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Srengthening Agri-Food Value Chains for Nutrition: Mapping Value Chains for Nutrient-Dense Foods in Ghana

Henry Anim-Somuah, Spencer Henson, John Humphrey and Ewan Robinson

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STRENGTHENING AGRI-FOOD VALUE CHAINS FOR NUTRITION: MAPPING VALUE CHAINS FOR NUTRIENT-DENSE FOODS IN GHANA

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Contents

List of Figures

List of Tables

List of Abbreviations

CFSVA	Comprehensive Food Security and Vulnerability Analysis
DFID	Department for International Development, UK
DHS	Ghana Demographic Health Survey
EU	European Union
FAO	Food and Agriculture Organization
GAIN	Global Alliance for Improved Nutrition
GFSI	Global Food Safety Initiative
IYCN	Infant and Young Child Nutrition (Project)
NGO	Non-governmental organisation
RUTF	Ready-to-use therapeutic food
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Developments
USI	Ghana Universal Salt Iodization Program
WFP	World Food Programme
WHO	World Health Organization

Executive Summary

This report details the findings of value chain mapping of nutrient-dense foods in Ghana. By providing evidence on value chains, the report assesses the potential of a number of products to contribute to reducing undernutrition in Ghana. It analyses the challenges that inhibit these products from having greater impact and identifies options for development agencies, public-private partnerships and others to help address these challenges. It focuses on the key actors and processes involved in producing, processing and delivering foods to consumers. This report supports an accompanying set of policy guidelines, which outline programmatic and policy approaches to promote the provision of nutrient-dense foods in Ghana. Both this mapping report and the accompanying policy guidelines are based on a value chain framework for assessing the impact of food-based and market-based approaches to address undernutrition.

First, based on interviews with stakeholders in the private sector, government, development agencies, NGOs and research institutions, the report scopes a set of agricultural commodities identified as having potential for contributing to nutrient-dense foods, and selects two types of products for detailed value chain mapping: groundnut products and complementary foods. These product types were selected because they scored highly on five important conditions necessary for foods to contribute to reducing undernutrition. They were also selected because providing an analysis for these products offers potential for uptake of findings through the efforts of development actors and public-private partnerships. These bodies are actively looking to invest in these product types in order to improve nutrition outcomes.

The report maps current value chains for groundnut and complementary food products, concentrating on whether they meet the key criteria of availability, affordability, acceptability and nutritional quality. These conditions are assessed in detail across key elements of the value chain: consumer groups, supplies of inputs, processing, distribution and business interest. Based on this mapping, the report analyses the key challenges preventing these products from having a greater impact on undernutrition and assesses options that might overcome these challenges, as well as areas where further evidence is needed to support choosing a particular option. The main findings of this analysis are summarised below.

The report briefly reviews the undernutrition situation in Ghana, focusing on the key micronutrient deficiencies that impact nutrition outcomes and the populations most affected by undernutrition. Vitamin A and iron deficiencies are extremely widespread in Ghana and are associated with negative health outcomes. Infants during the weaning period after six months of age are especially vulnerable to these deficiencies, and evidence shows that currently available foods and feeding practices contribute to poor nutrition outcomes.

For groundnut products, ubiquitous aflatoxin contamination of supplies poses major risks to human health. This poses substantial health consequences, especially for infants. At present, the products with the highest levels of contamination tend to be diverted towards the poor. New micronutrient-fortified groundnut products and distribution systems are needed to target nutrient-dense products towards key populations affected by undernutrition: women, children and poor consumers. However, to successfully address undernutrition, these products must address aflatoxin contamination. This will require an integrated approach with coordinated interventions across the value chain, from farmers and aggregators to retailers and consumers. Promoting a particular groundnut product in the absence of efforts at other stages of the value chain is unlikely to be successful. Further, efforts to bring new products to market must at a minimum avoid exacerbating the steering of aflatoxin towards poor and vulnerable populations. Options for intervention include creating traceable supply chains that incentivise actors to reduce infection with aflatoxin-carrying fungi, using non-commercial distribution

systems to control the consumer end of the value chain, raising consumer awareness about aflatoxin and developing alternative uses for contaminated groundnuts that remove them from the food system.

