Synthesis Paper

ICRW/OMNI Research Program

Focusing on Women Works: Research on Improving Micronutrient Status through Food-Based Interventions

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Contents

Acknowledgments

It is our hope that the readers—be they policymakers, researchers or program practitioners— give some thought to these results and what they suggest in terms of policies and programs. In fact, this set of findings strongly suggests that reducing women's resource constraints can enhance their contributions to nutrition, and that using the participatory process that builds on existing knowledge and practice can enhance the timeliness of achieving nutrition results through food-based interventions. Most importantly, these results are reflective of good development practice. We would like to thank the following people for their contributions to this document:

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Executive Summary

Micronutrient deficiencies are more widespread and have far greater impacts on health, productivity, and learning capacity than previously understood. Interventions have been developed to address micronutrient deficiencies, including fortification, supplementation, and dietary diversification. However, prevalence rates of these deficiencies continue to be high in many countries and regions around the world, often because of difficulties in implementing the interventions. To improve the effectiveness of micronutrient interventions, a better understanding of intra-household factors as they relate to assuring adequate micronutrient status is key. Foremost among these are the many contributions women make to nutrition on a daily basis — as income earners and care providers, and as food producers and processors. While there is recognition of those roles and acknowledgment of the constraints women face, little has been done programmatically to bring those roles and resources together in a practical way and then to document the nutritional impact.

In the five studies discussed in this report, the interventions were designed to provide women with both opportunities for active participation in problem solving and with the resources they need to enhance their contributions to nutrition. The studies, undertaken in Ethiopia, Kenya, Peru, Tanzania, and Thailand, included intervention trials and measurement of impacts. The trial interventions aimed at:

- Promoting the adoption of new varieties of beta carotene-rich sweet potatoes by women farmers in Kenya and encouraging their consumption to improve vitamin A intake;
- Improving women's skills and knowledge in food production, processing and preparation methods, and feeding practices to improve vitamin A intake in Ethiopia;
- Improving iron status by strengthening women's problem solving and management skills to improve quality of services in Peruvian community kitchens;
- Increasing women's access to and utilization of a modified solar drying technology for year-round availability of vitamin A-rich foods in Tanzania; and
- Strengthening women's leadership skills to organize community-based interventions aimed at reducing deficiencies in vitamin A, iron, and iodine in rural Thailand.

Within a relatively short period of time, participants in the trial interventions had better nutrient intake and, in some cases, better nutrient status than nonparticipants. The results suggest that it is possible to increase the effectiveness of micronutrient interventions by increasing women's active participation in problem solving and by increasing their access to such key resources as knowledge, technologies, and skills; thereby, enabling them to enhance their food production and care-giving contributions to nutrition. This has significant implications for planning micronutrient strategies that need to be scaled up and improved in effectiveness.

Introduction

Reducing micronutrient malnutrition can contribute significantly to improvements in health, productivity and well-being, particularly for women and young children. For example, eliminating iodine deficiency can lower neonatal deaths and stillbirths, and raise the mean IQ of entire populations by more than 10 to 15 points, improving individual initiative, school achievement, and work performance (Hetzel et al. 1998). Improving vitamin A status can prevent one out of four infant and child deaths and reduce the severity of illnesses (Beaton et al. 1993; Ghana VAST 1993). And reducing iron deficiency can lower maternal deaths by about one-third, prevent neurological damage in young children, and increase work capacity by 20 to 40 percent (Levin et al. 1993).

As a result of the growing understanding of the importance of micronutrient malnutrition, in addition to generalized malnutrition (which was earlier called protein-energy malnutrition or PEM), health policymakers now give greater emphasis than before to policies and programs that influence the micronutrient status of populations. In fact, the World Bank estimates that controlling micronutrient deficiencies is one of the most cost-effective approaches for strengthening human capital in developing countries, and significant health savings can result from reductions in mortality, morbidity, and the economic burden of caring for the sick (World Bank 1993).

Three types of interventions are commonly used to deliver micronutrients to target groups —

- Oral supplements such as iron tablets, iodized oil capsules, and vitamin A capsules;
- Food fortification by adding micronutrients to foods commonly consumed by target populations; and
- Dietary diversification through promoting production and consumption of micronutrient-rich foods.

These approaches have been known for over two decades and a number of countries have implemented them with varying success. Rates of clinical vitamin A deficiency decreased worldwide between 1985 and 1995, and, while iron deficiency anemia continues to be a significant public health problem, increasing interest and attention are being given by policymakers to addressing this nutritional problem (UN ACC/SCN 1997b). However, some of the varying success in results can be attributed to limited economic and physical access to fortified foods or supplements. Moreover, dietary diversification strategies have been slow to demonstrate impacts on micronutrient intakes and to scale up. Consequently, there is a need to seek improvements in micronutrient interventions.

A critical factor in nutrition interventions is the contribution women make within the household in their dual care-giving and productive roles. While nutritionists generally recognize these roles and acknowledge the constraints women face in implementing them, nutrition interventions have principally addressed factors that directly contribute to nutrient intake and health, less so such basic factors as education and economic resources. And where they pay attention to women, it is generally through their care-giving activities (Leslie 1991).

The International Center for Research on Women's (ICRW) action-research program, funded by the United States Agency for International Development's Opportunities for Micronutrient Interventions (OMNI) Research Project, was designed to find practical means to improve micronutrient status through the application of social science principles as a complement to the traditional bio-medical approaches. The program has emphasized women's contributions to household nutrition and sought their involvement through the use of participatory methods.

This report synthesizes the results of five community-based interventions to improve micronutrient status of women and children by applying these broader socioeconomic approaches with a view to enhancing the effectiveness of micronutrient interventions. The five studies are as follows:

Ethiopia

Ayalew et al.
1999.
"Reducing Vitamin A Deficiency through a Woman-Focused Dairy Goat Development Project in Ethiopia".

Kenya

Hagenimana et al.
1999.
"The Effects of Women Farmers' Adoption of Orange-Fleshed Sweet Potatoes: Raising Vitamin A Intake in Kenya".

Peru

Carrasco Sanez et al.
1998.
"Increasing Women's Involvement in Community Decision-Making: A Means to Improve Iron Status".

Tanzania

Mulokozi et al.
1999.
"Improved Solar Drying of Vitamin A-rich Foods by Women's Groups in the Singida District of Tanzania".

Thailand

Smitasiri et al.
1999.
"Sustaining Behavior Change to Enhance Micronutrient Status: Community- and Women-Based Interventions in Thailand."

Background and Rationale

The studies were conducted in five medium-sized countries representing a broad spectrum of economic and social development, as well as health and nutrition status, as reflected in the indicators shown in table 1.

It is not surprising to see that as GNP rises so do literacy rates and per capita energy supplies, and health indicators improve. These data also illustrate the simultaneity of low socio-economic status and poor health and nutrition for women and children.

Most forms of malnutrition result from a combination of causes that include inadequate diets and frequent illnesses. Underlying causes include not having access to enough nutritious foods; inadequate health services and poor environmental sanitation; and inappropriate caring and feeding practices. For women and girls, gender discrimi-

Table 1. Overview of nutrition and related indicators in participating countries

Indicator	Ethiopia	Tanzania	Kenya	Peru	Thailand
Socio-economic					
GNP[1] per capita ($)	100	120	280	2310	2740
% Urban Population	16	20	30	71	25
Population	58 million	31 million	28 million	24 million	59 million
Adult female (male) literacy rates (%)	25 (46)	57 (79)	70 (86)	83 (95)	92 (96)
General health and nutrition					
Maternal mortality rate (MMR)	1400	770	650	280	200
Infant mortality rate (IMR)	113	93	61	45	31
% Children <5 years Underweight	48	29	23	11	25
% Children < 5 years Stunted	64	43	34	32	22
Per cap energy supply (cal/day), 1990-1992	1620	2110	1970	1880	2220
Micronutrient-specific					
Vitamin A Deficiency (WHO classification)	Clinical	Clinical	Clinical	Severe subclinical	Moderate subclinical
Total Goiter Rate	31	37	7	36	8

[1] *GNP = gross national product*

Sources: UNICEF 1998; UN ACC/SCN 1997b; Bread for the World, 1999.

