UNITED REPUBLIC OF TANZANIA

Action plan for enrichment of staple foods

Enrichment

Provision of Vitamins and Minerals

Fortification

Plan

Food Enrichment

Action Plan

For the

Provision of Vitamins and Minerals to the Tanzanian Population through the Enrichment of Staple Foods

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Executive summary

The United Republic of Tanzania has a severe vitamin and mineral deficiency problem. Every year deficiencies in iron, vitamin A and folic acid cost the country over US$ 518 million, around 2.65 % of the country's GDP.[1] Beyond the economic losses, vitamin and mineral deficiencies are a significant contributor to infant mortality, with over 27,000 infant and 1,600 maternal deaths annually attributable to this cause.[2] In fact, if all of these deaths could be avoided, the infant mortality rate (IMR) in Tanzania could be reduced to 41.5 per 1,000 population, which would virtually ensure achievement of the MDG goal for IMR (40/1,000).

To reduce this huge annual loss, an integrated national vitamin and mineral deficiency control programme is needed which is embedded in the national nutrition policy. Food fortification or enrichment should be an integral but not the only part of such a programme.

Table E.1 summarizes the food vehicles considered and their attributes for enrichment in Tanzania.

Table E.1 Chosen food vehicle's projected coverage and feasibility

Food vehicle	Projected coverage	Feasibility
Wheat flour	14 million mostly adults	++++ immediately doable
Maize flour	23 million all ages	++++ industrial +++ commercial hammer mills
Vegetable oil	>30 million	++++ large processors ++ small crushers (needs analysis)

Wheat flour and maize flour in large industrial mills are the most immediately feasible because there are a small number of mills plus many have the equipment in place to enrich. The small and medium size maize millers in the Dar es Salaam area are an important part of the milling sector because of their coverage and distribution of commercially produced maize flours.

1. The large vegetable oil processors are considered to be quite feasible; however there are a number of small and medium scale processors

[1] Based upon the cost benefit analysis provided by the authors, see also VMD Report MI Website www.micronutrient.org

[2] based upon the cost benefit analysis and UNICEF VMD reports

which service the oil market in Tanzania, particularly in the Mwanza and Singida regions where cotton and sunflower are grown respectively.

It is recognized that large scale food fortification will not reach all the population of Tanzania unless special efforts are made in this regard. Further work is needed on cost-effective and sustainable approaches. An estimated 17 million people use maize from home milling or small millers not supplied by the mills in Dar es Salaam, or consume other staple foods such as cassava, bananas and other crops which cannot be directly fortified. An additional component will need to be added to the programme that is targeted at the following groups:

- Those consuming other staples, i.e. cassava, bananas, sorghum etc.
- Those processing maize at the household level or in rural mills
- Those (and their families) living with HIV/AIDS
- School children and children under 5 years old

Options for providing micronutrients to this population include:

- Home fortification mix (a premix added directly to cooked food at the household level
- Fortified complementary foods for both People Living with HIV/AIDS (PLWHIV/AIDS) and children
- Fortified foods for school children feeding programmes

The net economic benefit of food enrichment in Tanzania is considerable. As shown in Table E.2, $1 invested in food enrichment in Tanzania can result in an economic return of $ 8.22 or an increase in GDP of 0.58%. In addition, it is estimated that almost 6,800 deaths per year would be averted.

Table E.2. The net economic benefits of food enrichment in Tanzania

COMPONENT	Amount	Percent of GDP
Benefits: Annual averted attributable losses due to deficiencies	**$126.8 million**	**0.65%**
Costs: Annualized costs Enriched Food Investment	**$ 13.8 million**	**0.07%**
Net annual benefit	**$113.0 million**	**0.58%**
Estimated lives saved annually	**6,767**	

The consumer ultimately pays for the enrichment through a one-time cost increase. However, it should be noted that the price of maize can vary during the year by as much as +/- 15% compared to a one time increase in enrichment costs of less than 1%. If all of the cost is passed along to the consumer, the

extra cost for eating foods from fortified maize, wheat and oil should be only around Tsh. 1,025 per person per year.

Successful and sustainable food enrichment programmes are characterized by initial investments by development partners followed by equitable investments and sharing of costs by the government, consumer and industry. An appropriate distribution of costs needs to be agreed among the various partners as an essential next step in the process.

The fortification action plan contained in this document outlines the key steps that are needed to make food fortification a reality in Tanzania. The following are some of the specific actions that are needed:

1. **Production and distribution of enriched foods** including: recruiting producers, producer certification and training, finalizing equipment needs, developing national specifications for fortificants/premixes, procuring and importing premix, and establishing distribution channels for special target groups.

2. **Quality monitoring and legislation** including: developing national standards and regulations, developing legislation mandating enrichment of wheat, maize flour and edible oil, developing quality assurance (QA) and quality control (QC) protocols for producers and food and drug authorities, implementing QA\QC training for producers, integrating enriched food inspection systems and procedures in the existing systems, implementing training programmes for food inspectors, developing food sampling and micronutrient analysis programmes in relevant public health laboratories, assessing the equipment needs for enhancing testing capacity, implementing food control systems including publication of assessments and corrective actions taken as appropriate.

3. **Social marketing and communications** including: advocacy seminars, developing communications and social marketing strategies to inform the public about the health benefits of enriched products, developing and field testing logos for enriched products, social marketing campaigns to promote recognition of logo's and implementation, demand creation for fortified products to underpin the production of good quality fortified foods and information to the public on the benefits of enriched products, and sensitization of wheat and maize millers, and oil producers.

4. **Monitoring and surveillance** including: development of a monitoring and evaluation plan to include all enriched foods, including iodized salt, implementation of the M & E plan, establishing a registration of neuro tube defect (NTD) incidence at major hospitals and inclusion of NTDs in routine reporting.

5. **Programme management** including: strengthening the National Food Fortification Alliance (NFFA) including expansion of membership and high level mandate and executive powers, establish working groups by activity/food vehicle, establishing an enrichment programme manager and support staff and needs, establishing coordinating mechanisms and overall programme management.

This action plan was discussed at a technical stakeholders' workshop in May, 2009, and was endorsed by a High Level Forum (HLF) on September 10, 2009. From these and other deliberations, it is clear that multisectoral action is needed to make food fortification a reality. However, it is also clear from the potential benefits from such a program that such action will pay off handsomely both in terms of health and economic impact. The consensus opinion from the HLF was that the sooner that these actions are completed, the sooner that all Tanzanians will enjoy these benefits.

The following key points were made during the HLF:

> *… a concerted effort is needed by all stakeholders to implement the Food Fortification Action Plan and get started on food fortification in Tanzania. An important outcome of this meeting should be the endorsement of the action plan by stakeholders, and a consensus on the essential next steps and the timetable for moving forward quickly with this essential intervention. To be successful, this will also require commitment to a financial investment by all stakeholders – government, development partners, food industry and the consumer – and obtaining this commitment will be an important next step.* The Chief Medical Officer, as chair, on behalf of the Permannent Secretary, Prime Minister's Office.
>
> *There is need to work in partnership with the private sector. The local milling industry needs support with better quality processing to add valuable micro-nutrients. We need to work … with other development partners … and with civil society to educate the public on the value of fortified foods. Food fortification is a whole industry, but a legislative and regulatory framework is crucial to impose discipline and standards.*
> *… Most fortified foods used by WFP in Tanzania are imported off-shore. Why can't these be manufactured locally to benefit from WFP's policy for local food procurement (P4P)? Tanzania has potential to be source of fortified foods for WFP programmes in the region.* Mr. Ronald Sibanda, the Resident Representative of the World Food Program, on behalf of the development partners.

The NFFA is convinced that, fortification is, definitely going to significantly mitigate micronutrient deficiencies and save the many lives lost every year, but also improve health status of our people … the discussion on food fortification must take a human face so that people can understand how big the problem is. The difficult social and economic situation of most Tanzanians contributes strongly to the growth of the problem, since people are unable to get food enrichment. Mr. Linus Gedi, chair of the NFFA.

1. Introduction

The United Republic of Tanzania has a severe vitamin and mineral deficiency problem. Every year deficiencies in iron, vitamin A and folic acid cost the country over US$ 518 million, around 2.65 % of the country's GDP[3]. Beyond the economic losses, vitamin and mineral deficiencies significantly contribute to infant and maternal mortality, with over 27,000 infant and 1600 maternal deaths, or 28,600 total deaths annually attributable to this cause[4]. Increased intake of essential vitamins and minerals, such as iron, improves cognitive function and intellectual capacity of children and work performance of adults. Hence improving the nutritional status of Tanzanians could help Tanzania to achieve commitments under the Millenium Development Goals (MDGs) 1 and 2 as well (see Table 1.1). In fact, if all of the deaths could be avoided, the infant mortality rate (IMR) in Tanzania could be reduced to 41.5 per 1,000 population, which would ensure achievement of the IMR goals under the National Strategy for Growth and Reduction of Poverty (NSGRP) and virtually ensure achievement of the MDG goal for IMR.

Table 1.1 Micronutrient deficiencies and the Millennium Development Goals (MDG's)

MDG 1: Eradicate extreme poverty and hunger	Micronutrient deficiencies erodes human capital through irreversible and intergenerational effects on cognitive and physical development
MDG 2: Achieve universal primary education	Micronutrient deficiencies affect the chances that a child will go to school, stay in school, and perform well.
MDG 3: Promote gender equality and empower women	Anti-female biases in access to food, health and care resources may result in micronutrient deficiencies, possibly reducing women's access to assets. Addressing micronutrient deficiencies empowers women more than men.
MDG 4: Reduce child mortality	Micronutrient deficiencies are directly or indirectly associated with most child deaths, and are the main contributor to the burden of disease in the developing world.
MDG 5: Improve maternal health	Maternal health is compromised by micronutrient deficiencies, which is associated with most major risk factors for maternal mortality. Maternal stunting and iron and iodine deficiencies particularly pose serious problems.

[3] based upon the cost benefit analysis provided by the authors
[4] based upon the cost benefit analysis and UNICEF VMD reports

MDG 6: Combat HIV/AIDS, malaria and other diseases	Malnutrition may increase risk of HIV transmission, compromise antiretroviral therapy, and hasten the onset of full-blown AIDS and premature death. It increases the chances of tuberculosis infection, resulting in disease, and it also reduces malaria survival rates.

Adapted from World Bank 2006. Repositioning Nutrition as Central to Development. A Strategy for Large-Scale Action. (Washington D.C., The World Bank).

2. The current burden of vitamin and mineral deficiencies

Vitamin A

Vitamin A deficiency (VAD) is the leading cause of visual impairment and preventable blindness and increases the risk of disease and death. The National Vitamin A survey of 1997 found that 24 % of children had low serum retinol while 69 % of women had low breast milk retinol, indicating that Vitamin A deficiency is a significant public health problem.

Visual impairment and preventable blindness caused by vitamin A deficiency has obvious consequences on school achievements, productivity and future earnings.

Vitamin A deficiency significantly increases the risk of morbidity and mortality from common childhood infections such as diarrhoea and measles.

According to the 2005 Demographic Health Survey (DHS), only 52% of the children in rural areas consumed fruits and vegetables rich in vitamin A in the previous day. In urban areas this is 61%. Some differences in consumption were also observed along wealth and education lines.

In Tanzania the national vitamin A supplementation (VAS) programme has been one of the reasons behind the drop in infant mortality rates from 156 in 1995-99 to 112 in 2000-04. However a VAS programme alone is not sufficient as it is merely trying to control the problem, not eliminating it. In addition, VAS is a focused intervention with special target groups and does not reach the entire public, including adult women and men.

Iron

Iron deficiency has multiple negative impacts on survival, health, productivity and learning capacity. It contributes to maternal and perinatal mortality (approx 20% of deaths) and leads to a 17% loss of productivity in heavy manual labour and a 5% loss of productivity in light manual labour.

