ENHANCING THE NUTRITIONAL QUALITY OF RELIEF DIETS
OVERVIEW OF KNOWLEDGE AND EXPERIENCE

Background Paper Prepared for the Workshop by the Congressional Hunger Center, April 1999

by Steven Hansch, Congressional Hunger Center

CONTENTS

INTRODUCTION

This paper was prepared for participants of the April 28-30, 1999, Workshop on Enhancing the Nutritional Quality of Relief Diets, hosted by the American Red Cross, and organized by Food Aid Management, the Micronutrient Initiative of Canada, US Agency for International Development Ferris-Morris Associates, and the Congressional Hunger Center, with support from SUSTAIN, and the FANta Project. It was written to provide participants with basic background information on the questions that will be addressed. In addition to describing field experience, technical factors and program options it also reviews some of the historical backdrop of inquiry and debate on approaches to improving nutrition in emergencies.

The nutritional status of emergency-affected populations has always been of paramount concern to agencies involved in refugee, natural disaster and famine relief. While evident for many decades, it is now scientifically understood that nutriture closely correlates with mortality and disability that accrue in crises.[1] Only in recent years, however, have aid agencies appreciated the full impact of deficiencies of essential micronutrients—vitamins and minerals—in humanitarian emergencies.[2] Moreover, relief agencies now recognize that low-nutrient food aid itself can be part of the etiology of deficiencies such as scurvy, beri-beri and xerophthalmia.[3]

The workshop builds on the achievements of past meetings, each of which also included a mix of non-governmental organizations, donors and technical experts. It specifically addresses the growing realization that more can be done to address inadequate provision of micronutrients in large relief programs. At conferences in Boston (1985), Washington DC (1988),[4] Oxford (1991),[5] Rome (1992), [6] Machakos Kenya (1995),[7] Dublin (1997), and Amsterdam (1997)[8] field evidence has drawn new attention to the severe inadequacies of vitamins and minerals in many relief diets. An August 1997 Montreal workshop on fortification in developing countries also inspired new thinking by NGOs.[9]

During the same period, strong new evidence was accumulating about the importance of micronutrients in short-term human health, risk of death, and in long-term human function.[10] As just one example, whereas fifteen years ago vitamin A deficiency was of concern primarily because of the few cases of blindness that resulted, today it is understood as being far more important in affecting immune response to infectious disease and is a leading factor influencing child mortality. In just the last few years, a wide array of initiatives have been undertaken to look into how micronutrients can be delivered in diverse settings via food rations and concentrated nutrients, including remote refugee camps and conflict zones. These new approaches build on and adapt proven technologies to the resource-poor environments where relief agencies work. For many countries, the introduction of micronutrient programs as part of emergency programs could prove to be a key means by which to initiate long-term fortification practice on a national scale.

There are large potential benefits to sharing this knowledge not only to other nutritionists and food programmers, but also to donors, the public and to the refugees themselves. This paper will focus on these micronutrient issues. The perpetual and larger problem of energy deficiency in emergencies warrants a separate paper and forum and will not be addressed here.

I. MALNUTRITION PATTERNS IN EMERGENCIES

Today, there is an estimated 80-100 million persons displaced, as refugees or IDPs, or otherwise affected by conflict or post-crisis reconstruction.

The risk of vitamin and mineral deficiencies is now known to be very high in humanitarian emergencies: not only does the total food available decrease so does, also, the variety of foods, and therefore the nutritional balance of the diet.[11] In war-torn countries where retail food chains are disrupted and populations are displaced from areas of production, fresh foods become unavailable. In most emergencies the micronutrient content of the diet is restricted even more than is the caloric intake.[12] More often than not, emergency-affected populations already had deficient diets prior to the onset of crisis; the intervention of relief agencies may merely 'discover' deficiencies that had long existed without outside notice.

Progress in applying food aid to prevent protein-energy malnutrition in emergencies has not translated to equal success in reducing micronutrient deficiency Even when relief foods are adequate in total calorie and protein composition, they tend to be limited in micronutrient content. The way aid is provided—just a few types of relief goods are delivered — reinforces the problem of poor dietary diversity. In marked contrast to macronutrient nutrition — calories and protein, which improve over time[13] as emergency-affected populations receive relief aid, [14] micronutrient problems frequently appear to remain prevalent, or even worsen as relief is provided. In some cases, dependence on bulk relief foods may even cripple tendencies for populations to diversify their diets by reducing the incentive or rationale for establishing local cultivation and household gardens. This effect becomes more important over time, as refugees stay in camps for many years, as in Pakistan, Thailand, Malawi. Refugees and emergency-affected populations are also very prone to inadequate sanitation and thereby suffer intestinal infections that lead to malabsorption: reduced digestion and absorption of micronutrients further heightens deficiencies.

In the 1980s, the importance of identifying and reporting nutritional deficiency diseases in emergencies was incorporated into systems of surveillance.[15] However, evidence of micronutrient deficiency diseases do not regularly get put into clinical records and there is little ability to conduct active case-finding amid the chaos of relief operations. As a result, most overt deficiency diseases that occur in emergencies are not reported or documented. Two of the most well-known deficiencies, vitamin A deficiency and iron-deficiency anemia, are exceptions; sometimes sample surveys are conducted for vitamin A deficiency prevalence, and iron-deficiency anemia is so widely reported in inpatient and outpatient clinic records that a good picture of the scope of these deficiencies is probably captured.

The largest impact of the micronutrient problem in emergencies is hidden — referred to as sub-clinical — and not dealt with adequately by medical referral systems, even where they do exist. Based on research from the last fifteen years, most nutritionists now recognize the severe and pervasive effects of the high numbers of moderate cases of deficiency diseases that do not manifest clinical signs.

Many micronutrient deficiencies also go un-addressed because they occur in emergencies that do not receive adequate international intervention. In many emergencies, there are no convenient refugee camps or distribution centers in large towns; instead, large numbers of the affected population can not be reached at all by aid agencies, and when they are accessible can only be reached through food drop-offs at the village level—no further contacts are possible, including case-detection, treatment, supplementary feeding, or education. Except for the most high-visibility crises that get media attention, more emergencies fit this category, and receive minimal attention: including internally displaced persons (IDPs) inside Burma, and in low-intensity conflict areas in northern Sierra Leone, northern Liberia, Eastern Colombia, northern Peru, eastern and southeast Angola to name just a few.

The General Pattern of Deficiency Diseases

Micronutrient Deficiency diseases are so high in prevalence that they overlap among much of the population. Throughout the emergency-prone Horn of Africa, it is estimated that 25 percent of the population is deficient in vitamin A; 33 percent suffer iodine deficiency disorders and 50 percent are iron deficient.

Vitamin A deficiency is almost as prevalent as anemia and is a particular hazard for emergency-affected populations who rely for years on food aid which is typically poor in vitamin A content. Vitamin A is available mostly from meats and green leafy vegetables. Because vitamin A deficiency promotes not only more infections but also increases the fatality rate from infections, it is underpins a great proportion of the deaths that occur in emergencies.

In refugee camps worldwide, **iron deficiency anemia** is ubiquitous; it is almost universally reported as one of the top medical complaints recorded in refugee outpatient and inpatient clinics from Thailand to the Sudan to Honduras. In addition to harming adult work output, growth potential of children, low hemoglobin levels predispose millions of refugee women to heightened risk of maternal mortality.

Niacin deficiency, resulting in **pellagra**, is likely to occur in the ever-growing populations reliant on maize consumption (ie. much of sub-Saharan Africa, and most of the population in eastern and southern Africa). Niacin deficiency is therefore localized to those areas where maize consumption is dominant. Because the niacin in maize is biologically unavailable, populations consuming maize are particularly vulnerable to pellagra. Mozambican refugees living in Malawi in the late 1980s experienced a large pellagra epidemic that has subsequently dramatized the importance of paying attention to the niacin content of diets. Niacin-deficiency pellagra is not only associated with emergencies, but is also pervasive today in maize-reliant countries from Tanzania to Mozambique.

Beri-beri is a thiamin (vitamin B1) deficiency seen in various refugee communities that consume primarily polished rice, without other sources of B vitamins. Because it is associated with rice-based diets, this deficiency is seen primarily in emergencies that have occurred in southeast Asia, in particular, Vietnamese refugees in camps in Thailand and Malaysia.

Even more localized than niacin and B1 deficiencies is vitamin C deficiency, which results in **scurvy**. Almost all the outbreaks of scurvy have occurred among Ethiopian and Somalis emergency victims, principally those who have been cut off from camel milk markets for months. Though striking, as an indicator of poor dietary variety, scurvy itself is not felt to be a pervasive risk nor a major life-threatening risk the way vitamin A deficiency can be.

Though not particular to emergencies, **iodine deficiencies** are particular to the poorest and more remote populations in the world. In any case, it has been important for aid agencies, like WFP and UNHCR to promote adherence to strict standards of salt iodization in countries where they work: that is, only purchasing iodized salt for ration distributions. This can reinforce national efforts to encourage small-scale salt sellers to iodize salt as per regulations.

Less frequently seen, but also with severe consequences are deficiencies of the B vitamins and vitamin C. These are all water-soluble, meaning that they are needed in the diet every day. Deficiencies of vitamins D and K occur often enough to warrant attention in emergencies.

Table 1: Indicative framework for comparing the major deficiency diseases in emergencies

Type of Defiency	Prevalence in Refugee and Refugee-like Settings	Ease of Detection	Case-related Disability	Net Disability
Vitamin A Def.	High	Good	High	High
Iron	High	Good	High	High
B1, B2, Niacin	Clumpy	Good, but often missed on subclinical level	Moderately high	Moderately high
Vitamin C	Limited	Clinical - good, Subclinical - not easy	moderate	Low-to-moderate
Iodine	Clumpy, rarely caused by crisis itself	Fairly easy	high	Low
Zinc	unclear	Hard	moderate	Unclear (low)

Vitamin A Deficiency

Vitamin A deficiency is common wherever dietary diversity is limited, and grows worse over time, as displacement or conflict becomes prolonged. Vitamin A deficiency (VAD) appears early in many emergencies, as upper respiratory infections, diarrhea, and multiple other morbidities strain the body's immune response. High rates of corneal scarring have been recorded among Ethiopian refugees. Overt ocular signs of vitamin A deficiency — Bitot's spots for example are indicative of xeropthalmia — were reported in 3% (Mauritania) to 7% (Somalia) of emergencies where CDC has collected data. The primary cause of vitamin A deficiency is insufficient dietary intake of the vitamin, though infection is also a risk factor, particularly measles which will drain the body's vitamin A stores; there are no pervasive anti-nutrients or reasons for malabsorption.[16] The risks of vitamin A deficiency are deceptively great, and sub-clinical deficiency exists almost everywhere in the developing world. Reflecting on the experience in Tanzania, Dr. Festo Kavishe wrote "Whenever the problem of vitamin A deficiency was looked for, it was found to be present, even in geographical areas where it was previously thought to not exist."[17]

While vitamin A deficiency—in both clinically-evident and subclinical forms—has one of the greatest impacts on human death and disability,[18] it is also one of the easiest deficiencies to prevent.[19] In recent years it has become routine to give out high-dosage vitamin A capsules early and regularly in emergency response. While women of child-bearing age are not to receive the high-dose capsules (because of risk of teratogenic effects) it is valuable to supplement adult women with doses of 10,000 to 25,000 IU weekly of vitamin A.[20] Meta-analyses of multi-country data indicate that in regions of poor nutrition one in four child deaths will be prevented by vitamin A capsule distribution.

Vitamin A's most potent impact in an emergency may be in reducing the case fatality rate of measles and diarrhea,[21] the two largest killers in refugee and famine crises. Indeed, vitamin A is supposed to be distributed as part of emergency relief vaccination. One important case: a measles epidemic swept through the famine zones of Somalia in the fall of 1992, and in just a few months (August to November) killed approximately 50,000 children who, unfortunately, were not immunized and did not receive vitamin A supplementation.[22] In other emergency-prone areas, including parts of Bangladesh and Indonesia, Helen

Keller International maintains a nutritional surveillance system that tracks rainfall, distress sales, and other indices of crisis, and uses this system to guide the emergency distribution of vitamin A capsules (VAC).[23]

B Vitamin Deficiencies

The B vitamins are water soluble: daily intake is necessary. Deficiencies of the water soluble vitamins are sometimes seen in conjunction with one another. Indeed, vitamin B2 (riboflavin) is essential to the functioning of niacin; it is difficult or even inappropriate to discriminate between micronutrients in circumstances where people are clearly consuming poor diets.

Thiamin/vitamin B1 deficiency is called beri-beri which manifests with nerve damage and insanity. It has occurred among emergency victims receiving polished rice, particularly in south and southeast Asia. The thiamin content of the rice shell is lost in the processing of polishing to a refined whiter product. Because food aid can be deficient in this regard, beri-beri has been referred to as an iatrogenic disease. In other words, the micronutrient deficiency was *caused* by the means of assistance. Thiamin deficiency has been recorded in many nations, and was endemic among New World slaves (primarily Brazil) receiving a limited ration of manioc and dried meat. The deficiency has occurred among institutionalized populations and military forces. In particular it has been a problem in southern and eastern Asia countries where populations consume white rice, or rice that has been mechanically de-hulled, milled and polished, in the course of which all the thiamin is lost. Beriberi was also observed more recently among refugees in Guinea and in Nepal.[24] A majority of camps on the Burma/Thai border were just reported this year to have some vitamin B1 deficiency.[25] Among the first micronutrient epidemics documenting the relationship between food aid and B1 deficiency were those in Cambodian refugee camps in the early 1980s where the refugees consumed mostly polished rice and therefore contracted beri-beri.[26] Nearby, one generation earlier in World War II, food rations provided to US and British prisoners of World War II were similarly deficient and vitamin B deficiencies were common.

Pellagra — niacin deficiency, which presents with dermatitis and nervous disorders, is a constant risk among populations consuming maize or sorghum and little else. It is of concern among millions living in southern and eastern Africa and Central America. Pellagra has been epidemic in camps of refugees from Mozambique settled in southern Malawi,[27] consuming mostly white maize, without legumes or meat, and without alkali treatment (lime) typical in Latin America. Niacin deficiency has also been suspected in Togolese in Benin.[28] Pellagra is believed to increase in large populations during severe drought, as does vitamin A deficiency. Pellagra is rarely documented or tracked at the national level, though it is often suspected but only occasionally confirmed.[29] Pellagra is felt by some to be just as prevalent in the communities surrounding the refugee camps in Malawi, not just among the refugees. Pellagra is also considered endemic in Zambia and Zimbabwe.

Folate deficiency is also a recognized problem whereever vegetable consumption is restricted. Folic acid deficiency leads to a macrocytic form of anemia, with all the same consequences as other forms of anemia. Increased requirements are present in women due to demands during pregnancy and lactation. As such, Folic Acid has long been a standard item given to women in pre-natal visits in refugee camps.

Vitamin C Deficiency

Scurvy — vitamin C deficiency, which can be dangerous; it presents with bleeding gums and occurs where populations are displaced for long periods and forced to go for months without fresh fruits or vegetables. Foods with this nutrient are highly perishable, as is the vitamin itself, yet humans require this nutrient daily. Risk of scurvy is high in any population cut off from fresh produce, such as boat people, or populations in closed refugee camps with only dry food aid commodities, such as in Sudan, Ethiopia, Somalia and Kenya.

