

Role of Animal Source foods in Improvement of Diet Quality and Growth and Cognitive Development in East African Children

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Narrative Summary

During the first year of the project, we initiated a controlled intervention study of school children in Embu District schools in order to verify our observational findings that animal products play a key role in the growth and cognitive development of children. In order to clarify the effects of micronutrient intake we initiated a set of nutritional interventions through daily school feedings with three types of recipes: meat, milk, or increased calories (oil) added to a basic local dish, githeri.

This first year's accomplishments included setting up a field operation in Embu District, establishment of a data management system, staff recruitment and training, pilot studies of the feeding interventions and study measurements, and baseline studies of the study sample. These activities have gone fairly smoothly, with the exception of several notable problems including a shortage of adequate transportation and a brief national teachers strike in July, which just resumed in October. The teachers were promised increased pay two years ago which has not been forthcoming.

Field Operation

An office site has been established in Embu, with three small field offices and a food preparation building donated by the rural health center in the study area. The major project supplies and equipment have been delivered to the project site and a new project vehicle was purchased a month ago.

Recruitment

Recruitment and training of field personnel and professional and scientific staff have been extensive. Field personnel are local residents, some of whom previously worked in the former Nutrition CRSP (NCRSP) study. Two nutritionists with MSc. degrees were recruited, and the Embu District Nutritionist as well as a community nutritionist were seconded to the project by the Ministry of Health, which has been extremely supportive. A Kenyan Field Coordinator has been hired, and we have also recruited and trained a field psychologist, a programmer/data manager, a data entry clerk, an administrator, about fifty field workers covering all measurements, and the crucial food preparation staff for the daily school feeding.

Field Activities

The definitive sample of twelve schools and over 500 Standard I students and their households have been enrolled. The schools were assigned to four groups: three each assigned to a specific intervention, and one control group. The following validation studies were undertaken:

- Comparison of three food intake measurement methods;
- Pilot studies of videotaping children classroom behavior, attention and classroom quality, and activity;
- Activity of the children in the schoolyard during free play was observed;
- Pilot studies of cognitive testing and measures of attention;
- Setting up and testing of the data entry system by computer scanning of field research forms;
- Recipe development and determination of nutrient composition, as well as recipe acceptance by the children (the recipe was the local dish, githeri, consisting of maize, beans, greens and onions, with the addition of meat, oil, or milk);
- A feasibility study of large-scale food preparation, where ingredients were obtained and cooked, measured into individual bowls, transported to the schools and fed to the children, with a measurement of leftovers;
- Baseline studies included a food intake study, cognitive performance, physical activity, classroom behavior, teacher ratings of children, literacy testing, and a socio-economic survey and census of each household, along with a monthly illness (morbidity) survey. Data analysis is in progress;
- Baseline health measurements included physical examinations and health histories, stool examinations for ova and parasites, hemoglobin, smears for red cell morphology and malaria. Blood samples have been obtained for micronutrient studies (zinc, ferritin, B12, Vitamin A) to be analyzed at a later date. Urine samples were obtained for iodine determinations as Iodine Deficiency Disease (IDD), albeit mild, is present in Embu and could be an important confounder for cognitive function.

Research

Problem Statement and Approach

The original problem statement was described in two phases. In phase I we planned to implement a controlled feeding intervention study of school children to test if animal source foods, particularly meat, eaten at school each day by Standard I children (ages 6 to 9 years) improves their micronutrient status, rate of growth, school performance, attention, and physical activity and health compared to these parameters in children who receive either added milk or extra calories (oil). All feeding groups receive the local dish githeri, a mixture of maize, beans and greens. A comparison group receives no school feeding and serves as a control group. This latter group will receive school feeding a year later. Thus between-child and inter-child comparisons will be possible.

This controlled intervention study research is of utmost importance, as the original observations of the beneficial effects of animal source foods on cognitive and school performance, activity and growth were based on non-intervention observational studies. Causality could not be ascertained, even with careful multi variate analyses, which controlled for relevant intervening and confounding variables.

In Phase II, years 3-4, we had planned to carry out a three country community-household intervention, working with livestock NGOs on an East African regional level. The approach would be to increase availability of a variety of small animal (rabbits, chickens, goats, etc.) to households in order to enhance the ability of families to increase the amount of meat in their diet and also to derive some income generation activities from the sale of some of the animals. The main targets are children and women of reproductive age, the most vulnerable groups. The NGOs would be responsible for the organization of groups of women into small credit groups

to obtain the animals and to train the women in the care, feeding, management, and breeding of these animals. Our team's responsibility would be to increase the utilization of these animals for diet improvement by intensive, practical, hands-on participatory nutrition education on how to slaughter, process, prepare and cook the meat for consumption by the family. Preservation of the meat through solar drying would also be included. The NGOs would be instrumental in training community volunteers as "paravets" or community health workers for animal care and to help with the marketing of any extra meat produced after satisfying household nutritional need. We plan to collaborate with Heifer Project International and with Farm Africa as a start and would develop close ties with such groups as KARI, ILRI, and the NARS. Intervention sites would be in Ethiopia, Kenya, and Uganda.

