passiveness and lassitude contribute to the vicious cycle of malnutrition and poverty since the child who does poorly in school is more likely to drop out. It could therefore be concluded that malnutrition affects the unacceptably low adult literacy rate and the overall poor educational attainment seen in many poor countries. Poor farms are nearly always labor intensive and children will find it necessary to either not enter school at all or leave school after a year in order to help with farm work. (10) Thus not only is the poor farm family trapped in a cycle of poor education, malnutrition and poverty, but also, poor farm children are forced to utilize their limited food intake to fuel farm labor at the expense of their own physiological growth and development. This exacerbates their chronic malnutrition and consequent stunted growth and increases their vulnerability to infection.

Furthermore, since poor nutrition is a direct or indirect cause of the premature aging seen in Third World women and men, being related to repeated illness, hard work, as well as many physiologically stressful, demanding pregnancies in women and repeated illness as well as continuous, very hard physical labor in men, it is a key factor in the low life expectancy seen in many Third World countries. (11) Given the above, it can be concluded that the goal of improving nutritional status is a sound one for any rural agricultural project, FSR-E or otherwise. And, an improvement in nutritional status is an indirect indicator of an improvement in other critical QOL indices so that by measuring nutritional status, a general view of QOL is available.

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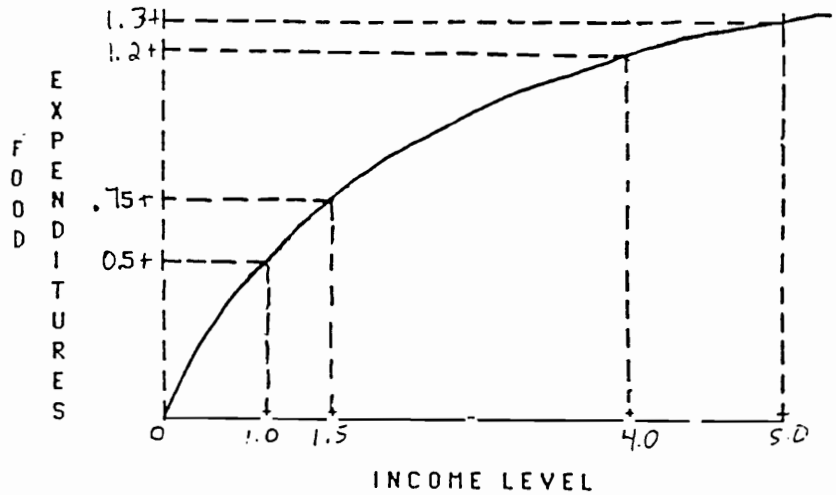
In the past, it was thought that income, i.e. socio-economic status, was an acceptable proxy for nutritional status. However, the relationship between nutritional status and income is plagued by many confounding variables and the wholesale use of income as a proxy for nutritional status has little validity at the micro and macro levels. Economists have demonstrated that the marginal propensity to spend on food may not be sufficient to cover a family's nutritional needs with an increase in income. (12) Furthermore, at the national level, high per capita income in the developing countries (for example Mexico and Brazil) belies a markedly skewed income distribution (13) which is responsible for hundreds of thousands of deaths, an unacceptably high incidence of preventable diseases and an army of stunted children whose stature at the age of 10 would lead one to think they were kindergarteners.

While Engel's Law (14) does give a view of the relationship between income level and the percentage of income spent on food, the law, shown graphically in Figure 2, shows a macro trend which may not hold at the micro level. For example, when cash crops are introduced to a farming population which previously had relied upon subsistence production, Engel's law in that context might predict that fifty percent of the income earned from farm sales would be spent on food. However, if crops are sold for lump sum cash payments (15) and the farmer has not been instructed in money management and saving, a disproportionate amount of the lump sum payment could be spent on non-food household items, alcohol, junk food, or other commodities which may suddenly flood a community that previously had only a few shops with limited inventory. And, with the shops comes a deluge of hard sell publicity campaigns designed to captivate the previously cash poor community putting manipulative pressures on the farm family recently introduced into the cash economy yet lacking an understanding of its shortcomings and traps. The

Figure 2. A hypothetical example of Engel's law



lump sum payment could exacerbate an already poor nutritional status even if it represented an increase in income. A further problem may arise if the cash cropping household does not purchase sufficient food stocks with the lump sum or is forced to purchase food stocks at a time when prices are at a seasonal high. Any number of such obstacles may impede the realization of the goal of improving nutritional status even in the face of an increase in income. However, in the absence of direct measurements of nutritional status, it is possible that a lack of improvement would go unnoticed if no effort is made to directly measure these variables particularly if the assumption has been made that income is a good proxy for nutritional status.

Development projects may produce any of several outcomes that affect nutrition. For example, a development project may increase the food supply, increase household income, change food prices or produce a combination of

these. However, it has been demonstrated that on a national level, increases in the food supply with no concomitant increase in household income may contribute little to an improvement in nutritional status. Similarly, increases in per capita income with no change in income distribution may have little effect on improving the nutritional status of the poorest households. Furthermore, trickle down strategies are not likely to produce an improvement in the nutritional status of the poorest households. (15)

In a study of villages in Nigeria, Longhurst showed how a small holder's production may be limited by his access to food energy if there are no labor saving devices and the farmer must rely on food consumption to fuel his labor power in labor intensive agriculture. If the farmer and family are short of food to provide sufficient energy to produce food for subsistence, the farmer becomes trapped in a vicious cycle of malnutrition and poverty linked in a causal pathway. The household simply does not have sufficient metabolic energy to get over the poverty barrier. (16)

