FORTIFICATION OF VEGETABLE OIL AND SUGAR WITH VITAMIN A IN UGANDA:

PROGRESS, ISSUES, COSTS AND PROSPECTS

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EXECUTIVE SUMMARY

Fortification has been a topic of public health discourse in Uganda since the early 1990s. The government mandated in 1994 that only iodized salt could be imported, and in 2002 the National Working Group on Food Fortification (NWGFF) was created and included diverse public and private sector agency representatives. The first fortification intervention in Uganda, apart from salt iodization, began in 2004 when Mukwano/AK Oil voluntarily pioneered fortifying vegetable oil with vitamin A. One year later, BIDCO built a new vegetable oil factory in Uganda, and chose to fortify with vitamin A and D. These two companies produce 85 percent of the vegetable oil consumed in Uganda. Today, most vegetable oil samples in the Ugandan market show the presence of the added micronutrient; the average content has been determined as 22 mg/kg of vitamin A.[1]

It is estimated that 57 percent of the Ugandan population (16.3 million persons) consume vegetable oil fortified with vitamin A. The additional intake of vitamin A, assuming a daily oil intake of 15 g/day and a vitamin a content of 20 mg/kg in the fortified oil at households, is approximately 300 µg/day—equivalent to 60 percent of the Estimated Average Requirement (EAR) of this vitamin.

According to the 2003 Household Income and Expenditure Survey (HIES), sugar has a wider penetration (65%; 18.6 million) than vegetable oil in Uganda, and on average a consumer eats about 34 g/day. If sugar is fortified at 10 mg/kg, as specified in the ECSA food fortification guidelines, or at 15 mg/kg, as enacted in the current Ugandan standard, sugar would be an excellent complement to fortified vegetable oil. It is estimated that the average content of fortified sugar in households, following the cited formulations, would be 5 and 7.5 mg/kg, respectively. Under the specified conditions, sugar would provide 170 and 255 µg/day of vitamin A; i.e. 34% and 51% EAR, respectively. The combination of both programs would cover 76 percent of the Ugandan population (21.7 million persons), most of whom would receive the whole daily requirement of vitamin A through consuming these two fortified foods.

Other food fortification programs (in addition to fortified vegetable oil and sugar) or micronutrient interventions will be required to extend coverage to other people or provide additional vitamin A intake. However, these two programs would constitute a remarkable public health achievement in the country.

This study was carried out to help develop a more evidence-based fortification program in Uganda. The industry and governmental costs of vegetable oil and sugar fortification programs were calculated; deductions and recommendations are offered to improve the efficiency of the oil program and to favor introducing the sugar fortification program.

1. The Food Regulatory System in Uganda

This report includes a chapter that examines the public sector's complex role in the fortification program. While regulatory system specifics have been planned, implementation actions are still being discussed. In some instances, specific activities

[1] A most recently result in 2009 found that the vitamin A level at retail stores was 31 mg/kg.

still need to be identified. In other instances, agencies charged with some fortification-related responsibilities have not been allocated budgetary resources to enable discharging those responsibilities adequately. In still other instances, agencies do not having adequate capacity to implement what they have been charged to do. A final reason for the incomplete articulation of the regulatory system is that quality control and monitoring activities require striking a balance between private sectors' compliance with regulations and the government enforcing compliance at a reasonable cost. This balance must be mutually acceptable to the private and public sectors.

Three observations—

(1) Some key public regulatory agencies' fortification-related activities are inadequately defined,
(2) All agencies are performing multiple tasks, of which their "new" fortification-related activities are but one, and
(3) The intensity of fortification-related activities (i.e., the frequency, sample numbers, etc) will be largely determined by budget availability.

To date the public sector costs are subjective and only activities related to the following agencies have been estimated:

- Ugandan Bureau of Standards (UNBS) cost to inspect a single factory
- UNBS's costs to monitor fortified food imports
- Costs for the National Drug Authority (NDA) to certify premix producers, and to test quantitative assays of imported premix
- Ministry of Health's costs for its food inspector's work to sample and test fortified foods at retail sales outlets
- Ugandan Industrial Research Institute (UIRI) analytical laboratory costs to conduct quantitative tests of vitamin A (for UNBS and the MOH).