A related project has been initiated in collaboration with the Child Health and Development Center (CHDC) of Makerere University. Our team was funded by the Thrasher Research Fund for a small two-year community intervention project in rural Uganda to increase consumption of animal source foods by rural subsistence families.

We are working with an NGO called VEDCO that supplies the expertise in community organization, rabbit care, rearing, breeding, and marketing. Their focus has been on marketing of rabbit meat and income generation. The input of our team is to work in the communities with women's groups who are raising the rabbits and increase household consumption of rabbit meat through intensive, hands on participatory nutrition education. The women would develop recipes and try these out. The CHDC has highly trained community nutrition educators. A doctoral student from Pennsylvania State University (student of Dr. Audrey Maretzki) will also work with the project to set up solar drying of rabbit meat to produce a powdered form of a weaning food supplement and meat sticks as snacks for older children. Households could store reserves and this product could possibly generate income. Testing the feasibility and acceptance of these products and their marketability will comprise the basis of a doctoral dissertation. Our team would also monitor food intake and child nutrition status - mainly growth and anemia.

In summary, the project currently involves the implementation of the controlled feeding intervention study of school children in Embu, Kenya. However, the small Thrasher funded project in Uganda retains some of the original approaches and is guided by the problem model.

Progress

The year's accomplishments include setting up a field operation in Embu District, establishment of data management systems, staff recruitment and training, pilot studies of the feeding interventions and study measurements, and a baseline survey among the study sample.

Recruitment of field personnel and professional and scientific staff has been extensive. Two nutritionists with MSc. Degrees were recruited in Kenya from the University of Nairobi, both of whom intend to use project data to obtain doctorates in Nutrition. A third Nutritionist, the Embu District Nutritionist was seconded to the project by the Ministry of Health, Government of Kenya.

We also recruited the following Kenyans: a part-time field psychologist with an MA, also interested in a doctorate; a part-time computer programmer and data manager who is from the Applied Nutrition Program of the University of Nairobi, a data entry clerk, and an administrator. Fifty Kenyan field workers covering all needed baseline and ongoing measurements (food intake, anthropometry, cognitive measures and

behavioral and activity measures, socio-economic status and morbidity), and a critical food preparation staff for the daily school feeding of over 500 individuals were also hired and trained. We recently recruited a Field Coordinator in September 1998 after a long search. She is a Kenyan national with a recent doctorate from the State University of New York (SUNY) at Buffalo, New York.

A project office has been established in Embu Town, some 18-20 km from the research site, with three small field offices scattered throughout the study area and a food preparation house donated to our project by the Rural Health Center. There is electricity, running water, and outdoor and indoor cooking facilities at the "cook house".

Food preparation group works under the strict supervision of two nutritionists and their assistants who work from evening to 7 am in order to have the food cooked and ready for delivery for a morning feeding. To ensure quality control, exact nutrient composition, and strict sanitation and food safety, the cooking, serving and feeding are carried out under strict supervision. All food handlers have been checked at the health center for intestinal parasites and other sources of obvious infection. Hand washing with soap is required before food or utensils are handled. A refrigerator and freezer are available for food storage. Two vehicles are required to cover the food delivery to the nine feeding schools. A project feeding assistant accompanies each driver to ensure food is properly delivered and schools supplied and project feeding assistants (one per classroom) ensure that food is properly distributed and the pre-numbered bowls are retrieved and leftovers measured. Milk is served and leftovers are measured at the schools.

Unfortunately, we could not carry out the school feeding for the definitive study on half of the schools in the month of July as planned for several reasons. The project statistician felt strongly that either all of the designated feeding schools receive food at the same start date or the feeding be delayed until all the feeding intervention schools could be fed. If half were to be fed, this would upset the design of the study with some bias being introduced. Also, all of the baseline studies were not completed in all of the schools because of the brief. The definitive sample comprising twelve schools and over 500 Standard I students and their households have been enrolled. The schools were randomly assigned to four groups: three each for a specific type of feeding intervention, and one as a control or comparison group. Each school has 1 to 2 Standard I classrooms per school with about 110-125 children per group.