There are examples of projects labelled successful in macro terms which were in reality failures since many of the stated goals were not reached. A classic case which demonstrates the way in which nutritional status actually declined as a result of a large scale development project is that of the Plan Chontalpa of Tabasco, Mexico undertaken in the 1950s (17-20). Commercial agriculture and land redistribution raised the average income of the valley. However, this increase in income was not global for all valley farm units. The income of many farms stayed the same while others, the poorest, actually lost real income. Part of the problem was due to increased prices making the peso worth less than previous to the development project. The increase in mean income was essentially the result of the rich getting richer. Evaluation studies of the nutritional impact of the project

demonstrated that the nutritional status of the poorest 30 percent showed no improvement. Between 1958-71, the combined rate of moderate and severe malnutrition among children under five years of age declined only 3.6 percent from 26.1 to 22.5 percent in the face of a sixfold income increase.

The conclusion to be drawn from these arguments is that if an improvement in nutritional status is a desired outcome of a project, then some care must be taken to insure that indicators of nutritional status are measured before, during and after the project is implemented including the FSR-E and its field trial stage.

Nutritional Status Versus Dietary Status

Both nutritional and dietary status should be measured within FSR-E since neither of them is sufficient in itself. Nutritional status is quantitative and, if done properly, is measurable with a great degree of precision and accuracy while dietary status is qualitative lacking precise, accurate measuring techniques. It must be understood that nutritional status and dietary status are not the same thing and the assumption that estimating food intake, i.e. dietary status, is a good substitute for measuring nutritional status is a serious error.

Nutritional status measures any combination of a large variety of physiological parameters that indicate the individual's status with reference to standards which have been painstakingly determined by such bodies as the National Academy of Sciences, National Center for Health Statistics, World Health Organization, plus a myriad of private and country specific educational and health institutions. (21-23) Nutritional status is typically measured at three levels: biochemical, clinical and anthropometric. (24)

Biochemical tests of nutritional status include the many blood and urine tests which may be performed in a sophisticated laboratory setting to determine such things as serum albumin, vitamin A, hemoglobin, hematocrit, triglycerides and other lipid substances, potassium, sodium, urinary creatinine excretion and the urinary excretion of vitamin metabolites. In more sophisticated settings, tests may be undertaken to determine an individual's hormone and enzyme status for such things as insulin, thyroid hormone, lipase, vitamin D (technically a hormone not a vitamin), etc. (25)

Clinical exams are used to indirectly determine some of the variables measured by biochemical methods. The clinical exam is frequently used in field settings because trained health personnel are all that is required whereas biochemical tests necessitate a laboratory setting, expensive equipment and technicians to obtain samples and operate the equipment. By examining the subject's tongue, skin, hair, nails, eyes, neck, abdomen etc., a trained clinician can detect overt deficiency symptoms for vitamin A, riboflavin, vitamin C, thiamine, niacin, iron and iodine, to mention a few. The clinical exam gives a good indication of whether or not an individual's poor biochemical nutritional status has reached a level of severity sufficient to produce clinical signs. While the absence of clinical signs does not indicate optimal health, the presence of clinical signs does indicate poor health and clear, definite nutritional deficiencies needful of attention. The coupling of clinical and anthropometric assessment, applied by trained field personnel, is an excellent, rapid means of determining the nutritional health status of an individual and may provide additional information on morbidity status. (24)

Anthropometric measurements to determine nutritional status are familiar to anyone who has been weighed and measured upon a visit to the doctor. Anthropometric measurements are the most reliable and commonly

used methods to detect protein energy malnutrition (PEM). (26) Adequate accepted standards exist for a variety of measures including height (recumbent length for children under two years of age), weight, head circumference, arm circumference and triceps skinfold thickness (coupled with mid upper arm circumference, triceps skinfold thickness is a measure used to determine relative amounts of fat, bone and muscle tissue). Standards to which such measurements are compared are based on age and sex and cover all stages of life from birth through adulthood.

Measurements of a population may be cross-sectional, i.e. a sample of the population is looked at one time and compared to standards. Or, measurements may be longitudinal, i.e. serial, in that a sample is looked at over time to see not only where the population is in terms of growth and development at one point in time but also how that development varies over a given lapse of time. (27) Longitudinal studies are critical for FSR-E and this will become clear in our examination of the methodology for integrating nutritional status measurements into FSR-E. Nutritional status measurements indicate the physiological outcome on the human body of ingested food and reflect the interactions between individual human genetics, food availability and environmental factors such as climate and environmental hygiene including the prevelance of parasitic and bacterial infections which compete for ingested food and interfere with food metabolism. (6) Among rural populations there are significant, often severe seasonal variations in the growth of children, the adequate development and growth of the fetus in pregnant women and the milk volume output of lactating women. Only through longitudinal surveys can these seasonal changes be detected.