The total public sector cost estimates for regulating fortification were approximate, and may not reflect the reality of current actions. It was estimated that the country needs to allocate 67 to 100 million UGX (US$40,000 to US$60,000) yearly to cover the cost of the governmental food control for all the food fortification programs at factories, importation sites, and retail stores.

The *Food Control in Uganda* chapter describes the fortification regulatory system's development, general activities remaining key policy issues that need to be addressed. This chapter also discusses each agency's role and objectives.

2. The Private Sector Cost of Fortifying Vegetable Oil with Vitamin A in Uganda

This report analyzed the vegetable oil industry of Uganda, focusing on characteristics that are pertinent to the feasibility, cost, and impact of fortifying oil with vitamin A. The production processes of the two largest plants are described and a prototype model from the two companies' data is devised so as not to disclose sensitive proprietary data. The model is used to estimate the annual incremental, recurrent costs of fortifying vegetable oil with vitamin A. The key findings about the recurrent costs to fortify 85 percent (105,000 MT) of the demand of vegetable oil in Uganda are:

- using Retinol Palmitate 1 million IU/g—954.4 million UGX (US$573,320)
- using Retinol Palmitate 1.7 million IU/g—907.9 million UGX (US$545,453)
- the average cost of fortification per liter of oil is 8.070 UGX (US$0.0048)
- the cost of fortification as a percent of the retail price of a liter of vegetable oil is 0.26 percent
- the start-up or one-time capital costs per factory is 31,118,250 UGX (US$9,050)
- The premix is roughly 400 million UGX (US$ 240,240), representing 89 percent of the total annual recurrent costs of fortification.

3. The Private Sector Cost of Fortifying Sugar with Vitamin A

It is commonly thought that the three largest sugar companies in Uganda—which together produce roughly 85 percent of the domestically produced sugar in the country—have long been willing to fortify. This is no longer the case. The sugar industry's market, structure, and business strategies are analyzed to assist public officials understand "where" the sugar industry is, what its concerns are, and where other Government of Uganda (GOU) actions, rules, or agreements affect or could affect the industry. This analysis gives the GOU some "tools" to negotiate more effectively with the sugar industry and to provide a better understanding that sugar fortification will likely need to be mandated to be realized in Uganda.

An estimate of the costs is presented. The GOU's sugar fortification standards are still in draft form. If fortification occurs at 15 mg/kg, then it is estimated that:

- the annual, incremental cost to fortify all domestically produced sugar in Uganda is 3,600 million UGX or US$2,158,656
- The cost of fortifying a ton of sugar is: **17,971UGX (US$10.79)**
- the cost of sugar fortification is 1.06 percent of sugar's retail price
- the start-up or one-time capital costs— 200,000,000 UGX (US$120,000) per mill
- the premix vitamin A cost is roughly 95 percent of the total annual recurrent fortification costs.

4. Comparing the Costs and Coverage of Sugar and Vegetable Oil Fortification

The average per capita consumption of oil adjusted for those who do not purchase oil (43% of the population), is 15 grams per day. Thus, the annual investment is 50 UGX (US$0.030) for each oil consumer.

The average per capita consumption of sugar, adjusted for the 35 percent who do not purchase it, is 34 grams per day. It was estimated that at fortification levels of 10 mg/kg (ECSA Guidelines) and 15 mg/kg (current Ugandan standard), the cost of fortification would be 12,487 UGX (US$7.50) and 17,971 UGX (US$10.79) per metric ton, respectively—a yearly consumer investment of 150 UGX (US$0.090) and 225 UGX (US$0.135), respectively.

While the cited fortification levels of sugar and oil result in delivering very similar percentages of the daily EAR of vitamin A, the cost of fortifying sugar is 5 times higher than fortifying oil. The cost difference comes from the type of vitamin A compound used; sugar requires a microencapsulated powder that is dispersible in water. Because vegetable oil fortification has limited coverage in Uganda (57% of the population), and the supply of vitamin A is limited (60% EAR on average), sugar fortification is necessary to reach epidemiological goals. The combined use of oil and sugar fortification seems to be a proper strategy. The annual investment per person would be 200 UGX (US$0.120)[2], and the total population coverage would be 76 percent (21.7 million persons).