Special attention has been given to pilot testing of the data entry system by computer scanning of field research forms rather than manual computer data entry. The data is then electronically transmitted to the USA and the University of Nairobi.

Recipe development for the feeding interventions and determination of nutrient composition has been labor intensive. The recipe comprises the local Embu dish Githeri (maize, beans, greens, and onions) with the addition of meat, oil, or milk. Taste tests in the pilot test area have been successfully carried out and the children and teachers liked the food and readily ate it.

A feasibility study of large-scale centralized food preparation was carried out. The ingredients were obtained, cooked, and portions were measured into individual bowls, pre-numbered with each child's study number, transported to the schools, and fed to the children; then, measurements of leftovers were made. This was successfully carried out for 80 children. Actual full-scale feeding of over 500 children began on August 31 with the start of the new term. The teacher's strike in July, which closed the schools for almost a week. Lastly, there needed to be a feeding and food delivery feasibility trial

from start to finish in two pilot schools before full-fledged feeding on over 400 children was initiated. This feasibility study proved to be invaluable. Lessons learned from the report made the feeding in the main study run smoothly.

Progress Relevant to the Criteria for Evaluation

We have largely accomplished what we set out to do in the first year. Baseline studies have been completed for food intake, anthropometry, socio-economic status, health evaluations and physical examinations (see below). Blood samples were obtained for hemoglobin determinations, and blood was collected, processed, and frozen for micronutrient determinations now begun at the University of Nairobi and at the University of California at Davis. Stool examinations for intestinal parasites and blood smears were examined for red blood cell morphology and malaria in Embu. Urine samples were collected for iodine determinations at Kenyatta University Hospital. Hemoglobins were measured in Embu using the Hemacue portable hemoglobinometer.

The final study sample has been selected, and the schools have been randomly assigned to intervention groups and a control group, three schools per group. The staff has been recruited on all levels, the field psychologist, the Field Coordinator, the administrator and others, and all groups of enumerators have been trained. The total staff now numbers about seventy total, with sixty local Embu district residents and the others from Nairobi.

Under the current Memorandum of Understanding with the Kenyan Government, all project supplies and equipment such as a refrigerator/freezer, have been allowed into Kenya and a new right-hand drive vehicle purchased duty free in Kenya. Dr. Bwibo has been an excellent colleague moving activities forward, problem solving and keeping the project afloat after its first launching through his personal management of staff and funds and frequent trips to Embu to provide leadership and supervision to the field staff and field scientists. Dr. Patterson Semenyé has provided invaluable part-time assistance from time to time in expediting many essential administrative and logistic details.

A Steering Committee for policy consideration and evaluation is being constituted and will be multidisciplinary with broad representation ? nutrition and food security, health and health planning, and education and agriculture (livestock). The steering committee will serve in a policy advisory capacity and will consider new policy issues as brought forward by the research findings and their implications. The group will assume increasing importance as more research findings are forthcoming. We hope to convene the steering committee this coming December around the time

- The above micronutrients are apt to be low when intake of animal source foods is low. An ongoing monthly illness (morbidity) survey will be carried out during the main study as illness can effect both nutritional status, food intake and school performance.

Descriptive findings from baseline studies

Selected Baseline Findings: In August and September, 1998, 535 Standard I children in the sample had health assessments. This included a health history and physical examination performed with the parent present and included past medical history obtained by a nurse, a physical examination conducted by three Ministry of Health Physicians and Clinical Officers working with Drs. Bwibo and Neumann who trained and oriented the and supervised the group. Blood samples were obtained for red cell

morphology, presence of malaria parasites and hemoglobin. Blood was processed and frozen into plasma and sera for biochemical analysis, some of which has started. Urine was collected for urinary iodine levels and stool specimens were examined within a few hours for ova and parasites. This was an extremely labor intensive and very ambitious undertaking in a relatively short time. Mrs. R. Ngaruro, the District nutritionist working with us, and the provincial clinical officer were of great assistance in selecting the physicians and lab technicians from Embu Provincial Hospital, as was the clinical Officer in Charge of the Karurumo Health Center of the Annual Review meeting in Kenya and Tanzania.