Further, iron deficiency at key stages in foetal life and early childhood is associated with cognitive losses that are often irreversible. Limited intervention trials suggest that anemia is associated with a 0.5 standard deviation (SD) lower score on cognitive tests in children which is associated with 4% lower wages as adults.

In Tanzania 73% of rural children, 66% of children who live in urban areas and 48% of women aged 15-49 are anemic. Anemia is even higher among pregnant women (58%). Although iron supplements are given to pregnant women (61% coverage) then adherence is low. Only 10% of women receiving supplements take them for the recommended 90+ days (DHS 2005).

Even though anemia can be caused by a variety of factors, in Tanzania about half of the anemia prevalence is due to iron deficiency.

However for each person suffering from iron deficiency anemia, there is another who is already iron deficient although not classified as anemic. This

means that virtually all women and children in Tanzania are at risk of iron deficiency.

Folic acid

Women of childbearing age need folic acid before pregnancy and in the first weeks of pregnancy to help prevent neural tube defects (NTD). NTDs are the leading cause of preventable birth defects and a significant cause of perinatal mortality.

The limited data available on NTD incidence in Africa suggest that rates are similar to or higher than those in other regions. A study in Dar es Salaam estimated a rate of 3.02 NTD's per 1000 live births (Kinasha and Manji, n.d.). A combination of folic acid enrichment and supplementation before and in the early stages of pregnancy can prevent NTD's. Studies in Canada, Chile, South Africa and the USA have demonstrated the effectiveness of folic acid enrichment. Folic acid supplements are routinely given to pregnant women at antenatal care service, however the coverage is not sufficient (61%) and 80% of women make their first visit after the first trimester of pregnancy[5]. Given that folate is needed within 3 weeks of conception[6], the folic acid administered at the antenatal care services will have no reducing effect on the burden of neural tube defects and perinatal mortality.

Zinc and B-vitamins

Zinc deficiency has a negative impact on immune status and growth of children as well as maternal health and pregnancy outcomes.

Zinc deficiency contributes to an increased risk in the incidence of infectious diseases in children such as diarrhoea, pneumonia, malaria and measles. In recent analyses, zinc deficiency was found to contribute to 3.8% of the burden of disease among children aged 6 months to 5 years and to account for 14.4% of all deaths by diarrhoea, 10.4% of malaria deaths and 6.7% of pneumonia deaths in this age group[7].

Zinc deficiency has also a highly significant negative effect on linear growth in children under-5 which is associated with poor early childhood development and poor school achievement.

Maternal zinc deficiency is also associated with preterm and prolonged labour, pregnancy induced hypertension, preeclampsia and an increased risk of postpartum infections. In addition children born by mothers with zinc deficiency have been found to be at a greater risk of intrauterine growth

[5] National Bureau of Statistics and Macro International Inc. Tanzania Demographic and Health survey 2004-05. Calverton, MD. 2005

[6] Scott J. M. et al. The role of folate in the prevention of neural tube defects. *Proceeding of the Nutrition Society*. 1994;53:631-6

[7] Fisher Walker C.L., Ezzati M. and Black R. E. Global and regional child mortality and burden of disease attributable to zinc deficiency. Eur J Clin Nutr 2009:63:591-97

retardation, low birth weight babies, poor fetal neurobehavioral development and increased neonatal morbidity.

According to estimates by the International Zinc Consultative Group, 37.5% of the Tanzanian population is at risk of inadequate zinc intake. This prevalence places Tanzania into the 'high' risk category for zinc deficiency.
Little is known about the prevalence of other micro-nutrient deficiencies in Tanzania, but the nature of most diets; undiversified, low in animal products and high in plant sources that are rich in anti-nutrients, makes it likely that zinc and vitamin B1 and B2 deficiency are a public health problem. Niacin deficiency has also been reported in Tanzania (E. Malangalila, personal communication). The cost of adding these nutrients to a fortificant mix is almost negligible at scale.

Iodine
Iodine deficiency is the leading cause of preventable mental retardation. Iodine is required for the production of thyroid hormones which are essential for normal brain development, hence when iodine deficiency occurs during fetal and neonatal growth and development there are large and irreversible damages made to the brain and central nervous system. As a result maternal iodine deficiency leads to increased perinatal and infant mortality, congenital abnormalities of the infant, cretinism and/or psychomotor defects[8]. Iodine deficiency also causes goiter, hypothyroidism, impaired mental function and retarded physical development in children, adolescents and adults.

In the 1980's, it was estimated that 41% of the population on mainland Tanzania lived in geographic areas subject to iodine deficiency[9]. Efforts were made to eliminate iodine deficiency and as a result reducing goiter prevalence from 25% in the 1980s to 7% in 2004.

In general
Vitamin and mineral deficiencies compromise the economic development of most developing nations, causing a loss of up to 2% of their gross domestic product (GDP). Applying the global knowledge of the impact of vitamin and mineral deficiencies to the specific data available for Tanzania, it is estimated that the economic losses (due to iron, vitamin A and folic acid only) amount to over $518 million annually (based on the cost benefit analysis carried out by the authors). Annex 1 provides the detailed calculations of the cost to Tanzania of the current levels of vitamin and mineral deficiencies.

[8] WHO/UNICEF/ICCIDD: *Assessment of iodine deficiency disorders and monitoring their elimination: A guide for programme managers.* Third edition. Geneva: WHO; 2007
[9] Kavishe F, Maletnlema T: Iodine deficiency disorders in Tanzania. In *Iodine deficiency disorders in the region Eastern, Central and Southern Africa. Volume NINI/ICFSN public No.5* Edited by: van de Haar F, Kavishe F. Wageningen: Netherlands International Nutrition Institute/ International Course in Food Science and Nutrition; 1987:51-65.

3. Rationale for an integrated nutrition programme

To reduce the huge annual losses and human suffering caused by vitamin and mineral deficiencies, a national control programme and action plan needs to be integrated with current strategies which should be embedded in a national nutrition policy. Since the year 2000, bi-annual campaigns aim to provide vitamin A supplements and de-worming tablets to all children aged 6 months to five years. The 2004/05 DHS indicated that 45.5 % of children received a vitamin A supplement in the previous 6 months, although the 2009 Health Sector Performance Report indicates that the proportion of children younger than five years old who received vitamin A twice per year has increased from 92% in 2003 to 98% in 2007. The latter figure is based on administrative data. Vitamin A is also given to women after delivery to replenish their body stores and to assure sufficient amounts of vitamin A in breast milk. According to the 2004/05 DHS, only one in five women actually received the recommended single postpartum dose of vitamin A. These findings illustrate the difficulties in delivering supplements to all those who need it. Other solutions such as enrichment of staple foods are required to improve the dietary intake of vitamin A.

Similarly, women should receive folic acid and iron before they get pregnant to benefit from the protective effect of these micronutrients. This cannot be achieved through supplementation, since many pregnancies are not planned.

The very recent global multi-partner "Scaling up Nutrition: A Framework for Action" highlights the importance of cost-effective interventions such as the planned Tanzanian food fortification program. In addition, Save the Children's "Hungry for Change, an eight–step, costed plan of action to tackle global hunger" includes food fortification as an important part of a national nutrition strategy as does the 2009 World Bank's "Scaling up Nutrition – what will it cost", the 2006 World Bank "Repositioning Nutrition as Central to Development – A Strategy for Large-Scale Action" and the Tanzanian specific 2007 World Bank report "Advancing Nutrition for Long-Term Equitable Growth".

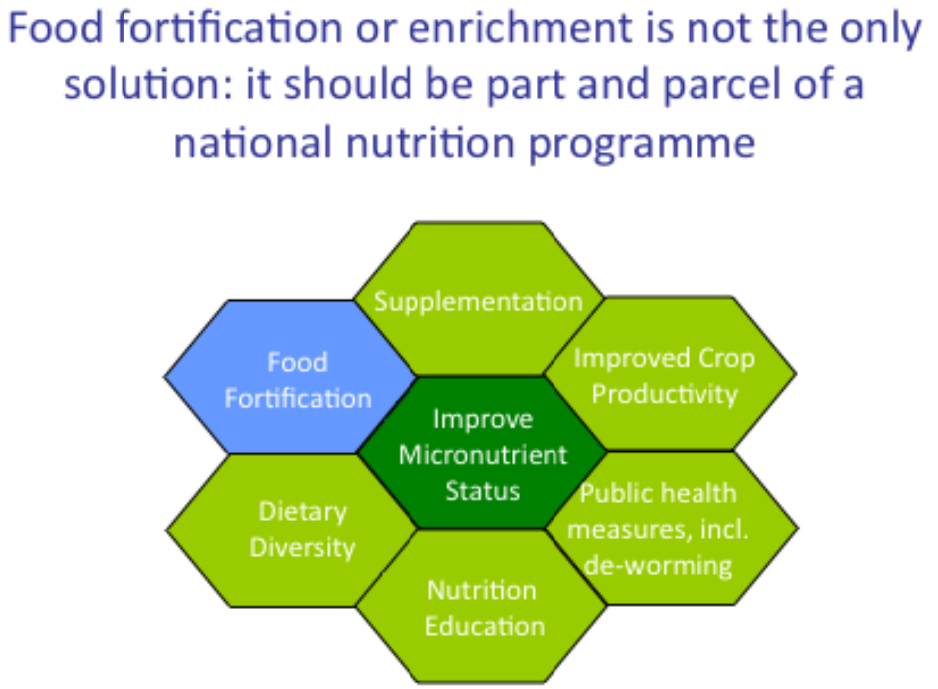
As will be shown below, enrichment of essential food items such as wheat and maize flour, cooking oil, as well as expanding the current salt iodization can reach more than half the Tanzanian population with essential vitamins and minerals, including iron, iodine, folic acid, vitamin B12, zinc and vitamin A.
This programme will however not reach the poorest of the poor in rural areas. It is important that other measures are taken to address specific risk groups through other, more labour and cost intensive strategies. This will be discussed in the gap analysis.

The diagram below shows that food fortification or enrichment should be an integral but not the only part of an integrated nutrition policy. The objective of

an integrated national nutrition policy is to sustain a healthy productive population. This requires 6 components, which are made up of:

- Supplementation of micronutrients to targeted populations such as children under 5 and women of child bearing age
- Improved crop productivity
- Public health measures including de-worming, support to breastfeeding, and vaccination programmes
- Nutrition education of school age children, men and women
- Dietary diversification, which is a long term strategy
- Food fortification or enrichment

It is critical that all these components be applied equally to have the required impact and they cannot be mutually exclusive. However the components that are not related to food fortification will not be dealt with in this Action Plan as they will be addressed in the National Nutrition Strategy which is expected to be finalized in the near future.



Source: J.P. Pena-Rosas, WHO Geneva 2008

4. History of enrichment in Tanzania

In 1998, USAID's Opportunities for Micronutrient Interventions (OMNI) project sponsored a food fortification assessment mission in Tanzania with a focus on vitamin A. Possible food vehicles identified were: maize flour, sugar, vegetable oil and wheat flour. A project to enrich maize flour processed in hammer mills was initiated in 2000 with support from the UN Foundation through UNICEF in Mazombe and Mlolo divisions in Kilolo district, Iringa. In 2002, World Vision Canada started a similar project in Korogwe as part of its Micronutrient and Community Health programme (MICAH). These interventions included a number of studies as well an assessment of the availability, physical state and management of hammer mills. In addition, Tanzania has an active salt iodization programme that currently covers 83.6% of households with iodized salt[10], however only 43% of the salt is iodized within the acceptable range[11]. Although the national iodine deficiency control program in Tanzania is operating in the right direction, currently, a large proportion of the salt producers iodize salt using very basic technology such as back-pack sprayers and there is a great deal of movement in and out of the industry by small producers. An extensive situation analysis is being done to determine the main issues hampering progress in the current programme, what new technology can be utilized to improve the spraying practices and thus the quality and what needs to be done to reach the 30 % currently not consuming iodized salt. The Micronutrient Initiative and the United Nations Children's Fund (UNICEF) are currently supporting this programme.