Whether the combined food fortification program (vegetable oil and sugar) delivers to the "right" Ugandans—i.e., those who are vitamin A deficient (VAD) and those who are most severely VAD is not known. This is a question that Uganda must answer much more definitively with data from the food consumption survey in progress. Modeling fortification impacts with food consumption data will show whether or not fortifying both sugar and oil will increase coverage to reduce VAD and if so, whether the current UNBS fortification standards should be modified to balance impact and safety.

[2] Adopting the ECSA Guidelines of 10 mg/kg vitamin A for sugar fortification.

A secondary audience of this study is other—especially neighboring—countries that might be considering fortification and would like a more detailed understanding of the structure, costs and operations of such a program. The study will provide a detailed descriptive analysis of the process through which the program was first discussed and the preparatory work that was undertaken so as to describe the issues and steps that other countries wanting to emulate the Ugandan experience can expect that they too will have to address.

Later, cost analysis of wheat and maize flour fortification may be considered upon the identification of financial resources and the interest of the country to carry out these studies.

The Costing Study Methodology

The cost study will employ an activity-based costing methodology combined with the ingredients approach (WHO 2004). The studies will be designed and implemented in such a way as to provide a detailed descriptive account of the program and how it is implemented. The activities of all of the public sector actors—including the Ministry of Health's Department of Nutrition, the Department of Food Control and Environmental Hygiene, the National Drug Authority, and the Ministry of Industry and Trade's UIRI-Lab and UNBS. Having a detailed understanding of the program—how it is structured, how it functions, who does what, as well as the types and quantities of initial capital investments (equipment and training) required and the additional annual recurrent costs of labor, premix and other inputs—allows getting beyond simply providing a cost estimate: it facilitates identifying and better understanding why costs are what they are, what kind of variations exist in the program and its costs, and whether the program's coverage can be increased, and/or the program can be made more effective in other terms, and/or its costs can be reduced.

The study will entail site visits to the two largest vegetable oil producing plants (BIDCO and Mukwano) and one of two of the three largest sugar mills (Kakira, Kinyara and Lugazi) during this consultancy. The purpose of the visits will be to interview plant officials and obtain data and a first hand understanding of the fortification program's requirements. In addition, there will be interviews with officials of each of the government agencies involved in the fortification program.

Expected Outputs/Products

The fortification costing study will produce several different products. First, it will produce an estimate of the total annual incremental costs of fortification, the total annual incremental costs to the public sector, the total annual incremental costs to the private sector, and the incremental costs per quantity of fortified food. Second, the study will produce a detailed set of algorithms that will identify the types and quantities of activities required to implement the fortification program and all of the inputs required to produce each major activity. There will be one set of these algorithms for the sugar industry, one for the vegetable oil industry and one for each of the government agencies monitoring the program or conducting related food quality assurance activities.

Tasks and Activities

1. From interviews and documents, develop a detailed description of the fortification program's structure and operations in each of the public sector agencies involved in its implementation and in the sugar and vegetable oil industries.
2. For each agency involved in implementing the public sector monitoring and regulatory program (and, if appropriate, each level of the agency) identify the key activities and the staff/positions responsible for each aspect of the program and the specific activities they perform or assist in undertaking in implementing the program.
3. Identify all of the inputs required to undertake the identified key activities at each level of the program for all of the organizations involved in implementing the program and the quantities and costs of those inputs.
4. Estimate costs of the planned social marketing program for the fortification program.
5. Analyze the data and write a draft report.
6. Send the draft report to those individuals or organizations that have participated in the study and solicit their comments and suggestions.
7. Revise the draft report, taking into account comments and suggestions of those reviewing the draft as deemed appropriate, and produce the final report.

Level of Effort

The total level of effort of this activity will be 29 days, including the 14 working days spent in-country.

Reference

World Health Organization (WHO). 2004. *Making Choices in Health: WHO Guide to Cost-Effectiveness Analysis*. Editors: T. Tan-Torres Edejer, R. Baltussen, T. Adam, R. Hutubessy, A. Acharya, D.B. Evans and C.J.L. Murray. WHO: Geneva. Updated version available at: http://www.who.int/choice/en/ (Accessed March 15, 2008.)