Baseline studies took place from late May to the end of August prior to the start of school feeding. Very limited analysis of data has taken place thus far and is mainly descriptive. Baseline data were collected on the following:

- Food Intake - Twenty-four hour recall of food intake on three non-consecutive days and a one-week food frequency was carried out on each study child.
- Anthropometry - height, weight, arm and head circumference, and fatfolds (subscapular and triceps);
- Cognitive testing;
- Physical activity- observations during free play;
- Classroom organization and quality- by videotaping;
- Child classroom attention - by videotaping and observation;
- Parental literacy (tested);
- Socio-economic status of the household;
- Household census;
- Health- Physical examinations, health histories, stool examinations for ova and parasites, hemoglobin, smears for red cell morphology and malaria, serum ferritin and urine iodine determinations are in progress, and plasma samples are being stored for future analysis of zinc and Vitamins B12 and A. The above were carried out by J. Siekmann, a UC Davis doctoral student, and by Kenyan physicians, nurses, and laboratory technologists hired short-term and supervised by Drs. Bwibo and Neumann in July and early August.

who gave us space and staff to assist us. Although this was an expensive undertaking it is essential that we know the main confounders present which can have an adverse impact on child growth and function as well as micronutrient deficiencies. Also it is essential to know if the different experimental groups are similar in their health status prior to starting the feeding interventions.

Some Common Clinical Findings

Health Status: From health examinations, over 50% of children had enlargement of their spleen. Normally, the spleen should not be palpable below the left costal margin. In this study, over 50% had spleens palpable over 1cm below the right costal margin. This is indicative of endemic malaria. This high spleen rate was corroborated by >50% of the children having malarial parasites present in their red blood cells.

Anemia: Using the Hemacue, a highly accurate portable method to determine hemoglobin, over 30% were found to be anemic. The WHO reference for children 6-10 years old is <12gm/dl indicates anemia. With increasing altitude 1 gm is added per 1000 ft of elevation. If 11gm/dl is taken as the cut-off for anemia, then 37.2% are anemic. Below 9gm/dl and particularly below 7gm/dl is severe anemia with 7.3% suffering from severe anemia (see Chart 1).

Chart 1: Anemia (by School Group) - Based on WHO reference for children 6 - 10

years old: <12gm/dl indicates anemia when 1 gm is added per 1000 ft of elevation. Severe anemia: <7gm/dl; Moderate anemia: 7-8.9 gm/dl; Mild anemia: 9-10.9 gm/dl; Low normal: 11-11.9 gm/dl; Normal: 12+ gm/dl.

Malaria Parasites: Examination of stained blood smears showed that malaria parasites were seen in over 50% of children, consistent with the splenomegaly and high anemia rate.

Intestinal Parasites: Examinations of stools for intestinal parasites were carried out in preparation for generalized deworming with mebendazole. Parasites were present in nearly half of the children, with the following distribution:

- Hookworm 35%
- Ascaris 30%
- Trichioris Trichura 20%
- Protozoa Omebioses
- (End. Histolytica) 23%
- Giardia H. 20%

The hookworm contribute to iron deficiency through blood loss.

Anthropometry: Baseline height, weight, head and arm circumference (MUAC) and fatfolds-triceps and subscapular were obtained. These were analyzed by age, sex, and intervention and control group (see Charts 2-5).

[Chart 2: Nutritional status \(by sex\) based on weight/age measurements.](#)

Specific Nutrient Deficiencies Noted on Physical Exams:

- Pallor of conjunctivae and nailbeds indicative of anemia.
- Enlargement of thyroid gland (goiter) 2/500.
- Mouth angular scars - indicator of vitamin B deficiency.
- No clinical signs of vitamin A deficiency were noted.
- The majority of children appeared underweight.

Problems Encountered

One unforeseen problem is the very high cost of photocopying forms for data collection. Expenditures to date now total

[Chart 3: Nutritional status \(by age\) based on weight/age measurements.](#)

Malnourished:

<80% of WHO/NCHS median weight for age - moderate to severe PEM.

Mildly malnourished:

80-89% of WHO/NCHS median weight for age - mild PEM.

Normal:

> 90% of WHO/NCHS median weight for age - no PEM

**** PEM = Protein-Energy Malnutrition.**

several thousand dollars. We are looking into purchasing our own photocopier should funds become available. Another major problem has been a shortage of transportation, now somewhat alleviated with the purchase of a new vehicle. To this end, the Ministries of Health and Agriculture of Embu District have assisted us greatly by allowing us considerable use of their vehicles; nevertheless, this has been costly as we pay for gas and repairs. Because of constant malfunction and the need for repeated expensive repairs of the former SRCRSP Subaru, we hope to replace this vehicle in 1999.

Chart 4: Height for age (by sex).

Chart 5: Height for age (by age). - Stunted: <90% WHO/NCHS median height for age

A current problem is the possibility of a recurring nation-wide Kenyan teacher's strike. After an initial strike in May, there was a recurrence this October which lasted for over two weeks. Our team, with Dr. Bwibo, met with school administrators, head teachers, and classroom teachers, and worked out an excellent contingency plan. The team was extremely cautious so as to not appear to be "strike-breaking". The schools allowed the feeding of the Standard I children to continue at schools daily despite the strike and allowed the children to have their anthropometric measurements carried out and to have their hearing and vision checked. Also they allowed the children to play in the school yard for an hour so that activity observations can take place as usual. All other measurements (food intake, morbidity, and cognitive testing) were carried out in their homes. The only observations missing were the classroom observations and videotaping of classes in session.