More recently, the process of developing the Fortification Action Plan (FAP) included the following important milestones:

- November, 2008 – International Food Fortification workshop in Arusha raised awareness and helped jump-start the process
- February-April, 2009 – two consultants financed by the World Bank began drafting the action plan together with stakeholders
- April, 2009 – the "Strategic Alliance for the Fortification of Oil and Other Staple Foods" (SAFO) workshop to review oil fortification approaches
- May, 2009 – Technical Review Meeting – members of the National Food Fortification Alliance and other stakeholders reviewed the draft action plan and provided comments on the next steps
- June-August, 2009 – revision of the FAP, including updating of the cost-benefit analysis
- September 10, 2009 -- High Level Forum, under the auspices of the Prime Minister's office, with representatives of key ministries, industry, the media and civil society

[10] Assey VD, Peterson S et al. Tanzania national survey on iodine deficiency: impact after twelve years of salt iodations. BMC Public Health 2009;9:319-330

[11] Assey VD, Mgoba et al. Remaining challenges in Tanzania's efforts to eliminate iodine deficiency. Public Health Nutr. 2007;10:1032-1038

- September-October, 2009 – Tanzania delegation attends the East, Central, and Southern African Health Community (ECSA) meeting on fortification and standards in Nairobi, and endorsed the decision to harmonize the WHO guidelines and current regional standards
- October-December, 2009 – Fortification Action Plan revised to incorporate the discussions and agreements at the HLF, as well as internal technical review within the World Bank.
- December 22, 2009 – the World Bank Board approves Additional Financing for the Tanzania Health Sector Development Project, Phase II, in the amount of $40 million, of which **$2 million is to support the implementation of the Fortification Action Plan**.
- February, 2010 – a working group is established, chaired by the Director of Policy and Planning, Ministry of Industry and Trade Facilitation, to guide the implementation of the Additional Financing food fortification activities.
- March, 2010 – the Government of Japan approves a **$2.69 million grant** to support sustainable approaches to rural food fortification.

5. Policy basis

The United Republic of Tanzania endorsed the commitment at the World Food Summit and the World Summit for Children, that several forms of malnutrition including micronutrient deficiency should be eliminated. The commitment of the government for ensuring food quality and nutrient content of food is also implied in the National Health Policy of 2002, which specifically mentions salt iodization. The Food & Nutrition Policy, which was written in 2005 but still has not been endorsed also explicitly mentions food fortification as a strategy to combat vitamin and mineral deficiencies. Similarly, Tanzania is signatory to resolution ECSA/HMC46/R10 that was adopted at the 46th Conference of ECSA-HC Health Ministers in February 2008 and which among others urges Member States to:

- Adopt and support implementation of ECSA food enrichment guidelines by end of 2009 and
- Allocate/increase financial resources by at least 20% within the next two years, for nutrition with a focus on micronutrients interventions such as Vitamin A supplementation, iron and folic acid supplementation, **fortification** and other food-based interventions in health budget/basket funds to ensure sustainability and reduce donor dependence.

In addition, the National Nutrition Strategy for 2009-2015, mentions food fortification as a potential strategy to reduce the prevalence of micronutrient deficiencies in Tanzania. The strategy aims at ensuring that legislation, regulations, standards and guidelines are set in place for fortification of appropriate food vehicles; a quality assurance system is established at critical control points and the undertaking of social marketing of fortified foods among consumers.

The above policy and regulation therefore show a strong commitment of the government on controlling micronutrient deficiency, thereby providing opportunities for all related institutions and sectors of the government, related industries and services, research centres and both local and international NGOs for building a better partnership for controlling micronutrient deficiency in the country.

6. Proposed food vehicles for enrichment

According to Lotfi et al. (1996), the rationale reasons to identify potential food vehicle for food fortification programs are: 1) The food vehicles should be consumed by a sizable proportion of the population. 2) The fortified products should be inexpensive, so that it is consumed by the low-income groups, which are more vulnerable to malnutrition. 3) To have a better control management, the food vehicles should be processed centrally in large scale. 4) The products should be distributed through a widespread network so that it reaches all part of the country. 5) There should be no change in taste, appearance, or color on food fortification. 6) There should be minimum loss of the nutrients on further processing/cooking of the foods. 7) The vehicles should be consumed in fairly constant amount so that fortificant dosages can be accurately calculated. These criteria are usually adopted by many countries in implementing mandatory food fortification programs. The choice of a food vehicle to enrich depends on consumption rates of an intended food and the feasibility of enrichment, which depends on scale and number of processing units, availability of enrichment technology and scope for quality monitoring.

6.1. Consumption patterns

For Tanzania, wheat and maize flour are good food vehicles for enrichment with multiple micronutrients, especially iron, zinc, folic acid and other B-vitamins, while oil is a good vehicle for vitamin A. At present no national food consumption data are available for these commodities from nutrition surveys. The last HBS provides an insight in food purchases by households while stratification by urban-rural populations has been provided by the World Bank based on the raw data of the survey. This data is considered to be a valid alternative.

In 2007, TFNC carried out a study using the Fortification Rapid Assessment Guideline (FRAT) tool. The study was carried out in Dodoma rural and Arumeru districts to establish suitable food vehicles for enrichment with micronutrients and their per-capita consumption by women and children at complementary age. The study results are summarized in the table below.

Table 6.1: Per-capita consumption for maize flour, wheat flour, and edible oil for women and children in Arumeru and Dodoma Rural districts.

Age group	Maize flour Gram\day	Wheat flour Gram\day	Edible oil ml\day
Children <5	216 – 220	111 - 116	24 – 26
Women	301 - 579	121 - 132	41.6 – 43.5

This data is consistent with food purchase data obtained from the Household and Budget Survey.

Staple foods play a very important role in the nutritional status of Tanzanians as they make up a significant part of the diet, contributing to 70% of the energy intake, higher in rural areas (73%) and in poor households (76%)[12]. Combined with low intakes of animal foods and other nutrient rich foods[13,14], the fortification of staple foods with micronutrients offer a unique opportunity to provide essential micronutrients to all Tanzanians.

6.2. Selected vehicles for enrichment

The following vehicles were selected for enrichment after delineation of the issues and an extensive assessment of various possibilities.

Wheat flour

Wheat flour is a suitable food-fortification vehicle in Tanzania. This conclusion is supported by wheat-flour consumption levels and patterns, relatively low fortification costs, and the structure of the milling industry, which includes a small number of large, relatively modern mills. As soon as the standards and regulations are available, the millers can start. In the interim, the milling and baking trials should be done to make sure the premix selected works properly in the Tanzanian situation.

Edible oil

The large edible oil producers are already familiar with enrichment of the margarine and cooking fats as these are fortified with Vitamins A & D. Recently, technical advocacy and training has been provided by the SAFO initiative. Some millers have already entered technical trials for mass fortification including quality control. The millers are ready to operationally scale-up as soon a technical standard, ideally including a logo, is adopted. In order to finally achieve 100% participation among oil producers, a full situation analysis of the number, size and location of the mills as well to determine the small and medium size oil millers' willingness to enrich and to determine the dosing and blending equipment requirements need to be carried out. The SAFO initiative seems to be well-positioned to undertake this.

Once the oil enrichment standard including a logo has been adopted, including a participatory transparent dialogue process with selected industries, the enrichment can start. The cost of Vitamin A as fortificant is as low as 0.1-0.2%

[12] Smith, L., Alderman, H. and Aduayom, D. (2006). Food insecurity in Sub-Saharan Africa: New Estimates from Household Expenditure Surveys. Research Report 146. (Washington D.C.:IFPRI)
[13] World Bank (2007). Advancing Nutrition for Long-term equitable growth. (Report No.41315-TZ)
[14] Mazengo, M.C., Simell, O. et al. Food consumption in rural and urban Tanzania. Acta Tropica. 1997;68:313-326

of the product market price and can be absorbed by producers or consumers without affecting the reach to poorer population groups. Oil is not only the technically most feasible form of fortification, but also the most cost-effective.

Maize flour

As stated before, there have been some initiatives to enrich the maize flour processed at hammer mills at village level, which is mostly a toll-milling operation. The enrichment technology for this is simple but the logistic issues of providing premix and quality control are challenging. For rural areas a home fortification or a micronutrient powder programme may be easier to implement.

Contrary to the rural village milling operation, the situation in Dar es Salaam is unique and offers scope for effective enrichment of hammer-milled maize flour. The concentration of these hammer mills in a few wards in Dar es Salaam makes the enrichment of this product an option well worth considering. The Municipal Authorities are fully aware of the exact numbers and production levels, while the food inspectors of the Tanzania Food and Drug Authority (TFDA) reportedly regularly check the operation.

The mills all use an identical bucket of 20 kg to fill up the mill hopper. A standardized kitchen scoop of premix then can easily be added to the 20 kg of maize grain. The milling process grinds the grain into flour and blends the premix into the flour during the grinding step. The process proposed at the hammer mills needs extensive sensitization and training but is eminently feasible. Commercial hammer milling operations in other cities are being mapped with a view to expanding the programme to also include these mills.

In the timeline, the maize enrichment can start as soon as the standards are finalized and the sensitization and training programme are organized. The sensitization will need to be carried out both at the milling level as well as through communication and social marketing for the consumer on the benefits of fortified flour. These activities will need to be provided simultaneously so that the millers are sensitized and that the consumer demands access to fortified maize.

Sugar

While sugar enrichment is possible there are a number of technical problems relating to the stability of vitamin A in sugar and the use of unfortified sugar in soft drinks, as well as questions about imported sugar which is a very important contribution during certain times of the year. Considerable additional analysis is needed before embarking on sugar enrichment, so it is not proposed that it be included in the programme at this time.

6.3. Gap analysis

Based on production, consumption and purchase data, the enrichment programme will be able to reach over half the Tanzanian population with fortified wheat flour (14 million, mostly adolescents and adults), maize flour (23 million of all ages) and cooking oil (30 million of all ages). This coverage data is based on consumption information from the Fortification Rapid Assessment Tool (FRAT) studies, the HBS survey data and the production data from the wheat milling industry, the large vegetable oil processors and an estimate of the combined output of the small and medium size maize millers in Dar es Salaam.

It must also be borne in mind that on the one hand, fortified cooking oil will reach a large segment of the population, but will not contain iron or folic acid. On the other hand fortified flour will carry those nutrients. Both flour and oil are therefore complementary as vehicles and components of an integrated fortification programme.

Other measures must be taken to cover the remaining population, estimated at around 17 million based on the current estimates of maize and wheat flour consumption. Also, during the course of project implementation, there is a need to re-confirm the population coverage data for maize and wheat flour consumption of this population group and monitor consumption patterns over time. As part of the development of this plan, consultants were asked to study the maize milling operations in other major centers in Tanzania, with a view to determining if agglomerations of mills existed similar to those in Dar es Salaam. The study was conducted in regional centers of nine regions of Tanzania mainland namely Arusha, Dodoma, Iringa, Kigoma, Mara, Mwanza, Rukwa, Ruvuma and Tanga. It found that quite a number of small and medium scale millers exist in the urban areas surveyed, but they are poorly coordinated and monitored and do not appear to be in concentrated areas such as in Dar es Salaam. However, there are a large number with significant capacity, which may have implications for extending fortification coverage.

Mills are located in highly populated areas. There are a total of 653 small mills plus 4 medium and 4 large scale mills. The number of mills is increasing as many traders are venturing into the sector because more consumers are now consuming processed and packaged maize flour. It is considered more convenient and the flour is felt to be of "good quality". Consumers do not process the maize themselves anymore as it used to be just some few years back. Mwanza (177) and Musoma (131) have the highest numbers of mills. Surprisingly, Songea (26) and Iringa (33) have the lowest number of mills despite being the highest maize producing and consuming areas.

