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INCAP

Development of Evidence-Based Dietary Recommendations for Children, Pregnant Women, and Lactating Women Living in the Western Highlands in Guatemala

June 2014

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Preface

The promotion of appropriate complementary feeding has been identified as one of the most effective strategies for reducing stunting and the associated burden of disease (Bhutta et al. 2008). The World Health Organization (WHO) recommends that food-based recommendations (FBRs)[1] be used in nutrition education and communications to promote a diverse array of locally available and produced foods and traditional foods where possible, and rely on introduced products or supplements only if they are able to address critical nutrient gaps (WHO 2008a). The Optifood tool was developed to support the design, identification, and testing of FBRs that are evidence based and population specific.

This report presents an analysis of data collected on local dietary patterns and food costs in the Western Highlands of Guatemala and evidence-based and population-specific FBRs for children 6–23 months old, pregnant women, and lactating women in the region. The report describes how the FBRs for the target population groups were developed using the Optifood program and presents the final FBRs for nutritionally adequate diets, including and excluding micronutrient supplementation. Finally, the report provides an overview of expected or recommended actions, based on key findings of this project.

This document is complemented by a summary report, available for download in English or Spanish.[2]

This document is intended for readers who have knowledge of the processes and data used to conduct dietary analyses in Optifood. A program manual with further information about Optifood, its data requirements, and its functions will be available following the official 2014 launch of the software.

[1] FBRs are dietary messages for members of the specified target group to promote consumption of specific foods or food groups. They may also include the recommended frequency of consumption of the foods or food groups in a 1-day or -week period (FAO/WHO 2001).

[2] Spanish and English versions of the summary report are available at http://www.fantaproject.org/tools/optifood.

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Abbreviations and Acronyms

AI	adequate intake
BMI	body mass index
CDC	U.S. Centers for Disease Control and Prevention
cm	centimeter(s)
CSB	corn-soy blend
dL	deciliter(s)
EAR	estimated average requirement
ENMICRON	Encuesta Nacional de Micronutrientes (National Survey of Micronutrients)
ENSMI	Encuesta Nacional de Salud Materno Infantil (National Maternal-Infant Health Survey)
FANTA	Food and Nutrition Technical Assistance III Project
FAO	Food and Agriculture Organization of the United Nations
FBF	fortified-blended flour
FBR	food-based recommendation
FCT	food composition table
FTF	Feed the Future Initiative
FWA	Federalwide Assurance
g	gram(s)
GLV	green leafy vegetable
GHI	Global Health Initiative
GOG	Government of Guatemala
GTQ	Guatemalan quetzal
HFIAS	Household Food Insecurity Access Scale
HHS	Household Hunger Scale
INCAP	Instituto de Nutrición de Centro América y Panamá (Institute of Nutrition of Central America and Panama)
INE	Instituto Nacional de Estadística (National Statistics Institute)
IOM	Institute of Medicine
IYCF	infant and young child feeding
iZiNCg	International Zinc Nutrition Consultative Group
kcal	kilocalorie(s)
LSHTM	London School of Hygiene and Tropical Medicine
µg	microgram(s)
mg	milligram(s)
mL	milliliter(s)
MNP	micronutrient powder(s)
MPE	meat, poultry, or eggs
MSPAS	Ministerio de Salud Pública y Asistencia Social (Ministry of Public Health and Social Assistance)

n.d.	no date
NGO	nongovernmental organization
OHRP	Office for Human Research Protections
OPS	Organización Panamericana de la Salud
PAHO	Pan American Health Organization
PEC	Programa de Extensión de Cobertura (Program for the Extension of Coverage)
PRDC	Programa para la Reducción de la Desnutrición Crónica (Program for the Reduction of Chronic Malnutrition)
RDA	recommended dietary allowance
RNI	recommended nutrient intake
RVC	Rural Value Chain Project
SBCC	social and behavior change communication
SD	standard deviation(s)
SUN	Scaling Up Nutrition
tbsp	tablespoon(s)
TIPs	Trials of Improved Practices
U.S.	United States
UNU	United Nations University
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
WFP	World Food Programme
WHO	World Health Organization

Executive Summary

Background

Nearly half of children under 5 in Guatemala are stunted, and anemia affects 29% of pregnant women, 21% of lactating women, and 48% of children under 5. Stunting and other indicators of poor nutrition are even more pronounced in the Western Highlands region (Ministerio de Salud Pública y Asistencia Social [MSPAS] [Ministry of Public Health and Social Assistance] 2010). This high level of chronic malnutrition has severe consequences for the physical and cognitive development of affected children and women, their families, communities, and the country overall (MSPAS/Instituto Nacional de Estadística [INE]/U.S. Centers for Disease Control and Prevention [CDC] 2010; Black et al. 2013).

Poor nutritional status in the Western Highlands has been attributed to suboptimal infant and young child feeding (IYCF) practices, low dietary diversity, food insecurity, and poor access to health services (Chaparro 2012; De Pee and Bloem 2009). As part of the United States Government's Feed the Future Initiative[3] (FTF) and Global Health Initiative[4] (GHI), the U.S. Agency for International Development (USAID) is supporting the Government of Guatemala (GOG) to implement the Plan of the Zero Hunger Pact,[5] through integrated health, nutrition, agriculture, and local governance projects in the Western Highlands.

To support implementation of the Zero Hunger Plan, USAID/Guatemala requested assistance from FHI 360's Food and Nutrition Technical Assistance III Project (FANTA) to identify strategies to improve the nutritional quality of the diet in the Western Highlands for pregnant and lactating women and children 6–23 months of age based on locally available foods. In partnership with the Instituto de Nutrición de Centro América y Panamá (INCAP) (Institute of Nutrition of Central America and Panama) and the London School of Hygiene and Tropical Medicine (LSHTM), FANTA initiated an activity to use a computer program called Optifood to identify a set of evidence-based, population-specific, food-based recommendations (FBRs) for these target populations.

Optifood analyzes the actual dietary patterns of target groups and the costs of local foods to identify the lowest-cost combination of local foods that will meet or come as close as possible to meeting the nutrient needs of specific groups. Optifood can also be used to identify "problem nutrients" (dietary requirements that would be difficult to meet using diets based on locally available foods), analyze diet costs, and compare and test different FBRs or interventions.

Methods

To establish the dietary patterns of the target groups, data were collected using a cross-sectional survey of randomly selected children 6–11 months old (n=202) and children 12–23 months old (n=190), pregnant women (n=75), and lactating women (n=80), across 40 rural communities in the departments of Huehuetenango and Quiché between July and September 2012. The data collection process included:

1. A **household survey** to collect socioeconomic, demographic, and health information
2. The **Household Food Insecurity Access Scale** (HFIAS) (Coates et al. 2007) to determine the level of food insecurity experienced in study communities

[3] http://www.feedthefuture.gov/.

[4] http://www.ghi.gov/.

[5] http://www.sesan.gob.gt/index.php/descargas/17-plan-del-pacto-hambre-cero.

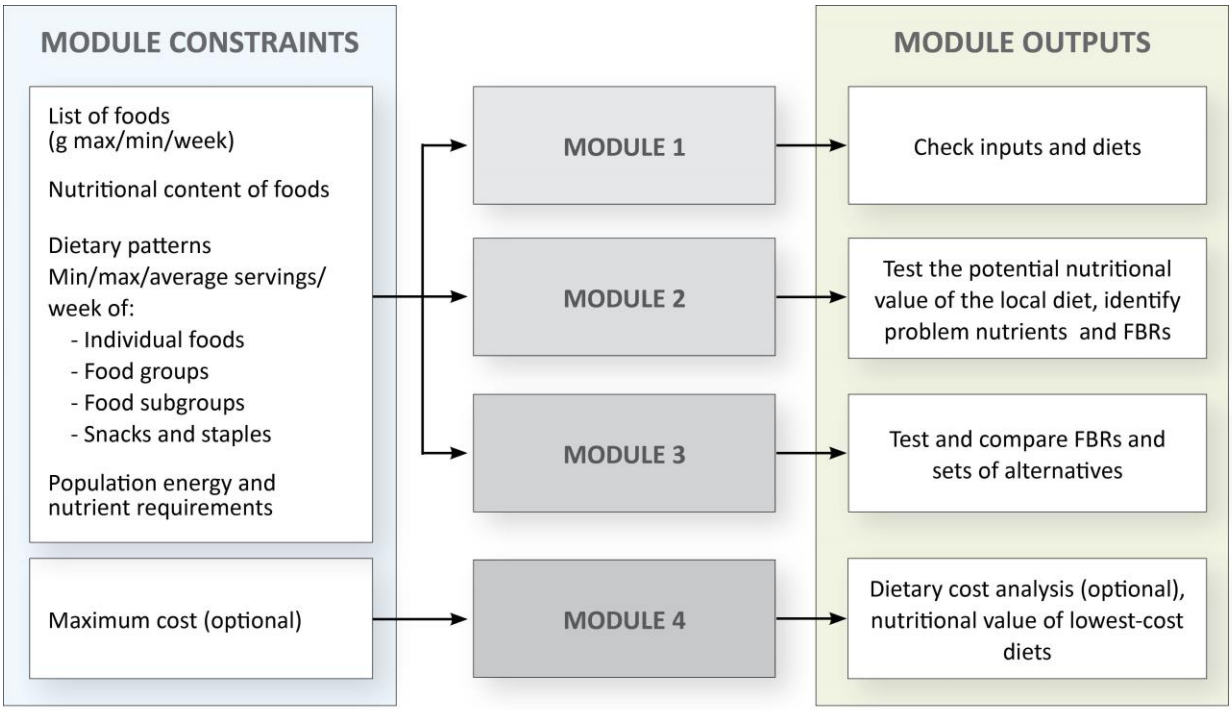
3. A **24-hour dietary recall tool** to collect information on foods commonly consumed by the target populations, serving sizes, and consumption patterns
4. An **anthropometric survey** of study participants for determining nutritional status and for calculating energy and protein requirements of the population
5. A **market prices survey instrument based on the *Pro*PAN methodology**[6] to collect data on the local names for foods, local costs, seasonality, and availability of food

The study was carried out during the rainy season. Despite the fact that this time of the year is also called the lean or hungry season (because families are between maize harvests and there is little paid agricultural labor available to provide income for food purchases) (Mazariegos and Méndez 2013), many native green leafy vegetables and fruits are more readily available during the rainy season, because they are either produced in home gardens or purchased in the market. This study did not address the issue of seasonality; however, the impact of seasonality on the feasibility of putting FBRs into practice will be explored in subsequent household trials of the FBRs.

Figure 1 describes the data used by Optifood to set the model parameters and the four modules of data analysis. Data used to develop realistic FBRs include actual dietary patterns and portions consumed by the target population, reference values for recommended dietary allowances (RDAs), and costs of foods consumed by the target population. The first Optifood analysis module checks that these model parameters are realistic. The second module identifies the diet that would meet or come as close as possible to meeting nutrient needs, within the model parameters, as well as the best possible diet regardless of these parameters. This module is also used to identify problem nutrients and food sources of problem nutrients, for drafting FBRs. The third module is used to test and compare alternative FBRs, taking into consideration current practices, nutrient needs, and cost, if cost is included in the analysis. Last, a cost analysis is conducted (Module 4) to identify the lowest-cost diet that meets or comes as close as possible to meeting nutrient needs.

[6] See *Pro*PAN Module 1. http://www.paho.org/common/Display.asp?Lang=E&RecID=6048. This manual, aimed at ministries of health, NGOs, organizations, and bilateral and international organizations interested in improving IYCF practices to prevent early childhood malnutrition, describes how to design an intervention and reviews evaluation strategies. At the time of the study, the *Pro*PAN modules were being updated so that they could easily be used with Optifood. The *Pro*PAN tools used in this activity were draft updated versions.

Figure 1. The Four Modules of the Optifood Analysis



Key Findings

The women and children surveyed came from predominantly rural, indigenous households characterized by a high prevalence of stunting and anemia, from Western Highlands departments that have been prioritized for nutrition interventions. Roughly half of households experienced anxiety or concern regarding food security in the 30 days preceding the survey, although few households reported experiencing hunger due to lack of food, according to the subset of questions focused on these criteria.

The largest problems identified in the diets of the women and children surveyed related to diet quality, not quantity. Observed diets in all target groups were largely plant based, with few animal-source foods or fortified foods. This was disadvantageous, given the relatively high content of antinutrients that impede the uptake of other nutrients, the lower bioavailability of certain micronutrients, and the lack of specific nutrients and active compounds contained in animal-source foods (De Pee and Bloem 2009). Further, given that animal protein was consumed by all target groups only in small amounts and that grains and legumes were not often consumed together, it is possible that protein levels in the population are inadequate.

The Optifood analysis revealed that zinc, iron, vitamin B12, and folate were problem nutrients. Further, iron and zinc nutrient requirements for children 6–8 months old and iron requirements for pregnant women could not be met using diets based on local foods.

The Optifood results suggested that a combination of six FBRs that include fortified-blended flour (FBF) for children 6–23 months old and a similar set of six FBRs that include FBF for pregnant and lactating women could ensure that dietary adequacy is met for all target groups, except for the requirements of iron and zinc for children 6–8 months old and iron for pregnant women. Nutrient adequacy for children 6–8 months old and pregnant women was not possible without micronutrient supplementation. While nutrient adequacy could be met using a combination of FBRs for all other target groups, the quantity of local food

required to put these FBRs into practice was high and the recommendations may not be feasible or acceptable for target communities given the cost of implementation, the gastric capacity of individuals, and dietary preferences. Therefore, it is suggested that a more conservative set of 4–7 FBRs be recommended for each target group, in combination with appropriate micronutrient supplementation.[7,8,9]

Even given the adjustments to the modeled diets once micronutrient supplementation was considered, it was concluded that nutritionally adequate diets might not be affordable or accessible for some households in the Western Highlands. Other constraints may also prevent families from implementing the final sets of FBRs. It is therefore recommended that potential constraints, such as cost, access to foods, seasonality of production, time required to prepare food, and cultural beliefs regarding recommended foods, should be further explored to test the feasibility, availability, and acceptability of putting the FBRs in place and to develop effective strategies for supporting a nutritionally adequate diet for the most vulnerable groups.

Next Steps

Further activities are required to investigate the feasibility and acceptability of promoting the FBRs for the target populations. Additionally, while there is a need to promote the FBRs through dietary changes, there is also a need to promote complementary strategies to increase the nutrient intake for women and children, taking into consideration local availability, production, and costs of foods. Thus, the next step in this process is a review of the results of this project by USAID/Guatemala, the GOG, and partners to develop an integrated plan for the improvement of women's and children's nutrient intake in the Western Highlands, considering the most promising programmatic options, which may include promotion of FBRs through behavior change, promotion of agriculture or animal husbandry, food fortification, supplementation with micronutrients, or other approaches. The following issues should be considered in this process:

1. **The use of findings to develop messages for a social and behavior change strategy and program activities** by the GOG with the support of cooperating agencies (including the Nutri-Salud project[10])
2. **The role of agricultural interventions** in increasing home production and market availability of important food sources for problem nutrients, including black beans, animal-source foods, green leafy vegetables (GLVs), and factors influencing home/local production
3. **Food fortification and micronutrient supplementation policies,** including an analysis of the complementarity (or redundancy) of current GOG micronutrient policies, their effectiveness to meet desired objectives (e.g., prevent anemia, promote linear growth), recommended modifications, and their relationship to the findings presented in this report
4. **Complementary foods** that would provide adequate iron and zinc densities for young children and further analysis to evaluate the need for and the effectiveness and feasibility of complementary food supplements
5. **Feasibility and affordability of FBRs:** Planned trials during 2014 will identify individual FBRs that are feasible for families to implement, as well as barriers and potential motivating factors to

[7] The World Health Organization (WHO) recommended a duration and time interval for supplementation with multiple micronutrient powders (MNP) for children 6–23 months old of one sachet per day for a minimum period of 2 months, followed by a period of 3–4 months off supplementation so that use of a multiple MNP is started every 6 months.

[8] The composition of the Sprinkles Global Health Initiative's "Nutritional Anemia Formulation Sprinkle" includes: 12.5 mg of iron, 300 µg of retinol, 5 mg of zinc, 160 µg of folic acid, and 30 mg of vitamin C (Sprinkles Global Health Initiative 2008).

[9] Recommended supplementation for pregnant and lactating women includes 600 mg/week of ferrous sulfate and 5 mg/week of folic acid (MSPAS 2004).

[10] The Nutri-Salud Community Nutrition and Health Project, administered by University Research Co. LLC, is a USAID-funded project that operates in 30 municipalities in 5 departments of the Western Highlands of Guatemala to support the Guatemalan Ministry of Health's efforts to expand health coverage at the community level. Information is available at http://www.urc-chs.com/project?ProjectID=243.

help encourage their adoption; the final outcomes from the trials will be a realistic set of evidence-based, population-specific FBRs, and the content for messages to promote them in the Western Highlands

6. **Strengthening agricultural/nutrition linkages** through collaboration with the Ministry of Agriculture and Livestock and MSPAS to develop extension programs that support the production of nutrient-dense foods and to develop social and behavior change communication (SBCC) messages that help consumers optimally integrate those foods in their diets
7. **Applicability of the FBRs to other areas of the Western Highlands:** Studies are needed to determine the extent to which the FBRs are applicable to other areas within the Western Highlands
8. **Involving the private sector** to develop and field test complementary foods products that would address identified nutrient inadequacies

1. Background

1.1 National Context

Guatemala has the highest percent of children suffering from chronic malnutrition in the Western Hemisphere (USAID 2012). Almost 50% of children under 5 years of age are stunted, that is, too short for their age (Black et al. 2013; MSPAS/INE/CDC 2010). The GOG, through its Zero Hunger Plan, aims to dramatically reduce chronic malnutrition among children under 5 years, with a goal of a 10% reduction by 2015 and a 24% reduction by 2022 (GOG n.d.). The Zero Hunger Plan is based on the national Programa para la Reducción de la Desnutrición Crónica (PRDC) (Program for the Reduction of Chronic Malnutrition) and the international Scaling Up Nutrition (SUN) Movement.[11] The actions of the Zero Hunger Plan are focused on the 1,000 days from pregnancy through a child's second birthday, "the 1,000-day window," when the most-rapid physical growth of the child occurs and a critical time in cognitive development. The Zero Hunger Plan includes 10 key actions to prevent chronic malnutrition and 5 key actions to prevent seasonal hunger (**Figure 2**).

Figure 2. Zero Hunger Plan: Key Actions

10 key actions to prevent chronic malnutrition in Guatemala
1. Promotion and support of breastfeeding 2. Improvement in complementary nutrition after 6 months of age 3. Improvement in hygiene practices, including washing of hands 4. Provision of vitamin A supplements (for children 6–23 months old) 5. Provision of therapeutic zinc supplements in cases of diarrhea 6. Provision of powdered micronutrients (for children 6–23 months old) 7. Deworming and vaccination campaigns for boys and girls 8. Provision of iron and folic acid supplements for the prevention and/or treatment of anemia in pregnant women 9. Prevention of iodine deficiency through iodized salt 10. Provision of food products fortified with micronutrients
5 key actions to prevent seasonal hunger
1. Support of family agriculture to increase production for self-consumption and sale, with proper techniques and few inputs 2. Prevention and treatment of moderate acute malnutrition at the community level by providing ready-to-use foods 3. Treatment of acute malnutrition in a timely fashion using ready-to-use therapeutic food at the community level and in nutritional recovery centers, with guidance and follow-up provided by health care practitioners 4. Establishment of a food and nutrition surveillance alert system based on nutritional surveillance networks that include sentinel sites 5. Social protection network against seasonal hunger through a temporary work program (intensive hand labor) and conditional monetary transfers and humanitarian assistance

Source: GOG. n.d.

As part of FTF and GHI, USAID is supporting the GOG to implement the Zero Hunger Plan through integrated health, nutrition, agriculture, and local governance projects in the Western Highlands. This support is specifically focused on the departments of Huehuetenango, Quetzaltenango, Quiché, San Marcos, and Totonicapán.

[11] See http://scalingupnutrition.org/.

To complement the Zero Hunger Plan, USAID/Guatemala requested assistance from FANTA to identify strategies to improve the nutritional quality of the diet in the Western Highlands for pregnant and lactating women and children 6–23 months of age based on locally available foods. In 2012, in partnership with INCAP, FANTA initiated an activity to use Optifood, a computer program, to identify a set of evidence-based, population-specific FBRs that can be promoted to improve the nutritional status of women and young children in the Western Highlands.[12]

1.2 The Nutritional Status of Women and Young Children in the Western Highlands of Guatemala

Chronic malnutrition is rampant in the Western Highlands (**Table 1**) (MSPAS/INE/CDC 2010). According to the 2008–09 Encuesta Nacional de Salud Materno Infantil (ENSMI) (National Maternal-Infant Health Survey), four of the five departments in the Western Highlands have stunting prevalence among children 3–59 months old greater than the national average, and three of the five departments—Huehuetenango, Quiché, and Totonicapán—are among the four departments with the highest prevalence of stunting in the country.[13] Anemia is also pervasive: Nationally, 48% of children 6–59 months old are anemic, and the prevalence of anemia in the Western Highlands ranges from 40% in Quetzaltenango to 62% in Totonicapán. Nationally, 20.6% of pregnant women and 35.5% of non-pregnant women between 15 and 19 years old are anemic, with rates between 20.6% (Quetzaltenango) and 32.3% (Totonicapán) for non-pregnant women and 17.9% (Huehuetenango) and 36.3% (Totonicapán) for pregnant women in the Western Highlands. More than half of all women with children aged under 5 years (50.5%) in the Western Highlands are less than 145 cm tall, compared to 31.2% nationally, with prevalence ranging from 33% in San Marcos to 53.9% in Quiché.

Table 1. Prevalence of Stunting and Anemia in the Western Highlands in Children 3–59 Months Old (Stunting) and Children 6–59 Months Old (Anemia)

	Huehuetenango	Quetzaltenango	Quiché	San Marcos	Totonicapán	National
Prevalence (%) of stunting	69.5	43.1	72.2	53.5	82.2	49.8
Prevalence (%) of anemia	47.7	40.2	47.4	52.6	62.2	47.7

Source: MSPAS/INE/CDC. 2010.

[12] Note that FBRs may not constitute the entire diet, but are intended to be put into practice as part of the usual diet of locally available foods for the target group. The "usual" diet is based on preference, food frequency, and cost data. Some FBRs are not tested or promoted if they are already put into practice by the population as part of a normal diet. For example, the majority of the population surveyed in 2012 was already following the FBR of "Eat tortillas or tamalitos 3 times a day, 7 days a week." The final set of FBRs that are tested include messages that would constitute a change in dietary practices that would help improve nutrient intake, to be practiced along with consumption of other nutritious, commonly consumed foods. Also note that Optifood does not include recommendations to not eat a particular food.

[13] Stunting is defined as height-for-age < −2 standard deviations (SD) from the median of the 2006 WHO Child Growth Standards. See http://www.who.int/childgrowth/en/.

1.3 Optifood

Optifood was developed by the World Health Organization (WHO) in collaboration with LSHTM; FANTA; and Blue-Infinity, an information technology company. Optifood analyzes the actual dietary patterns of target groups and food costs to identify the lowest-cost combination of local foods that will meet or come as close as possible to meeting nutrient needs of specific target groups.[14]

Analysis in Optifood provides the following categories of results:

1. **Best food sources.** Based on locally available foods and dietary patterns, Optifood determines which local foods are good sources of nutrients for a given target group.
2. **Problem nutrients.** Problem nutrients refer to nutrients that are likely to remain low in diets given local food sources and existing dietary patterns. As well as identifying problem nutrients, Optifood analysis indicates whether inadequate dietary intakes are related to the food selection practices of a target group or to inadequate availability in the area or access to nutrient-dense foods in the household. This information helps elucidate the strategies required to improve dietary intake. When inadequate dietary intakes are related to food selection, a focus on behavior change is needed; when they are related to inadequate availability or access to appropriate foods, a focus on alternative strategies (e.g., supplementation, agricultural, and/or income generation interventions) in addition to behavior change is required.
3. **FBRs.** Based on the best food sources and taking into account the problem nutrients for each target group, alternative sets of FBRs are tested by Optifood using linear programming and compared based on nutrient adequacy and cost. Through this process, Optifood can develop a set of FBRs that ensures, or comes as close as possible to ensuring, a nutritionally optimal diet for individuals in the target group.
4. **Lowest-cost diet that meets or comes as close as possible to meeting nutrient needs.** The lowest-cost diet that meets or comes as close as possible to meeting nutrient needs is a diet in which the Optifood program uses cost data to minimize cost while meeting or coming as close as possible to meeting nutrient needs in the diet. This result provides information about the affordability of this diet for specific target groups in the study area.[15]

Thirteen key nutrients are considered by the Optifood analysis: total fat, total protein, iron, zinc, calcium, vitamin A, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, and vitamin B12. Some important nutrients in the diet cannot yet be analyzed in Optifood due to a lack of adequate food composition table (FCT) data or because exact requirements have not yet been established. These include selenium, iodine, biotin, vitamins K and D, essential fatty acids, and protein quality.

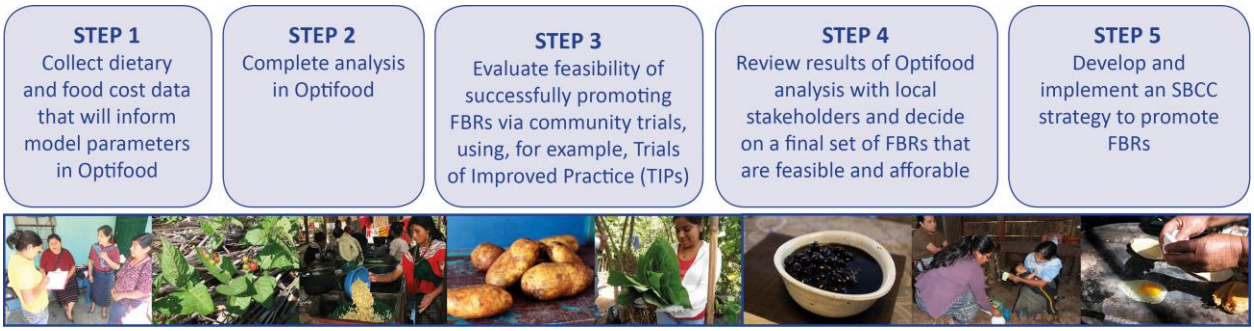
The process of using Optifood to develop FBRs has five main steps (**Figure 3**). This report describes methods and results of Optifood to collect data on local dietary patterns and food costs (Step 1) and the analysis in Optifood (Step 2) for children 6–23 months old, pregnant women, and lactating women with infants under 6 months to develop the FBRs that were presented to and discussed with relevant stakeholders. The report also discusses considerations for the next steps (Step 3 and 4), during which the feasibility and acceptability of the FBRs will be tested in household trials and the GOG, USAID/ Guatemala, and partners will review the results of the Optifood analysis to decide on a final set of FBRs.

[14] "Dietary pattern" is defined by the locally available foods that are most commonly consumed by the target group, the quantities of these foods most commonly consumed by the target group, and the frequency of consumption of these foods by the target group during a 1-week period.

[15] Cost data for Optifood can be collected through a market prices survey in the target area. A market prices survey tool is available in the *Pro*PAN toolkit, which can be found at: http://www.paho.org/hq/index.php?option=com_content&view=article&id=5668&Itemid=4067.

Step 5—development and implementation of an SBCC strategy—will be conducted by Nutri-Salud after Steps 3 and 4 have been completed.

Figure 3. Process of Using Optifood to Develop and Promote FBRs



1.4 Characteristics of a Diet Associated with Good Child Growth and Development

Table 2 (adapted from an article by de Pee and Bloem [2009]) shows the nutrient groups and active compounds that are vital for good child growth and development, together with their main dietary sources. In summary, the diets of young children should have a high micronutrient content, high energy density, adequate protein content and quality, low antinutrient content, and adequate fat content and quality.

Table 2. Essential Nutrients and Active Compounds and Their Dietary Sources

Nutrients and active compounds of concern	Dietary sources	Comments
Vitamins, plant origin	Vegetables and fruits, grains	Bioavailability (due to antinutrient content of plant foods) as well as absolute quantity of foods to be consumed is of concern.
Minerals	Animal-source foods and plant foods	When largely relying on plant foods, intake has to be high and bioavailability has to be improved, particularly by reducing contents of antinutrients and/or adding vitamin C.
Vitamins, animal origin	Breast milk, animal milk, organ meat, red meat, poultry, fish, eggs	A variety of animal-source foods is required.
Iodine	Seafood and iodized salt	The use of iodized salt contributes greatly to the prevention of iodine-deficiency disorders.
Proteins	Soybeans, peanuts, legumes, breast milk, animal milk, organ meat, red meat, poultry, fish, eggs	Similar to vitamins from animal-source foods, a variety of foods is required to ensure adequate intake (AI) of all essential amino acids. Plant sources of protein also have a relatively high content of antinutrients, which affects absorption of minerals.
Essential fatty acids	Fatty fish or their products, soybean oil, rapeseed (canola) oil	Only fatty fish and a few oils have a favorable fatty acid profile, and these are not generally consumed in large amounts in most developing-country diets, including Guatemala (Menchú and Méndez 2011).

Nutrients and active compounds of concern	Dietary sources	Comments
Growth factor from milk*	Dairy products (breast milk, animal milk, yogurt, cheese)	Skimmed-milk powder when reconstituted with water is not appropriate for young children because of the lack of fat. Full-cream milk powder is usually skimmed-milk powder to which powdered vegetable fat has been added. When reconstituted with clean, safe water, this is good milk for children.
Phytase, α-amylase (antinutrients)	Present in grains themselves, released when germinating, malting, or fermenting	These processes require modification of food processing as well as use of whole grains rather than purchased flour. Also, the impact of these food-processing technologies on improving mineral bioavailability and micronutrient status has not been shown to be substantial enough to markedly reduce deficiencies.

* The presence of factors in milk (peptides or non-phytate-bound phosphorus) that promote growth is very likely but not fully proven as yet.

WHO has established guidelines with respect to the nutrient content of complementary foods for children 6–23 months of age (Pan American Health Organization [PAHO] and WHO 2004; WHO 2005). These guidelines include a recommendation that meat, poultry, fish, or eggs should be eaten daily, or as often as possible, because they are rich sources of many key nutrients. Diets that do not contain animal-source foods cannot meet all nutrient needs at this age unless fortified products or nutrient supplements are used, especially for children between 6 and 23 months of age that are not breastfed. In addition, if milk and other animal-source foods are not eaten in adequate amounts, both grains and legumes should be consumed daily, if possible within the same meal, to ensure adequate protein quality. The complementarity of grains and legumes is related to the amino-acid content of each component. In an example relevant to the Guatemalan context, the protein contained in maize is deficient in lysine and tryptophan but rich in sulfur-containing amino acids (methionine and cystine), while the protein contained in legumes, such as black beans, is rich in lysine and tryptophan but low in sulfur amino acids (Bressani and Elías 1974). As such, it is recommended that beans and maize be consumed together where possible, in a ratio of 30 parts beans to 70 parts maize (Food and Agriculture Organization of the United Nations [FAO] 1993).

2. Methods

2.1 Step 1 – Collect Dietary and Food Cost Data: Methods of Cross-Sectional and Market Prices Surveys for Information Gathering on Local Dietary Patterns and Food Costs

2.1.1 IRB Approval and Ethical Procedures

The study protocol was approved by the INCAP Institutional Ethics Review Committee, which is registered with the Office for Human Research Protections (OHRP) at the United States Department of Health and Human Services, through the Federalwide Assurance (FWA) for the Protection of Human Subjects for International (Non-U.S.) Institutions[16] and with the Institutional Review Board Information.[17] The protocol approval was issued in July 2012, prior to beginning any contact with potential families. Ethical approval for the analyses of the data collected by INCAP was obtained from LSHTM's Ethics Committee in November 2012.

The local leaders of the communities where the data collection took place were informed of the project, the procedures to be undertaken, and how the data would be used. Relevant staff from the health services and from the MSPAS Programa de Extensión de Cobertura (PEC) (Program for the Extension of Coverage) were contacted and informed of the study prior to the recruitment. Fieldworkers carried an identification card and a letter explaining their presence in the community when they were recruiting participants and collecting data.

When a fieldworker identified an eligible participant, she or he explained the rationale, procedures, time commitment, risks, and benefits of the study to the potential participant (or the mother/caregiver, in the case of a child), and asked permission, both verbally and in writing, to interview the eligible participant. If the pregnant or lactating woman or the mother/caregiver of the child consented, the participant signed the informed consent form with either her signature or a thumbprint. For illiterate or non-Spanish-speaking women, the informed consent was read or translated into the local language. INCAP hired local fieldworkers who supported the field team as guides and translators, facilitating the translation needs during the informed consent process and the interviews. For a participant who could not sign her name, in addition to the participant providing her thumbprint, a local witness also signed the consent form.

As part of the benefits, the study provided nutrition counseling to all participating mothers, geared toward improving feeding practices of the child, and to pregnant and lactating women, that included the topics of breastfeeding, complementary feeding, and handwashing. The counseling sessions took place right after completing the survey interview. In addition, mothers of children received free of charge a plastic dish and a cup for child feeding used to promote good feeding practices.

2.1.2 Selection of Study Sites

Selection of Departments

As mentioned earlier, the goal of this study was to identify population-specific FBRs that can be promoted to improve the nutritional status of women and young children in the Western Highlands. To carry out the studies, FANTA and INCAP focused on nine municipalities in the Highlands (four municipalities in the department of Huehuetenango, which is populated predominantly by the Mam

[16] Through the FWA, an institution commits to the Department of Health and Human Services that it will comply with the requirements in the Protection of Human Subjects regulations at 45 CFR Part 46. INCAP's identification number is 00000742.
[17] Identification numbers IORG0006269 and IRB000075.

ethnolinguistic group and five municipalities in the department of Quiché populated predominantly by the Ixil and Quiché ethnolinguistic groups). Conducting the study in two different locations allowed for a greater range of diet patterns and for evaluation of the applicability of the FBRs for both departments. These two departments were purposively selected based on regional priorities of the GOG Zero Hunger Plan and USAID/Guatemala. Study departments were selected from USAID FTF and GHI areas of intervention, including the USAID-funded FTF Rural Value Chain Project (RVC) and PEC.

The RVC is led by a consortium of Guatemalan nongovernmental organizations (NGOs) including Agexport, INCAP, and Vital Voices (collectively known as the *Consorcio Unidos por el Desarrollo Rural* [United Consortium for Rural Development]). The RVC works through local farmers' associations and aims to improve nutrition and food security by promoting economic growth through support of horticulture and coffee production. The rationale for selecting RVC participants was that they may have greater dietary diversity due to the agricultural activities in which they are engaged and, therefore, represent a broad range of dietary patterns in the area.

Under PEC, MSPAS NGOs are contracted to provide health services to rural areas where the government health system does not have adequate coverage. The respondents from PEC were selected from the same municipalities as the RVC participants. The rationale for selecting participants from PEC is that families receiving PEC services represent the majority of the population in these communities. In addition, they are often the poorest and most vulnerable, and subsequently at high risk of chronic malnutrition. The dietary patterns of PEC participants also could be different than those of RVC participants who may have more resources (e.g., land and income).

Selection of Municipalities

Municipalities within departments were purposively selected considering their ecological and geographic zones so that current agricultural production and dietary practices would be similar across contiguous priority municipalities, to ensure geography-specific FBRs that would be generalizable across the geographically targeted areas.

Figure 4. Criteria for the Selection of Municipalities

Municipality Selection Criteria
1. Similar ecological zone within department
2. Similar geographic zone within department
3. Participation in PEC project
4. Participation in RVC project

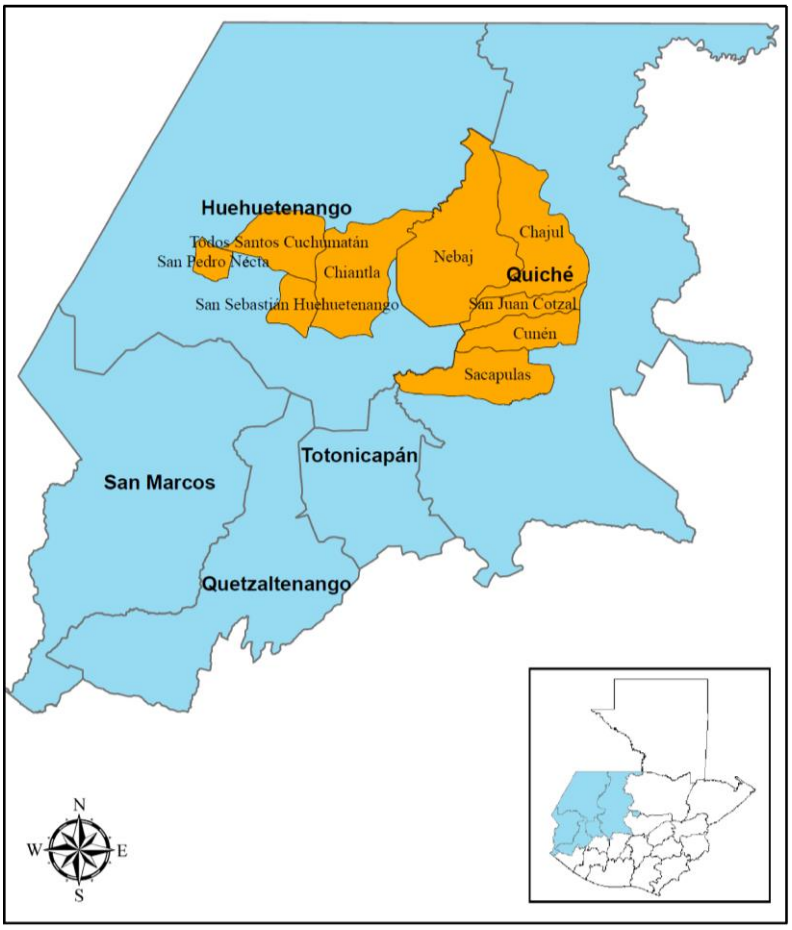
Quiché has a total of 21 municipalities; 5 of these were selected for data collection, including 4 in the "Quiché region" of the department—Cunén (Ki'che language), Nebaj and Chajul (Ixil language group), and Sacapulas (Sacaputecol language group)—and one in the Ixil region of the department—San Juan Cotzal (Ixil language group).

At the time of the survey, the RVC project was present in eight municipalities in the Quiché department, four of which (Cunén, Nebaj, Chajul, and Sacapulas) were selected for the study. San Juan Cotzal municipality was not supported by RVC at the time of the survey, but since the survey it has been added to the RVC project. San Juan Cotzal has similar characteristics to those in the Quiché region and was selected for the survey because of the interest and support received by the health authorities. The five municipalities surveyed in Quiché had PEC presence.

Four municipalities were selected in the Mam ethnolinguistic group areas in the department of Huehuetenango: San Sebastián Huehuetenango, San Pedro Nécta, Chiantla, and Todos Santos Cuchumatán. Huehuetenango has 31 municipalities, of which 8 were participating in the RVC project. The four survey municipalities in Huehuetenango had PEC and RVC presence, as shown in **Table 3** (on the next page).

Figure 5 shows the five departments where the USAID FTF is being implemented by *Consorcio Unidos por el Desarrollo Rural* and the nine municipalities where the study was carried out.

Figure 5. Municipalities of Huehuetenango and Quiché Departments Included in the Study



Selection of Communities

Study communities were purposively selected based on the presence of families participating in the RVC project and/or the presence of PEC. Selection of communities was also based on verbal support for the survey obtained by governors from Huehuetenango and Quiché and leaders of the associations participating in the RVCs, as well as written authorization from the directors of the Health Areas and Health Municipal Districts who are responsible for the PEC.

Twenty communities each were selected from Quiché and Huehuetenango departments. Originally in the sampling design, each municipality was considered a stratum that consisted of a set number of communities, with each community contributing equally to the overall study sample size. However, due

to difficulties in locating households with young children or pregnant women, it was necessary to allow differentiation in the number of communities in the strata by adding additional communities to some of them. For example, when it was not possible to locate enough young children and pregnant women in a selected community, a neighboring community was included in the stratum so that the required sample size could be met. **Table 3** and **Table 4** present the final list communities surveyed in each municipality.

Table 3. Communities Participating in Huehuetenango, by Municipality

Municipality	Community Name	Type of Population Center*	RVC (name) or PEC Presence Community**
San Sebastián Huehuetenango	Piol	Village	PEC presence
	Sipal	Caserío	PEC presence
	Quiajola	Village	PEC presence
	Chelam	Caserío	PEC presence and RVC (ASOSAM)
Chiantla	Buena Vista	Caserío	PEC presence
	Chochal	Village	PEC presence and RVC (ADICHO)
	La Esperanza	Caserío	PEC presence
	Cuatro Caminos	Without information	PEC presence
San Pedro Nécta	El Llano	Without information	PEC presence
	Chimiche	Village	PEC presence and RVC (ACODIHUE)
	El Rancho	Without information	PEC presence
	La Pinada	Caserío	PEC presence and RVC (ACODIHUE)
	Guachipilin	Caserío	PEC presence
Todos Santos Cuchumatán	San Martín	Village	PEC presence and RVC (ADAT)
	Los Lucas	Caserío	PEC presence and RVC (ADAT)
	Chiabal	Caserío	PEC presence
	Chicoy	Village	PEC presence
	Tujchoj	Without information	PEC presence
	Tuiich	Without information	PEC presence
	Los Gómez	Caserío	PEC presence
Total	**20**		

* INE toponymy: A *caserío* is a rural hamlet with fewer than 500 inhabitants.

** The purpose of distinguishing between PEC and RVC was for the first source of identification and recruitment of participants.

Table 4. Communities Participating in Quiché, by Municipality

Municipality	Community Name	Type of Population Center*	RVC (name) or PEC presence in community**
Nebaj	Turanza	Caserío	PEC presence
	Acul	Village	PEC presence
	Río Azul	Caserío	PEC presence
	Bisán	Caserío	PEC presence
	Pexlá	Village	PEC presence and RVC (ASIES)
	Xeucalvitz	Caserío	PEC presence and RVC (Agros. Café Ixil)
Chajul	Juil	Caserío	PEC presence
	Xolcuay	Village	PEC presence and RVC (APRODEFI)
	Xix	Village	PEC presence and RVC (APRODEFI)
	Chacalté	Village	PEC presence
	Chajul	Township	PEC presence and RVC (ASIES)
San Juan Cotzal	Cajixay	Village	PEC presence
	Villa Hortencia A.	Village	PEC presence
	Pinal	Village	PEC presence
	Buenos Aires	Village	PEC presence
Cunén	El Pericón	Village	PEC presence and RVC (AIDA)
	Tierra Colorada	Caserío	PEC presence and RVC (ACODE)
Sacapulas	Río Blanco	Village	PEC presence and RVC (PROGRESAR)
	Rancho de Teja	Village	PEC presence
	La Abundancia	Farm	PEC presence
Total	**20**		

* INE toponymy: A *caserío* is a rural hamlet with fewer than 500 inhabitants.
** The purpose of distinguishing between PEC and RVC was for the first source of identification and recruitment of participants

Process for Informing Departmental, Municipal, and Community Stakeholders

The study was presented to the directors of the Departmental Health Areas, Departmental Governors, and appropriate leadership teams of the NGOs running PEC services in the study communities. With the approval and support of these key stakeholders, local leaders from the communities in which the data collection took place were informed of the study, its procedures, and how the data were going to be used. Local staff from the RVC and PEC were also informed about the study prior to the start of participant recruitment.

2.1.3 Target Groups, Sample Size, and Participant Selection

Target Groups for Sampling

Data for the survey were collected for the following target groups:

1. Children 6–11 months of age
2. Children 12–23 months of age
3. Pregnant women
4. Lactating women with children under 6 months of age

Sample Sizes

Sample sizes for the collection of household and dietary data from the target groups were based on sample sizes previously reported in the literature that used Optifood's linear programming techniques (Santika et al. 2009) and recommendations provided by researchers experienced with Optifood (Ferguson 2012) as to how many replicates were assumed to be sufficient to capture the potential variability in dietary patterns. Based on these sources of information, the proposed sample size for the study included:

- 200 children 6–11 months of age
- 200 children 12–23 months
- 75 pregnant women
- 75 lactating women with infants under 6 months

The intention was that the overall sample size would be split equally among the departments of Huehuetenango and Quiché. **Table 5** through **Table 8** shows the actual sample sizes by target group.

Local Support for Participant Recruitment

Local representatives from the RVC and PEC guided the survey team through the community and introduced them to the selected families. Fieldworkers carried identification and a letter of presentation explaining their presence in the community when recruiting respondents and collecting data. Local community members associated with the RVC and PEC translated Mam, Ixil, and Quiché for fieldworkers when respondents did not speak Spanish.

Selection of Participants

In each community, potential survey participants were randomly selected from either the RVC list in RVC communities or the PEC list from the PEC clinic in PEC communities. In some communities, when there were no more eligible RVC participants, the PEC list was used to complete the selection of potential participants. The number of eligible families participating in the rural value chains was usually small and, therefore, its contribution to the overall sample size was lower with respect to the PEC.

If a selected participant (pregnant or lactating woman or mother of a child 6–23 months old) was not available in her home, a repeat visit was conducted later in the day. However, if the participant was not available by the end of the day, a replacement was selected from a list of available replacements.

Table 5. Sample Size of Breastfed Children 6–11 Months, by Department, Municipality, and Program Participation (RVC or PEC)

Department	Municipality	Number of participants from RVC communities	Number of participants from communities with PEC presence	Total
Huehuetenango	Chiantla	8	20	28
	San Pedro Nécta	4	27	31
	San Sebastián Huehuetenango	2	16	18
	Todos Santos Cuchumatán	2	22	24
	Total number	**16**	**85**	**101**
	Total percentage	**16**	**84**	**100**
Quiché	Nebaj	3	25	28
	Chajul	5	17	22
	Cotzal	0	24	24
	Sacapulas	5	18	23
	Cunén	4	0	4
	Total number	**17**	**84**	**101**
	Total percentage	**17**	**83**	**100**
Total	**Total number**	**33**	**169**	**202**
	Total percentage	**16**	**84**	**100**

Table 6. Sample Size of Children 12–23 Months, by Department, Municipality, and Program Participation (RVC or PEC)

Department	Municipality	Number of participants from RVC communities	Number of participants from communities with PEC presence	Total
Huehuetenango	Chiantla	8	13	21
	San Pedro Nécta	6	20	26
	San Sebastián Huehuetenango	1	22	23
	Todos Santos Cuchumatán	6	22	28
	Total number	**21**	**77**	**98**
	Total percentage	**22**	**79**	**100**
Quiché	Nebaj	4	26	30
	Chajul	5	15	20
	Cotzal	3	24	27
	Sacapulas	7	5	12
	Cunén	3	0	3
	Total number	**22**	**70**	**92**
	Total percentage	**24**	**76**	**100**
Total	**Total number**	**43**	**147**	**190**
	Total percentage	**23**	**77**	**100**

Table 7. Sample Size of Pregnant Women, by Department, Municipality, and Program Participation (RVC or PEC)

Department	Municipality	Number of participants from RVC communities	Number of participants from communities with PEC presence	Total
Huehuetenango	Chiantla	2	5	7
	San Pedro Nécta	1	10	11
	San Sebastián Huehuetenango	2	7	9
	Todos Santos Cuchumatán	1	10	11
	Total number	**6**	**32**	**38**
	Total percentage	**16**	**84**	**100**
Quiché	Nebaj	0	7	7
	Chajul	2	7	9
	Cotzal	2	9	11
	Sacapulas	1	5	6
	Cunén	4	0	4
	Total number	**9**	**28**	**37**
	Total percentage	**24**	**76**	**100**
Total	**Total number**	**15**	**60**	**75**
	Total percentage	**20**	**80**	**100**

Table 8. Sample Size of Lactating Women, by Department, Municipality, and Program Participation (RVC or PEC)

Department	Municipality	Number of participants from RVC communities	Number of participants from communities with PEC presence	Total
Huehuetenango	Chiantla	3	4	7
	San Pedro Nécta	3	11	14
	San Sebastián Huehuetenango	3	7	10
	Todos Santos Cuchumatán	1	7	8
	Total number	**10**	**29**	**39**
	Total percentage	**26**	**74**	**100**
Quiché	Nebaj	3	9	12
	Chajul	1	9	10
	Cotzal	0	10	10
	Sacapulas	4	4	8
	Cunén	1	0	1
	Total number	**9**	**32**	**41**
	Total percentage	**22**	**78**	**100**
Total	**Total number**	**19**	**61**	**80**
	Total percentage	**24**	**76**	**100**

Screening and Eligibility of Potential Participants

After randomly selecting the potential participating families, the INCAP study team visited them at their homes, with the support of local personnel from the MSPAS PEC and/or RVC project. The INCAP study team was introduced to the potential participating family and the purpose of the visit was explained. After a potential participating family verbally accepted participating in the screening process, the eligibility of the participant was assessed with a screening form for mothers and children (**Appendix 32** and **Appendix 33**, respectively). Inclusion criteria for participation in the data collection included: a) children 6–23 months of age and b) pregnant or lactating women at least 18 years of age at the time of contact. Exclusion criteria for the study were: a) child born with congenital malformation or other disability (physical or mental) or b) child experiencing a severe illness. Immediately after the screening was conducted and the consent form was signed, the interview was carried out by project staff.

