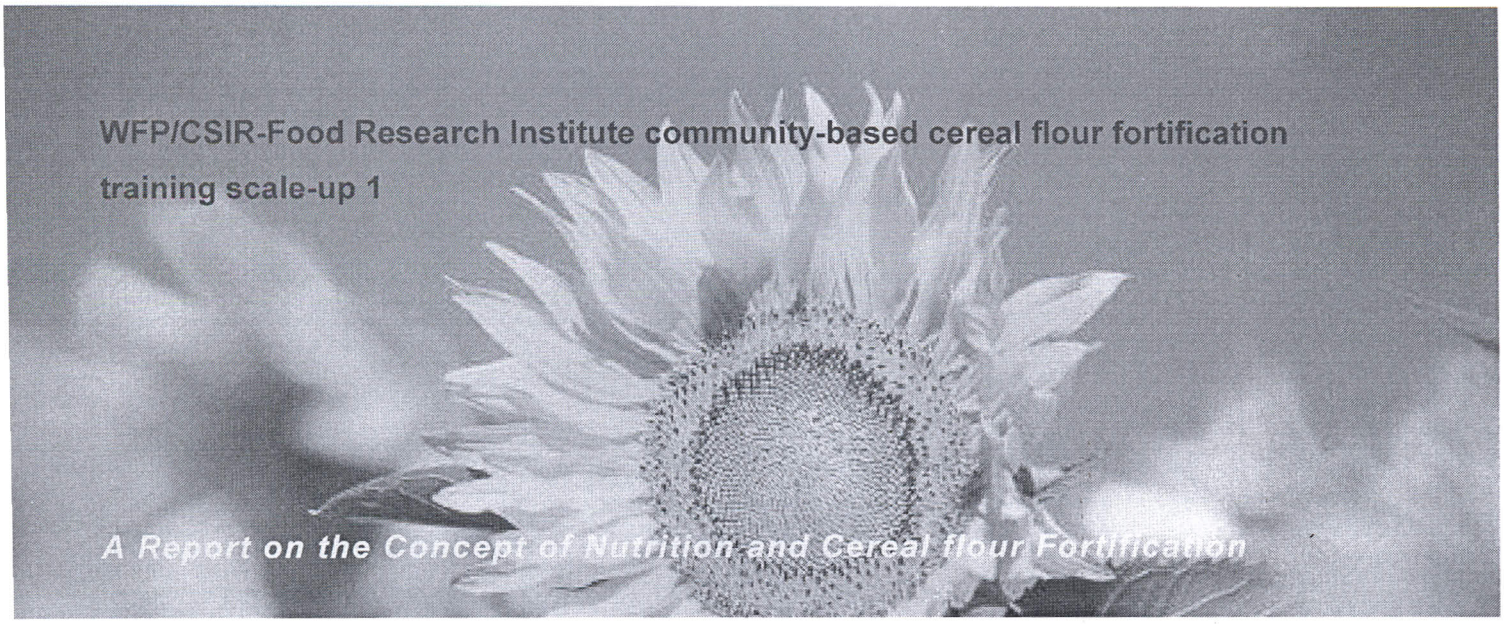
Technical Report

WFP/UNICEF Joint Programme on Malnutrition

under

"Tackling Malnutrition in Northern Ghana"



written by

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Organized from the 12th – 28th August, 2010.

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Abbreviations and Acronyms

CHN	Community Health Nurse	CSIR	Council for Scientific and industrial Research
DNO	District Nutrition Officer	FAO	Food and Agriculture Organization
FF	Food Fortification	FRI	Food Research Institute
GHP	Good Hygienic Practices	GHS	Ghana Health Service
IFPRI	International Food Policy Research Institute	MDGs	Millennium Development Goals
MNM	Micronutrient Malnutrition	MTMSG	Mother-to-Mother Support Group
RBC	Red Blood Cells	RDA	Recommended Daily Allowance
UNICEF	United Nations Children Fund	UNSCN	United Nations Standing Committee on Nutrition
UNWFP	United Nations World Food Programme	UWR	Upper West Region
WFS	World Food Summit	WG	Women's Group