A high proportion of small scale millers (87%) use the hammer mill and only a few (13%) millers use the roller mill for processing maize into flour.
In all the mills surveyed a maize dehuller and a milling machine have been installed. The mode of operation for the small-scale mills includes:

- Service milling (44%) whereby clients come with their own maize to be processed at the mill.
- Production milling (24%) whereby small-scale millers buy maize grain, mill and package it for sale to various customers including local shops, schools, institutions and individual customers.
- Combined (32%) i.e. service and production milling.

The milling capacity of most millers (62%) surveyed range between 1 and 5 metric tons of maize per day and only about 18% of the millers process less one metric ton per day. The mean mill capacity for small scale mills is 2871 kg per day (230 – 8600 kg), suggesting an aggregate maize processing capacity of the small scale mills in the surveyed areas is estimated to be 1,880 tons per day. The mean capacity for the medium size mills is 13,000 kg per day and the estimated aggregate maize processing capacity of the medium scale mills is 52 metric tons per day. Therefore total maize processing capacity is about 2000 tons per day. Based on a portion size of 300 grams, this means that these mills provide sufficient maize flour for a combined population of about 6.7 million people.

A high proportion of millers (87%) have poor understanding of fortification, due to lack of training (27%) and lack of awareness (38%) of the importance of fortification. Some millers are not even aware that the flour they produce is deficient in micronutrients. There were concerns that millers will encounter problems in selling their products because consumers might not like the product and or the price of fortified flour might increase, therefore affect the volume of sales and the business in general. Millers were also concerned that the addition of fortificants would discolour the flour and make it unacceptable to consumers. Finally, millers said that they did not fortify flour because they have not been requested by consumers. On the other hand, close to 87% of the millers surveyed indicated that they would be willing to participate in the maize flour fortification programme if they are trained on fortification and provided that the right regulatory environment is in place and that it should apply equally to all millers without discrimination.

The milling industry in the surveyed areas is highly disorganized; there is no communication structure for millers and 93% of the millers operate alone (single unit). There is no association of millers which could oversee their interests. About 9% of the millers indicated that they are members of an association but these are international associations, they cannot cater for local millers. This is a constraint to the development and improvement of the industry, not to mention the extension of fortification to these mills. The price of flour in the surveyed areas ranged between 450 and 750 Tsh. per kilogram of flour. The calculated additional cost of $4.41 per metric ton for fortificants would add 6 Tsh. per kilogram of flour, or 0.78 to 1.29% of the current cost.

The food enrichment programme will not reach those who do not purchase maize or wheat flour either because they produce their own maize and mill it locally, or because they consume locally grown cassava or bananas. This sector of the population is considered to include those at or below the poverty line living in rural areas.

To reach this population home fortification seems to be the best option. Studies have shown that using the same methodology have been carried out by TFNC with support from UNICEF in the Iringa area in 2004 and World Vision International (Tanzania and Canada offices) in the Korogwe district in 2006. In one of these studies, using a multiple-micronutrient beverage powder, it was found that adding a sachet 5 days per week for 6 months[15] significantly improved the iron status and anthropometric measurements as well as lowered the overall prevalence of anemia and vitamin A deficiency.[16] The basis of this is to add a diluted premix (containing the same micronutrients as for the staple foods) to the cooked food at mealtimes. The principle is simple, but the obvious challenges are the provision of the premix, the assurance that the quantities added is adequate without overdosing and that the programme is sustainable and continues until fortified foods can reach this population. The estimated cost per adult for the home mix option is $0.03 per day or $11 per year. Assuming 10 million adults use home mix the estimated national cost of the home mix option is $110,000,000 per year.

Children 6-24 months are a special group with high micronutrient needs that are not easily covered by enrichment of staples, although the fortified maize flour and cooking oil should contribute. For this group a home based enrichment programme using micronutrient powders such as "Sprinkles" is proposed, although the options for bringing such a program to scale on a sustainable basis needs to be explored.

This approach is to add a sachet containing the Recommended Daily Allowance (RDA) of vitamins and minerals[17] to the meal of particularly young children. This is used for a period of 60 days and repeated 3 times per year[18].

The "Sprinkles" approach has been used by many agencies in other countries such as World Vision in Ghana, Mongolia and Ethiopia. The approach has been found to be technically effective in combating micronutrient malnutrition in children under 5 years old. Based on other countries' experiences with

[15] Containing the following nutrients: 5.4 mg Iron, 1750 IU Vitamin A, 45 µg Iodine, 5.25 mg Zinc, 72 mg Vitamin C (ascorbic acid), 0.6mg Riboflavin, 0.14mg Folic acid, 3 µg Vitamin B_{12}, 0.7 mg Vitamin B_6 and 10.5 mg Vitamin E

[16] Ash D. M., Tatala S. R., et al. Randomized efficacy trial of a micronutrient-fortified beverage in primary school children in Tanzania. *Am J Clin Nutr*. 2003;77:891-8

[17] The most common types of Sprinkle sachets include: 300 µg (RE) Vitamin A, 30 mg Vitamin C, 160 µg folic acid, 12.5 mg iron (ferrous fumarate) and 5 mg zinc (gloconate)

[18] Zlotkin S. H., Schauer C. et al. Micronutrient sprinkles to control childhood anaemia. *PLoS Med.* 2005;7:e188

Sprinkles the estimated cost per household with 2 children under 5 years is $0.05 per child per day.

Another possible vehicle could be a multi-micronutrient fortified spread such as *Plumpydoz* or *Plumpynut,* currently being produced in several countries in East Africa under license from Nutriset, France. At a later stage, the scope of enriched complementary foods needs will be examined, but the details – including strategies for ensuring ongoing sustainability and potential public-private partnerships – are beyond the scope of this Action Plan.

Additional issues to be addressed are the continuing need to provide multiple micronutrient and or iron/folate supplements to pregnant women. The needs for iron and folate are so high in this group that they will never receive enough through enrichment to cover their needs. In addition, earlier antenatal visits need to be encouraged.

Institutional feeding wherever it occurs should utilize only enriched foods. The World Food Programme (WFP) has already committed to this and will explore the mechanisms for local purchase and enrichment.

In the case of HIV/AIDS and TB patients, the scope for blended enriched foods needs to be examined. Proposed programmes such as "food by prescription" or others need to utilize enriched products or provide premix for home fortification. All of the above potential interventions will require further assessments and a possible pilot scheme to measure effectiveness within the Tanzanian national context.

7. Enrichment Programme Goals and Objectives

Goal

The goal of the programme is to enhance the immune status, reduce mortality of women and children, improve learning capacity, work performance and reduce human suffering from neural tube defects and preventable disabilities.

Objective

The proposed food enrichment programme aims at making enriched foods available and encouraging their consumption, so that more than half of the Tanzanian population obtain essential iron, folic acid, zinc, vitamin B12 and vitamins A & D. The programme is a generalized approach, a population based strategy, which aims to improve the nutritional status of all Tanzanians and not just the high risk groups, while ensuring physical and economic access for all socioeconomic and vulnerable groups.

Expected beneficiaries

The expected coverage of the proposed wheat flour enrichment is estimated to be 14 million people, mainly adolescents and adult men and women. The proposed enrichment of maize flour in both hammer mills and large mills is estimated to be 23 million people of all ages. The edible oil enrichment programme is estimated to cover 23 million people, and in a later stage possibly 30 million once the smaller scale oil mills are included.[19]

Expected contribution of enriched products to the diet of the target groups

Based on the estimates of consumption provided by the FRAT study and the proposed standards for enrichment, the anticipated contribution of the programme will provide at least 1/3 of the Recommended Nutrient Intake (RNI) of vitamin A, Folic Acid, vitamin B12, Iron and Zinc.

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[19] These coverage figures are based on the following sources and calculations: *Wheat:* the total amount of flour produced in Tanzania from industry statistics is 558,800 metric tons (MT) per year or 1,530 MT per day. Based on meetings with TFNC staff, the consumption of wheat flour per person (pp)/per day is 110 grams (versus the Tanzania Food Consumption tables of 100g/pp/day). Using 110 grams and the daily flour production figure of 1530 this means 13.9 million consumers per day. *Maize:* Assuming 700 small mills operating at 10MT per day the production of the hammer mills in Dar is 7000 MT maize per day. Using the same source of consumption data from TFNC of 300 grams/pp/day this works out at 23 million consumers per day. *Vegetable oil:* Using the same rationale and the information from a Fortification Rapid Assessment Tool (FRAT) study of consumption of 30g/pp/day and figure given for large scale production of oil of 263,000 MT per year or 720.55 MT per day, this works out at 24 million consumers per day. In addition there are a number of smaller producers of vegetable oil outside the Dar es Salaam area who may be able to fortify, giving an overall total of around 30 million consumers per day. As stated before, a more comprehensive industry assessment is needed.

Stakeholder ownership

It is essential that all stakeholders (Tanzanian and international stakeholders) should agree on the importance of the proposed programme, take ownership and assume responsibility before the country proceeds with the implementation of the action plan.

8. Programme components:

The programme consists of five components with several individual subcomponents or activities as described below. The timeline for each of these activities can be found in annex 3. Many of these activities, and hence the success of the programme, is dependent on the establishment of national food fortification standards (activity 2.a) and hence the speed at which these standards are developed needs to be addressed.

8.1. Production and distribution:

Recruitment of oil and flour producers
All wheat flour millers have expressed their willingness to enrich flour provided standards and regulations are in place and the enrichment will be mandatory.

Industrial maize flour produced at large mills poses no problem whatsoever.

The hammer-milling maize flour producers in Dar es Salaam are interested in principle to enrich but an extensive sensitization and training campaign is needed to ensure all are fully on board and able to enrich appropriately. The Small Industries Development Organization (SIDO) is able to carry this out while the training of trainers and communications support could be provided by World Vision.

In some countries, a revolving fund has been set up to facilitate the purchase of premix. This approach could be considered for Tanzania but the management and logistical arrangements of such a fund will need to be developed.

The largest oil millers have been recruited and will be trained by the SAFO initiative partners.

Producer certification and training
The certification of staple food producers that demonstrates the capacity to properly enrich will be done by the TFDA. Training of food inspectors and TFDA staff will be carried out so that the certification process is effective.

Equipment needs for both enrichment and QA/QC at production level
Quality assurance and control is a must for each industry to protect consumers from unsafe and low quality product; and to ensure that the manufactures follow the technical specifications. To meet current assessed needs, maize flour millers will be provided with scoops and record books for premix in/out. Wheat millers will be supplied with micro dossiers. In addition, the SAFO initiative partners will carry out a situation analysis for laboratory QA/QC as well as equipment needs of the oil millers.

Development of national specifications of the premixes
Specifications for premix for wheat flour and maize flour enrichment based upon the new science endorsed by WHO and its partners in 2009 have been provided for review and adoption by the Tanzania Bureau of Standards (TBS). TBS will follow the established national procedures for this review and consequent promulgation of the standards for local use. Adopting national premix specifications allows the food industry to compare premix products on an equal footing in terms of costs and composition.

Procurement and importation of the premix required
Once the standards are adopted, a mechanism for the purchase and importation of premix needs to be established. This will involve bringing into force tax and tariff exemptions for fortificants and fortification equipment, surveillance and quality control system.
This approach is followed by many countries which are implementing food enrichment programmes. In the Tanzanian case, the TFDA has the option of requesting the Minister for Health and Social Welfare to declare such waiver. This is already happening for potassium iodate used in salt iodization.

Establishment of distribution channels for special target groups
The Government of Tanzania is responsible for the establishment of distribution channels for special target groups. The WFP and UNICEF could both provide the technical and financial support as required. Other partners could include the USAID funded "food by prescription" project as well as NGO's.