Terms of Reference
For One or Two Ugandan Participants in the Fortification Cost Study

A2Z, the USAID Micronutrient Project, will be conducting a cost study of the fortification process at vegetable oil and sugar industries in May-June 2008. The A2Z health economist, Jack Fiedler, will be in Uganda May 9-29 to undertake the study. The study provides an opportunity to learn first-hand how to conduct such a study, and A2Z is encouraging one or two Ugandans to participate in the study. Given the discussions currently taking place regarding new fortification possibilities in Uganda, it is hoped this opportunity will provide the participants the experience and materials necessary to conduct similar such studies of other foods in Uganda or in other ECSA countries. Recognizing the common regional approach to fortification that has been championed by ECSA—including the development of common standards and a common regulatory structure and methods—there will be direct applicability of portions of the experience that will be gained from this Uganda-based work, to other member countries of ECSA.

The attendance to this in-hand training will be without cost for the Ugandan colleagues who are accepted in the field team. Furthermore, A2Z is going to provide per diem and transportation costs of the participants while conducting the study in sites outside of Kampala.

Agencies, Organizations and Companies to be Visited for the Cost Study

1. Ministry of Health:
    a. Department of Nutrition
    b. Department of Food Control and Environmental Hygiene
    c. National Drug Authority

2. Ministry of Trade and Industry
    a. Uganda National Bureau of Standards (UNBS)
    b. Uganda Industry Research Institute (UIRI)

3. Vegetable oil producers:
    a. BIDCO
    b. Mukwano

4. Sugar mills
    a. Kakira
    b. Kinyara
    c. Lugazi

5. National Working Group on Fortification

6. GAIN Project

Annex 2:
Household Income and Expenditure Surveys

Household surveys have been conducted in most countries for a decade or more and have become increasingly important routine sources of information for monitoring economic and social conditions. In most cases, periodic, routine household surveys were initiated to provide data for national income accounts, consumer and wholesale price indices, and poverty and inequality analysis. Over time, as countries' needs for detailed information on a wide variety of household characteristics and activities have grown, the surveys conducted by most countries have evolved to become integrated, multi-purpose instruments. As the use of these tools has grown, starting in the mid-1980s, there has been a commensurate growth in interest in improving their design and implementation in order to make them more precise, while enabling cross country comparisons, avoiding duplication and reducing costs.[20]

These efforts have produced general guidelines for conducting household surveys, there remains a variety of different types of surveys and multi-purpose surveys include a variety of different combinations of modules, depending upon country's perceived needs and priorities. This paper makes use of a variety of different household surveys, including income and expenditures surveys, as well as the income and expenditure sections of integrated, multi-purpose surveys covering different topical areas, but refers to all of them as simply "household income and expenditure surveys" (HIES).

Due to their country-specific character, as well as differences in how the fieldwork of the surveys is conducted and differences in how the data coding, data entry and data cleaning are implemented, data may vary considerably across countries in terms of quality and content.

Another important type of inter-country variation in HIES data that is of particular importance in investigating fortification possibilities is the number of reported food categories. Some countries collect and/or record data on only a few dozen food item categories, whereas others report several hundred. For most of the 31 countries analyzed, three of the four main candidate food vehicles analyzed here are staples. The exception is maize flour, which is a staple primarily only in Sub-Saharan African and Latin American countries. In countries, where maize flour is not a staple, there frequently is no maize flour food item category.

Limitations and Potential Uses of HIES Data to Proxy Food Consumption Data

The HIES provide data on food expenditures, not food consumption. This is a proxy measure for food consumption data. Household food expenditures, however, may vary for a variety of reasons. Food consumption might be less than food expenditures, for example, because they might simply add to stocks of food in the household, or the food might be lost, wasted or given away. Thus the results would be described as "apparent household consumption".

[20] Among the most important of these efforts have been the World Bank's development and promotion of Living Standards Measurement Surveys (LSMS) and their more general household survey lessons (13, 14), the United Nations' Household Survey Capability Program which is now the UN Demographic and Social Statistics Unit (15), and, of more recent vintage, the International Household Survey Network (16).

Another limitation of the HIES, is that they provide household-level data, not individual-level data. While they do provide information about key characteristics of the households—including the number of persons and the age, sex and education levels of each—as well as the household's rural-urban location and its relative income (expenditure) level, they do not provide any insight into how the food that is purchased is distributed within the household or how much of it is actually consumed by each individual in the household.[21] Nor do they provide information about the types or quantities of food that are consumed while household members are away from the home.