List of tables and figures

Training team

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Summary

The WFP and its partner agencies have long been recognized for its ability to deliver food to deprive and resource –poor people all over the world. Relatively little is known about the efforts it puts in place to check that the food they supply provides vitamins and minerals and not just calories. In this report, the technology of cereal flour fortification with micronutrient (vitamin/mineral) premix was transferred in twelve communities in the Upper East, Upper West and the Northern regions of Ghana. This was organized as part of WFP/UNICEF joint project on Tackling Malnutrition in Northern Ghana using fortification of their staple foods (cereal flour) with six vitamins and two minerals as a means of meeting their nutritional needs. The communities that benefited from the technology included Gorogo, Zorko Goo, Tangasia, Chuchuliga Namosa in the Upper-East Region, Woribogu-Kukuo, Yilonayili, Gortani, Yankazia, Nansoni in the Northern Region and Lam-Uollo, Ketuo and Dahile-Kpanagaan in the Upper-West Region. A hand operated mixer designed and fabricated at the CSIR-Food Research Institute was employed for the mixing process. The training sessions were also facilitated by the use of a poster which showed step-by-step procedures both in graphic and words. A Group discussion approach was adopted to help participants feel a sense of ownership of the programme and to also appreciate the intervention.

In conclusion, food fortification programmes need to be implemented as part of a more comprehensive strategies to reduce micronutrient malnutrition. Such broad-based strategies include poverty reduction programmes along with agricultural, health, education and social intervention programmes to promote consumption of nutritious foods by all, but in particular by the nutritionally vulnerable.

1.0 Introduction

This report discusses the joint intervention programme organized by WFP/UNICEF in collaboration with GHS and other stack holders on "tackling malnutrition in Northern Ghana" in the face of Nutrition and food fortification.

This seeks to throw more emphasis on the concept of food fortification, reasons for its implementation especially in the three Northern regions and the impact it sought to have on the benefiting communities in the context of this project.

Between 2007 and 2008, WFP initiated, supported and coordinated the implementation of community-based cereal flour milling and fortification project. A pilot project which included 5 women groups in the following communities: Saan and Tanina women groups in Upper West Region, Bogni and Gbumgbum groups in the Northern Region and Kwongwania in the Upper East Region using mainly maize, millet and micronutrient fortificant. These fortificants were however highly concentrated (0.175 kg to 50 kg of flour) and so recommendations were made to reduce the concentration by formulating premixes of 0.25 kg which would mix 10 kg of flour.

Various Steps were undertaken to ensure a right implementation plan in the communities. This included construction of places to house the engine for milling, training in flour fortification, monitoring and supervision. New Energy focused on activities related to plant installation and milling operations whiles CSIR- Food Research Institute was contracted for the training processes.

One of the main objectives was to improve the nutritional status of women and children by promoting cereal flour fortification and at the same time provide an alternate source of income for the women groups through milling and sale of fortified flour as a business. The pilot project had the overall goal of fighting against micronutrient malnutrition (MNM) while increasing income of women groups in their respective communities to enhance the opportunities for achieving a better and healthy live.

With this in mind, WFP coordinated the scaling- up of the community –based cereal flour milling and fortification in some selected communities in Northern Ghana between the months of May 2009 to April 2010. An assessment report was written based on the pilot project and programme activities were proposed for the spreading of the project to 12 other communities in the Northern, Upper East and Upper West regions (see appendix 1) based on the recommendations made by the assessment team. Much emphasis was also laid on the fact that food fortification was one of the medium-term food based strategies for combating MNM and so better understanding and utilization of fortified flour for the benefit of all and sundry would go a long way to meet their recommended daily allowance (RDA) and improve their nutritional status.

The Food Research Institute under the Council for Scientific and Industrial Research of Ghana (CSIR-FRI) was contracted for formulating the premix for fortification, construction of a less laborious hand- operated flour mixing machines which will take between 10-20 kg of flour.