Dietary status, on the other hand, gives a rough picture of nutrient intake. The main difficulty with dietary status is its accurate measurement. The most accurate means to determine food intake is the method of prior weighing of all food eaten by a subject. This method is extremely time consuming and may be a serious nuisance to the subject. The continuous interrupting presence of the interviewer in the household, necessary for this type of dietary measurement, may alter eating patterns to the point of making the results unrepresentative. Furthermore, this method requires that sophisticated, accurate food composition tables be available so that the accurate weighings of items such as rice, beans, casseroles, fish, meat, yams, potatoes, etc. can be converted into their component nutrients. Since soils vary in mineral composition and climatic and other variable conditions influence plant growth, no food composition table can ever give an exact nutrient composition for a given food. It can give a good estimate, however. (28)

The most typical means of assessing dietary status is known as the '24 hour recall' in which a trained interviewer asks the subject to recall what they have eaten during the past 24 hours. (28, 29) Validation studies have shown that due to memory lapses, over and under reporting of intake are significant and the recall method can only be considered accurate for population studies using a large sample size. However, to evaluate individual intake, the 24 hour recall is a good means to get an idea of food variety, major sources of calories, protein, vitamins and minerals in a given individual's diet, etc. In other words, it gives a good idea of an individual's dietary quality and only a rough estimate of the quantity of food ingested. (28) For small sample sizes or for reporting on individuals, it is recommended that up to seven consecutive 24 hour recalls be taken. (30) However, three consecutive 24 hour recalls should suffice among low-income

rural groups where day-to-day variability in food consumption is low. A 24 hour recall can be administered in approximately one half hour while anthropometric and clinical assessment together take about the same amount of time as one dietary recall per individual.

School aged children who are between 5-10 years of age should be assisted by a parent in giving their recall. Recalls for infants and for children under 5 years of age should be totally administered to a parent. Such indirect dietary recalls given by a parent for their child have even more error than the direct recall and serve only to give an idea of what the child is and is not eating. Since young children are frequently the most vulnerable to both malnutrition and disease, it is easy to see how dietary information on these youngsters is not an accurate means of assessing their dietary status, much less their nutritional status.

Complementing the recall method is the food frequency method. This is important to assess long term intake patterns. If foods are eaten only on holidays or are so expensive or scarce that they cannot be easily attained, it is unlikely that even three consecutive 24 hour recalls would indicate the weekly, monthly, etc. frequency with which these foods are eaten particularly with small sample sizes. When foods have been judged to be important sources of a given nutrient, a low frequency of consumption of those foods by a subgroup of the population is an indication of a dietary problem and clinical/anthropometric studies could back up this conclusion although not necessarily. Certainly the food frequency is useful to determine changes in food consumption patterns and this is important for determining if new crops or varieties introduced into a population have been integrated into the diet. (28, 29)

Either food frequency or the 24 hour recall may be used to estimate the daily dietary diversity which has been shown to parallel nutritional status

for certain age groups in some populations. (28) Theoretically, if an individual consumes a wide variety of foods, the healthier they will be since no pair, trio or quartet of foods can completely cover an individual's nutritional needs. Given the fact that the 24 hour recall when used as a means to calculate daily nutrient intake, is plagued with many sources of error, dietary diversity, a measure of dietary quality, may prove to be a useful dietary indicator. However, it cannot replace the measurement of nutritional status since any possible parallel relationship between nutritional status and dietary diversity is discovered upon gathering both types of information simultaneously. Since dietary diversity can be estimated with either the food frequency or the 24 hour recall, it is advisable to use a food diversity score as part of the data workup.

A study of food habits is recommended to assess a number of parameters of interest to FSR-E. For example, if a new subsistence crop or variety is introduced, it may or may not be palatable or acceptable to the population. If the crop is not acceptable, a prior study of food habits may have revealed that one of the two to three meals eaten per day has less ceremony or ritual associated with it. For example, in the U.S., breakfast and lunch are meals that are frequently taken alone, on the run and with little attention paid to observing customs, etiquette, etc. The evening meal, however, is a time of sharing food, of serving persons in a given order, of serving certain foods preferentially to certain individuals, etc. In contrast, in most European and Latin American countries, the most ritualistic meal is the mid-day meal and entire communities essentially 'shut down' between approximately 1-3 PM as workers return home for this repast. A new food which has been shown to have low palatability in a community may have greater acceptability potential if introduced into the less ritualistic meal, as compared to the meals that are highly ritualistic.

Furthermore, food habits studies reveal things like who serves food, who cooks food, who decides what the household eats, how foods are divided between members, food taboos, etc. (28) Any or all of these items may be important in understanding some of the causes of malnutrition and may give ideas as to how to improve nutrition, what crops could make a difference, etc. If, for example, young children are last and least fed, a new legume which has been introduced into the community and which is unacceptable to adults could be stressed as a good food for young children and cooking methods could be devised to make the food appropriate for young children. If the new legume is part of an intercropping or other scheme which does not diminish the land used for traditional staples, more traditional staple foods are available for the adults and a new highly nutritious food is preferentially available for children. However, without prior baseline research into food habits, such a mechanism for introducing a new cultivar would not be evident.

To conclude this comparison of nutritional and dietary status, a quote from agricultural economists Reutlinger and Selowsky, is appropriate: "Just as the educational level of a population should ideally be measured by its educational achievements and not by its exposure to, and use of educational inputs, so malnutrition should ideally be defined by its consequences, such as health status, rather than by nutrient intake." (12) Dietary status measures dietary status, and is not a direct measure of health status. It tells much about what, when, why and how people consume food. Nutritional status, on the other hand, is a measure of health status or health outcome and the correct application and evaluation of nutritional status measurements, particularly to high risk groups such as pregnant and lactating women and children, gives a very accurate appraisal of one of the most important QOL indices. Nutritional and dietary assessment complement each other. Neither is a substitute for the other and it is urgent that the rigorous application of

nutritional and dietary assessment become a regular component of FSR-E. An understanding of nutritional and dietary deficiencies at the FSR-E stage will add greatly to the development of appropriate intervention strategies with the goal, among others, of ameliorating the specific nutritional problems of the region under consideration.