Deficiency of ascorbic acid, or vitamin C, has been reported from many emergencies and wars, but has been principally seen in recent years in Sudan, Somalia, Ethiopia and Kenya. Where there are no fruits or vegetables, refugee life seems to be particularly prone to the risk of scurvy. Scurvy has been associated with long periods of stay in camps, as in Ethiopian camps in Somalia in the 1980s.[30] Because vitamin C helps the body absorb iron, scurvy and iron deficiency anemia tend to be related, as in Somalia.[31] Some foods given in rations are fortified with vitamin C which, unfortunately, is lost during shipping and cooking.[32] Thus, food aid has not helped prevent or control scurvy.

The main source of vitamin C in refugee camps has been fresh foods bought in local markets. On occasion UNHCR or NGOs purchase local citrus fruits, small tomatoes, or leafy vegetables for refugees. Most of the intake of vitamin C, however, occurs where refugees themselves purchase from local markets. In some sites, such as Uganda and Mexico, refugees have plentiful access to mangoes and papaya nearby.

Iron Deficiency

Iron deficiency is one among several causes of *anemia.* Anemia has multiple causes, but in refugee camps iron-deficiency anemia is ubiquitous. It is so common that specific "outbreaks" are not relevant to report; but outpatient clinic records in refugee camps around the world reflect anemia as one of the top three problems seen, particularly among women. Anemia is debilitating, increases the risk of death in childbirth, saps the work capacity of adults, and impairs the educability of children. It is a serious problem for infants and for women of child-bearing age.[33] Anemia is exacerbated by malaria, schistosomiasis and intestinal parasites to which displaced populations are frequently exposed. Food rations in particular have been inadequate in the provision of adequate, and long-term reliance on rations is a key predictor of anemia among displaced people.

Other Mineral Deficiencies

The monotonous and small diets provided to refugees predispose these populations to numerous other sub-clinical nutrient deficiencies that may be difficult to discriminate from other illnesses.

Zinc deficiency is known to be a problem where populations, particularly growing children, subsist for long periods only on cereals such as wheat.[34] It is increasingly suspected that populations dependent on bulk grains for long periods are prone to zinc (a mineral) deficiency which results in notable stunting and functional disability. However, zinc deficiency is notoriously difficult to measure in an individual, let alone track over time in a population in an emergency.[35] Only in recent years have nutrition scientists concluded that Zinc deficiency is both widely prevalent in the world and severe. A 1997 conference at Johns Hopkins University brought together evidence, for the first time, that zinc deficiencies are common and that zinc supplementation can have a powerful positive impact on morbidity (including acute respiratory infection rates) and mortality. Recent research in Peru demonstrated that take-home supplements of zinc, iron and folate led to a sizeable 20-30% reduction in infant mortality. The zinc additionally improved the neural development of the infants.

Iodine deficiency disorders, manifest most visibly in "goiter" an outgrowth of the thyroid gland in the throat, seen often among refugees from inland/highland areas. Iodine deficiency is exacerbated by situations where populations are cut off from global markets, sea products and fortified foods for long periods. Because it is so simple to prevent, aid agencies have common agreement on the importance of iodizing all salt given in emergencies. However, monitoring the compliance with this principle is widely neglected.

Copper, selenium, and chromium are other minerals required in trace amounts for which deficiencies have been identified. There is evidence of calcium deficiency resulting in inadequate bone growth.

Calcium deficiency—sometimes appearing as osteomalacia in adults or rickets in children—may be a long term problem where populations subsist primarily on cereals and a short term problem among growing children who had previously been accustomed to consuming calcium-rich foods (such as displaced pastoralists). Magnesium depletion is caused by many diseases and disorders, including protein-energy malnutrition, malabsorption, diarrheal disease, kidney diseases, and is exacerbated by generally low food intakes. Persons requiring special, therapeutic feeding—parenteral or tubal feeding for instance—are at particular risk.

Consequences of Deficiency Diseases: Disability and Mortality

Micronutrient deficiencies result in too many biochemical and functional problems to list in this one document. The reason for concern about micronutrient deficiency diseases is not the signs themselves — the pallor, the bleeding gums, the dermatitis, or dozens of other outwards signs that doctors might notice. The larger concern is due to the many underlying enzymatic, catalytic, immunological, tissue-building and, even, cognitive functions for which they are required. The functional effects of these deficiencies manifest in overall health, as well as social capital. Functional outcomes include long-term learning disability (goiter, anemia) and work output (from, for example, anemia).[36] The pervasive effects of micronutrient deficiencies in emergencies are compounded further by the costs to health systems and the losses of time and energy by women and other care-takers.

Malnutrition is intimately linked to one's immunity, resistance to disease, the severity and duration of illness, and the rate of fatalities from illness. Though child survival is often discussed in terms of infectious-diseases, authorities acknowledge that up to 80% of the current burden of illness related to these diseases could be *prevented or lessened* through improved nutriture.[37] And malnutrition introduces other dangers when it forces refugees to spend much of their lives in supplementary or therapeutic feeding centers: by promoting cross-infection of disease between children, by promoting dislocation of the family, and are an expensive drain on the mothers' the time. There is also interaction between the micronutrient intake and macronutrient effects, some direct, some indirect. For example, micronutrients (vitamin A) effect diarrhea, measles and malaria[38] which in turn also have marked effects on anthropometric status.

An enhanced micronutrient content in emergency diets:

- Increases chances for survival, particularly among children who experience high death rates
- Reduces immediate disability, including blindness
- Reduces incidence, prevalence, severity and duration of diseases,
- Improves cognitive function, physical growth
- Improves work output capacity
- Reduces the expenses, burden and distraction of health personnel and facilities

Regardless of which specific deficiencies are looked for or reported, it is apparent that in most emergencies, there will be multiple overlapping micronutrient deficiencies among much of the population. Responding to one nutrient problem at a time is therefore inefficient. Instead, approaches are needed that address the range of micronutrient needs at once.

II. HUMANITARIAN RELIEF STANDARDS FOR NUTRITION

Micronutrients receive a very small fraction of the overall attention to food and nutrition needs in emergencies. The emergency food and nutrition guidelines that do exist, reviewed in the pages that follow, give inadequate attention to micronutrients or to the range of practical options available to prevent deficiencies from arising, practical implementation considerations, resource mobilization, quality assurance or impact monitoring.

Overall, the literature deals mostly with generalized food security and issues around the delivery[39] of and access to bulk food, measured in tonnage, [40] and on numbers of people reached.[41] Emergency manuals provide detailed how-to options about how to achieve equitable ration systems and targeted feeding.[42] In contrast, few guidelines give details about how to address micronutrient deficiencies. Not surprisingly, only a few existing relief systems in the field survey micronutrient consumption or problems.[43]

Treatment Guidelines

Where emergency guidelines speak to micronutrient deficiencies the focus is primarily on case management, relevant to those clinical cases that present to clinics. In 1999, the World Health Organization has published a manual for health workers on the *Management of Severe Malnutrition* which gives an overview of how to treat severe nutritional deficiencies, presumably in an inpatient setting where specialty recovery foods, electrolytes and tube feeding are available.[44] The Medecins Sans Frontieres (MSF) 1995 *Nutrition Guidelines*,[45] briefly explains what micronutrients are, what foods provide them, and mentions the availability of some micronutrient capsules. The rest of the book is dedicated to protocols that relate more toward protein-energy malnutrition and overall child growth. Other guidelines focus more on the physical equipment needed to run a feeding program, where monitoring is geared almost entirely to measuring weight gain as an overall index of nutrition.[46]

Guidelines on Infant Feeding

Among UN, NGO and Red Cross aid agencies there is consensus that even in emergencies, bottle-feeding and infant formulas are to be discouraged by any means possible (through education and demonstration) and to be prohibited as part of the international aid package. The introduction of impure water at an early age greatly increases the infant's risk of death. Whereas, a mother's breastmilk will almost always provide the key calories and other nutrients needed, even in the worst emergencies. The healthiest feeding practice for 0-6 month old infants is to exclusively breastfeed, and then to introduce complementary foods with a cup and spoon while continuing to breastfeed through the second year of life. [47]

SPHERE Guidelines As Part of Humanitarian Charter

The recently published NGO-developed "Minimum Standards in Nutrition" makes the case that micronutrient deficiencies are preventable and "should be tackled by population-wide interventions." Guidance #2, Section #2 states, "There are a range of possible options for prevention of micronutrient deficiencies. These include: increasing the quantity of food in the general ration to allow more food exchanges; improving the nutritional quality of the ration; local purchase of commodities to provide nutrients otherwise missing in the ration; measures to promote local production of foods contributing nutrients estimated to be low; provision of micronutrient rich food stuffs as a supplement to rations; appropriate fortification of staple foods or blended foods; and/or medicinal supplementation."[48]

Prevention Guidelines

Prevention guidelines recognize the importance of inclusion of nutrient-rich foods in the general rations given to emergency-affected populations. There is no consensus however on how to balance different approaches, based on available resources, access to the population, and existing deficiencies.

Until recently, UN guidelines gave most attention to the inclusion of vegetables in diets, "where possible" being implicit. UNICEF's widely available handbook, *Assisting in Emergencies*,[49] for example, suggests that vitamin-A deficiency can be prevented by "Inclusion of dark green leafy vegetables, yellow fruits and vegetables, eggs, small dried fish or palm oil in the daily diets of young children." The same handbook notes that legumes and animal products increase vitamin intake, and that germination of beans and cereal grains can increase the vitamin C content of diets.[50] The World Food Programme's internal policy manual for working in emergencies does not distinguish different nutritional risks or examine options for preventing deficiency diseases. It does recommend that "where people are dependent on food aid rations for long periods… a range of foods should be assured, including some fresh foods wherever possible… some variation in the diet should be provided."

In 1995, at the U.N. nutrition conference in Machakos, Kenya, the dominant recommendation for solving refugee micronutrient problems was to ensure a minimum level of highly-fortified foods in each ration. Thus, 40-60 grams per capita per day of corn -soy-blend, Unimix, or a variant should be delivered in every refugee/emergency situation from the earliest stages on. Nutritious, fortified foods should not just be used on in response to micronutrient deficiencies that have already developed, at the later stages of emergencies. MSF's latest (1998) nutrition guidelines simply recommend that "fortified blended food can be included in the general rations. The recommended daily allowance may be provided by 60 grams of blended food (except for pregnant and lactating women who require additional amounts)," [51] reiterating the recommendations from Machakos. MSF advises, "the best preventive measure is food diversification, alternatives are food fortification and mass supplementation" without giving advice on how to achieve these.

Delivery of food in emergencies is a large task, and considerable advances have occurred in the last ten years in clarifying which organizations will be involved in implementation. Several NGOs now have written memoranda of understanding with WFP to implement final distribution of emergency food in a rapid manner. WFP and UNICEF have been negotiating a memorandum to clarify how they will work together in support of supplementary feeding in emergencies.

In the 1990s, UNHCR and WFP have agreed to a series of Memoranda of Understanding that accord responsibilities between the two agencies. Among other things, UNHCR and WFP agreed to "cooperate in the provision of food assistance, the maintenance of adequate nutritional status and the promotion of eventual socio-economic self-reliance among the identified refugees, returnees and IDP beneficiaries, especially the vulnerable groups." WFP will provide all basic commodities (i.e. cereal, pulses, oil, salt). WFP is responsible for mobilizing the resources necessary for milling of whole grain cereals. In principle, this responsibility extends to technical support—parts and labor—for small-scale hand mills and hammer mills inside refugee camps. UNHCR is responsible for providing "complementary" foods (sugar, vegetables, fish or meat, eggs, spices and condiments, coffee and tea).[52] Also: *"Both agencies will explore the possibilities for the local production and/or stockpiling"* of blended food. However, the provision of blended/fortified foods in the refugee ration does not adequately meet micronutrient requirements.[53]

The most recent WFP/UNHCR *Guidelines for Estimating Food and Nutritional Needs in Emergencies* does not detail various approaches to ensuring micronutrient intake. It states that "it is preferable to provide flour particularly in the early stages of emergency. If whole grains need to be provided, local milling capacity must be available, and the ration should include compensation for milling cost and losses (subject to local milling charges, in the range of 10 to 20%)". It suggests micronutrient targets in an annexed table, a reduced version of which is presented here:[54]

Table 2. Minimum micronutrient consumption levels defined by UNHCR/WFP

Age/Sex Group (years)	Vit A, grams Ret Equiv	Vit D, g calciferol	Thiamine, mg	Riboflavin, mg	Niacin equiv., mg	Folic acid, g	Vit B12, grams	Vit C Ascorbic Acid; mg	Iron mg 5-9% Bioavailability	Iodine (:g)
0	350	10.0	0.3	0.5	4.2	24	0.1	20	13	50
1	400	10.0	0.5	0.8	6.4	50	0.45	20	8	90
2	400	10.0	0.55	0.9	7.5	50	0.53	20	8	90
3	400	10.0	0.60	1.0	8.2	50	0.61	20	9	90
4	400	10.0	0.65	1.1	8.9	50	0.69	20	9	90
0-4	390	10.0	0.5	0.8	7.1	45	0.50	20	9	90
5-9	400	2.5	0.75	1.2	10.3	80	0.82	20	16	110
10-14	550	2.5	0.9	1.5	12.2	140	1.0	25	26	140
15-19	550	2.5	1.0	1.6	13.6	185	1.0	30	24	150
20-59 M	600	2.5	1.0	1.7	14.5	200	1.0	30	15	150
20-59 F	500	2.5	0.8	1.4	11.5	170	1.0	30	32	150
20-59 M & F	570	2.5	0.9	1.55	12.9	185	1.0	30	23	150
Pregnant	+100	+ 7.5	+ 0.1	+ 0.1	+ 1.1	+ 250	+ 0.4	+ 20	+ 120	+ 50
Lactating	+350	+ 7.5	+ 0.2	+ 0.3	+ 2.7	+ 100	+ 0.3	+ 20	+17	+ 50
60+	540	3.2	0.8	1.3	10.9	185	1.0	30	15	150
Whole Population	500	3.2 - 3.8	0.9	1.4	12.0	160	0.9	28	22	150

The Importance of Addressing Micronutrient Needs on a Population Basis

A case can be made that humanitarian aid agencies have put too great attention to treating the extreme cases of nutritional deficiencies that occur, and proportionally too little time to preventing deficiencies. Safety-net programs are increasingly encouraged as standard measures for large populations, not dependent on specific case-finding by intervening health agencies.[55]

Emergency nutritionists recognize this need to prevent nutritional deficiencies by investing in improving the general ration: this was a major recommendation coming out of the 1995 Machakos Conference. This philosophical shift — away from attention to treating cases and toward the health of the overall population — is also demonstrated by new ways of measuring malnutrition, namely to report malnutrition in terms of the mean (average) Z-score for the population which describes the nutritional status of the entire population directly, without resorting to a subset of individuals below a set cut-off.[56]

Practice

Only a small fraction of emergency food aid is currently fortified. Where it is fortified, it is only done in conjunction with more extensive processing, adding protein, salt and energy as well. Of the products supplied to refugees, those that are fortified are just UNIMIX (for example, in East Africa) or Corn Soy Blend CSB (provided by donors).

NGOs, the Red Cross, UNICEF, and other aid agencies face different choices, for example in holding stocks of high-energy biscuits, of procuring and packaging specialized grains locally. At a meeting of aid agencies convened to discuss emergency diets, a little over a year ago in Nairobi, NGOs shared the fact that were no principles or procedures that dealt with the real problems they have to face, including budgeting, warehousing, quality control, worrying about infestation and spoilage, easy and rapid shipment, and managing contracts with commercial vendors.[57] ICRC reported that it maintains 20,000 metric tons of emergency food supplies at all times, rotated regularly, obtained using 3 or 4 local suppliers. Action

Contre la Faim procures a variant of UNIMIX working closely with one local food processor, and manages its own random sampling at the production site to provide quality control.