The training group which included Emma Anaman (WFP), Zackaria Fuseini(WFP), Joseph Gayin (CSIR-FRI), Ali Seidu Sampare (CSIR-FRI) and Hannah Oduro (CSIR-FRI) joined the various DNOs, CHNs, Community Development Officers in each of the districts for each training session.

1.1 Objective of the Scaling-up programme

This phase of the programme had the sole aim of correcting the inadequacies in micronutrient intakes through cereal flour fortification to 12 women groups in 12 communities in the 3 northern regions thereby preventing or reducing the severity and prevalence of micronutrient deficiencies in the targeted population groups. In doing so, the beneficiary groups would be able to improve upon their socio-economic status and conditions of living.

2.0 Background Information

In the concept of malnutrition, the economic and political structure of a country as well as the issues of inadequate assess to food, care, sanitation and health services play major roles which usually affects individuals.Research usually points to gaps in resources in whichever areas these need attention. Simply put, malnutrition (under nutrition and obesity) is both a cause and manifestation of poverty. About 1 billion people who live in extreme poverty usually consume fewer than their minimum requirements of 2100 calories per day which in totality also lacks quality (FAO/IFPRI, 2008; FAO, 2009). Poverty violates the fundament right to having adequate food, health and care as enshrined in our laws. Hence the Millennium Development Goals (MDGs) cannot be reached unless malnutrition is addressed.

In Northern Ghana, the level of poverty is still relatively high even though the national statistics shows a decline from previous years (Alima, 2009). These areas are generally characterized by only one raining season and fewer economic opportunities. There is no enough to eat because majority of the farmers practice subsistence farming. The level of poverty also affects their ability to purchase large-scale commercial land for agricultural purposes. These and other factors contribute to the widespread hunger and food insecurity problems observed in these regions which invariably affect the determinants of food security.

Food security as defined by the world food summit (WFS) exist when all people in a community or other spatial unit, at all times, have physical and economic access to safe and nutritious food and other food preferences that is sufficient to meet their dietary needs for an active and healthy life, and is obtained in a socially acceptable and ecologically sustainable manner (WFS, 1996). As such, it is often interchangeable with malnutrition which indicates various forms of under nutrition (stunting, wasting, deficiencies in essential vitamins and minerals) and also over nutrition.

The latter however is not often the case in rural communities in the northern Ghana- at least not in the communities we visited but rather an emerging factor for the growing populations of obese people in the urban areas where poor diet, high energy dense foods are consumed in addition to less physical activity. Under the circumstances of not having adequate food to eat lies the issue of micronutrient deficiencies.

Micronutrient malnutrition (MNM) also known as "hidden hunger" or the existence of sub-optimal nutritional status due to lack of intake, absorption or utilization has been proven to be contributing to 7.3% of the global burden of diseases which includes diet-related chronic diseases, the most prevalent being, Iron, iodine, zinc and vitamin A deficiencies (Lindsay et al., 2006). These micronutrients are needed by the body in very minute quantities (around a few thousandths of grams or less) but in constant supply to the body each day for proper physiological development and the maintenance of health. Deficiencies are marginal and most of the time produces no clinical symptoms (e.g. Scurvy, pellagra, and anemia). Due to this, people with adequate weight or even overweight can be malnourished. The best way to tackle this is to ensure the consumption of a balanced diet. However this is far from being achievable especially in northern Ghana since it means being food secured (having available food, accessibility of food, stability of food supply and food utilization)(UNSCN,2010) , diversifying their food consumption, observing good dietary practices and ensuring good food processing practices, all this in the advent of climate change. Hence food-based intervention strategies such as home gardening projects, nutritional education aimed at getting people to improve upon their eating habits, supplementary feeding programmes, nutrient supplementation, promotion and development of superior plant varieties (bio fortification) in addition to food fortification is aimed at preventing and eliminating MNM (Clarke, 1995) . However any one of these interventions taken alone is inadequate and so a right balance must be found to ensure adequate utilization of food.