For most countries a number of different food items include the food vehicle in some form. This is most importantly the case with wheat flour. In most countries, wheat flour often has its own food item category—reflecting the fact that households purchase the wheat flour itself as a final consumer product. Wheat flour is also contained in a number of other foods that have their own food item categories, as well.

Uses of HIES data in Assessing the Feasibility and in Designing Fortification Programs

1. Assessing the Potential Coverage of a Candidate Food Vehicle

The potential reach of three different approaches to wheat flour fortification was investigated by constructing two composite variables of different wheat products. First, wheat flour consumption (as a final consumer product) was analyzed. Then, wheat flour was combined with all other wheat flour-based products, to provide a measure of the maximum potential reach of a program that fortified all wheat flour. Third, in the interest of examining how excluding "luxury" foods from the wheat flour-based foods measure would affect fortification program costs and reach, all wheat flour-based staple foods were collapsed into a single composite which excluded cakes, pastries and biscuits.[22] In constructing these different measures, it was necessary to estimate the flour content of the different food items in order to be able to add the flour content of the different products weighted by the quantity of the different products purchased, into a single measure.

For a fortification program to be regarded primarily as a public health intervention, a rule of thumb used by food fortification experts is that it must be consumed by at least 30 percent of the population.[23]

2. Information for Mapping and Targeting Micronutrient Interventions

The HIES also contains information about the size and composition of the household—including the number of persons, their ages and gender—the place of residence (rural or urban), and geographic location. In some instances the samples are information statistically representative down to a region or a state/province level. Thus the HIES can be used to investigate how the coverage of a potential food fortification programs is likely to vary by these characteristics.

[21] It is customary to use total expenditure data as a proxy for income. The relative income level is indicated by the household's national expenditures/income quintile, which is empirically derived from the survey data.

[22] "Luxury" foods are defined here (in the economic use of the term) as those that have a higher income elasticity of demand; i.e., they are foods the demand for which increases more than in proportion to increases in income, other things being equal.

[23] In contrast to being primarily a public health intervention, fortification might alternatively be motivated primarily by other goals, such as the promotion of Good Manufacturing Practices, GMP.

This can be useful information for designing policies and programs so that complementary or substitute programs can be targeted to individuals or households of particular characteristics or targeted to geographic areas so as to better ensure higher coverage or more adequate impacts. Conversely, the HIES can also provide a better understanding of the characteristics of the households and individuals who are likely to benefit less, or not at all, from a fortification program.

3. Identifying "New" Potential Food Vehicles

The discussion has focused up to this point on only the four most commonly considered "best" candidate food vehicles (exclusive of salt iodization). The HIES, of course, contains information on many more potential food vehicles that might also be of interest. For instance, in the four countries in which bouillon cubes were reported—Burkina Faso, Cameroon, Cote d'Ivoire and Guinea—it appears as though this might be a promising vehicle: with 72 to 89 percent of households reporting purchases of this low priced condiment and the proportion is relatively constant over all five income quintiles.

4. Investigating Combinations of Foods and Potential "Substitute" Vehicles

Another potentially important use of the HIES is to investigate the combinations of specific types of foods that households purchase. A large proportion of Cambodians, for instance, consume fish sauce daily and some food industry analysts have suggested that it is a substitute for table salt, which has important implications for an iodine fortification strategy. Analysis of the Cambodian HIES found that:

- 46 percent of households purchase table salt,
- 62 percent purchase fish sauce,
- 75 percent purchase both fish sauce and salt,
- 13 percent purchase only salt-not fish sauce and
- 29 percent purchase only fish sauce-not salt.

This suggested that iodizing fish sauce, rather than table salt, would enable reaching a larger proportion of the population. The data were re-analyzed by household expenditure quintiles and it was found that salt purchasing patterns were independent of income quintile and although the poorest 20 and poorest 40 percent were not as likely to purchase fish sauce compared to all-households, fortifying fish sauce rather than salt would reach an additional 10 percent of the poorest 40 percent of the population, who are also more likely to be iodine deficient.