8.2. Quality monitoring and legislation

Development of national standards
Standards for defining safe and affordable levels of fortification are essential. In addition, industry should participate in the process of drafting such standards to assure their technical feasibility while promoting industry acceptance. It is therefore instructive that the process to develop edible oil enrichment standards is underway. Besides, there is an existing standard for the enrichment of margarine with Vitamin A and D. A draft standard for enrichment of edible oils with vitamins A & D has also been provided to TBS as well as a proposed premix standard. It is recommended that standards for premix and for wheat and maize flour should be fast-tracked as these may hamper implementation of this Action Plan, and consequent achievement of the related benefits.

Development of national regulations

The Tanzanian Food and Drug administration (TFDA) is responsible for developing the regulations and for licensing producers. The regulations currently drafted specify that enrichment is mandatory, which is consistent with practice in many other countries. There is extensive evidence that food fortification is ineffective where it is voluntary. In many countries, the food industry insists on mandatory fortification so that cheating does not take place and that a "level playing field" is created.

Development of QA and QC protocols for producers and food and drug authorities

Manuals are ready and need to be translated into simple flow charts. This activity can be carried out by the TFNC with technical support from the ECSA the and development partners.

Implementation of QA/QC training for the producers

Implementation of QA/QC training protocoals for the producers can be embarked on as soon as all equipment is available and standards are made available.

Integration of enriched food inspection systems and procedures

The TFDA already has a system of food inspection in place. This will need to be strengthened as part of the implementation phase with the transfer of food inspection from other government ministries.

Implementation of training programmes for food inspectors

These programmes need to be based on the manuals already prepared by the NFFA but also need to take into account quality assurance schemes put in place by the food industry such as the Hazard Analysis and Critical Control Point (HACCP) system. Training of food inspectors together with industry quality assurance technicians will enhance the cooperation between the partners.

Food sampling and micronutrient analysis

A situation analysis is needed to ensure that all equipment is available and functioning. All PH laboratory staff involved need training on the appropriate methodologies. This activity should be carried out in the first year of the implementation of food enrichment and will require financial and technical support from the development partners.

Establish an effective government monitoring and regulatory system
The effectiveness of food control systems is based upon the publication of assessments and corrective actions that have been taken against food processors whose products do not conform to the prescribed standards and regulations. Countries with effective publicity campaigns against offenders include Morocco and Nigeria. These can act as models for consideration by Tanzania. An important component of the monitoring and control will be the complementary use of semi-quantitative screening methods, such as the SAFO VA field test kit, and quantitative methods, such as high-performance liquid chromatography (HPLC). SAFO will be in the position to provide training and the reasonably necessary number of test kits.

8.3. Social Marketing and behavior change strategy

Whether fortified foods appear in the market through mandatory or voluntary measures, knowledge of the value of consuming fortified foods as a means of improving nutritional well-being and health is critical to the long-term success of a program. A comprehensive social marketing and behavior change strategy will therefore be necessary to ensure that the public is informed about issues of nutritional benefit and other behavioral measures to enhance the impact of the fortified foods. An identifying logo is to be developed as part of this strategy. Experience suggests that a logo, recognized by the consumer, is useful to promote fortified foods among consumers and to sustain planned levels of fortification. Sustained demand for fortified products by the consumer is the best means of guarding against industry or government changes in policies and plans that might jeopardize the entire program.

The activities of this program consist of development of IEC materials for print (poster, flyer, sticker) and broadcast (radio and TV), production of collateral materials (advocacy kit), print and broadcasting advertising materials, strengthening activities via symposiums and workshop, conducting advocacy activities for stakeholders through launchings, and media relations (radio, TV guests, interviews, press conference). In addition, Tanzania is a culture steeped in oral tradition, with the large rural sector, in particular, having a strong reliance on dialogue-oriented and participatory approaches to communication. This traditional system is indispensable for three main reasons. First, they use dances, popular theatre, music and humour to raise people's awareness of an issue that is affecting them. Secondly, people can be encouraged to join in and play a part in the presentations. Lastly, the presentations can also be filmed or recorded for radio or TV and thus made available to a wider audience. It would seem to be extremely important, as a matter of public policy and implementation strategy that this well-developed inter-personal system of communication be utilized as well.

8.4. Monitoring and Surveillance

Monitoring and evaluation plan

A comprehensive Demographic and Health Survey (DHS) with support from the WHO, UNICEF, World Bank and USAID is underway and is envisaged to have a comprehensive nutrition component. This will act as baseline survey and include consumption of the products to be enriched as well as coverage and will allow assessment of the evolution of micronutrient status in consuming versus non-consuming populations.

In addition to a baseline and impact survey, process monitoring as well as monitoring of purchase and consumption of the enriched food vehicles will be necessary. The yearly panel survey offers good scope for this and hence the incorporation of appropriate indicators will be pursued. All relevant stakeholders will need to review the best options for an ongoing and comprehensive monitoring, evaluation and surveillance programme beyond the base-line survey including the possibility of geographically representative "surveillance sites". A comprehensive M&E framework and action plan is needed as soon as possible to ensure that the impact of this initiative is clearly identified and measured.

> Regular monitoring by the use of a Fortification Rapid Assessment Tool (FRAT) developed by the Micronutrient Initiative and PATH Canada is one such option. FRAT surveys collect information at the household level among a population sample that is representative of the target population for fortification to give representative quantitative data on the consumption of fortified foods among children aged 12-36 months and women between 16-45 years of age. A FRAT survey can answer key questions about adequate population coverage, e.g. if young children and women of child-bearing age consume fortified foods, the rage of consumption level, if consumption is restricted by low socio-economic status, if there are significant losses of the fortificant as a result of storage at the household level or during food preparation. TFNC has experience in using such a survey.

Registration of NTD incidence

Including the registration of NTD incidence in the routine reporting system of the Ministry of Health and Social Welfare will allow for analysis of the trend over time and offer an excellent tool for social communications.

8.5. Programme management

Oversight and stakeholder commitment

The membership of the NFFA must be expanded to include all stakeholders. A high level mandate and executive powers need to be granted by the Prime Minister and line ministries. It will also be necessary to establish working groups aligned to the chosen food vehicles. The day to day running of the programme must be anchored as well. Government staff and resources will be needed for this sort of oversight.

The TFNC will be tasked with developing proposed coordinating mechanisms that are effective and sustainable for the enrichment programme.

9. Programme implementation and timeframe

The revised programme implementation and time frame has been incorporated into a Gantt chart which has been attached as Annex 3 to this Action plan. The Gantt chart should be read in conjunction with the text above under section 8.

10. Cost of the proposed food enrichment programme

Wheat Flour Enrichment Costs

Table 10.1 summarizes the cost of wheat flour enrichment on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 110 gm per day serving size), would be **$0.26 or Tsh. 354 per person per year**.

Table 10.1 Cost of wheat flour enrichment on an annual basis

Component	Start-up Costs	Recurring Costs	10 year $ million	Amortized annual	Cost per MT flour
Mill enrichment	$52,000	$3,550,000	$35,553,000	$3,555,000	$6.36
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.05
Social Marketing	$372,000		$ 372,000	$ 37,000	$0.07
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.08
Total	**$752,000**	**$3,590,000**	**$36,655,000**	**$3,666,000**	**$6.56**

Maize Flour Enrichment Costs

Table 10.2 summarizes the cost of maize flour enrichment on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 300 gm per day serving size), would be **$0.48 or Tsh. 647 per person per year**.

Table 10.2. Cost of maize flour enrichment on an annual basis

Component	Start-up Costs	Recurring Costs	10 year $ million	Amortized annual	Cost per MT flour
Mill enrichment	$18,000	$9,143,000	$91,451,000	$9,145,000	$4.35
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.01
Social Marketing	$372,000		$ 372,000	$ 37,000	$0.02
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.02
Total	**$718,000**	**$9,183,000**	**$92,553,000**	**$9,255,000**	**$4.41**

Vegetable oil enrichment costs

Table 10.3. summarizes the cost of vegetable oil in large processors on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 30 gm per day serving size), would be **$0.018 or Tsh. 24 per person per year**.

Table 10.3. Cost of vegetable oil enrichment on an annual basis

Component	Start-up	Recurring	10 year $ million	Amortized annual	Cost per MT flour
Refinery enrichment	$220,000	$ 719,000	$7,412,000	$ 741,000	$1.45
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.06
Social Marketing	$371,000		$ 371,000	$ 37,000	$0.07
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.09
Total	**$920,000**	**$ 759,000**	**$ 8,514,000**	**$ 851,000**	**$1.67**

Summary of food enrichment investment costs

The following table summarizes the total food enrichment costs for wheat flour, commercially produced maize flour and vegetable oil (from large scale processors).

Table 10.4. Summary of total food enrichment costs

Food vehicle	Annual costs in US$
Wheat flour	3.7 million
Maize flour	9.3 million
Vegetable oil	0.9 million
TOTAL	**13.8 million**

11. Annual cost of the proposed food enrichment programme (annualized over 10 years)

In view of the significant social and economic benefits, the annual cost of food enrichment is often shared between government, development partners, and the consumer or industry. The contribution of the government is usually in the form of tax reductions on fortificants and pre-mixes as well as the ongoing monitoring and program management costs. Development partners can contribute to the start-up costs, and can also cover the foregone tax revenue for an initial period of time, possibly on a declining basis over time. Industry costs are usually passed along directly to the consumer in the form of a one-time price increase. The specific contribution of each of these partners in the enrichment effort needs to be determined through dialogue and negotiation.

Table 11.1. Annual cost of food enrichment programme

Expense item	Government/ Development Partners*	Consumer/ Industry
Food enrichment Vitamin & mineral premixes	$3,440,000	$10,000,000
Regulations and food control	$ 88,000	
Social marketing &communications	$ 110,000	
Monitoring & evaluation and programme management	$ 132,000	
TOTAL	$3,770,000	$10,000,000

* Including start-up costs

As noted, the consumer ultimately pays for the enrichment through a one-time cost increase. However, it should be noted, for example that the price of maize can vary during the year by as much as +/- 15% compared to a one time increase in enrichment costs of less than 1%. This means that a consumer eating daily serving of fortified maize, wheat and oil would pay an extra cost of 1,025 Tsh. per year.

12. Summary of the cost benefits and proposed budget by component item and contribution over 10 years

Based on the economic analysis and estimates of the costs of micronutrient deficiencies to the economy of Tanzania and the investment costs of enrichment of the selected food vehicles, the cost benefit can be calculated.
It must be noted that not all the costs of the deficiencies can be resolved by food enrichment. Based on the experiences of other countries, an estimate of the potential impact of food enrichment on the deficiencies has been made for Tanzania:

- The projected reduction in anemia rates for children is estimated at 20% and 30% for women of child bearing age.
- The projected reduction in Neural Tube Birth Defects is estimated to be 30%
- The projected reduction in vitamin A deficiency is estimated to be 30%

The projected reductions are considered to be conservative estimates so that the potential savings may be higher.

The following table provides a summary of the cost benefit of food enrichment in Tanzania and estimates the annual number of lives to be saved. Annex 1 provides more details on the methodology and results.

Table 12.1. The net economic benefits of food enrichment in Tanzania

COMPONENT	Amount	Percent of GDP
Benefits: Annual averted attributable losses due to deficiencies	**$126.8 million**	**0.65%**
Costs: Annualized costs Enriched Food Investment	**$ 13.8 million**	**0.07%**
NET ANNUAL BENEFIT	**$113.0 million**	**0.58%**
Estimated lives saved annually	**6,767**	

Over a 15-year period, $1 invested in food enrichment in Tanzania can result in an economic return of $ 8.22 (on a net present value basis), assuming a 5 percent discount rate.