From this standpoint, food fortification (FF) which has the advantages of adding essential nutrients to food without altering the consumption pattern of the people is highly recommended especially in resource poor communities in Northern Ghana where food security is a major challenge.

This is the deliberate addition of one or more micronutrients to particular foods (usually staples) so as to increase the intake of these micronutrient(s) in order to correct or prevent a demonstrated deficiency and provide a health benefit (Lindsay et al., 2006). More often than not, foods are fortified with more than one micronutrient since a dietary deficiency in one nutrient means a likely deficiency in other nutrients.

2.1 Food vehicle

To ensure that the 12 communities benefited from this training and also for the purpose of sustainability, an appropriate food vehicle, maize flour was chosen. This is due to the fact that majority of this population group if not all consume diets prepared from this cereal at least twice a day thereby favouring the low income groups. Also, it was consumed within a short period of time after purchase or production and so vitamin retention will be high if fortified. On average cereals provide about 60-75% of the caloric intake of Africans (Clarke, 1995). Selecting maize didn't mean changing their food habits; it is safe and readily available in the communities.

2.1.1 Choice of food vehicle

Selection of a carrier for fortification is one very important step which should be considered appropriately because when ignored can undermine the success of the intervention.

One such consideration is its functional interaction with the fortificants in order to enhance bioavailability of the nutrients. Addition of the fortificants did not change the colour, texture and appearance or taste of the maize flour. Moreover, most of the B-vitamins (thiamin, riboflavin, and niacin), iron, zinc and folate are lost during milling and cooking. These B- vitamins are very heat labile and so fortification will effectively restore lost nutrients thereby improving the nutrient intake of the benefiting communities.

2.2 Micronutrient Fortificant

This vitamin and mineral composite (IS 576, DSM Nutritional Products, South Africa (Ply) Ltd) consisted of six (6) vitamins and two (2) minerals in appropriate and recommended proportions meeting the safety limits for fortification and promoting a

healthy diet. Table (1) shows the nutritional information per 100 g fortified maize flour when 0.175 kg of the fortificant is added to 50 kg of maize or any other cereal flour.

Table 1. Composition of the vitamin/mineral premix used

Vitamin/Mineral		Per 100g fortified maize/cereal meal
Vitamin A	(IU)	650.56
Folic Acid	(µg)	96.95
Vitamin B12	(µg)	10.00
Vitamin B1	(mg)	0.39
Vitamin B2	(mg)	0.38
Nicotinamide	(mg)	4.0
Iron	(mg)	4.5
Zinc	(mg)	2.03

2.3 Advantages of multiple micronutrient fortification

Vitamins and minerals such as niacin, riboflavin, thiamine, zinc etc. serve as cofactors and coenzymes and are active components of certain metalloenzymes involved in most biochemical processes in the body. As such their deficiencies co-exist concomitantly and a deficiency in one nutrient can impair the utilization of the other. For example, iron deficiency can cause vitamin A retention in the liver. This is because vitamin A is a key component in the development of RBC during erythropoiesis. So is it with vitamins riboflavin, pyridoxine, cobalamin, zinc and folate. Conversely, increase in iron intake increases serum vitamin A levels (Ramakrishnan et al., 2001)

Also giotre proves resistance to iodine intake when iron is deficient because iron is required by the enzymes that synthesis thyroxine. Vitamin C consumption improves the absorption of non-heme iron from foods. Zinc is required for the synrhesis of retinol binding protein which is required for the transport of vitamin A to the body (Berdanier, 1998). Hence the development of fortification programmes dealing with more than one micronutrient has more positive and rapid outcomes which are economically profitable too compared to single micronutrient fortification.

Generally, food fortification as a food –based strategy for preventing and treating micronutrient deficiencies is well planned to prevent over intake of certain nutrients especially the fat soluble ones like vitamin A. Recommendations are made based upon delivering a predetermined proportion of the RDA for the nutrients in so that individuals who meet their minimum requirements per day do not over indulge. On the other hand, those who are not able to meet their daily dietary requirements are catered for. This is also done with the knowledge that certain groups may be taking in dietary supplements and fortified complementary foods.