Implications

Individually or taken as a whole, existing guidelines do not sufficiently suggest ways to mitigate the multiple micronutrient deficiencies characteristic of humanitarian emergencies. An integrated approach is needed, which addresses the range of nutrients needed, and ensures coverage of large populations in a way to prevent moderate deficiencies from developing.

III. COMPARISON AND INTEGRATION OF APPROACHES

No one method appears likely to achieve complete coverage of a population. No one approach is necessarily an option in different crisis settings. As with other health interventions, successful coverage may necessitate the use of several measures taken at once.[58]

In general, population-based micronutrient interventions can be separated into four categories. Associated with each are very differing cost rates, implementation timeframes, coverage patterns, and convenience for delivery in war zones.

1). Improving the nutritional quality of the general food ration provided (not only the special foods given to the small portion of severely malnourished who are helped in special supplementary or therapeutic feeding centers);

2). Periodic distribution on a population basis of special consumption items, such as micronutrient capsules, condiments, or periodic fresh fruits. Included would be prophylaxis of the population with vitamin A on first contact (e.g., screening, or camp entry), or weekly distribution of vitamin C capsules, as was the practice in the Ethiopian refugee camps in the Sudan.[59]

3) Supplementary and therapeutic feeding programs. Often the target groups benefit from supplementary foods that are rich in nutrients, including biscuits or fresh foods. It is common to add ferrous sulphate powder to milks and porridges to address anemia.

4) Nutrition education, which emphasizes the importance of dietary diversity, as well as instruction about growth monitoring, the value of breastmilk, valuable food sources of specific nutrients, proper feeding of the sick child, etc.

Several important studies conducted in the 1990s compared these options. Two were circulated in 1994. One, by Mike Toole of the US Centers for Disease Control, concludes that some form of fortified cereals need to be included in the general ration as offering "the best potential for satisfying basic miconutritional needs of refugees and food-dependent populations… in the short-term." Toole gives layered recommendations, recognizing that fortified cereals are rarely stocked and frequently not provided. He recommends groundnuts be a part of maize-based diets and ongoing supplementation of vulnerable groups.[60] Toole pinpointed the need for operational research into the fortification of different food vehicles, monitoring the stability of nutrients (such as vitamin C) after transport, and various cooking methods.[61] The importance of developing regional food industries was echoed in a nutrition expert advisory meeting convened by one NGO, Action Contre la Faim.[62]

The other report produced in 1994, commissioned by USAID via the OMNI project, recommended some increases to the levels of certain nutrients—zinc, riboflavin and B12 -- in blended foods and to begin adding many micronutrients—iron and B vitamins specifically --- to wheat flour (non-blended) provided in food aid programs. The report goes on to recommend that "USAID should consider ways to encourage local enrichment and/or fortification in the country," while cautioning that capacities are presumably insufficient to fortify in emergency settings, where "only in special circumstances should on-site fortification … be considered."[63]

Conducted at roughly the same time, a lengthy study commissioned by the Canadian International Development Agency (CIDA) concluded that there was considerable untapped potential for in-theater fortification of foods. [64] The author and Principal Investigator, George Beaton, found that the cereals which are ubiquitous in emergency rations may be the best vehicle for the provision of micronutrients. He cautioned, however, that it is essential that there be further practical exploration of logistical, technical and cost feasibility, as well as acceptability to the final recipients. He articulated the need for field-based research on existing patterns of refugee-camp milling and food distribution chains, and how they connect to actual household consumption. Beaton identified that:

- Regional pre-distribution fortification will tend to be cost-effective and have important long-term benefits to the general population (emergency affected as well as non-emergency effected);
- Fortification in local mills, after the food ration is given out to the displaced households, will pose problems with conformity and quality control, but reduces the problems of shelf-life that occur in larger, centralized fortification;
- Post-distribution fortification at the household level, while cumbersome and irregular, would be more cost-efficient and effective than the current reliance on blended foods.

In the following years, 1997 and 1998, three studies were conducted in Africa to test the question of whether food fortification was viable as part of emergency relief. Each found that local fortification opportunities did exist, were feasible with proven appropriate technologies, and should become part of actual pilot programs by relief NGOs. These three studies will be explained further in the following section on in-theater fortification.

In 1998 NGOs came together to share knowledge on micronutrients in a conference organized by the Child Survival Collaborations and Resources (CORE) Group . The intent was to update NGOs on micronutrient research findings about iron, folate, vitamin A, and zinc, and to identify and promote relevant operations research. Among the perspectives expressed by NGOs working in food aid was that food-based approaches can simultaneously provide several micronutrients, and that a multi-sectoral approach increases the number of stakeholders and strengthens community development. The CORE Conference also strongly encouraged better partnership between NGOs, which work overseas, and commercial industry, which has critically-needed technical expertise in food fortification and formulation, as well as some unique marketing and management techniques.

Examples of Multi-Pronged Approaches

An example of how multiple responses were appropriate to a single nutrient deficiency is the case of the Pellagra epidemic in Malawi, where the Red Cross, MSF, ACF, IRC, ARC and other NGOs were actively involved helping the refugees. When niacin deficiency disease (pellagra) epidemics occurred in the (Mozambican) refugee population living in Malawi in 1989 and 1990,[65] several responses were tried, which complemented one another. One solution to this problem was to incorporate groundnuts into the ration, at higher levels than had before. Most of these groundnuts were purchased within the region (Zambia, Zimbabwe and Tanzania all export). An increase from 40 to 100 grams per person per day was effective at reducing the problem. Another solution used in Malawi was to buy the equipment for fortifying the donated maize; Save the Children worked with local millers to use batch-mixing equipment to fortify flour as it came out of the hammer mills. Niacin capsules were used aggressively in the population; particularly in the stepped-up supplementary feeding programs. Nutrition education taught the refugees about the importance of B vitamins and of cultural practices to complement maize with other staples.

Another example of a multi-pronged approach is the effort to address anemia—which is also increased by malaria—through mosquito control. Recent research conducted by CARE and CDC have shown the efficacy of use of impregnated bed-nets in refugee camps of Burundian refugees in Tanzania as one method to control malaria and reduce the prevalence of severe anemia.

Table 3: Key elements of an integrated approach. This table is presented here as a means of organizing information and to stimulate discussion.

	Ration-Based: Add nutrients to Staple	**Supplement. Feeding: Treat Malnourished with Specialty Foods**	**Education, Gardens: IEC, use MCH clinics and Agric. associations**	**Capsule Distribution via instit. contacts & CHWs**
Coverage of Whole Population	Good	Limited	Variable	Possible
Cost	Low per unit, Significant overall	High	Low	Low
Reliability	High	N/A because of low coverage	Uncertain	Uncertain
Long-Term Benefits	Medium	Medium	High	Low
Risk of Over-Dose Toxicity	Limited	Small - modest	Very small	Can be High
Implementation, Supervision Demands	Minimal	Significant	Modest	Modest
Utility in Conflict Zones, dispersed IDP and ill-defined non-camp settings	Good	Modest	Low	Limited, unclear

Blended Foods vs. Fortified Foods

Blended foods—such as Corn-Soy Blend and UNIMIX—are typically fortified, but not all fortified foods are blended. In recent years there has been a tendency to blur this distinction: many people refer to "blended foods" and "fortified foods" interchangeably which can be confusing. In fact, any flour can be fortified with the same form of premix as the blended foods. The difference is that the blended foods include other ingredients as well, in particular extruded soy protein, which adds to the protein content of the product. Blended foods can be prepared in-theater. For example, a number of food processing companies in Africa produce UNIMIX to order, using extrusion cooking (with high temperature/short time technology). When some nutritionists have called for the inclusion of blended foods in refugee rations, or for the support of the local capacity to produce blended foods, the goal is to ensure the broad mix of nutrients, but blended foods per se are not the only form fortified foods can take. While simple fortification of basic grains would add only dollars to the per metric ton cost of rations, a recent study finds that the costs of UNIMIX production in East Africa is significantly more expensive than imports of CSB - which is not inexpensive itself.[66]

Population Coverage

There are two issues in population coverage. One is the pattern of physical distribution and receipt of foods. Physical coverage of households occupies a lot of attention of aid agencies: precise registration is important both in terms of ensuring equitable food distribution and in terms of conserving aid expenses.[67] It is well known that in many refugee settings where rations are provided against indices of formal registration, the system is widely abused and many refugees receive multiple rations, while others

apparently miss out altogether - particularly those who chose to be away from the camp, presumably seeking short-term paid labor, during the key ration distribution time.

Receiving much less attention of aid agencies is the end-use of the foods that are received by households. The extent of variation in diet consumed is much higher than nutritionists take into account. Standard practice in emergencies is to define the donated ration down to the third digit—per grams per person per day. Aid workers typically do not make general estimates of the within-population variation in consumption in terms of:

- Same-person intra-week or inter-day consumption;
- Intra-household heterogeneous consumption: different family members eat proportionally different items in the household food basket. Indeed, it is intended this way.
- Extra-household uses: these include savings (tinned foods or other foods that are believed to store well for future dates of repatriation or crisis) and feed to poultry and livestock;
- Inter-household variation in consumption: even within one camp the amount of variation in food stocks and cuisine patterns is seen to be enormous, even where all families supposedly receive identical rations to start each month with.
- Inter-group variation in consumption: This is exacerbated where rations are distributed to community leaders or elders who in turn apportion the household rations. In most cases where this occurs it is known that households do not receive equitable portions.[68]
- Meanwhile, some food items are not even consumed within the emergency-affected population

Because each of these sources of variation exist at once, the net variation in meals across time and persons is high, even in crises. Meanwhile, even the 'target' rations are often not provided in many problematic warzones. Internally displaced persons—as in El Salvador in the mid 1980s—often receive a significantly lesser ration, with even less variety and more emphasis on cereal staples. Standards for internally displaced populations (IDPs) are not common and tend to be based on extension of refugee standards.[69]

Reliability and Time-consistency

Case studies of relief operations point repeatedly to the fundamental fact that ration delivery is irregular and often unpredictable. Even in long-term refugee camps, refugees may see a double distribution of flour one month, and then go two months without any grain. Different food items—oil vs. staple vs. sugar—have different procurement sources, shipment routes and, therefore, pipeline problems.[70] As a result, there is a problem with time-consistency when relying on any one food vehicle for delivery of nutrients to a population.

Three implications emerge: First, use multiple vehicles in each operation—as aid agencies will seek to provide some food ration even if other items are still en route; second, put more emphasis into the foods that are most reliably distributed—basic grains; and third, work within the camp to fortify foods at mill-site, which means that any commodity can be fortified regardless of whether the current ration used a back-up grain (e.g. sorghum) or whether the affected population is eating food they obtained on their own (e.g. cassava).[71]

Costs

There is an unfortunate misperception by some nutritionists that there is no significant cost differential between whole grains and blended foods. From the point of view of donor agencies—who fund these programs (e.g. Congress), or that make decisions about how to allocate foods to fit different country needs (e.g., USAID), there is an absolute cost constraint that means there are tradeoffs between the total volume of different foods that can be made available. Moreover, many relief NGOs—such as ACF, MSF, Save the Children UK—procure considerable

amounts of food out of their own budgets, and European donors often support local purchase in country. Blended foods like Corn-Soy Blend cost up to three times that of a whole grain, whether calculated per weight or per kilocalorie provided.

Blended foods were originally developed as specialty foods to respond to malnutrition, and are used for their nutritional value as the main part of the food given in most supplementary feeding centers. Some aid analysts suggest that the effort involved in setting up and maintaining supplementary feeding programs (at the same time as a general household ration is given) is an inefficient use of resources in an emergency.[72] For example, based on a conference in London, Borton and Shoham wrote: "Supplementary feeding programs, especially wet-feeding programs, are extremely resource intensive and in many situations have not achieved the results desired.... The opportunity cost of wet-feeding programs is often so high that the targeting of some other more numerous group may be warranted." [73]

Taking into Account Food processing

Food preparation at mill-site and at the household level is the element in the equation that complicates ration-based efforts to deliver micronutrients. Milling tends to destroy most vitamins, including the B vitamins and vitamin C which is heat labile. Similarly, when emergency-affected families cook food for long hours, certain vitamins are destroyed and some minerals are lost in the washing. "Too often the rations provided are inappropriate to the refugees dietary traditions or may require preparation that cannot readily be accomplished in the camp."[74]

Technical inputs to refugee food processing may help protect nutrient stability. For example: instead of just leaving foods to dry in the sun, a solar box dryer[75] helps protect the nutrients in the food while actually speeding the drying process. The dryer helps reduce crop wastage from contamination, damage, and spoilage. Properly dried foods can be kept from three to eight months, which allows consumption of crucial high-vitamin foods in the off-season. It also allows products to be transported and sold in areas where the high-vitamin foods may not currently be available. Mango and papaya are especially good to dry.

IV. FRESH FOODS AND CAPSULES

Provision of Fresh Foods

In many situations fresh fruits have been added to rations—primarily through local purchase[76] -- and in many emergency situations fortified processed foods have been distributed. Direct distribution of nutrient-rich foods, including fruits and vegetables, has been a common approach taken by many aid agencies, when time and opportunities permit.[77] The benefit is that it supports nutrition education programs, has a 'demonstration' effect, and is popular among recipients. But direct procurement and distribution of fresh foods is logistically demanding and expensive. In many famine-affected areas, the supply of fresh fruits and vegetables is also limited. Often refugee and IDP camps are located in areas that are relatively inaccessible to retail markets.

One benefit of spending resources on purchase of varied local foods—versus one bulk good—is that it minimizes the disruption to local markets[78] which means that the emergency-affected population can sell goods at fair prices and obtain more foods in turn for their money.

Fresh foods nevertheless remains one of the key methods to address vitamin C needs. In those populations where access to fruit markets was disrupted (e.g., central Somalia, 1996), scurvy has been seen to rise as a result. In populations where access to fresh vegetables and fruits was unencumbered (e.g. western Sudan, refugees from Chad, 1996), no deficiencies were seen.

Supplementation via Nutrient Capsules or Tablets

The direct distribution of small micronutrient supplements (capsules, tablets) can be and has been an extremely inexpensive yet effective mechanism for achieving adequate intakes. For instance, vitamin C tablets have been given weekly in refugee camps to prevent scurvy. Regardless of whatever food-based programs may be operative, including fortified food aid, specific vulnerable groups such as pregnant women and severely malnourished children will continue to receive micronutrient supplements wherever possible.

There are two main limitations to the use of capsules. One is the practical challenge of physically delivering capsules to a large population on a frequent basis.[79] Unfortunately, the bulk of emergency victims and displaced peoples are often spread thinly in rural areas or spontaneously settled outside of camps. These people are less easily reached by NGOs and the U.N. Vitamin A capsules—from 20,000 I.U. to 200,000 I.U.—can be distributed through mass campaigns, through outpatient clinics, or other points of contact.[80] In many complex emergencies it is impractical or impossible to reach hundreds of thousands of persons with such an intervention. Direct distribution of micronutrients requires a delivery infrastructure which only exists in established populations or stable refugee camps.[81] In many larger population emergencies health networks become dysfunctional. Moreover in many famine-affected regions, there never has been a fully functional community health worker or primary care network that has the ability to reach all households on a weekly basis.

Even where possible, regular distribution of capsules or tablets poses a major drain on health resources, for the regular supervision and networking.