List of Annexes:

Annex 1: Cost Benefit Analysis

A.1.1. The economic justification for an integrated national nutrition plan for Tanzania

Traditionally, expenditures by the Ministry of Health in any country have been viewed as a costly expense to the nation. However, studies[20] have shown that addressing nutrition problems including micronutrient deficiencies is one of the most cost effective interventions that a country can adopt for the benefit of its population. This is because the funds spent on nutrition-focused activities will have a two-fold impact:

- The first and most obvious is an improvement in the health status of the population and therefore a reduction in overall healthcare costs in the future
- A well integrated and operational nutrition programme that addresses micronutrient deficiencies will have significant economic benefits to the nation in terms of economic performance due to improved learning capacity and improved productivity.

This annex covers the methodology of the cost benefit analysis and provides a summary of the findings. The detailed calculations and spreadsheets are available in soft copy versions in Excel software. It should be noted that the cost benefit analysis has been carried out on the potential impact of national scale enrichment programmes only for wheat flour, maize flour and vegetable oil. At this point, there are several issues related to the proposed implementation of sugar enrichment which need to be resolved before a cost benefit analysis should be carried out. Therefore sugar has been excluded as a vehicle for enrichment in this analysis.

A.1.2. The methodology of the cost benefit analysis

Since 2000, different economic models that are used to determine the cost of micronutrient deficiencies for a country have been developed. These models have been refined by economists and consultants working for a number of international agencies including the Asian Development Bank and the World Bank. Several countries using the current model include Indonesia, Iran, Malaysia, Morocco, Uzbekistan and Vietnam. The following steps are taken to determine the costs and the benefits of addressing micronutrient malnutrition using Excel software.

[20] The Copenhagen Consensus www.copenhagenconsensus.com

a) Determine the levels of iron deficiency anemia, folic acid and vitamin A, which can be measured either directly or indirectly using internationally accepted databases and national surveys
b) Using the data from #1 above, population data, and income data from national statistics the costs of deficiencies can be calculated in terms of lost present and future productivity and health status for each deficiency. The data can then be summarized into a national aggregate
c) Determine the costs of enrichment of the selected food vehicles i.e. wheat flour, maize flour, vegetable oil. This will include both the start up and ongoing costs. Amortize the enrichment costs over a 10 year period because food enrichment is a long term intervention and the capital equipment depreciation costs are normally amortized over 10 years.
d) Calculate the annual benefits of the enrichment programme. It must be noted that food enrichment will not address all the economic consequences of the deficiencies. Normally an estimation of the expected benefit[21] is made based on the consumption patterns of the food vehicles, the coverage of the population and the access of the enriched food.
e) In many countries the initial cost benefit analysis is reviewed by national experts from the relevant government ministries (finance, agriculture, health, industry etc.), the national food industry and other national experts. The cost benefit analysis is refined and as a result multi-stakeholder buy-in is achieved. In Tanzania, the draft cost benefit analysis was reviewed at a Technical Stakeholder Workshop in May, 2009, and appropriate revisions have been incorporated.
f) The cost benefit analysis document can then be used as a powerful advocacy document for promoting the advantages of food enrichment and funding for the programme from the government and international donor agencies.

For the cost benefit calculation, the following data sources were used:

- Economic Indicators – value added by sector from UN Statistics Division (2007), and projections from World Bank (2009)
- Population (various years) – National Bureau of Statistics population projections
- Labor force characteristics – Integrated Labor Force Survey (2006)
    - included participation rates, and percent of the workforce engaged in different sectors
    - manual labor was classified as those working in agriculture, manufacture and private households, while heavy manual labor included those in fishing, mining and quarrying, and construction

[21] Ross and Horton: The Economic Consequences of Iron Deficiency Anemia, 1998 published by The Micronutrient Initiative

A.1.3. The economic cost of micronutrient deficiencies in Tanzania

The following table illustrates the current levels of micronutrient deficiencies that affect the population of Tanzania.

Table A.1.3.1. Current levels of micronutrient deficiencies in Tanzania

Micronutrient	Indicators	Source
Vitamin A	Children < 5 years 24% deficient Lactating women 69% deficient	TFNC
Folic Acid	Neural Tube Defects (NTDs) 3.1 per 1000 live births	Municipal Hospital Dar es Salaam
Iron	Children <5 years 71.8% iron deficient Women 48.4% iron deficient	TFNC
Zinc	Stunting	TFNC

The indicators in the table above were used in the calculations and spreadsheet to estimate the cost of the micronutrient deficiencies for Tanzania (see table A.3.2.) The cost of micronutrient deficiencies can be made up of two components. The first component is the human cost in terms of deaths that can be estimated to be directly attributable to the micronutrient deficiencies. The second component is the economic loss due to poor productivity of the current adult population and the future adult population.

Table A.1.3.2. The human cost of micronutrient deficiencies.

Cause of death	Annual Number	Micronutrient Deficiency
Perinatal due to anemia	18,683	**Iron**
Maternal mortality due to anemia	1,602	**Iron**
Neural Tube Birth Defects	3,308	**Folic Acid**
Children < 5 years lack of Vitamin A	5,190	**Vitamin A**
Total	**28,783**	

The following table (table A.1.3.3.) summarizes the estimated annual costs of the deficiencies to Tanzania. The costs are based on the net present value of the reduced value added to the economy, assuming a working life of 37 years (starting at age 15 and continuing until age 52; the current life expectancy), and a 5% discount rate. The costs are adjusted for the current participation rate (2006 ILFS) in the workforce of 89.6% (including agriculture). Based on these parameters, the estimated economic costs of micronutrient deficiencies can be calculated. The results are shown in the next table, indicating an economic loss of approximately 2.65 percent of projected 2009 GDP.

Table A.1.3.3. Estimated Costs of Iron, Folic Acid and Vitamin A Deficiencies in Tanzania

Group	Estimated Economic Losses	Percent of Total
Anemia		
Perinatal	$116,324,201	22%
Children	$169,163,266	33%
Adults -- Productivity loss	$167,125,419	32%
Adults -- Maternal mortality	$4,588,867	1%
Total Anemia	**$457,201,753**	88%
Neural Tube Defects		
Deaths	$20,596,288	4.0%
Survivor Lost Productivity	$6,621,570	1.3%
Care & Welfare	$1,205,300	0.2%
Total NTD	**$28,423,158**	5.5%
Vitamin A deficiency	**$32,314,008**	6%
TOTAL	**$517,938,919**	100%

Folic Acid deficiency has been linked to the incidence of cardiovascular and heart disease in many countries. In the case of Tanzania the losses have not been calculated at this point, however, this would only improve the business case for food fortification.

A.1.4. Selected food vehicles for enrichment in Tanzania

Table A.4. summarizes the selected food vehicles and their attributes for enrichment in Tanzania. The projected coverage is based on calculations from the TFNC nutrition profiles, the Fortification Rapid Assessment which was done by TFNC in Arumeru and Dodoma Rural districts, the Household Budget Survey analysis and calculations by the consultants who assisted in preparing this action plan based on their observations and discussions during several fact-finding missions. The methodologies used are similar to those used in planning food fortification programs in other countries.

Table A.1.4. Selected food vehicle's projected coverage and feasibility

Food vehicle	Projected coverage	Feasibility
Wheat flour	14 million mostly adults	++++ can be started immediately
Maize flour	23 million all ages	++++ industrial +++ commercial hammer mills
Vegetable oil	>30 million, needs countrywide oil mill situation analysis	++++ large processors ++ small crushers (needs analysis)

The table illustrates both the estimated coverage of the food vehicle as well as an indication of the feasibility. Wheat flour and maize flour in large industrial mills are the most immediately feasible because of the small number of mills and many have the equipment in place to enrich. The small and medium size maize millers in the Dar es Salaam area are an important part of the milling sector because of their coverage and distribution of commercially produced maize flours.

The large vegetable oil processors are considered to be quite feasible; however there are a number of small and medium scale processors which service the oil market in Tanzania, particularly in the Mwanza area where oilseeds are grown.

A.1.4.1. Wheat Flour Enrichment Costs

Table A.1.4.1. summarizes the cost of wheat flour enrichment on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 100 gm per day serving size), would be **$0.26 or Tsh. 354 per person per year**.

Table A.1.4.1. The annual cost of wheat flour enrichment

Component	Start-up Costs	Recurring Costs	10 year $ million	Amortized annual	Cost per MT flour
Mill enrichment	$52,000	$3,550,000	$35,553,000	$3,555,000	$6.36
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.05
Social Marketing	$372,000		$ 372,000	$ 37,000	$0.07
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.08
Total	**$752,000**	**$3,590,000**	**$36,655,000**	**$3,666,000**	**$6.56**

A.1.4.2. Maize Flour Enrichment Costs

Table A.1.4.2. summarizes the cost of maize flour enrichment on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 300 gm per day serving size), would be **$0.48 or Tsh. 647 per person per year**.

Table A.1.4.2. The annual cost of maize flour enrichment

Component	Start-up Costs	Recurring Costs	10 year $ million	Amortized annual	Cost per MT flour
Mill enrichment	$18,000	$9,143,000	$91,451,000	$9,145,000	$4.35
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.01
Social Marketing	$372,000		$ 372,000	$ 37,000	$0.02
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.02
Total	**$718,000**	**$9,183,000**	**$92,553,000**	**$9,255,000**	**$4.41**

A.1.4.3. Vegetable Oil Enrichment costs

Table A.1.4.3. summarizes the cost of vegetable oil in large processors on an annual basis. If the entire annualized cost of fortification was passed along to the consumer, the additional cost (using a 30 gm per day serving size), would be **$0.018 or Tsh. 24 per person per year**.

Table A.1.4.3. The annual cost of vegetable oil enrichment

Component	Start-up	Recurring	10 year $ million	Amortized annual	Cost per MT flour
Refinery enrichment	$220,000	$ 719,000	$7,412,000	$ 741,000	$1.45
Legal, Regulatory and Food Control	$89,000	$ 20,000	$ 291,000	$ 29,000	$0.06
Social Marketing	$371,000		$ 371,000	$ 37,000	$0.07
Monitoring and program management	$240,000	$ 20,000	$ 440,000	$ 44,000	$0.09
Total	**$920,000**	**$ 759,000**	**$ 8,514,000**	**$ 851,000**	**$1.67**

A.1.4.4. Summary of food enrichment investment costs

Table A.1.4.4. summarizes the total food enrichment costs for wheat flour, commercially produced maize flour and vegetable oil (from large scale processors). Consumers who use all 3 products in the serving sizes mentioned above would expect to pay $0.76 per person per year, or about Tsh. 1,025.

Table A.1.4.4. summary of total food enrichment costs

Food vehicle	Annual costs in US$
Wheat flour	3.7 million
Maize flour	9.3 million
Vegetable oil	0.9 million
TOTAL	**13.8 million**

A.1.5. The net benefit of food enrichment in Tanzania

Based on the economic analysis and estimates of the costs of micronutrient deficiencies to the economy of Tanzania and the investment costs of enrichment of the selected food vehicles, the benefit cost ratio can be calculated.

It must be noted that not all the costs of the deficiencies can be resolved by food enrichment. Based on the experiences of other countries, an estimate of the potential impact of food enrichment on the deficiencies has been made for Tanzania:

- The projected reduction in anemia rates for children is estimated at 20% and 30% for women of child bearing age.
- The projected reduction in Neural Tube Birth Defects is estimated to be 30%
- The projected reduction in vitamin A deficiency is estimated to be 30%

The projected reductions are considered to be conservative estimates so that the potential savings may be higher.

The following table provides a summary of the cost benefit of food enrichment in Tanzania.

Table A.1.5.1. Summary of cost benefit of food enrichment in Tanzania

COMPONENT	Amount	Percent of GDP
Benefits: Annual averted attributable losses due to deficiencies	**$126.8 million**	**0.65%**
Costs: Annualized costs Enriched Food Investment	**$ 13.8 million**	**0.07%**
NET ANNUAL BENEFIT	**$113.0 million**	**0.58%**

In summary, an investment in food fortification is projected to yield annual benefits equal to $113.0 million (2009 dollars) or 0.58% of GDP, as well as the reduction of 6,700 deaths. Since these deaths are largely in infants and women giving birth, food fortification will also help with achieving the MDGs. For example, the reduction in infant deaths would address 21 percent of the gap between the current Infant Mortality Rate (IMR) and the MDG target for IMR, and about 5 percent of the Maternal Mortality Ratio (MMR) gap. Such investments are also highly cost-effective, since over a 15-year period, $1 invested in food enrichment in Tanzania can result in an economic return of $ 8.22 (on a net present value basis), assuming a 5 percent discount rate. This benefit-cost ratio is consistent with the values calculated in other countries.