Table 2: Health Benefits/Implications of Micronutrients if deficient

Micronutrient	Summary of health benefits	Health implications if deficient
Vitamin A	Keeps eyes and skin healthy. Boost the immune system	Increased risk of mortality among children and pregnant women. Increased incidences of measles and diarrhea Causes night blindness and xerophthalmia
Vitamin B1 (Thiamine)	Helps cells obtain energy from food Keeps nerves health Promotes appetite and digestion	Beriberi Wernicke-korsakov disease associated with alcoholics
Vitamin B12 (Cobalamin)	Promotes normal growth Protects against anemia	Anemia Neural tube defects Impaired cognitive function or brain development
Vitamin B2 (Riboflavin)	Helps cells use oxygen to release energy from food Maintains healthy skin and tongue	Anemia, dermatitis, fatigue, eye changes
Folic acid (B9)	Produces normal red blood cells Prevents neural tube defects	Anemia, heart disease and stroke, depression, neural tube defect. High homocysteine levels
Iron (Fe)	Combines with protein in the blood to for hemoglobin	Anemia Reduced brain performance Lower work performance Reduced iodine and vitamin A metabolism, High mortality
Zinc	Assist in wound healing, blood formation Growth and maintenance of tissues	Poor pregnant outcomes Stunted growth Diarrhea Decreased resistance to infections

Nicotinamide	Helps cells to use Oxygen to release energy from cell Maintains healthy cells	Pellagra or dermatitis Diarrhea and vomiting Loss of memory, depression

Table 3: Micronutrient dietary sources

Micronutrient	Food source
Vitamin A	Liver, eggs, dairy products, fruits and vegetables
Thiamine (B1)	Wheat germ, dried brewer's yeast extracts, offals from meat, lean pork, legumes and green vegetables
Cobalamin (B12)	Meat, eggs, milk (animal source only)
Riboflavin (B2)	Meat and dairy products, leafy green vegetables
Folic acid (B9)	Broccoli, legumes, fruits and green vegetables, yeast extracts
Iron	beef, spinach, fish, eggs

Zinc	Pork, sea food, lean red meat, whole grains cereals, pulses, legumes
Nicotinamide	Baker's yeast, animal and dairy products, cereals, legumes and leafy green vegetables

2.4 Factors which affect bioavailability of these micronutrients

In order to enhance the bioavailability of the micronutrient enriched cereal flour, these factors have to be taken note of

1. Phytates: these are found in cereals and affect iron and zinc absorption. Dietary proteins improves zinc absorption
2. High pH of the stomach, vitamin A deficiency, virus infection, tea, coffee, tannins and polyphenols decrease iron absorption and transport. Vitamin C will increase absorption and the use of iron cooking pots may increase the iron content of the food.
3. Alcoholics, folate deficiency affects thiamine bioavailability
4. Leaching out during cooking affects all the B vitamins. Steaming, eating raw vegetables, less cooking time, reuse of vegetable stock should be encouraged.
5. Celiac disease, intrinsic factor deficiency which causes anemia may affect Vitamin B12 absorption

3.0 Methodology

3.1 Flour mixer design

A hand-operated flour mixer was designed and made by the CSIR-Food Research Institute for the effective mixing of flour and micronutrient premix. Stainless steel was used for its construction which enabled proper washing and drying to prevent food contamination. **See fig. 1** below.

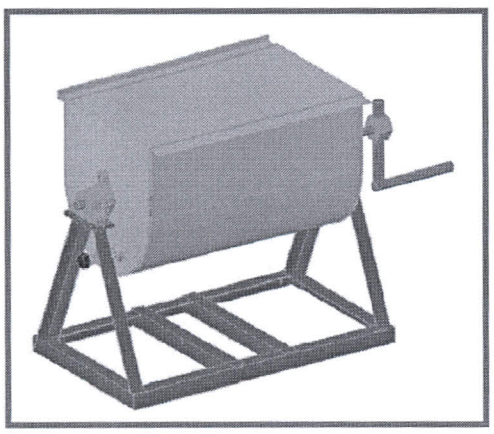

Fig. 1 An isometric drawing of the cereal flour mixer (adapted from WFP/FRI community based cereal milling and fortification scale-up 1).