In many complex emergencies relief providers necessarily concentrate their efforts on a minimal number of contacts with the affected populations: for example monthly bulk food drops at villages or camps, and annual immunization campaigns. Vitamin A dosing is now incorporated into emergency immunization efforts. But the more frequent provision of other micronutrients cannot be achieved by piggy-backing on these infrequent contacts with large populations.

Vitamin A capsules

As discussed in Section I, there is general agreement on the practice of giving vitamin A capsules where possible, particularly on screening, in emergencies, even if other vitamin A interventions are also being supported. High-dose vitamin A capsules are inexpensive, less than three cents per capsule. Close supervision is needed in many high-dose interventions in order to ensure against an accidental overdose that can result in toxicity; very high doses of vitamin A are lethal; and high doses will also cause fetal deformities. Critical protective functions are sustained by a 4-5 month period, or dosing interval, in a population with moderate-to-low vitamin A deficiencies and high prevalence of gastroenteritis, diarrhea, malnutrition, measles and malaria. Benefits are assured following distribution of even a single high dose, irrespective of the time of year it was given.[82]

V. DONOR COUNTRY FOOD PROCESSING MEASURES

USAID's Commodity Reference Guide defines the nutritional values and suggests uses the dozens of foods on the US "docket" from which NGOs can select in their program proposals. In the past, effort was put into fortifying dried skim milk powder with vitamins D and A. As new evidence revealed the importance of vitamin A, its level in fortification was increased. The milk and soy based blends, such as corn soy milk, which were fortified with six minerals and eleven vitamins, were given in large quantities in the 1970s and 1980s, but became less available (more expensive) as dairy surpluses were drawn down. Today, dried skim milk (DSM) is no longer available at all under US Title II programs.

Today, Corn-Soy Blend (CSB), Wheat Soy Blend, various flours, and oil are the commodities best able to directly address micronutritional deficiencies. Currently, the specifications for these are detailed in the CRG fact-sheets available on the USAID website. However there remain long-standing questions about tradeoffs between ideal and feasible targets for vitamin C, and iron, and the form to specify.[83]

Experience with inclusion of foods fortified in the donor country have proven expensive. The commodity of choice used over and over has been Corn-Soy Blend (CSB), which costs significantly more than whole, or unprocessed grain. Over time, CSB has progressed from being used primarily in stable child feeding centers (e.g., the ICDS program in India) to inclusion in emergency rations.

Though micronutrients themselves are fairly inexpensive, the option of processing and fortifying grains in the US adds about 300% to the cost of the commodity. A metric ton of grain costs approximately $100-$150. The process of turning it into CSB, among other things, costs an additional $200. From the point of view of essential nutrients added for emergency needs, the value achieved for that extra $200 is simply the value of the micronutrients. The micronutrients, however, only cost about $20 for that metric ton. The rest of the cost is eaten up in the extrusion, heating, physical blending and special packaging that is needed to keep the highly refined food from spoiling along its long journey. Except for the cost of the premix itself, most of these expenses could be spared if fortification occurred further down the pipeline, closer to the point of consumption. Long shipping periods also leave the grain more vulnerable to spoilage and losses.

Adding micronutrients in-country poses the potential of significant cost-savings.

In the US, there are legislative provisions which establish that a minimum portion of US food aid must be "processed", which is one reason why CSB is as available as it is. In the 1980s dairy products were in surplus in the US and Europe, so these were included in a lot of programming.

Interest-group support for food aid does not transfer to support for cash aid. Even where it would be, in theory, more cost-efficient for governments to provide the cash for in-theater purchases, such cash funding is not available. Cash funds for local purchases could be generated as a result of monetization of foods, turning the local currency proceeds around for purchase of ration foods, but this is rarely done.

VI. IN-THEATER FORTIFICATION / ENRICHMENT MEASURES

Fortification refers to the addition of nutrients to foodstuffs somewhere in the food processing cycle for the purpose of restoring or enhancing the nutritional quality of the food when consumed.[84] For decades, nutritionists have worked to promote commercial fortification of basic dietary staples in poor countries because it automatically achieves high coverage of large populations at low cost.[85] Still, the World Bank, in its 1993 annual report, argued that micronutrient interventions like fortification are among the most cost-effective programs known for improving health and reducing disability-adjusted life-years. The addition of vitamin and mineral mix (a powder) is common practice where specialty foods are developed for vulnerable groups—as in Fafa in Ethiopia, Likuna Phala in Malawi and Uni-Lito (a wheat/soy blend) in Nepal Uni-Lito has been used by UNHCR to feed children among refugee from Bhutan.[86]

One of the principal—and under-recognized -- benefits of fortification in emergency response is that it leverages humanitarian aid resources to introduce needed perspectives and technologies into poorer areas where fortification standards do not yet exist.[87]

Based on recent field studies, fortification of emergency foods with a broad spectrum of about twenty vitamins and minerals now appears practical and affordable.[88] Fortification of the staple food—wheat or maize in most cases—offers a practical way to safely reach the highest percentage of refugees. Development of regional fortification programs would provide the added benefit of contributing to the growth of the regional milling industry, rounding out the investment.

One recent USAID-commissioned (OMNI) study in the Horn of Africa, undertaken with USAID funding,[89] found that in-country fortification capabilities were good enough that USAID should proceed to support new fortification efforts, providing technical assistance in technical areas, quality control, social marketing and advocacy and the development of legislation. The team found that sugar and maize were prime vehicles for fortification. In Kenya wheat flour, maize meal, and cooking oils were also potential vehicles.

At roughly the same time, a study undertaken by the Micronutrient Initiative of Canada[90] concluded that not only can centralized fortification be effective, but there are ample opportunities for fortification in refugee camps themselves. The team recognized that aid agencies had sufficient presence in these camps, and were already often involved in supporting hammer mills for the refugees. The added cost would be small to train, supervise and monitor a small team of local personnel to add premix to flour at the already-existing refugee mills — similar in scale and kind to various other key public health interventions that are now understood to be well worthwhile in emergencies, — such as rapidly chlorinating the local water supply or training CHWs to conduct nutritional surveillance.

A third study was also conducted during this time period, by Oxfam, with support from MI Canada and from UNHCR, which looked at the usage of blended foods in three different emergency settings.[91] In the three settings studied, the acceptability of blended foods was high, and re-sale values were low. A preferential bias toward allocation to men, and to children was reported. Storage of meal and blended foods was a problem in all sites. The same project also looked at fortification options, concluding that "Camp-level fortification would require adequate, affordable and accessible milling capacity, training and health education and close monitoring of mill technicians to ensure in particular the even mixing of the fortification mix. Camp-level fortification would be most appropriate where the staple grain being distributed was eaten in milled form and highly acceptable. Fortification of cereal at the time of grinding or pounding at household level did not appear to be feasible. However a household level fortification mix in the form of a salt could be added during cooking, as salt and/or spices were used routinely in all sites."

Bulk Grain Fortification at the National or Regional Level

Fortification in emergencies would build on experience transferring fortification policies and programs to developing nations as experienced in countries like Guatemala,[92] Indonesia and Egypt. Salt iodination is well established in most of Latin America and Asia. Sugar fortification with vitamin A is now implemented on a regular basis in Guatemala, Honduras, and El Salvador. In the Philippines, rice is routinely fortified by small millers with thiamin, and more recently with iron.

NGOs may consider field-based fortification as both an immediate response to nutritional needs of a target population, and also as a means to initiate and promote fortification into local industry practice.

Fortification can also be approached at a regional level, where food aid passes through more sophisticated roller mills to produce flour. Ironically, much of the experience in the poorer countries is in fortifying animal feeds—though the premix and dosing techniques are the same for enhancing foods for human consumption as well.

Refugee/IDP Camp Level Fortification

Small privately operated mills can be found in almost all refugee camps.[93] And in some camps NGOs like IRC and Concern, or WFP, provide small mills as well. Though these small commercial hammer and plate mills generate great heat in grinding the grain, there is no reason that micronutrient mix can not be added immediately afterwards, either by hand, or by a batch mixer or, if necessary, by in-line dosing equipment.

Costing less than $10 per Metric Ton of delivered grain, fortification at the site of local, camp-based grain mills may prove to be one of the most cost-effective health interventions available to NGOs and may become a standard best practice for emergency response. Field based fortification is less expensive for several reasons. For one: the addition of micronutrients does not have to include other processing and extrusion and inclusion of protein, which is what drives up the cost of CSM. (Blended foods are produced using gelatinized cornmeal or wheat flour, de-fatted soy flour and soy oil, and then added a mix of 6 essential minerals and 11 vitamins.) The closer to the point of consumption, the less that the storability and spoilage is a problem, and therefore the less elaborate the packaging. Meanwhile, by fortifying flour at the point of milling in a refugee camp, the shelf-life of the grain is maximized while still adding vitamins and minerals close in time to their being eaten.

Increasingly, humanitarian agencies are becoming interested in providing the means for camp level milling. The goal of projects that provide milling equipment, and sometimes maintenance, is to relieve the burden on individual refugees to pound their grains or pay high fees to have grains commercially milled. In some instances, the need to cook bulk grains longer forces refugees to spend hours travelling outside of camps for fuelwood. The resulting violence they suffer (and rape, for women), and the resulting deforestation, make the provision of grain mills a high priority for NGOs involved in reproductive health and environment protection. Attempts at providing NGO-managed mills appeared less successful than locally inspired versions, for a variety of reasons. In Dagahale camp, along the Kenya/Somali border, CARE representatives have rarely been called upon to provide maintenance assistance. Small-scale commercial millers obtained the equipment from Ethiopia originally and managed to pick up spare parts from Somalia as needed, otherwise they managed to improvise.

Options for adding automatic-dosing fortification equipment to existing small-scale mills are limited. Most mills in refugee camps observed in Africa tend to be two-foot-high posho mills: too small to accommodate volumetric feeders or similar equipment. Fortification with plate mills would be entirely unsuitable. With some small hammer mills, use of a manually driven feeder is feasible, but it would result in an inconsistent flow and frequent breakdowns. To achieve this marginally effective operation, requirements would include a technology feeding system interlocked within a hammer mill. Material could be inserted into a feeding hopper, to be metered out with a series of pulleys. Flow rates would not be very even because the premix would be hand-fed.

In some circumstances, refugees appear to prefer hand-grind grains, eschewing the use of mills. This was said to be the case, and confirmed on observation in the Kakuma camp in Kenya, and supported by past

visits in northern Ugandan camps, among IDP camps in Sudan and in Somalia. Generally, in Somalia rural people hand-grind their flour. For approximately 50-60 villages, there might be 5 machine mills that operate only for several months of the year, during harvests. Most people cannot afford outside milling, they do not know how much it costs exactly, and those that can may have to walk three hours. In these minority settings in Somalia, hammer and plate mills will not provide high coverage rates for the whole affected population.

It is often the case that there are commercial hammer and plate mills in the localities and towns near to refugee camps. It was no surprise to find that this proved to be the case more often in regions where refugee camps were near to large towns.

Because these are small mills, also with irregular flow rates, run on diesel engines, it is difficult to imagine how fortification equipment could be adapted and then used reliably. Furthermore, it is difficult to envision how monitoring and appropriate usage would be insured, as such mills could not be placed under NGO supervision as easily as refugee camp mills could be. Less subject to strict controls, smaller millers would likely be more tempted to stretch the premix by adding less than recommended per batch, and thus disrupting careful measurement requirements.

Opportunities for Pilot Tests

Recent research suggests that there is fertile ground for pilot testing of field-based fortification of emergency foods. Pilot research underway or needed includes:

- Introduction of fortification of maize flour among local hammer mill in Malawi, using micronutrient premix, testing different blending systems—a project World Vision Canada is implementing as part of its MICAH program.[94]
- Technical assistance and subsidies for dosing equipment to large commercial flour mills in capital cities in regions that are emergency prone;
- Testing of camp level fortification of the general ration with cement mixers;[95]
- Testing in various settings the ergonomics and acceptability of the new "Odjob" hand-rolled mixing system for flours and grains in small scale mills in displaced persons camps;[96]
- Initiating a system of pooling resources among NGOs in regions that are emergency prone to maintain stocks of different premixes, and report on the cost implications, stability and institutional experience; this might be conducted in Abidjan, Cote d'Ivoire, Tblisi, Peshawar, Bangkok, and Costa Rica;
- Testing the double-fortification of salt for emergency purposes—Salt can carry both iron and iodine in a stable way, according to recent findings.[97]

VII. COMPARISON OF FOOD VEHICLES

Refugee and emergency feeding dry rations are typically comprised of 300-400 grams (per recipient per day) of a whole grain (maize, wheat, rice, sorghum) or flour, 30-50 grams of beans or other lentil, and lesser amounts of vegetable oil, sugar and salt. This standard ration mix is usually a poor source of most micronutrients. However, in most refugee camps, the ration is only one part of a complex web of food sources, which dictates the overall levels of micronutrients available.

Table 4. Relief food characteristics that relate to their potential as vehicles for providing essential nutrients to large emergency-affected populations

	Grain	Fortified Flour	CSB	Vegetable Oil	Biscuits	Sugar
Expected Population Coverage—Actual Consumption	90%+	95%+	30-80%	20-70%	In extreme circumstances 95%, on long-term basis, 10%	95%
Cost per Metric Ton[98]	$100-$200	$120-$220	$350	$1,000	$2,000	$600
Micronutrient Carrying Capability	--	all	all	Vit A	All	At best, Iodine and Vit A
Stability of the Food and the Micronutrients	Moderate	Low	Low	Medium to High	High	Medium

Food Exchange As A Factor Influencing Population Coverage

In the past, observers (donors, media) looked at the sale of rations by recipients as a sign that the recipient was disinterested in the food received and had a surplus. Various studies since then present a different dynamic at work. Emergency-affected populations sell off some portion of their ration primarily as a measure to obtain other things. Sales are less a reflection of what they have too much of than a measure of how desperate they are.