Of course the cost-benefit results are dependent on a number of assumptions, and some variation from these assumptions may be experienced in real life. To provide some indication of the potential impact of the assumptions to such variation, a sensitivity analysis was also undertaken. The key assumption in determining the potential benefits is the figure used for the value added to the economy by each worker. Therefore this becomes the primary focus of the sensitivity analysis. The discount rate is the other assumption which is subject to scrutiny.

Table A.1.5.2. shows the results of the sensitivity analysis. It shows that even with the value added per worker cut by 50 percent, there is still a substantial net benefit to food fortification, including a benefit cost ratio of 3.62:1, and net benefits of over half a billion dollars, equivalent to 0.25 percent of GDP. As shown in the last column, food fortification only becomes uneconomic when a 10 percent discount rate is used and the value added per worker is reduced to 20 percent of the originally calculated amount. This gives a high degree of confidence that such a national fortification program will provide net economic benefits in addition to the health and MDG impact.

Table A.1.5.2. Sensitivity analysis of net benefit of fortification according to value added per worker

						Breakeven
Scale -- Value added/worker	100.00%	80.00%	50.00%	100.00%	100.00%	20.00%
Discount rate	5.00%	5.00%	5.00%	3.00%	7.00%	10.00%
Value added per worker	$864.46	$691.57	$432.23	$864.46	$864.46	$172.89
Female value added	$739.33	$591.46	$369.66	$739.33	$739.33	$147.87
Value added manual labor	$550.09	$440.07	$275.05	$550.09	$550.09	$110.02
Value added heavy labor	$3,707.47	$2,965.97	$1,853.73	$3,707.47	$3,707.47	$741.49
Benefit-Cost Ratio	8.22	6.38	3.62	12.55	5.93	0.07
Net benefit % GDP	0.58%	0.45%	0.25%	0.88%	0.42%	0.01%
Cumulative NPV ($ million)	$1,174	$911	$517	$2,056	$745	$7

Annex 2: Options of food fortification standards for Tanzania

Wheat flour

Table A.2.1. Wheat flour standard, no vitamin A (based on WHO Consensus Statement[22])

Micronutrient	Compound	Micronutrient Target Level mg/kg	Regulatory Maximum mg/kg
Vitamin B-9 Folic Acid	Folacin	2.6	4.5
Vitamin B-12	Vitamin B-12 0.1% WS	0.02	0.03
Iron	Sodium Iron EDTA	40	60
Zinc	Zinc Oxide	55	65

Table A.2.2. Premix standard for wheat flour, no vitamin A
Premix formulation

Micronutrient	Compound	Micronutrient Target Level in Wheat flour mg/kg	Fortificant Compound g/kg premix
Vitamin B-9 Folic Acid	Folacin	2.6	7.0
Vitamin B-12	Vitamin B-12 0.1% WS	0.02	48.8
Iron	Sodium Iron EDTA	40	750.5
Zinc	Zinc Oxide	55	167.7
Filling material	Tri Calcium Phosphate		26.
Total			1000.0

Premix Feed rate: 400 gram per MT wheat flour

[22] WHO, FAO, UNICEF, GAIN, MI, & FFI. Recommendations on wheat and maize flour fortification. Meeting Report: Interim Consensus Statement. Geneva, World Health Organization, 2009. Attached as Annex 4

Table A.2.3. Wheat flour standard, vitamin A
(based on WHO consensus statement)

Micronutrient	Compound	Micronutrient Target Level mg/kg	Regulatory Maximum mg/kg
Vitamin A	Retinyl Palmitate 250,000 IU/g (dry)	3.0	4.5
Vitamin B-9 Folic Acid	Folacin	2.6	4.5
Vitamin B-12	Vitamin B-12 0.1% WS	0.02	0.03
Iron	Sodium Iron EDTA	40	60
Zinc	Zinc Oxide	55	65

Table A.2.4. Premix standard for wheat flour, vitamin A
Premix formulation

Micronutrient	Compound	Micronutrient Target Level in Wheat flour mg/kg	Fortificant Compound g/kg premix
Vitamin A	Retinyl Palmitate 250,000 IU/g (dry)	3.0	80
Vitamin B-9 Folic Acid	Folacin	2.6	5.8
Vitamin B-12	Vitamin B-12 0.1% WS	0.02	40
Iron	Sodium Iron EDTA	40	615.4
Zinc	Zinc Oxide	55	137.5
Filling material			121.3
Total			1000.0

Premix Feed rate: 500 grams per MT of wheat flour

Maize flour

Table A.2.4. Maize flour standard (based on WHO Consensus Statement)

Micronutrient	Compound	Micronutrient Target Level mg/kg	Regulatory Maximum mg/kg
Vitamin A	Retinyl Palmitate 250,000 IU/g (dry)	1.0	3.0
Vitamin B-9 Folic Acid	Folacin	1.0	3.0
Vitamin B-12	Vitamin B-12 0.1% WS	0.008	0.012
Iron	Sodium Iron EDTA	15	25
Zinc	Zinc Oxide	30	45

Table A.2.6. Premix standard for maize flour
Premix formulation

Micronutrient	Compound	Micronutrient Target Level in Maize flour mg/kg	Fortificant Compound g/kg premix
Vitamin A	Retinyl Palmitate 250,000 IU/g (dry)	1.0	66.7
Vitamin B-9 Folic Acid	Folacin	1.0	5.6
Vitamin B-12	Vitamin B-12 0.1% WS	0.008	40
Iron	Sodium Iron EDTA	40	576
Zinc	Zinc Oxide	55	187.5
Filling material			123.4
Total			1000.0

Premix Feed rate: 200 grams per MT of maize flour

Vegetable oil

Table A.2.7. Vegetable oil standard (at point of production)

Micronutrient	Compound	Target Level mg/kg	Regulatory Maximum mg/kg
Vitamin A	Retinyl Palmitate 1.7 million IU/gram	35.00 (60 IU/gram)	40
Vitamin D-3	D-3 1.0 million IU/gram	0.60	0.80

Table A.2.8. Vegetable oil standard
Premix formulation

Micronutrient	Compound	Target Level mg/kg	Fortificant Compound grams
Vitamin A	Retinyl Palmitate 1.7 million IU/gram	35.00 (60 IU/gram)	68.6
Vitamin D-3	D-3 1.0 million IU/gram	0.60	24.0
Vegetable oil			7.4
Total			100.0

Premix addition rate: 100 grams per MT of vegetable oil.

NOTE: Good Manufacturing Practices by oil processors usually requires that the premix concentrate is diluted at the factory level before being blended with the vegetable oil. The dilution rate is determined by the daily or hourly production rate of the factory and prepared according to Good Manufacturing Practices

ANNEX 3

Programme implementation and time frame

PLEASE NOTE THAT *ALL* PROGRAMME COMPONENTS SHOULD BE IMPLEMENTED AT THE SAME TIME, THE TIME FRAME RUNS PARALLEL, NOT CONSECUTIVE!

Programme components	By Whom	2nd Q 2009	3d Q 2009	4thQ 2009	1st Q 2010	2nd Q 2010	3d Q 2010	4th Q 2010	1st half 2011	2nd half 2011
1. Production and distribution:										
a. Recruitment of producers of wheat flour,	NFFA,	DONE								
Recruitment of producers ofmaize flour (hammer mills)	NFFA, SIDO									
Recruitment of producers of oil,	NFFA, SAFO									
Recruitment of producers of sugar	NFFA, SAFO									
b. Producer certification and training as required (especially hammer mill operators)	TFDA, SIDO for hammer mills, SAFO for semi quantitative									
c. Identification of equipment needs by industry (oil, wheat, sugar) for both enrichment and QA\QC at production level	Technical committee NFFA,Food industry sectors, SAFO (test			URGENT for WORLD BANK FUNDING						
d. Development of national specifications of the fortfificants and\or premixes	TBS			PROCESS TO BE FAST TRACKED						
e. Procurement and importation of the premix required	Industry									
f. Fortification programme ongoing	Industry									
g. Establishment of distribution channels for special target groups	UNICEF & WFP									
2. Quality monitoring and legislation		2nd Q 2009	3d Q 2009	4thQ 2009	1st Q 2010	2nd Q 2010	3d Q 2010	4th Q 2010	1st half 2011	2nd half 2011
a. Development of national standards	TBS with technical support from WHO, WFP and WB			PROCESS TO BE FAST TRACKED						
b. Development of national regulations	TFDA to review proposed regulations based on NFFA comments and finalize		DONE							
c. Development of legislation mandating enrichment of wheat and maize flour as well as edible oil	TFDA									
d. Development of quality assurance (QA) and quality control (QC) protocols for producers and food and drug authorities	TFDA, Food Industry									
e. Implementation of QA\QC training for the producers	TFDA, SIDO and NFFA technical Committee									
f. Integration of enriched food inspection systems and procedures in the existing systems.	TFDA									
g. Implementation of training programmes for food inspectors	TFDA									
h. Development of food sampling and micronutrient analysis programmes in relevant PH laboratories	TFDA									
i. Assessment of equipment needs for enhancing testing capacity	TFDA to submit list of requirements			URGENT FOR WB FUNDING						
j. Implementation of food control system including publication of assessments and corrective actions taken as appropriate	TFDA									

3. Social Marketing and communication		2nd Q 2009	3d Q 2009	4thQ 2009	1st Q 2010	2nd Q 2010	3d Q 2010	4th Q 2010	1st half 2011	2nd half 2011
a. Advocacy meeting for high level Ministry staff, industry leaders and economists	NFFA & Development Partners									
b. Advocacy seminar for Parliamentarians	Responsible Ministers & Partners									
c. Development of a communications and social marketing strategy to inform the public about the health benefits of enriched products	NFFA and UNICEF									
d. Develop and field test logo's for enriched products.The NFFA has formed a working group to coordinate the communication strategy including the development of Tanzanian FF logo. Through the SAFO initiative a communications firm will be hired to develop a Tanzanian logo that will be used for all enriched products. The logo's application, maintenance and monitoring shall be put in brief procedures that should be incorporated into the fortification standards to be developed.	TFNC as secretariat to NFFA, TBS, TFDA for implementation, NFFA Working Group (5 members), SAFO									
e. Social marketing campaigns to promote recognition of logo's and implementation. Also, demand creation for fortified products to underpin the production of good quality fortified foods and information to the public on the benefits of enriched products for their health, development and wellbeing.	NFFA, UNICEF & SAFO									
f. Sensitization of wheat and maize millers and oil producers	SIDO, WV, UNICEF as well as SAFO for the oil millers									
4. Monitoring and Evaluation		2nd Q 2009	3d Q 2009	4thQ 2009	1st Q 2010	2nd Q 2010	3d Q 2010	4th Q 2010	1st half 2011	2nd half 2011
Development of a monitoring and evaluation plan to include all enriched foods, including iodized salt. Plan should address baseline and impact surveys as well as process monitoring and purchase and consumption of enriched products	TFNC and partners as well as DHS and Bureau of Statistics to review best options									
Implenetation of M & E plan										
Include registration of NTD incidence at major hospitals	Ministry of Health and Social Welfare									
5. Programme management		2nd Q 2009	3d Q 2009	4thQ 2009	1st Q 2010	2nd Q 2010	3d Q 2010	4th Q 2010	1st half 2011	2nd half 2011
a. Strengthening of NFFA , including expansion of membership and high level mandate and executive powers	Development partners to engage PM and line ministries									
b. Establish working groups by activity\foodvehicle	NFFA									
c. Establish enrichment programme manager and support staff and needs	Responsible Ministers & Partners									
d. Establish coordinating mechanisms	Responsible Ministers & Partners									
e. Programme Management	As above									

Annex 4:

World Health Organization

Recommendations on Wheat and Maize Flour Fortification Meeting Report: Interim Consensus Statement

PURPOSE

This statement is based on scientific reviews prepared for a Flour Fortification Initiative (FFI) technical workshop held in Stone Mountain, GA, USA in 2008 where various organizations actively engaged in the prevention and control of vitamin and mineral deficiencies and various other relevant stakeholders met and discussed specific practical recommendations to guide flour fortification efforts being implemented in various countries by the public, private and civic sector. This joint statement reflects the position of the World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), The United Nations Children's Fund (UNICEF), Global Alliance for Improved Nutrition (GAIN), The Micronutrient Initiative (MI) and FFI. It is intended for a wide audience including food industry, scientists and governments involved in the design and implementation of flour fortification programs as public health interventions.