5. Informing the Decision of the Amount of One or More Fortificants to Add

The HIES data on the quantity of the food purchased can also be used to help inform the setting of the level at which micronutrients should be added to a potential food vehicle. Here, the limitations of the HIES –namely containing household level purchases, not individual level consumption—become more apparent and thus some caution is necessary. The data limitations require certain assumptions about intra-household distribution since estimates for the amount of fortificant are determined on an individual basis.

One possible approach is to apply FAO algorithms to calculate adult consumption equivalents (ACE) to the household composition data available in HIES. The HIES data can also be used to model other assumptions and to test their sensitivity. Having chosen a method for estimating the intra-household distribution, the HIES can then be used to estimate the mean and median quantity purchased as well as the quantity purchased by the 5^{th} and 95^{th} percentiles. These values are important parameters that inform the setting of the safe upper limit for the amount of the fortificant(s) to be added to the food so as to ensure that individuals with high consumption levels are not at-risk of receiving excess amounts of any micronutrient that might be included in the fortification formulation.

Even though operationalizing this approach requires making some critical assumptions, this approach is likely to be an improvement over less comprehensive, less systematic and less verifiable approaches. Still—because of the need to base the final decision on a key assumption—it is imperative to make any and all assumptions explicit and transparent, and to conduct sensitivity analysis.

If there is data on the location or other characteristics of the population with micronutrient deficiencies, this information can be used to assess how well a potential fortification program is likely to cover this target population. Or it can identify (by location or other characteristics) the deficient population that will not be reached by the fortification lives. One potential use of this information would be to use it to target a supplementation program to the areas or persons who the fortification program will not reach (at least not immediately).

Annex 3:
Adult Consumption Equivalents and Updating Future HIES Data with Data from the Makerere University 2008 Food Consumption Survey

As noted in the text discussion of the HIES, the HIES provides important empirical information about the skewed right nature of the distribution of consumption, which should be regarded as preferable to simply making some assumptions about these key parameters. Given the information void about individual consumption levels and the use of household purchases as its proxy, however, setting the amount of fortificant to be added to a vehicle still requires making one or more assumptions about the intra-household distribution of the household's purchases of the vehicle in question. The simplest approach makes use of the HIES information about household size and implicitly assumes that all individuals in the household receive equal amounts of the food. This approach does not take into differences in the age or sex of household members, which (as reflected in the age- and sex-specific EARs) give rise to differences in "need".

An alternative approach would be to make use of the HIES information about the number of household members and their ages and sex and either (1) calculates the "adult consumption equivalents" (ACE) using the FAO algorithms (presented in the table below) which are based on energy requirements, or (2) in the case of analyzing a single micronutrient--vitamin A in this case—the vitamin A-specific EAR age and sex categories can be used to calculate vitamin A-specific-adult consumption equivalents.

FAO Adjustment Factors for Calculating the Number of Adult Equivalent Consumption Units

AGE	***MALE***	***FEMALE***
< 1 year	0.27	0.27
1 – 3 years	0.45	0.45
4 – 6 years	0.61	0.61
7 – 9 years	0.73	0.73
10 – 12 years	0.86	0.78
13 – 15 years	0.96	0.83
16 – 19 years	1.02	0.77
20 years and above	1.00	0.73

While the ACE approach makes use of more detailed empirical data, it is important to note that its application implicitly assumes that the food purchased by the household is distributed within the household in direct proportion to "need" as reflected in whichever of the two specific algorithms is applied.[24]

[24] This simplifying assumption "smoothes" the intra-household distribution of food consumption, resulting in an underestimation of extreme values and thereby increasing the potential risk of pushing individuals who are outliers (in terms of their level of consumption of the food vehicle) over the UL for a given level of fortification.

An alternative approach to making this assumption would be to use the HIES data to model some other intra-household assumptions and to test their sensitivity or to use the food consumption survey that Makerere University is currently conducting to provide an evidence-based approach to devising an algorithm for determining intra-household distribution of purchases, which can then be used in the future, in combination with "new" HIES surveys to update the food consumption survey data. Even though operationalizing this approach requires making some critical assumptions, this approach is likely to be an improvement over less comprehensive, less systematic and less verifiable approaches. Still—because of the need to base the final decision on a key assumption—it is imperative to make any and all assumptions explicit and transparent, and to conduct sensitivity analysis.[25]

[25] If there is data on the location (e.g., region or rural-urban place of residence) or other characteristics of the population with micronutrient deficiencies, this information can be used to assess how well a potential fortification program is likely to cover this target population. Or it can identify (by location or other characteristics) the deficient population that will not be reached by the fortification lives. One potential use of this information would be to use it to target a supplementation program to the areas or persons who the fortification program will not reach (at least not immediately).