One of the key categories of things that displaced persons are known to purchase with the proceeds from ration sales are other foods—fresh foods, meats, dairy products, etc., that effectively diversify the diet of that person's household. This was a key finding of a study commissioned by UNHCR in 1996, conducted in the Rwandan refugee camps in the Uvira region of Zaire (today the "Democratic Republic of Congo"). The study's author concluded in her report that "while food sales improved the micronutrient content of their diets, gains were made at tremendous expense of energy content," and recommends simple supports that can bolster the household's ability to diversify the diet in other ways—time-saving devices, improved cooking equipment and support of refugees' food production efforts (gardens).[99] In an earlier article in *Lancet*, John Mason et al. made the point that "If the only food source is provided by camp organizers, these rations have to be adequate in all nutrients. This requires a mixed food basket, including fruits and vegetables. If this cannot be ensured, then trading may have to be encouraged if refugees are not to become undernourished and deficient in micronutrients. The fact that some foods may be traded, to add variety to the diet, is no grounds for reducing the ration." [100]

Observations across a wide range of camps confirms that the most desperate emergency-affected households trade more of their ration foods. It has been found that those refugees with the highest value of rations received did in fact consume the greatest amounts of fruits and vegetables.[101]

Within any one camp, there is large variation between households in sales practices. Some sales occur by individuals, others by households, others by section leaders[102] or camp-wide committees.[103] There is actually a substantial literature documenting the patterns of recipient trade, though volumes or prices are rarely quantified. Ken Wilson of the Oxford Refugee Studies Program writes that: "Refugees exchange food rations as part of their quest to improve the quality of their ration: to turn several dried commodities into a diet that is physiologically and culturally acceptable, and biochemically balanced. In all camps and in the self-settled areas one of the main means by which refugees obtain green vegetables is through exchange of food aid, generally flour.... people were also exchanging pigeon peas for cassava... the selling of portions of the bean rations has had a significant observable effect on local bean markets."[104] Hanne Christensen, working in Afghan camps noted that trade benefited refugees and locals alike: "Part of the food relief was reportedly used by the refugees for barter or sale to surrounding local people. Refugees thus obtained access to other types of food such as fresh fruit. The Pakistanis received wheat, which forms their staple food. The diet of the refugees is slightly improved by the addition of vitamins."[105] She reported similar findings from refugee camps in Mexico.[106]

The Costs of Milling Appear to Force Some Sales

Where the recipients receive large amounts of whole grains, and have little income, they find that they must sell up to half of their grain to the miller for the service of milling the other half into a flour that can be cooked.[107] Households infrequently sell/unload more than approximately a quarter of their grain ration, though there are cases where most households have sold most of their maize, because they preferred to swap it on local markets for more desirable wheat products.[108]

Another means by which refugees and populations in emergencies react to their nutritional needs is through broader self-reliance: through remittances from abroad[109], barter,[110] income-generating activities and through payment-in-kind with food in local employment. There are numerous obstacles to self-reliance ranging from national laws that deny refugees legal access to employment or renting of land, to the built-in disincentives in international assistance that discourage self-sufficiency and independence.[111]

Grains

The staple grain has the key advantage that it will be consumed by almost all individuals in almost all households, regardless of whether or not substantial amounts are traded, sold or lost. Most cultures recognize one of the main grains—maize, wheat, rice, sorghum or cassava—as a staple, meaning that it is part of the cuisine, in one or more meals every day. Because of the sheer volume in which it is delivered in the ration, even if the household swaps part of the received ration for other grains, or flours, a significant portion of the ration grain is nevertheless consumed by everyone. Thus, the ration grain is unique in assuring almost comprehensive coverage of the emergency-affected population. Unlike sugar, which is provided less regularly, and in small quantities, it does not carry such a high market value that it is likely to be intercepted before equitable distribution.

Another advantage of considering grains as a vehicle for conveying micronutrients is the extensive experience accumulated with fortifying grains in different countries. Many countries now have years of positive experience demonstrated the efficacy and cost-effectiveness of fortifying and enriching flour with a wide range of nutrients.[112]

Blended Foods

Blended foods represent a new type of food for emergency affected populations. At first, many do not know how to value it, nor do local markets. By and large, soy-fortified foods do not command re-sale values that reflect their production costs. Nevertheless, recipients sometimes sell them, [113]sometimes target them to their children, and sometimes covet them. It tends to vary from culture to culture and, in particular, evolves over time as populations become familiar with its consumption.

Milk - including Dried Skim Milk

Dried Skim Milk has been viewed for a long time as a key means to deliver vitamin A and, less often, vitamin C to target groups. However, milk products are rarely available to be given in the general ration now (for example, DSM is currently not available under the PL 480 Title II program), as surplus stocks of dairy products are no longer backed up, in the US and Europe. Of equal importance, nutritionists were successful in establishing standards against the distribution of foods, like dried skim milk and whole-skim milk, which may lead mothers to cease breastfeeding their infants.

Amylase-Fortified Cereals to Enhance Energy Availability

Amylase-rich foods (ARF) address the special energy needs of young children who are being introduced to solid foods. The texture, viscosity, kilocalorie content and taste of complementary and transitional foods are critical factors for the child whose appetite and stomach size are limited.[114] In Africa, virtually every culture has its own traditional weaning food, based on local staples: *ogi* from maize, *gari* from cassava, *koko* from sorghum, *obusera* from millet, *fafa* and *injera* from teff, to name a few.[115]

Oils

Vegetable oil provided in cans, drums or plastic containers can be readily fortified with vitamin A, and is by some donors.[116] Vegetable oil is a key element of almost all emergency rations. Equally as ubiquitous is its large-scale sale by recipients to garner its cash value from local markets. Vegetable oil has the lowest diet coverage of any of the ration foods. Even those portions that are retained are not received by all recipients. For some households it's used primarily for porridge, for others its used for cooking.

A recent study of options for fortifying US-donated vegetable oil found that, using proven, cost-efficient technologies to add vitamin A to the oil, "the stability of vitamin A in oil is greater than other currently used food vehicles such as flour, sugar or corn soy blends. Losses are estimated at 5% during shipping and 10% during open storage in the field. Cooking losses will range from 5% for boiling or simmering to 20% when the food is fried." The report therefore recommends that all vegetable oil, destined for consumption by the target population be fortified with 60-75 Ius of vitamin A palmitate.[117] Similar conclusions were reached in a 1995 study of vegetable oil delivered to India: "Cost calculations suggest significant savings in using oil as the vehicle for vitamin A instead of Corn-soy Blend."[118] The authors add that "there are physiological complementarities in combining vitamin A with oil as well, as presence of fat in diet enhances the absorption and utilization of vitamin A." As a result of this study, as of December 1, 1998, all vegetable oil purchases for foreign food assistance programs are required to be fortified with vitamin A in the form of retinol palmitate.

Sugar

Sugar has the exceptional quality that it is almost never sold by recipients no matter their emergency state. Even among people who had little prior exposure with or taste for sugar, once they receive it, they consume it. Thus, sugar poses a valuable vehicle for fortificants. Unfortunately, sugar is expensive to procure and therefore given irregularly in emergencies, and when it is it is targeted to bolster the appetite of malnourished and anorexic children.

Salt

Salt is a relatively inexpensive portion of diets and is frequently purchased by donors from within the region where it is delivered. Universal salt iodization is considered the principal measure needed to reduce iodine deficiency IDD. The technology for fortifying all salt in most emergency affected areas is inexpensive and can be readily implemented. Most countries do have access to iodized salt at an affordable cost, although not all households are using salt from producers who conform to national iodization requirements. Many areas still need country-level legislation and regional trade policies. Aid agencies can help monitor these patterns in salt markets, and provide technical aid to improve quality of processing, delivery, and education programs.[119]

WFP and UNHCR standards prescribe that salt must be iodized, although the multiplicity of vendors providing it means that this standard is not always met. Even where governments have passed laws to require iodization, it is difficult to enforce, particularly among small-scale providers. Aid agencies can play a role in both monitoring—by testing sample lots—and by providing technical assistance to train on simple methods, including hand-held spraying, and inclusion of spraying chambers to mixers. In a recent manual, WHO even describes a mobile iodization 'plant': a mixer that is transported on the back of a truck.[120] The Machakos Conference concluded with a call that all salt contain at least 50 ppm of potassium iodate.[121]

Biscuits

In those crises that receive high media attention, donors flood the theater with a wide array of strange biscuits and crackers.[122] Biscuits are popular and readily eaten by refugee children, including children with reduced appetite.[123] While their nutritional content varies widely, they tend to expensive, unsustainable, unpredictable, and do not fit well with efforts to complement with local purchase or nutrition education. Biscuits provide nutritionally dense, light (dehydrated), stable (sealed) food that can be deployed flexibly in exotic environments, including airlifts as rapid response. The European biscuit, BP-5, is often referred to as "high protein" biscuit in the media, and is a common WFP and UNICEF item brought in during the peak periods of crises. Other specialty foods that can be biscuit-like are provided by US manufacturers, that can meet any nutritional specification, though at costs roughly 100 times the per calorie cost of a bulk grain.

Beverages

Beverages have the potential to provide some problematic nutrients, including vitamin C which can be protected in a container not exposed to air or sun. A MI-sponsored multiple micronutrient-fortified powdered beverage is being tested in Tanzania and Bangladesh.

Vacuum-Packed 'Humanitarian Daily Rations'

Specialty foods developed by the military have received some visibility in certain instances, but their use remains very limited. The Humanitarian Daily Ration (HDR) was created in 1993 as a response to the apparent value in distributing excess military rations (meals ready to eat, or MREs) after US military involvement in the Middle East and elsewhere. Rather than produce extra MRE's, the Pentagon initiated a project to design HDRs that were cheaper per unit than MREs and more culturally and nutritionally appropriate to the various populations that might receive them. A key value of the HDR is its vacuum-seal, which allows it to be stored for long periods and introduced into unusual environments, including high humidity and flooding. A year ago, the HDR underwent a nutritional review, recommendations to: increase the amount of Vitamin A to 900 mcg (micrograms)of stabilized retinol equivalent or 3333 IU; increase the levels of calcium to 1300 mg, phosphorus to 1300 mg, magnesium (to 350 mg, and folate to 400 mcg; and, to decrease the levels of iron to 12 mg. And of B12 to 2.0 mcg.[124]

VIII. INPUTS NECESSARY FOR IN-COUNTRY FORTIFICATION

Grains like wheat, maize and sorghum, offer the best potential to prevent occurrences of deficiency diseases as they are the only foods eaten by the whole population in, say, a refugee camp. Yet humanitarian organizations have been uncertain about how to add micronutrients to a grain, presumably during or immediately following milling. Despite some experience with 'local purchase' arrangements for procuring food in-country, there has been little experience seeing that food aid is fortified in-country.

Currently, a small portion of emergency food aid is processed or fortified in many emergency-prone areas, including west, south and east Africa where grains are almost never fortified except with one ingredient in extrusion-processed blended foods.

Project Management Skills by Aid Agencies

NGOs are developing increasing experience in working with emergency-affected communities to set up and run small-scale mills that can grind ration grains. These mills are valuable because they save refugees many hours of hand pounding and cooking. By reducing the cooking time, mills reduce the amount of firewood gathered and cut by refugees. Not only does this protect fragile ecosystems, but it also reduces the incidence of sexual assaults on refugee women who spend many hours far from camp on foot in search of wood. NGOs like Concern, Lutheran World Federation, and International Rescue Committee have learned that when turned over to refugee cooperatives, where some mills are subsidized and lower the price of grinding grain, sabotage can result. Commercial millers without NGO support seek to level the playing field by finding ways to thwart non-commercial milling projects.

Availability of Nutrients in the Form of Premix

A variety of premixes are available in even the most remote emergency-affected parts of the world. The total cost of adding a premix to the general ration is tiny compared to other costs – like the cost of the ration itself. A broad premix offering a full range of 15-20 vitamins and minerals costs about $5 per metric ton of grain fortified. The additional cost of mixing the premix to the grain would be about $1,000 per camp of 10,000 refugees per year.

Micronutrient premix, that covers a broad range of nutrients, is easily available throughout the developing world. In Africa, for example, the market for broad-spectrum premix is not very wide or deep. Most countries do not require fortification of any consumption foods, and few millers in Africa fortify. The main uses of any premixes tend to be for feed for cattle and pigs. As a result, the high-value premix for human consumption is not stocked in quantity by the manufacturer. There is thus a lag-time in acquiring premix when needed.

Hoffman La Roche manufactures a broad-spectrum premix that has been regularly used by UNICEF and the World Food Program in their procurement specifications. Based on research and decisions by UNICEF, contracts put forth in Nairobi often specify that Roche premix, per se, is to be used by whoever is producing the UNIMIX product. This reflects the research that UNICEF has done to identify that Roche has proper form of nutrients in the right balance. In the heavily disaster-afflicted economies of the Horn of Africa, most millers are familiar with the Roche premix, its availability and how to access it. Companies

with experience using the Roche premix noted a serious problem of delivery lag-times. Because Hoffmann-La Roche does not store stock in Nairobi, but produces stock in South Africa on demand, there is a 4-6 week lag between order and delivery. An additional delay is caused by the time-consuming but mandatory testing procedure for reactions between vitamins A and C in the mix. The routine lag time of about six weeks causes frequent problems among those agencies producing UNIMIX under contracts to UNICEF and WFP because the contracts require delivery of the final product in four or five weeks. Thus emergency assistance invariably suffers delays because there is no rotating supply of Roche premix in East Africa to meet orders on a just-in-time basis. Other manufacturers or suppliers of premix, such as BASF, are familiar with the level of local demand for premix and of the specifications that Roche meets. Some other premix suppliers in the region have protested the fact that NGOs accept Hoffmann-La Roche as the standard for production of corn-soy-blend (CSB), leading to what others perceive as a monopoly. NUTRISET (commercial supplier in France) produces different premix packages that provide a range of nutrients that is comparable to what is provided by Roche, but which comes in mixes that are more precisely tuned to different stages of re-feeding of malnourished children. One product produced in East Africa, MIXPLUS from Soy Afrique (Nairobi), is based on the NUTRISET premix and provides an alternate model of fortification of refugee foods. This model, however, while more expensive is meant for populations in greatest nutritional need.

Because micronutrient premix from Hoffman la Roche entails a lag time, between order and delivery, NGOs might pool resources to maintain a contingency stock. Similarly, if more NGOs bought Nutriset formula (for re-feeding severely malnourished children) in bulk, could prices be reduced. At the September 1997 conference NGOs agreed that because of delays in Roche premix delivery, it would be wise to pool resources to stock some premix year-round. The Machakos Conference issued the following recommendation: "Stockpiling of a 3 month supply of the vitamin/mineral premix in places where the capacity is available for the production of blended food and strengthening the local capacity for production ins recommended."

Equipment for Dosing or Mixing

For large roller mills, found in companies in capital cities like Kampala or Dar es Salaam, the best option appears to be to add dosing equipment that is calibrated to add premix automatically and in the right proportions, without human monitoring. The equipment can be purchased from overseas or, often, from local manufacturers in country for roughly $5,000 per dosing device. There is not much difficulty installing the equipment, although most mill operators expressed a need for overall technical advice.

For smaller hammer mills, which are ubiquitous in and around refugee camps, the opportunities for adding special equipment is limited. The mills themselves are not electrified and the flow of grain or flour is highly irregular. The best approach for adding premix is on-site immediately after milling, with a carefully monitored hand-mixed procedure.

Food Packaging and Preservation

There was considerable discussion between commercial firms and relief agencies about specifications for bagging foods. At a meeting convened in Nairobi in 1997, it was felt that the feasibility of processing and fortifying food in large quantities at a centralized location was related to how long it would last before spoilage. Flours are very prone to spoilage in the high humidity emergency-prone areas of East Africa. Much of the spoilage factor is related to the quality of bagging of the flour. At the meeting, commercial firms stressed that it was important for the contractors (i.e. NGOs) to "make up their minds" about what exact standards of bagging they sought and are willing to pay for. The NGOs responded by calling a separate meeting to share ideas about what standards are cost-effective.

In general, large commercial grain millers are interested to learn more about fortification, to draw on international experience and expertise. Those commercial millers that do not currently fortify, recognize that fortification would require equipment (volumetric feeders and installation), upgrades and training, help with maintenance, and help with community education efforts and advertising. One miller, who produces specially priced products for slum dwellers in Nairobi, feels he can not just initiate fortification on his own, because if he had to raise the cost of his products (such as low-grade energy bars) by even a couple of cents he would lose his biggest market. Large corporate milling companies tend to have diversified product lines, each of which could include fortification.[125]

Even the largest flour millers, by volume, lack the technology or experience to fortify. The range of experience with fortification varied considerably; three millers who were contacted in Nairobi were able to identify the type of equipment they would need, and where they might obtain it. Tanzanian millers were less familiar with the technological needs, even though some possessed more sophisticated equipment than Nairobi mills (for example, Azam Bakery and Ice Cream, in Dar es Salaam, possesses about twenty industrial size roller mills).