Table 2. Anemia among women 15-49 years old by region

Region	Pregnant		Non-pregnant	
	Mean hemoglobin (g/dl)	%<11g/dl	Mean hemoglobin (g/dl)	%<12 g/dl
Sub-Saharan Africa	10.9	49.6	11.9	40.3
South America	11.9	30.5	13.1	20.9
South East Asia	10.5	56.4	11.8	46.8

Source: UN ACC/SCN, March 1993.

nation in dietary, health care, and work-related practices also play a role (UNICEF 1990; Ramalingaswami, Jonsson, and Rohde 1996; Kurz and Johnson-Welch 1997; UN ACC/SCN 1998).

Micronutrient malnutrition, in particular, can have significant impacts on women and children. These include reduced productivity and learning capacity due to anemia, poor immune response and increased severity of illnesses related to vitamin A deficiency, and neurological damage from iodine deficiencies (Hetzel et al. 1988; Beaton et al. 1993; Ghana VAST 1993; Levin et al. 1993). New research suggests that vitamin A can have important effects on maternal mortality (West et al. 1999), and can protect infants from the effects of maternal-to-child transmission of the HIV /AIDS virus (Semba et al. 1994).

Further, inadequate dietary intakes including micronutrients, and frequent illness can result in stunting with consequences that persist into adulthood (Martorell et al. 1998). Neurological damage from anemia and iodine deficiency lasts through adulthood. More adult women than men suffer from anemia. The World Health Organization reports that "iron deficiency anemia affects about 43 percent of women and 34 percent of men in developing countries" (UN ACC/SCN 1997b)(see table 2).

The high levels of malnutrition in women, in turn, have significant effects on malnutrition in children —both boys and girls. This is because women's ability to prevent malnutrition in children is linked to their own health and nutrition, which, in turn, affects their ability to meet their multiple roles and responsibilities (McGuire and Popkin 1990; Leslie 1991; Merchant and Kurz 1992).

Women make critical contributions to family nutrition. They earn income that is used to buy food, vitamin supplements, and other health- and nutrition-related products. They produce food for home consumption and sale; they process and prepare food; and they care for themselves, their children and others (Huffman 1987; Holmboe-Ottesen et al. 1989; Piwoz and Viteri 1987). Policies and programs that aim to improve nutrition have long acknowledged these important contributions, as well as the linkage between women's own health and nutrition, and that of their children.

There also is a general recognition that women's access to resources has enormous influence on their contributions to nutrition (Rogers and Youssef 1988; UN ACC/SCN 1997a; Smith and Haddad 1999). For instance, women need access to land and agricultural technologies to produce food for home consumption. They need technologies and skill training opportunities to improve their productivity and efficiency, and they need access to education and information to stimulate changes in behaviors that affect their own and their children's nutrition. Yet, women have limited access to those resources (McGuire and Popkin 1989, 1990).

However, policies and programs that aim to improve nutrition tend to focus on ameliorating factors most directly related to the nutritional outcomes (specifically food, care, and health), and less on the indirect contributing factors (such as access to economic, social or educational resources). Ultimately, this partial focus may contribute to minimizing the nutritional improvements that could be achieved through a more holistic analysis of women's roles and their resource needs.

The studies synthesized here attempted to address this programmatic gap by engaging women through the use of participatory methods in the development and implementation of community-based trial interventions. These interventions were designed to increase women's access to care-giving and production resources, and to measure the nutritional impact.

Conceptual Framework

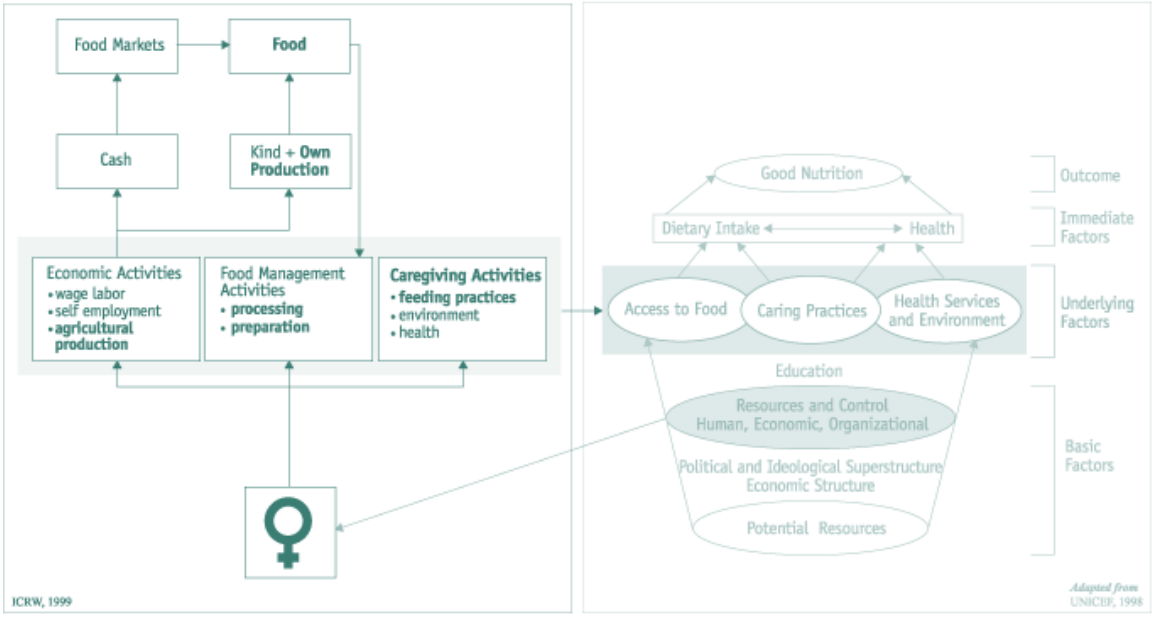
UNICEF's causal framework for nutrition identifies three levels of contributing factors (UNICEF 1990). The most immediate or direct factors, as shown in figure 1, are dietary intake and health. These are influenced by individuals' access to adequate food resources (household food security), availability of health care services, and caring practices — the underlying factors. These are, in turn, dependent on the ability of individuals to access human, economic, and organizational resources.

An assumption underlying the interventions in the five ICRW/OMNI studies is that women's access to the basic contributing factors—resources and their control—can strengthen the underlying contributing factors (see figure 1). Further, the studies expand the UNICEF definition of "resources" to include those specifically linked to women's productive and care-giving role—technologies and other physical inputs, skill-building opportunities, and health and nutrition information.

With these resources, women can enhance their economic and agricultural production, food processing, and care-giving activities. Their economic activities yield cash and agricultural products that are processed for home consumption or sale. Their earned income is used to purchase food in the market place and pay for health services and other products that support the care and health of their family. Women prepare food and feed their family members, and provide for their health and well-being through their care-giving roles. Achievement of these productive and care-giving activities feeds directly into strengthening the underlying factors that determine nutritional status.

The interventions in the five ICRW/OMNI studies specifically addressed those components highlighted in figure 1—agricultural production, food processing and preparation, and care-giving activities. Other components were not explicitly addressed or tested by the five studies.

Figure 1. Linking women's access to resources and nutrition



ICRW studies focused on factors in boldface in above figure.