When the desired number of recruited families was achieved in each community, the recruitment activities were stopped and the field staff moved on to the next selected community.

2.1.4 Training of Data Collectors

Field supervisors with nutrition training (e.g., registered dieticians) planned and conducted the data collection in the field. Data collection staff trained in dietary assessment were in charge of the 24-hour recalls. Eight data collectors were trained on the specific methodology of the project. The data collection staff were educated personnel with extensive experience conducting health and nutrition surveys, including anthropometrics and dietary assessment using the 24-hour recall methodology. Data collection staff were under the supervision of two nutritionist field supervisors and one nutritionist serving as field coordinator. The study training involved a period of 2 weeks of group sessions with presentations on the nature and objectives of the study, procedures, logistics, etc. Specific sessions were dedicated to the review of survey forms question by question. During these sessions, practice exercises were completed, followed by supervised simulations with women volunteers. Training in dietary assessment involved a review of the users' manual with supervised practice exercises, first among the trainees and then with women volunteers. For anthropometric measurements, the training sessions were focused on standardization of the trainees in the measurement of length and weight in children and height and weight in women. There were also practice sessions with volunteer children.

The training sessions were conducted by the study investigators (M. Mazariegos; V. Echeverría), with the support of an experienced trainer (B. Sulecio).

2.1.5 Data Collection Methods

The cross-sectional survey of the four target groups took place from July to September 2012. The majority of data collection took place during the lean or hungry season (Mazariegos and Méndez 2013) in Guatemala, which is from mid-March through August. The implications of the data collection during the hungry season are discussed in the results section. Fieldwork was conducted from Monday through Saturday to ensure representation of normal week days and market days.

2.1.6 Data Collection Tools

Several tools were used to fulfill the specific aims of the study, including a survey tool to collect data on socioeconomic status, demographics, and health; a food security survey, a tool to collect anthropometric data; a 24-hour dietary recall tool to collect dietary data; and an adaptation of the *Pro*PAN survey

modules[18] to collect cost data from local markets. While the socioeconomic, demographic, and health survey tool and the food security survey were not required for the Optifood analysis, they were included by FANTA and INCAP to provide contextual data for the interpretation of the Optifood results. The tool to collect anthropometric data was essential to provide average weight of respondents to calibrate energy and protein requirements to body size as part of the Optifood analysis, as well as to provide information about the current nutritional status of the population studied. Dietary data collected using the 24-hour recall tool was necessary to determine a list of foods consumed by the studied groups and dietary patterns (serving size and frequency of consumption) to provide a basis for the Optifood analysis. Finally, the *Pro*PAN market cost tool was used to provide a price per each 100 edible grams of the foods reported as being consumed by the target population so that Optifood could estimate the affordability of recommended diets. These tools are described in more detail below. The time required to collect the data in each household was approximately 45–60 minutes. All data collection took place in participants' homes, except for the collection of the data on food costs, which took place in major local markets in each municipality.

Tool to Collect Socioeconomic Status, Demographics, and Health Data and Tool to Collect Anthropometric Data

As mentioned, a survey tool that included questions on socioeconomic status, demographics, and health, and a tool to collect anthropometric data were used to obtain an overall description of characteristics of the sample of pregnant and lactating women and children 6–23 months of age and their households (**Appendix 34**). These tools had been developed and tested by INCAP and had been used for similar surveys that INCAP had conducted. The purpose of the anthropometric data was to quantify the nutritional status of the target population, and to use the data on average body weight for specific target groups to determine recommended calorie and protein needs per kilogram of body weight in the Optifood program. An assessment of household food insecurity was carried out using a standardized questionnaire developed by FANTA, the HFIAS, which complemented the data inputs for the Optifood program by informing the potential feasibility of Optifood FBRs to improve nutrient intake in the target population (Ballard et al. 2011). The survey tools were applied with the pregnant woman, the lactating woman with a child under 6 months of age, or the mother or caregiver of a child 6–23 months of age in the household. The information was recorded using a paper data form and pencil.

24-Hour Dietary Recall Tool

The 24-hour dietary recall was carried out using INCAP's instruments (**Appendix 35**) and methodology (Méndez 2012) (**Appendix 36**), with an adaptation to include a question on the weekly frequency of consumption of the foods listed in the 24-hour dietary recall. The dietary assessment was carried out to:

1. Collect inputs needed for use in the Optifood software, including a list of foods consumed by each target group, the median serving size, and the weekly frequency of consumption
2. Compare the current dietary practices with nutritional recommendations using INCAP´s Dietary Recommendations (INCAP 2012), and identify nutrient adequacy of the current diet practices

The INCAP methodology for the 24-hour dietary recall required the recording of all food items, either single foods or recipes for foods prepared in the home, that were eaten by the individual on the previous day, as well as the estimated or calculated serving sizes. The survey team recorded the main meals, snacks, and, in the case of breastfed children, nursing episodes on the 24-hour recall form. Optifood

[18] See information on *Pro*PAN at http://www.paho.org/common/Display.asp?Lang=E&RecID=6048. The manual is aimed at ministries of health, NGOs, and bilateral and international organizations interested in improving IYCF practices to prevent early childhood malnutrition, describes how to design an intervention, and reviews evaluation strategies.

requires data on frequency of food intake, i.e., the number of times each food was consumed per week, so each food item reported by the mother in the 24-hour recall was further investigated to determine the frequency of consumption over the last week. The dietary assessment also included a few questions following the 24-hour recall to determine if there were other foods not mentioned in the 24-hour recall that are regularly consumed. For these foods, the frequency of consumption and estimated median serving size were recorded. Examples of standard portion sizes were used in the field (spoons and cups), as were digital scales for weighing foods. Although data collection for the 24-hour recalls was not staggered, there was good representation of the diet from regular weekdays, weekends, holidays, and market days.

Market Prices Survey Tool

The Market Prices Survey Form (**Appendix 37**) was adapted from a standardized instrument from *Pro*PAN (PAHO 2013) to collect information on the local market costs of foods identified in the 24-hour dietary recall. The market prices survey involved recording the cost of foods in the main market of each of the nine municipalities included in the study. For each food, data were collected, primarily in the morning, on the local food name, prices from various vendors in the market to calculate the average price in the market, and weights to determine price per weight. The average cost per 100 g of the edible portion of each food item was determined for the survey area and this average cost was entered into the Optifood program.

2.1.7 Recruitment Rates

A total of 1,688 potentially eligible participants were identified in the selected communities. Of these, 727 (43% of potentially eligible participants) were contacted, from which 604 (83% of contacted participants) were screened, 569 (78% of contacted participants) were eligible, 569 (100% of eligible participants) consented to participate, and 553 enrolled (76% of contacted; 97% of eligible). A total of 547 participants completed the study and were included in the analysis. Of this total, 392 were children, of whom 202 were 6–11 months of age and 190 were 12–23 months of age, and 155 were women, of whom 75 were pregnant and 80 were lactating. A total of 16 persons (2.8%) refused to participate. The primary reasons for refusal included a lack of time or of interest in participating. One withdrawal case was reported. In six cases, the 24-hour dietary recalls or other key information was missing in the data forms, and, therefore, these six cases (1%) did not enter into the analysis.

Twenty percent of the final sample was obtained from lists of families participating in the RVC, while the rest (80%) were recruited through the PEC program listings. It is important to clarify that the families participating in the RVC (economic productive activity) could also be part of the PEC program coverage that provided basic preventive health services.

2.1.8 Data Quality

Data quality assurance procedures were performed at the field level by supervisors. Completed data forms were reviewed daily. Usually, at the end of the day when the staff returned from field, the supervisor (a nutritionist/field coordinator) reviewed all data forms completed during the day. Completed paper data forms were sent weekly to the INCAP data center in Guatemala City. A senior staff person from INCAP reviewed the data and worked closely with field staff to ensure the quality of the data collected and entered. A trained data processing team entered the data into the specific databases following standardized quality assurance procedures, including double entry, use of summary reports, checking for outliers, etc.

2.1.9 Data Analysis

Analysis of the dietary data was carried out using SAS software version 9.2. The analysis included the calculation of macronutrient content of foods consumed, such as energy, protein and fat, and micronutrients, especially those considered key nutrients that may be lacking in the diet, such as iron and zinc, based on actual intake from the 24-hour dietary recalls. These analyses used the food nutrient values from the INCAP Food Composition Tables for Central America and Panama (INCAP 2007). The adequacies in terms of micronutrient intake were calculated for the target groups—children 6–11 months of age, children 12–23 months of age, and pregnant and lactating women—using INCAP Daily Dietary Recommendations (INCAP 2012).[19]

2.2 Step 2 – Complete Analysis: Methods for Conducting Analysis Using Optifood

2.2.1 Data Entered into Optifood and Model Parameters

Optifood analysis is based on actual dietary patterns of the target groups. Therefore, data related to actual dietary patterns are necessary for Optifood to set the model parameters that will constrain FBRs to what is realistic. (FBRs are defined by the number of required servings per week from individual foods, food subgroups, or food groups to meet, or come as close as possible to meeting, nutrient needs.[20]) In addition to data on dietary patterns, Optifood requires reference values for RDA values and the nutrient content of all the foods that are used for modeling diets. The data requirements for Optifood and their sources for the analysis presented in this report are summarized in **Table 9**.

[19] Note that Optifood provides adequacy of nutrient intake based on dietary patterns, while the data analysis on adequacy of micronutrient intake conducted with SAS was based on actual intake from the 24-hour dietary recalls, adjusted for intra-individual variability given only one 24-hour dietary recall was conducted for each respondent.

[20] Each food in the Optifood FCT is categorized according to 1 of 17 food groups and 1 of the respective food subgroups. Food groups include: grains and grain products; bakery and breakfast cereals; roots; legumes; dairy; meats; fruits; vegetables; fats; sugars; sweets; beverages; miscellaneous (such as condiments, herbs, and sauces); composite meals (e.g., recipes); special fortified products (such as a multiple MNP, lipid-based nutrient supplements); human milk; and savory snacks (such as salty, spicy, or fried snacks). An example of food subgroups includes for fruits: vitamin A source fruits, vitamin C-rich fruits, and other fruits. Each food group has at least one food subgroup that starts with the label "Myfoods_Special and ends with the name of the food group for new or user-defined categories; for example, there is a fruit subgroup call "Myfoods_Special_Fruits and a dairy subgroup called Myfoods_Special_Dairy' The user may use a "special" subgroup to differentiate between any new or unique food being added to the dietary list, compared to regular foods. Examples of "special" foods include chia seeds, amaranth, or fortified foods.

Table 9. Data Requirements for Optifood and the Sources of These Data

Data Requirements	Data Sources
List of foods For each food:	24-hour dietary recall[a]
• Median serving size (g/day or g/meal)	24-hour dietary recall
• Maximum number of times per week consumed[b]	24-hour dietary recall
• Cost per 100 g of the edible portion	Market prices survey
Food group patterns (low, average (median), and high number[c] of servings per week from different food groups)	24-hour dietary recall
Food subgroup patterns (low and high number of servings per week from different food subgroups)[d]	24-hour dietary recall
RDA	INCAP Daily Dietary Recommendations[e]
FCT values	INCAP Central American FCT[f] Optifood FCT U.S. Department of Agriculture (USDA) FCT[g] USDA Retention Factors[h]

[a] 24-hour recall was collected in the cross-sectional survey described in Section 1.
[b] 24-hour recall included a question on the frequency of consumption during the past week for each food reported during the 24-hour recall.
[c] Low, average, and high servings of different food groups defined as the 10th, 50th, and 90th percentiles of consumption of foods from each food group.
[d] Low and high number of servings of food subgroups defined as the 10th and 90th percentiles of consumption of foods from each food subgroup.
[e] INCAP. 2012.
[f] INCAP. 2007.
[g] USDA. 2005.
[h] Nutrient content of raw foods in the Guatemalan FCT, which were consumed in a cooked state, were adjusted for cooking losses using the retention factors presented in: USDA. 2007.

To prepare data for entry into Optifood, summary statistics from the cross-sectional survey were first generated in MS Access.[21] The outputs from MS Access were:

- A list of foods consumed by the target group
- The number and percentage of participants who consumed each food
- The median serving size for each food expressed in grams per day and grams per meal
- The 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles for the number of food servings per week from Optifood specific foods groups[22]
- The 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles for the number of food servings per week from Optifood specific food subgroups[23]

Prior to entering the data into Optifood, the dietary patterns of children 6–8 months old and children 9–11 months old were compared and found to be significantly different. Therefore, the original target group of children 6–11 months old was split into two groups (6–8 months and 9–11 months). In addition, almost all of the children 6–11 months old were breastfeeding, so those who were not breastfeeding were

[21] The MS Access program to calculate the Optifood inputs was provided by Elaine Ferguson of LSHTM in November 2012.
[22] These 7-day estimates were calculated by multiplying the 1-day 24-hour recall data by 7; they were estimated on both a per day and a per meal basis.
[23] These 7-day estimates were calculated by multiplying the 1-day 24-hour recall data by 7; they were estimated on both a per day and a per meal basis.

excluded from the analysis. The dietary pattern of children 12–23 months old who were not breastfeeding was also found to be different than children of the same age who were breastfeeding. Therefore, this age group was split into breastfed and non-breastfed children 12–23 months old. The sample sizes of each of the resulting six target groups are shown in **Table 10**.

Table 10. Sample Sizes of Target Groups by Department

Department	Breastfed 6–8 months	Breastfed 9–11 months	Breastfed 12–23 months	Non-Breastfed 12–23 months	Pregnant Women	Lactating Women
Huehuetenango	60	35	70	27	38	38
Quiché	50	47	71	21	30	41
Total	**110**	**82**	**141**	**48**	**75**	**79**

As a result of separating the children into age groupings, the sample size for each age group was very small for each department. Therefore, to have sufficient data to define the model parameters, it was necessary to combine data for the two departments. Before combining the departments, the dietary patterns of the target groups across the two departments were compared (see **Section 3.1**). The most commonly consumed foods were very similar for all of the target groups; there are no region-specific foods. Therefore, it was assumed that FBRs developed using Optifood could be applicable to both departments.

Food Lists

A list of foods for each target group was entered into Optifood. The inclusion criteria for these lists were:

- The food was consumed by ≥ 5% of the target group.
- The food was consumed by < 5% of the target group, but it was a good source of nutrients, it could be promoted for consumption, and a similar food was not already included in the food list based on the first criterion, i.e., consumed by ≥ 5% of the target group.

The exclusion criteria from these food lists were:

- Water
- Condiments consumed in small amounts

Breast milk was added to the food lists for target groups of breastfed children.

Overall, 210 foods were consumed by the study participants. The most commonly consumed foods were sugar (fortified with vitamin A) (consumed by 78%–97% of each target group), tomatoes (58%–84%), coffee (53%–88%), tortilla prepared from white maize (64%–74%), onion (54%–64%), reconstituted dehydrated soup (35%–51%), vegetable oil (24%–56%), and potatoes (without skin) (35%–51%).

From these 210 foods, 61 were selected to be used in the Optifood analysis (see **Appendix 12**): 50 because they were consumed by ≥ 5% of a target group and 11 because, while they were not commonly consumed, they were nutrient-dense foods that were found to be present in the area and therefore could be promoted for consumption to improve diet quality in a target group (see starred foods in the table in **Appendix 12**). The food lists, however, varied for each target group, ranging from 42 foods for children 9–11 months old to 49 foods for non-breastfed children 12–23 months old.

Food Serving Sizes

The median observed serving size of each food was entered into Optifood (see **Appendix 12**). Food serving sizes were defined on a meal basis (g/meal) or on a day basis (g/day), depending on the food group. A day-basis serving size was used (g/day) for all foods except those in the food group "Grains and Grain Products." The meal-based serving size (g/meal) was used for foods in the "Grains and Grain Products" food group because there was great variation in the number of times foods from this group were eaten per day and foods from this food group provided substantial amounts of energy, so it was important to accurately represent amounts consumed each day and allow for more precision in defining the food patterns for this food item. For example, tortillas were usually eaten two times per day and tamalitos eaten one time per day. For children 6–8 months of age, a serving of tortilla was 13 grams, usually consumed twice per day, while a serving of tamalito was 35 grams, usually consumed once per day, so the median daily portions of tortilla versus tamalito represented significantly different serving sizes. For all food groups, a serving size was defined by the median daily (g/day) or meal-based (g/meal) serving sizes generated in the MS Access outputs for each target group.

For foods modeled using a daily serving size, the serving sizes ranged from 0.4 g/day for coffee powder to 460 g/day for pumpkin; those modeled using a meal-based serving size (i.e., all grains and grain products) ranged from 4 g/meal for fortified instant oats to 414 g/meal for tamalito. Across all target groups, the portion sizes for 55% of foods were estimated from 10 or more consumers, although 26% of foods were estimated from fewer than 5 consumers.

Breast milk consumption was not measured in this study; instead, the estimations of average daily breast milk intake for breastfed children 6–8 months old, 9–11 months old, and 12–23 months old was determined by subtracting the median energy intake from complementary foods estimated from the 24-hour dietary recall data from the average energy requirements for each age group from the INCAP Daily Dietary Recommendations, divided by the USDA standard energy content per gram of breast milk (0.7 kcal/g) (INCAP 2012; USDA 2005) (**Table 11**).

Table 11. Average Breast Milk Intake per Day Input in Optifood by Target Group

	Average energy requirements (kcal)	Median energy intakes from complementary foods (kcal)	Average breast milk intake (g/day)	
Breastfed children 6–8 months (n=111)	620	268	(620 − 268) / 0.7 =	503
Breastfed children 9–11 months (n=83)	700	353	(700 − 353) / 0.7 =	496
Breastfed children 12–23 months (n=142)	850	512	(850 − 512) / 0.7 =	483

Food Frequency

In Optifood, the minimum and maximum numbers of days per week that each food can be consumed are defined based on the 24-hour recall findings, to help ensure the development of realistic FBRs. These frequencies are multiplied by the food's median daily serving size to define the lowest and highest quantities (g/week) of each food that can be realistically included in each diet. In general, the minimum frequency for all foods was 0, i.e., a diet can be selected without the food in it. The exception was a food that was eaten by all individuals in a target group, which in this study was breast milk for the three target groups of breastfed children. For these children, the minimum frequency for breast milk was 6.9 servings

per week and the maximum frequency was 7.0. (A value of 7.0 was not used for the minimum frequency because the minimum and maximum values must be different for the analysis to run.)

For each food, the maximum frequency was defined as the 90th percentile of each target group's food frequency distribution. (See **Appendix 12** for the maximum frequency for each food entered into Optifood.) These percentiles were generated from the food frequency data collected for foods reported in the 24-hour recalls. In cases where a food was eaten more than once a day, the highest frequency was used, i.e., if a food was eaten 2 times per week at lunch and 5 times per week at dinner, a maximum frequency of 5 times per week was entered into the database. In cases where a food was not eaten, a value of 0 was entered in the database. Thus, for any individual, the maximum weekly frequency for each food could range from 0 times per week (food not consumed) to 7 times per week.

To generate the maximum frequencies for foods in the "Grains and Grain Products" food group, that is, foods where serving sizes were defined in grams per meal, the maximum frequency was defined as the 90th percentile of each target group's food frequency distribution adjusted to a per meal basis, rather than a daily basis.[24]

Food Groups and Food Subgroups

In Optifood, constraints are set on the number of servings per week from individual food groups and food subgroups to ensure that the diets modeled conform to the observed target group's food pattern ranges. For each food group, the minimum, average,[25] and maximum number of servings per week was defined by the 10th, 50th, and 90th percentiles generated by the MS Access program, and then the data were entered into Optifood. For food subgroups, the minimum and maximum number of servings per week was defined by the 10th and 90th percentiles generated by MS Access and then entered into Optifood. The minimum, median, and maximum number of servings per week for food groups and minimum and maximum number of servings per week for food subgroups for each of the target groups is shown in **Appendix 13** and **Appendix 14**, respectively.

For all food groups except "Grains and Grain Products," the 10th, 50th, and 90th percentiles from the MS Access outputs were expressed on a daily basis. For "Grains and Grain Products," the 10th, 50th, and 90th percentiles from the MS Access outputs were expressed on a meal basis.

For several food groups and food subgroups, the lowest level constraint was 0, meaning a diet can be selected that does not include these foods. In cases where the 50th percentile for the food group was 0, a value of 1 was entered in Optifood to avoid mathematical divisions by 0. In cases where the 10th, 50th, and/or 90th percentiles were identical, adjustments were made to the lowest and highest number of servings per week because the low, average, and high number of servings per week values that are entered into Optifood must differ. For example, the lowest number of servings from the food group/subgroup was adjusted to the 10th percentile value minus 1, the highest number of servings from the food group/food

[24] Specifically, the frequency of consumption on a per meal basis is calculated in the following way: a) if the 90th percentile was fewer than 7 servings per week and the size of a serving at a meal and the size of the serving for the entire day were similar, the simple 90th percentile was used; b) if the 90th percentile was 7 servings per week and the size of the serving at a meal and the size of the serving for an entire day were different, the 90th percentile values were adjusted based on the ratio of the day-based serving size to the meal-based serving size. So if the day-based serving size of tortilla was 26 grams and the meal-based serving size of tortilla was 13 grams, a ratio of 2 (26/13) was used to adjust the 90th percentile on a grams/day basis to a grams/meal basis, so a maximum frequency of 7 times per week would be adjusted by a factor of 2, to 14 times per week.

[25] In the Optifood program, the labels minimum, average, and maximum are used to define the constraints for food groups. The values given for "average" constraints are defined by the 50th percentile or median consumption of items from a food group by members of a target group.

subgroup was adjusted to the 90th percentile value plus 1, and the average number of servings for the food group (i.e., the food pattern goal) was equal to the value observed (i.e., the 50th percentile).

Food Cost

The cost per 100 g of the edible portion for each food was entered into Optifood based on the cost data from the market prices survey completed by INCAP. **Appendix 12** includes the cost per 100 g of the edible portion for each food.

Dietary References

RDA values, adequate intake (AI) values, and protein and energy requirements found in the INCAP Daily Dietary Recommendations were entered into Optifood for each of the target groups (**Appendix 15**) (INCAP 2012). The RDA is defined as the average daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97%–98%) healthy individuals in a particular life stage and gender group (Otten et al. 2006). The RDA is set by adding two standard deviations (SD) to the estimated average requirement (EAR). The EAR is the average daily nutrient intake level that is estimated to meet the nutrient needs of half of the healthy individuals in a life stage or gender group (Otten et al. 2006). When an RDA cannot be determined, an AI value is used. The AI is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate (Otten et al. 2006). To simplify language in this report, "RDA" refers to both RDA and AI values.

Food Composition Table

An FCT based on the INCAP Central American FCT was created and entered into Optifood (INCAP 2007). The new entries added to the Optifood FCT were carefully scrutinized for missing or incorrect values; any such entries were then imputed from either the Optifood FCT or the USDA FCT database (USDA 2012), after adjusting for the differences in moisture, using the USDA retention factor, that result from cooking. The sources for these imputed values were recorded in the comments section of the user-defined Guatemalan food composition values in the Optifood FCT. Zeroes or missing values in the INCAP Central American FCT for folate were also scrutinized.[26] If data for folate were not available in the INCAP FCT, values were imputed from the USDA database, after adjusting for differences in moisture. Folate values were not taken from the USDA database for cereals because of the practice of folate fortification in the United States.

For Incaparina,[27,28] the food composition values were calculated from packet information of Incaparina "Tradicional," the version of Incaparina designed for the general population that was consumed by all six target populations. Finally, in the INCAP Central American FCT, values appeared unrealistically high for the iron content of potatoes and the riboflavin content of tamalitos[29] prepared from yellow and white corn.

[26] Missing values for folate in the INCAP FCT were due to lack of availability of the data when they were sourced externally for the INCAP FCT.

[27] Incaparina is a fortified corn- and soy-based flour commercially produced in Guatemala by Alimentos S.A. It is fortified with iron, zinc, calcium, thiamine, riboflavin, niacin, vitamin B12, vitamin B6, folic acid, and vitamin A in four formulations. Incaparina is consumed by family members, as a complementary food for children 6–23 months, and by pregnant and lactating women.

[28] Vitacereal, a complementary food similar to Incaparina, was not included in the Optifood analysis as it did not appear in the observed diets. At the time of data collection Vitacereal was not yet being distributed by the GOG. See Section 3.4.8 for further discussion of Vitacereal.

[29] Tamalitos are a maize-based food prepared in a similar manner to tamales. Stone-ground, nixtamalized maize dough is wrapped in plantain leaves or corn husks and steamed.

For potatoes and tamalitos, realistic values were imputed from similar foods in the USDA and INCAP FCTs, after adjusting for differences in moisture.

Food composition values in the INCAP Central American FCT are for foods in their raw state. To avoid overestimating nutrient intakes from foods consumed in their cooked state, their nutrient values were adjusted for cooking losses using the USDA retention factors (USDA 2007). These adjustments meant that the food composition database uploaded into Optifood contained nutrient values for raw foods that were adjusted to reflect losses during cooking. These food composition data were appropriate because the food consumption data, for ingredients from cooked foods, were recorded in the equivalent of their raw ingredient weights.

2.2.2 Data Analysis in Optifood

Module 1: Check Diets

After entering the data described above for each target group, Module 1 of Optifood was run and the outputs were examined. Module 1 tests the constraints previously set in the food lists, food groups, and food subgroups to ensure that there is sufficient flexibility in food choices for modeling diets and to ensure at least some individuals from the target population could consume the diets generated by Optifood. If any of the resulting test diets were deemed to be unrealistic, changes were made to the model parameters to ensure that the modeled diets could realistically be consumed by the corresponding target population.

Changes Made from Observed Food Patterns. Several model parameters were changed to ensure consistency in terms of average servings per week (food groups only) and upper and lower limits of servings per week (food groups, food subgroups, and individual foods), or to test an FBR that included a food that was not in an original food list for a target population.

- For breastfed children 6–8 months old:
  - The maximum frequency constraint on fortified instant oats[30] was increased from 1 to 7 servings per week to test the FBR of 2 servings per day of fortified grains (i.e., Incaparina and fortified instant oats).
  - The maximum constraint on vitamin C-rich fruits was increased from 1 to 7 to be consistent with the maximum frequency constraint on lemons and oranges.
  - A minimum of 3 servings of "Added Sugars" was set to correspond with the minimum servings (5) observed for other target groups.
- For breastfed children 9–11 months old:
  - No changes were made
- For breastfed children 12–23 months old:
  - Constraints for vegetable subgroups were increased to ensure consistency with the overall vegetable food group and individual food constraints (increased by 1 for "other vegetables" and by 2 for "vitamin A-source vegetables").
- For non-breastfed children 12–23 months old:
  - To ensure consistency with the Optifood constraints for the food group "animal source foods," the maximum numbers of servings for individual foods in this group were increased by 0.5 servings/week for lamb (from 0.5 servings/week) and by 1.0 serving/week for eggs and chicken (from 4 and 1 servings/week, respectively). Similarly, the individual food constraint

[30] The instant fortified oats consumed by the target population and analyzed by Optifood in this project are fortified with iron, zinc, calcium, vitamin B12, niacin, folic acid, thiamine, and vitamin A.

for "black beans" was increased from 3 to 7 servings/week to correspond to the constraints for the legume food group.
    - The maximum numbers of servings per week for fortified instant oats and Incaparina were increased to 7 for each one (from 3 and 1 servings/week, respectively) to test an FBR of 2 servings per day of fortified grains.
- For pregnant women:
    - While not consumed by pregnant women in the sample, liver was added to the food list for this target group to enable the evaluation of a liver FBR. The serving size and constraints were set using the values for liver in the food list for lactating women.
- For lactating women:
    - No changes were made

In addition to these changes, all grains that could be prepared as *atoles*[31] were categorized into a "Special Grains" food subgroup to limit the number of *atoles* selected in a 7-day diet to ≤ 2 servings per day. Only tortillas and tamalitos were classified as staples, and the lowest constraint level for staples was set as ≥ 7 servings per week.

Module 2: Identify Draft Recommendations

To fully explore the diets of and potential recommendations for the study population, four types of analysis per target group were run in Module 2. For each analysis the two best diets were generated.

1. In the first analysis, the food list included all foods originally selected for the Optifood analysis, as guided by the results of the 24-hour recalls in the cross-sectional survey.
2. In the second analysis, highly fortified foods—Incaparina and fortified instant oats—were excluded from the food list.
3. In the third analysis, the FAO/WHO (2004) and WHO/FAO/United Nations University (UNU) (2007) recommended nutrient intakes (RNIs) for micronutrients and protein were used for all child target groups instead of the INCAP Daily Dietary Recommendations. For pregnant and lactating women, the INCAP recommendations were replaced with the Institute of Medicine (IOM) 2001 (USA-Canada) (National Research Council 2001) estimates adjusted for low bioavailability of iron in the diet.
4. In the fourth analysis, the International Zinc Nutrition Consultative Group (iZiNCg) RDAs (Brown et al. 2004) for zinc, assuming low bioavailability, were used instead of the INCAP RDAs for zinc. For all other nutrients, in this fourth analysis, the INCAP Daily Dietary Recommendations were used.

The first analysis was used to identify the best food and food subgroup sources of micronutrients in existing diets, based on current food supply; to formulate and test the FBRs; and to generate the lowest-cost nutritionally best diets using Modules 3 and 4. The additional analyses (Steps 2–4 above) were carried out to provide information on whether or not nutritionally adequate diets could be selected using unfortified local foods alone (second analysis) and to assess the sensitivity of results to the dietary reference values used (third and fourth analyses).

[31] *Atole* is a traditional hot, cereal-based beverage, commonly used to feed children and pregnant or lactating women. It is usually prepared with water, sugar, and a ground cereal, legume, or maize flour in a diluted form, and is the most common and accepted way of preparing Incaparina and Vitacereal (Estrada et al. 2007). The preparation of food as *atole* has been recognized as a contributor to protein malnutrition in young children because of the low protein content of flours commonly used (corn, rice, or yucca/starch) and the tendency for over-dilution (Barenbaum et al. 2001).

In all analyses, Module 2 was initially run to select the two best diets:

- Diet A: A diet that comes as close as possible to achieving the target population's RDAs for selected nutrients while adhering to the set dietary patterns as much as possible (defined by median consumption for food groups, set at 50th percentiles of observed consumption, labeled as "average" consumption in the Optifood software)
- Diet B: A diet that comes as close as possible to meeting the target population's RDAs, without taking dietary patterns into account

The selected nutrients for both diets included protein; calcium; iron; zinc; vitamins A, C, B1, B2, B3, B6, and B12; and folate. They also included achievement of 30% of energy from fat. If the RDAs and/or "average" food pattern goals[32] were achievable, for any target group, then the diet's cost was also minimized to select the best diet.

The results from these analyses, specifically the differences between Diets A and Diets B, were used to identify problem nutrients, i.e., nutrients for which the requirements are not able to be met using local food sources. The first analysis (analysis that included Incaparina and fortified instant oats) was also used to help formulate draft FBRs to test and compare using Module 3. The draft FBRs were selected using a systematic process that included:

- An examination of the changes that occurred in food group patterns in order for nutrient requirements to be met
- Identification of the best food sources of nutrients and subgroup sources of nutrients as per the results of Diets B

The draft individual FBRs defined the number of servings per week of individual foods, food subgroups, and/or food groups, and are described below.

Module 3: Test Draft Food-Based Recommendations

Before testing the draft FBRs, Module 3 was first run without adding any new constraints (i.e., based on observed [low or average consumption] dietary practices as opposed to diets that included any FBRs) to provide a benchmark diet against which to compare different FBRs. This benchmark diet could be used to compare nutrient levels when testing each FBR to assess whether the percent RDA of each nutrient that was being covered in the worst-case scenario[33] was a significant improvement compared to the existing practices. This first run was also used to distinguish between problem nutrients, resulting in a list of "absolute" and "partial" problem nutrients, as described below.

The Module 3 analysis generates 34 diets per run. In one set of diets (17 of the generated diets), energy and each nutrient were individually maximized to show the nutrient levels that could be achieved in the best-case scenario; a nutrient's highest achievable level in any diet, expressed as a percentage of its RDA (e.g., a diet with the highest achievable calcium content, a diet with the highest achievable protein content, etc.). The best-case scenario nutrient levels from these analyses were used to define the absolute and partial problem nutrients. An absolute problem nutrient was defined as a nutrient whose best-case scenario level was less than its RDA (i.e., the RDA could not be met using local foods and local food patterns). These nutrients will likely remain inadequate given the local food supply and the target population's food consumption patterns. Partial problem nutrients were defined as those whose best-case

[32] Based on median or 50th percentile of consumption of particular food groups.

[33] The "worst case scenario" refers to a diet with the lowest possible level of a nutrient (% RDA) possible, given minimum and maximum constraints and any FBRs that need to be followed.

scenario levels met or exceeded their RDAs, but whose levels in the Module 2 best diets were below their RDAs, meaning that meeting the RDAs would likely have detrimental effects on the intake of other nutrients given local food patterns because foods with other nutrients would need to be replaced by the problem nutrient. In contrast, in the other set of diets (the remaining 17 diets), each nutrient was individually minimized to show the worst-case scenario nutrient levels: a nutrient's lowest possible level in any diet, expressed as a percentage of its RDA (e.g., a diet with the lowest possible calcium content, a diet with the lowest possible protein content, etc.).

The objective of the FBRs developed using Optifood is to promote a diet for the target group with the highest level of nutrient adequacy possible, given local food availability and food patterns. The results of Module 3 display the minimum (or "worst-case scenario") percentage of RDAs for selected nutrients that would be met if an FBR or a set of FBRs was put into practice. The criterion for determining whether a particular FBR or set of FBRs will ensure nutrient adequacy is a worst-case scenario level of ≥ 70% of the RDA for a particular nutrient. The worst-case scenario level simulates the lower tail, approximately the 5th percentile, of a nutrient intake distribution and aims to ensure that the prevalence of inadequacy in the target group is no more than 2%–3%. The illustration in **Appendix 31** uses iron intake among breastfed children 6–8 months to illustrate this concept.

The choice of ≥ 70% of the RDA as the criterion of acceptability is somewhat arbitrary and lower cutoffs have been used in other Optifood projects (Skau 2013).

However, the number of individuals in a target population at risk of inadequate nutrient intakes would progressively increase as the worst-case scenario levels fell farther below 70% of the RDA.

The Module 3 analyses were done in three stages, for each target group, using a series of iterative steps in each stage. In the first stage, a set of FBRs was chosen that would best ensure a nutritionally adequate diet for the target population. In the second and third stages, this set of FBRs was carefully scrutinized to determine the importance of each individual FBR in the set. In addition, in the third stage, alternative sets of FBRs, based on different combinations of the individual FBRs selected in Stage 1, were tested to determine the nutritional and cost implications of using a simpler set of FBRs than the final one selected. Each of these stages is described below.

Stage 1. Stage 1 involved five steps.

1. Approximately 15 individual draft FBRs (number of servings/week for a food group, subgroup, or individual food, e.g., 7 servings/week of dairy products), based on the Module 2 results, were selected.
2. Each FBR was tested using the Module 3 analyses.
3. The worst-case scenario results for each FBR were compared on the basis of micronutrients (% of RDAs) and cost to select subsets of FBRs for further testing. The criteria for selecting individual FBRs for combination into subsets of FBRs were that their worst-case scenario level was ≥ 70% of the RDA for a particular nutrient or, when none of the FBRs tested achieved 70% of the RDA for a nutrient, FBRs with the highest worst-case scenario levels were selected.
4. The subsets of FBRs were tested together via the Module 3 analyses.
5. The worst-case scenario results for the subsets were again compared on the basis of micronutrients and costs.

Iterations of Steps 3 and 4 were continued until a final set of FBRs was selected for each target group. The criteria used to select the final set of recommendations were cost, worst-case scenario nutrient levels (i.e., ≥ 70% of the RDA), simplicity/feasibility (a subjective judgment in which more general

recommendations were favored over recommending specific foods and commonly consumed foods were favored over rarely consumed foods), and consistency with FBRs selected for other similar target groups. The aim was to select a practical set of FBRs for each target group that would ensure a nutritionally adequate diet, while also being as inexpensive as possible. An additional goal was to make the recommendations similar to those of other similar target groups (i.e., similar recommendations for breastfed and non-breastfed children 12–23 months) to facilitate their promotion.

Stage 2. Once a set of FBRs was selected for each target group, the nutritional importance of each individual FBR within the set was assessed. In this stage, an iterative process was used in which each FBR was individually removed from the entire set of FBRs and the Module 3 analyses were run. The worst-case scenario values for each nutrient were examined to determine if any fell below 70% of their RDAs when an individual FBR was removed from the set. For some FBRs, these analyses were also done with a reduced number of servings per week (e.g., oranges 3 times/week instead of oranges 7 times/ week). These analyses confirmed the nutritional importance of each FBR in the set of FBRs and that the nutrient requirements they helped ensure were met.

Stage 3. In the final analyses, the nutritional and cost implications of selecting alternative sets of FBRs that recommend fewer foods than were originally proposed were evaluated, and the nutritional importance of each individual FBR within the set of FBRs chosen in Stage 1 was again confirmed. In this stage, each individual FBR from the set of FBRs chosen in Stage 1 was systematically combined with other individual FBRs to create sets with one, two, three, four, five, and six FBRs. These analyses covered all possible permutations of the individual FBRs selected in Stage 1. In these analyses, the worst-case scenario nutrient levels (expressed as percentage of their RDA) and the lowest-cost diets, for each permutation, were examined. In addition, the best combinations of FBRs from a given number of individual FBRs were identified. These combinations were selected on the basis of the number of worst-case scenario nutrient levels that were ≥ 70% of the RDAs and the cost of their lowest-cost diet. For example, the best set of FBRs containing two recommendations was identified, the best set of FBRs containing three recommendations was identified, etc. These analyses were done to inform future decisions with stakeholders regarding the final set of FBRs to promote in the Western Highlands.

Module 4: Cost Analysis

While it is possible to set cost as a constraint in the Optifood analysis, this was not used for this project as the research question was focused on identifying the lowest-cost nutritionally best diet as opposed to identifying the most nutritionally adequate diet possible for a particular budget.

Module 4 was run, for each target group, to identify the lowest-cost nutritionally best diet (a diet that was modeled on meeting energy requirements and following existing dietary patterns only). This lowest-cost diet was used as a baseline to explore the cost of adding individual or various sets of FBRs to the diet.

In this module, a linear programming model was first run to determine if all RDAs could be achieved in a diet for the target population using local foods; where they could not be achieved, the highest level achievable for that nutrient was determined. In the second analysis in Module 4, diet cost was minimized with constraints imposed to ensure that a realistic diet according to observed food patterns was selected (constraints on energy, foods, food groups, and food subgroups) and that the desired nutrient levels were achieved (i.e., constraints on nutrients that were set at their RDA levels or the highest levels achievable when their RDAs could not be achieved).

3. Results

3.1 Results from the Cross-Sectional Survey and Information Gathering on Local Dietary Patterns and Food Costs

3.1.1 Background Characteristics

Table 12 shows selected socio-demographic characteristics of households and women who were surveyed.

Table 12. Selected Socio-Demographic Characteristics of Households and Women Surveyed

Characteristics		Huehuetenango	Quiché	Total
Households				
Number of people living in the household (mean)		7.3	7.4	7.3
House owned by respondent or spouse (% yes)		68.8	86.8	77.6
Flooring material is sand, dirt, or clay (% yes)		59.5	62.3	60.8
Access to electricity (% yes)		84.4	53.3	69.2
Household effects (% yes)	Radio	68.8	59.1	64.0
	Television	34.2	25.7	30.0
	Mobile telephone	82.9	78.2	80.6
Access to piped water (% yes)		74.4	90.7	82.3
Purify water using acceptable method (% yes)[34]		95.5	91.1	93.4
Access to latrine or toilet and sewage system (% yes)		87.4	77.9	82.7
Home garden (% yes)		24.3	45.1	34.5
Use of food produced in home garden (% yes)	Sold	7.8	4.4	5.5
	Consumed	65.8	75.2	71.9
	Sold and consumed	25.9	20.6	22.6
Livestock (% yes)		78.9	86.8	82.8
Type of livestock (% yes)	Chickens	93.3	96.9	95.1
	Pigs	37.8	45.3	41.7
	Goats/sheep	14.8	11.2	13.0
	Cows	2.9	7.0	5.32
Use of livestock and/or livestock products (%)	Sold	10.4	16.1	13.3
	Consumed	72.2	57.0	64.4
	Sold and consumed	17.5	26.9	22.3
Women respondents				
Age, years (mean)		26.2	27.8	26.9
Education (%)	Primary or less	58.9	49.0	54.1
	Never attended	28.2	42.0	34.9
Ethnic group is indigenous by enumerator observation (% yes)		72.9	99.6	85.9
Speaks Spanish (% yes)		79.9	53.7	67.1
Language of the interview (%)	Spanish	65.9	45.5	55.9
	Ixil	0.0	33.9	16.7
	Mam	34.1	0.0	17.3
	Quiché	0.0	20.6	10.2

[34] Acceptable methods of water purification were defined as boiling, using chlorine, or solar disinfection.

Selected characteristics of children 6–23 months, pregnant women, and lactating women who participated in the survey are shown in **Table 13**. Consumption by surveyed children of a multiple micronutrient powder (MNP), known locally as "Chispitas," in the 24 hours prior to the survey was low and it is important to mention that the distribution of Chispitas by PEC was in its initial stage of implementation when the survey was carried out. While most pregnant women surveyed were receiving micronutrient supplements as part of their antenatal care, a smaller percentage of women reported receiving micronutrient supplements postpartum. MSPAS protocols include iron and folic acid supplementation for pregnant women and for women 6 months postpartum (MSPAS 2004).

Table 13. Selected Characteristics of Children 6–23 Months, Pregnant Women, and Lactating Women Surveyed

Characteristics		Huehuetenango	Quiché	Total
Children 6–23 months				
Sex (% male)		47.5	49.7	48.6
Age, months (mean)		13.0	13.4	13.2
Consumed supplement in the last 24 hours (% yes)	Iron	9.2	3.9	6.5
	Folic acid	3.9	2.3	3.1
	Chispitas	1.5	37.7	19.6
Pregnant women				
Number of completed months of pregnancy (mean)		6.1	6.6	6.4
Received some form of supplement in last month (% yes)		81.6	86.8	84.2
Reports regularly consuming supplement in last month (%)	Iron	70.6	73.7	72.2
	Folic acid	58.8	63.2	61.1
	Multiple micronutrient	20.6	13.2	16.2
Currently breastfeeding (% yes)		5.4	7.9	6.7
Lactating women				
Received supplements from postnatal care provider (% yes)		32.4	55.3	44.0
Reports regularly consuming supplement in last month (%)	Iron	45.8	41.0	42.9
	Folic acid	29.2	46.1	39.7
	Multiple micronutrient	8.3	2.6	4.8

3.1.2 Household Hunger and Food Security

Food insecurity was measured through two different tools, the Household Hunger Scale (HHS), which focused on lack of food in the household, and additional survey questions on any existing anxiety or concerns about accessing sufficient food and affording a diverse diet (Ballard et al. 2011).[35] The HHS focuses on the food quantity dimension of food access and has been specifically developed and validated for cross-cultural use. The HHS consists of three occurrence questions and three frequency-of-occurrence questions. The HHS occurrence questions ask whether or not a specific condition associated with the experience of food insecurity ever occurred during the previous 4 weeks (30 days). The HHS frequency-of-occurrence questions ask how often a reported condition occurred during the previous 4 weeks: rarely, sometimes, or often (see **Table 14**).

[35] Additional questions regarding concern or anxiety regarding food security were derived from the HFIAS, which is also discussed by: Ballard et al. 2011.

Table 14. Household Hunger Scale

Occurrence questions	Frequency-of-occurrence[a]		Huehuetenango	Quiché	Total
Reports not having food of any kind in house because of lack of money to buy food in last 30 days (%)	No		91.4	94.9	93.1
	Yes	Rarely	6.0	3.1	4.6
		Sometimes	2.6	1.6	2.1
		Often	0.0	0.4	0.2
Reports household member going to sleep at night hungry (without eating dinner) because there was not enough money to buy food in the last 30 days (%)	No		94.8	92.6	93.7
	Yes	Rarely	3.0	3.1	3.0
		Sometimes	1.9	4.3	3.0
		Often	0.4	0.0	0.2
Reports household member going a whole day and night without eating anything at all because there was not enough food in the last 30 days (%)	No		99.6	99.2	99.4
	Yes	Rarely	0.4	0.8	0.6
		Sometimes	0.0	0.0	0.0
		Often	0.0	0.0	0.0
Household hunger categories and HHS (%)	Little or no hunger in the household (household hunger score of 0–1)		97.0	97.3	97.1
	Moderate hunger in the household (household hunger score of 2–3)		3.0	2.7	2.9
	Severe hunger in the household (household hunger score of 4–6)		0.0	0.0	0.0
HHS (median)			0.0	0.0	0.0

[a] "Rarely" is once or twice in the past 30 days.
"Sometimes" is 3–10 times in the past 30 days.
"Often" is more than 10 times in the past 30 days.

According to responses to questions in the HHS, few households reported experiencing recent hunger—defined as a lack of food in the household, members of the household going to sleep hungry, or members of the family going without food for a whole day and night—in the last 30 days (Ballard et al. 2011). Only 3% of households were classified as experiencing moderate hunger according to the HHS.

Responses to additional survey questions related to household food access are shown in **Appendix 1**. The results of these questions indicate that roughly half of households experienced anxiety or concerns regarding food insecurity in the 30 days preceding the survey. In Quiché, 84.4% of households reported worrying about the amount of food in the household and 77.0% reported a family member eating a less diverse diet, as compared to 53.0% and 45.5%, respectively, in Huehuetenango. Therefore, although few households reported experiencing hunger according to the HHS, a large percentage of households, especially in Quiché, reported experiencing problems with food access. This finding is important, as it indicates that even when nutritious foods are locally available, they may not be accessible to a large percentage of the households.

3.1.3 Nutritional Status of Children 6–23 Months

Anthropometric data collected during the cross-sectional survey confirms the results of the 2008–09 ENSMI regarding the severity of chronic malnutrition in Huehuetenango and Quiché. **Table 15** shows the prevalence of stunting (low height-for-age), wasting (low weight-for-height),[36] and underweight (low weight-for-age).[37] By the end of the first year of life, almost half of children in the sample (47.3%) are already stunted. In the second year of life, the prevalence of stunting increases to 70.5% of children. The prevalence of stunting among children 6–23 months is significantly higher in Quiché (64.3%) than in Huehuetenango (52.9%) ($p = 0.02$).

[36] Wasting is defined as weight-for-height < −2 SD from the median of the 2006 WHO Child Growth Standards; see http://www.who.int/childgrowth/en/.

[37] Underweight is defined as weight-for-age < −2 SD from the median of the 2006 WHO Child Growth Standards; see http://www.who.int/childgrowth/en/.

Table 15. Nutritional Status of Children 6–23 Months

	Height-for-age[a]			Weight-for-height[a]			Weight-for-age[a]			
Background characteristic	Percentage < −3	Percentage < −2[b]	Mean z-score	Percentage < −3	Percentage < −2[b]	Mean z-score	Percentage < −3	Percentage < −2[b]	Mean z-score	N
Age (months)										
6–11	14.6	47.3	−1.92	0	0.5	0.15	2.5	17.1	−1.05	199
12–23	33.7	70.5	−2.58	0	2.1	−0.47	7.9	33.6	−1.65	191
Sex										
Male	25.0	61.7	−2.35	0	1.1	−0.18	4.8	27.7	−1.4	188
Female	22.9	55.7	−2.14	0	1.5	−0.14	5.5	22.8	−1.29	202
Department										
Huehuetenango	22.6	52.9	−2.1	0	1	−0.6	4.6	22.9	−1.23	197
Quiché	25.4	64.3	−2.35	0	1.6	−0.26	5.7	27.5	−1.46	193
Total	**23.9**	**58.6**	**−2.24**	**0**	**1.3**	**−0.16**	**5.1**	**25.1**	**−1.34**	**390**

[a] Each of the indices is expressed in SD from the median of the 2006 WHO Child Growth Standards.