The second product type, complementary foods, has high potential to address undernutrition among infants and young children; they are also acceptable to consumers and already have distribution systems in most cities. The key to enhancing their impact is controlling their nutrition quality and signalling this quality to consumers, while marketing products at an affordable price. Well-established value chains for these products provide opportunities for intervention to leverage existing systems. Options to enhance the value chains for complementary foods include developing a certification scheme to guarantee nutrition quality; working with particular food processors to upgrade operations and to market to the poor; enhancing the capacities of small businesses; and advocating for leading firms to pursue 'bottom of the pyramid' approaches.

Drawing together lessons from the mapping of individual products, the report highlights broader challenges to the provision of nutrient-dense foods in Ghana. Aflatoxin contamination concerns a broad array of foods. It requires coordinated value chain action and the generation of incentives to implement improved practices. The absence of mechanisms to signal the nutritional value of foods to consumers spans many products and is a key area for policy intervention. Traceable value chains are largely absent in domestic food markets; fostering traceable value chains is key to establishing incentives and upgrading nutrient quality and food safety. Finally, private sector actors in Ghana face challenges to building viable business models to market nutrient-dense foods so they reach poor consumers. These four cross-cutting challenges are key areas for broader policy and programmatic interventions to enhance the provision of nutrient-dense foods through value chains. The accompanying policy guidelines assess the feasibility of policy options and the evidence required to support effective action.

1 Introduction and Overview

This report presents the outcomes and findings of value chain mapping of nutrient-dense food products in Ghana. This work was carried out by the Institute of Development Studies (IDS) and partner organisations, as part of the IDS Accountable Grant, funded by the Department for International Development (DFID). These efforts are part of the 'Strengthening Agri-food Value Chains for Nutrition' workstream of the 'Reducing Hunger and Undernutrition' theme.

This report is intended to inform public-private partnerships and other initiatives seeking to promote nutrient-dense foods in Ghana, especially those working on groundnut and complementary food products. As will be identified below, these audiences include initiatives currently under way that focus on these product types. The report is particularly concerned with the potential to create incentives for the private sector and for public-private partnerships to develop, produce and distribute foods that will contribute to reducing undernutrition.

The report uses a value chain approach to identify and assess the potential of two key food types as part of a country study of Ghana. For these products, the report systematically outlines evidence on the key stages in their value chains, including their nutrition content, target consumers, inputs and sourcing, processing, distribution and levels of current business interest. It analyses these value chains to identify particular areas of potential, as well as identifying the key challenges that need to be overcome in order to enhance the contribution of these foods to reducing undernutrition. Finally, the report identifies options for strengthening the value chains of groundnut products and complementary foods, in order to maximise their contribution to reducing undernutrition. This report is paired with a set of policy guidelines that provide a framework for analysing policy challenges to promoting nutrient-dense foods through value chains. These guidelines outline in greater detail the approach underlying the analysis of value chains for nutrient-dense foods. The guidelines draw on the value chain mapping undertaken here to identify the broader challenges facing nutrient-dense foods in Ghana and to outline feasible options that policymakers, donors, NGOs and private sector actors can use to help address these challenges.

This report proceeds as follows: the introduction highlights the value chain approach employed in the analysis (this approach is examined in greater detail in the accompanying policy guidelines); it then explains the methods used to gather evidence. The remainder of the report provides a country study of value chains for a number of nutrient-dense foods in Ghana. Section 2 briefly reviews the undernutrition situation in Ghana, highlighting key micronutrient deficiencies and the role of food-based approaches for addressing these problems. Section 3 is a systematic mapping of value chains for two priority food types – groundnut products and complementary foods. It provides a rationale for why these products were selected for in-depth mapping and provides the context and evidence to support the analysis in the sections that follow. Section 4 draws on the value chain mapping to identify areas where particular products have potential to make a greater contribution to reducing undernutrition. It identifies the challenges that must be overcome to unlock this potential, highlighting both challenges for specific products and broader challenges that are particular to enhancing the nutritional impact of foods in general. Section 5 focuses on value chains for groundnuts and complementary food products, proposing options for how these value chains could be strengthened to generate greater impacts on reducing undernutrition. These options relate closely to the areas for policy and programmatic action identified in the policy guidelines.