Seasonality

No review of nutrition and Third World farming systems is complete without a thorough discussion of the concept of seasonlity. Seasonality is a term with which agronomists, meteorologists, etc. are familiar. However, there are seasonal fluctuations in nutritional status which are critical and frequently life threatening. Among small holders and peasants, food stocks, either purchased or harvested for subsistence consumption, may not be sufficient to provide for the household's nutritional needs until the next crop is ripe enough to be gathered for sale or consumption. In this case, there appears what has been termed a pre-harvest famine period during which time entire families, whose nutritional status is already sub optimal, may lose as much as ten percent of body weight in a period of several weeks. (31) Such situations are aggravated by socio-economic conditions which do not provide off farm employment to farm populations during the pre-harvest period when employment/income needs are high. (32)

Seasonality effects vary according to the ecology, both human and environmental, of the region under study. In areas where there are rainy and dry seasons, seasonal fluctuations in nutritional status frequently occur showing weight loss and depressed growth in the rainy season and improved growth in the dry season. These results indicate the synergistic effect of nutrition and infection since infections tend to be more prevalent during the

rainy season. As stated above, infection can precipitate or exacerbate protein energy malnutrition. And, the rainy season famine often coincides with the pre harvest period since farmers normally time their planting so that the crop is in the ground during the finite, often very limited, rainy season. (31) Vulnerable members of the population, such as the elderly, pregnant and lactating women, infants and young children, may not survive these stresses. Therefore, to successfully and rationally integrate nutritional and dietary status measurements into FSR-E, seasonality must be taken into account.

Special Relevance for Nutrition in Arid Lands FSR-E

Seasonality factors are particularly important for arid lands where rainfall is usually seasonal. Another factor important for FSR-E in arid and semi-arid lands is the study of disease patterns before and after the construction of large scale irrigation projects which are often the method of choice for arid lands development in both the developed and less-developed countries. Stagnant water in holding areas and farmers' fields due to poor land grading or erratic water delivery may provide excellent breeding sites for parasitic or bacterial infections. (33-34) In arid lands, the consequences of diarrheal disease, which is associated with water contamination, are compounded by the fact that not only is the victim losing large amounts of body water through diarrhea, he/she is also simultaneously losing large amounts of water through evaporation/perspiration producing a double jeopardy situation. This is particularly grave for infants and toddlers whose corporal surface to volume ratio is high as compared to the adult. And, since such infections may severely debilitate an individual, their unintended introduction as a result of a development project may negate any positive results. Furthermore, if an area already had a relatively high incidence of

these infections, any agricultural intervention should have as a principal aim the control and ideally the elimination of such diseases. If no baseline health data is gathered, either the introduction of such diseases or their equal to increased prevalence before and after the intervention will go undetected by the team carrying out the agricultural intervention. While water quality analyses are important and should be undertaken, because of intermediate vectors and infectious seasonality which are characteristic of many parasitic diseases, the simple sampling of water for quality analysis is insufficient to detect a problem. Furthermore, since irrigation water may collect in surface irregularities in farmers' fields, it is impossible to monitor every potential breeding site for such organisms. The best method to monitor such disease prevalence is to examine the target population for signs of disease. In the event that such parasitic diseases can be minimized but not totally avoided, prophylactic measures can be undertaken to protect the population.

Educational activities and research stemming from the International Drinking Water Supply and Sanitation Decade, 1980-1990, are bringing into focus these environmental health concerns which for many years have not received adequate attention to the detriment of large sectors of the world's population. (For an excellent overview of these issues see Reference 34.)

In a broader sense, any agricultural development project produces an ecological change in the region or community experiencing the intervention. It is wise to anticipate a broad range of ecological changes which could result from a project and include study of the relevant parameters in baseline research undertaken prior to the intervention. Since FSR-E is a baseline research methodology, the incorporation of many ecological variables into FSR-E is critical to understand current relationships within that particular eco zone and to insure that post-intervention changes can be adequately detected and monitored. Ecology should not be looked at only in terms of

plants and animals, both wild and domesticated. An understanding of disease ecology, frequently ignored in agricultural baseline research, is critical since disease patterns do change as a result of environmental changes and the potential negative impact of parasitic and infectious diseases is significant and may be life threatening. In any case, development means a decrease in disease, not an increase, nor the maintenance of a poor status quo.

Methodology

The methodology for integrating nutritional and dietary assessment into FSR-E should be built on the elements presented in the rationale section. While the individual items to be investigated will vary depending on the local human and environmental ecology, it is possible to sketch out the principal elements in adequate detail. What follows is a condensation of the methodology used for integrating nutrition and dietary research into FSR-E in Ecuador. Because FSR-E work was going on in a number of communities in various ecological zones, the research protocol was designed in three stages. Stage three may be considered the actual data gathering stage. The first two stages allow items in stage three to be tailored to the unique attributes of the community under FSR-E study. Stage one involves the collection of secondary data. Stage two is the collection of information from community leaders and other expert contacts. Stage one and two methods have been used in the past by FSR-E teams for studies of agronomic and socio-economic variables so they are not new to FSR-E.

Many of the socio-economic variables which would normally be included in a nutrition survey will not be examined. Since multi-disciplinary FSR-E teams include social scientists, such socio-economic variables will have been amply provided for in FSR-E. What will be presented in this methodology

is a skeleton of socio-economic variables with the major focus on nutritional, dietary and health status variables.