[b] Includes children who are below −3 SD from the 2006 WHO Child Growth standards population median.

3.1.4 Nutritional Status of Women

Non-pregnant women were weighed and measured as part of the cross-sectional survey. **Table 16** shows the percentage of women with a body mass index (BMI) classified as underweight (BMI < 18.5), normal (BMI ≥ 18.5 to < 25.0), overweight (BMI ≥ 25.0 to < 30.0), and obese (BMI ≥ 30.0). Approximately two-thirds of non-pregnant women surveyed in Huehuetenango and Quiché had a BMI within a normal range (67%) and almost one-third of women had a BMI classified as overweight or obese (29%). The percentage of women classified as overweight or obese may be overestimated since the sample includes lactating women with infants under 2 months.[38] Few women were classified as underweight (4%).

3.1.5 Infant and Young Child Feeding Practices

Table 17 presents indicators of IYCF practices for breastfed children 6–23 months and non-breastfed children 12–23 months. Almost all (96%) of the children 6–11 months old were breastfed at the time of the survey. Among children 12–23 months old, 75% were being breastfed. Dietary diversity was low among the children surveyed: only 36% of children 6–8 months old, 49% of children 9–11 months old, and 37% of children 12–23 months old consumed food from at least four food groups in the 24 hours preceding the survey (WHO 2008a).[39] A smaller percentage of children in Quiché (32.1%) had adequate dietary diversity as compared to Huehuetenango (46.5%). In contrast, 96% of all children 6–23 months old met the minimum meal frequency as defined by WHO indicators.[40] Among non-breastfed children, diets were of particular concern given that none of the children surveyed were being fed according to WHO's minimum feeding practice standards.

[38] The Demographic and Health Surveys supported by ICF Macro measure BMI in women 15–49 years of age who are 3 months or more postpartum. That is, BMI is not measured in pregnant women or women within 2 months postpartum.

[39] The WHO report on indicators for assessing IYCF practices defines minimum dietary diversity as the proportion of children between 6 and 23 months old who receive foods from four or more groups.

[40] Minimum meal frequency is defined as the proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of two times per day for breastfed infants 6–8 months old, 3 times for breastfed infants 9–23 months old, and 4 times for non-breastfed children 6–23 months old.

Table 16. Nutritional Status of Non-Pregnant Women (Including Lactating Women)

	BMI									
	Huehuetenango					Quiché				
Age (years)	N	Percentage < 18.5	Percentage ≥ 18.5 and < 25.0	Percentage ≥ 25.0 and < 30.0	Percentage ≥ 30.0	N	Percentage < 18.5	Percentage ≥ 18.5 and < 25.0	Percentage ≥ 25.0 and < 30.0	Percentage ≥ 30.0
16–19	18	5.6	83.3	11.1	0.0	15	0.0	73.3	26.7	0.0
20–24	25	4.0	64.0	28.0	4.0	22	4.6	77.2	18.2	0.0
25–29	23	0.0	52.2	34.8	13.0	23	4.4	65.2	17.4	13.0
30–34	13	0.0	61.5	30.8	7.7	23	0.0	60.8	34.8	4.4
35–39	10	0.0	70.0	30.0	0.0	16	12.5	56.2	31.3	0.0
40–44	4	0.0	75.0	25.0	0.0	6	16.7	66.6	16.7	0.0
Total	93	1.6	67.7	26.6	4.1	105	6.4	66.6	24.2	2.9

Note: BMI classifications: Underweight (BMI < 18.5), normal (BMI ≥ 18.5 to < 25.0), overweight (BMI ≥ 25.0 to < 30.0), and obese (BMI ≥ 30.0)

Table 17. Infant and Young Child Feeding Practices

	Among breastfed children 6–23 months, percentage fed:				Among non-breastfed children 6–23 months, percentage fed:					Among all children 6–23 months, percentage fed:				
Background characteristic	4+ food groups[a]	Minimum meal frequency[b]	Both 4+ food groups and minimum meal frequency	Number of breastfed children 6–23 months	Milk or milk products[c]	4+ food groups[a]	Minimum meal frequency[d]	With 3 IYCF practices[e]	Number of non-breastfed children 6–23 months	Breast milk, or milk products[f]	4+ food groups[a]	Minimum meal frequency[g]	With 3 IYCF practices	Number of children 6–23 months
Age (months)														
6–8	36.0	97.3	36.0	111	0.0	33.3	100.0	0.0	3	97.4	36.0	98.2	35.1	114
9–11	50.6	95.2	50.6	83	0.0	20.0	80.0	0.0	5	94.3	48.9	94.3	47.7	88
12–23	47.2	98.6	47.2	142	25.0	6.3	89.6	0.0	48	74.7	36.8	96.3	35.3	190
Sex														
Male	43.2	96.1	43.2	155	0.0	15.2	84.9	0.0	33	82.5	38.3	94.2	35.6	188
Female	44.9	98.3	44.9	178	0.0	0.0	95.7	0.0	23	88.6	39.8	98.0	39.8	201
Department														
Huehuetenango	53.6	97.6	53.6	168	0.0	6.7	83.3	0.0	30	84.9	46.5	95.5	45.5	195
Quiché	35.1	97.0	35.1	168	0.0	12.0	96.0	0.0	25	87.1	32.1	96.9	30.6	183
Total	44.1	97.3	44.4	336	3.6	9.1	89.1	0.0	56	85.7	39.3	96.2	38.0	392

[a] Food groups: infant formula, milk other than breast milk, cheese, or yogurt or other milk products; foods made from grains, roots, and tubers, including porridge and fortified baby food from grains; vitamin A-rich fruits and vegetables; other fruits and vegetables; eggs; meat, poultry, fish, and shellfish (and organ meats); legumes and nuts.

[b] For breastfed children, minimum meal frequency is receiving solid, semi-solid, or soft food at least twice a day for children 6–8 months and at least three times a day for children 9–23 months.

[c] Includes two or more feedings of commercial infant formula; fresh, tinned, and powdered animal milk; and yogurt.

[d] For non-breastfed children 6–23 months old, minimum meal frequency is receiving solid, semi-solid, or soft food or milk feeds at least four times a day.

[e] Non-breastfed children 6–23 months old are considered to be fed with a minimum standard of three IYCF practices if they receive other milk or milk products at least twice a day, receive the minimum meal frequency, and receive solid, semi-solid, or soft foods from at least four food groups not including the milk/milk product group.

[f] Breastfeeding, or not breastfeeding and receiving two or more feedings of commercial infant formula; fresh, tinned, and powdered animal milk; and yogurt.

[g] Children are fed the minimum recommended number of times per day according to their age and breastfeeding status as described in notes [b] and [d].

3.1.6 Most Frequently Reported Foods

The types of foods consumed by all the target groups and in both departments were very similar (see **Appendix 2** and **Appendix 3**). The 10 most frequently consumed foods were maize products, sugar, salt, tomatoes, onions, coffee, black beans, potatoes, dehydrated soup mix, and eggs (for children 12–23 months old). Enriched and fortified foods (e.g., pasta, fortified instant oats, and Incaparina) and GLVs (e.g., nightshade [hierba mora {*Solanum tuberosum*}] and amaranth leaves) were reported less frequently. Animal-source foods, except for eggs, were almost completely absent from the diets. Maize consumption was found to be very high in both departments. However, there are differences in the types of maize consumed and their preparation. In Quiché, more women consumed yellow corn (instead of white) and tamalitos (instead of tortillas). More women in Quiché than in Huehuetenango also reported consuming hot chili.

Processed foods with low nutrient value are shown in **Table 18**. Few "junk foods" were consumed by the women and children surveyed, except for sweetened beverages, which were consumed by 13.5% of women and children.

Table 18. Consumption of Processed Food with Low Nutritional Value by Children 6–23 Months Old and Women

Food	% of children consuming food	% of women consuming food
Dehydrated soup mix, chicken noodle or ramen noodle	48.4	45.8
Dry broth cubes, chicken or beef	32.6	35.5
Sweetened beverages (carbonated or from concentrate)	10.2	18.7
Cookies	6.8	–

3.1.7 Main Food Sources of Nutrients

The main food sources of energy, protein, iron, zinc, calcium, vitamin A, and folate are shown in **Appendix 4** and **Appendix 5**. For all target groups, maize products and sugar (fortified with vitamin A and iron) are the major sources of energy, contributing almost half of the energy in the diets of children and two-thirds of the energy in the diets of women. Due to the quantity of maize products consumed, this category of foods also contributes much of the protein, iron, zinc, calcium, and folate in the diets of all the target groups. Similarly, since sugar is fortified with vitamin A, sugar is the main source of vitamin A. Although sugar consumed in the Western Highlands is also fortified with iron,[41] sugar is not a major source of iron in the diet, which could be a result of the level of fortification (0.9 mg/100 g). In addition to maize and sugar, Incaparina, black beans, potatoes, eggs, and bread provide the majority of nutrients, emphasizing the lack of dietary diversity and low intake of animal-source foods. The majority of protein in the diets of women and children was provided by non-animal food sources, mainly maize, as well as potatoes, black beans, and Incaparina (for children). Eggs provided between 7.5% and 11.3% of dietary protein for children and from 3.9% to 6.0% of protein for pregnant and lactating women (**Appendix 4** and **Appendix 5**).

[41] By law, all sugar in Guatemala is fortified with vitamin A. In some areas of the country, double-fortified sugar with both vitamin A and iron is available; however, fortification with iron is currently not mandatory.

3.1.8 Nutrient Intake and Adequacy

Analysis of adequacy of nutrient intake was based on the INCAP FCT (INCAP 2007) and the INCAP Daily Dietary Recommendations (INCAP 2012). The purpose of the cross-sectional survey was to identify the dietary patterns of the target groups as a basis for analysis in Optifood. To identify the dietary patterns, only one 24-hour recall was required. However, to determine the usual distribution of nutrient intake of a group of individuals to assess the proportion who are at risk of inadequate intakes, it is necessary to conduct at least two 24-hour recalls from each person on nonconsecutive days to avoid overestimates of nutrient inadequacy or to use an analysis of variance based on second 24-hour recalls from a subset of participants to adjust the distribution of observed intake (Otten et al. 2006; Gibson and Ferguson 2008). Given that only one 24-hour recall was obtained for all participants through the cross-sectional survey, it was not possible to report on the proportions of individuals within the target groups at risk of inadequate intakes. The distributions of nutrient intake are shown in **Appendices 6–11**.

Despite the limitation of only one 24-hour recall, it is notable that the amount of energy and protein intake for all child target groups in both departments was in the range of being adequate (**Table 19**). In contrast, the mean estimated energy and protein intake for women in both departments was low compared to the estimated requirements for pregnant and lactating women. However, the SD was large, so it is difficult to know if actual intakes were low. **Table 20** shows the estimated energy and protein intake for pregnant and lactating women based on the 24-hour recall data.

Although the quantity of protein intake among children surveyed seemed sufficient, the quality of protein may be inadequate considering that the majority of protein in the diet was from maize. Very few animal-source foods were consumed and both grains and legumes were often not consumed together. Further details on protein consumption are discussed below.

Figure 6 provides information on the average iron and zinc densities of children's complementary foods, compared to desired densities for iron and zinc. The average iron densities of the complementary foods consumed by breastfed children 6–8, 9–11, and 12–23 months were 1.1 mg/100 kcal, 1.1 mg/100 kcal, and 1.2 mg/100 kcal, respectively. The average desired iron density values are 4.5 mg/100 kcal, 3.0 mg/100 kcal, and 1.0 mg/100 kcal for breastfed children 6–8, 9–11, and 12–23 months, respectively (Dewey and Brown 2003). These results suggest that the iron content in the diet is suboptimal for breastfed children 6–11 months.

The average zinc densities of the complementary foods consumed by breastfed children 6–8, 9–11, and 12–23 months were the same, 0.5 mg/100 kcal. The average desired zinc density values are 1.6, 1.1, and 0.6 mg/100 kcal for breastfed children 6–8, 9–11, and 12–23 months, respectively (Dewey and Brown 2003). These results suggest that the zinc content in the diet is also suboptimal for breastfed children 6–11 months.

Table 19. Energy and Protein Intake from Complementary Food for Children 6–23 Months

	Estimated energy requirement from complementary food based on moderate activity level (kcal)[a,b]	Huehuetenango Mean kcal (SD)	Quiché Mean kcal (SD)	Estimated protein requirement from complementary food (g)[c]	Huehuetenango Mean g (SD)	Quiché Mean g (SD)
Breastfed children 6–8 months	≈ 200	346 (220)	268 (209)	≈ 2	11 (7)	7 (6)
Breastfed children 9–11 months	≈ 300	430 (209)	385 (237)	≈ 3	13 (7)	11 (7)
Breastfed children 12–23 months	≈ 550	578 (367)	612 (313)	≈ 5	19 (11)	18 (10)
Non-breastfed children 12–23 months	≈ 900	924 (546)	1,048 (515)	≈ 16	26 (13)	31 (19)

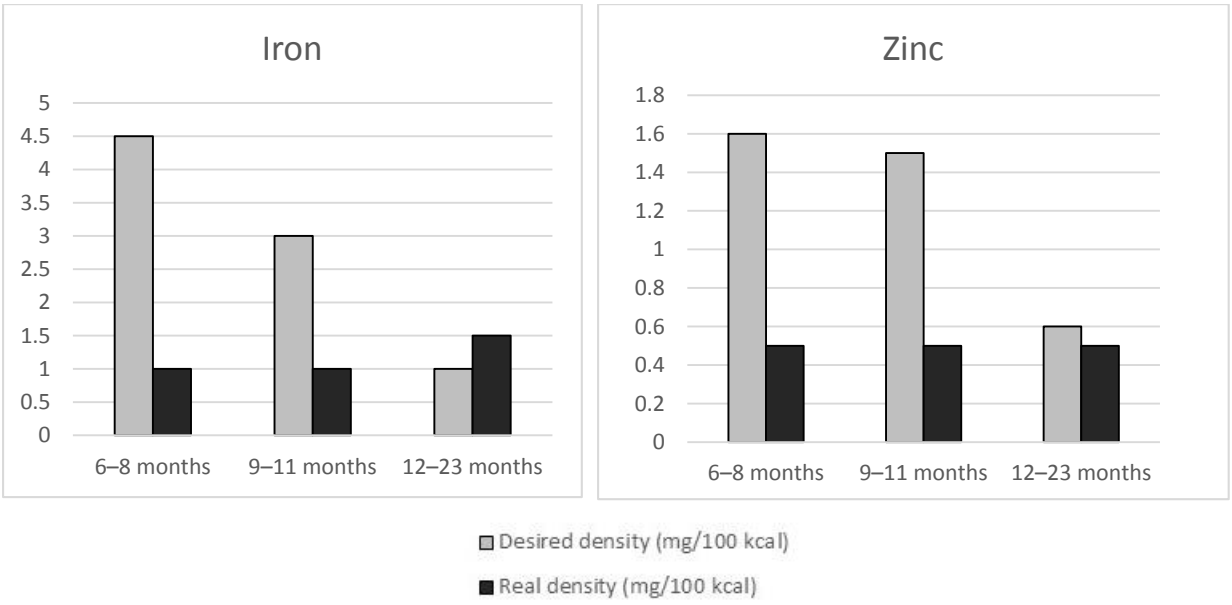
[a] PAHO/WHO. 2003.
[b] WHO. 2005.
[c] WHO/UNICEF. 1998.

Table 20. Energy and Protein Intake for Pregnant and Lactating Women

	Estimated energy requirement based on moderate activity level (kcal)[a]	Huehuetenango Mean kcal (SD)	Quiché Mean kcal (SD)	Estimated protein requirement (g)	Huehuetenango Mean g (SD)	Quiché Mean g (SD)
Pregnant women	≈ 2,700	2,178 (792)	2,255 (993)	≈ 80	68 (29)	68 (37)
Lactating women	≈ 2,900	2,243 (838)	2,730[b] (835)	≈ 85	71 (33)	77 (22)

[a] INCAP. 2012.
[b] Mean comparison between departments, $p < 0.05$.

Figure 6. Average Iron and Zinc Densities of Children's Complementary Foods and Recommended Densities



3.1.9 Protein Consumption

Children

Based on the nutrient density of the complementary food consumed, the average protein density in the diet was 2.9, 2.9, and 3.1 for children 6–8 months, 9–11 months, and 12–23 months, respectively. According to the reference authority used (WHO/FAO/UNU 2007), the average desired values are 1.0, 1.0, and 0.9 for each respective target group, which suggests that the protein content in the diets of each of the child age groups is adequate. Further, the values observed in this study group were higher than those previously reported for Guatemalan children by Dewey and Brown (2003). Despite this, the nutrient density approach to evaluate protein intake does not take into account the quality of the protein consumed. Although protein intake from complementary foods for all child target groups in both departments was in the "adequate" range, the quality of protein may be inadequate considering that the majority of the protein in the diet was from maize and that very few animal-source foods were consumed. Additionally, grains and legumes were not often consumed together, an important distinction, as this combination provides the essential amino acids for a complete protein. However, analysis of essential amino acids in the diet was beyond the scope of this activity. Building on **Appendix 4,** the presence of animal foods as a protein source in the diets of young children was as follows.

- **Breastfed children 6–8 months.** Within the top 16 foods comprising 80.5% of the protein contribution, chicken eggs were the only animal product, representing about 7.5% of protein contribution.
- **Breastfed children 9–11 months.** Within the top 15 foods, which make up 80% of the protein contribution, only chicken eggs (top 3, representing 7.8% of protein contribution) and cow's milk (top 14) were animal products.
- **Breastfed children 12–23 months.** Within the top 15 foods, which make up 80% of the protein contribution, only chicken eggs, beef, and cow's milk corresponded to an animal product, which combined represented about 15% of protein contribution.

- **Non-breastfed children 12–23 months.** Within the top 14 foods, which make up 80% of the protein contribution, only three foods—chicken eggs (top 2), cow's milk (top 10), and beef (top 12)—corresponded to an animal product, which combined represented about 15% of protein contribution.

Women

The mean ± SD (median) protein intake in pregnant women was 68.2 ± 28.9 (69.0) g for Huehuetenango and 67.8 ± 37.3 (58.7) g for Quiché, meeting about 78% and 66% of required adequacy for each area, respectively (**Table 20**). The mean ± SD (median) intake in lactating women was 70.8 ± 33.4 (66.9) g and 77.0 ± 22.4 (75.6) g for Huehuetenango and Quiché, respectively, with adequacies of 98% and 80%, respectively (**Table 20**). Protein intake is comparable among pregnant and lactating women in Huehuetenango, but in Quiché, lactating women have a higher intake than pregnant women. However, for all groups, the mean intake is relatively low and there was notable variation between respondents. These findings suggest that different patterns may exist in the dietary intake of women during the reproductive cycle in these two neighboring departments, with lactating women from Huehuetenango facing the highest risk of protein deficiency. The top five foods sources of protein for pregnant and lactating women are presented in **Appendix 5.** The presence of animal food in the diets of these target groups was as follows:

- **For pregnant women,** within the top nine foods, which make up 80% of the protein contribution, only chicken eggs (top 3), chicken (top 6), and beef (top 9) corresponded to an animal product, which combined represented about 7.5% of protein contribution.
- **For lactating women,** within the top 5 foods, which make up 80% of the protein contribution, only chicken eggs (top 3) and chicken (top 6) corresponded to an animal product, which combined represented about 7.3% of protein contribution.

Overall, the protein intake of pregnant and lactating women is suboptimal, and therefore presents a risk of protein deficiency. In addition, it is important to highlight the quality of the protein in the diet given the predominance of plant-based sources in this population, in which maize is the main source, accompanied by limited animal food.

3.2 Results from Step 2: Analysis using Optifood

3.2.1 Weekly Food Group Servings Needed to Optimize Nutritional Content of Diets

The numbers of servings of foods from each food group selected in the two best diets as per the results in Module 2 are shown in **Table 21**. The food pattern goal in each model (i.e., observed medians) is shown in parenthesis for each food group and target group. These results show that to optimize the nutritional content of local diets there was an increase in the numbers of servings of vegetables for all target groups from 2 or 3 servings/day of vegetables to 3 or 5 servings/day, depending on the target group. The observed median intakes of dairy products were low in all target groups (< 1 serving/week) and were increased to 1 serving per day in the optimized diets of most target groups. Other food groups that showed an increase in the number of servings per week from the observed median intakes were meat, poultry, or eggs (MPE) (4 target groups), fruits (3 target groups), legumes (3 target groups), and roots (2 target groups). Bakery products and composites increased in the optimized diets of non-breastfed children and adults, presumably to increase the dietary fat content to meet the fat recommendations. For legumes in adult diets and root vegetables in young child diets, their observed intakes were already at or close to once per day, so the absence of an increase with diet optimization was not surprising. Of interest was the decrease in the number of servings of fortified sugar selected in the optimized diets for all target groups to the lowest constraint levels possible.

Table 21. Range in Food Group Patterns (servings/week) Selected for the Two Best Diets from Module 2 and Modeled Food Group Pattern (individual servings/week) Goals[a]

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months		Pregnant		Lactating	
Food Pattern	**Diet A**[c] servings/w	**Diet B**[d] servings/w	**Diet A**[c] servings/w	**Diet B**[d] servings/w	**Diet A**[c] servings/w	**Diet B**[d] servings/w	**Diet A**[c] servings/w	**Diet B**[d] servings/w	**Diet A**[c] servings/w	**Diet B**[d] servings/w	**Diet A**[c] servings/w	**Diet B**[d] servings/w
Added sugars	6 (6)	3	7 (7)	5	7 (7)	5	7 (7)	5	7 (7)	5	7 (7)	5
Added fats	0 (0)[b]	0	0 (0)[b]	0	0 (0)[b]	0	3 (6)	3	4 (0)[b]	4	5 (0)[b]	5
Fruits	1 (0)[b]	1	0 (0)[b]	0	4 (4)	7	7 (0)[b]	7	4 (4)	8	0 (0)[b]	0
Vegetables	14 (14)	28	14 (14)	23	14 (14)	24	21 (21)	35	21 (21)	27	21 (21)	28
Dairy products	7 (0)[b]	7	7 (0)[b]	7	6 (0)[b]	2	7 (0)[b]	7	7 (0)[b]	7	6 (0)[b]	6
Legumes	7 (0)[b]	7	7 (0)[b]	7	7 (0)[b]	7	0 (0)[b]	0	7 (7)	8	7 (7)	7
MPE	2 (0)[b]	2	6 (0)[b]	5	5 (0)[b]	7	6 (7)	6	4 (4)	8	7 (7)	8
Roots												
Grains and grain products	6 (6) 28 (28)	6 29	7 (0)[b] 28 (28)	4 35	0 (0)[b] 28 (28)	3 35	4 (4) 35 (35)	0 30	7 (7) 28 (28)	7 40	7 (0)[b] 35 (35)	0 39
Bakery, breakfast cereal	0 (0)[b]	0	0 (0)[b]	0	0 (0)[b]	0	6 (0)[b]	7	7 (0)[b]	7	7 (0)[b]	7
Beverages												
Composites	7 (7) 7 (7)	0 0	7 (7) 7 (7)	0 4	7 (7) 7 (7)	7 0	7 (7) 11 (11)	7 14	7 (7) 7 (7)	7 12	7 (7) 7 (7)	7 14

[a] The 'average' food pattern (median or 50th percentile) in each model is shown in parenthesis.
[b] The goal entered into Optifood was 1 instead of the observed value of 0 for mathematical reasons. However, these goals were not active in the models.
[c] Diet A is a diet that comes as close as possible to achieving the target population's RDAs for selected nutrients while adhering to the set dietary patterns as much as possible (defined by the 50th percentile or median consumption for food groups).
[d] Diet B is a diet that comes as close as possible to meeting the target population's RDAs, without taking dietary patterns (median consumption of food groups) into account.

3.2.2 Food Sources of Nutrients

The foods providing 5% or more of nutrients in best Diet B, the diet optimized to meet only nutrient requirements without considering dietary patterns, are shown in **Table 22**. These results show that 35 of the 61 modeled foods were good sources of at least one nutrient. Of these 35 foods, 11 were selected 10 or more times as a good source of a nutrient for a target group and 6 were selected for 7 or more nutrients (range of 7–9 nutrients). These 11 foods were[42]:

- Incaparina (39 times; 9 nutrients)
- Tortilla from yellow corn (31 times; 7 nutrients)
- Tamalito from yellow/white corn (25 times; 7 nutrients)
- Nightshade leaves (hierba mora [*Solanum tuberosum*]) (21 times; 8 nutrients)
- Amaranth leaves (21 times; 8 nutrients)
- Oats, instant, fortified (14 times; 7 nutrients)
- Black beans, mature (12 times; 5 nutrients)
- Potatoes (11 times; 3 nutrients)
- Chayote fruit (*Sechium edule*) (10 times; 3 nutrients)
- Eggs, whole (10 times; 3 nutrients)
- Pumpkin, yellow (10 times; 3 nutrients)

[42] The list shows "food source (# of times selected as a good source of a nutrient for a target group; # of nutrients for which it is a good source)."

Table 22. Foods Providing > 5% of the Total Micronutrient Content of the Optifood Diet That Met or Came as Close as Possible to Meeting Nutrient Needs

Calcium	Iron	Zinc	Vitamin C	Vitamin A	Vitamin B12
Tortilla, or other maize products Incaparina Amaranth leaves Nightshade leaves* Milk, powder Cabbage Chipilin leaves** Cheese	Tortilla, or other maize products Incaparina Amaranth leaves Nightshade leaves* Black beans Bread, sweet Oats, instant, fortified	Tortilla, or other maize products Incaparina Black beans Amaranth leaves Chayote/guisquil fruit***	Chayote/guisquil fruit*** Potatoes Pumpkin, yellow Amaranth leaves Nightshade leaves* Cabbage Chipilin leaves** Beans, snap green Tomato, red Tomato tree Onions, bulbs and tops Oranges, sweet	Sugar, fortified Amaranth leaves Pumpkin, yellow Nightshade leaves* Carrots Oats, instant, fortified Chipilin leaves** Turnip greens Eggs, whole Liver Incaparina	Incaparina Milk, powder Eggs, whole Chicken, meat and skin Lamb, meat Frankfurter, beef and pork Liver
Thiamin	**Riboflavin**	**Niacin**	**Folate**	**Vitamin B6**	
Tortilla, or other maize products Incaparina Oats, instant, fortified Black beans Nightshade leaves* Broth, beans Pasta, enriched Oranges, sweet	Eggs, whole Incaparina Milk, powder Oats, instant, fortified Amaranth leaves Tortilla, or other maize products Nightshade leaves* Bread, sweet Chipilin leaves** Liver Pasta, enriched	Tortilla, or other maize products Incaparina Potatoes Oats, instant, fortified Chicken, meat and skin Liver Pasta, enriched Oats, not fortified	Incaparina Chayote/guisquil fruit*** Black beans Oats, instant, fortified Amaranth leaves Nightshade leaves* Pumpkin, yellow Oranges, sweet Cabbage Beans, snap green Broth, beans Corn grains, yellow Pasta, enriched	Tortilla, or other maize products Potatoes Black beans Nightshade leaves* Oats, instant, fortified Amaranth leaves Cabbage Crotalaria leaves Chayote/guisquil fruit*** Chayote/guisquil shoots and leaves***	

* Hierba mora (*Solanum tuberosum*). Note: This should **not** be eaten when the plant is producing seeds.
** *Crotalaria longirostrata*.
*** *Sechium edule.*

The top three food sources and food subgroup sources for each nutrient and target group are presented in **Table 23** and **Table 24**. These results, combined with the optimized nutrient levels in the best Diets A and B and the worst-case scenario results, helped guide the selection of FBRs to test in Module 3. These results show that the important food and food subgroup sources of each nutrient were relatively consistent across all target groups. As a subgroup, whole corn (maize) products such as tortillas or tamalitos were an important source of minerals, thiamin, niacin, and vitamin B6. However, due to the higher nutrient value, yellow corn was consistently selected by Optifood instead of products made from white corn. Nevertheless, yellow corn was not selected for further analysis because INCAP researchers deemed that it was unrealistic that people in the target communities would change their maize crops. *Atoles*, which included Incaparina and fortified instant oats, were within the top three food sources for all nutrients except for vitamin C. Vegetables, especially GLVs, were also important sources of most nutrients, and, depending on the target group, black beans were an important source of folate, thiamin, B6, iron, and zinc. MPE was an important source of B12, riboflavin, and fat. Of the GLVs, amaranth leaves and nightshade leaves (hierba mora [*Solanum tuberosum*]) were the best sources of nutrients and, from the vegetables, it was chayote (*Sechium edule*). Potatoes were an important source of B6. In contrast, fruits were not a main source of nutrients, even for vitamin C, in four of the six target groups' best Diet B.

Table 23. Top Three FOOD SUBGROUP Sources (excluding breast milk) in Ranked Order, of Micronutrients and Fat in the Best Diet That Does Not Take Dietary Patterns into Account (Diet B from Module 2)

	Calcium	Iron	Zinc	Vitamin C	Vitamin A	B12	B1	B2	B3	B6	Folate	Fat
Breastfed 6–8 months	Whole grain GLVs *Atoles*	*Atoles* GLVs Whole grain	*Atoles* Whole grain Other veg	GLVs Other veg Roots	*Atoles* GLVs Vit A veg	*Atoles* Eggs Milk	*Atoles* Whole grain GLVs	*Atoles* GLVs Eggs	*Atoles* Whole grain Roots	Roots Whole grain *Atoles*	*Atoles* Beans Other veg	Eggs *Atoles* Milk
Breastfed 9–11 months	GLVs Whole grain *Atoles*	GLVs *Atoles* Whole grain	*Atoles* Whole grain GLVs	GLVs Other veg Vit C veg	GLVs Fort'd sugar *Atoles*	*Atoles* GLVs Eggs	*Atoles* Whole grain GLVs	*Atoles* GLVs Egg	*Atoles* Whole grain GLVs	Whole grain GLVs Roots	*Atoles* Beans GLVs	Eggs *Atoles* Milk
Breastfed 12–23 months	Whole grain *Atoles* GLVs	*Atoles* GLVs Whole grain	*Atoles* Whole grain Beans	GLVs Other veg Vit C veg	*Atoles* GLVs Sugar	Eggs *Atoles* Milk	*Atoles* Whole grain Beans	*Atoles* Eggs GLVs	*Atoles* Whole grain Beans	Whole grain *Atoles* GLVs	*Atoles* Beans Other veg	Egg *Atoles* Whole grain
Non-breastfed 12–23 months	Whole grain *Atoles* GLVs	*Atoles* Whole grain GLVs	*Atoles* Whole grain Bread	Vit C veg GLVs Other veg	Sugar *Atoles* GLV	Eggs *Atoles* Milk	*Atoles* Whole grain Bread	*Atoles* Egg Bread	*Atoles* Whole grain Poultry	Whole grain GLVs Vit C veg	*Atoles* Vit C veg Bread	Bread Eggs Whole grain
Pregnant women	Whole grain GLVs *Atoles*	Whole grain *Atoles* Beans	Whole grain *Atoles* Beans	Vit C fruit GLVs Other veg	GLVs Vit A veg Sugar	Eggs Proc'd meat Red meat	Whole grain *Atoles* Enrich grain	*Atoles* Whole grain Eggs	*Atoles* Whole grain Poultry	Whole grain Roots Beans	Beans *Atoles* GLVs	Poultry Proc'd meat Whole grain
Lactating women	Whole grain GLVs Cheese	Whole grain *Atoles* GLVs	Whole grain *Atoles* GLVs	GLVs Vit A veg Vit C veg	Organ meat GLVs Vit A veg	Organ meat Eggs *Atoles*	Whole grain *Atoles* Beans	*Atoles* Whole grain Organ meat	Whole grain *Atoles* Poultry	Whole grain GLVs Beans	Beans Other veg *Atoles*	Whole grain Poultry Bread

Veg = vegetables; Vit = vitamin; Fort'd = fortified; Proc'd = processed; *atoles* included Incaparina and fortified instant oats

Table 24. Top Three FOOD Sources (excluding breast milk) in Ranked Order of Fat and Micronutrients in the Best Diet That Does Not Take Dietary Patterns into Account (Diet B from Module 2)

	Calcium	Iron	Zinc	Vitamin C	Vitamin A	B12	B1	B2	B3	B6	Folate	Fat
Breastfed 6–8 months old	Tortilla, Y Nightsh. lvs Tamalito	Fort'd oats Nightsh. lvs Incaparina	Incaparina Tortilla, Y Tamalito	Nightsh. lvs Chayote Potato	Fort'd oats Carrots Nightsh. lvs	Incaparina Eggs Milk	Incaparina Fort'd oats Tortilla, Y	Incaparina Fort'd oats Nightsh. lvs	Incaparina Fort'd oats Tamalito	Potatoes Fort'd oats Nightsh. lvs	Chayote Black beans Incaparina	Eggs Incaparina Milk
Breastfed 9–11 months old	Tortilla, Y Amaranth lvs Nightsh. lvs	Nightsh. lvs Incaparina Amaranth lvs	Incaparina Tortilla, Y Amaranth lvs	Nightsh. lvs Amaranth lvs Chayote	Amaranth lvs Fort'd sugar Nightsh. lvs	Eggs Incaparina Milk	Incaparina Tortilla, Y Fort'd oats	Incaparina Eggs Nightsh. lvs	Incaparina Fort'd oats Tortilla, Y	Potatoes Tortilla, Y Nightsh. lvs	Incaparina Chayote Black beans	Eggs Milk Incaparina
Breastfed 12–23 months old	Tortilla, Y Incaparina Black beans	Incaparina Fort'd oats Black beans	Incaparina Black beans Eggs	Nightsh. lvs Chayote Crotalaria lvs	Fort'd oats Fort'd sugar Eggs	Eggs Incaparina Milk	Incaparina Fort'd oats Black beans	Incaparina Eggs Fort'd oats	Incaparina Fort'd oats Tamalito	Fort'd oats Tortilla, Y Black beans	Black beans Incaparina Chayote	Eggs Incaparina Tortilla, Y
Non-breastfed 12–23 months old	Tamalito Tortilla, Y Incaparina	Incaparina Nightsh. lvs Bread	Incaparina Tamalito Tortilla	Cabbage Nightsh. lvs Beans, snap	Fort'd sugar Nightsh. lvs Incaparina	Eggs Incaparina Milk	Incaparina Tamalito Tortilla, Y	Incaparina Eggs Bread	Incaparina Tamalito Tortilla, Y	Tamalito Tortilla, Y Nightsh. lvs	Incaparina Cabbage Bread	Bread Eggs Tamalito
Pregnant women	Tortilla, Y Tamalito Amaranth lvs	Tortilla, Y Tamalito Incaparina	Incaparina Tortilla, Y Tamalito	Oranges Amaranth lvs Chayote	Lamb liver Fort'd sugar Amaranth lvs	Lamb liver Eggs Frankfurter	Incaparina Tortilla, Y Pasta	Incaparina Liver, lamb Egg	Incaparina Tamalito Chicken	Tortilla, Y Tamalito Potatoes	Black Beans Chayote Incaparina	Chicken Frankfurter Bread
Lactating women	Tortilla, Y Tamalito Amaranth lvs	Tortilla, Y Tamalito Amaranth lvs Incaparina	Tortilla, Y Tamalito Incaparina	Amaranth lvs Pumpkin Chayote	Lamb liver Amaranth lvs Pumpkin	Lamb liver Eggs Incaparina	Tortilla, Y Incaparina Tamalito	Incaparina Liver, lamb Tortilla, Y	Tamalito Incaparina Tortilla, Y	Tortilla, Y Tamalito Amaranth lvs	Black Beans Chayote Amaranth lvs	Chicken Tamalito Bread

Y = yellow corn; Fort'd = fortified; lvs = leaves; Nightsh. = Nightshade

Notes: Nightshade (hierba mora [*Solanum tuberosum*]. Note: This should **not** be eaten when the plant is producing seeds.)
Chipilin (*Crotalaria longirostrata*)
Chayote (*Sechium edule*)

3.3.3 Problem Nutrients

The problem nutrients were explored for diets with and without Incaparina and fortified instant oats and using dietary reference values from different authorities:

- INCAP RDAs[43] (standard dietary reference used in this analysis)
- iZiNCg RDAs
- FAO/WHO RNIs
- IOM RDAs for iron for pregnant and lactating women

Using the iZiNCg RDAs for zinc did not change the results of the analysis when compared with the INCAP RDAs. Differences using the dietary reference values for FAO/WHO, INCAP, and IOM for iron for pregnant and lactating women are shown in **Table 25** (page 53).

Breastfed Children 6–8 Months Old

The results showed that for breastfed children 6–8 months calcium, iron, and zinc were consistent problem nutrients, suggesting that local food sources will not ensure their needs for these three nutrients will be met. Their requirements for niacin would also not be met if Incaparina and fortified instant oats were excluded from the diets. The results showed identical problem nutrients for children 6–8 months old regardless of the dietary references used.

Breastfed Children 9–11 Months Old

For breastfed children 9–11 months old, zinc was the only problem nutrient. Iron also was a problem nutrient when the FAO/WHO RNI that assumes low bioavailability, 18.6 mg/day, was used. The INCAP Daily Dietary Recommendations assume that the diets of children 9–11 months old are of moderate bioavailability and therefore no separate RDA is given for low bioavailability. The FAO/WHO RNI assuming moderate bioavailability, 9.3 mg/day, is similar to the INCAP RDA of 9 mg/day. Therefore, iron is a problem nutrient only when the FAO/WHO RNI assuming low bioavailability is used. A further analysis for all dietary references was run that excluded Incaparina and fortified instant oats from the diets with results showing that iron would also be a problem nutrient for this age group, using all dietary references if these foods were not available/eaten.

Breastfed Children 12–23 Months Old

For breastfed children 12–23 months old, iron was a problem nutrient using the INCAP dietary references. Zinc, calcium, and niacin became problem nutrients when Incaparina and fortified instant oats were excluded from the modeled diets. However, calcium and niacin were only partial problem nutrients, indicating that local food sources could supply adequate amounts of these nutrients but that this would be to the detriment of other nutrients (meaning other nutrients would not be able to be accessed in the same levels). Iron was not a problem nutrient for this age group when the FAO/WHO RNIs were used. The FAO/WHO RNI for iron, assuming low bioavailability, is 11.6 mg/day, compared with 14 mg/day for the INCAP RDA, assuming low bioavailability. With regard to zinc, the opposite situation occurs: It is a problem nutrient when using the FAO/WHO RNIs but not when using the INCAP RDAs.

[43] The INCAP RDAs were developed by an expert panel at INCAP. They were based on RNIs/RDAs from different authorities, including FAO/WHO RNIs, with adjustments for bioavailability

Non-Breastfed Children 12–23 Months Old

For the non-breastfed children, only fat was a consistent problem nutrient in the modeled diets. Breast milk is an important source of fat for this age group. Iron was a problem nutrient for non-breastfed children 12–23 months old when Incaparina and fortified instant oats were not included in the diets. Iron was not a problem nutrient for this age group when the FAO/WHO RNIs were used. The FAO/WHO RNI for iron, assuming low bioavailability, is 11.6 mg/day, compared with 14 mg/day for the INCAP RDA, assuming low bioavailability.

Pregnant Women

For pregnant women, fat was low in all modeled diets, indicating it was difficult to select a diet that provided 30% of energy from fat. Folate and zinc were partial problem nutrients for pregnant women, indicating that local food sources could supply adequate amounts of these nutrients but that this would be to the detriment of other nutrients (meaning that people would have to eat such large amounts of the folate and zinc-rich foods that it would displace foods providing the other nutrients). Vitamin B12 would have been a problem nutrient if liver was not included in the food lists. When Incaparina and fortified instant oats were excluded from the models, folate and zinc became problem nutrients (**Table 29**).

FAO/WHO and INCAP do not provide values for dietary iron requirements in pregnant women because iron intake from food is generally not sufficient to meet nutrient requirements during pregnancy. Analysis using an estimated RDA value (81.3 mg/day) based on the IOM RDA for pregnant women in the third trimester value, and adjusted proportionally for 5% bioavailability of iron in the diet, confirmed that iron is a problem nutrient for pregnant women if only local foods are consumed (without supplementation).

The iron balance in pregnancy depends on the properties of the diet and the amounts of stored iron. In Guatemala, the prevalence of anemia, defined as < 11.0 g/dL for pregnant women and < 12.0 g/dLfor non-pregnant women over 15 years old (World Health Organisation 2001), among non-pregnant women is 21% and among pregnant women is 29% (MSPAS/INE/CDC 2010). The low bioavailability of iron in the diet and probability of a high prevalence of low iron stores make it unlikely that pregnant women in Guatemala can meet their daily requirements for iron. As a result, MSPAS recommends the consumption of 600 mg once per week of ferrous sulfate and 5 mg of folic acid once per week for pregnant women (MSPAS 2004). As INCAP does not provide an RDA for iron for pregnant woman, the INCAP RDA for iron for lactating woman was used for the purpose of modeling the FBRs.

Lactating Women

For lactating women, micronutrients were not problem nutrients unless Incaparina and fortified instant oats were excluded from the food list (**Table 29**). Fat was low in all modeled diets, indicating it was difficult to select a diet that provided 30% of energy from fat. Vitamin B12 would be a problem nutrient if liver was not included in the food lists. When Incaparina and fortified instant oats were excluded from the models, zinc became a problem nutrient, but iron did not. However, iron was a problem nutrient when the IOM RDA for lactating women, adjusted proportionally for 5% bioavailability, was used. The adjusted IOM RDA is 58.8 mg/day as compared with 31.2 mg/day for the INCAP RDA.

Table 25. Problem Nutrients

	Modeled diets included:		Problem Nutrients					
Dietary reference authority	**Incaparina and fortified instant oats (yes/no)**	**Liver (yes/no)**	**Breastfed 6–8 months old**	**Breastfed 9–11 months old**	**Breastfed 12–23 months old**	**Non-breastfed 12–23 months old**	**Pregnant**	**Lactating**
INCAP	Yes	No	Iron Zinc Calcium	Zinc	Iron	Fat	Iron *Zinc* *Folate* B12 Fat	B12 Fat
	No	No	Iron Zinc Calcium Niacin	Iron Zinc	Iron Zinc *Calcium* *Niacin*	Iron Fat	Iron Zinc Folate B12 Fat	Zinc B12 Fat
	Yes	Yes	–	–	–	–	Iron *Zinc* *Folate* Fat	Fat
FAO/WHO, except for iron for pregnant and lactating women, which were based on IOM	Yes	No	Iron Zinc Calcium	Iron Zinc	Zinc	Fat	Iron *Folate* Fat	Iron Fat

Note: Nutrients in italics are partial problem nutrients, defined as those whose best-case scenario levels met or exceeded their RDAs, but whose levels in the Module 2 Best Diets were below their RDAs, meaning that meeting the RDAs would likely be detrimental for other nutrients given local food patterns.

3.3.4 Food-Based Recommendations

In formulating the FBRs for all target groups, only micronutrients were taken into account. Even though fat was a problem nutrient for women and non-breastfed children, dietary requirements are not well established and it is difficult to develop recommendations for fat intake.

Stage 1 of the analyses in Module 3, which derived the set of individual FBRs to evaluate further in Stages 2 and 3, is presented in **Appendices 16–21**. Stages 2–3 of the analyses, which were used to justify the selection of the final set of FBRs, are shown in **Appendices 22–27**. In these sets of analyses, all permutations of the seven final individual FBRs selected in Stage 1 for the final set of FBRs are shown.

The cost of a lowest-cost diet (GTQ/day) that includes the FBR or set of FBRs is shown for each target group in **Table 26** and **Table 27**. It is important to note that the calculated costs of putting the FBRs into practice is inclusive of an existing "base diet"[44] around which the FBRs would be implemented. In Module 3, Optifood generates a "base diet" for the target group that is derived from the observed dietary patterns to show the impact or nutritional value of putting the chosen FBR into place in the context of the existing diet of the target group, showing this diet in either the worst-case (minimized) or best-case (maximized) scenario. As such, the final cost of putting a complete set of FBRs into practice does not equal the sum of putting each individual FBR into practice, but rather the sum of providing each individual food *in addition to* necessary food required to maintain a very basic diet based on observed intakes.

The full set of FBRs for children ranged from 2.0 GTQ/day to 5.2 GTQ/day and the full set of FBRs for women ranged from 10.2 GTQ/day to 12.1 GTQ/day.

The four common messages across all target groups were to:

- Consume Incaparina or fortified instant oats twice a day
- Consume at least four different vegetables every day, including GLVs and chayote (*Sechium edule*)
- Consume beans every day
- Consume potatoes every day

Of these four messages, the message "to consume potatoes every day" was necessary only for children 6–8 months old and pregnant women (**Table 28**). This message could be changed to "consume potatoes at least three times per week" for children 9–11 months old and non-breastfed children 12–23 months old. This message was not required to ensure ≥ 70% of the micronutrient RDAs for breastfed children 12–23 months old and lactating women (**Table 28**). The sub-messages to include GLVs and chayote (*Sechium edule*) were added to the vegetable FBR because they were important vegetable sources of micronutrients in the best diets (**Table 28**).

[44] Two diets (one minimized, one maximized) are constructed to compare the percent of the RNI for each individual nutrient in Module 3 if FBRs were put into place in both the worst- (minimized) or best- (maximized) case scenarios in terms of the existing diet. For each nutrient, Optifood calculates the percent RNI when it is minimized and maximized in diets that include the FBRs and respect the set constraints (such as minimum breast milk consumption). For example, the percent RNI for calcium would be shown in the context of a diet including FBRs where calcium content was minimized (base diet includes lowest amount of calcium possible, given constraints) and maximized (base diet includes highest amount of calcium possible, respecting constraints). As such, it is difficult to define just one base diet, but important to understand that the percent RNI covered by an FBR or set of FBRs shown for minimized diets is in the context of a very basic, existing base diet.

Table 26. FBRs and the Cost (GTQ/day) of the Lowest-Cost Diet That Includes the FBR(s) for Children

FBR	Cost in GTQ/day for: Breastfed Children 6–8 Months Old	Breastfed Children 9–11 Months Old	Breastfed Children 12–23 Months Old	Non-Breastfed Children 12–23 Months Old
Breastfeed your child on demand	–	–	–	–
Feed your child tortilla or tamalito at least three times per day	0.8	1.1	1.5	2.5
Feed your child Incaparina or fortified instant oats in porridge at least twice per day	0.9	1.2	1.7	2.7
Feed your child 4 servings of different vegetables every day, including GLVs and chayote (*Sechium edule*)	1.0	1.4[a]	1.9	2.8
Feed your child potatoes every day	0.9	1.2[b]	1.6[c]	2.6[b]
Feed your child black beans every day	0.8	1.1	1.5	2.9
Feed your child MPE every day	1.6	1.7	2.6	3.7
Full set of FBRs listed above	2.0	2.4	3.5	5.2

[a] The FBR for 4 servings of vegetables was not essential, but the message is then consistent with the younger children's FBRs. An FBR for GLVs every day was sufficient.
[b] The FBR to consume potatoes every day is consistent with the younger children's FBRs. However, this FBR could be changed to "Feed your child potatoes at least three times per week."
[c] The FBR to consume potatoes every day is consistent with the younger children's FBRs. However, this is not essential for breastfed children 12–23 months.

Table 27. FBRs and the Cost (GTQ/day) of the Lowest-Cost Diet That Includes the FBR(s) for Pregnant and Lactating Women

FBR	Cost in GTQ/day for: Pregnant Women	Lactating Women with Infants under 6 Months
Consume Incaparina or fortified instant oats at least twice per day	8.2	10.1
Eat at least four different vegetables every day, including GLVs and chayote (*Sechium edule*)	9.0	10.2
Eat potatoes every day	8.0	9.9[a]
Eat black beans every day	7.9	10.1
Eat liver at least once per week	7.9	10.0
Eat an orange at least three times per week[b]	8.2	9.9[c]
Full set of FBRs listed above	10.2	12.1

[a] The FBR to consume potatoes every day is consistent with pregnant women's FBRs. However, this is not essential for lactating women with infants under 6 months.
[b] If oranges are only seasonally available, then a message to consume vitamin C-rich fruits and vegetables could replace the messages for oranges.
[c] The FBR to consume oranges every day is consistent with lactating women's FBRs. However, this is not essential for pregnant women.