Annex 4
UIRI Analytical Laboratory Costs

UIRI Analytical Laboratory Personnel Costs

In US$

Number of Persons	Gross Monthly Salary (US$)	Comments	Monthly Benefits	Total Remuneration Monthly	Total Remuneration Annually
1	2000	Manager	200	2,200	26,400
2	1000	Lab Analysts - Experienced	100	2,100	25,200
4	500	Lab Analysts - New	50	2,050	24,600
1	300	Assistant	30	330	3,960
8	3800		380	6,680	80,160

In UGX

Number of Persons	Gross Monthly Salary (UGX)	Comments	Monthly Benefits	Total Remuneration Monthly	Total Remuneration Annually
1	3,330,000	Manager	333,000	3,663,000	43,956,000
2	1,665,000	Lab Analysts - Experienced	166,500	3,496,500	41,958,000
4	832,500	Lab Analysts - New	83,250	3,413,250	40,959,000
1	499,500	Assistant	49,950	549,450	6,593,400
8	6,327,000		632,700	11,122,200	133,466,400

Source: Author's derivation from data obtained from UIRI Laboratory

Notes:
UIRI has been growing. Increased from 5 to 8 staff in the past year, largely due to the ECSA initiated activities (Proficiency Tracking Scheme Project PTS) and UG-specific TA provided by A2Z

1 OF 88 SAMPLES RELATED TO VITAMIN A FORTIFICATION

AVG. OF 10% OF ALL WORK IS FORTIFICATION RELATED
HALF OF THAT, 5% OF TOTAL IS RELATED TO REGULATORY COMPLIANCE (UNBS-COMMISSIONED WORK)
THE OTHER HALF, 5% OF TOTAL, IS RELATED TO WORK THAT IS DONE DIRECTLY WITH COMPANIES TO IMPROVE THEIR IN-PLANT QA CAPABILITIES

Annual UIRI Administrative and Indirect Costs

Item	Total UIRI Costs US$	Total UIRI Costs UGX	Lab's Pro-Rated Share	UIRI Lab Costs US$	UIRI Lab Costs UGX
Electricity	432,432	720,000,000	5%	21,622	36,000,000
Water	36,036	60,000,000	5%	1,802	3,000,000
Common Services (Security/Transport/Clerical)	93,694	156,000,000	5%	4,685	7,800,000
Annual Maintenance of Lab Equipment at 5% of value				45,045	75,000,000
Supervision	214,715	357,500,000	5%	10,736	17,875,000
Total	**776,877**	**1,293,500,000**		**83,889**	**139,675,000**

Annual UIRI Lab's Use Value of Capital Equipment

	Total Value of Equipment US$	Total Value of Equipment UGX	Annual Use Value US$	Annual Use Value UGX
Use Value of UIRI Lab Capital Equipment (assumes 10 year useful life)	900,901	1,500,000,000	90,090	150,000,000

(No account of building use value)

Source: Author's derivation from data obtained from UIRI Laboratory

Annex 5
The GAIN/Uganda Grant

One and a half-years ago, GAIN awarded Uganda a US$2.4 million grant, which has just become effective. The table below shows the budget for each of the project's five major planned activities.

Recognizing the limited budget relative to the substantial regulatory system responsibilities of UNBS, the GAIN grant provides for paying two additional UNBS staff and purchasing a vehicle.