Objectives

The overall objective of the five studies was to change iron, iodine or vitamin A intake and status in women and young children. The specific program objectives were to:

- Engage women in the design and implementation of interventions that address women's productive and care-giving roles;
- Strengthen women's productive and care-giving roles by providing them with physical and other resources; and
- Strengthen women's problem-solving skills through training and information.

The central questions for the five studies in this report were how to reduce micronutrient deficiencies in women and children, and how to effectively engage women in these processes. Proposals were solicited from research institutions and nongovernmental organizations (NGOs) in developing countries. The studies were designed to field-test approaches either by adding a micronutrient component to interventions that aimed to improve women's economic or social status, or by adding a component that addressed women's roles and their resource needs to an existing micronutrient intervention.

Design and Methodology

The ICRW/OMNI research program was implemented over a period of six years, between October 1993 and September 1999 (see Appendix A for project timeline). The overall design features of the research included:

- Creating a network of research and program practitioners who could work toward a common objective, using similar designs and methods, and who could enhance each others' skills and knowledge;
- Partnering researchers and program practitioners to assure technical soundness and program relevance of the findings;
- Using a participatory process that engaged women in the design and implementation of the trial interventions in order to be responsive to women's needs and resource constraints;
- Building on women's and communities' knowledge and current practices, and lessons learned from previous interventions, rather than introducing a totally new activity or product; and
- Implementing trial interventions and measurement of impact.

Key steps taken to develop the collaborative network included bringing the teams together in workshop settings; consultative visits to the teams by ICRW research team members; exchange visits between field teams for mutual learning; and regular review and input from the ICRW research team and external expert members of a Peer Review Panel (PRP).

The set of studies used a similar implementation design. After establishing the prevalence of micronutrient deficiencies in the study areas, quantitative and qualitative data were collected to inform the design of the trial interventions. Each trial intervention was preceded and followed by collection of quantitative and qualitative data to measure impact. The study teams also implemented advocacy plans to inform relevant policymakers of the key research findings and recommendations for action.

A unique characteristic of this study design was the explicit attention given to engaging women in identifying the resources they needed to enhance their contributions to household nutrition, and in developing and implementing (and managing, in some cases) the interventions. Women's engagement in this process provided the structure for strengthening their problem-solving capacities—learning how to identify problems, prioritize among them, develop solutions, and identify resources to support their implementation. Furthermore, men were engaged in this process, providing an opportunity to inform them of the studies' goals and objectives, drawing them into discussions that focused around household resource allocation and nutrition, and raising their awareness of how they contribute to the health and nutrition of their families—either directly or indirectly through women.

To measure impact, the studies used quasi-experimental designs and compared two groups—one that received the intervention and another that did not. In four of the five studies (Kenya, Peru, Tanzania, and Thailand), differences between the groups were measured through a survey and focus groups conducted before and after the trial intervention. In these studies, comparisons were made pre- and post-intervention in the intervention group versus pre- and post-intervention period in the non-intervention group, as well as between the intervention and non-intervention groups after the intervention period. In the fifth study (Ethiopia), differences

Table 3. Country study design features

Features	Ethiopia	Kenya	Peru	Tanzania	Thailand
Partner institutions	FARM Africa; Alemaya University of Agriculture	Kenya Agric. Research Institute; Int'l Potato Center; CARE/Kenya	Center for the Study & Promotion of Nutrition (CEPREN)	Tanzania Food & Nutrition Centre; Min. of Agriculture	Mahidol University
Study site location	Rural, Kombolcha and Gursum districts	Rural, Rongo & Ndhiwa/ Nyarongi divisions	Peri-urban, Lima	Rural, Singida district	Rural, Kanthararom district
Micronutrient deficiency addressed	Vitamin A	Vitamin A	Iron, vitamin A	Vitamin A	Iron, vitamin A, iodine
Study type	Intervention trial	Randomized intervention trial	Intervention trial	Intervention trial	Intervention trial
Objective of the interventions	Improve women's skills and knowledge in production, processing, preparation of vitamin A-rich foods & feeding practices	Promote women farmers' adoption of new varieties of beta carotene-rich sweet potatoes and their consumption	Strengthen women's skills to initiate improvements in meal quality and management in community kitchens	Promote women's adoption of modified solar dryer to improve year-round availability of vitamin A-rich foods	Strengthen women's leadership and problem solving skills to develop and implement community-based actions
Intervention activities and inputs	Health and nutrition education; skill training; provision of seeds	Health and nutrition education; skill training; provision of planting materials	Health and nutrition education; skill training; provision of seed grants	Health and nutrition education; skill training; provision of modified dryer design; access to materials	Health and nutrition education; skill training; provision of iron supplements, iodine, seed grants
Sample size for measuring impacts	364 households (4 peasant associations)	313 children<5 (20 women's groups)	310 women (before), 189 (after); 7 kitchens	231 women (intervention); 123 (control)	354 women and adolescent girls
Indicator(s) of nutritional impact	Nutrient intake, clinical signs	Nutrient intake	Nutrient intake, hemoglobin	Nutrient intake	Nutrient intake, hemoglobin, serum retinol, ferritin, urinary iodine

between households that participated or did not participate in the intervention were measured based on cross-sectional, post-intervention data and use of multi-variate analysis. An overview of the design features is given in table 3.

ICRW led discussions in the first team workshop (June 1995) that contributed to a common understanding of concepts and objectives, and the use of a set of common indicators for measuring impacts that would enable comparability across studies. In the second workshop (October 1996), the five teams presented and discussed their baseline and formative research data, as well as the design and content of their trial interventions. ICRW staff trained the field researchers in designing policy communication strategies. The final meeting, held in Cairo in September 1997, coincided with a major international nutrition conference (IVACG) in which the five studies shared their findings with other conference participants and ICRW led a discussion group on using the approaches developed in this research program. During an internal project team meeting, ICRW led discussions on identifying the cross-study results based on the individual studies' results.

Methods

Both qualitative and quantitative data collection methods were used for intervention design and impact measurement purposes. Qualitative methods were used at baseline to inform the design of the trial intervention, during the process of the intervention trial to determine if adjustments were needed, and at the end of the project to measure the effects of the interventions. Particular methods used included transect walks, wealth ranking, and social mapping; market surveys; focus groups; and key informant interviews.

Quantitative methods were used to determine the magnitude and severity of problems and patterns of food production and consumption. These methods were used at baseline to define the characteristics of participants and sample households in the intervention and non-intervention groups, and at post-intervention to measure the impacts of the trial intervention. Measurements were made using social sciences techniques and tools, in combination with epidemiological, dietary, clinical, and biochemical techniques and tools. Methods used to determine micronutrient intakes and status by the five studies are given in Appendix B.

Trial Interventions

Based on formative research, the trial interventions either added a micronutrient component to interventions that aimed to improve women's economic or social status, or added a component that addressed women's roles and their resource needs to an existing micronutrient intervention. Thus, the interventions focused on promoting incremental changes in peoples' current behaviors or practices, which may explain, in part, the rapid impact reported in the next section. In most instances, the trial interventions promoted better use of micronutrient food sources for consumption by women and children. The food-based components of each intervention lasted from about four months (in Peru) to 18 months (in Tanzania).

To support the implementation of the trial interventions, and in keeping with the conceptual framework, women received the key resources they needed to maximize on specific productive and care-giving activities as identified in the formative research. These included agricultural inputs such as planting materials (Kenya), seeds (Ethiopia), and processing technologies (Tanzania); financial capital (seed grants in Peru, up to $1000 per kitchen, and Thailand, between $83 and $140 per community); skill training (all five); and health and nutrition information (all five studies). The research teams' knowledge and skills also served as a critical technical and organizational resource, and they played important intermediary roles with relevant in-country and external institutions. For instance, the Thai team assisted communities with accessing iron supplements and iodine drops from the Ministry of Health.