Table 28. Effect of Removing Individual Recommendations from the Set of FBRs for Each Target Group[a,b]

Recommendation and the change made	Breastfed 6–8 months old[c] % RDA	Breastfed 9–11 months old % RDA	Breastfed 12–23 months old % RDA	Non-breastfed 12–23 months old % RDA	Pregnant Women % RDA	Lactating Women % RDA
Incaparina or fortified instant oats 14 servings/week						
• None	Ca 68%; B1 67%; B3 60%; Fe 29%; Zn 36%	Fe 56%; Zn 43%	Ca 65%; B3 52%; Fe 35%	Ca 57%; B12 60%; Fe 45%	Folate 56%; Fe 61%; Zn 55%	Folate 58%; Zn 64%
• 7 servings/week	Fe 47%; Zn 48%	Zn 57%	Fe 54%	Ca 65%; Fe 59%	Folate 63%; Zn 66%	Folate 68%
Vegetables 4 servings/day						
• None	Vitamin C 59%; Fe 61%; Zn 59%	Vitamin C 59%; Zn 67%	Fe 64%	Ca 65%; Vitamin C 51%; Fe 69%	Folate 54%	Folate 67%
• 3 servings/day	Vitamin C 65%; Fe 65%; Zn 59%	Zn 68%	Fe 67%	Ca 67%	Folate 58%	Folate 69%
Black Beans 7 servings/week						
• None	Fe 61%; Zn 59%	Zn 68%	Fe 65%	Fe 68%	Folate 52%	Folate 55%
• 3 servings/week	Fe 63%; Zn 60%	Zn 69%	Fe 67%	OK	Folate 59%	Folate 61%
Potato 7 servings/week						
• None	Vitamin C 64%; Fe 62%; Zn 58%	Zn 69%	OK	Ca 69%	Folate 68%	OK
• 3 servings/week	Vitamin C 68%; Fe 64%; Zn 60%	OK	OK	OK	Folate 69%	
Staples[d] 3 servings/day						
• 2 servings/day	Fe 62%; Zn 58%	Zn 68%	Fe 67%	Ca 53%	Not applicable	Not applicable
MPE 7 servings/week						
• None	Fe 61%; Zn 57%	Zn 68%	Fe 67%; B12 54%	B12 34%	Not applicable	Not applicable
• 3 servings/week	Fe 62%; Zn 58%	Zn 69%	Fe 68%	B12 52%		
Liver 1 serving/week						
• None	Not Applicable	Not Applicable	Not Applicable	Not Applicable	B12 16%; Folate 67%	B12 17%; Vitamin A 63%
Orange 7 servings/week						
• None	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Folate 63%	Not Applicable
• 3 servings/week					Folate 66%	Vitamin C 53%

[a] OK - All nutrients ≥ 70% RDA

[b] Ca = calcium; Fe = iron; Zn = zinc

[c] The FBR for children 6–8 months does not guarantee 70% iron and zinc; for iron = 67% and for zinc = 61%.

[d] Staple foods for the target groups analyzed: tortillas and tamalitos made from white and yellow corn

For all target groups, a combination of six or seven individual FBRs was required to ensure a nutritionally optimal diet for most individuals in the target population. The most critical FBR for ensuring dietary adequacy, for all target groups, was the FBR to consume 2 servings of either Incaparina or fortified instant oats per day in porridge[45] for children and in *atoles* or porridge for women (see rows 1 to 8 in **Appendices 22–27**) (**Table 29**). However, this FBR did not ensure adequate iron and vitamin C for five of the six groups; adequate calcium, folate, and vitamin B12 for four of the six groups; adequate zinc and vitamin B6 for three of the six groups; and adequate vitamin A for two of the six groups. A combination of additional FBRs was essential to improve levels of these nutrients in the selected worst-case scenario diets (meaning that diets containing these foods would ensure nutrient adequacy for the majority of the population).

In formulating sets of FBRs, efforts were made to create consistent messages across all target groups to facilitate their promotion (**Table 30** and **Table 31**). Encouraging similar improved dietary practices across all target groups should help reinforce the messages and result in less disruption to family eating practices. However, it also meant including an unnecessary FBR for some target groups, namely, to consume potatoes daily.

[45] The Spanish word for porridge is "papilla."

Table 29. Problem Nutrients in Modeled Optifood Diets That Came as Close as Possible to Meeting Nutrient Needs (from Module 3 results)

	Breastfed Children 6–8 Months Old	Breastfed Children 9–11 Months Old	Breastfed Children 12–23 Months Old	Non-Breastfed Children 12–23 Months Old	Pregnant Women	Lactating Women with Infants under 6 Months
Iron	Not possible to meet requirement	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF	Not possible to meet requirement	
Zinc	Not possible to meet requirement	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF		Not possible to meet requirement without FBF	Not possible to meet requirement without FBF
Vitamin B12				Not possible to meet requirement without FBF	Not possible to meet requirement without liver	Not possible to meet requirement without liver
Folate					Not possible to meet requirement without FBF	Not possible to meet requirement without FBF
Vitamin C						Not possible to meet requirement without oranges
Niacin	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF	Not possible to meet requirement without FBF		

FBF includes Incaparina or any other blended flour with the same micronutrient content as Incaparina.

Table 30. FBRs without Including Micronutrient Supplementation for Children

In combination with other foods, breastfed children 6–8 months should consume at a minimum (Note: This diet does not meet iron and zinc requirements):				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Tortilla or other maize products	7	3	20	60
Vegetables	7	4	20	80
Potatoes	7	1	55	55
Beans	7	1	25	25
FBF as porridge[b]	7	2	10	20
MPE	7	1	20	20
In combination with other foods, breastfed children 9–11 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Tortilla or other maize products	7	3	25	75
Vegetables	7	4	25	100
Potatoes	7	1	60	60
Beans	7	1	25	25
FBF as porridge[b]	7	2	10	20
MPE	7	1	30	30
In combination with other foods, breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Tortilla or other maize products	7	3	25	75
Vegetables	7	4	35	140
Potatoes	7	1	60	60
Beans	7	1	30	30
FBF as porridge[b]	7	2	15	30
MPE	7	1	35	35
In combination with other foods, non-breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Tortilla or other maize products	7	3	50	150
Vegetables	7	4	40	160
Potatoes	7	1	75	75
Beans	7	1	60	60
FBF as porridge[b]	7	2	15	30
MPE	7	1	40	40

[a] The estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.
[b] The FBF should have similar micronutrient content to Incaparina.

Table 31. FBRs without Micronutrient Supplementation for Pregnant and Lactating Women

In combination with other foods (particularly tortillas and other maize products), pregnant women should consume at a minimum (Note: This diet does not meet iron requirements):				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Vegetables	7	4	85	340
Potatoes	7	1	120	120
Beans	7	1	90	90
FBF[b]	7	2	25	50
Liver[c]	1	1	90	90
In combination with other foods, lactating women should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[a]**	**Total quantity per day (g)**
Vegetables	7	4	80	320
Potatoes	7	1	170	170
Beans	7	1	90	90
FBF[b]	7	2	30	60
Liver[c]	1	1	90	90
Oranges[d]	3	1	205	205

[a] The estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.
[b] The FBF should have similar micronutrient content to Incaparina.
[c] Liver is included in the dietary recommendations so that pregnant and lactating women can meet vitamin B12 requirements.
[d] If oranges are seasonally unavailable, then a message to consume the same quantity of other vitamin C-rich fruits and vegetables could replace the messages for oranges.

Messages differed slightly between children and women (**Table 30** and **Table 31**). For children, a serving of MPE every day and tortilla/tamalito three times per day were recommended, while the FBRs for women included consuming liver once per week and oranges three times per week. Liver was not modeled for children because it was not consumed by any child surveyed. Oranges were not required in the modeled child diets to ensure nutrient adequacy. Messages to consume tortilla or tamalito were not included in the FBRs for women because these foods were habitually consumed in amounts that would help ensure dietary adequacy (i.e., minimum constraints on staples were 14 servings/week for pregnant women and 20 servings/week for lactating women). For women, the feasibility of the recommendation to consume oranges might depend on seasonal access. However, an FBR to consume any type of vitamin C-rich fruits alone did not ensure dietary adequacy, which was likely due to the small serving size modeled for lemons.

For all target groups, except children 6–8 months old and pregnant women, the selected set of FBRs, if adopted, would ensure ≥ 70% for each of their nutrient RDAs was met. For children 6–8 months old, ≥ 70% of the iron and zinc RDAs were not achievable even with a realistic set of FBRs (**Table 29**). For pregnant women, iron requirements are difficult to meet using food sources alone; ≥ 70% of the iron RDA was not achievable even with a set of realistic FBRs. These results for pregnant women and children aged 6–8 months were not surprising because the optimized diets and best-case scenario diet,[46] for zinc, were below 70% of the zinc RDA. For iron, they remained below 100% of the RDA.

[46] Diet modeled to provide the highest amount of zinc possible, based on local food and minimum and maximum constraints for foods and food groups. An RDA of < 100% with the optimized diet shows that even with FBRs and a base diet providing the greatest amount of zinc possible based on observed food patterns, it was not possible to achieve nutrient adequacy using local foods.

In the worst-case scenario diets for all target groups, the number of nutrients remaining below 70% of their RDAs decreased as the number of FBRs per set increased (**Appendices 22–27**). When only one recommendation was tested, even for the best FBR evaluated, between five and seven nutrients did not achieve 70% of the RDA, depending on the target group. This number decreased to between one to four nutrients, when there were two FBRs per set; to between one and three nutrients when there were three FBRs per set; to between one and two nutrients when there were four FBRs per set; and to between zero and two nutrients when there were five FBRs per set, depending on the target group.

The most costly FBRs (analyzed using Module 4) were MPE, vegetables, and Incaparina and fortified instant oats (**Appendices 22–27**). Of these, the FBR for MPE was the most expensive FBR for children, ranging from an increase of between 48% and 100% of the cost of the lowest-cost diet available (a diet that was modeled on meeting energy requirements and following existing dietary patterns only), without following any dietary recommendations. For pregnant women, the FBR for vegetables was the most expensive (an increase of 14% from the lowest-cost diet); for lactating women, it was the FBR for Incaparina and fortified instant oats (an increase of 9%). For all target groups, the recommendation to consume Incaparina or fortified instant oats twice per day increased the cost of the lowest-cost diets from between 9% and 27% compared with the baseline of not adding any recommendation (i.e., following observed dietary practices and meeting energy requirements) depending on the target group.

Children

The Module 2 best diet analyses showed that a diet based on current food patterns that would ensure nutritional adequacy for all individuals in a target group was likely feasible only for non-breastfed children 12–23 months old and only if Incaparina or fortified instant oats were consumed. For other child target groups (breastfeeding children 6–8, 9–11, and 12–23 months old), iron, zinc, and/or calcium were absolute problem nutrients, so 100% of their RDAs will be difficult to achieve using a behavior change strategy based on current dietary patterns alone (**Table 25**). Nevertheless, the worst-case scenario analyses, in Module 3, indicated that there was a set of FBRs that would ensure achievement of ≥ 70% of the nutrient RDAs for all child target groups except children 6–8 months old. At these levels, the nutrient needs of most children in each target group are likely to be met. For children 6–8 months old, alternative strategies, such as micronutrient supplementation, would also be required to meet iron and zinc requirements.

The most critical FBR for children was the FBR to consume 2 servings of either Incaparina or fortified instant oats per day in porridge. It is very important to emphasize that children should not consume Incaparina or fortified instant oats in an *atole*. The common preparation of *atole* is 4 tablespoons of Incaparina or fortified instant oats (approximately 18.5 g/tbsp., giving a total of 74 g) per 1 L of water. For a child 6–8 months old to consume the recommended total of 16 g/day of Incaparina or fortified instant oats, he or she would need to consume 258 grams of *atole*, which is equivalent to about one full meal given the estimated stomach capacity (237 grams) of a child 6–8 months old (Dewey and Brown 2003). Consuming this large quantity of *atole* could decrease the quantities of other foods also necessary to meet nutrient requirements. In addition, it is likely that the *atoles* will be consumed in a bottle, introducing hygiene problems. Therefore, the FBR is to consume Incaparina or fortified instant oats as porridge.

Identical FBRs were formulated for all child target groups, because consistent messages will be advantageous for FBR promotion. For this reason, the FBR to consume potatoes every day was included in the set of FBRs for breastfed children 12–23 months old, even though it was not required to ensure nutrient adequacy (**Table 28** and **Appendix 24**).

An FBR for dairy products was not included in the final set of FBRs for children to avoid inadvertently promoting the consumption of milk in place of breast milk. An FBR for fruit was not included in the final

set of FBRs because it did not have a nutritional advantage over and above the other FBRs selected for children (**see Appendices 16–19**). Further, fruits were generally not commonly consumed by these target populations, so it might have been difficult to successfully promote them.

For children 6–8 and 9–11 months old, iron and zinc were the nutrients that were the most difficult to achieve using locally available foods. For the children 6–8 months old, a set of FBRs that ensured ≥ 70% of their iron and zinc RDAs was not achievable. For this target group, there were seven alternative sets of FBRs that provided ≥ 70% of all nutrients except iron and zinc in the worst-case scenario diets. The number of FBRs in these sets of FBRs ranged from four to the selected six messages (excluding the breast milk message). The lowest costs of achieving these alternative sets of FBRs ranged from 1.1 to 2.0 GTQ/day compared to 2.0 GTQ/day for the selected set of FBRs for the children 6–8 months old. However, in the cheaper sets of FBRs, the percentage of the RDAs achieved for iron and zinc were lower than for the set of FBRs selected (57% vs. 67% and 55% vs. 61%, for iron and zinc, respectively; see **Appendix 22**).

For children 9–11 months old, a recommendation to consume Incaparina or fortified instant oats in porridge twice per day and vegetables four times per day ensured ≥ 70% RDAs of all nutrients except zinc. Achievement of ≥ 70% RDA for zinc required the six FBRs selected. The difference in cost comparing the two versus six message sets of FBRs was 0.7 GTQ/day (**Appendix 23**). For this age group, 14 alternative sets of FBRs achieved ≥ 70% RDAs of all nutrients except zinc.

For children 12–23 months old, calcium and iron were the most difficult RDAs to achieve, although ≥ 70% of all RDAs was achievable for three sets of FBRs (i.e., in two sets of FBRs for the breastfed and in one set of FBRs for the non-breastfed children 12–23 months old) (**Appendix 24** and **Appendix 25**). For breastfed children, six alternative sets of FBRs achieved ≥ 70% of RDAs for all nutrients except iron. Their numbers of messages (excluding the breast milk message) ranged from four to five. Their lowest-cost diets ranged from 3.0 to 3.5 GTQ/day compared with 3.5 GTQ/day for the slightly superior (for iron) set of FBRs selected. However, the percentage of the iron RDA achieved generally declined as the lowest-cost diet's price declined. For non-breastfed children 12–23 months old, achieving ≥ 70% the calcium RDA was as challenging as achieving ≥ 70% of the iron RDA. One of the four-message sets of FBRs and two of the five-message sets of FBRs achieved ≥ 70% of the iron RDA, but not the calcium RDA. One five-message set of FBRs achieved ≥ 70% of the calcium RDA, but not the iron RDA. The lowest-cost diet for these slightly inferior sets of FBRs ranged from 4.7 to 5.2 GTQ/day compared with 5.2 GTQ/day for the selected set of FBRs that achieved ≥ 70% of the RDAs for all nutrients.

Pregnant and Lactating Women

The Module 2 analyses showed that a nutritionally adequate diet was feasible for lactating women using locally available foods, whereas iron, folate, and zinc were problem nutrients for pregnant women, so achieving ≥ 70% of their RDAs using FBRs would be difficult. For lactating women, the message to consume potatoes every day was not essential and could be omitted from the set of FBRs for this target group. If oranges are available only seasonally, then a message to consume other vitamin C-rich fruits and vegetables could replace the messages for oranges, although that might not guarantee that vitamin C RDAs were met (**Appendix 26** and **Appendix 27**).

For all women, the folate RDAs were the most difficult to achieve (without supplementation, which is discussed below). Five sets of FBRs achieved ≥ 70% of RDAs for all nutrients except one (usually folate) for both pregnant women and lactating women. The number of messages in these five sets of FBRs ranged from four to five. Their lowest costs ranged from 9.9 GTQ/day to 10.2 GTQ/day compared with 10.2 GTQ/day for the FBRs that achieved ≥ 70% for all nutrients for pregnant women, and from 11.2 GTQ/day to 11.9 GTQ/day compared with 12.1 GTQ/day for lactating women. For lactating women, the five-message set of FBRs that achieved ≥ 70% RDAs for all nutrients (potato message not included) was

slightly cheaper than the six-message set of FBRs selected to test in community-based trials (i.e., 11.8 GTQ/day vs. 12.1 GTQ/d). The FBR to consume liver once per week might be difficult to promote because this food was rarely consumed. However, this FBR was critical for achieving the RDA for vitamin B12.

3.4.5 FBRs without Micronutrient Supplementation:

As described above, for all target groups, a combination of four to seven individual FBRs was required to meet or come as close as possible to meeting nutrient needs for individuals in all target groups. The final set of FBRs developed for children (not taking into account micronutrient supplementation) is shown in **Table 30**, and the FBRs without supplementation for women are shown in **Table 31**. If the FBRs were adopted by the target groups as presented in **Table 30** and **Table 31**, they would ensure a nutritionally adequate diet for almost all target groups, except for children 6–8 months old and for pregnant women.

3.4.6 FBRs with Micronutrient Supplementation

The second set of analyses that were carried out with Optifood to develop FBRs allowed for the addition of micronutrient supplements to the diet. This was included in recognition of the fact that the nutrient needs of infants and young children are very high due to their rapid rate of growth and development during their first 2 years and to test the effect of implementing FBRs in combination with the MSPAS-recommended supplementation program. Breast milk can make a substantial contribution to the total nutrient intake of children 6–23 months of age, particularly for protein and many of the vitamins, but breast milk is relatively low in several minerals, such as iron and zinc, even after accounting for bioavailability. Given that children 6–23 months of age consume relatively small amounts of complementary foods, the nutrient density (amount of each nutrient per 100 kcal of food) of complementary foods needs to be very high (PAHO 2003).

FBRs including supplementation for children. The diets of children surveyed did not include sufficient animal-source foods and/or fortified complementary foods to meet their nutrient needs. In addition, local fortified foods like Incaparina were consumed as a thin gruel (*atole*), which is low in nutrient density. The inclusion of animal-source foods could increase the amount of iron and zinc in the diets of young children. However, the cost of animal-source foods is relatively high and may not be affordable for families in the Western Highlands. Furthermore, the amounts of animal-source foods that can feasibly be consumed by infants under 12 months of age are generally insufficient to meet iron and zinc requirements (PAHO 2003; WHO/UNICEF 1998). Therefore, it is necessary to promote more nutrient-dense complementary foods, such as fortified complementary foods, prepared at the appropriate consistency, and/or micronutrient supplements.

MSPAS supplementation protocols mandate that children 6–59 months of age should be given a multiple MNP, but the composition that should be used is not specified in the norms (MSPAS 2004). At the time of the survey, multiple MNP distribution was taking place in only a portion of the municipalities and included several different multiple MNP formulations depending on the agency or donor. The Optifood analysis included the WHO recommendation for multiple MNP composition of 12.5 mg of iron, 300 µg of retinol, and 5 mg of zinc (WHO 2011). The WHO recommended duration and time interval for supplementation with a multiple MNP is one sachet per day for a minimum period of 2 months, followed by a period of 3–4 months off supplementation, so that use of the multiple MNP is started every 6 months.[47]

It is theoretically possible for all target groups to meet folate and vitamin C requirements from locally available foods. However, the analysis using Optifood and the market prices survey suggests that it would

[47] WHO. 2011. *Guideline: Use of multiple micronutrient powders for home fortification of foods consumed by infants and children 6–23 months of age.* http://apps.who.int/iris/bitstream/10665/44651/1/9789241502047_eng.pdf.

be complex (e.g., requiring the intake of at least four vegetable servings every day) and possibly too costly for some families living in the Western Highlands (see cost results below). Therefore, a multiple MNP that contains folic acid and vitamin C, in addition to iron, vitamin A, and zinc, could be beneficial for the nutritional status of children 6–23 months. The composition of the Sprinkles Global Health Initiative's "Nutritional Anemia Formulation Sprinkle" includes: 12.5 mg of iron, 300 µg of retinol, 5 mg of zinc, 160 µg of folic acid, and 30 mg of vitamin C (Sprinkles Global Health Initiative 2008). The FBRs for children 6–23 months therefore include the Nutritional Anemia Formulation Sprinkle as summarized in **Table 32**.

Table 32. FBRs including Micronutrient Supplementation for Children

Supplement[a]	Dosage	
Multiple MNP	12.5 mg/day iron 300 µg/day retinol 5 mg/day zinc	160 µg/day folic acid 30 mg/day vitamin C

In combination with other foods, breastfed children 6–8 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[b]**	**Total quantity per day (g)**
Tortilla or other maize products	7	2	20	40
Potatoes	3	1	55	55
Beans	3	1	25	25
Eggs	3	1	25	25
FBF as porridge[c]	3	1	20	20
Meat, poultry, or fish[d]	7	1	20	20
In combination with other foods, breastfed children 9–11 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[b]**	**Total quantity per day (g)**
Tortilla or other maize products	7	2	25	50
Potatoes	3	1	60	60
Beans	3	1	25	25
Eggs	3	1	30	30
FBF as porridge[c]	3	1	20	20
Meat, poultry, or fish[d]	7	1	30	30
In combination with other foods, breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[b]**	**Total quantity per day (g)**
Tortilla or other maize products	7	4	25	100
Potatoes	4	1	60	60
Beans	4	1	30	30
Eggs	4	1	50	50
GLVs	4	1	30	30
FBF as porridge[c]	4	1	30	30
Meat, poultry, or fish[d]	7	1	35	35
In combination with other foods, non-breastfed children 12–23 months should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)[b]**	**Total quantity per day (g)**
Tortilla or other maize products	7	4	50	200
Potatoes	4	1	75	75
Beans	4	1	60	60
Eggs	5	1	50	50
GLVs	4	1	30	30
FBF as porridge[c]	5	1	30	30
Meat, poultry, or fish[d]	7	1	40	40

[a] The composition of the multiple micronutrient supplement is based on the Sprinkles Global Health Initiative's "Nutritional Anemia Formulation Sprinkle."
[b] The estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.
[c] The FBF should have similar micronutrient content to Incaparina.
[d] This recommendation is not necessary to meet micronutrient requirements if a multiple MNP is consumed. However, the recommendation is included because WHO recommends that children 6–23 months of age consume meat, poultry, fish, or eggs daily, or if daily consumption is not possible, as frequently as possible.

FBRs for pregnant women. The consumption of locally available foods generally cannot meet the nutrient requirements of pregnant women for iron and folate given their high requirements for those micronutrients. Therefore, WHO recommends that pregnant women consume iron and folic acid supplements during pregnancy (WHO 2012a). In alignment with WHO recommendations, the MSPAS protocol is for pregnant and lactating women to consume 600 mg of ferrous sulfate and 5 mg of folic acid once per week (MSPAS 2004). The FBRs summarized in **Table 33** include the iron and folic acid supplementation as recommended by MSPAS.

Table 33. FBRs with Micronutrient Supplementation for Pregnant and Lactating Women

Supplement[a]	**Dosage**			
Iron and folic acid supplementation	600 mg/week ferrous sulfate 5 mg/week folic acid			
In combination with other foods, pregnant women should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)**[b]	**Total quantity per day (g)**
Fortified cereal[c]	7	1	25	25
Vegetables	7	4	85	340
Potatoes	7	1	120	120
Liver[d]	1	1	90	90
In combination with other foods, lactating women should consume at a minimum:				
Food	**Frequency per week**	**Servings per day**	**Estimated serving size (g)**[b]	**Total quantity per day (g)**
Fortified cereal[c]	7	1	30	30
Vegetables	7	4	80	320
Potatoes	7	1	170	170
Liver[d]	1	1	90	90
Oranges[e]	3	1	205	205

[a] Supplement content and dosage is based on MSPAS 2004.
[b] The estimated serving sizes are based on the dietary data collected in Huehuetenango and Quiché.
[c] The fortified cereal should have similar micronutrient content to Incaparina.
[d] Liver is included in the dietary recommendations so that pregnant and lactating women can meet vitamin B12 requirements.
[e] Oranges could be replaced with another fruit or vegetable with high vitamin C content.

3.4.7 Alternative Best Sets of FBRs

A final analysis was done to identify the best set of FBRs for each target group given the desired number of individual FBRs to promote (**Appendices 22–27**). This information can be used to select alternative sets of FBRs for different target groups when fewer than six messages are desired or if one or more of the FBRs is determined to be infeasible/unacceptable for the target population/context. These sets of FBRs were selected on the basis of the number of nutrients at < 70% of their RDA in the worst-case scenario diets and their lowest cost when compared to other FBRs in their message number category. A message to consume Incaparina or fortified instant oats twice a day was the only consistent message in all best alternative sets of FBRs selected for all target groups. A message to consume liver once per week was in all best alternative sets of FBRs selected for pregnant and lactating women.

3.4.8 Analysis of Four Fortified Cereal Blends: Incaparina, Incaparina-Crecimax, Vitacereal, and Corn-Soy Blend

Programs aiming to reduce chronic malnutrition in Guatemala often include distribution of an FBF. For example, the World Food Programme (WFP) has supported the distribution of Vitacereal[48] and the USAID-funded Title II Development Food Assistance Program distributes a corn-soy blend (CSB).[49] However, global evidence suggests that FBFs are not appropriate to meet the nutritional needs of young children, for several reasons (De Pee and Bloem 2009).

- They do not contain all the required nutrients in adequate amounts.
- They contain a relatively large amount of antinutrients and fibers, especially when prepared from non-dehulled soybeans and non-degermed, non-dehulled maize or wheat.
- They do not provide enough energy per serving and are bulky.
- The overall fat content and essential fatty acid levels are low.
- They contain no milk powder, which increasingly appears to be important for linear growth of young children.

Despite the known limitations of FBFs, additional analysis was undertaken using Optifood to assess whether Incaparina, Incaparina-Crecimax, Vitacereal, or CSB could contribute to the micronutrient content of the diet of the target groups with the highest nutrient requirements and the most limited gastric capacity, namely, breastfed children 6–8 months old and breastfed children 9–11 months old (**Appendix 28**).

Each of the four FBFs was tested separately in combination with the final set of FBRs developed for children (without micronutrient supplementation), including the maximum number of FBRs allowable given energy constraints on the diet (2 servings per day of staples, 4 servings per day of vegetables, 1 serving per day of MPE, and 1 serving per day of beans). The quantities of FBFs tested were based on the serving size of Incaparina based on the cross-sectional survey and increased to reflect a thicker preparation of the cereal in porridge (a 50% greater serving size). For children 6–8 months old, the estimated serving per day was 27 grams of fortified cereal blend. For children 9–11 months old, the estimated serving per day was 30 grams. The results of the analysis are shown in **Appendix 29** and **Appendix 30**.

Incaparina

Incaparina alone does not provide sufficient quantities of calcium, vitamin C, vitamin B6, and iron for breastfed children 6–8 months old or breastfed children 9–11 months old. However, Incaparina has a high zinc content compared to the other fortified cereal blends and ≥ 70% of the RDA for zinc was met even when Incaparina was tested without additional FBRs for both target groups.

For children 6–8 months old, it was not possible to achieve ≥ 70% of the RDA for vitamin C and iron, even when Incaparina was consumed in combination with the maximum number of FBRs allowable given

[48] Vitacereal is a fortified, maize-soy meal produced in Guatemala and distributed by the GOG as part of its social programs. This complementary food is fortified with iron, zinc, calcium, thiamine, riboflavin, vitamin B6, vitamin A, vitamin D, vitamin E, vitamin C, niacin, folic acid, vitamin B12, and iodine. Vitacereal is specifically marketed as a complementary food for children 6–23 months of age and also for pregnant and lactating women.

[49] CSB is a fortified corn-soy flour that is provided in USAID Food for Peace Title II food assistance programs in Guatemala. CSB is fortified with vitamin A, vitamin D, vitamin E, vitamin K, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C, biotin, iodine, iron, zinc, potassium, calcium, and phosphorus. Please note the CSB currently provided in Guatemala is not CSB+, which is a CSB product with improved amounts and forms of vitamins and minerals in the vitamin/mineral premix.

energy constraints on the diet. For children 9–11 months old, all nutrient requirements were achievable when Incaparina was recommended in combination with at least 2 servings per day of staples and 4 servings per day of vegetables.

Incaparina-Crecimax

Incaparina-Crecimax is marketed as a fortified food product formulated to promote growth among children starting at 9 months of age. It contains a higher level of micronutrients than the traditional formulation of Incaparina, with the exception of zinc (Incaparina-Crecimax contains 10.7 mg/day of zinc and Incaparina contains 16.0 mg/day). For breastfed children 6–8 months old, the sole recommendation of consuming Incaparina-Crecimax twice per day met ≥ 70% of the all the RDAs except for zinc; Incaparina-Crecimax in combination with 2 servings per day of staples and 4 servings per day of vegetables met ≥ 70% of the RDA for zinc. For breastfed children 9–11 months old, the sole recommendation of Incaparina-Crecimax met ≥ 70% of the all the RDAs.

Vitacereal

For breastfed children 6–8 months old, it was not possible to achieve ≥ 70% of the RDAs for calcium, iron, and zinc when Vitacereal was tested, even in combination with 2 servings per day of staples and 4 servings per day of vegetables. When tested with the maximum number of FBRs allowable given energy constraints on the diet, Vitacereal still could not meet iron and zinc requirements for children 6–8 months old. For breastfed children 9–11 months old, Vitacereal could not achieve ≥ 70% of the RDA for zinc when tested in combination with 2 servings per day of staples and 4 servings per day of vegetables. However, Vitacereal could achieve ≥ 70% of the RDA in combination with the maximum number of FBRs allowable given energy constraints on the diet.

CSB

CSB alone does not provide sufficient quantities of niacin, iron, and zinc for children 6–8 months old or iron and zinc for children 9–11 months old. When combined with the maximum number of FBRs allowable given energy constraints on the diet, a diet including 2 servings of CSB per day was able to meet all nutrient requirements except for zinc for children 6–8 months old and children 9–11 months old.

3.4.9 Cost Analysis

Module 4 was used to carry out an analysis separate from that used to develop and test FBRs in order to identify the lowest-cost nutritionally best diet possible, given local foods and local dietary patterns, and to provide information on the nutritional content of this diet and how much it would cost to provide nutrient adequacy. **Table 34** shows the total cost of the lowest-cost nutritionally best diet, the foods that contribute ≥ 10% of cost, and the highest percentage of the RDA achievable in the diet. This table shows how much it would cost to provide nutritionally adequate diets (or "best-case scenario" diets) for individuals in the target groups. The cost of the lowest-cost nutritionally best diets selected in Module 4 ranged from 1.8 GTQ/day for children 6–8 months old to 19.1 GTQ/day for lactating women. Except for fat, these diets achieved 100% of the RDAs for all nutrients for lactating women and non-breastfed children. For other target groups, these lowest-cost nutritionally best diets met or exceeded the RDAs for all nutrients, except the problem nutrients (iron and zinc for children 6–8 months old and iron for pregnant women). The most-expensive foods in these lowest-cost nutritionally best diets were eggs, chicken, Incaparina, tamalito, and tortilla. The high cost of the last two reflects the large quantity required to meet RDAs.

Table 34. Lowest-Cost Nutritionally Best Diet[a] for Each Target Group

Target group	Cost (GTQ/day)	Cost (US$/day)	Foods ≥ 10% of cost[b]	Nutrients < RDAs[c]
Breastfed 6–8 months old	1.8	0.22	Tortilla, or other maize product (24%) Egg (11%) Incaparina (10%)	Calcium (97% RDA) Iron (94% RDA) Zinc (64% RDA)
Breastfed 9–11 months old	2.6	0.33	Egg (21%) Tortilla, or other maize product (10%)	Zinc (77% RDA)
Breastfed 12–23 months old	4.3	0.54	Egg (35%)	Iron (91% RDA)
Non-breastfed 12–23 months old	5.7	0.72	Eggs (17%) Tortilla, or other maize product (16%) Bread (13%)	Fat (60% of recommended)
Pregnant women	15.6	1.99	Tortilla, or other maize product (28%) Chicken (12%)	Folate (96% RDA) Zinc (90% RDA) Fat (56% of recommended)
Lactating women	19.1	2.43	Tortilla, or other maize product (39%)	Fat (46% of recommended)

[a] Not including micronutrient supplementation
[b] Value in parentheses is the percentage of the total cost for that food.
[c] Value in parentheses is the highest percentage of the RDA achievable and the value achieved in the lowest-cost nutritionally best diet.

The foods selected in the lowest-cost nutritionally best diets for each target group are presented in **Table 35**. The blank spaces in this table show foods that were not included in the food list for a target population. The zeroes indicate foods that were not selected in the lowest-cost nutritionally best diet for that target group even though they were in the food list. Foods that were not selected in the lowest-cost nutritionally best diet for any target group are not presented in this table.

Tortilla (yellow corn), Incaparina, milk, eggs, and fortified sugar were selected in the lowest-cost nutritionally best diets for all target groups. Of these foods, fortified sugar was forced into all modeled diets by the model constraints because it was consumed by the surveyed population. Tamalito (yellow/white corn), fortified instant oats, chayote (*Sechium edule*), cheese, tomato, and amaranth leaves were selected in the diets of five of the six target groups. Nightshade leaves (hierba mora [*Solanum tuberosum*]) were selected in all the lowest-cost nutritionally best diets for children. Chicken, chicken broth, bread, and oil were selected in all the lowest-cost nutritionally best diets of target groups that were not consuming breast milk, presumably to increase diet fat content.

Table 35. Food Selected for Lowest-Cost Nutritionally Best Diets for Each Target Group*

Foods	Breastfed 6–8 months servings/week	Breastfed 9–11 months servings/week	Breastfed 12–23 months servings/week	Non-breastfed 12–23 months servings/week	Pregnant servings/ week	Lactating servings/ week
Tortilla, yellow corn	14	14	14	12	11	14
Tortilla, white corn	0	7	0	0	0	1
Tamalito, y/w	7	0	7	14	10	10
Incaparina	7	7	7	7	7	7
Fortified instant oats	7	3	7	7	7	0
Non-fortified instant oats	0	4	0	0	0	7
Pasta, enriched	0	0	0	0	5	0
Bread, sweet	0	0	0	7	7	7
Milk	6	6	1	7	6	6
Cheese	1	1	1	0	1	1
Potatoes	6	4	1	0	7	0
Tomatoes	7	7	7	0.1	7	0
Tree tomato	–	4	–	2	–	4
Husk tomato	–	–	–	0	–	–
Carrots	5	0	1	0	2	0
Chayote[a]	4	4	5	0	3	4
Nightshade leaf[b]	4	4	4	7	0	0
Amaranth leaf	3	3	1	0	5	7
Crotalaria leaf	0	–	2	–	0	0
Turnip greens	0	–	–	0	2	0
Cabbage	–	–	–	3	–	2
Pumpkin	–	1	2	0	1	4
Peas, green	–	0.2	1	–	–	–
Beans, snap, green	–	–	–	3	–	–
Spring onion	3	–	3	3	4	7
Onion	2	0	2	0	3	0
Lemons	1	0	7	7	0	0
Orange	0	0	0	0	7	0
Banana	0	0	0	0	1	0
Egg	1.5	5	7	5	4	4
Chicken	0	0	–	1	2	2
Frankfurter	–	0	0	–	1	1
Lamb	–	–	–	1	1	–
Liver	–	–	–	–	1	1
Black bean, cooked	5	4	0	0	3	7
Black beans, dry	1	3	7	–	5	0
Protemas, soy	1	–	–	–	–	–
Broth, beans	0	4	0	0	–	–
Broth, chicken	0	0	0	4	5	7
Broth, beef	–	–	–	3	–	–
Soup, dehydrated, chicken noodle	0	0	0	0	7	7
Soup, dehydrated, ramen noodle	–	–	–	–	–	–
Sugar, fortified	–	–	–	2	2	–
Coffee	–	–	–	–	–	–
Oil	3	5	5	5	5	5
	0	0	7	7	7	7
	0	0	0	3	4	5
	–	–	–	–	–	–

* The blank spaces in this table show foods that were not included in the food list for a target population. The zeroes indicate foods that were not selected in the lowest-cost nutritionally best diet for that target group even though they were in the food list. Foods that were not selected in the lowest-cost nutritionally best diet for any target group are not presented in this table.

[a] *Sechium edule*

[b] Hierba mora (*Solanum tuberosum*)

4. Discussion

The results of the cross-sectional survey undertaken as part of this study are consistent with previous studies in the Western Highlands that have shown high levels of chronic malnutrition, poor complementary feeding practices, and low dietary diversity (MSPAS 2010; Vossenaar et al. 2013). The study participants came from predominantly rural, indigenous households characterized by a high prevalence of stunting and anemia. By the end of the first year of life, already almost half of children in the study population (47.3%) were stunted.[50] In the second year of life, the prevalence of stunting increased to 70.5% of children. The overall prevalence of wasting among children 6–23 months was very low at 1.3%.[51]

Roughly half of the households surveyed experienced anxiety or concern regarding food security in the 30 days preceding the survey, although few households reported experiencing hunger according to the subset of questions focused on lack of food. Moreover, results from the Optifood analysis confirmed that the largest problem in the diets of the women and children surveyed was related to diet quality, not to the amount of food consumed in terms of energy and calories.

The diets of participating women and children were largely plant based, with few animal-source foods or fortified foods. Maize products (e.g., tortillas, *atole* made of corn dough) and sugar constituted half of the energy in the diets of children and two-thirds the energy of women. A largely plant-based diet with few animal-source or fortified foods is disadvantageous, because of the relatively high content of antinutrients, the lower bioavailability of certain micronutrients, and the lack of specific nutrients and active compounds contained in animal-source food (De Pee and Bloem 2009). Accordingly, the iron and zinc densities of complementary foods consumed by children 6–11 months old in this population were inadequate.

The amount of energy consumed by all child target groups in both departments was considered adequate. The mean estimated energy and protein intake for pregnant and lactating women in both departments was low compared to their estimated requirements. However, given the variability in the amounts consumed, looking at average consumption makes it difficult to assess if actual intakes were low.

Although protein intake from complementary foods for all child target groups in both departments was in the "adequate" range, the quality of protein may be inadequate considering that the majority of the protein in the diet was from maize and that very few animal-source foods were consumed. The 24-hour recall data showed that grains and legumes were not often consumed together, resulting in inadequate essential amino acids for a complete protein.

The dietary analysis conducted using Optifood as part of this study found similar results to previous studies in Guatemala with regard to problem nutrients (i.e., calcium, iron, zinc, folate, and vitamin B12) (Vossenaar and Solomons 2012; Dewey and Brown 2003). The problem nutrients identified by Optifood also coincide with deficiencies in iron, zinc, and vitamin B12 among children and women identified in the 2009–2010 Encuesta Nacional de Micronutrientes (ENMICRON) (National Survey of Micronutrients) (**Table 36**) (MSPAS 2011).

[50] http://www.who.int/childgrowth/en/.
[51] http://www.who.int/childgrowth/en/.

Table 36. Prevalence of Micronutrient Deficiencies among Children 6–59 Months Old and Women 15–49 Years Old, ENMICRON, 2009–2010

	Prevalence of micronutrient deficiency (%)				
	Iron		Zinc	Vitamin B12	
Characteristic	Children	Women	Children	Children	Women
Urban	29.7	16.4	24.8	10.1	16.4
Rural	24.0	20.1	41.8	14.7	21.1
Non-indigenous	26.1	18.1	29.8	9.6	17.7
Indigenous	26.7	17.3	41.2	16.9	20.8

For all target groups, a combination of six or seven individual FBRs was required to ensure that the diet provided ≥ 70% of all micronutrient RDAs (apart from iron and zinc for children 6–8 months old and iron for pregnant women). In addition, most individual FBRs in the final set of FBRs were already at their highest food group constraint levels (i.e., at their maximum number of servings per week from a food group according to the target groups' dietary patterns). Adoption of the final set of FBRs will therefore require a shift away from the target groups' usual food consumption patterns. Nevertheless, all FBRs fell within the observed range of dietary practices of the target groups, suggesting that they can be successfully promoted. Still, it will require a well-designed behavior change intervention to successfully promote them.

Maize, GLVs, black beans, Incaparina, and fortified instant oats were important sources of problem nutrients. Thus, the FBRs rely predominantly on these foods to meet nutrient requirements. However, questions can be raised about the high content of antinutrients and low bioavailability of iron, zinc, and calcium from these plant-based food sources. Low bioavailability was taken into account via the RDAs used in the analyses. These conservative RDAs might have overestimated the extent of the problem for young children, except that the FBR to consume MPE every day might not improve iron and zinc bioavailability, if eggs instead of flesh foods are consumed. Eggs were the most common foods consumed from the MPE food group.

For children 6–8 months old, the high densities of iron and zinc recommended in complementary foods could not be achieved, even when locally available fortified foods (Incaparina and fortified instant oats) were included in the FBRs. For this target group, alternative strategies are required for iron and zinc requirements to be met. Similarly, a diet based on locally available foods cannot meet the requirement for iron for pregnant women.

Additional analysis was undertaken to assess the extent to which Incaparina, Incaparina-Crecimax, Vitacereal, or CSB could contribute significantly to improving the quality of the diet of the target groups with the highest nutrient requirements and the most limited gastric capacity, namely, breastfed children 6–8 months old and breastfed children 9–11 months old. Incaparina-Crecimax, without any additional FBRs, met ≥ 70% of the all the RDAs for breastfed children 9–11 months old and all the RDAs, except for zinc, for breastfed children 6–8 months old. For breastfed children 6–8 months old, it was not possible to achieve ≥ 70% of all the RDAs with Incaparina, Vitacereal, or CSB, even when the fortified cereal blends were tested in combination with other FBRs. For breastfed children 9–11 months old, it was not possible to achieve ≥ 70% of all the RDAs with CSB, even when the fortified cereal blends were tested in combination with other FBRs.

These results indicate that interventions using fortified cereal blends tested in this analysis are not sufficient to address problem nutrients, especially iron and zinc, among breastfed children 6–11 months old. The findings are consistent with previous research in Haiti that assessed whether adding CSB to diets of children 6–23 months old would ensure nutrient adequacy (Ruel et al. 2004). Furthermore, these fortified cereal blends are not suitable as a food supplement for young children for additional reasons, including their relatively large content of antinutrients and fibers; overall low fat content; low level of essential fatty acids; and lack of milk powder, which may have important effects on children's linear growth.

Other disadvantages of fortified cereal blends available in Guatemala include the tendency to prepare them as *atoles* (e.g., 75 g of Incaparina in 1,000 mL of water). Although INCAP has developed and promoted recipes for preparing Incaparina in porridge form, the practice of preparing porridges from Incaparina is very limited (e.g., none of the respondents in the cross-sectional survey report consuming Incaparina in porridge). In addition, it is common practice to prepare *atole* once per day for the entire family and not to prepare special foods for young children. Therefore, although the FBRs include preparing Incaparina as porridge, the feasibility and acceptability of this recommendation needs to be field tested.

It was necessary to combine FBRs with micronutrient supplements to meet the nutrient requirements for zinc and iron for children 6–8 months old and the requirement for iron for pregnant women. In addition to micronutrient supplements, for all target groups, a combination of four to seven individual FBRs was required to ensure that dietary adequacy of all nutrients was met. To maintain consistency of recommendations across target groups, the FBRs for children and pregnant and lactating women should be promoted in conjunction with micronutrient supplementation.[52] While Optifood analyses that included appropriate micronutrient supplements for both children and women were carried out, the analyses did not specifically consider the full range of MSPAS supplementation policies. As a part of next steps discussed below, there is a need to assess and review MSPAS supplementation policies with the information gained in this analysis, using the Optifood tool.

The lowest-cost nutritionally best diets ranged from 1.8 GTQ (US$0.22)/day for children 6–8 months old to 19.1 GTQ (US$2.43)/day for lactating women. Half of the population living in the five departments of the Western Highlands earns less than 25 GTQ/day (US$3.13/day), and 15% of the population earns less than 12 GTQ/day (US$ 1.50/day) (INE 2011). The average household size among the study population is seven people. Therefore, putting a nutritionally adequate diet in place for young children and pregnant and lactating women, in addition to other family members is probably not affordable for the majority of households in the Western Highlands.

Multiple constraints may prevent families from implementing the FBRs. Programs that provide micronutrient supplementation—using either FBFs or a multiple MNP—and that are contemplated by the GOG could also help in this regard. Other constraints, such as time required to prepare food and fuel needed, should be further explored to develop effective strategies for supporting a nutritionally adequate diet for the most vulnerable groups

[52] Recommended supplementation for children 6–23 months old include 12.5 mg/day of iron, 300 µg/day of retinol, 5 mg/day of zinc, 160 µg/day of folic acid, and 30 mg/day of vitamin C, and for pregnant and lactating women include 600 mg/week of ferrous sulfate and 5 mg/week of folic acid.

5. Challenges in Using Optifood to Develop FBRs

It is important to note a number of challenges regarding the implementation of a comprehensive dietary analysis as was done with Optifood.

This study required the collection of high-quality dietary data from a randomized sample of multiple target groups so that the target population's actual food consumption practices would be accurately captured. Daelmans et al. (2013) recommend 24-hour dietary recalls, based on the *Pro*Pan methodology, for use in collecting input data for Optifood analysis. This data collection process is lengthy and detailed, requiring well-trained staff for fieldwork and data entry. Working with an experienced local partner with a strong research capacity was found to be extremely helpful. Using staff who were well trained in the use of dietary assessments and adapting previously validated instruments significantly reduced the amount of time required for dietary data collection.

Another important challenge is finding staff with the skills required to prepare the dietary and FCT data for Optifood analysis. This analysis requires considerable attention to accurately examine the quality of the FCT values, impute missing values, and prepare all dietary data. It would be useful to develop computer software to simplify this process. Until then, the effort and skills required for data preparation will remain a hurdle to using Optifood. In addition, the time required to fully analyze each target group should not be underestimated, as at least 1 day per target group is required, even by operators who are well trained in the use of the program. And, since some FBRs can be strategically proposed across various target groups, sufficient time is needed to ensure that recommendations are, to the extent feasible, consistent across target groups.

A further challenge is managing the effect of seasonality on food availability, production cycles, and consumption. The application of Optifood for this analysis did not take seasonality into account; thus, the recommendations identified refer essentially to the season during which data were collected. Further field testing (such as through the use of household trials) will be needed to verify whether the FBRs would be appropriate during other times of year or whether alternative recommendations are needed.

It is important to acknowledge the geographic limitations posed by a cross-sectional survey that captures a snapshot of dietary patterns and food cost/availability in a restricted area, as was done here in the two surveyed departments. Further testing of the FBRs in other departments and geographic areas would also allow for greater consideration of whether the recommendations would be appropriate for use outside of Huehuetenango and Quiché.

Given the scope of this project, another limitation was the small sample size for individual target groups, which meant that model parameters for FBRs were defined from a limited number of data points. Special effort was needed to carefully scrutinize the consistency of model parameters both within and across target groups and regions. Although a larger sample size is not likely to have changed the foods selected for the final FBRs, it might have increased the accuracy of the estimated serving sizes of nutrient-dense foods. Despite this limitation, the high-quality data entered into Optifood during the Guatemala work resulted in a quality analysis that provides valuable insight into recommended approaches to improve nutrient intake.

6. Next Steps

The analysis provided technical information regarding problem nutrients, best food sources for nutrients, FBRs that could meet or come as close as possible to meeting the nutrient needs for individuals in the target groups, and the cost of consuming a diet that meets or comes as close as possible to meeting nutrient needs. However, questions remain regarding food availability and the feasibility, and affordability of implementing the FBRs and strategies needed to bridge nutrient gaps in the local food supply. Therefore, an immediate next step for USAID/Guatemala, the GOG, and partners is to review the results of the analysis, in the context of their experience and current programs, and to select the most promising programmatic options to improve the nutrient intake of women and children, which may include promotion of FBRs through behavior change, promotion of agriculture or animal husbandry, food fortification, supplementation with micronutrients, or other approaches. The following issues should be considered.