3.2 Vitamin/Mineral Premix.

A premix is a mixture of a micronutrients and another ingredient, often the same food that is to be fortified, that is added to the food vehicle to improve the distribution of the micronutrient mix within the food and to reduce the separation between the food and micronutrient particles

In order to ensure an effective fortification system which was easier and reproducible, a 0.25 kg premix containing maize flour and the selected micronutrient was prepared at CSIR-Food Research Institute under strict quality control measures. This was to avoid contamination and ensure standardization and even distribution between batches. This quantity was designed to fortify 10 kg each of cereal flour (app. 5 'koko' bowls of flour). Adequate packaging was employed using 200 microns polyethylene bags to prevent moisture uptake during storage.

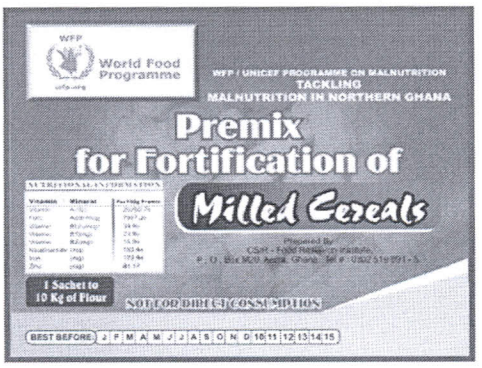

Fig. 2 Label used in packaging vitamin/mineral premix (adapted from WFP/FRI community based cereal milling and fortification scale-up 1).

3.3 Training session

The training in each community began with an introduction of the women groups and the WFP/FRI team. This was followed by a brief address that emphasized the rationale behind the exercise and encouraged the trainees to fully participate in the exercise and to make every effort to understand the process. In the end the beneficiaries were not only expected to patronize the use of fortified cereal flour, but to also help popularize the use of the fortified flour in their communities and immediate environs to help address micronutrient malnutrition.

The reasons and the basic principles underlying food fortification were explained to the trainees. All trainees were encouraged to observe Good Hygienic Practices (GHP) and were made aware of their role and responsibility in protecting food from contamination or deterioration by handling food hygienically. Emphasis was placed on personal hygiene, cleanliness of processing environment and processing equipment before and after use. This was followed by a demonstration of the various parts of the mixer, mode of operation and general maintenance rules and the fortification process. Participants were then taken through the various steps of the mixing process as depicted in the poster developed (Fig.3).

The attention of the participants was drawn to the fact that the premix does not affect the colour, taste, texture, and appearance of the cereal flour which is fortified or food prepared from it. Because premix is concentrated it was stressed to participants that it was **not for direct consumption** and under no circumstance should it be further divided into smaller portions for fortification of smaller portions of flour. To effect the fortification the flour must have been finally milled and cooled to room temperature. That

is to say, fortification of flour right after milling cereal was not advisable. Though the fortificant is meant for fortifying maize and wheat flour, it was extended to millet, sorghum, rice and cassava flour which is consumed frequently in different dishes in these communities. It is imperative to also note that, the premix is not to be used to fortify or enrich legume (and other pulses) flour such as cowpea, soy and bambara because of their apparent good nutritional composition. It is also important that the current premix is not added to wet cereals as in dough and slurries because it is not designed for such but rather dry flour.

See appendix 3 for some pictures during the demonstration session.