The following are summaries of each country's trial interventions:

Thailand: In both intervention (four subdistricts) and non-intervention (four matched subdistricts) areas, a previous social marketing project had promoted production and consumption of vitamin A-rich foods and fats in the diet. In the current study, communities selected women leaders who were trained in problem-solving methodologies and community-organizing techniques. Based on their success in applying those lessons to develop community-action plans, they received small seed grants (between $83 and $140) to implement those plans. To promote changes in food production and intake of vitamin A, iron, vitamin C, and fat, the research team provided the women leaders with informational messages that were broadcast through public announcement systems, billboards, and mailings. Women leaders reinforced these messages through home visits, as time permitted. School-based interventions included classroom instruction using relevant health and nutrition messages; promotion of school gardens and use of that produce to enrich school-provided lunches. Girls (10 to 13 years old) purchased iron tablets (60 mg ferrous sulfate tablets) at the rate of one per week for 12 weeks. Salt was locally iodized and sold by the women leaders for less than the price of factory-iodized salt.

Peru: Community kitchens had been operating in the study area for nearly 20 years as part of a poverty alleviation program. Seven kitchens were identified as the intervention sites. Comparisons were made between women members and non-members of the kitchens. A subset of kitchen members attended a series of eight workshops from March 1996 through February 1997. These workshops aimed at improving women's nutritional knowledge and their skills as kitchen managers. The kitchens were given seed money (less than $1000) for upgrading equipment and infrastructure, and uniforms for the women volunteer members. Women were trained as quality assurance supervisors to ensure consistency in management and food preparation. Meals were developed by the women using

affordable sources of heme iron and vitamin A, and vitamin C-rich drinks were introduced to improve iron and vitamin A status.

Ethiopia: The study was based on women's participation in a previous dairy goat development project that aimed to improve household income and well-being by increasing women's access to productive resources. Although household income increased, nutritional status had not been affected by participation in the project. Thus, FARM Africa, with its partner institutions, collected data that suggested the need for increasing women goat owners' knowledge and skills in producing, processing, preparing, and serving vitamin A-rich foods. New vitamin A-rich foods (e.g., carrots) were introduced while use of underutilized, locally available vitamin A-rich foods (e.g., milk, pumpkins, and sweet potatoes) was promoted. Members of women's groups attended two three-day seminars in the two study districts. These seminars aimed to increase participants' knowledge of vitamin A-rich food sources and the link between food consumption and health, and their skills in developing or expanding home gardens and preparing nutritionally-enriched meals. Broad dissemination of key messages occurred in five community-level education sessions in each of 12 communities and through four radio broadcasts and three television broadcasts. Vegetable seeds were distributed, and nutrition extension workers hired by the project led problem-solving group meetings.

Kenya: Results of the formative research found that women generally had control over small parcels of land that could be used to produce vitamin A-rich foods, decided when to plant sweet potatoes, and used the proceeds of sweet potatoes' sale. It seemed logical, therefore, to focus on a food crop that fell within women's control — from production to processing to consumption. Thus, the trial intervention worked with women's groups in two districts in western Kenya and compared two extension packages to promote adoption and consumption of varieties of orange-fleshed sweet potatoes rich in beta carotene. Both packages included technical extension support — access to planting materials and training in their production and harvesting — to promote cultivation of the new orange-fleshed sweet potato varieties. In addition, one of the packages also included nutrition education, training in sweet potato processing methods, and home visits by project-hired extension agents to promote consumption of foods prepared with the new varieties.

Tanzania: Communities in the intervention areas took part in two earlier projects. One introduced indirect solar drying technology that promoted the year-round availability of vitamin A-rich foods, and protected these food sources from contamination and degradation by direct sunlight. The second project promoted the production of vitamin A-rich foods, particularly green leafy vegetables (e.g., amaranth, sweet potato leaves, and cowpea leaves) and fruits (papaya, mangoes, and guavas). The trial intervention introduced two modifications to the indirect solar drying technology—both made in response to women's preferences in size (smaller than the original model) and options in construction materials (wood or mudbrick — and used nutrition education to encourage consumption of dried foods to prevent vitamin A deficiency. Carpenters and masons were trained in construction and maintenance of the improved dryers. They assisted households in constructing their own dryers and received a small cash incentive to make home visits to adopter households. Agricultural extension agents also made home visits for the purpose of ensuring quality control. Women adopters were trained in storage, marketing, and pricing practices for the dried foods. Non-intervention communities were not given these inputs but continued their traditional food drying procedures.

Results

All five interventions, with the exception of the iron supplementation of 10- to 13-year-old Thai girls, focused on dietary diversification. The following section summarizes the results of the five interventions by micronutrient and outcome indicator. Overall the positive direction of change supports the assumption that increasing women's access to necessary resources may improve the effectiveness of micronutrient interventions.

Iron

Iron intake and anemia were assessed by two of the five teams.

In **Peru**, within one year of the implementation of training and interventions to improve the quality of meal services at the community kitchens (including only four months of food-based activities), iron intake and serum iron levels among women in the program improved compared to baseline. There was a 35 percent increase in iron content of the meals (from 6.1 to 8.2 mg per ration). This was principally due to a three-fold increase in use of heme-iron foods (from 0.2 to 0.6 mg per ration). Heme iron is highly absorbable and, therefore, more bioavailable than non-heme iron in foods. Heme iron intake increased ($p < 0.05$), particularly among kitchen members (from 0.2 to 0.4 mg). Bioavailability of iron increased slightly but significantly from 3.7 to 4.2 percent ($p < 0.01$). Finally, there was a decrease in anemia (with hemoglobin levels < 12 micrograms/dl) among all women from 49 percent to 41 percent ($p < 0.05$). Overall, kitchen members and anemic women benefited most (see table 4).

Over the nine-month intervention period, the study in **Thailand** resulted in a slight but not significant rise in hemoglobin levels among adolescent girls (12.8 to 13.1 g/dl); whereas, there was a slight deterioration among the control group members (see table 5). Serum ferritin levels among the adolescent girls showed a highly significant improvement among intervention members (from 45.6 to 85.1 ng/ml, $p < 0.001$). The difference in improvements between the control (7.7 ng/ml) and intervention (39.4 ng/ml) groups was significant at $p < 0.001$-level. It appears that the school-based distribution system for iron supplements was both feasible and effective, and because the girls' families purchased the supplements, it is likely that the parents recognized the value of these supplements for their daughters. This intervention also involved school lunches with higher iron content and promotion of foods rich in vitamin C and iron.

Table 4. Significant changes in nutrient intake among Peruvian women by membership status in community kitchens and by anemia status (pre- to post-intervention)

	TOTAL	Members	Non-members	Anemic women	Non-anemic women
Total iron	—	—	—	—	—
Heme iron	↑	↑	—	↑	↑
Bioavailable iron	↑	↑	↑	↑	↑
Vitamin C	—	↑	—	↑	—
Vitamin A	↓	—	—	—	—

Note: — = no significant change

Table 5. Average vitamin A, iron, and iodine status for Thai school girls 10 - 13 years, before and after intervention[1]

	Intervention				Control			
	n	1996	1997	Difference[2]	n	1996	1997	Difference[2]
Serum Retinol Levels µg/dl	42	22.8 (6.9)	33.7[a] (8.3)	+10.9	36	26.5 (6.9)	29.8 (6.7)	+3.3[c]
Hemoglobin Levels g/dl	87	12.8 (1.5)	13.1 (1.2)	+0.3 (1.58)	77	13.4 (1.7)	13.1 (1.4)	-0.2 (2.0)
Serum Ferritin Levels ng/ml	56	45.6 (4.0)	85.1[b] (5.1)	39.4 (4.6)	45	47.1 (4.0)	54.9[a] (3.3)	7.7[d] (2.5)
Urine Iodine Levels µg/dl	74	9.2 [0.0-93.3]	12.6 [1.5-41.3]	–	70	12.4 [0.0-66.1]	12.7 [1.8-48.7]	–