Before describing the various components of stages 1-3, it is necessary to give the basic research design scheme for FSR-E and the development project which should theoretically follow it. These are:

1- collection of stage 1 and stage 2 information

2- development of stage 3 questionnaire

3- selection of treatment and control group households

4- baseline longitudinal survey of nutritional, dietary, socio-economic, agronomic, environomental impact, public health, demographic, etc. variables applied to both treatment and control households (this will entail multiple visits)

5- application of development program or FSR-E trial intervention to treatment group only

6- post-intervention/trial longitudinal survey as described in 4 above to all households to determine if the intervention produced a change and if so, in what direction

Stages 1 and 2

Stage 1 is the study of secondary data which will be used to inform items referring to health status, nutritional deficiencies and any other item for which published or otherwise recorded information is available in libraries or archives. Stage 1 may be undertaken simultaneously with stage 2 which is the gathering of information from local contacts at the national and local levels. Stage 2 contacts and questions to be addressed to them are described in Table 1 below. Emphasis in this discussion will be on parameters related to nutritional and dietary status.

One of the most important components of the design is the selection of stage 3 study households and their allocation, either by pairing or random selection, into treatment and control groups. Since harvest yields and other ecological variables are not static over the course of a year or between years, if no control group is selected and studied, it cannot be stated with certainty that any significant post-intervention difference is a result of the intervention and not a normal year to year fluctuation.

Table 1. Example of the type of information to be gathered in stage 2

Contact	Information to be obtained from them
Local Midwife	Prenatal care and pregnancy problems, delivery procedures and common problems, estimate of birthweights, problems, infant mortality and morbidity patterns, food taboos during pregnancy and lactation, infant feeding and weaning, etc.
Local market seller (one man and one woman)	Items sold in this village market (to inform the food frequency), seasonal availabilities and fluctuations of prices, sexual division of labor in the market, etc.
Health Department Official and traditional healer	Prevalent parasitic and infectious diseases and nutritional deficiencies and their clinical symptoms and signs, birth rate, infant and general mortality rates, life expectancy, most common causes of adult and child morbidity and mortality in the region, etc.
Local Mayor or other official	Common marital arrangements in the community, norm of household composition, local events calendar, etc.
Farmer and Wife (choose 5 to interview)	Food storage and preservation techniques, how would additional land or cash be put to use?, what do people hunt or forage when they are short of food?, what are festival foods? how many meals/day does family eat?, garbage disposal, latrines, water source, metabolic cost of farm work, sexual and age division of labor, agricultural cycle, livestock owned by farmers and use, sharecropping terms, migratory work patterns, etc.

While there are statistical methods to determine sample size based on published or otherwise previously determined variances of key variables for the population under study, a ball park estimate of sample size is approximately 15-20 households, divided into treatment and control groups, for each 100 households in the community. While these sample sizes might appear small for nutrition surveys, it must be recalled that nutrition in FSR-E will of necessity be longitudinal due to the seasonal variations in nutritional status and the necessity to monitor human growth and development periodically over the course of the agricultural cycle. Longitudinal surveys can be of a much smaller sample size than the cross-sectional variety and still maintain statistical validity. If it is necessary to match communities as well as households sample size will necessarily be greater than that recommended above. The necessity to match communities could occur if a large scale irrigation project is built and the control group must come from a community in the same human and environmental ecological zone but which will not be affected by the irrigation project.

It is necessary that households selected for treatment and control groups are not out of the ordinary in terms of composition. For example, if the mother or father has left the village or is deceased and if this is a rare situation among households in the village, it is advisable to exclude such households from the survey. Stage 2 contacts in the community can give an idea of the range of household composition which is the norm. In many if not most developing countries, extended families due to multiple wives, the inclusion of grandparents, aunts, and/or other realtives in the household, will be the norm. In the census period it is necessary, therefore, to eliminate unusual households from the pool to be sampled.

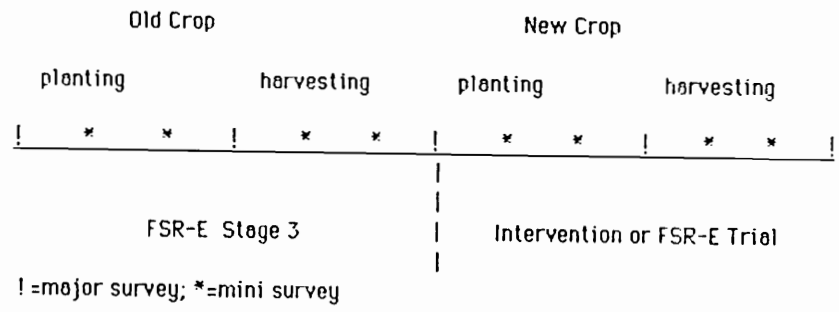
It should be underscored that treatment and control households should be selected to eliminate, as much as possible, any possibility of transfer of

information between treatment and control households in the post-intervention period. If the control group is exposed to and adopts new treatment group technologies, their validity as controls may be significantly diminished.

One of the many advantages of including nutritional assessment in FSR-E becomes apparent upon review of the design scheme shown above. If the treatment group plants a totally new cultivar, then comparing many crop-related variables between the treatment and control group is literally comparing "apples to oranges". Nutritional status, which is an outcome variable, provides a common denominator of measurement for the two groups and it is a far more sensitive indicator of human well-being than is cash income, another common denominator outcome variable.

Stage 3 interviews must be scheduled so that seasonality, both agronomic and nutritional, can be carefully taken into account. Figure 3 is an hypothetical example of an agricultural cycle calendar. "Mini" surveys

Figure 3. Hypothetical calendar of activities for two agricultural cycles.



may or may not include other FSR-E variables. It should be pointed out that after the baseline study, it will not be necessary to repeat collection of historical information such as the morbidity and immunization history,

birthdates or other non-varying items from the baseline survey. Subsequent surveys should focus on obtaining information which is expected to vary over time and with the application of an agricultural intervention. A brief description of items to be included in the questionnaires are given in more detail below.