Gender Analysis

The project staff positions, at all levels, are held predominantly by women. This is in large part due to the fact that most nutritionists and child development specialists are women. Many of the women were trained in the previous CRSP study and wished to be working once again to earn income of their own. Women also enjoy working with the young school children, and are more comfortable with the home visiting aspects, wherein they obtain information on food intake and illness. The following personnel are women:

Senior level: Principal and Co-Principal Investigators (Neumann, Murphy, Sigman); Co-Investigator (Allen). These are all senior level faculty at the University of California.

The newly appointed field coordinator, Dr. Edith Mukudi, is a young Kenyan woman who just received her Ph.D. from SUNY at Buffalo in Education Development with a minor in Nutrition. Her dissertation research dealt with the interrelationship of "Education Achievement and Nutrition in Rural Kenyan Children". She holds a teaching appointment of Lecturer at Kenyatta University in the Department of Education. She has done extensive fieldwork in Embu District. She is also appointed as a Post-doctoral Scholar at UCLA.

The senior field staff resident in Embu are all women, and with one exception are all Kenyan. Three hold Masters and one a Bachelor's degree. Three are nutritionists and one is a psychologist/educator and all but one were educated in Kenya. The

nutritionists are C. Gewa, R. Ngaruro, M. Grillenberger (Germany) and M. Kamore. One of the Kenyan Nutritionists who is the Embu District Nutritionist (R. Ngaruro) was seconded to the project for its duration by the Ministry of Health. A Community Field Nutritionist was seconded to us as well to act as a supervisor for the Food Intake measurements.

The Master's level nutritionists and the psychologist plan to get Ph.D. degrees using the project to collect their dissertation data. Two hope to study at the University of Nairobi and one in Holland. The Bachelor's level nutritionist would like to obtain a Master's degree. We felt it important to recruit as many Kenyan women as possible who would assume senior positions of leadership in the University or the Government of Kenya as part of infrastructure building. The field coordinator and senior investigators also provide excellent role models and mentoring for the younger scientists who wish to carry out doctoral studies. We also have a University of California at Davis student doing her doctoral research in the project (S. Bunch) and a postdoctoral scholar from UCLA (S. Whaley) who divides her time between UCLA and Embu. These young women also serve as role models and mentors for the Kenyan staff.

In regards to the proposed policy advisory committee, Dr. Charity Kabutha, well known in gender issues, especially in Women in Leadership in Agriculture, has been a consultant and will serve in an advisory role on the steering committee. She will play an important role when we get to a community and household intervention phase.

The field workers are village women and are learning to bank and save their salary money aside from receiving training and carrying out highly responsible work. The schoolteachers and many head teachers (principals) at the study school are predominantly women as well.

Contributions to Policy

The study that we are undertaking has, even at its early stage, already stimulated policy considerations by the GLCRSP. By studying human health, growth, and cognitive development in relation to diet quality improvement through increased intake of animal source foods, the livestock community has begun to consider a linkage of livestock production with improvement of human well-being and nutrition as one of the outcomes or impacts of improved livestock production. Increasingly NGO's, the other livestock CRSPs, and International Livestock Research Institute (ILRI) are viewing human health and nutrition improvement as a desired positive outcome. Groups such as Heifer Project International (HPI), ILRI, and some of the other SR/GL CRSPs have invited our group to speak about such linkages and the evidence for the role of animal products in improving diet quality and human function at their meetings.

By working closely with the school administrators, physicians, parents and community leaders, there has been an awareness-raising of the need for school feeding, particularly of young school children. Children often come long distances to school without having eaten, and teachers and administrators are becoming very concerned about this. As children make it through their fifth year of life, 90% survive now compared to 50% less than a decade ago, and many more children are now enrolled in primary school. Lack of food, poor nutritional status, and poor health interfere with the children's ability to benefit from their educational experience, albeit relatively brief and of limited quality.

The health assessment activities of the children have a high visibility, with parents accompanying their children and watching a health professional examining their children. They get feedback and see their children being checked for anemia, malaria

and intestinal parasites, and receiving de-worming medication in conjunction with a school program. These activities introduce the community to the concept of the role for schools in health and nutrition services.