[1] *Mean (± SD) [range]*
[2] *(1997 values) – (1996 values)*
[a] *$p < 0.001$ (t-test)*
[b] *$p < 0.0001$ (t-test)*
[c] *Difference between intervention difference and control difference significant at $p < 0.001$, t-test*
[d] *Difference between intervention difference and control difference significant at $p < 0.0001$, t-test*

Vitamin A

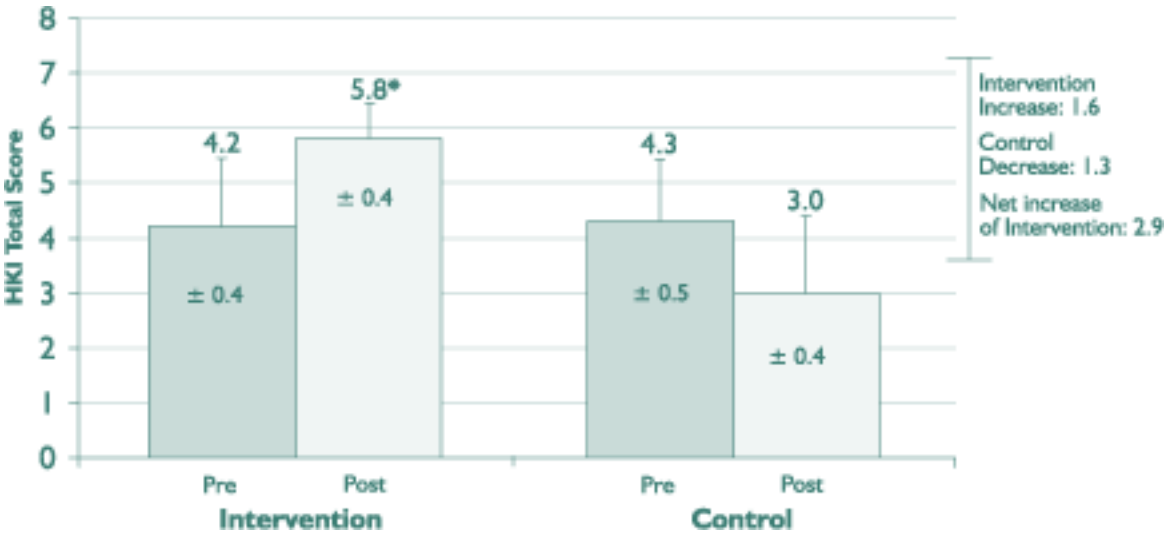
Vitamin A intake was measured by four of the five teams, and one team assessed vitamin A status using serum retinol.

In **Kenya**, nutritional impact of the nine-month trial intervention that promoted orange sweet potato production and consumption was measured using the Helen Keller International food frequency method. Because of a severe drought that occurred during the intervention period, there were serious food shortages among all communities—intervention and control—yet HKI scores increased among children in women's groups in both intervention communities while they fell in the control groups. In Ndhiwa/Nyarongi, the intervention score increased significantly (+1.6 points) from pre- to post-intervention, while the control group score decreased (-1.3 points), for a net increase of 2.9 points (see figure 2). This change represents a 93 percent increase and was highly significant ($p = 0.0015$). In Rongo, the increases in the HKI score for the intervention group were not statistically significant (from 6.5 to 7.1). As in Ndhiwa/Nyarongi, the control group score fell from 6.8 to 6.1. The absence of a similar decrease in the intervention groups in both communities suggests that the promotional activities may have contributed to these groups' ability to cushion the effects of the drought on their food consumption patterns.

Improvements in intake of animal sources (from 3.5 at baseline to 4.5 at post-intervention) of vitamin A contributed the major portion of change in the HKI score in Ndhiwa/Nyarongi due to higher consumption of egg yolks and *ghee* (butter). This is a result of the weighted scoring nature of the HKI method (animal sources are richer sources of vitamin A than plant foods). That said, promotion of sweet potato consumption and of other plant sources of vitamin A contributed to increased intake (from less than once a week to 1.3 times per week).

In **Thailand**, vitamin A intake increased significantly among all sample groups (children 2 to 5 years; schoolgirls 10 to 13 years; pregnant and lactating women), most likely a result of increased consumption of dark-green leafy vegetables, liver, and eggs. Serum retinol levels increased significantly among adolescent girls (from 22.8 to 33.7 mg/dl, $p < 0.001$) as compared to a smaller and insignificant improvement among the control group (see table 5). These results are particularly significant in view of the fact that the intervention did not include supplements or fortified foods; rather, activities focused principally on women

Figure 2. Frequency of consuming vitamin A-rich foods in Ndhiwa/Nyarongi (n = 154, children 0-5 years)

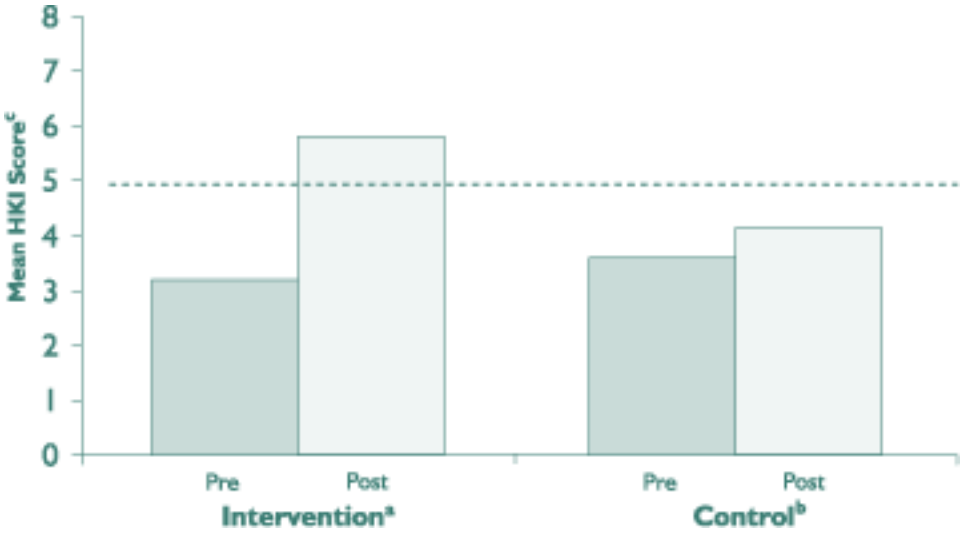


**The increase from pre- to post-intervention period was significantly greater in the intervention group than the change in the control group (ANOVA, p = 0.0015)*

leaders' efforts to encourage production and consumption of vitamin A-rich foods and fat (to enhance vitamin A absorption). Moreover, while their interventions were supported by small grants, these were not on a scale that would suggest they could not be replicated.

In **Tanzania**, there was greater improvement in HKI scores in the intervention communities (from 3.2 to 5.7) than in the control communities (3.6 to 4.1) over the 18-month intervention period (see figure 3). This difference was significant at the $p < 0.001$ level. This improved intake could be

Figure 3. Pre- and post-intervention HKI food frequency scores of individuals in Tanzanian communities



a. The difference between pre-intervention score and post-intervention score in intervention group is significant (P<0.001)

b. The difference between pre-intervention score and post-intervention score in control group is significant (P<0.001)

c. Calculated as days of animal food sources/week + [(days of plant food sources/week)6]

Table 6. Impact of participation in the intervention on nutritional outcomes[1]

	Participated in trial intervention	Didn't participate	Impact of intervention
Child in the top quintile of the HKI scores	0.49	0.37	20 %
Household had a vegetable garden	0.38	0.13	25%
Child consumed milk more than 4 times a week	0.76	0.51	22%

[1] These results are adjusted for other determinants of the expected outcomes.
[2] Differences are significant at $p<0.01$.

attributed to increased availability and consumption of dark-green leafy vegetables, such as amaranth, pumpkin leaves and sweet potato leaves, and, to a lesser extent, mangoes.