1. **Role of agricultural interventions.** The analysis identified several important food sources for problem nutrients that could be promoted through agricultural interventions, including increasing production and availability and access of low-cost GLVs, black beans, and animal-source foods. More information is needed regarding the feasibility of home production of these foods, including the quantities of foods that need to be produced, the time burden or opportunity cost required to produce or cook foods, current levels of production, seasonality, and requirements for production (e.g., seeds, inputs, water, etc.).
2. **Existing food fortification and micronutrient supplementation policies.** The GOG already has in place several fortification and supplementation laws.[53] For example, MSPAS norms include commercial fortification of sugar with vitamin A; salt with iodine and fluoride; and wheat flour (WHO 2012b) with iron, thiamine, riboflavin, niacin, and folate acid. Policies on supplementation include routine MSPAS provision of vitamin A every 6 months to children 6–59 months of age, iron and folic acid supplementation for pregnant and lactating women, and multiple MNP for children 6–59 months of age (in place of iron and folic acid) (MSPAS 2000; MSPAS 2004). MSPAS also provides zinc as a therapeutic treatment for children with diarrhea. These policies need to be analyzed for their complementarity (or redundancy) of micronutrient approaches, their effectiveness to meet desired objectives (e.g., prevent anemia, promote linear growth), and their relationship to the findings presented in this report.
3. **Complementary food supplements.**[54] This analysis indicates that the iron and zinc densities of complementary foods consumed by young children surveyed are inadequate. In addition, it seems that locally available FBFs do not meet the nutrient requirements of children 6–11 months old. Some households may not be able to consistently afford animal-source foods. Complementary food supplements, depending on the type (e.g., multiple MNP, lipid-based nutrient supplements), provide essential micronutrients, amino acids, fatty acids, and/or active compounds (enzymes). More analysis is required to evaluate the need for and the effectiveness and feasibility of complementary food supplements.
4. **Feasibility and affordability of FBRs.** More work is needed to ensure that the FBRs are realistic and practical. After consultation with USAID/Guatemala, the GOG, and partners to reach general consensus around the FBRs, the feasibility of successfully promoting these specific FBRs should be evaluated via household trials in the Western Highlands (Dicken and Griffiths 1997). Some

[53] CONAFOR. 2010. "Consolidado de Legislación para Fortificación de Alimentos." http://www.conafor.org/pp/bancofotos/326-6131.pdf.

[54] Complementary food supplements are defined as food-based supplements that can be mixed with or consumed in addition to the diet to add nutritional value (adapted from De Pee and Bloem 2009).

testing of the FBRs has already been initiated; from June to August 2013, Nutri-Salud, INCAP, and LSHTM, with technical input from FANTA, tested the feasibility of FBRs for children 6–11 months in Chiantla, one of the prioritized municipalities of Huehuetenango (Knight 2013). These activities used a combination of methods from the *Pro*PAN and Designing by Dialogue resources for running Trials of Improved Practices (TIPs) (Dicken and Griffiths 1997; PAHO 2013). The results of the TIPs found that mothers of children 6–11 months were willing to try several of the FBRs for this age group, particularly preparation of thick porridges and use of potatoes in children's food. Other FBRs were more challenging to implement, such as recommended daily consumption of beans and animal-source foods.

Building on these results, during 2014, FANTA, INCAP, and Nutri-Salud will further develop the findings from the Optifood analysis, support additional household trials of FBRs, and provide technical assistance to partners to address nutrient gaps through policy and programming strategies. Further exploration is needed on FBRs for children 6–11 months, along with FBR trials for children 12–23 months. For example, in Quiché, alternatives to the recommendation for daily potato consumption should be explored given stakeholders' comments that potatoes are rarely produced at the household level in Quiché and are not readily available. Additional FBR trials are also required because of the different prevalent socio-ethnographic groups in Quiché (Ixil and Quiché) versus Huehuetenango (Mam). Trials of FBRs for women should address the feasibility of pregnant women consuming liver once a week and oranges daily, as per current FBRs. Furthermore, FBR trials for women are needed to assess their feasibility given women's other time commitments for child care and food production and the fuel requirements, among other considerations. Planned trials during 2014 will identify individual FBRs that are feasible for families to implement, as well as barriers and potential motivating factors to help encourage their adoption. The final outcomes from such trials will be a realistic set of evidence-based, population-specific FBRs, and the content for messages to promote them in the Western Highlands.

5. **Strengthening agricultural/nutrition linkages.** The results provided here can inform government strategies in promoting the production and consumption of foods identified in the FBRs. Collaboration with the Ministry of Agriculture and Livestock in developing extension programs that support the production of nutrient-dense foods and with MSPAS in developing SBCC messages that help consumers optimally integrate those foods in their diets are promising areas of investment.
6. **Use of findings to develop messages for a social and behavior change strategy and program activities.** Based on the household trials and the resulting key messages, it is recommended that the GOG and other cooperating agencies (including Nutri-Salud) consider using the results of this project for the design of SBCC strategies that include activities aimed at promoting the FBRs among target groups
7. **Applicability of the FBRs to other areas of the Western Highlands**. Studies are needed to determine if the FBRs may be applicable to other areas within the Western Highlands. The data used to set the model parameters in Optifood through the cross-sectional survey came from a limited area of the Western Highlands. Despite the variation in ecological zones and ethnolinguistic groups between the two departments, the results of the cross-sectional survey show that the dietary patterns and locally available foods of the two study areas were similar. As a result, common dietary recommendations were developed for both study areas. However, the extent to which the dietary recommendations could be applied to other areas of the Western Highlands still needs to be assessed.

8. **Involving the private sector.** The Optifood results were shared with private sector companies in Guatemala that are involved in manufacturing complementary foods. The Optifood results generated their interest in tailoring some of their products using the micronutrient formulation suggested by Optifood. Further work is under way to extend this into collaboration to field test complementary food products currently under development. There is excellent potential for such collaboration, in terms of increasing access to optimal products at scale.

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Appendix 1. Perceptions of Household Food Security

Occurrence questions	Frequency-of-occurrence[a]		Huehuetenango	Quiché	Total
Reports worrying that the food would run out before having money to buy more in the last 30 days (%)	No		47.0	15.6	31.6
	Yes	Rarely	20.2	17.1	18.7
		Sometimes	26.5	53.7	39.8
		Often	6.3	13.6	9.9
Reports family member not being able to eat foods of animal origin such as eggs or meat because there was not enough money to buy them in the last 30 days (%)	No		66.0	31.5	49.1
	Yes	Rarely	14.2	16.7	15.4
		Sometimes	16.8	38.9	27.6
		Often	3.0	12.8	7.8
Reports not giving foods of animal origin such as eggs or meat to children because there was not enough money to buy them in the last 30 days (%)	No		71.9	37.0	54.6
	Yes	Rarely	11.4	16.0	13.7
		Sometimes	13.7	36.6	25.0
		Often	3.0	10.5	6.7
Reports family member eating a less-diverse diet because there was not enough money to buy a variety of foods in the last 30 days (%)	No		54.5	23.0	39.1
	Yes	Rarely	17.2	15.2	16.2
		Sometimes	26.9	48.3	37.3
		Often	1.5	13.6	7.4
Reports family member eating foods that they did not like because there was not enough money to buy food in the last 30 days (%)	No		66.0	31.5	49.1
	Yes	Rarely	18.0	16.3	17.2
		Sometimes	15.4	45.1	30.0
		Often	0.8	7.0	3.8
Reports family member eating less quantity of food because there was not enough money in the last 30 days (%)	No		75.8	36.2	56.4
	Yes	Rarely	12.3	16.3	14.3
		Sometimes	9.7	35.8	22.3
		Often	2.2	11.7	6.9
Reports family member skipping meals because there was not enough money to buy food in the last 30 days (%)	No		88.4	82.5	85.5
	Yes	Rarely	5.6	11.3	8.4
		Sometimes	5.6	5.8	5.7
		Often	0.4	0.4	0.4

[a] "Rarely" is once or twice in the past 30 days.
"Sometimes" is 3–10 times in the past 30 days.
"Often" is more than 10 times in the past 30 days.

Source: Ballard et al. 2011.

Appendix 2. Foods Most Commonly Consumed by Children 6–23 Months[a,b]

	Huehuetenango								Quiché							
	6–8 months		9–11 months		12–23 months BF		12–23 months NBF		6–8 months		9–11 months		12–23 months BF		12–23 months NBF	
Name	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank
Maize products	93.4	1	94.4	2	94.4	1	96.3	2	80.0	1	91.5	2	95.8	2	100.0	2
Salt	86.9	2	91.7	3	90.1	2	96.3	1	66.0	3	85.1	3	85.9	3	90.5	3
Sugar, fortified with vitamin A and iron	80.3	3	94.4	1	90.1	3	92.6	3	74.0	2	93.6	1	95.8	1	100.0	1
Tomato red, raw	57.4	7	69.4	6	73.2	4	85.2	5	58.0	4	63.8	4	74.6	4	81.0	4
Onions, tops, raw	59.0	6	77.8	4	70.4	5	85.2	4	46.0	7	59.6	5	64.8	7	61.9	8
Coffee, grain, toasted powder	62.3	4	75.0	5	69.0	6	81.5	6	42.0	8	59.6	6	74.6	5	81.0	5
Beans products	42.6	10	58.3	8	49.3	7	55.6	9	54.0	5	59.6	7	69.0	6	66.7	6
Egg, whole, raw, fresh	31.1	13	41.7	12	47.9	8	48.1	11	18.0	13	17.0	18	32.4	11	42.9	10
Oil vegetables, all types	34.4	12	52.8	9	43.7	9	44.4	13	12.0	19	25.5	12	28.2	14	57.1	9
Potatoes, without skin, raw	60.7	5	66.7	7	40.8	10	59.3	7	34.0	9	34.0	9	38.0	9	38.1	11
Dehydrated soup mix, chicken noodle or ramen noodle	44.3	8	41.7	13	32.4	13	51.9	10	48.0	6	48.9	8	64.8	8	66.7	7
Dry broth cubes, chicken or beef	44.3	9	52.8	10	40.8	11	48.1	12	18.0	15	12.8	22	21.1	17	33.3	14
Banana mature. Raw	18.0	18.0	8.3	26	25.4	14	18.5	23	22.0	10	25.5	11	21.1	16	19.0	20
Chayote (*Sechium edule*), raw	26.2	14	25.0	17	14.1	20	18.5	20	20.0	11	19.1	16	11.3	25	19.0	19
Chayote *Sechium edule*) leaves and shoots, raw	-	-	-	-	-	-	-	-	6.0	26	27.7	10	28.2	13	33.3	12
Bread wheat, sweet (Guatemala)	14.8	20	22.2	19	22.5	16	37.0	15	12.0	18	19.1	17	33.8	10	19.0	23
Coriander, raw	34.4	11	44.4	11	33.8	12	55.6	8	12.0	16	23.4	13	21.1	15	9.5	29

[a] cells with "-" represent foods that were not consumed by the target group.
[b] shading indicates a top-10 rank for the food.

Appendix 3. Foods Most Commonly Consumed by Pregnant Women and Lactating Women with Infants under 6 Months[a,b]

	Huehuetenango				Quiché			
	Pregnant		Lactating		Pregnant		Lactating	
Name	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank	% Consumed food	Rank
Salt, table	97.4	1	97.4	2	94.6	2	97.6	2
Maize products	97.4	2	100.0	1	100.0	1	100.0	1
Sugar, fortified with vitamin A and iron	89.5	3	87.2	3	94.6	3	97.6	4
Onions, tops, raw	84.2	4	76.9	5	70.3	7	80.5	6
Tomato red, raw	84.2	5	79.5	4	78.4	6	87.8	5
Coffee, grain, toasted powder	84.2	6	76.9	6	86.5	4	97.6	2
Beans products	60.5	7	61.5	7	83.8	5	61.0	7
Potatoes, without skin, raw	55.3	8	48.7	8	43.2	8	22.0	15
Dry broth cubes, chicken or beef	55.3	9	48.7	10	18.9	22	19.4	18
Oil vegetable, all types	47.4	10	35.9	13	40.5	9	36.6	11
Dehydrated soup mix, chicken noodle or ramen noodle	36.8	13	48.7	9	40.5	10	56.1	8
Egg, whole, raw, fresh	42.1	11	43.6	11	35.1	11	53.7	9
Spicy dried chili	-	-	-	-	18.9	20	43.9	10

[a] cells with "-" represent foods that were not consumed by the target group.
[b] shading indicates a top-10 rank for the food.

Appendix 4. Food Sources of Nutrients of Children 6–23 Months

Energy

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	37.9	Maize products	31.3	Maize products	36.6	Maize products	36.9
2	Sugar	10.5	Sugar	12.8	Sugar	10.1	Sugar	11.2
3	Potatoes	6.8	Potatoes	6.5	Bread	5.7	Bread	5.2
4	Banana	4.5	Rice	5.0	Egg	4.7	Rice	4.8
5	Bread	3.6	Bread	4.3	Black beans	4.5	Incaparina	3.8

Protein

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	39.7	Maize products	29.6	Maize products	36.7	Maize products	33.9
2	Potatoes	9.5	Black beans	10.4	Egg	11.3	Egg	8.9
3	Egg	7.5	Potatoes	9.0	Black beans	10.5	Black beans	6.5
4	Black beans	6.2	Egg	7.8	Potatoes	4.7	Incaparina	6.4
5	Incaparina	4.1	Rice	3.9	Incaparina	4.0	Potatoes	5.5

Iron

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	35.2	Maize products	26.8	Maize products	31.9	Maize products	30.9
2	Incaparina	7.7	Black beans	7.4	Black beans	7.6	Incaparina	11.3
3	Potatoes	6.9	Potatoes	7.0	Incaparina	6.7	Bread	6.0
4	Bread	4.3	Incaparina	5.7	Bread	6.7	Black beans	5.7
5	Egg	3.8	Bread	5.0	Egg	6.0	Potatoes	4.1

Zinc

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	44.3	Maize products	39.3	Maize products	42.9	Maize products	44.5
2	Incaparina	9.6	Incaparina	7.7	Incaparina	8.2	Incaparina	13.9
3	Chayote (*Sechium edule*)	5.4	Black beans	6.8	Egg	7.5	Rice	4.6
4	Egg	4.5	Potatoes	5.5	Black beans	6.6	Egg	4.3
5	Potatoes	4.2	Egg	5.2	Rice	3.1	Black beans	4.1

Calcium

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	49.4	Maize products	49.4	Maize products	52.4	Maize products	52.5
2	Potatoes	8.1	Potatoes	8.9	Egg	4.7	Incaparina	6.8
3	Incaparina	4.6	Incaparina	3.9	Potatoes	4.7	Potatoes	5.2
4	Egg	3.1	Egg	3.7	Incaparina	4.7	Milk	3.1
5	Black beans	3.0	Black beans	3.7	Black beans	4.4	Egg	3.0

Vitamin A

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Sugar	43.7	Sugar	58.8	Sugar	53.1	Sugar	49.7
2	Incaparina	8.0	Tomatoes	6.4	Egg	11.0	Incaparina	11.5
3	Egg	6.7	Egg	6.0	Incaparina	7.0	Egg	7.1
4	Tomatoes	5.9	Incaparina	5.8	Tomatoes	5.7	Carrots	6.8
5	Carrots	5.9	Fortified instant oats	2.6	Mustard green	3.0	Turnip leaves	4.7

Folate

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months	
Rank	**Food**	**%**	**Food**	**%**	**Food**	**%**	**Food**	**%**
1	Maize products	14.5	Black bean	19.7	Black beans	22.1	Black beans	20.1
2	Chayote (*Sechium edule*)	10.7	Maize products	10.7	Egg	8.1	Maize products	13.0
3	Potatoes	9.7	Potatoes	9.1	Pasta	7.7	Potatoes	7.3
4	Banana	6.6	Chayote (*Sechium edule*)	7.5	Banana	6.7	Pasta	7.3
5	Black beans	6.4	Pasta	6.8	Maize products	10.8	Egg	6.3

Appendix 5. Food Sources of Nutrients of Pregnant Women and Lactating Women with Infants under 6 Months

Energy

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Maize products	58.4	Maize products	67.0
2	Sugar	6.4	Sugar	5.6
3	Black beans	5.7	Black beans	3.4
4	Bread	2.9	Egg	2.1
5	Potatoes	2.6	Bread	1.9

Protein

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Maize products	52.4	Maize products	59.8
2	Black beans	11.8	Black beans	10.4
3	Egg	3.9	Egg	6.0
4	Potatoes	3.7	Potatoes	2.3
5	Pasta	2.4	Pasta	1.3

Iron

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Maize products	50.7	Maize products	55.9
2	Black beans	10.4	Black beans	8.4
3	Bread	3.7	Egg	2.8
4	Potatoes	3.1	Incaparina	2.6
5	Incaparina	3.1	Bread	2.4

Zinc

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Maize products	65.4	Maize products	71.4
2	Black beans	7.4	Black beans	4.3
3	Incaparina	4.0	Incaparina	3.5
4	Egg	2.2	Egg	3.1
5	Beef	1.8	-	

Calcium

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Maize products	74.3	Maize products	77.0
2	Black beans	4.6	Black beans	2.4
3	Potatoes	2.7	Potatoes	1.7

Vitamin A

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Sugar	54.8	Sugar	45.6
2	Maize products	5.9	Egg	7.7
3	Incaparina	5.3	Mustard green	7.1
4	Egg	5.0	Maize products	7.5
5	Tomatoes	3.6	Tomatoes	4.6

Folate

	Pregnant women		Lactating women	
Rank	**Food**	**%**	**Food**	**%**
1	Black beans	35.9	Black beans	27.9
2	Maize products	18.6	Maize products	22.3
3	Potatoes	6.0	Egg	6.9
4	Pasta	6.0	Mustard green	6.4
5	-		Pasta	4.1

Appendix 6. Nutrient Intake from Complementary Foods of Breastfed Children 6–8 Months Old

	Huehuetenango					Quiché					p-value (mean comparison)
	Breastfed 6–8 months (n = 61)					Breastfed 6–8 months (n = 50)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	
Energy (kcal/d)	345.5	220.3	297.9	193.1	429.3	267.6	209.4	237	106.3	362.7	0.06
Protein (g/d)	10.6	7.3	8.6	4.7	14.8	7.4	6.0	6.1	2.9	9.5	0.01
Fat (g/d)	4.8	4.3	3.4	1.6	7.2	3.8	5.3	1.8	0.9	4.4	0.25
Carbohydrates (g/d)	68.0	44.0	58.4	38.5	86.1	53.2	39.6	49.4	22.8	73.3	0.07
Dietary fiber (g/d)	5.0	3.8	4.2	2.3	7.1	3.1	2.2	2.5	1.3	4.7	0.00
Calcium (mg/d)	142.6	77.4	140.3	93.6	188.0	112.4	122.1	84.7	36.5	144.0	0.12
Phosphorus (mg/d)	192.4	136.6	162.9	91.8	249.2	160.5	139.8	109.6	41.6	256.3	0.23
Iron (mg/d)	3.5	2.3	3.1	1.6	4.8	3.0	3.1	2.4	1.1	3.7	0.25
Zinc (mg/d)	1.8	1.2	1.5	0.9	2.5	1.5	2.1	1.2	0.5	1.8	0.42
Magnesium (mg/d)	21.9	20.8	16.2	6.6	28.2	26.1	25.9	15.8	7.6	35.1	0.34
Vitamin C (mg/d)	24.6	22.0	18.1	10.3	31.2	17.6	17.5	11.1	6.4	23.6	0.07
Retinol Equivalent (µg/d)	204.5	168.9	184.2	86.9	295.3	152.6	216.8	67.8	17.6	236.9	0.16
Thiamin (mg/d)	0.2	0.1	0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.2	0.81
Riboflavin (mg/d)	0.3	0.6	0.1	0.1	0.3	0.7	1.0	0.2	0.1	1.2	0.01
Niacin (mg/d)	2.6	1.9	2.2	1.3	3.2	2.4	2.3	1.9	1.2	3.0	0.58
Vitamin B12 (µg/d)	0.2	0.2	0.1	0.0	0.3	0.2	0.5	0.0	0.0	0.1	0.75
Folate (µg/d)	59.3	45.8	48.0	29.0	74.6	43.8	45.5	32.6	11.5	54.7	0.08
Sodium (mg/d)	873.4	1,572.8	584.3	234.5	936.8	822.8	1,154.0	372.5	60.9	930.2	0.85
Potassium (mg/d)	399.0	343.6	312.2	155.3	529.4	328.6	304.5	259.0	109.7	432.0	0.26
Saturated fatty acids (g/d)	0.9	1.0	0.4	0.2	1.2	0.7	1.7	0.2	0.1	0.6	0.64
Mono unsaturated acids (g/d)	1.3	1.5	0.6	0.3	1.9	0.8	1.2	0.4	0.2	1.1	0.09
Poly unsaturated acids (g/d)	1.0	1.0	0.8	0.4	1.3	0.8	0.8	0.5	0.2	1.1	0.21
Cholesterol (mg/d)	49.9	80.0	2.8	0.1	93.1	28.3	66.8	0.6	0.0	4.9	0.13

Appendix 7. Nutrient Intake from Complementary Foods of Breastfed Children 9–11 Months Old

	Huehuetenango					Quiché					
	Breastfed 9–11 months (n = 36)					Breastfed 9–11 months (n = 47)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	p-value (mean comparison)
Energy (kcal/d)	430.4	209.1	452.3	264.2	577.7	385.6	236.6	320.2	245.6	478.0	0.37
Protein (g/d)	13.1	7.4	12.2	7.7	18.2	10.6	6.5	8.7	6.7	13.7	0.10
Fat (g/d)	5.6	4.7	5.0	2.0	7.5	4.4	3.3	3.2	1.7	6.5	.017
Carbohydrates (g/d)	84.6	43.8	87.3	50.6	113.0	78.9	51.9	67.1	47.7	98.5	0.60
Dietary fiber (g/d)	7.6	6.3	5.7	3.4	10.0	4.7	4.1	3.8	2.2	6.1	0.01
Calcium (mg/d)	156.7	104.9	137.1	88.5	209.7	135.6	87.5	106.6	85.3	156.9	0.32
Phosphorus (mg/d)	244.5	134.0	225.7	135.0	355.2	188.0	138.3	156.2	112.7	211.6	0.10
Iron (mg/d)	4.2	2.7	3.9	2.0	5.9	4.3	3.1	3.2	2.2	6.2	0.87
Zinc (mg/d)	1.9	1.3	1.7	1.1	2.5	1.9	1.3	1.4	1.0	2.6	0.91
Magnesium (mg/d)	39.4	48.7	27.4	8.9	48.0	32.1	32.5	22.3	13.0	42.3	0.41
Vitamin C (mg/d)	48.2	82.5	23.3	7.0	51.4	21.4	18.8	16.1	5.3	32.9	0.03
Retinol Equivalent (µg/d)	221.8	191.3	167.3	99.4	285.2	237.5	268.4	137.9	58.2	297.8	0.77
Thiamin (mg/d)	0.2	0.1	0.2	0.1	0.3	0.3	0.2	0.2	0.2	0.4	0.17
Riboflavin (mg/d)	0.2	0.1	0.2	0.1	0.3	0.4	0.5	0.2	0.1	0.4	0.15
Niacin (mg/d)	2.9	2.4	2.5	1.4	3.7	2.9	1.9	2.4	1.5	4.1	0.95
Vitamin B12 (µg/d)	0.2	0.3	0.1	0.0	0.3	0.2	0.2	0.1	0.0	0.2	0.55
Folate (µg/d)	65.0	44.2	58.3	29.1	105.2	58.1	54.5	47.9	20.9	72.6	0.54
Sodium (mg/d)	1,085.8	1,824.9	660.0	259.5	1,097.8	1,164.8	2,048.1	474.0	156.7	1,072.2	0.86
Potassium (mg/d)	678.4	852.9	544.0	165.0	862.9	415.4	424.9	293.6	152.0	568.2	0.07
Saturated fatty acids (g/d)	1.0	1.1	0.8	0.3	1.6	0.8	0.8	0.5	0.3	1.3	0.30
Mono unsaturated acids (g/d)	1.7	2.0	1.0	0.5	2.6	1.2	1.3	0.9	0.4	1.6	0.23
Poly unsaturated acids (g/d)	1.0	0.6	0.9	0.6	1.3	1.0	0.7	0.9	0.6	1.2	0.88
Cholesterol (mg/d)	50.5	71.5	10.8	0.3	96.1	29.2	58.5	1.5	0.0	16.8	0.14

Appendix 8. Nutrient Intake from Complementary Foods of Breastfed Children 12–23 Months Old

	Huehuetenango					Quiché					p-value (mean comparison)
	Breastfed 12–23 months (n = 71)					Breastfed 12–23 months (n = 71)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	
Energy (kcal/d)	577.8	366.9	505.9	325.4	689.7	611.7	313.0	563.5	400.3	808.6	0.55
Protein (g/d)	18.5	11.4	16.5	11.4	22.9	17.8	9.9	16.1	10.7	22.7	0.71
Fat (g/d)	8.7	7.4	6.7	3.9	11.3	7.7	5.7	6.8	3.7	10.3	0.35
Carbohydrates (g/d)	110.9	75.0	98.1	57.6	128.6	121.6	63.7	108.4	77.1	158.1	0.36
Dietary fiber (g/d)	8.9	9.2	6.5	3.9	10.4	6.6	5.1	5.1	3.3	8.0	0.06
Calcium (mg/d)	252.2	214.9	206.5	132.5	322.4	224.4	126.4	193.6	136.1	282.7	0.35
Phosphorus (mg/d)	333.9	225.9	283.9	184.3	405.9	378.9	234.6	335.8	237.6	478.5	0.25
Iron (mg/d)	7.1	9.4	5.1	2.9	8.2	6.9	5.0	5.8	4.0	8.4	0.86
Zinc (mg/d)	2.9	1.9	2.4	1.6	4.2	3.3	3.2	2.7	1.7	4.0	0.39
Magnesium (mg/d)	41.0	40.5	33.1	11.9	56.2	45.4	41.4	34.3	18.9	60.2	0.53
Vitamin C (mg/d)	54.4	137.7	26.7	14.1	48.6	31.3	31.6	22.2	10.3	38.0	0.17
Retinol Equivalent (µg/d)	419.1	1,154.7	199.6	104.1	474.1	345.0	412.6	223.8	114.4	459.4	0.61
Thiamin (mg/d)	0.4	0.3	0.3	0.2	0.5	0.5	0.3	0.4	0.2	0.6	0.09
Riboflavin (mg/d)	0.4	0.5	0.3	0.2	0.6	1.6	2.4	0.5	0.3	2.5	< .0001
Niacin (mg/d)	5.4	13.6	3.3	2.0	4.5	5.1	4.3	4.2	2.5	6.2	0.85
Vitamin B12 (µg/d)	0.4	0.4	0.3	0.0	0.6	0.3	0.4	0.1	0.0	0.6	0.43
Folate (µg/d)	138.4	408.3	77.0	47.4	111.9	109.5	103.3	87.2	48.6	135.0	0.56
Sodium (mg/d)	1,247.3	1,762.4	656.6	325.0	1,586.5	1,482.0	1,359.7	1,139.4	404.8	1,820.7	0.38
Potassium (mg/d)	753.3	902.2	550.4	264.0	936.6	590.5	449.4	549.5	221.7	801.8	0.18
Saturated fatty acids (g/d)	1.8	2.1	1.2	0.3	2.7	1.4	1.4	1.1	0.3	2.0	0.20
Mono unsaturated acids (g/d)	2.5	2.6	1.7	0.6	3.0	2.2	2.3	1.5	0.6	3.1	0.48
Poly unsaturated acids (g/d)	1.6	1.4	1.1	0.7	2.0	1.7	1.3	1.3	0.8	2.2	0.81
Cholesterol (mg/d)	91.1	106.3	27.6	0.2	171.7	72.7	105.9	9.1	1.6	143.4	0.30

Appendix 9. Nutrient Intake of Non-Breastfed Children 12–23 Months Old

	Huehuetenango					Quiché					p-value (mean comparison)
	Non-breastfed 12–23 months (n = 27)					Non-breastfed 12–23 months (n = 21)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	
Energy (kcal/d)	924.3	546.2	815.4	518.2	1,207.6	1,048.3	515.4	1,030.0	618.9	1,345.4	0.55
Protein (g/d)	25.6	13.1	25.3	15.6	35.3	30.9	19.0	28.1	20.8	36.4	0.71
Fat (g/d)	12.2	7.8	11.4	8.0	13.9	12.7	11.6	10.3	5.9	14.8	0.35
Carbohydrates (g/d)	184.9	117.3	158.3	107.4	255.8	209.2	97.6	201.3	131.5	272.2	0.36
Dietary fiber (g/d)	12.0	9.2	9.3	6.8	16.0	12.4	8.8	8.4	6.5	20.5	0.06
Calcium (mg/d)	356.4	170.2	343.8	255.9	458.6	420.8	236.1	359.9	274.0	546.0	0.35
Phosphorus (mg/d)	497.9	279.9	435.7	313.4	592.7	711.4	467.7	642.1	353.1	1,224.3	0.25
Iron (mg/d)	9.2	5.3	7.9	5.6	13.7	12.3	7.6	9.8	8.4	16.0	0.86
Zinc (mg/d)	4.7	3.0	3.8	2.4	7.1	6.5	4.8	5.6	3.7	7.4	0.39
Magnesium (mg/d)	68.9	67.8	51.6	26.8	92.1	74.2	65.5	55.6	33.6	91.6	0.53
Vitamin C (mg/d)	57.1	59.7	44.6	13.0	79.0	41.9	31.7	34.1	18.1	51.6	0.17
Retinol Equivalent (µg/d)	566.6	472.1	320.0	234.6	971.6	682.1	732.7	385.0	285.1	510.8	0.61
Thiamin (mg/d)	0.6	0.4	0.6	0.3	0.7	0.8	0.4	0.7	0.6	0.9	0.09
Riboflavin (mg/d)	0.9	2.1	0.4	0.3	0.8	3.3	3.9	1.1	0.5	5.1	0.00
Niacin (mg/d)	6.1	3.9	4.9	3.4	8.2	8.9	6.0	7.0	5.8	8.9	0.85
Vitamin B12 (µg/d)	0.5	0.6	0.4	0.0	0.8	0.7	1.1	0.2	0.1	0.6	0.43
Folate (µg/d)	120.1	82.1	109.4	62.4	149.1	138.1	99.6	102.7	70.2	190.0	0.21
Sodium (mg/d)	1,286.5	1,033.0	950.1	608.1	1,851.6	1,568.0	1,489.3	1,343.1	390.2	2,109.7	0.38
Potassium (mg/d)	910.8	943.4	591.5	348.8	1,068.6	950.8	886.5	780.3	360.5	1,034.5	0.18
Saturated fatty acids (g/d)	2.4	2.2	1.8	1.2	2.9	2.4	3.0	1.7	1.2	2.4	0.20
Mono unsaturated acids (g/d)	3.4	2.8	3.2	1.9	4.2	4.0	4.8	2.6	1.6	3.5	0.48
Poly unsaturated acids (g/d)	2.5	2.0	2.3	1.3	2.9	2.8	2.0	2.3	1.3	3.7	0.81
Cholesterol (mg/d)	100.5	114.8	57.3	3.5	179.3	79.6	101.4	11.1	3.9	168.7	0.30

Appendix 10. Nutrient Intake of Pregnant Women

	Huehuetenango					Quiché					p-value (mean comparison)
	Pregnant (n = 38)					Pregnant (n = 37)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	
Energy (kcal/d)	2,177.9	791.6	2,291.4	1,700.5	2,657.1	2,254.5	992.7	2,129.7	1,567.2	2,692.4	0.71
Protein (g/d)	68.2	28.9	69.2	54.4	88.4	67.8	37.3	58.7	42.9	71.0	0.96
Fat (g/d)	26.2	23.5	19.8	12.9	34.5	21.9	17.2	16.7	12.7	27.0	0.37
Carbohydrates (g/d)	433.5	163.1	455.8	333.3	557.2	462.0	190.4	447.9	327.1	551.7	0.49
Dietary fiber (g/d)	36.9	18.1	35.7	20.4	53.0	35.3	23.5	34.8	18.0	44.8	0.75
Calcium (mg/d)	997.7	378.7	1,030.7	707.2	1,177.2	1,121.4	421.3	1,029.9	844.0	1,398.6	0.18
Phosphorus (mg/d)	1,354.9	642.2	1,263.9	1,040.9	1,656.6	1,982.1	1,154.6	1,602.9	1,187.4	2,559.0	0.00
Iron (mg/d)	19.0	7.3	17.7	15.6	24.2	24.5	14.1	22.2	17.9	24.7	0.04
Zinc (mg/d)	11.4	4.7	11.5	8.6	14.3	12.8	7.1	11.5	7.8	14.2	0.31
Magnesium (mg/d)	104.8	81.6	96.4	37.2	142.6	130.5	177.6	72.0	57.4	169.0	0.42
Vitamin C (mg/d)	103.3	95.2	74.5	40.8	142.4	58.9	44.0	57.4	17.4	81.1	0.01
Retinol Equivalent (µg/d)	739.4	387.5	741.8	456.6	962.4	685.3	771.5	467.4	284.6	712.6	0.70
Thiamin (mg/d)	1.2	0.5	1.1	0.9	1.5	1.6	2.1	1.2	1.0	1.5	0.22
Riboflavin (mg/d)	2.1	6.7	1.0	0.7	1.2	10.7	14.1	1.5	0.7	15.4	0.00
Niacin (mg/d)	14.5	7.1	13.8	10.3	18.6	17.0	15.7	13.2	9.5	17.3	0.37
Vitamin B12 (µg/d)	0.8	1.2	0.5	0.0	0.9	0.9	2.0	0.3	0.0	0.6	0.91
Folate (µg/d)	237.3	139.6	219.0	145.0	293.4	373.8	590.4	237.5	179.9	375.3	0.73
Sodium (mg/d)	3,745.2	3,231.4	3,134.0	1,605.6	4,611.9	2,396.5	1,977.7	1,718.5	1,001.0	3,954.2	0.03
Potassium (mg/d)	1,776.8	1,352.7	1,412.6	804.4	2,583.9	1,558.6	1,375.8	1,059.4	645.4	1,914.8	0.49
Saturated fatty acids (g/d)	5.3	7.0	3.0	1.5	6.7	3.3	3.8	1.9	1.0	3.8	0.12
Mono unsaturated acids (g/d)	8.5	10.0	6.1	3.2	10.8	6.5	7.2	4.8	2.1	7.7	0.32
Poly unsaturated acids (g/d)	7.3	4.8	6.8	3.8	9.2	6.9	3.8	6.6	4.1	9.0	0.71
Cholesterol (mg/d)	175.2	251.4	86.4	2.8	236.8	108.4	169.6	4.9	0.1	192.1	0.18

Appendix 11. Nutrient Intake of Lactating Women with Infants under 6 Months

	Huehuetenango					Quiché					
	Lactating (n = 39)					Lactating (n = 41)					
Name	Mean	SD	Median	25th percentile	75th percentile	Mean	SD	Median	25th percentile	75th percentile	p-value (mean comparison)
Energy (kcal/d)	2,243.8	837.7	2,136.1	1,634.6	2,748.4	2,729.8	835.3	2,657.8	2,188.5	3,090.7	0.01
Protein (g/d)	70.8	33.4	66.9	46.9	89.8	77.0	22.4	75.6	62.9	87.2	0.32
Fat (g/d)	24.7	18.3	19.2	10.6	34.9	27.7	15.7	24.0	17.6	30.7	0.43
Carbohydrates (g/d)	451.5	162.0	434.8	348.2	546.4	562.7	170.8	558.0	459.7	671.5	0.00
Dietary fiber (g/d)	43.0	21.5	40.5	30.6	50.6	35.2	18.5	38.3	20.2	51.5	0.08
Calcium (mg/d)	1,170.9	489.7	1,162.2	838.6	1,410.1	1376.0	411.3	1,337.1	1,043.5	1,613.9	0.05
Phosphorus (mg/d)	1,419.4	602.1	1,380.0	1,004.8	1,707.4	3,006.6	2,134.2	2,052.6	1,363.7	4,638.7	0.00
Iron (mg/d)	21.2	11.9	19.4	13.3	23.0	27.8	10.7	27.1	20.8	33.8	0.01
Zinc (mg/d)	12.5	5.9	12.0	8.4	14.0	15.1	4.9	14.5	12.3	17.8	0.03
Magnesium (mg/d)	68.9	72.5	45.8	13.3	104.4	93.3	66.8	90.2	32.0	123.7	0.12
Vitamin C (mg/d)	101.8	94.9	69.3	42.5	123.3	63.9	54.7	43.5	23.0	88.7	0.03
Retinol Equivalent (µg/d)	974.3	2,269.4	512.1	283.3	802.6	897.8	795.7	740.5	378.5	1,199.4	0.84
Thiamin (mg/d)	1.3	0.6	1.2	0.8	1.6	1.5	0.5	1.5	1.2	1.8	0.05
Riboflavin (mg/d)	1.1	1.0	0.9	0.6	1.1	22.4	28.1	1.5	0.9	38.3	0.00
Niacin (mg/d)	14.4	7.0	12.4	9.4	17.7	19.5	7.9	18.9	13.8	23.6	0.00
Vitamin B12 (µg/d)	4.0	20.3	0.5	0.0	1.0	0.8	1.2	0.5	0.0	0.8	0.32
Folate (µg/d)	279.0	179.8	218.9	152.4	349.0	262.8	134.9	223.4	162.5	323.3	0.04
Sodium (mg/d)	2,744.3	1,927.8	2,267.5	1,546.2	2,839.5	3,249.0	1,931.0	3,463.9	1,794.2	4,035.4	0.25
Potassium (mg/d)	1,644.3	1,425.5	1,178.2	648.8	2,233.5	1,288.5	947.0	1,141.3	610.9	1,595.2	0.19
Saturated fatty acids (g/d)	4.5	5.0	3.0	1.3	5.8	4.3	4.7	2.7	2.2	4.5	0.89
Mono unsaturated acids (g/d)	8.0	8.3	5.5	2.9	8.4	7.9	6.6	5.9	4.3	8.3	0.96
Poly unsaturated acids (g/d)	7.5	3.6	7.0	4.7	9.3	8.5	4.7	7.7	5.0	10.6	0.31
Cholesterol (mg/d)	170.4	208.5	91.3	2.3	250.2	181.9	215.4	160.1	3.9	229.2	0.81

Appendix 12. Food Lists Entered into Optifood: Cost per 100 g of the Edible Portion, Median Serving Sizes, Number of Consumers, and Maximum Number of Times per Week It Could Be Consumed (Freq) by Target Group[a]

	Cost	Breastfed 6–8 months			Breastfed 9–11 months			Breastfed 12–23 months			Non-breastfed 12–23 months			Pregnant			Lactating		
Foods	GTQ/ 100 g	Serv. (g)	n	Freq	Serv. (g)	n	Freq	Serv. (g)	n	Freq	Serv. (g)	n	Freq	Serv. (g)	n	Freq	Serv. (g)	n	Freq
Tortilla, yellow[b]	.7	13	12	14	19	16	14	22	36	14	37	7	14	185	21	14	237	18	14
Tortilla, white[b]	.7	16	74	14	19	58	14	20	91	14	50	24	21	205	53	14	240	59	14
Incaparina, powder[b]	1.96	9	20	7	10	14	7	20	20	7	24	10	7	26	11	7	29	12	7
Tamalito, white/yellow[b]	.7	35	12	7	45	2	14	35	23	7	66	8	14	207	17	10	414	19	10
Corn dough, white[b]	1.1	18	24	14	20	21	7	22	33	10	48	9	14	58	14	14	72	22	14
Corn dough, yellow[b]	1.1	24	9	14				33	10	7	58	3	7	121	7	14	220	6	7
Corn, white[b]	.5	13	31	14	17	16	7	23	39	7	31	14	14	50	22	10	51	28	10
Corn, white/black[b]	.5										54	2	2						
Corn, yellow[b]	.5							22	13	14	52	2	7	66	5	7	61	7	10
Pasta, commercial[b]	1.27	7	22	1	9	17	7	17	37	7	24	12	3	50	20	5	25	17	7
Oats, instant, fortified[b]	2.18	7	5	1	9	5	14	8	9	14	4	3	3	13	3	7	14	3	7
Oats, not fortified[b]	1	8	10	4	8	15	7	7	20	7	20	7	3	24	10	7	14	8	7
Pinol, plain (*atole*) [b]	1.07																38	4	14
Rice, white[b]	1.1	9	17	7	18	23	3	24	32	4	29	13	3	62	16	7	46	16	3
Cereal Corazon de Trigo	1.5										28	2	10						
Bread, white	1.37	37	15	7	25	15	7	32	40	7	53	10	7	65	21	7	72	12	7
Vegetable oil	2.33	1	27	4	1	31	7	1	52	4	1	20	3	2	35	4	2	29	5
Sugar	.9	8	86	7	9	78	7	12	132	7	22	35	7	33	69	7	29	74	7
Coffee, toasted powder	2.79	0.5	59	7	0.4	55	7	1	102	7	1	30	7	2	64	7	2	70	7
Potatoes	.37	55	55	7	57	40	7	58	56	7	75	18	7	120	38	7	168	28	7
Tomato, red	.45	10	64	7	12	55	7	25	105	4	28	30	4	44	61	7	52	67	7
Tree tomato	1.54				9	5	4				15	2	2				52	6	4
Husk tomato	.43										29	2	5						
Onion, bulb and tops	.64	2	7	3				4	14	3	16	3	3	10	11	4	32	7	7
Onion bulbs-cebolla	.47	3	59	7	4	56	5	7	96	4	8	25	4	15	58	7	15	63	7
Amaranth leaves[d]	.42	15	2	3	43	2	3	20	5	3	18	1	2	59	4	7	69	6	7
Turnip greens	.58	9	6	4							29	4	4	62	4	2	58	4	3
Nightshade leaves[d,e]	.86	27	4	4	28	3	5	21	10	4	25	2	7	55	10	7	64	9	7
Crotalaria, leaf and shoots[d]	1.15	5	1	5				28	2	2				95	2	2	80	2	7
Chayote (*Sechium edule*), leaves and shoots	.62	16	6	6	31	13	3	31	21	4	56	7	3	112	9	4	110	14	4
Pumpkin, leaves[d]	.26	22	1	2				33	3	3				64	1	3	133	3	4
Cabbage	.29										141	2	3				103	5	2

	Cost	Breastfed 6–8 months			Breastfed 9–11 months			Breastfed 12–23 months			Non-breastfed 12–23 months			Pregnant			Lactating		
Foods	**GTQ/ 100 g**	**Serv. (g)**	**n**	**Freq**	**Serv. (g)**	**n**	**Freq**	**Serv. (g)**	**n**	**Freq**	**Serv. (g)**	**n**	**Freq**	**Serv. (g)**	**n**	**Freq**	**Serv. (g)**	**n**	**Freq**
Chayote (*Sechium edule*)	.4	54	23	4	45	18	4	66	17	5	50	7	3	179	12	3	144	10	4
Carrots	.67	13	15	5	14	5	4	35	8	7	34	8	3	102	6	2	50	5	2
Pumpkin[d]	.8				174	1	4	86	1	2	460	1	2	450	2	1	401	1	4
Beans, snap	.56										109	2	3						
Peas, green[d]	3.38				22	1	0.2	46	1	1									
Plantain[d]	.64	78	5	3	311	3	3	127	3	1	428	3	3	250	4	7	200	3	3
Orange[d]	.39	115	2	2	48	2	7	171	7	7	161	1	3	149	5	7	204	4	3
Banana	.93	64	22	7	74	15	7	110	33	7	123	7	4	169	8	7	173	7	7
Banana datil	.8				35	6	7	46	12	7	164	2	3						
Lemon	.96	1	6	7	4	14	7	4	19	7	11	5	7	15	14	7	12	11	7
Apple	.42				86	5	3	76	10	7				140	6	7			
Milk, powder	8.13	2	11	7	3	10	7	8	20	7	5	9	7	10	10	7	5	6	7
Cheese[d]	4.07	8	1	1	25	1	1	20	2	1	4	1	0.5	77	1	1	230	1	1
Egg, whole	2.87	30	27	5	27	23	5	52	58	7	47	16	4	58	29	4	60	40	7
Egg, yolk	8.6	18	1	1															
Chicken	3.32	14	7	2	52	1	2				38	2	1	178	6	2	173	5	2
Lamb	4.7										43	1	0.5	115	1	1			
Frankfurter, beef and pork	2.6				3	1	0.5	18	3	2				180	1	1	40	1	2
Lamb liver[c]	2.8													90	0	1	90	1	1
Black beans	1	24	6	3	26	11	4	31	29	4	61	7	3	115	31	3	122	23	7
Black beans, dry	1.2	23	14	7	19	14	3	29	26	7				69	23	5	58	25	4
Protemas, soy protein[d]	1.36	4	1	1															
Bean broth	.1	29	33	7	21	24	4	36	34	4	41	10	7						
Chicken broth, powder	8.33	1	35	4	0.6	24	5	1	43	4	1	16	4	2	28	5	2	27	7
Chicken noodle soup, dehydrated	3.33	1	50	5	2	35	4	4	70	4	5	18	4	6	26	7	5	41	7
Beef broth, powder	10										1	2	3						
Ramen noodle soup, dehydrated	2.5										13	3	2						
Beverage, concentrate	6.92	1	6	7										4	5	7			
Orange, powder, drink	3																1	5	7

[a] Serving sizes were expressed in g/day for foods from all food groups except those in the "Grains and Grain Products" food group.

[b] Serving size was expressed in in g/meal.

[c] Liver was added to the food list for pregnant women, even though it was not consumed by any pregnant woman, to help meet vitamin B12 requirements.

[d] Consumed by < 5% for all target groups.

[e] Hierba mora (*Solanum tuberosum*).

Appendix 13. The Food Group Constraints Used in the Models (servings/week) for Each Target Group

	Breastfed 6–8 months			Breastfed 9–11 months			Breastfed 12–23 months			Non-breastfed 12–23 months			Pregnant			Lactating		
Food group	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week	**Low** serv/ week	**Aver**[a] serv/ week	**High** serv/ week
Added sugars	3	6	7	5	7	8	5	7	8	5	7	8	5	7	8	5	7	8
Added fats	0	1	7	0	1	7	0	1	7	0	6	7	0	1	7	0	1	7
Fruits	0	1	7	0	1	7	0	4	14	0	1	7	0	4	14	0	1	7
Vegetables	0	14	28	0	14	28	7	14	28	7	21	35	7	21	28	14	21	28
Dairy products	0	1	7	0	1	7	0	1	7	0	1	7	0	1	7	0	1	7
Legumes	0	1	7	0	1	7	0	1	7	0	1	7	0	7	14	0	7	8
Meat, poultry, eggs	0	1	7	0	1	7	0	1	7	0	7	8	0	4	14	0	7	8
Roots	0	6	7	0	1	7	0	1	7	0	4	7	0	7	14	0	1	7
Grains	7	28	42	7	28	42	14	28	49	21	35	56	21	28	49	28	35	49
Bakery, breakfast cereal	0	1	7	0	1	7	0	1	7	0	1	7	0	1	7	0	1	7
Beverages	0	7	14	0	7	14	0	7	14	6	7	14	6	7	14	6	7	14
Mixed foods	0	7	14	0	7	14	0	7	14	0	11	14	0	7	14	0	7	14
Staples	7	14	21	7	14	21	7	21	28	7	21	28	14	21	28	20	21	28
Snacks	0	1	7	0	1	14	0	7	14	0	1	14	0	1	14	0	1	7

[a] The “average” food pattern is defined by the median or 50th percentile of consumption observed by the target group.