Lastly, a food-based, rather than pharmaceutical approach, is being used to improve the micronutrient content of the diet. Foods available in the community are being used for the school feeding. In the words of a speaker at a workshop on "Food-Based Approaches to Control of Micronutrient Deficiencies through Food-based Solutions" sponsored by the Thrasher Foundation in 1997, participants were advised to "...look at their farms and not at their pharmacies..."

It is anticipated that the study will raise and call attention to the following policy issues:

- Food-based solutions to micronutrient deficiencies; particularly for zinc, iron, vitamins B12 and A, and calcium through the use animal source foods.
- The role of nutrition in learning and cognitive function: If the large investment in primary education is to realize a return, the children must be in the best condition to learn. Successful students go on to higher education and become future leaders contributing to social and economic development.
- The prevention of anemia through school-based feeding (and de-worming) will make increased physical work possible and increase the activity and learning of the children.
- Serious policy constraints that must be addressed include a lack of resources for any sustained school feeding programs, and the nationwide discontent among the organized teachers groups (Kenya Teacher's Union).

Outreach

Outreach will not receive direct attention until the third year of the study. Once the research has been completed and there are research results, then outreach will begin in earnest. An immediate goal of any outreach activity will be to make school feeding both affordable and sustainable by the community itself. There will need to be a major collaboration involving the parents, teachers, school administration and communities, women's groups, NGOs, and agricultural, home economics, and nutrition extension services. The health sector also plays a role, and the families of the children will be major players as they have already been.

Already, in the course of explaining the purpose and details of our research study, the interest and awareness for the need of school feeding has been stimulated among parents, teachers, school officials and the Ministry of Agriculture and of Health and some local NGOs. Increasing emphasis will be placed on increasing the intake of animal source foods, both meat and milk in the diet of children. The office of Nutrition and Health within the Ministry of Education are very interested in the research study.

Our vision for future outreach and extension is to emphasize community and school partnership in procuring or producing food for the feeding of toddlers and school children. Should the research findings support the advantages and "added value" of meat or other animal source foods in the diet, there would be ample opportunity for NGOs involved with livestock and other small animals to become involved in micro-enterprises involving particularly, but not exclusively, women. They would assist households in obtaining and maintaining animals for household consumption, particularly by the children and for preservation for future use and for income generation. Parents, children and even schools could be involved on the production side through 4H-like efforts. Intensive and practical health and nutrition education of a

participatory and practical nature would be needed through extension services of the Ministries of Health (Nutrition) and Agriculture. The latter would have a critical role to play in making school feeding of high quality feasible, affordable and sustainable.

Contributions to Development

Developmental Impact

The main developmental impact of this research project lies in the enhancement and fostering of human capital and future leadership potential of young school-aged children. Increased food intake and diet quality improvement, through increased intake of animal source foods, will promote better nutritional status, health, growth, and cognitive development of children and their ability to learn and be more productive adults.

The quality of life as children will also be improved so that they will be in a better condition to learn and benefit from their school experience. Record numbers of children are attending primary school in many developing countries. Governments like Kenya are investing a third of their budget (the third largest budget expenditure) in education and for the Government of Kenya and taxpayers to maximize and realize a return on their investment, children must be in a position to learn. School feeding with high quality food will also bolster school enrollment and attendance, the latter being essential for success in school. The World Bank states that "health and nutrition are equitable and cost effective interventions that contribute to human capital and social capital development".

As school feeding becomes more prevalent and the demand increases, sustainable community-based programs may evolve. School feeding will create an increase in demand for locally produced foodstuffs. Should animal source foods prove to be more effective than only cereal/legume/starchy feeds, then the demand and challenge for affordable production of animal source foods on a community basis will increase considerably, thus stimulating local production and markets.

Contributions to Agriculture

Iron deficiency and, to a lesser extent, zinc deficiency and vitamin B12 deficiencies are problems in the USA, particularly among poorer families in inner cities and in rural areas and among strict vegetarians and groups who have drastically reduced meat in their children's diets. The less severe cognitive deficits associated with iron deficiency, poor linear growth associated with zinc deficiency, and neurologic development problems associated with vitamin B12 need to be addressed in American children as well.

Contributions to Host Country

The development target is to improve the ability of children to learn, to benefit from their school experience and to enjoy better health. This will enhance their ability to contribute to leadership roles and social and economic development of their community and nation. Kenya spends over a third of its budget on education. Better-nourished children who are not iron deficient or suffer other micronutrient deficiencies will learn better, be more physically active and in better position to learn and increase the returns on Kenya's heavy investment in education. In addition to cognitive and school performance we anticipate improvements in physical growth and

reduction of anemia which will increase ability to perform physical work and therefore contribute to economic development.