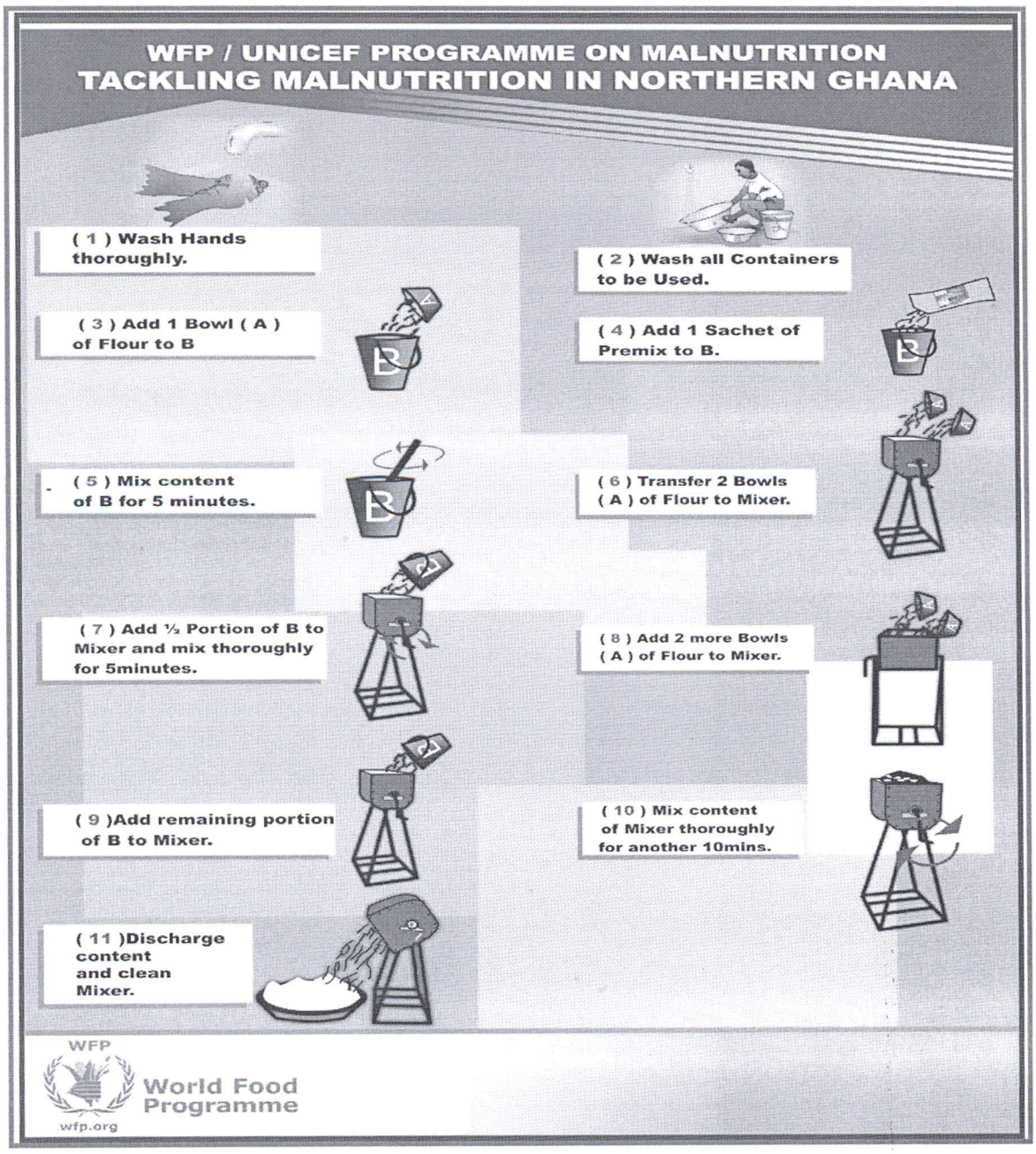

Fig. 3 Poster showing step-by step procedure during fortification (adapted from WFP/FRI community based cereal milling and fortification scale-up 1).

3.4 Advantages of community-based cereal flour fortification

1. Helps to overcome the problems of shelf-life of whole fortified maize meal because it is consumed within a short period of time.

2. Because of the subsistence nature of farming, it helps to enhance the nutritional value of procured cereals either bought of produced.
3. Fosters demand for fortified foods among local consumers beyond beneficiaries

4.0 Result/ Discussion

Generally, the training was successful. Initial nutritional status assessment should be conducted in subsequent programmes to ensure proper monitoring and evaluation.