The schedule shown hypothetically in Figure 3 is recommended because it is not ethical to intrude on a family for major interviews in the middle of the planting and harvest seasons or other season when labor and time demands on the household are great. In Nigeria, for example, the activity of 'ridging' the plants consumes more energy than either planting or harvesting. (16) Furthermore, if a team wishes to compensate the family for their time, a one day's food supply, given at the end of the interview period and consisting of common staples, will be welcome to the family and will not make a significant impact on results.

Questionnaires

There is not sufficient space to reproduce the entire set of questionnaires developed for the Ecuador study. However, in the few pages remaining, the important elements to be included in the questionnaires may be highlighted to provide a general guide for integrating nutritional and dietary assessment into FSR-E. Unless otherwise indicated, items 1-7, which are described below, should be administered to all members of the household. Parents should assist children between the ages of 5 and10 in responding and should give all information for children under 5. This, of course, does not apply to anthropometric and clinical assessment.

In an actual stage 3 FSR-E survey, it is wise to make a different set of questionnaires for different members of the family. In the Ecuador study

there are separate questionnaires for: mother; father; children under 5; children between 5 and 15 years of age; adults over age15. There is also a 'general household information' questionnaire containing items that can be answered by either the father or mother. The mother's questionnaire set, as an example, contained all of the items below plus household food habits, fertility, certain agricultural and other information specific for the mother to answer.

Be aware that individuals may enter or leave the household due to a number of factors (birth, death, marriage, migration, old age, etc.) and these will have to be taken into account in any survey.

All questionnaires should be pretested to refine their wording, streamline delivery of questions and develop a synchronized activity schedule among team members. Pretest the questionnaires on households not selected for the study itself.

Item 1, Anthropometric Assessment

Minimum measurements of anthropometric assessment are height (recumbent length for children under two years of age) and weight. To this may be added mid-upper arm circumference and triceps skinfold. For children under five, head circumference may be added to this list. Paraprofessionals may be trained to take these measurements and such skills should be added to the repertoire of the extension agency serving this population. If more than one individual will be making these measurements, their techniques must be standardized to eliminate inter-measurer as well as intra-measurer error. A description of equipment used to take anthropometric measurements is given by Latham. (24)

Accurate use of anthropometric standards requires that the exact age of a child be known. Since some societies do not record such information accurately or at all, and since parents often do not keep track of their

children's ages, it is important that a means be devised to determine the ages of children. This can be done in stage 2 by constructing a local events calendar with the help of a learned community member, village official and local farmers. The local events calendar highlights festival days, harvests, astronomic, climatic and other events which people are likely to remember and which have occurred over the previous 10-15 years and the exact dates of which are public record. When a child's age is not known accurately, the local events calendar is used as a memory aid: "Was your child born before or after the harvest three years ago? How many days after the harvest was the child born?" or "How many days after the eclipse (or flood, storm, holiday, etc.) was this child born?" By such persistent questioning, it is possible to narrow in on a child's birthdate so that a reasonably accurate age can be calculated. It is particularly important to get ages within a week of the true age for infants and toddlers. For children between approximately 5-15, ages should be no more than one month off. It is critical that accurate ages be obtained for the most vulnerable age groups: infants and young children.

Item 2: Clinical Assessment

A questionnaire developed by Latham (24) for clinical assessment in Africa is reproduced in Figure 4 and gives an indication of elements that may be included in a clinical assessment. However, it is important that items in this portion of the nutritional status survey be based upon secondary data and interviews with public health professionals in stages 1 and 2 of the protocol. Do not include clinical signs that are known to be absent or virtually absent from the population under study. In addition to clinical signs of nutritional deficiencies, signs of disease may also be added to the list and should also reflect known disease prevalences in the region

Figure 4. Clinical assessment questionnaire. (24)*

Clinical nutrition examination

(For use of medical personnel)

Name .....
Sex .....
Pregnant? .....
Height .....
Haemoglobin .....
Haematocrit .....

Date .....
Age .....
Lactating? .....
Weight .....
Upper arm circumference .....
Triceps skin thickness .....

Hair
1. Lack of lustre? .....
2. Dyspigmentation (colour change)? .....
3. Texture change (thinness or sparseness)? .....
4. Easily pluckable? .....

Face
1. Moonface? .....
2. Pallor? .....

Eyes
1. Xerosis conjunctivae or xerophthalmia? .....
2. Keratomalacia? .....
3. Conjunctival thickening or wrinkling? .....
4. Bitot's spots? .....
5. Conjunctival injection or vascularization? .....
6. Corneal scars? .....

Mouth
1. Angular stomatitis? .....
2. Cheilosis of lips? .....
3. Angular scars? .....
4. Gums spongy or bleeding? .....
5. Mottled teeth? .....
6. No. teeth decayed (D) .....
7. No. teeth missing (M) .....
8. No. teeth filled (F) .....
9. Total per teeth .....

Glands
Thyroid
Goitre
Grade 0 1 2 3 .....
Parotid enlarged? .....

Skin
1. Xerosis (dry scaly)? .....
2. Follicular hyperkeratosis? .....
3. Mosaic (crazy pavement)? .....
4. Pellagrous dermatosis? .....
5. Skin haemorrhages (petechiae or ecchymoses)? .....
6. Flaky paint dermatosis? .....
7. Scrotal or vulval dermatosis? .....
8. Oedema? .....
9. Ulcers? .....