GAIN's end-of-project indicators call for 16 companies to be fortifying (four of which already are):

Wheat: Nile Agro, Kengrow, UNGA, Ntake, Bakhresa (GAIN to start with 4, then add Bakhresa in last year) (5 total)
Maize: Maganjo and UNGA 2000 (Western region) already fortifying; UNGA (Kampala) to be added (it has WFP contract); WFP (has own mill too) and Eastern Grain Millers and Sunrise. (5 total)
Vegetable Oil: Mukwano, BIDCO and MUDDU (3 total)
Sugar: Kakira, Kinyara, SCOUL (3 total)

GAIN/Uganda's Estimated Project Budget and Planned Disbursements

Item	Year 1		Year 2		Year 3		Final Dis-bursement	TOTAL
	Months 1-6	Months 7-12	Months 1-6	Months 7-12	Months 1-6	Months 7-12		
A. Absolute Amount in US$								
1. Production & Distribution	97,932	429,294	187,837	160,423	50,767	35,537	5,077	**966,865**
2. Safety & Quality Control	72,050	62,403	71,846	73,854	81,887	57,321	8,189	**427,549**
3. Social Marketing & Communication	97,020	86,303	108,113	103,438	84,738	59,316	8,474	**547,402**
4. Monitoring & Evaluation	9,329	15,274	45,274	39,114	14,474	10,132	1,447	**135,042**
5. Program Management & Administration	96,480	41,874	48,570	48,570	48,570	33,999	4,857	**322,920**
Total:	**372,811**	**635,148**	**461,640**	**425,399**	**280,436**	**196,305**	**28,044**	**2,399,778**
B. Percentage Distribution by Year								
1. Production & Distribution	26%	68%	41%	38%	18%	18%	18%	40%
2. Safety & Quality Control	19%	10%	16%	17%	29%	29%	29%	18%
3. Social Marketing & Communication	26%	14%	23%	24%	30%	30%	30%	23%
4. Monitoring & Evaluation	3%	2%	10%	9%	5%	5%	5%	6%
5. Program Management & Administration	26%	7%	11%	11%	17%	17%	17%	13%
Total:	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
C. Percentage Distribution of Project Total								
1. Production & Distribution	4%	18%	8%	7%	2%	1%	0%	40%
2. Safety & Quality Control	3%	3%	3%	3%	3%	2%	0%	18%
3. Social Marketing & Communication	4%	4%	5%	4%	4%	2%	0%	23%
4. Monitoring & Evaluation	0%	1%	2%	2%	1%	0%	0%	6%
5. Program Management & Administration	4%	2%	2%	2%	2%	1%	0%	13%
Total:	**16%**	**26%**	**19%**	**18%**	**12%**	**8%**	**1%**	**100%**
D. Cumulative Percentage Distribution of Project Total								
1. Production & Distribution	4%	22%	30%	36%	39%	40%	40%	40%
2. Safety & Quality Control	3%	6%	9%	12%	15%	17%	18%	18%
3. Social Marketing & Communication	4%	8%	12%	16%	20%	22%	23%	23%
4. Monitoring & Evaluation	0%	1%	3%	5%	5%	6%	6%	6%
5. Program Management & Administration	4%	6%	8%	10%	12%	13%	13%	13%
Total:	**16%**	**42%**	**61%**	**79%**	**91%**	**99%**	**100%**	**100%**

Annex 6: Comments of What is Not Included in the Cost Analysis and Why

The training costs associated with the regulatory system—many of which have been paid for by MOST and A2Z—are not included in the cost estimates. These are capital costs, and are not included in the annual recurrent costs which are the focus of this analysis. Still, considerations should be given to whether or not there should be regular routine re-training and of which agencies' staff, how many staff, and at what interval or frequency. If they are done less than annually they are capital costs. If they are done at least annually, they are recurrent costs and should be included here. In that instance, not including them here means the estimates presented here under-estimated the "full costs" of introducing a fortification program. There are also other start-up costs that are not included in this analysis.

In addition, the opportunity cost of the persons who participate in the NWGFF and other meeting and study tour costs have not been included. These were not included because it is exceedingly difficult to identify which activities are "essential" and to estimate the costs of only those activities, as opposed to simply including all expenditures that have been made in Uganda by MOST / A2Z, GAIN, UNICEF and other international agencies that have helped to encourage fortification in Uganda.

This does not, in any way, mean to suggest that these activities are not necessary. It is simply recognition of the fact that judgments about which of these activities to include and which to exclude, starting when, are largely subjective and arbitrary. Rather than to include them, the analysis here has focused on the recurrent annual costs about which there is much greater consensus and which by and large involve more objective decisions.