In **Ethiopia**, nine months of community-based activities resulted in significant differences ($p < 0.01$) between participants' food intake score (2.6) and nonparticipants (1.6), and children in participant households consumed milk twice as often as nonparticipants ($p < 0.01$). Children who lived in households owning at least one cow (an indicator of wealth), who consumed milk more than four times a week, and whose HKI score was in the upper quintile were at lower risk of being vitamin A deficient (that is having night blindness or Bitot's spots[1] in either eye). Table 6 shows that a child is 20 percent more likely to score in the top quintile of the HKI scores if a household member participated in the trial intervention activities. Similarly, a household is 25 percent more likely to own and maintain a vegetable garden if they were exposed to the trial intervention. A child is 22 percent more likely to consume milk at least four times a week if a household member participated in the trial intervention. Thus, the nutritional benefits of participating in the intervention were not only statistically significant but also remarkably large.

Iodine

Only the **Thai** research addressed iodine deficiency disorders. Use of iodized salt increased among control and intervention groups; however, there was a greater improvement in median urinary iodine levels among adolescents in the intervention group (from 9.2 to 12.6 mcg/dl) as compared to no change in the control group. These results are notable in that these iodine levels were principally a result of the efforts of the women leaders' to increase availability of a less expensive, locally-produced (as compared to factory-produced) iodized salt, and to promote its use in cooking through door-to-door and media campaigns (see table 5).

[1] Bitot's spots are a clinical sign of Vitamin A deficiency.

Discussion

These five studies, while responsive to each setting, followed a similar process and applied a common approach—improving women's access to resources and thereby strengthening their contributions to nutrition. This section addresses some crosscutting issues that emerge from the set of studies.

Beginning with Women Led to Food-Based Interventions

A fundamental design principal of the studies was to use a participatory process that engaged women in determining the design of the trial interventions. Not surprisingly, the outcome was the development of trial interventions that focused on women's food-based activities, including agricultural production, food processing and preparation, and feeding practices, and that provided them with the resources they needed to enhance those activities.

Women were trained in skills related to the production, processing, and preparation of food; and they received nutrition and health education to increase knowledge of the link between food consumption and health. Two of the five projects provided financial resources to support community-based activities, and three of the five provided women with access to technologies that increased their productivity and efficiency. Finally, women's leadership skills were directly enhanced in the Peru and Thai trials; and women's groups in Kenya and Ethiopia were strengthened by their role in facilitating the intervention activities in those countries.

To support women's changes in practices, the trial interventions also provided fora to solve problems related to the adoption of new technologies and practices. For instance, project-hired extension agents made home visits in Kenya, as did women leaders in Thailand. Agricultural extension agents and project-trained artisans visited adopter households in Tanzania to address use and maintenance of the dryers. Women's groups met with extension personnel in Ethiopia and Kenya; and community-level meetings with technical specialists in all study sites provided another opportunity for problem solving.

As a result of these investments in reducing women's resource constraints and supporting changes in agricultural production and care-giving practices, vitamin A and iron intake improved significantly among relevant intervention groups. Anemia dropped among kitchen members in Peru and adolescent girls in Thailand. Vitamin A and iron status of adolescent girls improved in Thailand and iodine deficiency dropped among these same girls. Moreover, the fact that these investments in women-focused, food-based interventions yielded consistently positive results within a relatively short period of time should help dispel the belief that these types of interventions take too long to show results.

That said, dietary diversification has its limits. In Ethiopia, promotion of production and consumption of vitamin A-rich foods could not and should not be expected to overcome the degree of deficiency that was evident in those communities. Although there was a compelling need to intervene in a short-term therapeutic fashion, there was no infrastructure in place to undertake such an intervention. Despite that caveat, this study demonstrated that a food-based intervention can contribute to improving vitamin A intake, and that continued investment in this level of intervention has merit. In fact, the Ethiopia study is perhaps the best example of the need to have a package of interventions that addresses both prevention and treatment.

The Ethiopia and Tanzania studies also suggest that household economic conditions affect responses to interventions. In Ethiopia, children who lived in households that had at least one cow (as an indicator of wealth) were at reduced risk of being vitamin A deficient. In Tanzania, women adopters of the solar dryer technology tended to be from better-off households. This suggests that households that are economically better-off can take advantage of opportunities and respond to program inputs more so than households that are poor and less able to take risks. Nevertheless, resource-poor households can benefit from the same innovations once they are proven successful. Poorer households also benefit indirectly through increased availability of foods and increased employment generated by better-off households. Program planners could also develop explicit mechanisms to offset the opportunity costs to poorer households and subsidize their participation initially.

Participatory Approaches: Benefits and Limitations

Using participatory approaches clearly led to effective interventions that showed nutritional impact in a timely fashion. It is worth discussing how the use of such approaches contributed to the trial interventions' success.

First, while the use of participatory approaches may take time (in some of these studies the formative phase took up to a year), the food-based interventions that resulted from that process yielded improvements within a fairly short period of time — four months in Peru. Second, the participatory process was, in fact, an investment in developing women's human capital. The training women received in Thailand or in Peru enabled them to mobilize actions that may not have been feasible without their having spent considerable time learning how to be leaders or how to problem-solve. It is reasonable to presume that the skills they learned and used would most likely stay with them, to be used again and again. Similarly, skill training in food production, processing, and preparation, as well as feeding practices, are presumably useful over the long term and may, in fact, be transferable among women.

Third, the participatory process ensured that the interventions were responsive to participants' needs and acceptable to them. This suggests that such interventions might be more sustainable than those that are brought from the "outside" and "sold" to communities. Extending this acceptability of the interventions from the community to the level of policy and programs, the results of the Peru study were sufficiently convincing to policymakers and program practitioners that they are expanding the content and process to other community kitchens in Peru.

That said, it must be recognized that participatory processes also have their limitations. First, there can be significant opportunity costs to participants. This is particularly important for women who have multiple responsibilities, all demanding their attention. In fact, the Tanzania solar dryer project found that the women who adopted the technology as a result of attending community health and nutrition education sessions were from households with higher socio-economic status. This stands to reason in that those who have more resources might be better able to spend time coming to these meetings. These costs must be acknowledged and participation designed in such a way that potential participants can bear the opportunity costs, at least in the short term.

Second, participatory approaches are not necessarily gender sensitive (Guijt and Shah 1998). Having a community meeting to identify community needs may result in a biased assessment if women are reluctant to speak up in front of men. Similarly, women may have fewer windows of opportunity to participate — if meetings or events are scheduled at times that conflict with other tasks on women's plates, they may be less likely to attend. The result of this lack of gender-sensitivity might be solutions that, in fact, create more burdens for women. Finally, it is important to recognize that community-generated solutions generally need additional inputs that are currently beyond their reach, such as financial resources or

technologies, technical knowledge of appropriate health and nutrition practices, or skill training. If community-derived solutions are to be truly sustainable, the means to support those solutions must be in place.