1.1 Reducing Hunger and Undernutrition

The goal of the Strengthening Agri-food Value Chains for Nutrition workstream is to contribute to reducing undernutrition by increasing the accessibility, affordability and acceptability of nutrient-dense foods to poor and vulnerable populations (Hawkes and Ruel 2009: 2). To achieve this end, the workstream identifies opportunities to enhance private sector involvement in the production of these foods. This includes two sets of activities:

1. Identifying food products with high potential to address undernutrition for poor and vulnerable populations, focusing on foods that are consumed off-farm and products that are currently marketable or which have the potential to be taken up by private sector actors.

2. Providing policy guidelines outlining key actions that donors, government, NGOs and businesses can take to address barriers to delivering nutrient-dense foods.

1.2 The value chain approach to linking agriculture and nutrition

Recently, there has been widespread interest among development agencies in enhancing the link between agriculture and nutrition as part of strategies to tackle the persistent global problem of undernutrition (DFID 2009). The logic is to focus on 'nutrition-sensitive' development approaches to take place alongside direct interventions in nutrition, such as management of acute malnutrition and micronutrient supplementation (DFID 2011). But pursuing a goal of nutrition-sensitive agriculture can entail different courses for policy and programmatic action. There are multiple pathways through which agricultural production can lead to improvements in nutrition status (World Bank Agriculture and Rural Development Department 2007). Evidence shows that simply improving farm production and incomes is not sufficient to address undernutrition, especially key micronutrient deficiencies (DFID 2012). Two approaches to linking agriculture and nutrition described in the policy guidelines that accompany this approach are termed 'pre-farmgate' and 'post-farmgate' initiatives. The guidelines provide more detail on the policy context for these approaches. For the purposes of this report, it is sufficient to note that the pre-farmgate approach focuses on increasing the production of nutrient-dense foods and their consumption *by the farming households and communities* that grow them. By remaining on-farm, these approaches therefore have limited reliance on markets and value chains to deliver foods to consumers who need them. In contrast, post-farmgate approaches seek to link agricultural production with populations beyond on-farm consumption, whether in rural or urban areas. Given the importance of enhancing the consumption of nutrient-dense foods among undernourished populations off-farm, value chain approaches are crucial to understanding how foods reach these populations and how particular nutrient-dense foods can be promoted.

The analysis in this report – and the Strengthening Agri-food Value Chains for Nutrition workstream more broadly – employ a value chain approach to identify opportunities for providing nutrient-dense foods to populations affected by undernutrition. Box 1 highlights the key characteristics of a value chain approach; the relationships between this approach and broader market-based frameworks and provision of nutrient-dense foods in particular are discussed in the policy guidelines. The value chain approach begins with a different objective than efforts to promote pre-farmgate consumption. Rather than beginning with agricultural production and then making links to nutrition, the value chain approach begins with the populations affected by undernutrition that can be addressed through greater consumption of nutrient-dense foods. The approach then works backwards through the value chains that can deliver foods to these populations. The stages in the value chain can involve private sector actors, government and civil society. The value chain approach provides a lens that complements the pre-farmgate approach in identifying options for policy and programmatic

action to enhance consumption of nutrient-dense foods. Its strengths are that it highlights how to make nutrient-dense foods accessible on a sustainable basis to vulnerable populations off-farms, and enables identification of key challenges for private sector involvement – as well as the roles of other actors – in delivering these foods.