Appendix 14. The Food Subgroup Constraints Used in the Models (servings/week) for Each Target Group

	Breastfed 6–8 months		Breastfed 9–11 months		Breastfed 12–23 months		Non-breastfed 12–23 months		Pregnant		Lactating	
Food subgroups	**Low** serv/week	**High** serv/week	**Low** serv/week	**High** serv/week	**Low** serv/week	**High** serv/week	**Low** serv/week	**High** serv/w	**Low** serv/week	**High** serv/week	**Low** serv/week	**High** serv/week
Vegetable oil, unfortified	0	7	0	7	0	7	0	7	0	7	0	7
Sugar (fortified)	5	7	5	7	5	8	5	8	5	8	5	8
Enriched/fortified bread	0	7	0	7	0	7	0	7	0	7	0	7
Coffee	0	7	0	7	0	7	0	7	0	7	0	7
Juices											0	7
Sugar beverages	0	1	0	7					0	7		
Broths	0	7	0	7	0	7	0	14	0	7	0	7
Soups	0	7	0	1	0	7	0	7	0	7	0	7
Cheese	0	1	0	7	0	1	0	1	0	1	0	7
Milk, powder (unfortified)	0	7	0	7	0	7	0	7	0	7	0	7
Other fruit	0	7	0	7	0	7	0	7	0	7	0	7
Vitamin C fruit	0	1	0	7	0	7	0	7	0	7	0	7
Enriched/fortified grains	0	1			0	14	0	3	0	5	0	7
Atole	0	14	0	14	0	14	0	14	0	14	0	14
Refined grains	0	7	0	3	0	4	0	3	0	7	0	3
Whole grains	7	35	7	35	7	42	14	42	21	35	21	42
Cooked beans	0	7	0	7	0	7	0	7	0	14	0	7
Soy products	0	1										
Eggs	0	7	0	7	0	7	0	7	0	7	0	7
Organ meat											0	1
Poultry	0	1	0	1			0	7	0	7	0	7
Processed meat			0	1	0	1			0	1	0	1
Red meat							0	1	0	1		
Other root vegetable	0	7	0	7	0	7	0	7	0	14	0	7
Condiment vegetables	0	7	0	7	0	7	0	7	0	7	0	7
Other vegetables	0	4	0	4	0	4	0	7	0	7	0	7
GLVs	0	7	0	7	0	7	0	7	0	7	0	7
Vitamin A other vegetable	0	7	0	1	0	1	0	7	0	7	0	7
Vitamin C vegetable	0	14	0	14	0	14	0	14	0	14	0	14

Appendix 15. INCAP Recommended Dietary Allowances and Adequate Intakes (INCAP 2012)

	Calcium[a] mg/day	**Vitamin C** mg/day	**Thiamin** mg/day	**Riboflavin** mg/day	**Niacin** mg/day	**B6** mg/day	**Folate** µg DFE[c]/day	**B12** µg/day	**Vitamin A** µg RE/day	**Iron**[e] mg/day	**Zinc** mg/day	**Energy** kcal	**Protein** g
Children 6–9 months	400	50[b]	0.3	0.4	4	0.3	75	0.5	450[d]	9[f]	6.3	620.0	14
Children 9–11 months	400	50[b]	0.3	0.4	4	0.3	75	0.5	450[d]	9[f]	6.3	700.0	16
Children 12–23 months	500	15	0.4	0.5	6	0.5	150	0.9	210[d]	14	4.6	850.0	16
Pregnant women	1,000	75	1.4	1.4	18	1.9	600	2.6	500	n/a[g]	20.2	2,467.5	88
Lactating women	1,000	100	1.3	1.6	17	2.0	500	2.8	825	31.2	22.6	2,900.0	87

[a] Calcium values refer to adequate intake (AI) values.
[b] Vitamin C values for children 6–11 months refer to the AI values.
[c] Dietary Folate Equivalent
[d] Vitamin A values for children 6–23 months refer to AI values.
[e] Iron values for children 12–23 months, pregnant women, and lactating women are for a 5% level of bioavailability of iron in diet.
[f] Iron values for children 6–11 months are for a 10% level of bioavailability of iron in diet. There is no INCAP RDA for iron for children 6–11 months at 5% level of bioavailability of iron in diet. Note that the bioavailability of dietary iron during this period varies greatly. The WHO/FAO 2004 RNI for 5% level of bioavailability of iron in the diet for children 6–11 months is 18.6 mg/day.
[g] INCAP does not provide values for dietary iron requirements in pregnant women because the iron balance in pregnancy depends on the properties of the diet and the amounts of stored iron. The low bioavailability of iron in the diet and probability of a high prevalence of low iron stores make it unlikely that pregnant women in Guatemala can meet their daily requirements for iron.

Appendix 16. Module 3, Stage 1: Formulation of FBRs for Breastfed Children 6–8 Months Old with Incaparina and Fortified Instant Oats – Selection of the Key Messages

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	89	100	136	141	108	139	182	109	117	74	63	1.7
	Optimized-B	94	100	124	139	117	155	173	106	123	78	64	1.8
	Maximized[a]	97	138	152	166	135	245	213	146	144	80	66	3.0
	No Recommendations	**48**	**50**	**49**	**58**	**31**	**36**	**42**	**51**	**75**	**14**	**22**	**0.8**
1	Veg28	51	64	55	64	36	54	67	52	89	17	24	1.0
2	Veg21	49	56	52	60	34	45	47	51	78	15	22	0.9
3	GLV7	48	50	49	58	31	36	42	51	75	14	22	0.8
4	Dairy7	52	50	50	63	31	37	43	63	76	14	23	0.9
5	MPE7	51	50	50	83	34	46	54	107	84	16	26	1.6
6	MPE3	49	50	50	65	31	39	46	70	78	14	23	1.1
7	Legume7	50	50	56	58	33	45	79	51	75	17	24	0.8
8	Staple21	56	50	53	58	36	52	42	51	76	15	26	0.8
9	Staple14	52	50	50	58	33	42	42	51	75	14	24	0.8
10	Incaparina7	54	50	90	94	73	36	66	71	79	26	44	0.9
11	Fort oats7	54	50	69	77	53	67	65	51	92	34	24	0.8
12	Potato7	52	59	50	61	43	75	49	52	75	16	25	0.9
13	Potato4	50	54	49	59	36	53	45	51	75	14	23	0.9
14	Fruit7	48	60	49	64	38	100	54	52	75	14	22	1.2
15	10-11	59	50	110	113	96	67	89	71	96	48	46	0.9
16	8-10-11	68	50	113	113	101	85	89	71	96	50	50	0.9
17	9-10-11	64	50	111	113	98	75	89	71	96	47	48	0.9
18	1-8-10-11	72	64	119	119	107	104	113	72	111	54	52	1.1
19	1-9-10-11	67	64	117	119	104	93	113	72	110	51	50	1.1
20	2-8-10-11	70	56	116	115	104	94	93	71	100	51	50	1.0
21	2-9-10-11	65	56	115	115	101	84	93	71	99	49	48	1.0
22	1-8-10-11-12	76	74	120	122	120	144	120	73	111	57	55	1.2
23	1-9-10-11-12	71	74	117	122	117	134	120	72	110	54	53	1.2
24	2-8-10-11-12	74	65	118	118	117	136	99	72	100	54	53	1.1
25	2-9-10-11-12	69	65	115	118	114	126	99	72	99	52	51	1.1
26	1-8-10-11-4	74	69	119	121	114	127	116	72	111	55	54	1.2
27	1-9-10-11-4	69	69	117	121	111	117	116	72	110	52	51	1.2

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	89	100	136	141	108	139	182	109	117	74	63	1.7
	Optimized-B	94	100	124	139	117	155	173	106	123	78	64	1.8
	Maximized[a]	97	138	152	166	135	245	213	146	144	80	66	3.0
	No Recommendations	**48**	**50**	**49**	**58**	**31**	**36**	**42**	**51**	**75**	**14**	**22**	**0.8**
28	1-8-10-11-12-5	79	74	123	150	123	156	133	129	120	61	59	2.0
29	1-9-10-11-12-5	74	74	119	148	120	146	132	129	119	58	56	2.0
30	2-9-10-11-12-5	72	65	116	144	117	138	112	128	108	56	55	1.9
31	1-8-10-11-12-6	77	74	121	130	120	149	123	91	114	58	56	1.5
32	1-9-10-11-12-6	72	74	117	130	117	139	123	91	113	55	54	1.5
33	2-9-10-11-12-6	70	65	115	126	114	130	103	91	102	53	52	1.4
34	1-8-10-11-12-7	78	74	128	124	123	155	157	73	111	61	57	1.2
35	1-9-10-11-12-7	73	74	124	123	119	145	157	73	110	58	55	1.2
36	2-9-10-11-12-7	71	65	122	119	117	136	137	72	99	56	53	1.1
37	1-9-10-11-13-7	71	69	124	122	114	127	154	72	110	57	53	1.2
38	1-9-10-11-12-leg3	72	74	120	123	118	139	136	72	110	56	54	1.2
39	1-9-10-11-12-5-7	76	74	128	150	122	157	170	129	119	62	58	2.0
40	1-8-10-11-12-5-7	82	75	133	152	126	168	171	129	126	67	61	2.0
41	2-8-10-11-12-5-7	79	65	130	147	123	158	150	129	110	63	59	1.9
42	2-9-10-11-12-5-7	74	65	125	146	120	148	150	128	108	60	56	1.9
43	1-8-10-11-12-6-7	79	74	129	132	123	160	161	92	114	62	58	1.5

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 17. Module 3, Stage 1: Formulation of FBRs for Breastfed Children 9–11 Months Old with Incaparina and Fortified Instant Oats – Selection of the Key Messages

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	112	114	158	176	138	189	210	140	152	100	76	2.7
	Optimized-B	114	117	165	176	130	185	210	138	146	100	77	2.6
	Maximized[a]	125	203	205	207	203	374	271	146	195	136	78	3.6
	No Recommendations	**47**	**49**	**57**	**63**	**41**	**54**	**45**	**51**	**81**	**16**	**23**	**1.1**
1	Veg21	49	63	63	67	45	65	57	52	84	19	24	1.3
2	GLV7	58	72	64	81	45	85	63	52	99	38	24	1.2
3	Dairy7	54	49	58	71	40	54	46	70	83	16	24	1.3
4	MPE7	50	49	58	86	40	57	52	101	88	19	26	1.7
5	MPE3	48	49	57	70	40	55	47	67	83	17	24	1.3
6	Beans7	51	49	64	64	40	61	83	51	81	22	26	1.1
7	Staple14	53	49	59	63	41	59	45	51	81	17	25	1.1
8	Staple21	60	49	61	63	42	68	45	51	82	20	28	1.1
9	Incap7	54	49	103	103	84	54	70	73	86	31	47	1.2
10	Fort oats7	55	49	82	87	67	94	73	51	102	44	26	1.2
11	Potato7	54	59	58	66	51	91	51	52	81	23	30	1.2
12	Potato4	50	55	57	65	46	75	48	52	81	18	24	1.1
13	Veg28	59	89	69	84	50	95	91	52	102	39	27	1.4
14	Fruit7	47	53	57	63	40	55	46	51	81	16	23	1.1
15	9-10	62	49	128	127	113	94	98	73	107	58	50	1.3
16	1-9-10	63	63	133	131	118	105	110	74	110	61	52	1.5
17	2-9-10	73	73	135	144	118	124	116	73	125	80	52	1.4
18	9-10-11	68	59	128	130	124	130	105	74	107	61	55	1.4
19	2-9-10-7	78	72	137	144	120	132	116	73	125	80	55	1.4
20	2-9-10-8	73	79	138	146	121	129	119	74	126	81	52	1.5
21	2-9-10-6	76	73	142	145	120	133	156	74	125	86	55	1.4
22	2-9-10-5	74	72	135	151	118	126	119	89	127	80	53	1.7
23	2-9-10-4	75	72	136	167	118	129	125	123	132	82	55	2.0
24	2-9-10-11	78	82	135	147	130	163	124	74	125	82	56	1.5

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	112	114	158	176	138	189	210	140	152	100	76	2.7
	Optimized-B	114	117	165	176	130	185	210	138	146	100	77	2.6
	Maximized[a]	125	203	205	207	203	374	271	146	195	136	78	3.6
	No Recommendations	**47**	**49**	**57**	**63**	**41**	**54**	**45**	**51**	**81**	**16**	**23**	**1.1**
25	2-9-10-4-6	79	73	143	169	120	139	165	123	132	89	59	2.0
26	2-9-10-5-6	77	73	142	152	120	135	158	90	127	86	57	1.7
27	2-9-10-4-11	80	82	136	171	130	169	133	124	132	85	59	2.1
28	2-9-10-5-11	78	82	135	154	130	165	126	90	127	83	58	1.8
29	2-9-10-6–11	81	83	142	148	133	173	164	74	125	88	59	1.5
30	2-9-10-5-8	86	72	139	151	124	143	119	89	128	85	59	1.7
31	2-9-10-6–8	89	73	146	145	127	153	156	74	126	90	62	1.4
32	2-9-10-11-8	90	82	139	147	137	182	124	74	126	86	61	1.5
33	2-9-10-5-6–11	82	83	142	156	133	175	166	91	127	89	61	1.8
34	2-9-10-5-6–8	90	73	147	152	127	157	159	90	128	92	63	1.7
35	2-9-10-6–8-11	93	83	148	149	141	195	164	75	126	93	64	1.5
36	2-9-10-5-8-11	91	82	140	154	137	186	126	91	128	88	62	1.8
37	2-9-10-4-6–8	92	73	149	169	127	162	166	124	133	94	66	2.0
38	1-9-10-6–8-11	84	73	147	135	140	176	158	75	111	74	64	1.6
39	1-9-10-5-6–11	72	73	141	142	132	156	161	91	112	70	61	1.8
40	1-9-10-5-6–8	80	63	146	138	127	137	153	90	113	73	63	1.7
41	2-9-10-4-6–8-11	96	83	151	174	141	205	174	125	133	98	68	2.2
42	9-10-4-6–8-11-13	97	100	159	180	147	219	206	129	137	100	72	2.4
43	9-10-4-6–8-11-13	95	100	156	161	147	212	197	92	132	97	69	2.0

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 18. Module 3, Stage 1: Formulation of FBRs for Breastfed Children 12–23 Months Old with Incaparina and Fortified Instant Oats – Selection of the Key Messages

	Calcium % RDA	**Vitamin C** % RDA	**Thiamin** % RDA	**Riboflavin** % RDA	**Niacin** % RDA	**B6** % RDA	**Folate** % RDA	**B12** % RDA	**Vitamin A** % RDA	**Iron** % RDA	**Zinc** % RDA	**Cost** GTQ/day
Optimized-A	100	364	164	192	120	102	126	120	229	72	147	4.1
Optimized-B	100	394	179	212	139	134	147	121	261	90	155	4.3
Maximized[a]	121	1136	246	249	177	262	199	152	318	92	159	6.0
No Recommendations	**44**	**163**	**57**	**58**	**32**	**42**	**28**	**28**	**126**	**16**	**43**	**1.5**
Fruit7	44	177	57	58	32	43	28	28	126	16	43	1.6
Veg28	47	266	66	70	40	62	53	29	153	21	50	1.9
Veg21	44	208	62	63	36	52	34	29	132	18	44	1.7
MPE7	46	163	58	94	32	46	35	86	147	17	50	2.6
MPE3	44	163	58	70	32	43	30	50	133	16	45	1.9
Beans7	46	164	63	58	32	47	52	28	126	19	48	1.5
GLV7	46	179	60	66	34	53	34	28	142	20	43	1.6
Dairy7	56	167	59	73	32	47	28	54	132	16	46	2.0
Incap7	53	163	124	122	91	47	53	52	140	32	107	1.7
Fort oats7	48	163	73	76	48	63	41	28	154	30	46	1.7
Potato7	46	197	58	60	39	64	31	29	126	17	46	1.6
Potato4	44	182	57	59	36	55	30	28	126	16	44	1.6
Staple21	51	163	59	58	34	50	28	28	128	17	48	1.5
11-12	58	163	141	140	108	63	66	52	169	48	110	1.9
11-12-15	66	163	144	140	111	71	66	52	170	51	118	1.9
2-11-12	62	266	150	152	116	83	92	53	195	54	118	2.3
3-11-12	59	208	146	145	113	73	72	53	175	50	112	2.1
8-11-12	60	179	143	148	111	74	72	52	185	52	111	2.0
10-11-12	71	167	142	155	108	63	67	78	175	48	114	2.4
4-11-12	61	163	142	176	108	67	73	110	190	52	118	3.0
5-11-12	59	163	141	152	108	64	69	74	176	49	113	2.3
7-11-12	60	164	147	140	109	68	91	52	169	53	116	1.9
2-11-12-15	71	266	153	152	120	93	92	54	197	58	125	2.3
2-10-11-12	76	271	152	167	116	84	92	80	202	54	122	2.8
2-5-11-12	63	266	150	164	116	84	94	75	202	56	121	2.7
2-7-11-12	65	267	156	152	118	90	117	53	195	61	124	2.3
2-4-11-12	65	267	151	189	116	89	100	111	216	59	126	3.4

	Calcium % RDA	**Vitamin C** % RDA	**Thiamin** % RDA	**Riboflavin** % RDA	**Niacin** % RDA	**B6** % RDA	**Folate** % RDA	**B12** % RDA	**Vitamin A** % RDA	**Iron** % RDA	**Zinc** % RDA	**Cost** GTQ/day
Optimized-A	100	364	164	192	120	102	126	120	229	72	147	4.1
Optimized-B	100	394	179	212	139	134	147	121	261	90	155	4.3
Maximized[a]	121	1136	246	249	177	262	199	152	318	92	159	6.0
No Recommendations	**44**	**163**	**57**	**58**	**32**	**42**	**28**	**28**	**126**	**16**	**43**	**1.5**
2-7-10-11-12	79	271	158	168	118	92	119	80	202	61	128	2.8
2-5-7-11-12	66	267	157	164	118	92	120	75	202	62	127	2.7
3-7-10-11-12	76	213	155	160	114	81	98	79	182	56	122	2.6
3-5-7-11-12	63	209	153	157	114	81	100	75	182	58	121	2.5
2-4-7-11-12	69	267	158	190	118	97	127	111	216	65	132	3.4
2-10-11-12-15	85	271	154	167	120	95	92	80	203	58	129	2.8
2-4-11-12-15	75	266	154	189	120	101	100	111	218	63	134	3.4
2-5-7-11-12-13	69	301	157	167	126	117	124	76	202	64	130	2.8
2-5-7-11-12-14	68	286	157	166	122	106	122	76	202	63	129	2.7
2-4-7-11-12-13	72	301	158	193	126	122	131	112	216	67	136	3.5
2-4-7-11-12-14	70	286	158	191	122	111	129	112	216	66	134	3.4
2-7-10-11-12-13	82	305	158	171	126	116	123	80	202	62	131	2.9
2-7-10-11-12-15	84	166	152	155	114	81	92	79	177	57	128	2.4
2-4-7-11-12-15	78	267	161	190	123	112	127	112	218	70	141	3.4
2-5-7-11-12-13-15	79	301	160	167	132	131	124	76	204	68	138	2.8
2-7-10-11-12-13-15	92	305	162	171	132	131	123	80	203	67	139	2.9

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 19. Module 3, Stage 1: Formulation of FBRs for Non-Breastfed Children 12–23 Months Old with Incaparina and Fortified Instant Oats – Selection of the Key Messages

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	100	593	215	211	161	151	121	108	175	111	158	5.7
	Optimized-B	100	349	2202	206	167	138	104	108	153	115	164	5.7
	Maximized[a]	124	1002	337	270	252	391	246	115	313	124	197	8.5
	No Recommendations	**17**	**6**	**70**	**36**	**42**	**53**	**18**	**3**	**53**	**28**	**39**	**2.5**
1	Fruit7	17	45	70	36	42	54	19	3	53	28	39	2.6
2	Dairy7	25	9	71	46	42	53	18	20	57	28	41	2.8
3	Veg14	17	20	72	38	44	56	19	3	54	29	39	2.6
4	Veg21	18	54	75	40	46	60	23	3	58	30	40	2.7
5	MPE7	20	7	71	65	49	56	23	58	70	31	50	3.7
6	MPE3	17	7	70	43	42	53	19	21	56	29	42	3.0
7	Staple21	37	7	71	36	43	68	18	3	54	28	49	2.5
8	Incap7	30	7	150	113	114	53	49	32	70	49	116	2.7
9	Fort oat7	19	7	76	47	52	67	26	3	68	36	39	2.6
10	Beans7	20	7	83	37	43	61	64	3	53	33	45	2.9
11	GLV7	25	57	72	43	44	64	26	3	81	32	40	2.6
12	Potato4	19	32	70	38	47	69	20	3	53	29	41	2.6
13	Veg28	24	104	80	44	49	70	32	4	78	32	41	2.8
14	Potato7	25	51	73	39	51	80	22	4	53	35	50	2.6
15	7-8-9-2	62	9	163	135	124	80	59	49	89	58	132	3.4
16	7-8-9-5	57	7	163	154	132	88	64	87	101	61	142	4.3
17	7-8-9-6	54	7	162	133	124	81	60	50	88	59	134	3.6
18	7-8-9-4	55	54	167	130	128	88	64	33	89	60	131	3.3
19	7-8-9-10	57	7	175	126	125	93	104	33	85	64	136	3.5
20	7-8-9–11	62	57	164	133	126	91	66	32	113	62	131	3.2
21	7-8-9-2-10	66	9	177	136	125	94	104	50	89	64	139	3.8
22	7-8-9-2-11	70	60	165	142	126	92	67	49	117	62	134	3.5
23	7-8-9-5-10	60	7	176	155	132	102	109	88	101	67	149	4.7
24	7-8-9-2-10-11	74	60	179	143	127	106	112	50	117	68	140	3.9
25	7-8-9-2-10-5	69	10	178	164	132	204	110	104	105	67	151	5.0
26	7-8-9-2-10-11-5	77	60	180	171	134	115	117	104	133	71	152	5.1
27	7-8-9-2-10-11-6	75	60	180	149	127	109	113	66	120	69	144	4.3
28	7-8-9-10-5-13-14	74	149	187	166	151	155	126	89	126	74	159	5.2
29	7-8-9-10-4-6-12	62	80	181	138	135	123	112	52	93	68	144	4.2
30	7-8-9-10-4-6-14	65	98	181	139	138	137	113	52	93	70	150	4.3

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	100	593	215	211	161	151	121	108	175	111	158	5.7
	Optimized-B	100	349	2202	206	167	138	104	108	153	115	164	5.7
	Maximized[a]	124	1002	337	270	252	391	246	115	313	124	197	8.5
	No Recommendations	**17**	**6**	**70**	**36**	**42**	**53**	**18**	**3**	**53**	**28**	**39**	**2.5**
31	7-8-9-2-10-11-5-12	82	104	181	174	144	148	121	105	133	73	160	5.2
32	7-8-9-10-4-6-12-2	71	82	183	148	135	125	112	68	97	68	147	4.5
33	7-8-9-10-4-6-13-2	73	101	183	149	138	139	114	69	97	70	152	4.6

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 20. Module 3, Stage 1: Formulation of FBRs for Pregnant Women with Incaparina and Fortified Instant Oats and Liver – Selection of the Key Messages

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	144	186	126	141	120	137	72	381	287	100	86	13.3
	Optimized-B	139	206	144	164	155	135	96	407	287	115	90	15.6
	Maximized[a]	179	302	162	178	169	216	105	409	334	136	103	18.2
	No Recommendations	**71**	**2**	**63**	**37**	**51**	**83**	**9**	**4**	**39**	**44**	**46**	**7.9**
1	Fruit7	71	12	63	37	51	83	9	4	39	44	46	8.1
2	Veg27	78	57	68	48	57	96	25	5	101	51	49	9.1
3	MPE7	72	2	63	47	61	83	10	33	47	45	48	10.4
4	Dairy7	79	3	63	45	51	83	9	16	43	44	46	8.6
5	VtC7Frt7	71	12	63	37	51	84	9	4	39	44	46	8.1
6	GLV7	75	12	64	43	53	90	12	4	59	48	46	8
7	Beans7	75	2	68	38	51	84	27	4	39	49	48	7.9
8	Egg3	72	2	63	44	51	83	10	14	44	45	46	8.5
9	Redmeat1	71	2	63	38	52	83	9	15	39	44	48	8.6
10	Chicken2	71	2	63	39	66	84	9	8	41	44	46	9.2
11	Incap7	77	2	88	68	77	83	17	15	47	54	64	8.2
12	Fort oats7	75	2	70	48	61	94	14	4	58	55	46	8.2
13	Chayote3	72	18	64	39	52	84	18	4	40	45	48	8.1
14	Orange1	72	17	64	38	51	83	10	4	40	44	46	7.9
15	Liver1	71	4	64	64	59	86	12	338	148	46	48	7.9
16	Veg21	73	24	66	42	54	90	12	4	52	46	46	8.2
17	VtCveg7	71	13	64	38	52	84	9	4	42	45	46	8.0
18	Potato7	74	16	63	39	56	94	11	4	39	45	46	8.1
19	Orange7	76	107	70	40	51	84	16	4	41	44	46	8.2
20	Orange3	73	47	66	38	51	84	12	4	40	44	46	8.0
21	2-7-11	90	57	99	79	83	97	52	16	109	68	71	9.4
22	2-3-11	85	57	94	88	93	96	35	45	117	61	71	11.8
23	2-7-15	82	60	75	76	65	100	47	339	210	59	54	9.0
24	2-11-15	84	59	95	106	91	98	37	350	218	63	70	9.3
25	7-11-15	82	5	94	95	85	87	39	349	156	62	70	8.2
26	2-7-11-15	90	60	100	106	91	100	56	350	218	70	74	9.3
27	2-3-7-11	90	57	99	90	93	98	54	45	117	69	74	11.1
26	2-7-11-14-15*	91	75	101	107	91	100	57	350	218	70	74	9.4
27	2-7-11-15*-18	93	74	100	108	96	112	58	350	218	72	74	9.5
28	2-6-7-11-15*	90	60	100	106	91	100	56	350	218	70	74	9.3
29	2-7-11-15*-19	95	165	108	109	92	102	63	350	220	70	74	9.6

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	144	186	126	141	120	137	72	381	287	100	86	13.3
	Optimized-B	139	206	144	164	155	135	96	407	287	115	90	15.6
	Maximized[a]	179	302	162	178	169	216	105	409	334	136	103	18.2
	No Recommendations	**71**	**2**	**63**	**37**	**51**	**83**	**9**	**4**	**39**	**44**	**46**	**7.9**
30	2-7-11-12-14-15*	95	75	109	117	101	110	62	350	238	81	75	9.7
31	2-7-11-12-15*-18	97	74	108	119	106	122	63	350	238	83	76	9.9
32	2-7-11-12-15*-19	100	165	116	120	102	112	68	350	240	81	75	10.0
33	2-7-11-15*-18-19	98	179	108	111	97	115	65	350	220	72	74	9.9
34	2-7-11-12-15*-18-19	103	179	116	121	106	124	70	350	240	83	76	10.2
35	2-7-11-12-14-15*-18	98	89	109	119	106	122	64	350	238	83	76	9.9

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 21. Module 3, Stage 1: Formulation of FBRs for Lactating Women with Incaparina and Fortified Instant Oats – Selection of the Key Messages

		Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A	183	110	154	136	179	153	100	356	202	130	97	19.2
	Optimized-B	192	102	157	138	174	140	101	359	198	133	100	19.1
	Maximized[a]	221	219	202	178	216	223	132	364	256	162	106	22.3
	No Recommendations	**103**	**9**	**84**	**40**	**67**	**107**	**16**	**5**	**28**	**64**	**57**	**9.7**
1	Veg28	106	36	88	44	71	113	24	5	39	66	58	10.2
2	Veg21	104	21	86	41	69	110	18	5	30	65	57	9.9
3	VitC-veg7	103	13	84	40	67	107	16	5	28	67	59	9.8
4	GLV7	108	12	84	46	68	113	22	5	46	68	57	9.7
5	Chayote3	103	15	84	41	68	107	25	5	28	64	59	9.8
6	VC-frt7	108	16	86	40	67	107	16	5	28	67	59	9.8
7	Incap7	113	9	116	69	98	108	27	16	35	78	76	10.1
8	MPE7	103	9	84	51	67	107	18	24	34	64	58	11
9	Liver1	103	11	85	64	76	109	20	315	104	66	60	10
10	Beans7	105	9	90	41	68	108	37	5	28	67	59	10
11	Fort oats7	111	9	96	50	78	121	22	5	44	79	58	10.1
12	Potato7	108	24	85	42	74	121	19	5	28	66	60	9.9
13	Orange3	107	56	89	41	68	107	21	5	29	65	58	9.8
14	1-7-9	115	38	122	97	110	117	40	326	122	82	79	10.8
15	1-7-10	117	36	126	74	102	116	57	16	46	83	78	10.9
16	1-9-10	108	38	95	69	80	117	50	315	115	71	62	10.8
17	7-9-10	114	11	123	94	106	112	53	326	111	83	80	10.7
18	1-7-9-10	117	38	127	98	110	118	61	326	122	85	80	11.2
19	1-3-7-9-10	117	38	127	98	110	118	61	326	122	85	80	11.2
20	1-4-7-9-10	119	38	127	102	110	122	61	326	131	88	80	11.2
21	1-5-7-9-10	117	41	127	98	110	118	68	326	122	85	82	11.2
22	1-6-7-9-10	120	44	128	98	110	118	62	326	122	88	81	11.3
23	1-9-10-11	124	38	138	110	123	132	68	326	138	100	82	11.6
24	1-7-9-10-12	122	53	128	101	117	132	64	327	122	87	83	11.5
25	1-7-9-10-13	121	84	132	100	111	118	66	327	122	85	81	11.4
26	1-5-6 -7-9-10	120	47	128	98	110	118	68	326	122	88	83	11.3
27	1-7-9-10-11-12	129	53	138	112	130	147	71	327	138	102	84	11.9
28	1-7-9-10-11-13	128	84	143	111	123	133	73	327	139	101	83	11.8
29	1-7-9-10-11-12-13	133	99	143	113	130	147	76	327	139	103	85	12.1
30	2-7-9-10-11-12-13	130	84	141	110	128	144	69	327	130	102	85	11.7

[a] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 22. Module 3, Stages 2–3: Formulation of FBRs for Breastfed Children 6–8 Months Old with Incaparina and Fortified Instant Oats[a]

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		89	100	136	141	108	139	182	109	117	74	63	1.7
	Optimized-B		94	100	124	139	117	155	173	106	123	78	64	1.8
	Maximized[c]		97	138	152	166	135	245	213	146	144	80	66	3.0
	No Recommendations	**10**	**48**	**50**	**49**	**58**	**31**	**36**	**42**	**51**	**75**	**14**	**22**	**0.8**
1	Veg28	10	51	64	55	64	36	54	67	52	ok [2]	17	24	1.0
2	MPE7	9	51	50	50	83	34	46	54	107	ok	16	26	1.6
3	Beans7	9	50	50	56	58	33	45	79	51	ok	17	24	0.8
4	Staple21	10	56	50	53	58	36	52	42	51	ok	15	26	0.8
5	Incaparina7	6	54	50	90	94	73	36	66	71	ok	26	44	0.9
6	Fort oats7	9	54	50	69	77	53	67	65	51	ok	34	24	0.8
7	Potato7	9	52	59	50	61	43	75	49	52	ok	16	25	0.9
8	5-6	5	59	50	ok	ok	ok	67	89	ok	ok	48	46	0.9
9	1-2	7	53	64	56	89	39	65	78	ok	ok	19	28	1.7
10	1-3	9	52	64	62	65	39	63	ok	52	ok	20	26	1.0
11	1-4	9	60	64	58	64	42	71	67	52	ok	19	28	1.0
12	1-7	7	55	74	67	67	49	ok	73	53	ok	19	27	1.1
13	1-8	4	62	64	ok	ok	ok	85	ok	ok	ok	50	48	1.1
14	2-3	7	52	50	58	84	36	56	ok	ok	ok	19	27	1.6
15	2-4	8	59	50	54	83	39	64	54	ok	ok	18	29	1.6
16	2-7	7	55	59	51	87	46	ok	61	ok	ok	18	28	1.7
17	2-8	4	62	50	ok	ok	ok	78	ok	ok	ok	50	50	1.7
18	3-4	9	58	50	60	58	39	63	ok	51	ok	19	28	0.8
19	3-7	8	54	59	62	62	46	ok	ok	52	ok	19	26	0.9
20	3-8	4	61	50	ok	ok	ok	77	ok	ok	ok	50	50	0.9
21	4-7	9	61	59	53	61	49	ok	49	52	ok	17	28	0.9
22	4-8	4	68	50	ok	ok	ok	85	ok	ok	ok	50	50	0.9
23	7-8	4	63	59	ok	ok	ok	ok	ok	ok	ok	49	49	1.0
24	1-2-3	6	55	64	63	ok	42	75	ok	ok	ok	23	30	1.7
25	1-2-4	6	63	64	59	ok	45	ok	ok	ok	ok	22	32	1.7
26	1-2-7	5	58	ok	56	ok	52	ok	ok	ok	ok	21	30	1.8
27	1-2-8	4	66	64	ok	ok	ok	ok	ok	ok	ok	54	52	1.9
28	1-3-4	8	61	64	65	65	45	ok	ok	52	ok	22	30	1.0
29	1-3-7	7	57	ok	62	68	52	ok	ok	53	ok	22	29	1.1
30	1-3-8	4	64	64	ok	ok	ok	ok	ok	ok	ok	54	50	1.1
31	1-4-7	7	64	ok	58	67	55	ok	ok	53	ok	21	31	1.1
32	1-4-8	3	72	64	ok	ok	ok	ok	ok	ok	ok	54	52	1.1
33	1-7-8	3	66	ok	ok	ok	ok	ok	ok	ok	ok	53	51	1.2

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		89	100	136	141	108	139	182	109	117	74	63	1.7
	Optimized-B		94	100	124	139	117	155	173	106	123	78	64	1.8
	Maximized[c]		97	138	152	166	135	245	213	146	144	80	66	3.0
	No Recommendations	**10**	**48**	**50**	**49**	**58**	**31**	**36**	**42**	**51**	**75**	**14**	**22**	**0.8**
34	2-3-4	6	61	50	61	ok	42	75	ok	ok	ok	22	31	1.6
35	2-3-7	6	56	59	58	ok	49	ok	ok	ok	ok	21	30	1.7
36	2-3-8	4	63	50	ok	ok	ok	ok	ok	ok	ok	52	50	1.7
37	2-4-7	7	63	59	54	ok	52	ok	61	ok	ok	21	32	1.7
38	2-4-8	3	72	50	ok	ok	ok	ok	ok	ok	ok	54	54	1.7
39	2-7-8	4	66	59	ok	ok	ok	ok	ok	ok	ok	53	52	1.8
40	3-4-7	8	62	59	60	62	51	ok	ok	52	ok	21	30	0.9
41	3-4-8	3	70	50	ok	ok	ok	ok	ok	ok	ok	54	52	0.9
42	3-7-8	4	65	59	ok	ok	ok	ok	ok	ok	ok	53	51	1.0
43	4-7-8	3	72	59	ok	ok	ok	ok	ok	ok	ok	53	52	1.0
44	1-2-3-4	6	64	64	66	ok	48	ok	ok	ok	ok	26	34	1.8
45	1-2-3-7	5	59	ok	63	ok	54	ok	ok	ok	ok	25	32	1.8
46	1-2-3-8	4	67	64	ok	ok	ok	ok	ok	ok	ok	58	54	1.9
47	1-2-4-7	5	67	ok	60	ok	58	ok	ok	ok	ok	25	34	1.9
48	1-2-4-8	3	ok	64	ok	ok	ok	ok	ok	ok	ok	58	56	1.9
49	1-2-7-8	2	70	ok	ok	ok	ok	ok	ok	ok	ok	57	55	2.0
50	1-3-4-7	7	65	ok	66	68	57	ok	ok	53	ok	25	32	1.1
51	1-3-4-8	3	ok	64	ok	ok	ok	ok	ok	ok	ok	54	52	1.1
52	1-3-7-8	3	68	ok	ok	ok	ok	ok	ok	ok	ok	57	53	1.2
53	1-4-7-8	2	ok	ok	ok	ok	ok	ok	ok	ok	ok	57	55	1.2
54	2-3-4-7	6	65	59	61	ok	54	ok	ok	ok	ok	25	34	1.7
55	2-3-4-8	3	ok	50	ok	ok	ok	ok	ok	ok	ok	58	56	1.7
56	2-3-7-8	4	68	59	ok	ok	ok	ok	ok	ok	ok	57	54	1.8
57	2-4-7-8	3	ok	59	ok	ok	ok	ok	ok	ok	ok	57	56	1.8
58	3-4-7-8	3	ok	59	ok	ok	ok	ok	ok	ok	ok	57	54	1.0
59	1-2-3-4-7	5	68	ok	67	ok	60	ok	ok	ok	ok	29	36	1.9
60	1-2-3-4-8	3	ok	64	ok	ok	ok	ok	ok	ok	ok	62	58	1.9
61	1-2-3-7-8	2	ok	ok	ok	ok	ok	ok	ok	ok	ok	61	56	2.0
62	1-2-4-7-8	2	ok	ok	ok	ok	ok	ok	ok	ok	ok	61	59	2.0
63	1-3-4-7-8	2	ok	ok	ok	ok	ok	ok	ok	ok	ok	61	57	1.2
64	2-3-4-7-8	2	ok	59	ok	ok	ok	ok	ok	ok	ok	61	59	1.8
65	1-2-3-4-7-8	2	82	75	133	152	126	168	171	129	126	67	61	2.0

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.
[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.
[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 23. Module 3, Stages 2–3: Formulation of FBRs for Breastfed Children 9–11 Months Old with Incaparina and Fortified Instant Oats[a]

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		112	114	158	176	138	189	210	140	152	100	76	2.7
	Optimized-B		114	117	165	176	130	185	210	138	146	100	77	2.6
	Maximized[c]		125	203	205	207	203	374	271	146	195	136	78	3.6
	No Recommendations	**10**	**47**	**49**	**57**	**63**	**41**	**54**	**45**	**51**	**81**	**16**	**23**	**1.1**
1	Veg28	6	59	89	69	84	50	95	91	52	ok [2]	39	27	1.4
2	MPE7	8	50	49	58	86	40	57	52	101	ok	19	26	1.7
3	Beans7	9	51	49	64	64	40	61	83	51	ok	22	26	1.1
4	Staple21	10	60	49	61	63	42	68	45	51	ok	20	28	1.1
5	Incaparina7	6	54	49	103	103	84	54	70	73	ok	31	47	1.2
6	Fort oats7	7	55	49	82	87	67	94	73	51	ok	44	26	1.2
7	Potato7	9	54	59	58	66	51	91	51	52	ok	23	30	1.2
8	5-6	4	62	49	ok	ok	ok	ok	ok	73	ok	58	50	1.3
9	1-2	4	61	ok	70	ok	50	ok	ok	102	ok	42	31	2.0
10	1-3	5	62	ok	76	ok	51	ok	ok	52	ok	46	31	1.4
11	1-4	4	72	ok	74	ok	54	ok	ok	53	ok	43	33	1.4
12	1-7	5	65	ok	70	ok	61	ok	ok	53	ok	44	33	1.5
13	1-8	1	74	ok	ok	ok	ok	ok	ok	74	ok	81	55	1.7
14	2-3	7	53	49	65	ok	40	67	ok	ok	ok	25	29	1.7
15	2-4	7	62	49	62	ok	42	75	52	ok	ok	23	32	1.7
16	2-7	7	56	59	59	ok	51	ok	59	ok	ok	24	32	1.8
17	2-8	4	64	49	ok	ok	ok	ok	ok	ok	ok	61	54	1.9
18	3-4	8	63	49	68	64	44	79	ok	52	ok	26	32	1.1
19	3-7	8	57	59	65	67	52	ok	ok	52	ok	26	32	1.2
20	3-8	4	65	49	ok	ok	ok	ok	ok	73	ok	64	54	1.3
21	4-7	9	65	59	62	66	54	ok	51	52	ok	24	33	1.2
22	4-8	3	75	49	ok	ok	ok	ok	ok	73	ok	62	56	1.3
23	7-8	4	68	59	ok	ok	ok	ok	ok	74	ok	61	55	1.4
24	1-2-3	4	65	ok	ok	ok	51	ok	ok	ok	ok	48	34	2.0
25	1-2-4	3	ok	ok	ok	ok	54	ok	ok	ok	ok	46	37	2.0
26	1-2-7	4	67	ok	ok	ok	61	ok	ok	ok	ok	45	36	2.1
27	1-2-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	59	2.2
28	1-3-4	4	ok	ok	ok	ok	57	ok	ok	53	ok	49	37	1.4
29	1-3-7	5	68	ok	ok	ok	63	ok	ok	54	ok	48	36	1.5
30	1-3-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	59	1.7
31	1-4-7	4	ok	ok	ok	ok	66	ok	ok	54	ok	46	37	1.5
32	1-4-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	61	1.7
33	1-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	59	1.7

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		112	114	158	176	138	189	210	140	152	100	76	2.7
	Optimized-B		114	117	165	176	130	185	210	138	146	100	77	2.6
	Maximized[c]		125	203	205	207	203	374	271	146	195	136	78	3.6
	No Recommendations	**10**	**47**	**49**	**57**	**63**	**41**	**54**	**45**	**51**	**81**	**16**	**23**	**1.1**
34	2-3-4	6	66	49	69	ok	44	ok	ok	ok	ok	29	36	1.7
35	2-3-7	6	58	59	66	ok	52	ok	ok	ok	ok	28	34	1.8
36	2-3-8	4	68	49	ok	ok	ok	107	ok	ok	ok	67	58	1.9
37	2-4-7	7	67	59	62	ok	54	ok	59	ok	ok	25	36	1.8
38	2-4-8	3	ok	49	ok	ok	ok	ok	ok	ok	ok	65	60	1.9
39	2-7-8	4	69	59	ok	ok	ok	ok	ok	ok	ok	63	58	2.0
40	3-4-7	9	68	59	69	67	57	ok	89	52	ok	28	36	1.2
41	3-4-8	3	ok	49	ok	ok	ok	ok	ok	ok	ok	68	60	1.3
42	3-7-8	3	70	59	ok	ok	ok	ok	ok	ok	ok	66	58	1.4
43	4-7-8	3	ok	59	ok	ok	ok	ok	ok	ok	ok	64	60	1.4
44	1-2-3-4	3	ok	ok	ok	ok	57	ok	ok	ok	ok	52	41	2.0
45	1-2-3-7	3	70	ok	ok	ok	63	ok	ok	ok	ok	51	38	2.1
46	1-2-3-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	63	2.2
47	1-2-4-7	2	ok	ok	ok	ok	66	ok	ok	ok	ok	49	40	2.1
48	1-2-4-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	65	2.2
49	1-2-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	63	2.3
50	1-3-4-7	3	ok	ok	ok	ok	70	ok	ok	54	ok	52	40	1.5
51	1-3-4-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	65	1.7
52	1-3-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	90	63	1.7
53	1-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	75	ok	88	64	1.7
54	2-3-4-7	4	70	59	70	ok	57	ok	ok	ok	ok	32	39	1.8
55	2-3-4-8	2	ok	49	ok	ok	ok	ok	ok	ok	ok	72	64	1.9
56	2-3-7-8	2	ok	59	ok	ok	ok	ok	ok	ok	ok	70	61	2.0
57	2-4-7-8	3	ok	59	ok	ok	ok	ok	ok	ok	ok	68	63	2.0
58	3-4-7-8	2	ok	59	ok	ok	ok	ok	ok	ok	ok	71	63	1.4
59	1-2-3-4-7	2	ok	ok	ok	ok	ok	ok	ok	ok	ok	56	43	2.2
60	1-2-3-4-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	69	2.3
61	1-2-3-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	66	2.3
62	1-2-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	68	2.3
63	1-3-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	68	1.8
64	2-3-4-7-8	1	ok	59	ok	ok	ok	ok	ok	ok	ok	ok	67	2.0
65	1-2-3-4-7-8	0	97	100	159	180	147	219	206	129	137	100	72	2.4

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.

[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 24. Module 3, Stages 2–3: Formulation of FBRs for Breastfed Children 12–23 Months Old with Incaparina and Fortified Instant Oats[a]

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		100	364	164	192	120	102	126	120	229	72	147	4.1
	Optimized-B		100	394	179	212	139	134	147	121	261	90	155	4.3
	Maximized[c]		121	1136	246	249	177	262	199	152	318	92	159	6.0
	Number Recommended	**9**	**44**	**163**	**57**	**58**	**32**	**42**	**28**	**28**	**126**	**16**	**43**	**1.5**
1	Veg28	9	47	ok[2]	66	70	40	62	53	29	ok	21	50	1.9
2	MPE7	8	46	ok	58	94	32	46	35	86	ok	17	50	2.6
3	Beans7	9	46	ok	63	58	32	47	52	28	ok	19	48	1.5
4	Staple21	9	51	ok	59	58	34	50	28	28	ok	17	48	1.5
5	Incaparina7	6	53	ok	124	122	91	42	53	52	ok	32	107	1.7
6	Fort oats7	8	48	ok	73	76	48	63	41	28	ok	30	46	1.7
7	Potato7	9	46	ok	58	50	39	64	31	29	ok	17	46	1.6
8	5-6	5	58	ok	ok	ok	108	63	66	52	ok	48	ok	1.9
9	1-2	7	50	ok	67	107	40	68	61	ok	ok	24	58	3.0
10	1-3	7	50	ok	72	71	40	69	78	29	ok	26	56	1.9
11	1-4	7	55	ok	68	70	42	72	53	29	ok	23	55	1.9
12	1-7	7	50	ok	66	73	47	85	56	30	ok	22	53	2.0
13	1-8	3	62	ok	ok	ok	ok	83	92	53	ok	54	ok	2.3
14	2-3	7	48	ok	64	95	32	54	60	ok	ok	22	56	2,6
15	2-4	7	54	ok	60	94	34	57	35	ok	ok	20	56	2,6
16	2-7	6	49	ok	58	96	39	70	38	ok	ok	19	54	2.7
17	2-8	4	61	ok	ok	ok	ok	67	73	ok	ok	52	ok	3,0
18	3-4	9	54	ok	65	58	34	58	52	28	ok	21	54	1.5
19	3-7	8	48	ok	63	60	39	71	55	29	ok	21	51	1.6
20	3-8	4	60	ok	ok	ok	ok	68	91	52	ok	53	ok	1.9
21	4-7	8	54	ok	59	60	41	74	31	29	ok	18	51	1.6
22	4-8	4	66	ok	ok	ok	ok	71	66	52	ok	51	ok	1.9
23	7-8	4	61	ok	ok	ok	ok	85	69	53	ok	49	ok	2.0
24	1-2-3	4	52	ok	73	ok	40	76	ok	ok	ok	30	64	3.0
25	1-2-4	6	58	ok	69	ok	42	ok	61	ok	ok	27	64	3.0
26	1-2-7	6	53	ok	67	ok	47	ok	64	ok	ok	26	61	3.1
27	1-2-8	2	65	ok	ok	ok	ok	ok	ok	ok	ok	59	ok	3.4
28	1-3-4	5	58	ok	74	ok	43	ok	ok	29	ok	29	61	1.9
29	1-3-7	5	52	ok	72	ok	48	ok	ok	30	ok	27	59	2.0
30	1-3-8	3	65	ok	ok	ok	ok	ok	ok	53	ok	61	ok	2.3
31	1-4-7	7	58	ok	68	ok	49	ok	56	30	ok	25	59	2.0
32	1-4-8	2	71	ok	ok	ok	ok	ok	ok	54	ok	58	ok	2.3

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		100	364	164	192	120	102	126	120	229	72	147	4.1
	Optimized-B		100	394	179	212	139	134	147	121	261	90	155	4.3
	Maximized[c]		121	1136	246	249	177	262	199	152	318	92	159	6.0
	Number Recommended	**9**	**44**	**163**	**57**	**58**	**32**	**42**	**28**	**28**	**126**	**16**	**43**	**1.5**
33	1-7-8	3	65	ok	ok	ok	ok	ok	ok	54	ok	56	ok	2.4
34	2-3-4	7	57	ok	67	ok	34	66	60	ok	ok	26	62	2.6
35	2-3-7	6	52	ok	64	ok	39	ok	64	ok	ok	24	60	2.7
36	2-3-8	2	64	ok	ok	ok	ok	91	ok	ok	ok	53	ok	3.1
37	2-4-7	6	57	ok	60	ok	41	ok	38	ok	ok	22	59	2.7
38	2-4-8	1	70	ok	ok	ok	ok	78	73	ok	ok	55	ok	3.0
39	2-7-8	3	64	ok	ok	ok	ok	ok	77	ok	ok	53	ok	3.1
40	3-4-7	8	57	ok	65	60	42	ok	55	29	ok	23	57	1.6
41	3-4-8	2	70	ok	ok	ok	ok	79	ok	52	ok	57	ok	1.9
42	3-7-8	3	63	ok	ok	ok	ok	ok	ok	53	ok	55	ok	2.0
43	4-7-8	4	60	ok	ok	ok	ok	96	69	53	ok	53	ok	2.0
44	1-2-3-4	3	62	ok	ok	ok	43	ok	ok	ok	ok	33	70	3.0
45	1-2-3-7	4	56	ok	ok	ok	48	ok	ok	ok	ok	32	67	3.1
46	1-2-3-8	2	66	ok	ok	ok	ok	ok	ok	ok	ok	60	ok	3,4
47	1-2-4-7	6	61	ok	69	ok	49	ok	64	ok	ok	29	67	3.1
48	1-2-4-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	63	ok	3.4
49	1-2-7-8	2	68	ok	ok	ok	ok	ok	ok	ok	ok	61	ok	3.5
50	1-3-4-7	5	61	ok	ok	ok	52	ok	ok	30	ok	31	65	2,0
51	1-3-4-8	2	ok	ok	ok	ok	ok	ok	ok	54	ok	65	ok	2,3
52	1-3-7-8	3	68	ok	ok	ok	ok	ok	ok	54	ok	62	ok	2.4
53	1-4-7-8	3	74	ok	ok	ok	ok	ok	ok	54	ok	60	ok	2.4
54	2-3-4-7	6	60	ok	67	ok	42	ok	64	ok	ok	28	65	2.7
55	2-3-4-8	2	74	ok	ok	ok	ok	ok	ok	ok	ok	62	ok	3.0
56	2-3-7-8	2	67	ok	ok	ok	ok	ok	ok	ok	ok	60	ok	3.1
57	2-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	58	ok	3.1
58	3-4-7-8	2	ok	ok	ok	ok	ok	ok	ok	53	ok	59	ok	2.0
59	1-2-3-4-7	3	65	ok	ok	ok	52	ok	ok	ok	ok	35	ok	3.1
60	1-2-3-4-8	0	ok	ok	ok	ok	ok	ok	ok	ok	ok	70	ok	3.4
61	1-2-3-7-8	1	72	ok	ok	ok	ok	ok	ok	ok	ok	67	ok	3.5
62	1-2-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	65	ok	3.5
63	1-3-4-7-8	2	ok	ok	ok	ok	ok	ok	ok	54	ok	67	ok	2.4
64	2-3-4-7-8	1	ok	ok	ok	ok	ok	ok	ok	ok	ok	64	ok	3.1
65	1-2-3-4-7-8	0	82	301	162	193	132	138	131	112	218	72	144	3.5

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.