Bringing Men into the Process

Engaging men as well as women in the process facilitated the adoption of change. While women were the focus of the interventions, qualitative research and observations of field teams indicated that women were most effective when supported by male members of their communities and families. For instance, Ethiopian women noted that without the support of the male members of their households, they would have had difficulty both participating in the trial intervention activities and implementing what they had learned. The Kenyan and Tanzanian researchers also found that engaging men in the process facilitated the adoption of the orange-fleshed sweet potato varieties and the solar drying technology as well as the nutrition messages. Men contribute directly and indirectly (through women) to their families' nutrition through economic activities and, to a lesser degree, caring practices. Yet, they tend to be marginalized when interventions focus on nutrition as an outcome. Raising men's awareness of the critical contributions they make to nutrition could further enhance women's contributions and increase men's direct contributions through allocating income for purchase of food or health services.

Leveraging Existing Knowledge and Practices

Another design principal that contributed to this success was building on existing knowledge, expertise, and interventions. The five research teams did not start at ground zero. Consequently the interventions that were tested actually demanded that participants make only incremental changes in behaviors or practices; thereby increasing the likelihood that they saw the new practices as something they could do. For example, the Kenya study began with sweet potatoes, a traditional women's crop, and introduced new varieties that had higher beta carotene content. The Peru study drew on women's home management skills and knowledge of local food preferences to develop an intervention that increased intake of iron-rich foods and led to improvement in women's serum iron status. In Thailand, women community leaders used the knowledge and experience they had gained in an earlier social marketing project to develop interventions aimed at three different micronutrient deficiencies. In each case, formative or baseline data suggested an existing level of knowledge and experience, and readiness to change that served as fertile ground on which to build the next innovations. Thus, the relatively short time needed to achieve nutritional results in these intervention trials could be attributed, in part, to this design element.

Development and nonformal education literature suggest the value of building on existing knowledge and practices. People are more likely to adopt new or improved practices when the change is linked with comfortable or, at least familiar, practices. Further, community members can often adopt the new practice without many additional resources, training or time (Rogers and Youssef 1988).

The Value of Collaboration—Within and Across Countries

Good nutrition results from consuming nutritious food, using good caring practices, and being healthy (Gillespie and Mason 1991). This suggests the need to improve nutrition through a multidisciplinary approach. Operationally, this means bringing together the technical expertise and disciplines that may rest in different institutions, as well as drawing on the skills of researchers and program practitioners. The five studies reported in this paper applied such an approach at the country level while ICRW used it at the cross-country level. Nutrition specialists worked with agricultural extension agents; researchers assisted program practitioners in design and monitoring for change; and NGO staff worked with public sector employees. This mix of technical expertise, skills, and institutions contributed to the success of the studies. Take the case of the

Tanzanian project that partnered a research institute with Ministry of Agriculture extension agents. The team had developed rapport through working on previous projects and each institution had a respect for the skills and expertise of the other. As a result, this partnership needed less support and commitment from key decisionmakers in order for it to succeed.

On the other hand, partnerships between an NGO and various ministries in another of the countries needed more nurturing. In this case, the Ministry of Health saw the intervention as falling within the purview of the Ministry of Agriculture; while the Ministry of Agriculture felt its responsibilities stopped with the agricultural production side of the intervention. The Ministry of Education saw the value of an integrated approach but needed the skills and expertise of others to complement its interest and commitment. The regional administrative body also recognized the importance of collaboration, but was limited in terms of its authority to ask staff from different ministries to work together. The NGO did work with the different ministries but needed key advocates in each to ensure commitment by the line agents. Thus, it is important to go into partnerships aware of each partners' needs, constraints, and mandates, and to be ready to commit significant time and other resources to make the partnership work. In the end, it is institutional partnerships that can provide an integrated set of services to households whose needs cut across sectors and institutional mandates (Jolly 1985).

At the cross-country level, ICRW designed the research program in such a way as to create opportunities for the five teams to meet and draw on each other's experiences and skills. The three workshops occurred at the beginning to set up a common understanding of processes and indicators; at the middle to share experiences and lessons learned, to discuss trial interventions, and to learn how to link their research findings to policy action; and at the end to share final results with each other and discuss what components are most relevant to policymakers and program planners. This series of interactions, as well as exchange visits between teams, resulted in a sense of collegiality among the team members; contributed to a cross-fertilization of ideas, experiences, and skills; and led to research studies that were comparable in approach, design, and methods. The ultimate value of this network may yield benefits over the longer term — at the level of each team member but also in terms of the influence these interventions may have on their replication by others.

Methodological Issues Related to Vitamin A

A final point that needs some discussion is the choice of methodologies used to measure impact. The five research teams used a range of methodologies to capture the effects of their intervention trials on nutrition (see Appendix B). At the first team workshop, members of the Peer Review Panel and invited external experts focused on arriving at a recommendation for which method would be best for the teams to use — given technical expertise of the team and local circumstances. The options considered included blood tests for serum retinol, clinical eye signs (requiring large sample sizes), and indirect measures of the risk of vitamin A deficiency. . The factors taken into consideration included cost, risks of drawing blood safely in high HIV/AIDS areas, and logistics. Based on the literature and field experience of the experts, it was decided that the teams should use a method to assess the risk of vitamin A deficiency. Specifically, the food frequency method has been most commonly used for vitamin A.

The Helen Keller International (HKI) food frequency method was used to measure vitamin A intake (Rosen, Haselow, and Sloan 1993). A concern was the application of the HKI method as an evaluative tool. The HKI method was developed to identify communities at-risk of vitamin A deficiency. In the context of this research, studies in Ethiopia, Kenya, and Tanzania also used it to measure changes over time and between groups. The methodology has been validated relative to serum retinol and, in the case of the Ethiopia data, the scores correlated with clinical signs of vitamin A deficiency (Persson et al. 1998). Given

the use of the methodology for evaluating the intervention effects, the three teams presumed that a positive change in scores suggested an improvement in vitamin A status. Research elsewhere suggests that improvements in HKI scores that derive only from an increase in consumption of dark-green leafy vegetables should not be assumed to improve vitamin A status on their own. In these studies, however, HKI scores improved due to a variety of foods (de Pee et al. 1995). This assumption merits further consideration as it is an easy-to-use method that overcomes many of the cost and feasibility limitations of other food intake methods used for evaluation purposes.

In addition to food intake methods, two of the teams—Peru and Thailand—used biochemical indicators to assess the effects of their trial interventions. There is a body of literature that speaks to the reliability and validity of these indicators, including the need to control for health status when interpreting serum retinol data. In each case, informed consent was obtained from the sample members whose blood or urine was tested, and existence of in-country infrastructure made the use of these methods feasible in these two countries.

Study Limitations

As a set of studies that were implemented in diverse settings, and that used various approaches to effect a positive impact on micronutrient intakes and status, the consistent trend in terms of positive impacts is good evidence that dietary diversification strategies can work—when they are grounded on providing women access to the resources they need to support nutrition. However, broad generalizations should be made cautiously for the following reasons:

Self-selection versus randomization. Although statistical techniques were used to reduce the possibility that the observed results are not completely attributable to the intervention trials, randomization was used in only one study (Kenya). In other studies, the comparison of program participants versus non-participants (based on their own choice to participate or not) leaves open the possibility that participants may have the inherent tendency for better micronutrient intakes or better use of interventions. This limits the generalizability of the findings somewhat. However, several studies provided comparisons of micronutrient intakes and status across the intervention and comparison groups at baseline, so that it is possible to make some valid conclusions of likely impacts.

Controlling for diffusion effects. A few studies were faced with the practical problem of limiting the "spill-over" effects of nutrition education to non-intervention communities or households. While this diffusion has programmatic advantages, it would reduce the observed benefits attributable to the interventions.