Socio-economic development of a community and nation will be well served through improving the health, growth and development of its children and enhancing their ability to learn. Should the study results of the controlled intervention study establish a causal relationship between intake of animal foods and the child's cognitive function and growth, this would contribute immeasurably to policy in multiple areas - education, nutrition and health, agriculture, and economics.

Linkages and Networking

Community

This year, we employed over fifty members of the community. Community resources have been made available to the project, i.e. use of community halls, meeting rooms, and classrooms. We are "sponsored" and supported by the zonal education administration. On the provincial level, the Provincial Health Officer and the Provincial Education Officer have supported us with space, transport and office and work space at the local Health Center in the study area, and classroom work space in the schools.

Regional/National

We have full support and formal collaboration with the Ministries of Health, of Education, and the University of Nairobi School of Medicine and Applied Nutrition Program. Personnel have been seconded to us in nutrition and education.

Global

Due to the presence of this child nutrition project, livestock organizations, both governmental and non-governmental, have already started to consciously consider and even incorporate human nutrition linkages with livestock production. This has already occurred in the other GL-CRSP funded projects, which are now examining human nutrition impacts of their activities and finding a common thread of interest in looking at these impacts. This project has been and continues to be happy to consult with the other projects in helping to select nutrition outcome indicators. In addition, an ancillary project in rural Uganda is bringing together agriculture, human nutrition, health, and education, in a child nutrition project involving household rabbit production and consumption.

Collaboration

Interaction is occurring with other SR/GL CRSP projects not only in East Africa but also in Latin America and Central Asia. The improvement in human health and nutrition through enhanced livestock production is a shared theme.

Other Contributions

Support for Free Markets and Broad-based Economic Growth

Stimulation of small animal production, production of milk and local foodstuffs for

school feeding, and family diet improvement support income generation and the marketing and sale of the above foodstuffs.

Contribution and Compliance with Mission Objectives

Our project is promotive of and consistent with the revised strategic framework of USAID Agency Goal #4: "World Population Stabilized and Human Health Protected", and specifically REDSO/ESA Strategic Objective #4, that of "Improved Child and Reproductive Health Systems in East and Southern Africa".

In the context of improving diet quantity-quality and growth and cognitive development and health of children, our project will strengthen the following areas:

- Intermediate Result (IR) 4.1 Strengthening of information networks and improved policy
- IR4.2 Improving technical capacity of partners in nutrition assessment and promotion.
- IR4.3 Improving policy in the area of food based micronutrient approaches. Importance of school feeding in relation to enhancement of cognitive function and learning.
- IR4.5 Improving family diet quality through incorporation of animal source foods, particularly for your children, schoolers and women of reproductive age.

Concern for Individuals

Children who have severe anemia or any other serious condition will be referred for medical evaluation and treatment. All children will receive anti-helminthics as the prevalence of hookworm and ascaris is high. Children have all had physical examinations and health histories taken and those with problems referred for further evaluation and care. All children are having vision and hearing tested.

Support for Democracy

This project promotes democracy in several ways:

- Through membership in animal credit groups, women will obtain experience in leadership skills and be given hands-on experience in the processes of electing leaders and representatives and use the concept of majority rule. They will experience democracy in action. Also, through involvement in credit, savings, and investing they will be introduced into private enterprise.
- Improved food security, nutrition, and income generation allow community members to obtain better health and to become more active and creative participants in their communities. This leads to increased political stability, which fosters participation in community governance.
- The highly interactive and participatory style of operation of the Assessment Team has set the tone for the project teams. Decisions have been mainly by majority vote or by consensus and this will continue.

Humanitarian Assistance

Many school children in the study appear to come to school hungry. The school feeding is most welcome and is the only substantial food some children receive prior to or during the school hours. Also see the section entitled "Concern for Individuals".

Leveraged Funding and Linked Projects

A Thrasher Foundation grant for \$25,000 was received for 1998-2000 for a community intervention in Uganda entitled "Community Intervention to Improve Diet Quality for Children through Household Rabbit Production and Consumption in Rural Uganda: Food-based Approaches to Preventing Micronutrient Malnutrition". The project entails a community-based approach to increase animal source food intake by households through rabbit raising. This project targets women and children in Uganda, and is a collaboration with Dr. Jitta of Makerere University's Child Health Development Center and College of Agriculture, and a Ugandan NGO, VEDCO. This NGO has already introduced rabbits into communities in Lowero District through women's credit groups, with a focus on income generation. We will introduce the nutrition education components with hands on, participatory education, demonstrations and recipe development to increase meat intake of the households, particularly of women and children. This project will address diet quality improvement through increased meat in the diet, food security, and income generation by and for women. Impact will be evaluated by nutritional food intake and economic indicators.