In contrast to large grain mills, there are also specialty food processing companies that have the means to fortify, who do fortify refugee foods on contract, but who do not have a cost advantage is milling basic flours in large quantities. Rather, they have a niche in and remain intent on developing products with greater value added and would probably not have the capacity or the interest in fortifying only bulk grains.

Quality Assurance

In all food based approaches, aid agencies need to develop much more competence in quality assurance techniques, which involves knowing what are reasonable and achievable specifications to put into procurement contracts, knowing which companies have laboratories for testing product composition.[126] Humanitarian relief organizations routinely manage large stocks of food which are exposed to the elements, spoil and must be destroyed. More than in development situations, unpredictable spoilage of large lots is intolerable as lives are at stake.

Yet, NGOs in the field continue to experience short shelf-life problems with all kinds of ration foods, as well as Unimix and CSB. UNICEF had many problems in the Sudan with donated blended foods that came in bags that degraded when exposed to water—the donor presumed that bags would benefit from always being fork-lifted and stored on pallets, conditions that do not pertain at some stage of emergency pipelines.

Even canned tins of vegetable oil turn up punctured or pilfered, or destroyed in train or truck accidents. From discussions with NGOs, there clearly is a demand to understand how to procure and store food in a manner that meets nutritional objectives while also specifying methods that will reduce ex-factory infestation and spoilage.

While NGOs are concerned about improving the quality of foods procured, the companies providing these foods have quality control problems in limiting infestation.[127] Many of the shipments of UNIMIX, while fortified, were unusable because they spoil quickly. Food companies in Africa claim they have the expertise and technology to meet any specification. Communication between industry and NGOs in Africa has not been extensive to date.

An example to the contrary is Accion Contre la Faim (ACF), which has forged close ties to Soy Afric, a miller which produces a specially formulated CSB for the NGO. ACF has worked closely with the millers, and developed unique quality insurance tools such as surprise storage inspections, and examining stock samples instead of the samples offered by the millers. The Soy Afric/ ACF effort exemplifies a precedent for more NGO- private sector collaborations in the area of fortification.

Also neglected is the perception of the emergency-affected populations. Spoilage of foods—including fortified foods—in camp occurs at a level comparable to spoilage up to the point of distribution by the aid

agency to households. Because ration distributions in emergencies tend to be monthly, at best (often irregular), households know that they must store a large share of their food for many weeks. They also know, or learn, that the flours, CSB and Unimix will begin to spoil after a week or two and should be consumed up-front, or sold.

The Food and Agriculture Organization plays a role in promoting quality assurance standards in food processing,[128] publishing technical reports on food processing, and setting standards in food trade and hygiene. FAO supervises the Codex Alimentarus committees which establish international guidelines on food standards, including optional fortification of various food aid commodities A recent analysis of fortification options for FAO concluded that FAO could better consolidate its various findings and standards.[129]

IX. IEC, AGRICULTURE, AND OTHER INTERVENTIONS

Directly giving out nutrients fits the relief paradigm, but it is not the only way to improve diets, even in crises. Nutrition education and policy programs are frequently among the most economical and sustainable ways to enhance the affected population's understanding of and access to local vegetable and animal foods.[130] Often, interventions have dramatic consequences on micronutrient consumption, without having been planned ; for example, when clearing a new road to a refugee camp and thereby opening up opportunities for trade with local markets; or policies that permit refugees access to land, or exposure to health education or that free up mother's time to devote to care-taking behavior.

Information, Education and Communication

One set of interventions aimed to influence the health-related behavior of care-givers and household food authorities involves the communication of messages about vitamin and mineral requirements and the importance of diversifying the diet with fresh fruits and vegetables, and with the proper feeding of the sick child.[131] Most NGOs include some IEC component in their outpatient and community health programs, and certainly as part of any maternal-child health clinics or prenatal consultations. The irregular provision of fresh fruits and vegetables—by UNHCR[132] or NGOs—which would be an expensive intervention based purely on the short-term dietary effect, is justified for its nutrition education demonstration effect, in the hope of leading to a long-term behavior shift toward obtaining these foods, whether in the camp setting or later during reconstruction.

Gardens

The monotony and low nutrient quality of diets given is less of a problem where the recipients—refugees and displaced populations—have the means to increase the variety in their diets through local production. Household gardens were common among refugees from Chad in Darfur province of Sudan during the drought of 1985-86. Community vegetable gardens in the camps for Salvadorans in Honduras provided fresh vegetables to the entire camp population in the late 1980s.[133] But too often the norm is that refugees do not cultivate to vary their diets.

NGOs have become proficient in assessing the prospects for effective seeds and tool distribution as part of relief and rehabilitation. A key value added of external agencies is in recognizing and sourcing seeds of vegetables that can directly fill micronutrient gaps in the local diets. [134] IFPRI's main micronutrient activity, in collaboration with other international agricultural research centers, focuses on breeding rather than fortification. USDA is collaborating with the CGIAR on this initiative.[135]

Access to Markets

Micronutrient deficiencies have, in some instances, been directly related to the interruption of retail food markets. Policies undertaken to coerce refugees to be segregated from interaction with local populations both fail to achieve their purpose and decrease the overall food basket of both refugees and locals.[136] Refugees spontaneously seek out foods to sell and buy from regional markets. Witness the thriving fish market in camps in Malawi, or fruit market in Khao I Dang in Thailand, dried goods (confectioneries, crackers, dried vegetables, tea...) which sold from stalls in virtually every camp larger than 1,000 population.

One of the most cost-effective nutritional interventions documented in any emergency situation was in the camps of the Yucatan Peninsula in Mexico where refugees lived many miles from the nearest city or major market. While phasing down the general ration, UNHCR provided the refugees a bus service: one bus a day between the camp and the major regional city - an hour or more's drive away. The refugees took ample advantage of this service primarily as an opportunity to obtain, on their own, vegetables, meats and other high-nutrient foods from the city markets.[137]

In fact, access to markets can be directly influenced through assistance programs. One method is to influence government policies and their application, allowing refugees greater mobility, thus reducing their fear of harassment by authorities when visiting urban and town markets. Another method is to subsidize transport so that refugees can afford to visit markets to buy fruits and vegetables. This is accomplished through food-for-work or cash-for-work road building and road-maintenance projects that help link remote camps to feeder roads.

X. THE SPECIAL PROBLEMS RELATED TO VITAMIN C

Vitamin C poses unusual problems due to its high costs (relative to other micronutrients), its tendency to be easily lost in cooking or destroyed through oxidization and the fact that, being a water soluble vitamin, humans don't store it, but need to consume it each day. Because of the special problems of ensuring vitamin C in emergencies, a series of Congressional efforts and subsequent research studies have looked at the options. In the field, for practical purposes, nutritionists and food planners tend to deal with vitamin C needs as a separate programming issue, and not hold general fortification efforts hostage to the problems of vitamin C stability and cost .

In 1997 SUSTAIN completed its report to USAID on the variability of vitamin C found in field locations, at different steps along the food pipeline.[138] It found considerable variability in CSB levels of vitamin C and surprisingly high levels of vitamin C retention after cooking at the household level. This provided good news that vitamin C can be delivered in standard food vehicles.

Based on SUSTAIN's research, in 1997 the Institute of Medicine released its final report, ***Vitamin C Fortification of Food Aid Commodities—Final Report*** (National Academy Press).[139] The report reviewed recent field research by SUSTAIN, and analyzed the implications. It found that a surprisingly high amount of vitamin C was in fact retained after transport (roughly 90%) and even after local cooking (roughly half). Interestingly, retention rates of vitamin C were seen to be higher when initial fortification levels are higher: in other words, the more the vitamin C in the food, the higher the portion of vitamin C got through to the time of human intake. But the Institute of Medicine (IOM) report also concluded that increasing the levels of vitamin C in PL 480 blended foods was a very expensive and inefficient way to address vitamin C needs. It recommends, instead, using direct supplementation, market interventions, or field-based fortification. In fact, during the Ethiopian famine of 1984-86 aid organizations responded to scurvy problems by providing vitamin C tablets to all the children living in some camps: an effective, though short-term and unsustainable emergency intervention.

The Institute of Medicine report concludes:

"1. The level of vitamin C fortification of blended food aid commodities should not be increased to 90 mg/100g but should be maintained at the current level of 40 mg/100 g; based on the reported incidence of scurvy and the quantity of U.S. supplied blended food commodities going to regions where scurvy has been reported, increasing vitamin C fortification of all CSB and WSB is not cost-effective.

2. Strengthen health surveillance systems in refugee camps to monitor population risks of vitamin C deficiency and scurvy and to initiate a timely response.

3. Target identified population s at risk for scurvy with appropriate vitamin C interventions (including local fortification of commodities),

4. Improve the uniformity of blended food aid commodities by implementing specific produce and process procedures."

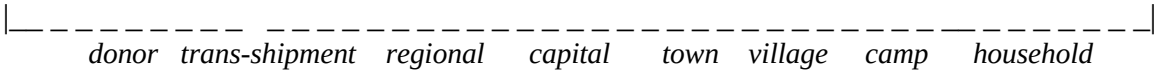
It goes on to recommend procedures that can promote uniformity of nutrient quality of foods, including: formulation documents reporting; product specifications; methods and statistical sampling and control procedures; and a hazards analysis critical control plan. The report also recommends that new research be undertaken to better understand approaches to camp-based vitamin C fortification: "This would be the most cost-effective approach to fortification."

XI. DISCUSSION AND GENERAL IMPLICATIONS

There is an important role for technical assistance to speed up the process of adaptation of fortification technologies in emergency-affected settings.

Uncertainty About Optimal Places to Intervene Along the Food Pipeline

Discussion about enrichment of foods tends to be inappropriately dichotomized two categories: donor-end or local; small scale or international. In fact, there are a wide range of options, reflective of the various points of transfer, illustrated below.



Formative research is needed to test the addition of premix by hand at local milling sites in refugee camps. Tests should be conducted to gauge the likelihood of compliance, the degree of human error, and identify what other impediments may reduce the prospects for wide-scale adoption of this approach. Tests should involve the hiring of mixers in camps who are guided to mix Roche micronutrient premix in to bags as they come out of the mill cyclones. These mixers should be blinded to the observations of their practice and of the overall quality control. Later they should be interviewed for their opinions about possible future obstacles.

Extensive research is needed in other parts of Africa to compare food industries, food storage, food fortification practices and the economics of production and distribution of relief foods.[140] In particular, refugee-prone areas of west Africa (i.e. Sierra Leone), southwest Africa (Angola), and southeast Africa (Mozambique) are important cases.

Research in other regions of Africa is also needed to identify and compare important food storage, Pilot projects are needed to test the technical options for initiating and sustaining fortification in displaced persons camps, in conflict zones and in post-crisis reconstruction. NGOs that bring in outside expertise on nutrition and administration are well-placed to shepherd such operational studies, but there are important reasons why they need to collaborate in doing so. A common methodology will allow NGOs to compare results across projects and across sites.

Governments in emergency-affected areas can play a lead role in seeing that grains are fortified, primarily in setting standards and developing a label system that will begin to educate their publics. Inter-ministerial national-coordinating committees have been formed to address iodine deficiency disease in numerous countries. Just as one example, the Government of Ethiopia, in its 1993 to 1995 Plan of Action for the Elimination of IDD, calls for a multi-pronged approach involving food quality control legislation, promotion of salt iodization at processing centers, feasibility studies, and consumer education using all available media.[141]

NOTES AND REFERENCES

[1] See for example, M Toole, P Nieburg, R. Waldman 1988 "The Association Between Inadequate Rations, Undernutrition Prevalence, and Mortality in Refugee Camps: Case Studies of Refugee Populations in Eastern Thailand 1979-1980, and Eastern Sudan 1984-85" *Journal of Tropical Pediatrics* Vol. 34:218-224.

[2] A key benchmark in this recognition was the publication in 1992 of "Micronutrient Deficiencies in Refugees" in *The Lancet*, written by Mike Toole of CDC, Vol. 339:1214-16.

[3] The declaration was the outcome of the December 1988 *Health Care for Displaced Persons and Refugees* Symposium held at Georgetown University.

[4] At the International Symposium on "Health Care for Displaced Persons and Refugees (December 1988), the *Georgetown Declaration on Health Care for Displaced Persons and Refugees* urging attention to primary health and nutrition priorities.

[5] See the Report of the International Symposium, *Responding to the Nutrition Crisis Among Refugees: The Need for New Approaches*, held March 17-20 1991, Oxford: Refugee Studies Program.

[6] Excerpts related to refugees and famines. from the Plan of Action for Nutrition, agreed to by 150 governments at the International Conference on Nutrition, held in Rome, December 1992:

> *Among refugees and displaced populations, high rates of malnutrition and micronutrient deficiencies associated with high rates of mortality continue to occur. The magnitude of the problem has grown over the last decade. Increased political commitment to an accountability for the protection and promotion of the nutritional well-being of refugees, displaced populations, those under occupation, prisoners of war and other affected groups are urgently required in accordance with international humanitarian law. Governments, in collaboration with the international community, should: (37)*
>
> *...Provide sustainable assistance to refugees and displaced persons and work to monitor and ensure their nutritional well-being, giving high priority to the control of diseases and to the prevention of malnutrition and outbreaks of micronutrient deficiency diseases. Wherever feasible, such assistance should encourage their ability to support themselves rather than increase their dependence on external assistance. The food provided should be nutritionally adequate and safe. (37(a))*
>
> *Governments should: (43)*
> *... Ensure and legislate for the fortification of foods or water with necessary micronutrients, where feasible, when existing food supplies fail to provide adequate levels in the diet. (43(f))*
>
> *... Recognize that refugees and displaced persons, as well as being susceptible to iodine, vitamin A and iron deficiencies, particularly vitamin B1 deficiency, niacin deficiency, and vitamin C deficiency. Donor countries and involved organizations must therefore ensure that the nutrient content of food used for emergency food aid meets nutritional requirements, if necessary through fortification or ultimately through supplementation. The extent possible, such foods should be culturally appropriate. (43(m))*

[7] Papers and consensus findings were published in 1995 by the University of Nairobi as *Report of a Workshop on the Improvement of the Nutrition of Refugees and Displaced People in Africa*, also available from the ACC/SCN in Geneva.

[8] See Refugee Nutrition Group 1997 "Food Security Assessments In Emergencies, Workshop Report" 1997, Amsterdam: MSF Holland.

[9] In August 1997, the Micronutrient Initiative of Canada, OMNI, Hoffman-LaRoche, Helen Keller International, ILSI, and the PAMM Project (Emory University) co-hosted a conference that looked at programs in a dozen countries in different parts of the world that have tested fortification of grains, condiments, starches, sauce, milk, cooking oil and margarine.

[10] Meanwhile, during the 1990s, WHO has built databases of the prevalence of deficiency diseases for most countries. These are referred to as the Micronutrient Deficiency Information System, which has produced Working Papers #1 (1994) and #2 (1995) on iodine deficiency and vitamin A deficiency.

[11] One of the first relief experts to emphasize this observation was CDC's Dr. Phil Nieburg; see, Nieburg, P., R.J. Waldman, R. Leavell, A. Sommer, & E.M. De Maeyer. 1988. "Vitamin A Supplementation for Refugees and Famine Victims." *Bulletin of the World Health Organization* 66 (6): 689-697.

[12] The key exception being where rural people are able to "cope" by resorting to consumption of wild, bush foods, including leaves, roots, nuts, and wild fruits.

[13] In most refugee and emergency situations the primary indicator of malnutrition status that is measured and tracked is weight-for-height -- as compared to age and sex standards.