Length of time to measure effects. The five studies were limited to two years. As such, the results of the studies do not fully capture the long-term effects of the intervention. For instance, the Thai study built on momentum developed through an earlier social marketing project. Comparison of end-of-project data (1991) and baseline for the current project (1995) found some leveling-off in vitamin A and fat intake, particularly among school children 6 to 12 years. With the resurgence of attention and additional inputs from the new project, there was an improvement in these same indicators, above and beyond the end of the previous project's levels. This suggests that some behavioral changes for some groups may need re-enforcement, and similar falling off for some of the indicators in the current set of studies may occur. That said, the five teams were careful in basing their interventions on factors that were important to women and their contributions to nutrition, and that were feasible and affordable. Further, the team built in an advocacy component to their study for the purpose of setting in place the mechanisms for sustaining achieved results.

Conclusions and Recommendations

The central feature of the five studies was a recognition that women are the link between agricultural production and food consumption and between caring practices and healthy children; and that beginning by identifying what women need to maximize their contributions to household nutrition makes sense—conceptually and operationally. In order to do that, the research teams used participatory methods that engaged women in the design and implementation of the intervention trials and built on existing knowledge and practices. They developed partnerships among technical specialists and across institutions. Not surprisingly, all five studies focused on food-based interventions, but, somewhat surprisingly, each study led to nutritional benefits within a relatively short period of time. Intake of key nutrients increased in all five studies; rates of anemia fell in two; and vitamin A and iron status improved in others. Given that most country strategies to address micronutrient malnutrition include dietary diversification to assure sustained improvements in micronutrient status, these studies provide useful insights into designing micronutrient programs worldwide. The following conclusions and recommendations are drawn from the practical lessons learned:

■ **Food-based interventions can work—in a short time.** Replicating the components of the approach used in these studies could yield significant gains in reducing micronutrient deficiencies. The intervention trials demonstrate that agricultural technologies and extension activities, paired with health and nutrition education, make the link between food production and processing, and food consumption. Indeed, the Kenya study demonstrates that a focus on agricultural production alone will not yield the nutritional benefits that a combination of activities focusing on both production and consumption will. *National governments should increase the role of these dietary strategies, which also contribute to sustainable development, while continuing to implement other complementary strategies, including supplementation and food fortification.*

■ **Women are key to resolving nutrition problems.** It is clear that these trial interventions owe much of their success to their entry point, that is, women as household providers of nutrition. Women produce, process, and prepare food; they care for their children; and they contribute to creating a healthy environment in which their families can thrive. Investing in efforts that increase women's access to the resources they need to make their contributions to nutrition is wise, necessary and effective. *Institutions that support, direct, and implement interventions to improve nutrition should build in explicit attention to strengthening women as the household agents of nutritional improvements.*

■ **Men are important to the process and outcome.** An important observation made by the researchers and women in the communities was the importance of bringing men into the process. Just as food-based interventions cannot be expected to resolve all micronutrient deficiencies, women cannot single-handedly ensure that they and their families have good nutrition. Rather, interventions should build on the collective pool of human resources — from young to old, men and women, within and outside of households. Men, in particular, are an under-invested resource for ensuring household nutrition. Given the critical roles they play as gatekeepers to resource allocation and income earners, increasing men's recognition of the importance of those roles and their awareness of how they can contribute to nutrition would complement the investments in women. *Program planners should create opportunities to increase men's contributions to their families' nutrition through education, sensitization, and other promotional strategies.*

■ **Multi-center studies are a valuable means to test ideas in different settings and draw policy-relevant conclusions.** The process of designing and implementing the five studies as a set of interventions using the same approach and comparable methods can yield convincing and compelling evidence for policy-level decisionmaking. While one study in one place may be limited in terms of what it says to others, the commonality of results issuing from these five studies that were implemented in a range of settings and circumstances suggests the reliability of the results and the approach and processes through which they were achieved. Moreover, bringing the research teams together to ensure a common understanding of approach and methods proved to be a useful means for developing comparable multi-site testing of innovations. *Donor agencies should consider supporting cross-country studies that build in partner exchanges as a reasonable and effective means to collect a solid body of evidence that can inform the development of appropriate policy action.*

■ **Inter-sectoral collaborations contribute to positive outcomes but need encouragement.** Institutions, including government agencies, and nongovernmental and community-based organizations, are the means through which households access financial and technical assistance. Each institution has its own mandate and is staffed and organized to meet its own responsibilities. Yet, institutions need to coordinate their activities to provide a set of integrated services that meet the cross-sectoral needs of household members and address the multiple factors that contribute to nutrition. *Institutions should develop operating procedures and policies that enable their staff to work collaboratively with staff in other institutions or in other divisions of the same institution, and donors should encourage these cross-sectoral collaboration through their funding support.*

Appendix A
Project Implementation Milestones

Countries	9/95 to 2/96	3/96 to 8/97	9/97 to 12/98
Ethiopia	2 workshops, baseline survey	Food production and H/N education intervention (9 months)	Evaluation,advocacy, final report
Kenya	Community selection, study design	Promotion of consumption activities (9 months)	Evaluation, advocacy, final report
Peru	Project start-up, in-depth interviews, focus group interviews	Training workshops (1 year) with nutritionally improved meals (4 months) intervention	Evaluation, advocacy, final report
Tanzania	Baseline, training, construction of dryers	Introduction of dryer; training and H/N education (18 months)	Evaluation, advocacy, final report
Thailand	Formative research, baseline	Training women leaders, community interventions (9 months)	Evaluation, advocacy, final report

Appendix B
Nutritional Indicators and Methods

Micronutrient Intake: To measure micronutrient intake, three studies (Ethiopia, Kenya, and Tanzania) used the Helen Keller International Food Frequency Method (Rosen et al. 1993). The HKI method determines if a community is at risk of vitamin A deficiency. The method recommends that selected mothers in each of 15 randomly selected communities be interviewed about their and their children's intake of vitamin A-rich foods in the preceding 7 days. A community is considered at risk of vitamin A deficiency if animal sources are consumed 4 or fewer days a week or if the mean weighted frequency of consumption of plant and animal sources is 6 or fewer days a week. This method was developed to identify at-risk communities and was validated against measures of serum retinol. In this series of studies, country teams used the HKI method to assess changes in frequency of intake of vitamin A foods (as a proxy for risk of vitamin A deficiency). This decision was taken in consultation with the Technical Advisory Committee and from other nutrition experts on the basis of cost, effectiveness, and feasibility.

Two other teams, Peru and Thailand, used 24-hour recall method for measuring dietary intake. In this method, the selected respondent identifies and then quantifies the foods consumed during the previous 24 hours. This permits the investigator to calculate a broader range of nutritional intakes including caloric intakes and intakes of protein, fat, vitamins, and minerals.

Micronutrient Status: Three of the five teams – Ethiopia, Peru, and Thailand – collected clinical and biochemical data to assess vitamin A, iron, and iodine status. Serum retinol was used by the Thai team as an indicator of vitamin A status. Many countries use a cut-off level of 20 micrograms/100 ml below which an individual is considered deficient. In the Thailand study, a cut-off of 30 micrograms/100 ml was used; this may be more appropriate to track changes in the Thai population that has a less severe form of vitamin A deficiency. The Ethiopian team used clinical eye signs such as night blindness, Bitot's spots, xerosis, and corneal damage as indicators of vitamin A deficiency. In areas with severe forms of this deficiency, such as the study communities in Ethiopia, these are reasonable indicators.

To assess anemia, the Thai and Peru teams used serum hemoglobin. This is often used as an indicator of iron deficiency, although other causes of anemia such as malaria, hookworm, and reproductive patterns are also important. The Thai team also used serum ferritin as an indicator of iron status. Unlike hemoglobin, ferritin is a specific indicator of iron deficiency. Finally, urine iodine levels were used to measure iodine status by the Thai researchers. Urinary iodine is the preferred method for assessing iodine status under field conditions as it captures sub-clinical forms of iodine deficiency (unlike goiter).

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