In addition, applications are being prepared for IDRC's micronutrient initiative, the World Bank, the Cattlemen's Association of America, the Thrasher Research Fund, and the Foundation of Conservation, Food and Health. Visits in Nairobi are being arranged with representatives of the World Food Program, UNICEF, the Ford Foundation, SIDA, DANIDA, and REDSO/ESA.

Travel funding in the amount of \$3,000 was received from the James S. Coleman African Studies Center and International Studies and Overseas Programs (ISOP) at UCLA for travel to East Africa (Kenya, Uganda) in 1998-99.

Training

All of the trainees will carry out or use project data for their dissertations. A great deal of training and retraining has gone on of the field enumerators and supervisors. Over fifty have been trained in various areas of food intake, anthropometry, cognitive testing and observations, censuses, morbidity, socioeconomic status, literacy testing, computer and data entry. These are marketable skills for future research or evaluation positions or in relevant ministries.

Degree Training

S. Bunch, Ph.D., Nutrition, University of California, Davis. Expected completion 2001-2.

C. Gewa, Ph.D., Nutrition, University of Nairobi or University of California, Davis. Expected completion 2002-3.*

M. Grillenberger, Ph.D., Nutrition, Wageningen University. Expected completion 2002-3.*

M. Kamore, Ph.D., Psychology, University of Nairobi. Expected completion 2002-3.*

J. Siekmann, Ph.D., Nutrition, University of California, Davis. Expected completion, 2001-2.

*Proposed - not yet admitted

Comments

Provincial level and district level Ministries of Education, Health and Agriculture are wholly supportive of our project in Embu District and Eastern Province. They have helped with extensive use of vehicles, secondment of personnel (District Nutritionist, Community Nutritionist), use of laboratory and clinic facilities, as well as use of two houses at the Rural Health Center at Karurumo. Also physicians, nurses, clerical officers have worked short term with the project as needed. Without this assistance, the project would not have been implemented according to schedule. In addition, ILRI has been of assistance in loaning our project a vehicle for 3 weeks.

Collaborating Personnel

United States

Lindsay B. Allen, Professor, Nutrition Department, University of California, Davis.

Suzanne P. Murphy, Professor, Nutrition Department, University of Hawaii.

Charlotte Neumann, M.D., MPH, Professor, Community Health Sciences and Pediatrics, School of Public Health and Medicine, University of California, Los Angeles.

Marian Sigman, Professor, Biobehavioral Development Department, University of California, Los Angeles - School of Medicine.

Shannon Whaley, Post-Doctoral Scholar, University of California, Los Angeles.

Kenya

Dolline Busolo, Food Technology Department, University of Nairobi.

Nimrod O. Bwibo, MPH, Professor, Pediatrics Department, University of Nairobi.

Edith Mukudi, Lecturer, Department of Education, Kenyatta University.

Robert Mwadime, PhD, Lecturer and Researcher, Applied Nutrition Program, University of Nairobi.

Hellen Ommeh, Lecturer and Researcher, Animal Economics Department, University of Nairobi.

James O'Mararo, Chief Economist, Kenyan Ministry of Health, Nutrition, Planning and Economics

Patterson Semenye, PhD, Animal Scientist, formerly of KARI/SRCRSP

E. Shako, Kenyan Ministry of Health, Division of primary health care, Nutrition office.

Uganda

Jessica Jitta, Director and Senior Lecturer, Child Health and Development Center,
Makerere University.

Imelda Zimbe, Nutritionist, Child Health and Development Center, Makerere
University.

Louise Sserunjogi, Community Nutritionist, Child Health and Development Center,
Makerere University.

Collaborating Institutions

Kenya

University of Nairobi

Pediatrics, School of Medicine

Applied Nutrition Program

College of Agriculture

Department of Food Science

Ministry of Health, Nutrition, Planning, Economics

AYFA House, Cathedral Road

P.O. Box 30016

Nairobi, Kenya

Ministry of Agriculture

Eastern Province, Embu

Ministry of Education, Nutrition and Health Division

Jogoo House "B", Harambee Ave.

P.O. Box 30040

Nairobi, Kenya

Uganda

Makerere University

Child Health and Development Centre

Kampala, Uganda

Tel: 541684; Fax: 531677

Presentations and Abstracts

Dr. Charlotte Neumann has made the following presentations on "The Role of Animal Source Foods in Child Growth and Development":

- World Federation of Public Health Associations, October 1997
- ILRI workshop on Agricultural Ecosystems Health and Livestock, May 15-19, 1998, Addis Ababa, Ethiopia.
- Heifer Project International Nutrition Symposium, October 14, 1998, Little Rock, Arkansas.