Muscles
1. Wasting? .....

Skeleton
1. Epiphyseal enlargement? .....
2. Beading of ribs (rickety rosary)? .....
3. Skeletal deformities? .....
4. Subperiosteal haematomas? .....

Central nervous system (CNS)
1. Psychomotor change (apathy, misery, etc.)? .....
2. Sensory loss? .....
3. Calf tenderness? .....
4. Loss of ankle or knee jerks? .....
5. Motor weakness? .....

Internal system
1. Hepatomegaly? .....
2. Splenomegaly? .....

Remarks (include other abnormalities)
.....
.....
.....

*This sample clinical assessment questionnaire includes space for recording anthropometric measurements. Since the clinical and anthropometric assessment are frequently undertaken at the same time and by the same person, this is a reasonable format.

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as well as parasitic or bacterial infections that may be introduced to the population after the agricultural intervention.

Item 3: Morbidity History

It is important to determine what diseases each individual has had in their lifetime since the extent and pattern of morbidity as well as mortality are an indicator of poverty and underdevelopment. (35, 36) Furthermore, subsequent long term follow up surveys on the population will be greatly enriched by having this information since new morbidity patterns cannot be determined without baseline morbidity information. Since people do not always recognize symptoms in the same way and since many people in developing countries have no medical facilities wherein standard diagnoses may be offered, morbidity history may have to be undertaken according to and within the realm of local traditional medicine. (see Reference 37) The local traditional healer, farmers and health professionals familiar with the region being studied can provide information to tailor this section of the survey. The history should include both acute and chronic ailments. Once the list of ailments is prepared, the subject will respond either 'yes' or 'no' when asked if they have ever had the given ailment and this is recorded on the questionaire. Include on either the mother or father's questionnaire a mortality history for the household.

Item 4: Current Morbidity Status

Due to a lack of standardization in the classification and perception of disease from country to country and region to region, it is important that morbidity history be bolstered by information on current symptoms. The description of and names used to identify symptoms should be tailored to the local culture but reflect a standardization recommended by a national or international health body such as the World Health Organization. Items to be included in this list should be developed in a manner similar to that

of Morbidity History. Once the list is developed, the respondent simply gives a 'yes' or 'no' answer when asked if they have had the given symptom in the past week and this is recorded on the questionnaire. Current morbidity status complements information obtained in the clinical signs section. If parasitic diseases are prevalent in the community or may become so as a result of an agricultural intervention, it is necessary to carry out laboratory tests for parasites. These tests should be undertaken as a part of each major survey (indicated by vertical arrows in Figure 3).

Item 5: Immunization History

Prepare a list of ailments for which immunization campaigns have been carried out in the country wherein the FSR-E research is being carried out. Ask each individual to respond 'yes' or 'no' to whether they have received each vaccination. The list should be prepared based upon information gathered in stages 1 and 2.

Item 6: Dietary Recall

The 24 hour recall form should minimally contain the following elements: time of day meal (or snack) was eaten; foods consumed at that meal; portion size of each food consumed; how the food was prepared. For complex dishes such as stews which are eaten by various members of the household, the recipe should be obtained from the individual that cooked the food and noted on that individual's recall form. Stage 2 data can provide information on who usually cooks for the household in a particular community and that individual's questionnaire can be allocated additional space to record food preparation information. For children it is important to determine if the child shared his/her bowl with another family member. Sanjur (28) and den Hartog and van Staveren (29) provide excellent, detailed information on studies of food habits and the administration of dietary recalls, food frequencies, etc. in developing countries. As stated earlier,

with small sample sizes, it is advisable that dietary recalls be administered on three consecutive days. Like anthropometric assessment, a dietary recall can be administered by a paraprofessional who has undergone a training regime.

Item 7: Food Frequency

A food frequency is taken by asking each member of the household how frequently they eat each of the food items on a list prepared carefully to reflect dietary patterns prevalent in the region under study. Stage 1 and 2 data and interviews with local farmers will provide the items for the list. For each item, ask the respondent the number of times per day, week, month or year that they eat a given food. It is important that food frequencies be taken for all members of the household since this will indicate age/sex differentials in food consumption over the long term and give information not available in a single or 3 consecutive 24 hour recalls. If a new crop or variety is introduced, it should be on the list even though it is not consumed in the pre-intervention FSR-E phase. And, if to prepare the new food other condiments, oils, etc. must be used, those additives should also be on the food frequency list.

Item 8: Food Stocks

Post-harvest information on yields is always gathered in FSR-E. From a nutritional point of view it is important to estimate the nutritional value of these staple stocks, particularly for subsistence farming populations whose food intake is significantly dependent on the yearly harvest. Once the weight or volume of the harvest is determined, the total protein, calories, vitamins and minerals available to the family from the harvest can be calculated using food composition tables for bulk foods

published by the USDA. (38) Based on this information, it is possible to determine the number of days the food will last. The World Health Organization and the National Academy of Sciences' National Research Council are two organizations that have determined the protein and energy requirements for persons of different age and sex groups accounting for the extra needs of pregnant and lactating women and for activity level. (21, 23) Once the daily requirement for each member of the household has been determined, these can be summed to get an estimate of daily calorie and protein needs for the household unit. Dividing this respectively into the protein and calories available from the harvest will give a quotient representing the number of days the food will last at optimal intake. It is easy to then determine if the family will run out of food since a ball park estimate of when the next harvest will come in can be made. This set of calculations is easy to do and offers useful dietary information.