[14] Variously interpreted as the endemic malnutrition rates among locals, or the estimated baseline rates from the sending communities, or, simply, somewhere around 5% of the under-fives population below -2 S.D. of NCHS norms.

[15] NGO field staff are now trained to anticipate and recognize nutritional deficiencies. Unlike ten years ago, there are now excellent mechanisms for summarizing and circulating reports from the surveillance data. Reports from specific countries exist, such as the 7 year-old bulletin produced in Mozambique, implemented by MSF and AEDES, *The Boletim Da Seguranca Alimentar: CIS-Conslolidated Information System.* At the international level, the Refugee Nutrition Information System (RNIS), based in Geneva at WHO headquarters under the auspices of the UN ACC/Subcommittee on Nutrition, summarizes data for emergencies in all of Africa.

[16] Vitamin A malabsorption occurs during infections with acute gastroenteritis, ascariasis, giardiasis, severe hookworm infestation, salmonellosis, and schistosomiasis. Respiratory infection also inhibits vitamin A absorption. Measles tend to precipitate blindness in children who are vitamin A deficient already.

[17] F Kavishe 1993 *From Vitamin A Projects to Vitamin A Programs: What Does It Take?* Presentation at the March 8-12 IVACG Meeting in Arusha, Tanzania

[18] It has been estimated that over two million lives could be saved globally each year through improved vitamin A consumption.

[19] While the most potent impact is from frequent low doses, vitamin A impact can be achieved through a single dose of 200,000 I.U. (or 100,000 for infants) of oral vitamin A. Retinol palmitate is also given intramuscularly.

[20] See the Micronutrient Initiative and WHO1998 *Safe Vitamin A Dosage During Pregnancy and Lactation, Recommendations and Report of a Consultation. Geneva.* Also, a recent *British Medical Journal* (1999, 318:570-5) provides data from a case-control trial among pre-pregnant women in Nepal, which found improved birth outcomes and reduced blindness.

[21] WHO 1993 *Vitamin A Supplementation and Childhood Pneumonia* Report of Expert Meeting in Geneva, February 1993. However, no protective effect has been noted on the incidence or mortality from pneumonia. Because frequent, low-dose vitamin A capsule distribution is effective, low-cost and available immediately, some argue that it should become part of the Expanded Programme on Immunization.

[22] These children had survived two years of famine and conflict and their continued survival was the objective of some $100,000,000 in food aid and a humanitarian military intervention ultimately exceeding $2 billion. The overall intervention and assistance cost approximately $10,000 to $40,000 per life saved. Vitamin A supplements costing just $.05 apiece, had they been distributed broadly, could have spared many if not most of the lives lost to measles.

[23] See for example, Helen Keller International, Bangladesh *Nutritional Surveillance Project* reports, which receive support from USAID. PO Box 6066, Gulshan, Dhaka 1212, Bangladesh.

[24] Bhutanese refugees in Bhutan, fleeing in 1990, receiving a diet lacking variety, were found to have beri-beri in ddition to pellagra , goiter and other deficiencies. Reported by Save the Children, U.K., via communication with Judith Moore of the U.S. Centers for Disease Control and Prevention.

[25] Paul Spiegel 1999 *General Findings on Health Information Systems in Refugee Camps throughout Thailand during the Post-Emergency Phase*, unpublished February 26, 1999 report from the US Centers for Disease Control and Prevention, refugee unit.

[26] Phil Nieberg , DT Allegra 1985 "Emergency Refugee Health Care: A Chronicle of Experience in Khmer Assistance Operation, Epilogue" Centers for Disease Control

[27] During 1989 and 1990 over 19,000 cases were reported, constituting the largest epidemic of Pellagra in decades. Curiously, although pellagra had not been a principle complaint in refugee situations previously, the UNHCR nutritionist had in fact predicted this epidemic in advance of it occurring, noting the lack of dietary diversity and the over-dependence on maize.

[28] Nicolini S, Male S, Rakotomalala C 1993 *Evaluation Rapide des Conditions de Vie et Des Besoins Essentiels des Refuges en Provenance du Togo* Geneva: UNHCR Technical Mission Report

[29] Tagwireyi J, Greiner T note that in Zimbabwe 83% of surveyed health clinics indicated frequent cases of Pellagra, 1994 *Nutrition in Zimbabwe: An Update* Washington DC: World Bank

[30] Surveys found scurvy in over 1/3 of camp residents: see Desenclos JC et al 1989 "Epidemiological Patterns of Scurvy Among Ethiopian Refugees" *Bulletin of WHO* 67:309-16

[31] Sally Dunbar 1984 "Malnutrition and Anemia Among Somali Refugee Children in Long Term Camps" *Disasters* 8/3/1984.

[32] See *Results Report on the Vitamin C Pilot Program*, September 1997, Submitted to the USAID for Consideration by the Committee on International Nutrition of the National Academy of Sciences, Prepared by SUSTAIN: Peter Ranum, Program Director, Francoise Chome, Deputy Program Manager; also, Institute of Medicine 1997 *Vitamin C Fortification of Food Aid Commodities Final Report* National Academy Press, Washington, D.C.

[33] Shaller J 1988 "Maternal and Child Health: Mozambique" Mission Report, Physicians for Human Rights

[34] Zinc has been among the least studied of deficiency diseases, but is believed to be almost as prevalent worldwide as iron deficiency. Zinc has been specifically studied in the Somali refugees in Ethiopia in Robertson J 1992 *Effect of Zinc Supplementation on the Weight Gain of Somali Refugee Children Recovering From Moderate Protein-Energy Malnutrition.* London: Save the Children, UK.

[35] Although zinc intake can show up in increased plasma zinc levels, dietary zinc deprivation may not reslt in lowered zinc levels.

[36] One of the best "net" assessments of the aggregate impact of a deficiency disease is Henry Levin's 1986 review article for the World Bank "A Benefit-Cost Analysis of Nutrition Programs for Anemia Production."

[37] Analysis from the AED Nutrition Communication Project 1993 publications on infant and young child feeding practices.

[38] M Rowland, T Cole, R Whitehead 1977 "A Quantitative Study into the Role of Infection in Determining Nutritional Status in Gambian Village Children" *British Journal of Nutrition* 37:441-450.

[39] An excellent reference on the whole emergency food aid pipeline is UNHCR 1989 *Supplies and Food Aid Field Handbook* which explains management of vehicle fleet, warehouse, distribution port, handling and commodity tracking. Micronutrients are mentioned in but one table.

[40] For example, the recent 1993 *InterAgency Assessment of Drought-Affected Districts in Kenya* is a recent state-of-the-art synthesis that impressed donors with its all-inclusive data reporting and regionally-specific analysis of food and population trends and malnutrition. Nevertheless, throughout the report the only "malnutrition" measurements made refer to child weights -- regarding protein-energy malnutrition. is In addition, early warning systems track carry-over stocks only in terms of the quantity of commodities stored, not the quality and ability of the foods to meet a range of dietary needs.

[41] NGOs and AID have produced countless documents of this sort. For example, see Farnham H, Halbert R 1992 *Liberia Trip Report* Los Angeles: International Medical Corps. For technical lessons on assessing population size and needs *Counting and Identification of Beneficiary Populations in Emergency Operations: Registration and its Alternatives*, John Telford, Sept. 1997, Relief and Rehabilitation Network Good Practice Review.

[42] While many NGO and UN guidelines reinforce the premise that feeding efforts fit neatly into "supplementary" and "therapeutic" feeding centers, emergencies force aid workers to be flexible and creative. Thus, "blanket" feeding has been introduced recently as a third category of distribution adapted out of necessity. In one Ethiopian refugee camp of 10,000 in the Sudan there were ten distinct activities involved in providing food to the refugees: the general ration given out once a month, a free milk-bar for all children, a special "meals on wheels" of daily lunches for the elderly, "supplementary" hot-feeding of meals to children and other medically-referred ill persons, "therapeutic" all-day hot feeding for children malnourished below 70th percentile, all day intensive feeding for refugees on 6-month tuberculosis therapy, meals for hospital inpatients, and dry take-home supplementary rations for pregnant and lactating women, dry food provisions to the camp orphanage, and vitamin C prophylactic supplements each week to all children. Each program was administered by different teams, each with its own separate preparation facilities.

[43] From a review of the literature, such as the anthology CDC 1989 *The Public Health Consequences of Disasters* Atlanta: US Department of Health and Human Services; Western K 1982 *Epidemiologic Surveillance after Natural Disaster* which only cites communicable diseases in reporting systems; or Sidel V 1993 "Public Health Responses to Natural And Human-Made Disasters" in *Health Care Planning, Organization and Evaluation*

[44] WHO 1999 Geneva, ISBN 92 4 154 511 9.

[45] See Medecins Sans Frontieres 1995 *Nutrition Guidelines* Paris: MSF, a widely-used text which represents the experience of many programs and organizations. It remains one of the best guides for initiating random-sample-based nutrition surveys in a well-defined refugee or emergency-affected community.

[46] In the field, the Oxfam guidelines are among the most used. See for example the 1996 update, *Notes on the Revised Oxfam Feeding Kits*, Oxford, UK.

[47] The WHO General Assembly's 1980 International Code of Marketing of Breastmilk Substitutes was later reinforced by similar codes within humanitarian aid organizations. The 1990 UNICEF/WHO *Innocenti Declaration* urged governments to adopt the code in its entirety as a minimal basis for national legislation.

[48] Pg. 21. of the Sphere project report "Humanitarian Charter And Minimum Standards in Disaster Response" Geneva; Steering Committee for Humanitarian Response.

[49] UNICEF 1986 *Assisting in Emergencies: A Resource Handbook for UNICEF Field Staff*, NY: UNICEF.

[50] See "an Evaluation of Germination of Pulses on the Vitamin C Content of Refugee Foods" *European Journal of Clinical Nutrition* Vol. 1 pp113-118.

[51] Medecins Sans Frontieres 1997 *Refugee Health: An Approach to Emergency Situations* London: MacMillan.

[52] Stevens, Luc. *Paper 7: WFP/UNHCR Collaboration in Providing Assistance to Refugees, Returnees, and Internally Displaced Persons.* Presented at the UNHCR Training Workshop on Tools and Strategies for Needs Assessment and the Management of Food and Nutrition Programmes for Refugees and Displaced Persons.

[53] Schofield, C. 1994 *Estimating the General Ration*" Presented at the Machakos Conference.

[54] The basis of calculations of iron requirements: = 7.5% (diets as in developing countries). The vitamin A requirement is expressed in terms of the Retinol Equivalent (RE) which is defined as: 1: g retinol = 1.0:g RE; 1:g beta-carotene = 0.167:g RE; 1:g other provitamin A carotenoids = 0.084:g RE.

[55] Periodic controlled studies in the US point to the value of the Women Infants Children (WIC) program -- which provides nutritional supplementation and micronutrients, in reducing mortality and disability. See for example Nancy Moss, Karen Carver 1998 "The Effect of WIC and Medicaid on Infant Mortality in the US" *American journal of Public Health* Vol. (9): 13541361, which finds that WIC support has a significant odds ratio of reduced risk of infant deaths.

[56] "As an index of severity of malnutrition, it also addresses the conceptual shortcoming that standardized prevalence and minimum prevalence are intended to overcome by not assuming that only those individuals below the cut-off are affected." WHO/Expert Committee 1995 *Physical Status: Use and Interpretation of Anthropometry* Geneva: WHO Technical Report Series #854 (pg. 221 out of 452 pages).

[57] A meeting was organized by 25 NGO and UN representatives in Nairobi on September 11, 1997 attended by regional food and logistics coordinators for UNICEF, CRS, MSF, ICRC, IFRC, ACF, CARE, Save the Children, and other NGOs.

[58] T Greiner 1993 Combining Short and Long-term Vitamin A Deficiency Control Programs

[59] Implemented in the Fao camps in 1985-86, an action taken after noting the lack of fruits and vegetables in most diets, and also in reaction to seeing Ethiopian refugees already with scurvy on first arrival at the camps.

[60] Specifically: ferrous sulfate and folic acid in tablet form should be provided daily from the fourth month of pregnancy until the sixth month of lactation; and, vitamin A capsules should be provided every, the frequency depending on the degree to which fortified foods are included in the ration.

[61] M Toole 1994 *Preventing Micronutrient Deficiency Diseases* A Background Document for the Machakos Workshop on the Improvement of the Nutrition of Refugees and Displaced People in Africa.

[62] M Golden, A. Breind, Y. Grellety. 1995 "Report of Meeting on Supplementary Feeding Programmes with Particular Reference to Refugee Populations" *European Journal of Clinical Nutrition* 49:137-145.

[63] Gerald Combs, Pat Dexter, Susan Horton and Ron Buescher 1994 *Micronutrient Fortification and Enrichment of PL 480 Title II Commodities: Recommendations for Improvement* Virginia: OMNI Project, John Snow Intl.

[64] By George Beaton, Fortification of Foods for Refugee Feeding, Final Report to the Canadian International Development Agency Ottawa: IDRC.

[65] Which were, by the way, predicted in advance by the UNHCR nutritionist, Angela Berry who, analyzing the WFP ration concluded that there was a significant shortfall in niacin available.

[66] R Merx 1998 *Provision of Blended foods and High Energy Biscuits in the Great Lakes Region-- Draft Report*, International Agricultural Center, The Netherlands.

[67] In terms of humanitarian expenditures, food aid costs dwarf any other cost. The cost savings that can be realized by reducing over-counting of refugees is dramatic. Hence, WFP will invariably be the strongest advocate for improving the precision and accuracy of population estimates/counts. Groups like CARE, Catholic Relief Services, World Vision and Oxfam frequently have the on-the-ground chore of conducting camp registrations/counts.

[68] This has been practiced in many places, including the Thai/Cambodian border, the Kenya/Somalia border and Pakistan.

[69] The World Food Program does have a published rationale for its aid o IDPs. Though not addressing nutrition per se, new *Guiding Principles on Internal Displacement*, 1998, have been published by UN OCHA, with input from the Special Representative to the UN Secretary General on Internally Displaced, as well as the Inter-Agency Standing Committee, of UN agencies, that regularly meets to consider approaches to IDPs in emergencies.

[70] As one example, see Susanne Jaspars 1994 *The Rwandan Refugee Crisis in Tanzania: Initial Success and Failures in Food Assistance* London: ODI, Relief and Rehabilitation Network Paper 6.

[71] One long-term nutritionist with experience in emergencies explained that localized fortification is necessary because "we can not predict where the food is coming from any more; the source of food is no longer necessarily Europe or America."

[72] At the conference held in Machakos, Kenya in December 1995, 140 nutritionists from the U.N. and NGOs agreed to stop instigating supplementary feeding programs in response to emergency nutrition needs. Instead, the same resources and planning would be directed to establishing and ensuring a nutritionally-adequate general ration.

[73] John Borton, Jeremy Shoham "Experiences of Nongovernmental Organizations in the Targeting of Emergency Food Aid" *Disasters* Volume 13(1): 77-92. They point out that the response to the 1983-86 famine was different in that greater volumes of food were distributed to people still in their normal place of residence as opposed to camps. In such non-camp situations, the standard means of setting up feeding kitchens is inappropriate.

[74] Roberta Cohen 1995 *Refugee and Internally Displaced Women: A Development Perspective* Washington DC: Brookings Project on Internal Displacement.

[75] In a solar box dryer, sunlight heats air which then draws the water out of foods. Because the hot and wet air escapes from the top, cool air replaces it from below. The circulation of air speeds the drying of foods on the drying tray.