BACKGROUND

WHO and FAO published in 2006 the *Guidelines on Food Fortification with Micronutrients* (WHO/FAO, 2006). These general guidelines, written from a nutrition and public health perspective are a resource for governments and agencies implementing or considering food fortification and a source of information for scientists, technologists and the food industry. Some basic principles for effective fortification programs along with fortificants' physical characteristics, selection and use with specific food vehicles are described. Fortification of widely distributed and consumed foods has the potential to improve the nutritional status of a large proportion of the population, and neither requires changes in dietary patterns nor individual decision for compliance. Technological issues to food fortification need to be fully resolved especially with regards to appropriate levels of nutrients, stability of fortificant, nutrient interactions, physical properties and acceptability by consumers (WHO/FAO, 2006). Worldwide, more than 600 million metric tons of wheat and maize flours are milled annually by commercial roller mills and consumed as noodles, breads, pasta, and other flour products by people in many countries. Fortification of industrially processed wheat and maize flour, when appropriately implemented, is an effective, simple, and inexpensive strategy for supplying vitamins and minerals to the diets of large segments of the world's population. It is estimated that the proportion of industrial-scale wheat flour being fortified is 97% in the Americas, 31% in Africa, 44% in Eastern Mediterranean , 21% in South-East Asia , 6% in Europe, and 4% in the Western Pacific regions in 2007 (FFI, 2008).

THE FFI SECOND TECHNICAL WORKSHOP ON WHEAT FLOUR FORTIFICATION

Nearly 100 leading nutrition, pharmaceutical and cereal scientists and milling experts from the public and private sectors from around the world met on March 30 to April 3, 2008 in Stone Mountain, GA, USA to provide advice for countries considering national wheat and/or maize flour fortification. This *Second Technical Workshop on Wheat Flour Fortification: Practical Recommendations for National Application* was a follow up to a FFI, the US Centers for Disease Control and Prevention (CDC) and the Mexican Institute of Public Health, first technical workshop entitled "Wheat Flour Fortification: Current Knowledge and Practical Applications," held in Cuernavaca, Mexico in December 2004 (FFI, 2004). The purpose of this second workshop was to provide guidance on national fortification of wheat and maize flours, milled in industrial roller mills (i.e. >20 metric tons/day milling capacity), with iron, zinc, folic acid, vitamin B_{12} and vitamin A and to develop guidelines on formulations of premix based on common ranges of flour consumption. A secondary aim was to agree on the best practices guidelines for premix manufactures and millers. Expert work groups prepared technical documents reviewing published efficacy and effectiveness studies as well as the form and levels of fortificants currently being added to flour in different countries. The full reviews will be published in a supplement of *Food and Nutrition Bulletin* in 2009 and the summary recommendations of this meeting can be found in http://www.sph.emory.edu/wheatflour/atlanta08/ (FFI, 2008).

RECOMMENDATIONS FOR WHEAT AND MAIZE FLOUR FORTIFICATION

Wheat and maize flour fortification is a preventive food-based approach to improve micronutrient status of populations over time that can be integrated with other interventions in the efforts to reduce vitamin and mineral deficiencies when identified as public health problems. However, fortification of other appropriate food vehicles with the same and/or other nutrients should also be considered when feasible. Wheat and maize flour fortification should be considered when industrially produced flour is regularly consumed by large population groups in a country. Wheat and maize flour fortification programmes could be expected to be most effective in achieving a public health impact if mandated at the national level and can help achieve international public health goals. Decisions about which nutrients to add and the appropriate amounts to add to fortify flour should be based on a series of factors including the nutritional needs and deficiencies of the population; the usual consumption profile of "fortifiable" flour (i.e. the total estimated amount of flour milled by

industrial roller mills, produced domestically or imported, which could in principle be fortified); sensory and physical effects of the fortificant nutrients on flour and flour products; fortification of other food vehicles; population consumption of vitamin and mineral supplements; and costs. Flour fortification programs should include appropriate Quality Assurance and Quality Control (QA/QC) programs at mills as well as regulatory and public health monitoring of the nutrient content of fortified foods and assessment of the nutritional/health impacts of the fortification strategies. Though the wheat and maize flours can be fortified with several micronutrients, the technical workshop focused on iron, folic acid, vitamin B_{12}, vitamin A and zinc, which are five micronutrients recognized to be of public health significance in developing countries.

1. IRON

The suggested levels for fortification of wheat flour with iron were reviewed by experts from published efficacy and effectiveness studies with various iron-fortified foods (Hurrell R *et al,* 2009). The authors estimated the daily amounts of selected iron compounds, including NaFeEDTA, ferrous sulphate, ferrous fumarate and electrolytic iron that have been shown to improve iron status in populations. The selection of the type and quantity of vitamins and minerals to add to flour, either as a voluntary standard or a mandatory requirement, lies with national decision makers in each country and therefore the choice of compounds as well as quantities should be viewed in the context of each country's situation. Based on available data from the Food Balance Sheets of FAO and World Bank-supported Household Income and Expenditure Surveys (HIES), it was proposed that four wheat flour average consumption ranges be considered in designing flour fortification programs: >300 g/day, 150-300 g/day, 75-150 g/day and <75 g/day.

2. FOLIC ACID

Well conducted studies from the United States (Williams LJ *et al,* 2002), Canada (De Wals P *et al,* 2007), and Chile (Hertrampf E & Cortes F, 2004) have documented decreases of 26%, 42%, and 40%, respectively, in the rate of neural tube defects (NTD) affected births after implementation of national regulations mandating wheat flour fortification with folic acid. Wheat and maize flour fortification with folic acid increases the intake of folate by women and can reduce the risk of neural tube and other birth defects.

3. VITAMIN B_{12}

An unpublished pilot study testing the feasibility of adding B-complex vitamins and iron to flour in Israel showed that vitamin B_{12} added to flour was stable during baking, did not affect the quality of the bread, and increased plasma B_{12} concentrations slightly within six months (Allen L *et al,* 2008). However, evidence is still lacking about the population impact of fortification of wheat flour with vitamin B_{12} to improve vitamin B_{12} status. Nevertheless, fortifying flours with vitamin B_{12} could be a feasible approach to improve vitamin B_{12} intake and the status of populations as there are no known adverse consequences of vitamin B_{12} fortification, and there are no known adverse effects of high intakes of the vitamin.

4. VITAMIN A

Wheat and maize flour can technically be fortified with vitamin A as vitamin A is stable in flour without producing organoleptic changes. As is the case for some other vitamins, high humidity and high temperatures can adversely affect vitamin A content during the preparation of wheat and maize flour products. Experience with vitamin A fortification of wheat and maize flour in developing

Table 1. Average levels of nutrients to consider adding to fortified wheat flour based on extraction, fortificant compound, and estimated *per capita* flour availability

Nutrient	Flour Extraction Rate	Compound	Level of nutrient to be added in parts per million (ppm) by estimated average per capita wheat flour availability (g/day)[1]			
			<75[2] g/day	75-149 g/day	150-300 g/day	>300 g/day
Iron	Low	NaFeEDTA	40	40	20	15
		Ferrous Sulfate	60	60	30	20
		Ferrous Fumarate	60	60	30	20
		Electrolytic Iron	NR[3]	NR[3]	60	40
	High	NaFeEDTA	40	40	20	15
Folic Acid	Low or High	Folic Acid	5.0	2.6	1.3	1.0
Vitamin B_{12}	Low or High	Cyanocobalamin	0.04	0.02	0.01	0.008
Vitamin A	Low or High	Vitamin A Palmitate	5.9	3	1.5	1
Zinc[3]	Low	Zinc Oxide	95	55	40	30
	High	Zinc Oxide	100	100	80	70

1. These estimated levels consider only wheat flour as main fortification vehicle in a public health program. If other mass-fortification programs with other food vehicles are implemented effectively, these suggested fortification levels may need to be adjusted downwards as needed.
2. Estimated per capita consumption of <75 g/day does not allow for addition of sufficient level of fortificant to cover micronutrients needs for women of childbearing age. Fortification of additional food vehicles and other interventions should be considered.
3. NR = Not Recommended because very high levels of electrolytic iron needed could negatively affect sensory properties of fortified flour.
4. These amounts of zinc fortification assume 5 mg zinc intake and no additional phytate intake from other dietary sources.

countries is increasing. Although vitamin A is most often used in the fortification of oils and fats, currently 11 countries are fortifying or propose to fortify wheat and/or maize flour with this vitamin. Two published efficacy trials have reported the impact of vitamin A fortified wheat flour on vitamin A nutritional status but there are no published studies that have evaluated the effectiveness of this intervention on a national scale (West KP *et al*, 2009). Wheat and, more broadly, other cereal grain flour (e.g. maize) can be considered as a vehicle for delivery of vitamin A to populations at risk of vitamin A deficiency.

5. ZINC

Unpublished results from a trial of wheat flour fortification in China suggests that zinc fortified flour could improve zinc status in women of childbearing age (Brown K *et al*, 2009). Fortification of other foods with zinc has shown that zinc intake and absorption increase when some zinc fortified foods are consumed but the impact as a public health intervention remains unknown. More research on efficacy and effectiveness of large scale zinc fortification programs is needed. The levels of nutrients to consider adding to fortified wheat flour based on extraction, fortificant compound, and estimated per capita flour availability are presented in Table 1. These levels and compounds could theoretically improve the nutritional status of the populations consuming the fortified wheat flour regularly in different preparations.

SUMMARY OF STATEMENT DEVELOPMENT

This statement was prepared by the core group from WHO's Department of Nutrition for Health and Development in close collaboration with FAO, the nutrition section of UNICEF, GAIN, MI and FFI. The core group members were: Dr Francesco Branca (WHO), Dr Juan Pablo Pena-Rosas (WHO), Mr Brian Thompson (FAO), Mr Arnold Timmer, (UNICEF), Dr Regina Moench-Pfanner (GAIN), Dr Annie Wesley (MI) and Dr Glen Maberly (FFI). The core group evaluated the commissioned scientific reviews prepared by international nutrition, pharmaceutical and cereal scientists and milling experts from the public and private sector working in the area of micronutrients, milling and food fortification, as well as the summary of discussions and conclusions from the consultation. This position statement is based on these documents and was initiated at WHO headquarters and further discussed and reviewed by members of the core group who provided technical and editorial advice. This statement contains all the consensus recommendations of the core group.

CONFLICTS OF INTEREST

All members of the core group were asked to submit and sign Declaration of Interest statements which are on file. There were no known conflicts of interest disclosed among the core group members developing this statement.

PLANS FOR UPDATE

It is anticipated that the recommendations in this statement will remain valid until December 2010. The Department of Nutrition for Health and Development at WHO headquarters in Geneva will be responsible for initiating a review following formal *WHO Handbook for Guideline Development* procedures at that time.

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