In line with this is the concept of displacement. If a new crop is being introduced, some thought should go into calculating the nutritional content of the new food as compared to the old food it displaces. (39) If a food crop to be introduced is nutritionally inferior and is also targeted for consumption, it is probably unwise to introduce the technological change.

Displacement of calories:

$$\frac{\text{calories old crop harvest}}{\text{calories new crop harvest}}$$

Displacement of protein:

$$\frac{\text{protein old crop harvest}}{\text{protein new crop harvest}}$$

Furthermore, it is important to determine palatability and acceptability of a new food in the FSR-E phase. If a new subsistence crop is not liked and if there appears to be no way to successfully create a taste for it, it should not be introduced at the intervention stage.

If cash crops are introduced, some thought should go into determining what food items the family will buy and at what cost. After the cash crop is harvested and sold, the family may stock up on food. The length of time this food will last can be calculated in a manner similar to that given above for the bulk food value of subsistence crops.

Items to be Included in Household Heads' Questionnaires

The male and female head of household (frequently a man and woman joined in marriage) will answer a number of questions about the household and its function. Examples of items to be included in these questionnaires are shown in Table 2.

When to Interview

Do not interview on festival days or holidays since dietary information obtained on such days will not be representative. Information on the sporadic consumption of festival foods will be available from the food frequencies. Do not use 'typical day' criteria because a subject might call a typical day one that is in reality an unusually good day to impress the interviewer. Typidal day criteria introduces even more error into the recall. Because of the seasonality effects described above, it is imperative that treatment and control households be measured in the same season when household members are involved in similar activities, eat similar foods, suffer pre harvest shortages, etc. If, for example, an FSR-E team measures the nutritional and dietary status of the control group in the immediate

Table 2. Selected items for 'mother' and/or 'father' questionnaires

Category	Types of information to be obtained
1. Food/nutrition	Foraging and hunting; hungry season; infant feeding history; food habits; food preparation, preservation and storage; food taboos; preferential allocations of foods; feeding ill children (taboos, etc.); food stocks; foods purchased the past week; when do you spend more on food than you spent last week; when less; foods you would like to eat more of
2. Agricultural organization	Tasks that children perform and from what age; tasks that women perform; description of land holding and cultivars, their seasons, planting, harvesting, etc.; livestock and use; off farm employment; how market crop (if at all); migratory labor;
3. Socio-economic	Pregnancy history; education of all household members; age at marriage; birth order; household composition (who lives there); preference for one sex child over the other; contraception; housing; access to water; latrine access; durable goods, if any; income estimate; which season is the high income season and why; do you receive lump sum payments and how are they spent; transportation; distance to school (if there is one); subsistence rating (percentage of crop grown for consumption)

post-harvest period having measured treatment group households in the immediate pre-harvest period (since these two seasons follow each other, a researcher ignorant of seasonality effects could commit precisely this error) the information gathered will not be comparable. If such an error is committed in the post-treatment major survey, the results could erroneously indicate that the development project was a failure since the control group was measured at a time of plenty and the treatment group at a

time when the family may be rationing food. Every attempt must be made to collect data in a uniform timeframe particularly with respect to the treatment and control groups.

Coordination between teams is also imperative since it is necessary to have collected socio-economic data at the same time that nutrition and dietary data are collected. Therefore the field teams described below should be modified to include an additional person or persons to collect socio-economic and agronomic, if appropriate, data simultaneously with the nutrition related data.

The Field Team

There should be 2-4 teams of approximately 4 field workers per team consisting of an anthropometrist, clinician (nurse or other trained health professional), recall taker and general information interviewer. Each team should visit 2 families per day. It is advisable to visit one at daybreak and one at the end of the day when all household members are likely to be available. The number of teams necessary will depend on two factors: sample size and the distances to travel between households. As an example, team one of two would visit two control families on day one and two treatment families on day two. Treatment and control households must be visited on alternate days and all households within a two week period to avoid the introduction of error due to seasonality. If three consecutive 24 hour recalls are to be taken, then a team of recall takers should work in concert with the main team visiting households for three consecutive days after the main team collected the majority of information. For the subset of nutritional and dietary status information to be collected at times designated by an asterisk in Figure 3, a sub-team of 3 members should be sufficient to visit all households.

Conclusion

A sound rationale for the introduction of nutritional and dietary status assessment into FSR-E has been demonstrated. The incorporation of these variables into the research protocol of FSR-E studies will greatly enrich such research and permit a far more sophisticated and in depth understanding of farming populations and the modes by which their health and well-being may be improved. Since the improvement of the welfare of a rural population is usually the stated goal of agricultural interventions, the inclusion of nutritional and dietary criteria into FSR-E will have the ultimate impact of increasing the scope and sensitivity of both baseline data as well as post-intervention evaluation studies. The incorporation of nutritional and dietary studies into FSR-E will go far in eliminating the confounding variables which have prohibited development specialists from explaining their project successes and failures.

The use of secondary data and local, regional, or national level contacts in two preliminary stages (referred to in this paper as stage 1 and stage 2) of background data gathering are an integral part of FSR-E methodology (40). Since this methodology is also necessary for structuring and tailoring nutritional and dietary assessment, the incorporation of nutrition into FSR-E will not necessitate a deviation from current protocol. Furthermore, many of the special techniques used to collect nutrition related data such as anthropometric measurements and the 24 hour recall interview, can be taught to paraprofessional workers whose skills can then enrich the range and scope of the extension service serving the study population. The incorporation of these studies into FSR-E can thus be accomplished easily and without significant alterations to the protocol already in use in on going FSR-E work.

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