[76] In fact, the entire ration may be obtained and even processed locally. Protein-rich legumes are regularly purchased in Uganda and Tanzania for distribution by WFP in emergency areas in the Horn of Africa and East Africa. UNICEF has found in its feeding programs in southern Sudan and southern Ethiopia that it receives much more value for dollar spent by buying food ingredients locally and contracting to have special ration mixes processed locally. This also provides foods with reduced transport costs and in a more timely fashion.

[77] For instance, food aid to Guatemalans in Mexico. NGOs working on a long-term basis within refugee camps frequently make ad hoc purchase of fresh fruits.

[78] It is quite common that the consequence of massive amounts of food aid to emergency communities is that the local price for the major foods sold (e.g. maize, vegetable oil) becomes very depressed, so that each refugee receives little from their transaction.

[79] Jean Rigal 1993 "Actualite de Carences Vitaminiques Historiques Parmi Les Populations Refugiees ou Deplacees" in *Sante Developpment*, 106:4-7.

80 Up to date comparison of all available micronutrient interventions is presented in McGuire, J 1994 *Enriching Lives: Lessons from Micronutrient Programs* World Bank Population Health and Nutrition Dept.

81 Ideally, indigenous health care networks can be built upon to ensure primary care to all emergency victims. See Kuntz D 1990 *Serving the Health Needs of Refugees in Malawi: An Integrated Approach* Washington, D.C: Refugee Policy Group

[82] David Ross, Betty Kirkwood et al 1995 "Child Morbidity and Mortality Following Vitamin A Supplementation in Ghana: Time Since Dosing, Number of Doses and Time of Year" *American Journal of Public Health* Vol. 85(9): 1246-1251.

[83] For example, there are strong arguments for providing iron via the EDTA molecule which is believed to be safe and to increase bioavailability.

[84] As well, nutrients are often lost in processing, which is why fortification becomes necessary. Fortification depends on finding effective substrates, protective coatings and fixitives, which do not adversely change the taste, appearance or smell of the food. Nutritionists have long felt that fortification is affordable, effective, and brings a high return on investment. Best, it can achieve a high population coverage, higher than other interventions that often depend on behavior change or direct service contacts by health workers.

[85] For an excellent and up to date overview of the elements of introducing fortification practices in developing countries, see FAO and International Life Sciences Institute 1997 *Preventing Micronutrient Malnutrition: A Guide to Food Based Approaches.*

[86] Janak Upadhyay,Ph.D., 1998, *Local Production of blended Food in Nepal.*

[87] In contrast, fortification of basic foods with micronutrients is such common practice in developed countries, that it is rarely debated. For example, in most European countries flour is fortified with Thiamin, Riboflavin, Pyridoxine, Niacin, Calcium and Iron.

[88] During the 1990s, studies by OMNI, the Micronutrient Initiative of Canada and private groups have looked at the feasibility, costs, and current practice of field-based fortification. During the last two years, it has become increasingly apparent that there are numerous low-technology, low-cost routes to achieving full fortification of grains with many micronutrients at once.

[89] Peter McKinley, Lilian Marovatsanga, Ruth Oniang'o 1998 *East Africa food Fortification Potential, Assessment Trip,* OMNI Project (USAID Funded), John Snow International.

[90] Conducted by a team including Steve Hansch, Quentin Johnson, Gabriel Maritim and Dayna Kerecman, which conducted technical review in the US and Europe and field investigations in a dozen refugee camps in East Africa, including refugees from the Sudan, Ethiopia, Somalia, Rwanda and Burundi. The study was administered by the Refugee Policy Group, in

working collaboration with CARE Canada, ACF, UNICEF and Makerere University. The overall research is part of a larger MI program area described in the information note, *Fortification of Foods For Refugee Feeding: An Idea Whose time Has Come.*

[91] Catherine Meers, Helen Young 1998 *Acceptability and Use of Cereal-Based Foods in Refugee Camps: Case-Studies from Nepal, Ethiopia and Tanzania* Oxfam Working Paper, Oxford, UK.

[92] See MI's report by Venkatash Mannar, Jenny Cervinskas, Ivan Mendoza, Noel Solomons 1996 *Inuiry into the Feasibility of the Nutrient Fortification of Processed Foods for Making a Contribution to Closing the Deficit of Micronutrient-Intake Towards Adequate Nutrition for Poor Communities of Rural Guatemala*.

[93] Aid workers have noted that there are numerous small hammer mills in even remote rural camps in central Africa; these can provide a locus for batch mixing of fortificants.

[94] World Vision Canada 1998 *Small Scale Mills Fortification Concept Paper in Malawi for Pilot Project.*

[95] ACC/SCN 1993, pg. 91.

[96] The Odjob mixing pail is based on a commercial product that mixes up to 60 kg of cement in 25 liter plastic pail. The premix is blended into maize. It has been tested in Zambia, and CARE Zimbabwe is preparing to test it.

[97] See Micronutrient Initiative *Double Fortification of Salt* March 1999 Information Sheet.

[98] Data on food cost variations are based on a 1990 study by Jim Fitzpatrick and Associates for the Food and Agricultural Organization, Food Aid Cost Effectiveness, *Report Prepared for The Food Security Service*, by Jim Fitzpatrick and Steven Hansch, which conducted statistical review of actual CIF billings to the USG and local food transport, handling and administration expenses by NGOs and WFP. Available from Jim Fitzpatrick Associates, Dublin, or FAO, Italy.

[99] Barbara Reed, 1996 *Study of Food Ration Usage and Income Generation Among Refugees in Camps of Uvira, Zaire.* Report to UNHCR, Geneva.

[100] J Mason, S Gillespie, G Clugston, P Greaves 1992 "Misconceptions on Nutrition of Refugees" *The Lancet* vol. 340:1354.

[101] S Hansch 1992 "Diet and Ration Use in Central American Refugee Camps" *Journal of Refugee Studies, 5(4): 300-312*

[102] A big political issue in providing relief to the Cambodian refugees; see Reynell J 1989 *Political Pawns* Oxford: Refugee Studies Program.

[103] Stone S McGowan J 1980 Wrapped in the Wind's Shawl: Refugees of SouthEast Asia and the Western World San Rafael, CA: Presidio Press

[104] From Wilson K, Cammack D, Shumba F 1989 *Food Provisioning Among Mozambican Refugees in Malawi -- a Study of Aid, Livelihood and Development* Oxford: Refugee Studies Program

[105] Christensen H 1984 *Afghan Refugees in Pakistan: From Emergency Towards Self-Reliance* Geneva: UNRISD

[106] Aguayo S, Christensen H, O'Dogherty L, Varese S 1987 *Social and Cultural Conditions and Prospects of Guatemalan Refugees in Mexico* Geneva: UNRISD note that fruit and tomatoes are purchased outside the camps and that local villagers give and sell fruit to the refugees. pg. 43

[107] One major coping strategy is parlaying relief assistance into a more varied diet. In Somalia Christenson noted that "Food being transported out of the camp could be observed... on the distribution day and continued for two to three days... caravans of donkey carts [or] ... camel-loaded caravans were observed." But Christensen finds that "The exchange of ...food appears to be a reasonable action. It improves the diet slightly. It brings variety to the menu" adding meat, cheese, sugar, tea and vegetables.

[108] For example, in the Liboi camp of Somalis in Kenya in 1992. Many other examples could be cited of camps where most of a particular food is sold because an advantageous swap is available given local markets.

[109] Many refugees living in camps receive significant financial support from family living in third countries. Lao refugees in Thailand receive the highest levels of cash assistance from relatives, from the U.S.

[110] Trading portions of the ration received to obtain clothes, locally-gathered fuelwood.

[111] For example, food rations may be provided only to refugees actually in the camp each week, acting as a break on refugees leaving camps to seek gainful employment elsewhere in the region.

[112] USAID has funded investigations into applying this knowledge to developing countries. See, for example: Neal Hammond, Willem Wurdemann, Anthony Adams March 1999 *African Micronutrient/Small Enterprise Activity Mission Report in Malawi,* Washington DC: SUSTAIN; 1997 *Fortification of Corn Masa Flour with Iron and Other Nutrients: A Literature and Industry Experience Review*, SUSTAIN; and the forthcoming Final Report of the Micronutrient Assessment Project, expected in May or June 1999.

[113] The soy-fortified foods become an "acquired" taste. They are sold or swapped in situations where they are delivered for enough years that a taste is developed for them, particularly among adults. This was observed in Somalia in the mid 1980s, in the Dominican Republic, and in West Africa. For example, CSM was reported "flowing into local markets" from Somali refugee camps in the 1993 *InterAgency Assessment of Drought-Affected Districts in Kenya*

[114] For further discussion, see WHO 1998 *Complementary Feeding of Infants and Young Children* a report from a 1995 Consultation Held in Montpellier France.

[115] From a map of Africa in C. Fishman, S. Hansch 1995 *Beyond Child Survival: An Assessment of Infant and Child Nutrition in Africa* Washington, DC: Academy for Educational Development.

[116] For example, the following Canadian companies fortify their Canola Oil for relief aid at CIDA's request. CanAmera Foods, >14711-128th Avenue, Edmonton, Alberta, Canada T5J 2K1; and, ADM Agri-Industries Ltd 4805-62 Ave, Lloydminster, Alberta, Canada T9V 2B3.

[117] Jack Bagriansky, Peter Ranum, Liz Turner, Teresa Lozeau 1998 *Vitamin A Fortification of PL 480 Vegetable Oil,* Washington, DC: NCBA/Sustain, under USAID contract.

[118] S Atwood, T Sanghvi, V Sharma and N Carolan 1995 "Stability of Vitamin A in Fortified Vegetable Oil and Corn Soy Blend Used in Child Feeding Programs in India" *Journal of Food Composition and Analysis* 8:32-44. The study found little settling out of vitamin A fortificant from the vegetable oil. It did find significant variation in the vitamin A levels of different delivered batches of Corn Soy Blend.

[119] Lora Iannotti, Margie Ferris-Morris, Kimberley Lucas, and Anbrasi Edward Raj June 1998 *Regional Profile: GHAI Linking Food Security and Nutrition A Paper compiled for USAID and the Greater Horn of Africa Initiative*.

[120] See World Health Organization Regional Office for the Eastern Mediterranean, 1995 *Iodine Deficiency, What it is and How to Prevent it* Alexandria, Egypt.

[121] Specifically, the conference report states: "all rations issued to refugees must contain adequately iodized salt. Adequately iodized salt means an iodine level of 50-100 ppm (or 50-100 mg of iodine per kilo of salt). The compound to be used must be potassium iodate only. One gram of potassium iodate contains .6 grams of iodine."

[122] For an excellent overview of the multiplicity of biscuits, see Helen Young 1986 "The Development of Aid Agency Policy on the Use of Iimported Biscuits in Emergency Relief" *Disasters* Vol. 10, #4.

[123] As such, biscuits are often used in school feeding programs. See L van Stuijvenberg, S Benade 1998 "Addressing Micronutrient Deficiencies in Primary School Children with Fortified Biscuits" in the July 1998 *SCN News,* ACC/Sub-Committee on Nutrition.

[124] US Department of Defense, November 1997, *Memo: Information Paper, Nutritional Review of the Humanitarian Daily Ration (HDR).*

[125] Example: UNGA split its operations into wheat milling, cereal processing, maize milling and animal feeds.

[126] For some technical advice on quality assurance, see "Quality Assurance Project" at University Research Corporation in Bethesda, Maryland (Attention: Wayne Stinson, fax: 301-941-8427, http://www.urc-chs.com).

[127] The bucket elevator allows the doser to hit conveying food, common before pneumatic processes. However, the problem at UNGA is that it's almost impossible to ever fully clean out bucket elevator boot; hence it becomes an infestation trap.

[128] For example, see: Food and Agriculture Organization 1996 *Food Fortification Technology and Quality Control, Rome,* Italy: Food and Nutrition Paper # 60

[129] Pat Dexter writes: "The 19th Session of the CAC(1991) adopted the Guidelines on Formulated Supplementary Foods for Older Infants and Young Children, with the objective of facilitating the preparation of supplementary foods from locally available material. Processed cereal-based foods are best known and most widely used. The Guidelines included guidance on technical nutritional aspects including the addition of vitamins and minerals. Reference daily requirements for older infants and young children are provided in the guideline. In addition, a Standard for Processed Cereal-Based Foods (CODEX STAN 74-1981) has been developed for foods prepared essentially from one or more cereals and/or starchy root products that are used as supplementary foods. Vitamins and minerals and iodized salt are to be added in conformity with national legislation where the product is sold. To avoid overlap between the Guideline and the Standard, there was discussion to integrate the Guideline into a single Standard. The Commission however, later proposed that they remain separate and that the Standard for Processed Cereal Based Foods be revised." In Pat Dexter 1995 *Requirements for Effective Fortification in Food Aid Programs, FAO Technical Consultation* Rome, Italy: FAO, and University of Arkansas.

[130] See for example, GF Combs, RM Welch, JM Duxbury, N Uphoff and MC Nesheim 1996 *Food-Based Approaches to Preventing Micronutrient Malnutrition: An International Research Agenda* Ithaca, New York: Cornell University.

[131] For a field-based inquiry into food selection and breastfeeding practices in a resource-poor crisis, see Mary Lung'aho, Brenda Clause and Francois Butera 1996 *Rapid Assessment of Infant Feeding Practices in Two Rwandan Refugee Camps* Wellstart International.

[132] Stevens, Luc. *Paper 7: WFP/UNHCR Collaboration in Providing Assistance to Refugees, Returnees, and Internally Displaced Persons.* Presented at the UNHCR Training Workshop on Tools and Strategies for Needs Assessment and the Management of Food and Nutrition Programmes for Refugees and Displaced Persons.

[133] In Mesa Grande 11,000 refugees grew all their own fresh vegetables through large, in-camp communal gardens: Aga Khan S 1986 *Refugees: Dynamics of Displacement* London: Zed Books

[134] See Calloway, D. H. March 1995. Human Nutrition: Food and Micronutrient Relationships. Working Papers on Agricultural Strategies for Micronutrients, No. 1. Washington, DC: International Food Policy Research Institute.

[135] At IFPRI contact Howarth Bouis for more information: 202-862-5641, or Marie Ruel.

[136] Effort to "close" or "close off" a refugee camp typically fail to really shut down trade between the camp and local populations. Instead, the primary effect is to increase the transaction cost to the refugees and locals, causing greater un-recovered expense and reduced total purchasing power, decreasing their diet. Virtually every refugee camp on record has some indigenous market system: stores, stalls, or tea shops established in their first week of existence. Where markets are prohibited, these entities merely go underground. Within one or two years, large refugee camps will have a thriving marketplace for trade, as any densely-concentrated village will. Indeed, because many refugee camps are more densely settled than local populations, often economies of scale works to lead major trade networks to locate their regional hub within a refugee camp.

[137] S Hansch 1992 "Food Acquisition Strategies of Central American Refugees" in *Journal of Refugee Studies*, Winter issue

[138] Peter Ranum, Francoise Chome 1997 *Results Report on the Vitamin C Pilot Program* Washington DC: Sustain.

[139] IOM study, "Vitamin C Fortification of Food Aid Commodities." NAS 1997.

[140] See for example, David Sahn, R Pestronk 1981 *A Review of Issues in Nutrition Program Evaluation: A.I.D. Program Evaluation Discussion Paper No. 10*. Washington D.C.: U.S. Agency for International Development, which evaluate USAID support fortification initiatives in Guatemala, Java, India, Philippines, Tunisia, and Thailand.

[141] Transitional Government of Ethiopia UNICEF July 1993.