[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 25. Module 3, Stages 2–3: Formulation of FBRs for Non-Breastfed Children 12–23 Months Old with Incaparina and Fortified Instant Oats[a]

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		100	593	215	211	161	151	121	108	175	111	158	5.7
	Optimized-B		100	349	2202	206	167	138	104	108	153	115	164	5.7
	Maximized[c]		124	1002	337	270	252	391	246	115	313	124	197	8.5
	Number Recommended	**10**	**17**	**6**	**70**	**36**	**42**	**53**	**18**	**3**	**53**	**28**	**39**	**2.5**
1	Veg28	7	24	104	ok	44	49	70	32	4	78	32	41	2.8
2	MPE7	10	20	7	ok	65	49	56	23	58	69	31	50	3.7
3	Beans7	10	20	7	ok	37	43	51	64	3	53	33	45	2.9
4	Staple21	10	37	7	ok	36	43	68	18	3	54	28	49	2.5
5	Incaparina7	6	30	7	ok	113	113	53	49	32	70	49	116	2.7
6	Fort oats7	10	19	7	ok	47	52	67	26	3	68	36	39	2.6
7	Potato7	9	25	51	ok	39	51	80	22	4	53	35	50	2.6
8	5-6	6	33	7	ok	ok	ok	67	59	32	ok	57	ok	3.1
9	1-2	6	28	ok	ok	73	57	ok	37	58	ok	35	52	4.0
10	1-3	6	28	ok	ok	45	51	ok	77	4	ok	38	47	3.3
11	1-4	7	45	ok	ok	44	50	ok	32	4	ok	32	52	2.8
12	1-7	7	32	ok	ok	47	58	ok	35	4	ok	39	52	3.0
13	1-8	3	41	ok	ok	ok	ok	ok	72	33	ok	62	ok	3.4
14	2-3	10	23	7	ok	66	51	67	69	58	69	36	56	4.2
15	2-4	8	40	7	ok	65	50	77	23	58	70	31	60	3.7
16	2-7	9	27	51	ok	65	58	ok	27	58	69	37	59	3.8
17	2-8	5	36	7	ok	ok	ok	68	64	87	ok	60	ok	4.3
18	3-4	9	41	7	ok	37	44	82	64	4	54	34	55	2.9
19	3-7	9	28	51	ok	40	52	ok	68	4	53	40	55	3.0
20	3-8	4	36	7	ok	ok	ok	ok	104	33	ok	63	ok	3.5
21	4-7	9	43	51	ok	39	52	ok	22	4	54	35	60	2.6
22	4-8	5	54	7	ok	ok	ok	ok	59	32	ok	58	ok	3.1
23	7-8	5	40	51	ok	ok	ok	ok	62	33	ok	63	ok	3.2
24	1-2-3	5	31	ok	ok	ok	58	ok	ok	59	ok	41	59	4.5
25	1-2-4	6	48	ok	ok	ok	58	ok	37	59	ok	36	63	4.0
26	1-2-7	6	34	ok	ok	ok	66	ok	42	59	ok	40	62	4.2
27	1-2-8	2	44	ok	ok	ok	ok	ok	ok	ok	ok	65	ok	4.6
28	1-3-4	6	49	ok	ok	45	52	ok	ok	4	ok	38	58	3.3
29	1-3-7	6	35	ok	ok	49	60	ok	ok	5	ok	44	57	3.4
30	1-3-8	3	44	ok	ok	ok	ok	ok	ok	33	ok	68	ok	3.9
31	1-4-7	7	51	ok	ok	47	59	ok	35	5	ok	39	62	3.0
32	1-4-8	3	62	ok	ok	ok	ok	ok	ok	33	ok	62	ok	3.4

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		100	593	215	211	161	151	121	108	175	111	158	5.7
	Optimized-B		100	349	2202	206	167	138	104	108	153	115	164	5.7
	Maximized[c]		124	1002	337	270	252	391	246	115	313	124	197	8.5
	Number Recommended	**10**	**17**	**6**	**70**	**36**	**42**	**53**	**18**	**3**	**53**	**28**	**39**	**2.5**
33	1-7-8	3	48	ok	ok	ok	ok	ok	ok	34	ok	67	ok	3.6
34	2-3-4	8	44	7	ok	66	52	ok	69	58	ok	37	66	4.1
35	2-3-7	7	30	51	ok	70	60	98	74	59	69	41	65	4.2
36	2-3-8	3	39	7	ok	ok	ok	ok	ok	ok	ok	66	ok	4.7
37	2-4-7	7	46	51	ok	68	59	ok	27	59	ok	37	70	3.8
38	2-4-8	4	57	7	ok	ok	ok	ok	64	ok	ok	61	ok	4.3
39	2-7-8	4	43	51	ok	ok	ok	ok	67	87	ok	64	ok	4.4
40	3-4-7	9	46	51	ok	40	54	ok	68	4	54	40	65	3.0
41	3-4-8	4	55	7	ok	ok	ok	ok	ok	32	ok	60	ok	3.3
42	3-7-8	4	43	51	ok	ok	ok	ok	ok	33	ok	67	ok	3.6
43	4-7-8	5	59	51	ok	ok	ok	ok	62	33	ok	63	ok	3.2
44	1-2-3-4	5	52	ok	ok	ok	60	ok	ok	59	ok	42	69	4.5
45	1-2-3-7	5	37	ok	ok	ok	67	ok	ok	60	ok	45	68	4.6
46	1-2-3-8	1	48	ok	ok	ok	ok	ok	ok	ok	ok	71	ok	5.0
47	1-2-4-7	5	54	ok	ok	ok	67	ok	41	60	ok	40	72	4.2
48	1-2-4-8	2	65	ok	ok	ok	ok	ok	ok	ok	ok	66	ok	4.6
49	1-2-7-8	4	43	51	ok	ok	ok	ok	67	ok	ok	64	ok	4.4
50	1-3-4-7	6	54	ok	ok	49	62	ok	ok	5	ok	44	67	3.4
51	1-3-4-8	3	65	ok	ok	ok	ok	ok	ok	34	ok	68	ok	3.9
52	1-3-7-8	2	51	ok	ok	ok	ok	ok	ok	34	ok	71	ok	4.0
53	1-4-7-8	3	67	ok	ok	ok	ok	ok	ok	34	ok	67	ok	3.6
54	2-3-4-7	5	49	51	ok	ok	61	ok	ok	59	ok	41	ok	4.2
55	2-3-4-8	3	60	7	ok	ok	ok	ok	ok	ok	ok	67	ok	4.7
56	2-3-7-8	3	45	51	ok	ok	ok	ok	ok	ok	ok	69	ok	4.8
57	2-4-7-8	3	62	51	ok	ok	ok	ok	67	ok	ok	64	ok	4.4
58	3-4-7-8	4	62	51	ok	ok	ok	ok	ok	34	ok	67	ok	3.6
59	1-2-3-4-7	3	57	ok	ok	ok	70	ok	ok	60	ok	45	ok	4.6
60	1-2-3-4-8	1	69	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	5.0
61	1-2-3-7-8	1	53	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	5.2
62	1-2-4-7-8	1	70	ok	ok	ok	ok	ok	ok	ok	ok	68	ok	4.7
63	1-3-4-7-8	1	70	ok	ok	ok	ok	ok	ok	34	ok	ok	ok	4.0
64	2-3-4-7-8	3	65	51	ok	ok	ok	ok	ok	ok	ok	69	ok	4.8
65	1-2-3-4-7-8	0	74	149	187	166	151	155	126	89	126	74	159	5.2

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.

[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 26. Module 3, Stages 2–3: Formulation of FBRs for Pregnant Women with Incaparina and Fortified Instant Oats and Liver[a]

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		144	186	126	141	120	137	72	381	287	100	86	13.3
	Optimized-B		139	206	144	164	155	135	96	407	287	115	90	15.6
	Maximized[c]		179	302	162	178	169	216	105	409	334	136	103	18.2
	Number Recommended	**9**	**71**	**2**	**63**	**37**	**51**	**83**	**9**	**4**	**39**	**44**	**46**	**7.9**
1	Veg27	8	ok[2]	57	68	48	57	ok	25	5	101	51	49	9.0
2	Liver1	7	ok	4	64	64	59	ok	12	338	148	46	48	7.9
3	Beans7	9	ok	2	68	38	51	ok	27	4	39	49	48	7.9
4	Orange7	7	ok	107	70	40	51	ok	16	4	41	44	46	8.2
5	Incaparina7	7	ok	2	88	68	77	ok	17	15	47	54	64	8.2
6	Fort oats7	8	ok	2	70	48	61	ok	14	4	60	55	46	8.1
7	Potato7	9	ok	16	63	39	56	ok	10	4	39	45	46	8.
8	5-6	6	ok	2	ok	79	ok	ok	22	15	67	64	65	8.6
9	1-2	5	ok	59	70	75	65	ok	28	ok	ok	53	52	9.0
10	1-3	8	ok	57	74	49	57	ok	44	5	ok	57	52	9.0
11	1-4	6	ok	ok	ok	51	58	ok	32	5	ok	51	49	9.4
12	1-7	7	ok	71	68	50	64	ok	27	5	ok	51	50	9.2
13	1-8	4	ok	57	ok	ok	ok	ok	39	16	ok	72	69	9.7
14	2-3	7	ok	5	68	65	59	ok	30	ok	ok	52	51	7.9
15	2-4	5	ok	ok	ok	67	59	ok	19	ok	ok	46	48	8.2
16	2-7	7	ok	18	64	66	63	ok	14	ok	ok	47	49	8.1
17	2-8	4	ok	4	ok	ok	ok	ok	26	ok	ok	67	66	8.6
18	3-4	7	ok	ok	ok	41	52	ok	34	4	41	49	48	8.2
19	3-7	9	ok	16	68	40	56	ok	29	4	39	51	49	8.1
20	3-8	5	ok	2	ok	ok	ok	ok	41	15	67	71	68	8.6
21	4-7	7	ok	ok	ok	42	56	ok	17	4	41	45	46	8.4
22	4-8	5	ok	ok	ok	ok	ok	ok	29	15	69	64	65	8.9
23	7-8	6	ok	16	ok	ok	ok	ok	24	15	67	65	66	8.8
24	1-2-3	5	ok	60	ok	ok	65	ok	47	ok	ok	59	54	9.0
25	1-2-4	4	ok	ok	ok	ok	66	ok	35	ok	ok	53	52	9.4
26	1-2-7	5	ok	61	ok	ok	66	ok	28	ok	ok	53	52	9.1
27	1-2-8	2	ok	59	ok	ok	ok	ok	42	ok	ok	ok	72	9.7
28	1-3-4	6	ok	ok	ok	51	62	ok	46	5	ok	58	53	9.2
29	1-3-7	6	ok	71	74	51	62	ok	46	5	ok	58	53	9.2
30	1-3-8	3	ok	57	ok	ok	ok	ok	58	16	ok	ok	72	9.7
31	1-4-7	6	ok	ok	ok	53	62	ok	34	5	ok	51	50	9.6
32	1-4-8	3	ok	ok	ok	ok	ok	ok	46	16	ok	ok	69	10.0

		# Nut[b] < 70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		144	186	126	141	120	137	72	381	287	100	86	13.3
	Optimized-B		139	206	144	164	155	135	96	407	287	115	90	15.6
	Maximized[c]		179	302	162	178	169	216	105	409	334	136	103	18.2
	Number Recommended	**9**	**71**	**2**	**63**	**37**	**51**	**83**	**9**	**4**	**39**	**44**	**46**	**7.9**
33	1-7-8	2	ok	71	ok	ok	ok	ok	41	16	ok	ok	70	9.9
34	2-3-4	5	ok	ok	ok	68	60	ok	38	ok	ok	52	51	8.2
35	2-3-7	7	ok	19	68	67	64	ok	32	ok	ok	53	52	8.1
36	2-3-8	4	ok	5	ok	ok	ok	ok	44	ok	ok	74	71	8.6
37	2-4-7	5	ok	ok	ok	69	64	ok	21	ok	ok	47	49	8.4
38	2-4-8	3	ok	ok	ok	ok	ok	ok	33	ok	ok	67	68	8.9
39	2-7-8	4	ok	18	ok	ok	ok	ok	28	ok	ok	68	69	8.8
40	3-4-7	7	ok	ok	ok	42	56	ok	36	5	41	51	49	8.4
41	3-4-8	4	ok	ok	ok	ok	ok	ok	48	15	69	ok	68	8.9
42	3-7-8	5	ok	16	ok	ok	ok	ok	43	15	67	ok	69	8.9
43	4-7-8	5	ok	ok	ok	ok	ok	ok	31	16	69	65	66	9.1
44	1-2-3-4	4	ok	ok	ok	ok	66	ok	54	ok	ok	59	54	9.4
45	1-2-3-7	3	ok	ok	ok	ok	70	ok	49	ok	ok	61	56	9.2
46	1-2-3-8	2	ok	60	ok	ok	ok	ok	61	ok	ok	ok	ok	9.7
47	1-2-4-7	2	ok	ok	ok	ok	70	ok	37	ok	ok	53	52	9.6
48	1-2-4-8	1	ok	ok	ok	ok	ok	ok	49	ok	ok	ok	ok	10.0
49	1-2-7-8	1	ok	ok	ok	ok	ok	ok	44	ok	ok	ok	ok	9.9
50	1-3-4-7	6	ok	ok	ok	54	63	ok	53	6	ok	58	53	9.6
51	1-3-4-8	2	ok	ok	ok	ok	ok	ok	65	16	ok	ok	ok	10.0
52	1-3-7-8	2	ok	ok	ok	ok	ok	ok	60	16	ok	ok	ok	9.9
53	1-4-7-8	2	ok	ok	ok	ok	ok	ok	48	16	ok	ok	ok	10.2
54	2-3-4-7	5	ok	ok	ok	70	64	ok	40	ok	ok	53	52	8.4
55	2-3-4-8	2	ok	ok	ok	ok	ok	ok	52	ok	ok	ok	71	8.9
56	2-3-7-8	3	ok	19	ok	ok	ok	ok	46	ok	ok	ok	72	8.8
57	2-4-7-8	3	ok	ok	ok	ok	ok	ok	35	ok	ok	68	69	9.1
58	3-4-7-8	4	ok	ok	ok	ok	ok	ok	50	16	69	ok	69	9.1
59	1-2-3-4-7	3	ok	ok	ok	ok	ok	ok	56	ok	ok	61	56	9.6
60	1-2-3-4-8	1	ok	ok	ok	ok	ok	ok	68	ok	ok	ok	ok	10.0
61	1-2-3-7-8	1	ok	ok	ok	ok	ok	ok	63	ok	ok	ok	ok	9.9
62	1-2-4-7-8	1	ok	ok	ok	ok	ok	ok	51	ok	ok	ok	ok	10.2
63	1-3-4-7-8	2	ok	ok	ok	ok	ok	ok	67	16	ok	ok	ok	10.2
64	2-3-4-7-8	2	ok	ok	ok	ok	ok	ok	54	ok	ok	ok	72	9.1
65	1-2-3-4-7-8	0	103	179	116	121	106	124	70	350	240	83	76	10.2

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.

[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 27. Module 3, Stages 2–3: Formulation of FBRs for Lactating Women with Incaparina and Fortified Instant Oats and Liver[a]

		# Nut[b] <70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		183	110	154	136	179	153	100	356	202	130	97	19.2
	Optimized-B		192	102	157	138	174	140	101	359	198	133	100	19.1
	Maximized[c]		221	219	202	178	216	223	132	364	256	162	106	22.3
	Number Recommended	**8**	**103**	**9**	**84**	**40**	**67**	**107**	**16**	**5**	**28**	**64**	**57**	**9.7**
1	Veg28	7	ok	36	ok	44	71	ok	24	5	39	66	58	10.2
2	Liver1	5	ok	11	ok	64	76	ok	20	315	104	66	60	10.0
3	Beans7	8	ok	9	ok	41	68	ok	37	5	28	67	59	10.0
4	Orange3	8	ok	56	ok	41	68	ok	20	5	29	65	58	9.9
5	Incaparina7	5	ok	9	ok	69	98	ok	27	16	35	78	76	10.1
6	Fort oats7	6	ok	9	ok	50	78	ok	22	5	44	79	58	10.1
7	Potato7	7	ok	24	ok	42	74	ok	19	5	28	66	60	9.9
8	5-6	4	ok	9	ok	83	ok	ok	36	16	51	ok	ok	10.6
9	1-2	5	ok	38	ok	68	ok	ok	28	ok	ok	68	60	10.5
10	1-3	7	ok	36	ok	45	ok	ok	46	5	39	69	59	10.5
11	1-4	6	ok	82	ok	45	ok	ok	29	5	40	66	58	10.4
12	1-7	7	ok	51	ok	46	ok	ok	27	5	39	68	60	10.5
13	1-8	4	ok	36	ok	ok	ok	ok	44	16	62	ok	ok	11.1
14	2-3	5	ok	11	ok	65	ok	ok	41	ok	ok	69	61	10.3
15	2-4	5	ok	58	ok	65	ok	ok	24	ok	ok	67	60	10.2
16	2-7	5	ok	26	ok	66	ok	ok	22	ok	ok	68	62	10.2
17	2-8	2	ok	11	ok	ok	ok	ok	40	ok	ok	ok	ok	10.9
18	3-4	8	ok	56	ok	42	68	ok	42	5	29	68	59	10.2
19	3-7	7	ok	24	ok	43	ok	ok	40	5	28	69	61	10.3
20	3-8	4	ok	9	ok	ok	ok	ok	56	16	51	ok	ok	10.9
21	4-7	6	ok	71	ok	44	ok	ok	24	5	29	67	60	10.1
22	4-8	4	ok	56	ok	ok	ok	ok	40	16	52	ok	ok	10.7
23	7-8	4	ok	24	ok	ok	ok	ok	38	16	51	ok	ok	10.8
24	1-2-3	4	ok	38	ok	69	ok	ok	50	ok	ok	71	62	10.8
25	1-2-4	4	ok	ok	ok	69	ok	ok	33	ok	ok	68	60	10.7
26	1-2-7	3	ok	53	ok	70	ok	ok	31	ok	ok	70	62	10.8
27	1-2-8	2	ok	38	ok	ok	ok	ok	48	ok	ok	ok	ok	11.3
28	1-3-4	6	ok	ok	ok	46	ok	ok	51	5	40	69	60	10.7
29	1-3-7	6	ok	51	ok	47	ok	ok	49	5	39	71	62	10.8
30	1-3-8	4	ok	36	ok	ok	ok	ok	65	16	62	ok	ok	11.3
31	1-4-7	6	ok	ok	ok	48	ok	ok	32	6	40	69	60	10.7
32	1-4-8	4	ok	37	ok	ok	ok	ok	44	16	62	ok	ok	11.1

		# Nut[b] <70% RDA	Calcium % RDA	Vitamin C % RDA	Thiamin % RDA	Riboflavin % RDA	Niacin % RDA	B6 % RDA	Folate % RDA	B12 % RDA	Vitamin A % RDA	Iron % RDA	Zinc % RDA	Cost GTQ/day
	Optimized-A		183	110	154	136	179	153	100	356	202	130	97	19.2
	Optimized-B		192	102	157	138	174	140	101	359	198	133	100	19.1
	Maximized[c]		221	219	202	178	216	223	132	364	256	162	106	22.3
	Number Recommended	**8**	**103**	**9**	**84**	**40**	**67**	**107**	**16**	**5**	**28**	**64**	**57**	**9.7**
33	1-7-8	4	ok	51	ok	ok	ok	ok	46	17	62	ok	ok	11.2
34	2-3-4	4	ok	58	ok	66	ok	ok	46	ok	ok	70	61	10.5
35	2-3-7	4	ok	26	ok	67	ok	ok	44	ok	ok	71	64	10.6
36	2-3-8	2	ok	11	ok	ok	ok	ok	60	ok	ok	ok	ok	11.2
37	2-4-7	4	ok	ok	ok	68	ok	ok	27	ok	ok	69	62	10.4
38	2-4-8	2	ok	58	ok	ok	ok	ok	44	ok	ok	ok	ok	11.0
39	2-7-8	2	ok	26	ok	ok	ok	ok	42	ok	ok	ok	ok	11.0
40	3-4-7	4	ok	ok	ok	45	ok	ok	45	5	29	70	61	10.5
41	3-4-8	4	ok	56	ok	ok	ok	ok	61	16	52	ok	ok	11.0
42	3-7-8	4	ok	24	ok	ok	ok	ok	58	16	51	ok	ok	11.0
43	4-7-8	3	ok	ok	ok	ok	ok	ok	43	17	52	ok	ok	10.9
44	1-2-3-4	2	ok	ok	ok	70	ok	ok	55	ok	ok	ok	62	11.0
45	1-2-3-7	3	ok	53	ok	71	ok	ok	53	ok	ok	ok	64	11.1
46	1-2-3-8	2	ok	38	ok	ok	ok	ok	68	ok	ok	ok	ok	11.6
47	1-2-4-7	2	ok	ok	ok	72	ok	ok	36	ok	ok	ok	63	11.0
48	1-2-4-8	1	ok	ok	ok	ok	ok	ok	52	ok	ok	ok	ok	11.5
49	1-2-7-8	2	ok	53	ok	ok	ok	ok	50	ok	ok	ok	ok	11.5
50	1-3-4-7	5	ok	ok	ok	49	ok	ok	54	6	40	ok	62	11.0
51	1-3-4-8	3	ok	ok	ok	ok	ok	ok	69	17	63	ok	ok	11.5
52	1-3-7-8	4	ok	51	ok	ok	ok	ok	67	17	62	ok	ok	11.6
53	1-4-7-8	3	ok	ok	ok	ok	ok	ok	51	17	63	ok	ok	11.4
54	2-3-4-7	3	ok	ok	ok	69	ok	ok	49	ok	ok	ok	64	10.8
55	2-3-4-8	2	ok	58	ok	ok	ok	ok	64	ok	ok	ok	ok	11.3
56	2-3-7-8	2	ok	26	ok	ok	ok	ok	62	ok	ok	ok	ok	11.3
57	2-4-7-8	1	ok	ok	ok	ok	ok	ok	46	ok	ok	ok	ok	11.2
58	3-4-7-8	3	ok	ok	ok	ok	ok	ok	63	17	52	ok	ok	11.2
59	1-2-3-4-7	2	ok	ok	ok	73	ok	ok	58	ok	ok	ok	64	11.3
60	1-2-3-4-8	0	ok	ok	ok	ok	ok	ok	73	ok	ok	ok	ok	11.8
61	1-2-3-7-8	1	ok	53	ok	ok	ok	ok	71	ok	ok	ok	ok	11.9
62	1-2-4-7-8	1	ok	ok	ok	ok	ok	ok	55	ok	ok	ok	ok	11.7
63	1-3-4-7-8	2	ok	ok	ok	ok	ok	ok	72	17	63	ok	ok	11.8
64	2-3-4-7-8	1	ok	ok	ok	ok	ok	ok	67	ok	ok	ok	ok	11.5
65	1-2-3-4-7-8	0	133	99	143	113	130	147	76	327	139	103	85	12.1

[a] "ok" means that a subset of the set of FBRs tested ensured that ≥ 70% of the RDA was achieved.

[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

[c] Refers to maximized diet, that is, a diet following the final set of FBRs in which nutrient intake is maximized.

Appendix 28. Food Composition Values: Incaparina,[a] Incaparina-Crecimax,[a] Vitacereal,[b] CSB[c]

		Incaparina	Incaparina-Crecimax	Vitacereal	CSB
Food energy	kcal/100 g	389.0	427.0	380.0	376.0
Protein	g/100 g	21.3	21.0	9.5	17.2
Fat	g/100 g	5.3	5.0	4.3	9.7
Carbohydrate	g/100 g	64.0	64.0	71.0	61.7
Calcium	mg/100 g	299	341.0	200.0	831
Iron	mg/100 g	14.9	25.6	14.0	17.49
Zinc	mg/100 g	16.0	10.7	8.3	5.0
Vitamin C	mg/100 g	0.0	85.0	140	40.0
Thiamin	mg/100 g	1.5	1.71	0.36	0.53
Riboflavin	mg/100 g	1.7	1.87	0.36	0.48
Niacin	mg/100 g	19.2	24.3	6.1	6.23
Vitamin B6	mg/100 g	0.0	2.4	0.44	0.5
Folate	µg Dietary Folate Equivalents/100 g	213.0	533.0	83.0	300.0
Vitamin B12	µg/100 g	1.1	3.36	0.52	1.0
Vitamin A RE	µg Retinol Equivalents/100 g	213.0	533.0	249.0	784.0

[a] For Incaparina and Incaparina-Crecimax, the food composition values were calculated from packet information.
[b] For Vitacereal, the food composition values were obtained from a presentation of the WFP given to the Cargill/Fundación Mundial de la Soya II Conferencia de Responsabilidad Social Empresarial Soluciones Nutricionales para Centroamérica, February 22–23, 2011. Accessed in February 2013. http://www.worldsoyfoundation.org/news&events/workshops/int/feb2011/PMA-Conferencia-Soya.pdf.
[c] For CSB, the food composition values were obtained from the USAID Food for Peace Commodities Reference Guide. Accessed in February 2013. http://transition.usaid.gov/our_work/humanitarian_assistance/ffp/crg/.

Appendix 29. Analysis of FBF for Breastfed Children 6–8 Months Old

Nutrients % RDA for breastfed children 6–8 months old when consuming 27 g/day of Incaparina, Incaparina-Crecimax, Vitacereal, or CSB[a]												
	# Nut[b] < 70% RDA	Calcium	Vitamin C	Thiamin	Riboflavin	Niacin	B6	Folate	B12	Vitamin A	Iron	Zinc
		% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA
No Recommendation	10	48.2	49.5	49.3	57.8	31.0	32.2	42.3	51.0	75.0	13.6	22.0
Incaparina	4	65.6	49.5	172.4	166.6	157.0	32.2	114.2	109.9	87.7	51.7	86.9
Incaparina-Crecimax	1	70.5	95.4	200.8	186.7	193.8	254.0	238.8	232.4	107.0	88.5	67.1
Vitacereal	5	59.0	125.1	70.1	75.4	68.7	68.1	66.6	78.6	89.9	49.1	54.0
CSB	3	101.6	71.1	85.5	83.6	69.6	73.6	144.7	104.5	122.0	59.6	39.9
Staple (2 servings/day) + Veg (3 servings/day) +												
Incaparina	3	71.7	55.5	177.3	168.9	162.8	50.2	118.1	110.3	90.9	54.5	89.2
Incaparina-Crecimax	1	75.6	101.4	205.5	188.8	199.5	269.0	242.6	232.8	110.1	90.0	69.1
Vitacereal	3	65.0	131.1	75.0	78.0	74.4	87.0	71.0	79.0	93.1	51.8	56.2
CSB	2	107.6	77.1	90.4	86.2	75.3	92.4	149.2	105.0	125.2	62.3	42.1
Staple (2 servings/day) + Veg (4 servings/day) +												
Incaparina	3	73.7	63.9	179.7	172.5	165.5	59.1	138.1	110.8	102.2	56.8	91.1
Incaparina-Crecimax	0	77.5	109.8	207.8	192.1	202.3	277.4	262.3	233.3	121.4	92.1	71.0
Vitacereal	3	67.0	139.5	77.3	82.0	77.2	96.1	91.3	79.5	104.4	54.1	58.2
CSB	2	109.6	85.5	92.8	90.2	78.1	101.5	169.5	105.4	136.5	64.6	44.1
Staple (2 s/d) + Veg (4 s/d) + MPE (1 s/d) + Beans (1 s/d) +												
Incaparina	2	79.1	63.9	190.5	200.9	171	80.1	184.5	167.2	111.2	65.6	97.5
Incaparina – Crecimax	0	82.4	109.8	215.3	216.2	207.7	298.2	303.5	289.7	130.4	99.6	76.4
Vitacereal	2	72.4	139.5	87.9	110.4	82.6	118.8	137.7	135.9	113.4	62.9	64.5
CSB	1	115	85.5	103.2	118.5	83.5	124.3	215.8	161.8	145.5	73.4	50.3

[a] cells with nutrients < 70% of their RDAs in worst-case scenarios for this FBR are shaded in gray.
[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

Appendix 30. Analysis of FBF for Breastfed Children 9–11 Months Old

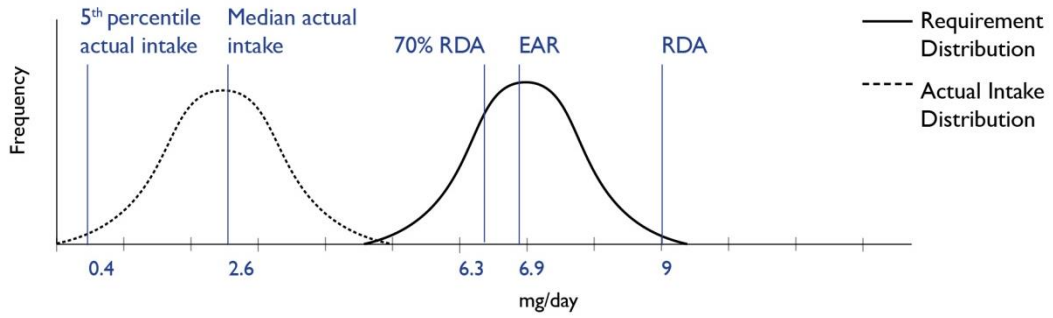
Nutrients % RDA for breastfed children 9–11 months old when consuming 30 g/day of Incaparina, Incaparina-Crecimax, Vitacereal, or CSB[a]

	# Nut[b] < 70% RDA	Calcium	Vitamin C	Thiamin	Riboflavin	Niacin	B6	Folate	B12	Vitamin A	Iron	Zinc
		% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA	% RDA
No Recommendation	10	47.3	48.9	57.0	63.1	39.5	43.0	45.4	51.0	80.9	16.4	22.9
Incaparina	4	68.5	48.9	194.1	182.8	174.4	43.0	122.5	116.3	95.1	60	95.8
Incaparina-Crecimax	0	72.6	99.9	225.3	204.7	222.0	304.3	259.5	253.0	116.5	100.5	73.0
Vitacereal	3	61.1	132.9	80.4	81.4	76.3	78.1	70.6	81.5	97.4	57.1	59.2
CSB	2	108.4	72.9	97.5	90.5	77.3	84.2	157.4	110.3	133.1	68.8	43.5
Staple (2 servings/day) + Veg (3 servings/day) +												
Incaparina	3	75.5	62.8	201.8	186.5	183.9	64.3	135.2	117.2	97.8	63.3	100.3
Incaparina-Crecimax	0	85.5	106.4	234.0	206.8	226.0	323.3	262.6	253.6	118.1	106.1	78.8
Vitacereal	3	68.1	146.8	88.1	85.5	85.7	104.2	83.3	82.4	100.2	60.4	63.7
CSB	1	115.4	86.8	105.3	94.6	86.7	110.2	170.1	111.2	135.9	72.1	48.0
Staple (2 servings/day) + Veg (4 servings/day) +												
Incaparina	0	86.0	89.4	208.7	203.6	190.4	96.9	170.3	117.8	116.8	84.0	103.9
Incaparina-Crecimax	0	89.7	140.4	239.8	224.9	232.8	348.4	304.8	254.1	138.1	124.0	80.2
Vitacereal	1	78.6	173.3	95.0	103.0	92.2	137.5	118.3	83.1	119.2	81.1	67.2
CSB	1	125.9	113.3	112.1	112.1	93.2	143.5	205.2	111.9	154.8	92.8	51.5
Staple (2 s/d) + Veg (4 s/d) + MPE (1 s/d) + Beans (1 s/d) +												
Incaparina	0	84.8	173.5	105	129.2	95.6	162.6	168.2	133.2	126.3	92.1	74.9
Incaparina – Crecimax	0	95.3	140.5	239.5	242.2	231.9	358.5	348.2	303.6	145.2	130.7	86.2
Vitacereal	0	84.8	173.5	105.0	129.2	95.6	162.6	168.2	133.2	126.3	92.1	74.9
CSB	1	132.1	113.5	122.0	138.2	96.7	168.6	255.0	162.1	162.0	103.8	59.2

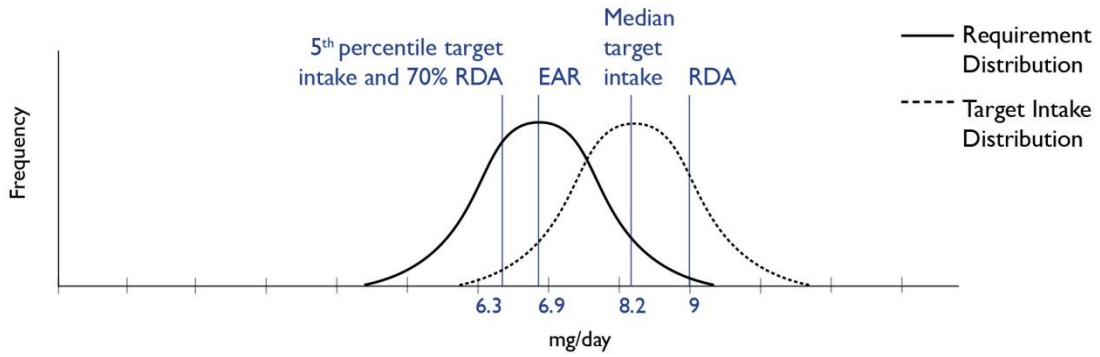
[a] cells with nutrients < 70% of their RDAs in worst-case scenarios for this FBR are shaded in gray.
[b] number of nutrients < 70% of their RDAs in worst-case scenarios for this FBR.

Appendix 31. Target Usual Intake Distribution of Iron for Breastfed Children 6–8 Months

Panel A



Panel B



Panel A shows the baseline usual nutrient intake distribution, based on the dietary analysis of the cross-sectional survey data, as compared to the EAR distribution and RDA. The mean iron intake is 2.6 mg/d and the 5th percentile of iron intake is 0.4 mg/d.

Panel B shows the shift up of the entire baseline distribution such that the worst-case scenario level (i.e., the 5th percentile) is ≥ 70% of the RDA. The mean iron intake of the target usual intake distribution is 8.5 mg/d and the 5th percentile of iron intake is 6.3 mg/d.

Appendix 32. Participant Selection Form for Pregnant and Lactating Women

	Evidence-based dietary intake recommendations for children aged 6-23 months and pregnant women and nursing mothers in the Western highlands of Guatemala using Optifood Software **SELECTION FORM (MOTHER)**	**Form: 01B**
Page 1 of 1	**Identification:** |___|___|___|___|___|___|___|	**Version 2.0** **11/June/2012**

This form is to be completed by Project staff with support from local community for all contacted mothers who agree to be SCREENED for participation in the study.

SECTION A. AGREEMENT TO BE SELECTED

1☐ 2☐

SECTION B. SCREENING QUESTIONS

Inclusion Criteria	**YES**	**NO**	**DK**
1. Presently are you pregnant?	1☐	2☐	3☐
2. Presently do you have a child aged under one and are you breastfeeding?	1☐	2☐	
Exclusion Criteria	**YES**	**NO**	**DK**
3. During the last two weeks, have you had or do you have a food-related problem, such as loss of appetite, frequent vomiting, food intolerance or allergy, frequent diarrhea, that has altered the normal way you eat; with or without medical treatment?	1☐	2☐	

5. IF ONE OF THE **INCLUSION CRITERIA** WAS MARKED "**YES**" AND IF NONE OF THE **EXCLUSION CRITERIA** WERE MARKED "**YES**", MARK HERE.
→1☐ Eligible for the Study.

OTHERWISE, MARK HERE
→ 2☐ Not eligible for the study ->GO TO **SECTION E.**

SECTION C. INFORMED CONSENT

You are eligible to participate in this study. Now I would like to tell you about the study we are conducting in this community and then I will ask you if you wish to participate.

GO OVER THE CONSENT FORM WITH THE MOTHER AND THEN ASK HER IF SHE WISHES TO PARTICIPATE.

1. REGISTRATION STATUS
   1☐ Will not participate → GO TO **SECTION D**
   2☐ Consent pending → GO TO **SECTION D**
   3☐ Will participate
2. Date consent is signed:
   \|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\| **GO TO SECTION E**
   dd mm yyyy

SECTION D. REASON (S) FOR NOT PARTICIPATING

1. Reason(s) for not participating: (MARK ALL THAT APPLY)

a ☐ Not interested
b ☐ Does not have time
c ☐ Is working
d ☐ Fear of examinations
e ☐ Has heard negative rumors about the study
f ☐ Fear of misuse of information provided
g ☐ Does not accept visitors at home
h ☐ Fear of other aspects of the study
i ☐ The husband or another relative does not allow her to participate
(SPECIFY) _____
j ☐ Other: specify: _____

SECTION E. COMMENTS

1. ARE THERE ADDITIONAL COMMENTS?
   1☐ Yes 2☐ No → GO TO **SECTION F**
2. RECORD COMMENTS HERE:

SECTION F. COMPLETION OF THE FORM

1a. Identification of the person completing this form:

1b. Date of completion:
\|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

2a. Identification of the person reviewing this form:

2b. Review date:
\|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

3a. Identification of the person entering the data:
\|___\|___\|___\|

3b. Entry date: \|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

Appendix 33. Participant Selection Form for Children 6–23 Months of Age

	Evidence-based dietary intake recommendations for children aged 6-23 months and pregnant women and nursing mothers in the Western highlands of Guatemala using Optifood Software **SELECTION FORM (BOY/GIRL)**	**Form: 01A**
Page 1 of 1	**Identification:** |___|___|___|___|___|___|___|	**Version 2.0** **11/June/2012**

Confidentiality: this form is to be completed by Project staff with the support from local community for all contacted mothers who agree to be SCREENED for participation in the study.

SECTION A. AGREEMENT TO BE SELECTED

1. DID THE MOTHER AGREE TO BE SCREENED?
   1☐ Yes 2☐ No→ Go to **SECTION D.**

SECTION B. SCREENING QUESTIONS

Inclusion Criteria	**YES**	**NO**	**DK**
1. Is your child between 6 and 23 months old?	1☐	2☐	
Exclusion Criteria	**YES**	**NO**	**DK**
2. Does your child have a birth defect?	1☐	2☐	
3. Does your child have a neurological deficiency (diagnosed brain disorder or has had attacks or convulsions)?	1☐	2☐	3☐
4. During the last two weeks, has your child had a feeding problem, such as loss of appetite, frequent vomiting, food intolerance or allergy, frequent diarrhea, that has altered his/herfeeding; with or without medical treatment.	1☐	2☐	

5. IF ALL **INCLUSION CRITERIA** WERE MARKED "**YES**" AND IF NONE OF THE **EXCLUSION CRITERIA** WERE MARKED "**YES**", MARK HERE.
→1☐ Eligible for the Study.

OTHERWISE, MARK HERE.
→ 2☐ Not eligible for the study ->GO TO **SECTION E.**

SECTION C. INFORMED CONSENT

You and your child are eligible to participate in this study. Now I would like to tell you about the study we are conducting in this community and then I will ask you if you wish to participate.

GO OVER THE CONSENT FORM WITH THE MOTHER AND THEN ASK HER IF SHE WISHES TO PARTICIPATE.

1. REGISTRATION STATUS
   1☐ Will not participate → GO TO **SECTION D**
   2☐ Consent pending → GO TO **SECTION D**
   3☐ Will participate
2. Date consent is signed:
   \|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\| **GO TO SECTION E**
   dd mm yyyy

SECTION D. REASON (S) FOR NOT PARTICIPATING

1. Reason(s) for not participating: (MARK ALL THAT APPLY)

a ☐ Not interested
b ☐ Does not have time
c ☐ Is working
d ☐ Is afraid of having the child examined
e ☐ Has heard negative rumors about the study
f ☐ Misuse of information provided
g ☐ Does not accept visitors at home
h ☐ Fear of other aspects of the study
i ☐ The husband or another relative does not allow her to participate
(SPECIFY) _____
j ☐ Other: specify: _____

SECTION E. COMMENTS

1. ARE THERE ADDITIONAL COMMENTS?
   1☐ Yes 2☐ No → GO TO **SECTION F**
2. RECORD COMMENTS HERE:

SECTION F. COMPLETION OF THE FORM

1a. Identification of the person completing this form:

1b. Date of completion:
\|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

2a. Identification of the person reviewing this form:

2b. Review date:
\|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

3a. Identification of the person entering the data:
\|___\|___\|___\|

3b. Entry date: \|__\|__\| - \|__\|__\| - \|__\|__\|__\|__\|
dd mm yyyy

Appendix 34. Survey Form for Family Demographic, Health, Diet, Food Security, and Nutritional Status of Women and Children

Nutrition Institute of Central America and Panama — INCAP

PROTOCOL: DEVELOPMENT OF EVIDENCE-BASED DIETARY INTAKE RECOMMENDATIONS FOR CHILDREN AGED 6-23 MONTHS AND PREGNANT AND NURSING MOTHERS IN THE WESTERN HIGHLANDS OF GUATEMALA USING OPTIFOOD SOFTWARE AS A CONTRIBUTION TO FOOD-BASED APPROACHES FOR IMPROVING NUTRITION. (PROTOCOL NUMBER: CIE-012-11).

FORM #3: FAMILY DEMOGRAPHICS, HEALTH, DIETARY PRACTICES, HEALTH, FOOD SECURITY AND CHILD'S NUTRITIONAL STATUS

INSTRUCTIONS: This form must be completed by project personnel by interviewing mothers who have given their consent to participate. If the mother has not signed the informed consent, **PLEASE DO NOT GO AHEAD WITH THE INTERVIEW**.

SECTION I: GENERAL DATA		
1.1	Mother's ID (assigned code): Participating child's ID (assigned code)	**# M_____;** **Initials: _____** **# C_____;** **Initials: _____**
1.2	Health Center ID card number:	**#_____;** Does not have one: _____
1.3	Name of the Community:	1|__] Cunén, Quiché 2|__] Nebaj, Quiché 3|__] Chajul, Quiché 4|__] Cotzal, Quiché 4|__] Sacapulas, Quiché 5|__] San Sebastián Huehuetenango 6|__] San Pedro Nécta 7|__] Chiantla, Huehuetenango 8|__] Todos Santos, Huehuetenango 9|__] San Miguel Ixtahuacán, San Marcos 10|__] Other; specify:
1.4	Conglomerate to which the interviewed family belongs:	1|__] Association of Agricultural Producers 2|__] Community in general
1.5	Place of assessment:	1|__] Home/residence 2|__] Health Center or Post 3|__] Other; specify: _____
1.6	Date of assessment:	dd_____; mm:_____; Year: 2012

SECTION II: POPULATION DATA (Interview with the child's mother or guardian)		
2.1	Please tell me your date of birth.	a[__|__] day b[__|__] month c[__|__][__|__|year d|__] Does not know
2.1A	How old are you?	1[__|__] years completed 2|__] Does not know
2.1B	What is your marital status?	1|__]Married 2|__] Living together 3|__]Single 4|__] Other; specify _____
2.2	ETHNIC GROUP (ONLY BY OBSERVATION)	1[__| Indigenous 2[__| Ladina 1[__| Other; specify: _____
2.2A	Do you speak Spanish?	1|__]Yes; 2|__]No

2.2B	What is your mother tongue?	1[__| Spanish 4[__| Mam 2[__| Quiché 5[__| Other; specify 3[__| Ixil
2.2C	In what language was the interview conducted?	1[__| Spanish 4[__| Mam 2[__| Quiché 5[__|Other; specify 3[__| Ixil
2.3.	How many children under five do you have? How old are they? 2.3.1. Number of children: _____	2.3A How old are they? (FROM THE YOUNGEST TO THE OLDEST) 1|__] _____ months 2|__] years_____; months: _____ 3|__] years_____; months: _____ 4|__] years_____; months: _____
2.4	Do you do paid work?	1|__]Yes; 2|__]No
2.5	Do you participate in agricultural activities outside the home, either for sale or for your own consumption?	1[__|Yes, I work in the fields at least one day a week 2[__|Yes, I work in the fields 1-3 days a week 3[__|Yes, I work in the fields 4-7 days a week 4[__| I do not work in agriculture or for crops
2.6	Does your family have a garden plot (for growing vegetables) either for sale or for your own consumption?	1[__|Yes, mainly for sale 2[__|Yes, mainly for consumption 3[__|Yes, enough is grown for sale and for consumption 4[__| There is no family vegetable garden. GO TO Q.2.8 If 1, 2 and 3 were answered, go to the next question.
2.7	What types of crops are grown in the family vegetable garden?	1[__|_____ 2[__|_____ 3[__|_____ 4[__|_____ 5[__|_____
2.8	Does your husband participate in agricultural activities, either for sale or for consumption?	1[__|Yes, he works in the fields at least one day per week 2[__|Yes, he works in the fields 1-3 days a week 3[__|Yes, he works in the fields 4-7 days a week 4[__| He does not work in agriculture or crops. GO TO Q 2.10
2.9	Do you own or rent the land used for farming by your family (i.e. you and your husband)?	1[__| Own 2[__| Belongs to the parents; no rent is paid 3[__| Belongs to somebody else; no rent is paid 4[__| Belongs to somebody else; rent is paid
2.10	Do you raise domestic animals in the household?	1[__|Yes 0[__|No **GO TO QUESTION → 2.13**
2.11	What animals? EXPLORE: Any other animals?	1[__| Hens, chickens or other barnyard fowl 2[__| Rabbits 3[__| Pigs 4[__| Sheep or goats 4[__| Cows and heifers 4[__| Other; specify: _____
2.12	What do you do with the animals you raise or the products of those animals? GIVE EXAMPLES, SUCH AS MILK, CHEESE, BUTTER, MEAT, EGGS, ETC.	1[__| Mainly for family consumption 2[__| Mainly for sale 3[__| There is enough for both consumption and sale 4[__| Does not know
2.13	Do you depend on the income of other household members?	1[__|Yes 0[__|No
2.14	Is the house where you live …?	1[__|Your own 2[__|A rented house 3[__|A rented room or apartment 4[__|Other; specify _____

2.15	Main flooring material ONLY BY OBSERVATION	1|__] natural (earth/sand) 2|__] rustic flooring (boards) 3|__] clay or earthen tiles 4|__] polished wood	5|__] cement tiles (mosaic), terrazzo 6|__] ceramic tiles 7|__] cement slab 8|__] Other; specify:
2.16	Main roofing material ONLY BY OBSERVATION	1|__] straw/thatch/palm 2|__] tile 3|__] zinc/sheet metal 4|__] asbestos sheets (Duralita®) 5|__] concrete/slab/terrace 6|__] Other; specify_____;	
2.17	Main wall material ONLY BY OBSERVATION (Consider waste materials such as cardboard, plastic, aluminum)	1|__] mud 2|__] adobe 3|__] blocks 4|__] sheet metal	5|__] lumber 6|__] clay tiles 7|__] waste material 8|__] Other; specify:
2.18	Do you have electricity at home?	1|__] Yes there is electricity service 2|__] No	
2.19	What APPLIANCES do you have at home? (CHECK ALL THOSE THAT APPLY).	1|__] Manual mill 2|__] Radio 3|__] TV 4|__] Cable TV 5|__] Home telephone (land line) 6|__] Mobile telephone	7|__] Refrigerator 8|__] Blender 9|__] Washing machine 10|__] Microwave oven 11|__] Computer
2.20	Which of the following VEHICLES do you have at home? (CHECK ALL THOSE THAT APPLY)	1|__] Bicycle 2|__] Motorcycle	3|__] Car 4|__] Pickup truck
2.21	How do you get your water during most of the year?	1|__] Piped (indoor) inside the home 2|__] Truck 3|__] Public open-air faucet for several families 4|__] River, lake, stream or creek 5|__] Well 6|__] Other; specify _____	
2.22	What do you do to purify or clean the water you drink? (CHECK ALL THOSE THAT APPLY)	1|__] Boil it 2|__] Chlorinate it 3|__] Place it in the sun (sodis method) 4|__] Nothing 5|__] Other; specify _____	
2.23	What type of toilet facilities do you have at home?	1|__] private toilet connected to sewer 2|__] shared toilet connected to sewer 3|__] toilet connected to septic tank 4|__] improved latrine (implemented by NGO) 5|__] latrine, outhouse 6|__] has no toilet facilities 7|__] other; specify _____	
2.24	What type of fuel do you use for cooking most of the time at home?	1|__] propane gas 2|__] kerosene 3|__] electricity 4|__] firewood	5|__] charcoal 6|__] agricultural waste 7|__] other; specify
2.25	How many people live in your home?		
2.26	How many bedrooms are there in your home?		