5.0 Recommendations

1. To achieve optimum results public health interventions such as the treatment and prevention of parasitic infection, ensuring good sanitation, access to portable drinking water etc. should be tired up with the programme
2. Baseline studies (i.e the ABCD of nutritional status assessment) should be conducted first to determine nutritional status which will eventually inform the fortification programme
3. WFP/UNICEF should ensure communities involvement and participation to promote sustainability
4. CSIR- FRI should develop wet premix to cater for doughs and other slurries. This in actual sense will help improve the bioavailability of the fortificants especially iron since antinutritional factors (phytate) in the cereal flour will be dephytinized by fermentation, soaking and or germination. On the other hand, microbial phytase can be added to the premix before bagging.
5. Premix should be protected from moisture and light to prevent B-vitamin loss.
6. A maximum of 6 months should be set as the expiry date for the premix in order to ensure vitamin quality especially Vitamin A.
7. Participants should be encouraged to use fat or oil in cooking to enhance the absorption of the fat soluble vitamins.

6.0 Conclusion

The community-based food fortification programme is an effective tool in combating micronutrient malnutrition. However, its use is required in combination with other techniques to obtain optimal results. Issues of food security; inadequate dietary diversity; lack of nutrition education and the state of food processing locally are among the factors which must be considered in determining the most appropriate strategy to be used and hence the role fortification will play. This intervention is rated high and it is hoped that it will go a long way to improve upon the nutriture of the benefiting communities.

7.0 References

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Acknowledgement

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Appendices

Appendix 1: Beneficiary Communities

Community	Name of Group	District	Region

Gorogo	Nontaaba Women's Group	Talensi-Nabdam	Upper-East
Zorko Goo	Asuntaaba	Bongo	Upper-East
Tangasia	Red Cross Society Women's Group	Kasena-Nankana West	Upper-East
Chuchuliga Namosa	Asuntaaba Women's Group	Builsa	Upper-East
Woribogu-Kukuo	Tiyumtaba	Tolon-Kumbugu	Northern
Yilonayili	Wunzooya	Tamale Rural	Northern
Gortani	Libitiche	Zabzugu-Tatale	Northern
SabobaYankazia	Yankazia MTMSG	Saboba-Chereponi	Northern
Nansoni	Anashiati Ganga	Saboba-Chereponi	Northern
Uollo	Zinlaafia Lamlo MTMSG	Jirapa	Upper-West
Ketuo	Dignang Women's Group	Lawra	Upper-West
Dahile-Kpanagan	Dahile-Kpanagan MTMSG	Lambussie	Upper-West

Appendix 2: Training Programme Schedule

Date/day	District/Community	Women's Group
Upper-East Region		
09/08/10 Thursday	Talensi-Nabdam/Gorogo	Nontaaba WG

10/08/10 Friday	Bongo/Zorko Goo	Asuntaaba
11/08/10 Saturday	Kasena-Nankana West/Tangasia	Red Cross Society WG
12/08/10 Sunday	Builsa/Chuchuliga Namosa	Asuntaaba
Northern Region		
16/08/10 Thursday	Tolon/Woribogu-Kukuo	Tiyumtaba
16/08/10 Thursday	Tamale Rural/ Yilonayili	Wunzooya
17/08/10 Friday	Zabzugu-Tatale/Gortani	Libitiche
18/08/10 Saturday	Saboba-Chereponi/Nansoni	Anashiati Ganga
19/08/10 Monday	Saboba-Chereponi/Yankazia	Yankazia MTMSG
Upper-West Region		
23/08/10 Thursday	Travel to UWR	
24/08/10 Friday	Jirapa/Uollo	Zinlaafia Lamlo MTMSG
24/08/10 Friday	Lawra/Ketuo	Dignang WG
25/08/10 Saturday	Lambussie/DK	Dahile-Kpanagan MTMSG
26/08/10 Sunday	Travel day	

Appendix 3: pictures