2.27	What is your highest educational level? DID YOU ATTEND PRIMARY OR SECONDARY SCHOOL?	1|__]Primary: grades passed _____ 2|__]Secondary: grades passed _____ 3|__]After high school: grades passed _____ 4|__] Did not go to school, but can read and write 5|__] Did not go to school, cannot read and write

SECTION III: PARTICIPATING CHILD'S HEALTH AND DIET		
3.1	3.1.1. Sex of the boy/girl: 3.1.1. Date of birth: 3.1.2.Age of the child: 3.1.3.Verification of child's age (MARK WITH AN "X" AS APPLICABLE)	1|__] Male; 2|__] Female Day:____; month:_____; year_____ _____ full months 1|__] Mother's report; 2|__] Health card; 3|__] Birth certificate
3.2	Has a doctor or health practitioner told you that your baby was born prematurely or small for the length of the pregnancy?	1|__] a) Premature _____number of months before the expected delivery date; b) Weight at birth _____.____kg 2|__] a) Small, but born on the due date (9 months); b) weight at birth _____.____kg 3|__] Neither premature nor small for the length of the pregnancy 4|__] Does not know
3.3	Has a doctor or health practitioner told you that your baby has a chronic disease or condition (since birth or for a long time)?	1|__] Yes; specify:_____ 0|__] No
3.4	During the last two weeks, how have you seen the child's health?	1|__] Apparently healthy (without symptoms or signs of disease and the baby's mother thinks he/she looks healthy) 2|__] Is now recovering from an acute illness suffered during the last two weeks (cold, diarrhea, fever, etc.); 3|__] Has had an illness for more than three weeks: diarrhea, vomiting, cough, skin rash, fever, etc.)
3.5	Which of the following options best describes the way you feed your son/daughter? ASK IF THE CHILD IS BREASTFED, GIVEN LIQUID OR SOLID FOOD, INFANT FORMULA OR WHOLE MILK.	1|__] Only breast milk (no fluids or solid foods, except for medicine) 2|__] Breast milk and other fluids (including formula) 3|__] Breast milk, other fluids and solid food 4|__] Stopped breastfeeding; only formula 5|__] Formula and solid foods 6|__] Only solid and liquid foods (does not receive breast milk or formula). **(If you marked option 1, 2 or 3 go to question 3.7)**
3.6	Presently are you nursing (breastfeeding) your child?	1|__] YES, **GO TO Q 3.6B** 2|__] NO
3.6A	How old was the child when you stopped nursing him/her?	_____ full months **GO TO 3.7**
3.6B	Do you remember how many times you nursed the baby yesterday?	# _____times during the day #_____ times during the night
3.7	At what age did you start giving him/her fluids or solid foods?	1|__] Some fluid (includes brews): _____months 2|__] First solid food: _____ months
3.8	When you (the mother) works or is out of the house, who takes care of _____ (the child)?	1|__] The mother takes the child with her 2|__] A family member 3|__] A neighbor/friend 4|__] The child is left alone; nobody takes care of the child 5|__] Does not work outside the home 6|__] Does not know/does not remember/does not answer 7|__] Other: (specify) _____

3.9	Has (NAME) been weighed or measured during the last 12 months?	1|__| YES 2|__| NO
3.10	Where is (NAME) weighed or measured?	1|__| At home 2|__| Community/convergence center 3|__| Health post 4|__| Health center 5|__| Hospital 6|__| Other
3.11	The last time that (NAME) was weighed, were you told he/she had the right weight or low weight?	1|__| Yes, she was told the child's weight was OK 2|__| Yes, she was told the child's weight was low 3|__| Yes, she was told but does not remember 4|__| She was not told
3.12	The last time (NAME) was measured, were you told he/she was growing well?	1|__| Yes, she was told the child's length was OK 2|__| Yes, she was told the child's length was inadequate or that he/she needed to grow more 3|__| Yes, she was told but does not remember 4|__| She was not told
3.13	And do you think your child is growing well?	1|__| YES 2|__| NO
3.14	The last time (NAME) was weighed or measured, did they tell you or advise you on the best way to feed and take care of your child?	1|__| YES 2|__| NO 3|__| DOES NOT REMEMBER
3.14A	Has your child received the vaccines at the health center or post?	1|__| Yes, he/she has received all the vaccines for his/her age 2|__| He/she has received some shots, but has not completed all the shots for his/her age 3|__| He/she has not been immunized
3.15	During the last 24 hours, did (NAME) take vitamins such as …?	1|__| Ferrous sulfate 2|__| Vitamin A 3|__| Folic acid 4|__| Sprinkles 5|__| RUTF (ready to use therapeutic food) 6|__| Other; specify: _____
3.16	Does your family receive aid in the form of food, inputs or cash? CHECK ALL THOSE THAT APPLY.	1|__| Government safety kit 2|__| Vitacereal 3|__| NGO sponsorship program 4|__| Zero Hunger 5|__| Fertilizers 6|__| Family remittances from abroad 7|__| Other; specify: _____
3.17	Was yesterday a community holiday?	1|__| YES 2|__| NO
3.18	Was yesterday a family holiday?	1|__| YES 2|__| NO

SECTION IV: PREGNANT WOMEN'S HEALTH AND DIET ***(IF THE MOTHER IS NOT PREGNANT, GO TO SECTION V, NURSING MOTHER)***		
4.1	4.1.1. Do you remember how many months pregnant you are? 4.1.2. How much time has elapsed since your youngest son/daughter was born?	_____ full months (SINCE THE DATE OF THE LAST PERIOD). _____ full years_____ months (YOU CAN ASK HOW OLD THE YOUNGEST CHILD IS)
4.2	Have you had prenatal checkups?	1|__| Yes 0|__| No Go to 4.9

4.3	How many months pregnant were you when you had your first prenatal checkup?	_____ full months
4.4	Where did you get your prenatal checkup?	1|__] Health post 2|__] Health center 3|__] Convergence center 4|__] CAIMI care center 5|__] Permanent Care Center (CAP) 6|__] Hospital 7|__] Private Clinic 8|__] Home (of the interviewee or midwife) 9|__] Other. Specify
4.5	Do you have a health card where visits to the health center or post are written down?	1|__] YES 0|__] NO
4.6	What provider gave you your prenatal checkup?	1|__] Doctor 2|__] Nurse 3|__] Midwife 4|__] Community medicine man 5|__] Other; specify:
4.7	Were you told your pregnancy is progressing well?	1|__] Yes, it's OK 0|__] No, it's not OK; specify:
4.8	The last time you went for a prenatal checkup, did they tell you or advise you on the best diet during pregnancy?	1|__] YES 2|__] NO 3|__] DOES NOT REMEMBER
4.9	Since you became pregnant, is the **amount** of food you eat every day …	1|__] the same as before 2|__] you are eating more 3|__] you are eating less
4.10	Since you became pregnant, is the **type** of food you eat every day …	1|__] the same as before 2|__] You are eating more of certain foods 3|__] You are eating less of certain foods
4.11	Have you received vitamin supplements from health care providers?	1|__] Yes 0|__] No
4.12	During the last month, have you been taking vitamins regularly, such as …? CHECK ALL THOSE THAT APPLY.	1|__] Ferrous sulfate (weekly) 2|__] Folic acid (weekly) 3|__] Prenatal vitamins (daily) 4|__] Sprinkles (daily) 5|__] RUF (ready to use therapeutic food) (daily) 6|__] Other; specify: _____
4.13	Are you currently breastfeeding (nursing) a small child?	1|__] Yes 0|__] No **Go to Q 4.15**
4.14	If you are breastfeeding (nursing), how many times did you breastfeed yesterday?	# _____ times during the day #_____ times during the night
4.15	If you are pregnant ant and have a small child that you are breastfeeding (nursing), you …	1|__] Stop breastfeeding immediately 2] __] Continue breastfeeding until the baby is 6 months old 3|__] Continue breastfeeding until the baby is a year old 4|__] Will continue breastfeeding until the baby is two 5|__] Will continue breastfeeding until the baby stops asking
4.16	Do you consider that your diet was "normal" yesterday? …	1|__] The same as every day 2|__] You ate more than other days 3|__] You ate less than other days

SECTION V: NURSING MOTHERS' HEALTH AND DIET		
5.1	5.1.1. Can you tell me how long it has been since your last delivery? 5.1.2. How long has it been since your last child was born?	A)_____ years _____ B) full months (YOU CAN ASK HOW OLD THE LAST CHILD OR THE YOUNGEST CHILD IS)
5.2	Have you had postpartum checkups?	1|__] Yes 0|__] No **Go to 5.6**
5.3	Where did you get your postpartum checkup?	1|__] Health post 2|__] Health center 3|__] Convergence center 4|__] CAIMI care center 5|__] Permanent Care Center (CAP) 6|__] Hospital 7|__] Private Clinic 8|__] Home (of the interviewee or midwife) 9|__] Other. Specify:
5.4	Which provider gave you your postnatal checkup?	1|__] Doctor 2|__] Nurse 3|__] Midwife 4|__] Community medicine man 5|__] Other; specify:
5.5	The last time you went for a postnatal checkup, did they explain or advise you on the best diet you should have after giving birth and breastfeeding?	1|__] YES 2|__] NO 3|__] DOES NOT REMEMBER
5.6	After you had your last child, is the **amount** of food you eat every day …	1|__] the same as before 2|__] you are eating more 3|__] you are eating less
5.7	After you had your last child, is the **type** of food you eat every day …	1|__] the same as before 2|__] You are eating more of certain foods 3|__] You are eating less of certain foods
5.8	Have you received vitamin supplements from health care providers alter your last delivery?	1|__] Yes 0|__] No
5.9	During the last month, have you been taking vitamins regularly, such as …? CHECK ALL THOSE THAT APPLY.	1|__] Ferrous sulfate (weekly) 2|__] Folic acid (weekly) 3|__] Prenatals (daily) 4|__] Sprinkles (daily) 5|__] RUTF (ready to use therapeutic food) (daily) 6|__] Other; specify:
5.10	Do you consider that yesterday your eating was "normal" ?	1|__] The same as every day 2|__] You ate more than other days 3|__] You ate less than other days

SECTION VI: PERCEPTION OF FOOD SECURITY IN THE HOME		
6-4.1	During the last 30 days, did you ever worry that food would run out before you would have money to buy more food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.2	During the last 30 days, were you or a member of your family unable to eat nutritious foods of animal origin such as eggs or meat because you could not afford them? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.2a	During the last 30 days, were you unable to give your children nutritious foods of animal origin such as eggs or meat because you could not afford them? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.3	During the last 30 days, did you or a member of your family have to eat a limited variety of foods because there was not enough money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)

6.4	During the last 30 days, did you or a member of your family have to eat foods you didn't really like because there was not enough money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.5	During the last 30 days, did you or a member of your family have to eat less than you thought you needed, because there was not enough money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.6	During the last 30 days, did you or a member of your family have to skip a meal because there was not enough money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.7	During the last 30 days, was there a time when there was no food at all at home because there was no money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.8	During the last 30 days, did you or a member of your family go to bed hungry (without dinner) because there was no money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)
6.9	During the last 30 days, did you or a member of your family go without any food at all for a whole day and night because there was no money to buy food? **1|__] YES; 2|__] NO -->**	1|__] Rarely (1-2 times) 2|__] Sometimes (3-10 times) 3|__] Frequently (more than 10 times)

SECTION VII: ANTHROPOMETRIC ASSESSMENT OF THE INFANT AND MOTHER (Two Measurements)

		CHILD		MOTHER	
	Measurement	1	2	1	2
7.1	Weight (0.1 kilograms)				
7.2	Length/Height (0.1 cm)				
7.3	BMI (estimated, 0.1 kg/sq m)				

7.4	Equipment used for anthropometric measurements:	
	7.4.1 Scale	1|__] Scale: assigned code:_____ 2|__] Scale different from the one assigned for the project (specify the reason for the equipment change in comments)
	7.4.2 Measuring tape	1|__] Measuring tape: assigned code: _____ 2|__] Measuring tape different from the one assigned for the project (specify the reason for the equipment change in comments)
7.5	Was the child weighed with or without clothing?	
	1|__] Clothed; -->	7.5.1.1 |__] Minimum amount of clothing 7.5.1.2 |__] Fully clothed
	2|__] Without clothing	7.5.1.3 |__] Weight of the clothing: _____.____kg
7.6	Relevant comments related to the interview:	1|__] NO; GO TO Q P 7.7 2|__] YES;
7.7	Interview and assessment date:	dd_____ mm_____ year_____
7.8	Interviewer:	ID:_____; first name: _____

Appendix 35. INCAP 24-Hour Dietary Recall Forms

FORM #4. 24-HOUR DIETARY RECALL

CHILD'S ID CODE:_____; MOTHER'S ID CODE:_____ Page 1 of 2

Instructions:

Help her remember yesterday based on the time the child got up, activities she had, etc. Go little at a time.

Ask: I want you to tell me everything your child ate and drank yesterday.

After the child got up, what was the first thing you gave him/her to eat or drink?

After that, what other food did you serve him/her?

Write down all the foods or preparations eaten the day before that the mother/caregiver mentions.

Don't forget to ask, "What do you call that meal (e.g. breakfast, lunch, dinner, between-meal snack)?

FORM #4. 24-HOUR DIETARY RECALL

CHILD'S ID CODE:_____; MOTHER'S ID CODE:_____ Page 2 of 2

RECORDATORIO DE INGESTA DE 24 HORAS - PROYECTO FANTA /Optifood (CIE-012-11)

Fecha:
día: _____ mes: _____ año 2012
MADRE:
Iniciales del Nombre: _____
Codigo de la Madre: _____
Estado fisiologico:
Embarazada:_____
Lactante : _____
Fecha Nac.:
día____; mes_____; año___

NIÑO::
Iniciales del Nombre : _____
Codigo del niño: _____
Sexo: M: _____ ; Fem: _____
Fecha Nac.:
día: ____; mes: _____; año: _____
Meses cumplidos: _____
Grupo: 6-11 meses: _____
12-23 meses_____

Asistencia a comidas

	D	R	A	R	C
Madre					
Niño					

Nombre de la encuestadora: _____
Código de la Encuestadora: _____
Revisado por : _____
Procesador de Datos: _____
Fecha digitación : día____; mes:____; año:____

				Consumo Familiar							Consumo del niño/a		Consumo de la madre		Frecuencia de consumo	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Nombre del alimento o la preparación	Tiempo Comida X	Código Alimento XXXXX		Nombre del alimento	Cantidad unidades caseras	Número de unidades XX.XX	Código de la medida XX	Peso medida (gr o mL) XXXX	No. total de porciones XX.XX	Porciones no consumidas XX.XX	Cantidad Servida XX.XX	Sobras XX.XX	Cantidad Servida XX.XX	Sobras XX.XX	Frecuencia 1 = diario 2 = semana 3 = mes 4= Ocasional	N de días
			1													
			2													
			3													
			4													
			5													
			6													
			7													
			8													
			9													
			10													

COMITE INSTITUCIONAL DE ETICA-INCAP
Consentimiento Aprobado
Fecha de Aprobación: 13/07/2012
Fecha de Caducidad: 13/07/2013
FIRMA

Formulario # 4, ver 2.1

FORMULARIO #4. RECORDATORIO DE INGESTA DE 24 HORAS

CODIGO ID NIÑO/A:_____; CODIGO ID MADRE:_____ Página 1 de 2

Instrucciones:

Ayúdela a recordar el día de ayer en base a las horas en que se levantó el niño, las actividades que tuvo, etc. Vaya poco a poco.
Pregunte: Quiero que me diga todo lo que su niño(a) comió y bebió el día de ayer.
Después de que se levantó el niño ¿Qué fue lo primero que le dio de comer o tomar?

Después ¿Qué otro alimento le sirvió?
Anote todos los alimentos o preparaciones consumidas el día anterior que la madre/cuidadora mencione.

No olvide de preguntar ¿Cómo le llama usted a ese tiempo de comida (por ejemplo, desayuno, almuerzo, cena, entre comida)?

Tiempo de comida		NOMBRE DEL ALIMENTO O PREPARACION
Definido por la madre	Código	

COMITÉ INSTITUCIONAL DE ÉTICA-INCAP
Consentimiento Aprobado
Fecha de Aprobación: 13/07/2012
Fecha de Caducidad: 13/07/2013
FIRMA

24-HOUR RECALL FORM

PARTICIPATING CHILD'S CODE: _____PARTICIPATING MOTHER'S CODE: _____

Mealtime		Name of food or preparation	Ingredients (specify characteristics)		OFFICE	Measurements obtained at the household					Conversion to grams	NET GRAMS	
			Ingredient	Characteristic	Food or Preparation Code	Served	Not eaten	Eaten	Weight 1=Gross 2= Net	Ingested form 1 = Raw 2 = Cooked		Served	Eaten

Mealtime: Breast milk: **00;** Main meals: **10** morning (breakfast), **20** noon (lunch) **30** evening (dinner);
Snacks: **01, 02, 03…** morning (before breakfast); **11, 12, 13…**: morning (after breakfast); **21, 22, 23…**: afternoon **31, 32, 33…**:evening

Preparation:				Total weight of cooked ingredients:					Preparation				Total weight of cooked ingredients:				
Ingredients	Amount used:	Weight 1 = Gross 2 = Net	Form used 1 = Raw 2 = Cooked	Conversion to cooked	Grams cooked				Ingredients	Amount used	Weight 1 = Gross 2 = Net	Form used 1 = Raw 2 = Cooked	Conversion to cooked	Grams cooked			

Appendix 36. Instructions for 24-Hour Dietary Recall (Spanish)

INSTRUCTIVO DEL FORMULARIO DE CONSUMO DE ALIMENTOS RECORDATORIO DE 24 HORAS[55]

1. INTRODUCCION

Para la planificación de programas nutricionales s requiere de un buen conocimiento de los problemas que afectan una población en donde se quiere intervenir. Los problemas nutricionales pueden aparecer a nivel del hogar, tal es el caso de la falta de recursos para adquirir alimentos o bien una baja o sobre ingesta de nutrientes a nivel individual. La utilidad de las encuestas alimentarias para la obtención de este conocimiento, es muy amplia y valiosa.

Existen diversos métodos para realizar estudios sobre consumo de alimentos, ya sea de individuos, familias o grupos. El presente estudio utilizara como referencia la "GUIA METODOLOGIA PARA REALIZAR ENCUESTAS FAMILIARES DE CONSUMO DE ALIMENTOS," preparada por la Licda.M.T, Menchu.

Uno de los métodos utilizados para determinar el consumo familiar e individual es el Recordatorio de 24 horas. Este método consiste en registrar, mediante una entrevista, todos los alimentos consumidos por los miembros del hogar o por el individuo en estudio, el día inmediato anterior. Este método comparado con otros más complejos, ofrece una alternativa para obtener buena información con relativa facilidad de aplicación.

Este método requiere que los entrevistadores estén familiarizados con los tipos de preparaciones que acostumbra consumir la población en estudio y que puedan juzgar apropiadamente la veracidad de las cantidades indicadas, a fin de obtener información de buena calidad. También requiere mucha habilidad por parte del encuestador(a) para que pueda facilitar la memoria de la persona entrevistada y evitar sesgos y omisiones.

Cada encuesta dietética tiene sus propios propósitos y énfasis, por lo tanto, tendrá un formato distinto. En este estudio el énfasis está en la dieta de familias y niños(as) de 6 a 23 meses de edad. Esta información nos ayudara evaluar la calidad de las dietas de las personas entrevistadas, así como a determinarla adecuación de la energía, macro y micronutrientes del grupo de niños y niñas de 6 a 23 meses de edad así como mujeres embarazadas y lactantes.

Se considera ideal realizar entrevistasen tres días no consecutivos para determinar la ingesta "Usual" de energía y nutrientes pero debido a los costos y los recursos disponibles, pueden realizarse dos entrevistas en días no consecutivos para recolectar la información delas familias y registrar el consumo individual de por lo menos un niño de 6 a 23 meses de edad en el momento del estudio.

A continuación se presenta un listado del equipo y materiales que las encuestadoras deben llevar a todas las entrevistas.

- Formularios
- Lápiz
- Sacapuntas
- Borrador
- -Bolso
- -Calculadora de bolsillo
- -Taza medidora
- -Juego de 4 cucharas
- -Tabla con prensa
- -Servilletas de papel
- -Balanza dietética

[55] Méndez, H. *Instructivo del formulario de consumo de alimentos. Recordatorio de 24 horas, INCAP, 2012 (documento interno).*

LLENADO DEL FORMULARIO

Técnica de la entrevista

En una encuesta de consumo de alimentos, la utilización correcta de la técnica de entrevista ayudara a disminuir las barreras que existen, ya que la alimentación es un aspecto íntimo de la familia el cual denota su nivel social, económico y cultural. Una entrevista sobre consumo de alimentos se debe realizar en el hogar y mejor si es dentro dela cocina. **No realice la entrevista en presencia de personas ajenas a la familia,** tales como los vecinos o visitas. Si la persona entrevistada tiene que interrumpir un momento la conversación para atender su hogar, deje que lo haga. Hable con soltura, utilizando un lenguaje claro y adecuado al nivel del entrevistado(a). Sea amable, adoptando una actitud de solicitud y no de imposición. Utilice un tono de voz moderado, sea natural. Es esencial que todos los(as) encuestado(as) actúen según las instrucciones, lo cual asegura que la información se recolecte en una forma estandarizada. Sea observador(a) y anote cualquier observación que influya en el desarrollo de la entrevista y la recolección de datos.

Cuando llegue al hogar, pregunte por la persona que prepara la comida al infante, con ella haga la entrevista siempre. Si está el jefe(a) de la familia, salude, preséntese y explique el objetivo de la visita de igual forma si llega el jefe(a) de la familia durante la entrevista. Un ejemplo de presentación es el siguiente:

> "Buenos días, mi nombre es ___ _____ del Instituto de Nutrición de Centro América y Panamá están realizado un estudio en esta comunidad y vengo a visitarla para conversar sobre los alimentos que usted prepara para su familia y los niños y niñas. Si me permite le voy a hacer algunas preguntas sobre lo que ustedes comieron el día de ayer: desde que se levantaron hasta que se fueron a dormir.

No influya en las respuestas al formular las preguntas. Estas deben ser neutras. Por ejemplo: ¿Cómo preparo su café? **O** ¿Qué puso en el café? NO DIGA ¿Cuánto le puso de azúcar al café? O ¿Cuánto uso de aceite para el huevo frito? **No influya en las respuestas con sus actitudes, expresiones faciales y comportamiento.** Por ejemplo, no muestre expresión de malestar cuando tiene que repetir las preguntas por que la persona no comprende, ni tome una actitud de sorpresa cuando uso demasiado azúcar para el café o leche del niño o niña.

Debe tener paciencia. No es necesario preguntar y hablar sin parar. Las pausas permitirán que la persona entrevistada piense y sienta más confianza, al mismo tiempo no se satisfaga con respuestas superficiales. Es responsabilidad del encuestador(a) conseguir toda la información necesaria para llenar el formulario completamente y en forma comprensible un buen encuestador sabe manejar una entrevista, escuchando al informante para obtener la información en forma eficiente. Una entrevista que tarda demasiado tiempo causa molestia al infórmate y es ineficiente para el trabajo del encuestador(a).

Instrucciones para llenar el formulario

Utilice lápiz para hacer las anotaciones, escriba con precisión adecuada para que no se vea borroso, haga letra y números legibles, borre completamente cuando se halla equivocado porque si no lo hace no queda claro lo que escribe después. Para cumplir con estas indicaciones no olvide que debe escribir con lápiz, deje líneas entre recetas para que la información en el formulación no aparezca muy cargada. El manejo limpio y ordenado de todos los formularios es necesario porque en el centro de cómputo deben entender correctamente todo lo que está registrado en los mismos, para su **correcto** procesamiento. Recuerde que las personas que utilizan los formularios después no estuvieron presentes durante la entrevista y todo tiene que

quedar completamente claro, lo que parece obvio en el momento, a veces no es obvio para quien no estuvo presente.

El Supervisor(a) del equipo de campo revisara los formularios en las comunidades, haciendo las correcciones pertinentes en color rojo si es necesario se deberá regresar a la casa para completar alguna información. Si algún error es detectado en el centro de cómputo en el momento de ingreso de los datos, este formulario será entregado al supervisor para que lo corrija y pueda continuarse con la digitación del mismo.

El formulario contiene 13 columnas alguna de ellas tiene un símbolo (▼) en la parte superior para indicar que pueden ser llenadas en la oficina; otras están sombreadas para indicar que estas columnas no serán digitadas.

Localización

Fecha: Anote la fecha exacta de cuando se realiza la entrevista utilizando dos dígitos para el día, mes y año. Ejemplo: Una entrevista realizada el 6 de junio del 2012 se debe registra si/06/06/12/.

Nombre de la Madre entrevistada: Escriba el nombre y apellidos de la madre o cuidadora que suministra la información de la encuesta de consumo de alimentos en el día de la entrevista.

Teléfono: Anote el número de teléfono correspondiente según el formulario.

Nombre del niño o niña: Escriba el nombre y los apellidos del niño o niña según el formulario.

Nombre del encuestador: Escriba su nombre y dos apellidos

Código: Anote el código de identificación que le fue dado previamente.

Identificación

Hoja No.____de____

Indique el número de hoja del total de hojas de la entrevista.

Ejemplo: si en una entrevista utiliza 5 hojas en la primera anote hoja No.1 de 5 en la segunda anote, hoja No. 2 de 5 y así sucesivamente hasta llegar hasta la última hoja No. 5 de 5.

Todas las hojas de una entrevista deben estar completamente llenas como se indicó anteriormente. Recuerde que existe la posibilidad que una hoja se desprende del resto y si no tiene toda la información, será imposible ubicarla en un lugar adecuada ocasionando perdida de información.

Luego inicie la entrevista preguntando por lo consumido durante el desayuno y anote en el formulario de acuerdo al siguiente orden:

1. Nombre del alimento de la preparación: Anote en esta columna Desayuno y empiece a listar todas las preparaciones y alimentos que comieron durante el desayuno. Luego regrese a la primera preparación y pregunte en orden y anote en el numeral de la columna de la siguiente forma :
2. Tiempo de comida: Anotar paralelamente a la entrevista
3. Alimentos usados en la preparación (nombre, tipo, color, tamaño, marca)
4. Cantidad usada
5. Código dela unidad de medida. En el caso que registre información de diferentes medidas o tamaños de alimentos

6. Número total de porciones
7. Porciones no consumidas
8. Cantidad servida
9. Sobras

Nota: Este no es el orden que llevan las columnas en el formulario sino la forma de conducir la entrevista para que le facilite anotar la información en el formulario.

Ejemplo de entrevista:

1. Señora, ¿que comieron para el desayuno? anotar en la columna 1 (nombre de la preparación) las preparaciones y/o alimentos solos que comieron para ese tiempo de comida.
2. ¿Cómo preparo los huevos? (anote los ingredientes en la columna 5: nombre, tipo).
3. Cuanto de cada ingrediente: ¿cuantos huevos?, ¿De qué tamaño? (continúe escribiendo la cantidad usada, el tamaño del alimento o la medida usada en la columna 6.
4. De esta preparación o alimento (ej. huevos) comió el niño o niña seleccionado. Si la respuesta es afirmativa, continuar preguntado:
5. ¿Cuantas porciones le salieron de esta preparación?
6. ¿Cuánto comió el niño o niña? Sobre la base del total de las porciones preparadas: ¿Cuánto le sirvió al niño o niña?
7. ¿Cuánto sobro? (se refiere a lo que sobro de la preparación o alimento de la "dieta familiar" y también lo que dejo o sobro delo que comió el niño o niña).
8. Que hizo lo que sobro? (se refiere a lo que sobro en la familia y lo que dejo el niño o niña). Esta pregunta no aparece en el formulario pero siempre que hay sobrantes debe hacerse y anotarse en observaciones.

Siempre pregunte por las pachas que consume el niño o niña seleccionando. Si la respuesta es afirmativa, anote que si consume en el espacio de "observaciones" para no olvidar preguntar durante la entrevista a qué horas le da pacha, refacción de la mañana, almuerzo, entre otros. Si alguna refacción se da en la madrugada, anótela como parte del desayuno, y si le da durante la noche, anótela como parte de la cena.

Después de obtener la información a través de la entrevista, deberá llenar en la oficina las siguientes columnas en este orden:

1. Número de unidades (columna 7).
2. Código de la unidad de medida (columna 8).
3. Peso de la medida en gramos ml (columna 9): cuando se utiliza el listado de pesos.
4. Código de los alimentos (columna 3).
5. Tiempo de comida (columna 2).

A continuación se indica la forma de llenar cada una de las columnas:

Columna 1: Nombre del alimento o de la preparación

Alimento solo: Un alimento puede codificarse como alimento solo en el caso de piña, papaya, pan o también cuando se ha obtenido previamente la receta y se determina la composición nutricional de esta.

Para nuestro caso, se contara como alimentos solos las siguientes preparaciones dado que se cuenta con recetas promedio:

- Frijol cocido.

La pregunta que le hará a la entrevistada puede ser: "Sra., cuénteme ¿Qué preparo o que comieron el día de ayer en el desayuno?

Primero escriba en esta columna el tiempo de comida al que corresponden las preparaciones o alimentos, Por ej. Desayuno, luego anote el nombre de todas las preparaciones o alimentos, dejando en blanco espacios suficientes entre cada preparación para anotar luego en la columna 5 todos los ingredientes usados en la preparación, Trate de obtener los nombres completos de las preparaciones.

Apunte todo lo que prepararon y comieron para el desayuno DEJANDO SUFICIENTESESPACIO, NO SE PREOCUPEPOR DEJAR LINEAS EN BLNACO, la revisión del formulario y el ingreso de datos va a hacer mucho más fácil si deja espacios entre preparaciones y alimentos.

Columna 2: Tiempo (tiempo de comida)

Esta columna se refiere al tiempo de comida que corresponden los alimentos y preparaciones de la **columna 1**. Las comidas consumidas antes del desayuno se toma como parte del desayuno, por ejemplo las pachas que se dan en la madrugada. Las comidas consumidas después de la cena se toman como parte de la cena. El tiempo será definido según lo considera la entrevistada, sin tomar en cuenta la hora.

1. Desayuno.
2. Refacción de la mañana.
3. Almuerzo.
4. Refacción de la tarde.
5. Cena o comida.

Esta columna puede ser llenada simultáneamente o después de la entrevista, por lo que es importante escribir el tiempo de la comida en la columna 1. Se usara 1 digito o sea, un numero entero (X) en esta columna.

No debe quedar preparación o alimento sin código de tiempo de comida.

Columna 3: Código

Aquí se anotara los códigos de los alimentos que corresponden a cada ingrediente que esta anotado en la columna 5. El código de cada alimento siempre estará expresado con 5digitosque corresponden a la tabla de Composición de Alimentos de Centroamérica. Esta columna será llenada en la oficina. Tenga especial cuidado si el alimento esta en crudo o en cocido, con cascara o sin cascara.

Columna 4: En el formulario, esta columna tiene impresos los números del 1-18, esto indica el número de líneas en la hoja. No escriba nada en esta columna, esto sirve para facilitar el ingreso de datos en el Centro de Cómputo.

Columna 5: Nombre del alimento

Durante la entrevista se preguntara ¿Qué alimentos uso para la preparación? Y escriba en esta columna todos los ingredientes o alimentos que se utilizaron en cada preparación. Observe que en esta columna también se anotan las características de cada ingrediente o alimento como por ejemplo: clase, variedad, tipo, color, tamaño, marca, crudo, cocido, con cascara o sin cascara. Anotarlas características de todos los ingredientes es importante porque es lo que permite su posterior codificación, si no lo hace se convierte en un serio problema cuando se codifique los alimentos.

Los siguientes son ejemplos del tipo de información necesaria para poder codificar un alimento:

- Leches: liquida o en polvo.

  Integra, descremada, deslactosada, condensada o evaporada, marca.
- Quesos: Blanco fresco o duro, amarillo, cuajada, crema mozarela, de capas y otros tipos.
- Carnes: Res, cerdo, pollo, pescado u otro animal.

  Con o sin hueso, con o sin piel, con o sin grasa.
- Frijoles: Indicar el color y variedad.

  Preparación: cocidos, arreglados o molidos.
- Verduras y frutas: Madura, verde, con o sin cascara, tamaño, color y variedad en caso que sea necesario.
- Arroz: Arroz corriente o precocido.
- Panes: Dulce, francés, precio o el tamaño.
- Galletas: Dulce o salada, con o sin relleno, tamaño del paquete, marca.
- Grasas: Manteca vegetal o de cerdo, tipo de aceite, mantequilla
- Bebidas: Diferenciar entre refresco embotellado tipo cola y otros, si son o no light
- Alimentos enlatados: Escribir el nombre completo del producto, tamaño y marca.

Cuando pregunte por ingredientes de una preparación frita no olvide registrar manteca, aceite u otra grasa, también cuando se trate de preparaciones dulces no olvide registrar azúcar, tapa de dulce o miel; en preparaciones saladas preguntar por la sal. Si estos ingredientes no han sido usados debe indicarlo en observaciones.

Los condimentos secos y frescos que se utilicen en pequeñas cantidades no se deben registrar.

Recuerde que en el caso de frijoles cocidos, arreglados o molidos, arroz frito, gallo pinto no necesitan conocer los ingredientes y cantidades, puesto que se consideran como alimento solo, interesa Sololá cantidad que se sirvieron y consumieron.

Columna 6: Cantidad unidades caseras

Esta columna se refiere a las cantidades utilizadas de cada alimento para hacer la preparación, expresadas en medidas caseras, unidades de compra, entre otros. Cuando se pregunte este dato, ya se tendrá anotados todos los ingredientes y se preguntara: Sra. ¿Cuánto uso de _____ (mencione cada uno de los ingredientes)?. La cantidad se anota en la línea de cada ingrediente, en las medidas que indica la entrevistada que puede ser: 2Cucharadas rasas o copetonas, 3 tazas, 2 unidades (pequeña mediana, grande). En el caso de cuchara, cucharita y cucharon verifique la unidad de medida con los modelos.

En esta columna, debe aparecer suficiente información que ayude a llenar las columnas 7, 8 y 9. Para el registro de la unidad de medida es necesario que utilice las abreviaturas que aparecen en el Cuadro 1 con el fin de estandarizar la forma de anotación.

CUADRO 1. Abreviaturas de unidad de medidas

Unidad de medida	Abreviatura	Unidad de medida	Abreviatura
Onza	OZ	Medida	Med
Kilogramo	Kg	Porción	P
Gramo	Gr	Rollo	Rol
Litro	Lt	Pieza	Pza
Botella	Bot	Frasco	Fco
Cucharada grande	Cda g	Bolsa	B
Cucharada Sopera	Cda	Sobre	S
Cucharita	Cdta	Lata	L
Taza	T	Barra	Bar
Vaso	V	Paquete	Paq
Unidad	U	Pedazo	Pzo
Unidad pequeña	U p	Poco	Poco
Unidad mediana	Um	Rodaja	Rod
Unidad grande	Ug	Chorrito	Chto
		Madura	mad

Consumo familiar

Columna 7: Número de unidades

En esta columna trasladara la información que anoto en la columna 6, usando solamente números: dos enteros y dos decimales (XX.XX), sin anotar las unidades de medida. Recuerde que estos datos son los que se digitaran en el centro de cómputo.

Por ejemplo "Si la señora estima que uso 2 cdas. De cierto tamaño según el modelo, se anota el número 02.00 para indicar que fueron 2 veces la cantidad de la cuchara.

Esta columna será llenada en la oficina.

Columna 8: Código de la medida

La información registrada en la columna 6 que se refiere a la unidad de medida, se codificara utilizando códigos específicos, con 2 números enteros (XX). Algunas veces esta columna se llena simultáneamente con la Columna 6.

Para estimar el tamaño de las tortillas hechas en casa, averiguar el tamaño para el adulto y el niño preescolar, si fueron del mismo tamaño pesar al menos 3 unidades y obtener el peso promedio. En caso de que no sean del mismo tamaño obtenga un peso promedio de cada una.

Los códigos a utilizar en esta columna son los siguientes:

01: Unidad
02: Onza fluida.
03: Chorrito.
04: Unidad pequeña.
05: Unidad mediana.
06: Unidad grande
07: cucharadita rasa.

08: Cucharadita copetona.
09: Cucharada rasa.
10: Cucharada copetona.
11: Cucharoncito raso.
12: Cucharoncito copetón.
13: Cucharon raso.
14: Cucharon copetón.
15: Bolsa
16: Libra.
17: Rama.
18: Manojo.
19: Botella.
20: Sobre.
21: Puñito.

Columna 9: Peso de la medida en gr o ml

En esta columna se registra el peso de los alimentos con 4 números enteros. Estos pesos deben escribirse únicamente cuando en la columna 8 aparecen los códigos 1 0 3. Si usa los códigos 2,4 al 19, la columna 9 deben quedar en blanco.

Columna 10: No. total de porciones

Antes de determinar el número total de porciones se pregunta si el niño o niña comió de esta preparación o sobro. Si el niño o niña no consumió ni sobro nada, deje esta columna en blanco y solo anote en la **columna 11 y 12 un cero (0)**.

Para obtener esta información es necesario saber cuántas porciones salieron y si todas fueron del mismo tamaño.

Por ejemplo: "Sra., de los macarrones ¿Cuántas porciones, platos, tazas o cucharadas le salieron?" "¿Todas las porciones fueron del mismo tamaño?". Si todas las porciones fueron del mismo tamaño anote el número indicado.

En el caso de que las porciones no fueron del mismo tamaño, pregunte por ejemplo: ¿Ud. Cuánto comió? ¿Y su esposo? La respuesta puede ser: la señora una porción, su esposo el doble y su hijo una porción de la mitad de la de ella. En este caso, el número total seria 3.5 porciones.

En esta columna se anota el número total de porciones con2 números enteros y 2 decimales (XX.XX). Así en el ejemplo anterior se anotaría 03.50.

Cuando en una preparación el número de porciones es igual para todos los ingredientes, trace una flecha desde el segundo ingrediente hasta el último. Esto evitara escribir la misma información para todos los ingredientes.

En caso de preparaciones que sobraron de otro tiempo de comida anote nuevamente toda la información desde la columna 1 hasta la columna 10.

Columna 11: Porciones no consumidas

La pregunta que se formula a la entrevistada es: "Sra., ¿de lo que preparo le sobro o se lo comieron todo?

Se anota en esta columna lo que sobro de la preparación (a nivel de la familia), usando 2 números enteros y 2 decimales (XX.XX). La cantidad que se anota debe tener la misma unidad de medida de las porciones registradas en la **columna 10**, si no sobro anote un cero (0).

Cuando se trate de sobrante de preparaciones elaboradas en otro tiempo de comida se debe anotar lo que se consumió en ese tiempo de comida más lo que volvió a sobrar.

Cuando existen sobrantes, debe anotar en "observaciones" que paso con el sobrante.

Consumo del niño y niña de 0 a 23 meses de edad

Columna 12: Cantidad servida

Aquí se anota la cantidad de porciones consumidas por el escolar. Se anota la información en la misma unidad de medida de la columna 10 y en la misma línea donde se anotó el número de porciones de la familia; use dos números enteros y dos decimales (XX.XX).

Por ejemplo se pregunta: "¿Señora, Carlitos comió macarrones"?. Si la respuesta es NO, escriba cero en la columna y continúe preguntando la siguiente preparación o alimento anotados en la columna 1. Si comió pregunte "¿Cuánto comió?". El tamaño de la porción servida debe tener relación con el tamaño de la porción anotada en la columna 10.

Por ejemplo pregunte: "¿Del tamaño de la porción que se sirvió Ud. Cuando le sirvió al niño o niña?".

Pregunte si la entrevistada le sirvió a toda la familia con la misma unidad o con el mismo modelo, si se trata de preparaciones y al niño o niña le sirvieron diferente unidad de medida sebe preguntar "De una porción de la familia ¿Cuántas salen del niño o niña?. Cuando se trate de alimentos y la medida del niño o niña es diferente al resto de la familia, abra otra línea para anotar el mismo alimento con el código de la medida correspondiente. Por ejemplo: la mama le sirvió frijoles a los adultos 3 cucharas de servir de teflón rasas (No. 16), pero al niño le sirvió dos cucharas soperas copetonas (No. 13), entonces anote en dos líneas diferentes esta información.

Columna 13: Sobras

Se pregunta: "¿De la cantidad que le sirvió al niño o niña, se lo comió todo o dejo algo?". Se anota la cantidad de comida que sobro, usando 2 números enteros y 2 decimales (XX.XX), se anota cero cuando la cantidad servid se consumió toda. En el caso que no hubo consumo, esta columna queda en blanco. Si sobro anote en observaciones el uso que se le dio al sobrante.

Se puede presentar diferentes casos en donde sobran alimentos:

1. El niño y/o niña no consumió todo y lo botaron o lo dieron a los animales. En este caso se anota la cantidad en la columna de cantidad servida y se escribe lo que sobro, sin hacer cambios en lo que se escribió en ninguna de las columnas.
2. El niño y/o niña no consumió todo, y otra persona se lo comió. Se resta la cantidad que no comió el niño y/o niña a la porción servida, y se escribe en la **columna 12** lo que en realidad se comió. En la columna de sobras se anota un cero. No debe hacer ningún otro cambio. Por ejemplo, si la madre

comió la mitad de la tortilla de su hijo, en la columna de cantidad servida al niño pondrá 00.50 y en la columna de sobras del niño y/o niña escribirá un 0.

3. El niño y/o niña seleccionado no consumió todo y lo dejaron para comer en otro tiempo de comida. Se resta de la cantidad servida al niño y/o niña lo que él no comió y en la columna de "sobras" anote un cero y escriba el sobrante en las raciones no consumidas de la familia (columna 11).

Observaciones

Anote cualquier información que estima de importancia para el supervisor equipo de campo o para aclarar algún aspecto de la encuesta.

3. COMO ANOTAR CASOS ESPECIALES EN LOS FORMULARIOS

Preparaciones en las que no se puede dividir en un número igual de porciones todos los ingredientes

Existen preparaciones que llevan varios ingredientes que se dividen o se cortan en diferentes tamaños o porciones, como son los caldos. En algunos casos el niño o niña no come alguno de estos ingredientes, por lo general verduras o carnes, o también el tamaño de las porciones en las que se dividieron el caldo. En estos casos todos estos ingredientes deben anotarse COMO **ALIMENTOS INDIVIDUALES.** Para cada alimento se anotara el **NUMERO TOTAL DE PORCIONES Y PORCIONES NO CONSUMIDAS** de la familia.

De igual forma, se procede con la cantidad servida y las sobras del niño o niña. Si este no come de un ingrediente, anote un cero en la columna de cantidad servida en la línea que corresponde al ingrediente no consumida.

Cuando en un picadillo o caldo, se corta los ingredientes en trozos muy pequeños de manera que no se puede contar, en este caso la porción de líquido será la misma de los demás ingredientes y puede considerarlo como preparación.

Frijoles cocidos

En el caso de estas preparaciones, solamente se preguntara por lo consumido y no por lo preparado. Solamente si es una preparación especial que lleve otros ingredientes como carne, chorizos, costilla, pollo o verduras se debe preguntar la receta. Tenga mucho cuidado al utilizar el código de arroz y frijol crudo o cocido según sea el caso.

Únicamente buscara el peso de la medida que exprese la madre.

Volumen de líquidos o bebidas

Se debe medir el volumen de líquido cuando:

1. En la dieta familiar hubo sobrante o hubo consumo del niño o niña y la persona entrevistada no puede estimar el número total de porciones.
2. La persona entrevistada no puede estimar en mililitros la cantidad servida al niño y o niña.

4. REVISION DE LOS FORMULAROPS EN EL CAMPO

Los formularios serán revisados en el campo con el propósito de verificar que se tomó toda la información necesaria y que no hay dudas sobre cantidades de alimentos. Las correcciones realizadas por el supervisor(a) del equipo de campo se deben realizar con lapicero rojo.

Para la revisión se deben considerar los siguientes aspectos:

Formulario de consumo de alimentos

- Verifique que en todas las hojas, los datos de identificación sea la misma y que las hojas estén numeradas y completas, para todas las hojas que se utilicen.
- Revise que los alimentos anotados en la columna 5 tengan los nombres completos y que concuerden con el nombre de la preparación indicada, ejemplo: carne sin o con hueso, frutas maduras o verdes, color del chile dulce, tipo de grasa utilizada en preparaciones fritas, azúcar para preparaciones dulces, ingredientes par salar, otros.
- Revise que en la columna 6 aparezca las cantidades con su respectiva unidad de medida. De acuerdo al tamaño de la familia revise si las cantidades anotadas son lógicas.
- Verifique si sobro alguna preparación y cuál fue su destino.
- En el consumo del niño o niña verifique que las porciones expresadas tengan la misma unidad que la medida del consumo familiar.
- Especialmente en el caso del niño o niña revise con mucha atención el consumo de todo el día para asegurarse si no se omitió algún tiempo de comida. Si comió muy poco o si el consumo parece demasiado alto.

5. REVISION DE LOS FORMULARIOS EN LA OFICINA, ANTES DE SER DIGITADOS

En esta etapa se verifica que todos los datos y las codificaciones se encuentren correctos. Esta es la etapa previa a la digitación, por lo tanto, la revisión debe ser muy cuidadosa para evitar mayores correcciones y ajustes durante la limpieza final. Las correcciones se deben realizar con lapicero azul.

Formulario de consumo de alimentos

Encabezado

Verificar que en el encabezado de cada hoja:

- Códigos de identificación.
- Numero de hoja.
- Fecha de recolección de datos.

Preparación

Revisar que todas las preparaciones y alimentos tengan código para tiempo de comida.

Alimentos usados

- Revisar que los alimentos registrados en la columna 5 tengan código correcto anotado en la columna 3.
- Revisar que las preparaciones fritas tengan registrada la grasa.

- Revisar que las preparaciones dulces tengan registrado el ingrediente para endulzar.
- Revisar que las preparaciones saladas tengan registradas el ingrediente utilizado para salar.

Consumo familiar

Analizar en función del número de personas en el hogar las cantidades de alimentos. Revisar que la columna 7 tenga anotada la información para todos los alimentos.

Consumo del niño y/o niña

Revisar que exista proporción entre las cantidades reportadas en las columnas 12 y 10.

Appendix 37. Market Prices Survey Form

Instituto de Nutrición de Centro América y Panamá, FANTA III/FHI360
Information Gathering Activity (OPTIFOOD)
August 2012

Market Prices Survey Form			
Sale Place (Market name)			
Location, municipality			
Surveyor´s name		ID code	
Reviewed by Supervisor		ID code	
Survey´s date dd/mm/yyyy			

Food item code	Food name	Measure Unit for sale	Weight (g)				PRICE					
			1	2	3	Average	1	2	3	4	5	Average