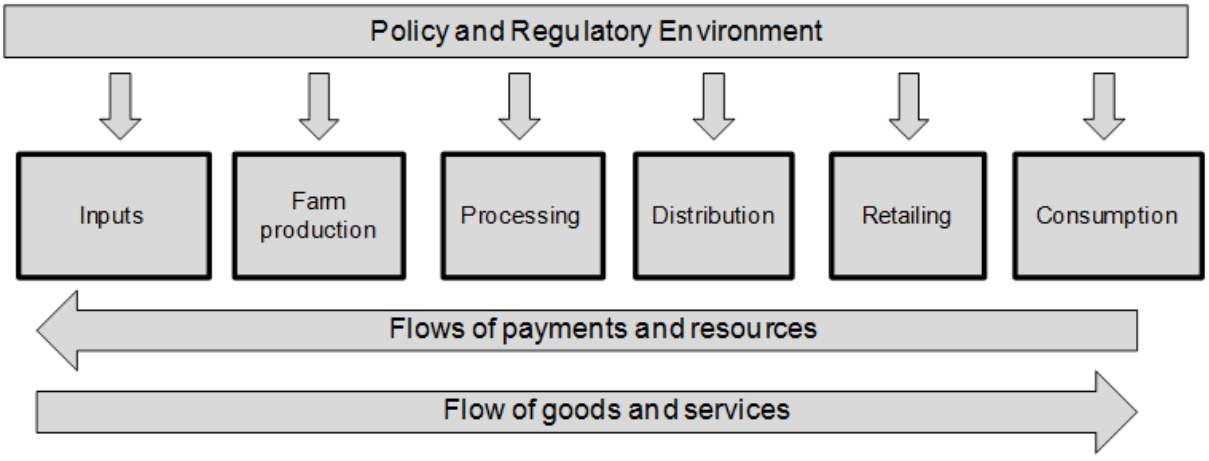
In the value chain approach, four over-arching conditions have been identified as necessary to enhancing consumption of nutrient-dense foods. In order for markets to deliver foods to populations affected by undernutrition, foods must be available, affordable, acceptable and of high nutritional quality. In addition, in order to address the problems with providing reliable information on credence goods such as nutrient-dense foods, the accompanying policy guidelines identify two key conditions necessary for the functioning of markets for these foods: value chain integrity and signalling of nutrition quality to consumers. Integrity refers to the accuracy and reliability of claims made about the qualities of products. In other words,

Box 1 Key elements of the value chain approach

A value chain is constituted by a sequence of agents (people, companies, etc.) and activities, as shown in Figure 1. The advantages of a value chain approach come not in elaborating all actors and relationships, but in identifying those of greatest significance. The advantages of the approach for understanding how to strengthen the delivery of important goods to the poor include:

- identifying the different activities and agents required to bring products to market;
- recognising that what happens at one point in the chain has consequences for activities and agents at other points;
- paying attention to the output of the chain, including the qualities delivered and the populations reached;
- highlighting the importance of flows that link actors, including exchanging goods and payments, but also flows of information, provision or credit and imposition of standards;
- enabling the incentives and limitations faced by private sector actors, including how they capture value control actions at other stages; and
- helping identify at which point in the chain, and with which actors, policy interventions can be most effective at improving the functioning of markets.

Figure 1 Generic value chain map



does a product really provide the nutritional value it claims to have? Signalling refers to the way the quality of the product is communicated to the consumer. Nutritional quality can be signalled in a number of ways, including product appearance and logos denoting that the product meets a particular standard. These conditions are summarised in Box 2 and explained in greater detail in the accompanying policy guidelines. These conditions are the starting point for assessing the potential of particular food products for reducing undernutrition; they were used in the assessment of product types in Ghana (see Section 3.1).

Box 2 Necessary conditions for addressing undernutrition through agri-food value chains

Food availability: The food must be present in a specific location.

Food affordability: At-risk households must be able to afford the available food.

Food acceptability: The food must be in a form that is acceptable to the consumer.

Food nutritional quality: The food must have adequate density of essential nutrients.

Value chain integrity and signalling: Conditions must be in place to allow consumers to reliably assess the nutritional quality of the food.

Source: Adapted from Hawkes and Ruel 2011: 2).

The value chains approach used in this report builds on an existing tool designed to facilitate private sector involvement in linking agriculture and nutrition (Henson *et al*. 2012). The existing tool, 'Nutritious Agriculture by Design', used the value chain approach to assess the different channels through which food can be produced, processed and delivered to target populations affected by undernutrition. This report develops additional elements of the value chain approach by systematically assessing how particular value chains create challenges and opportunities for private sector involvement. In addition, the accompanying policy guidelines identify options for policy and programme development to address the unique value chain challenges faced by nutrient-dense foods.

1.3 Methods

The information presented in this report was collected through interviews, group discussions and site visits with stakeholders in the areas of food processing, trade, agriculture and nutrition. The authors met with a total of 49 informants (Table 1), including researchers in universities and institutes, staff in NGOs and donor agencies, civil servants, managers in small and medium-sized food processing businesses, and commodity traders. The interviews focused on topics including agricultural production, storage, transport and marketing; food processing; consumer behaviour; and regulations and policies affecting the environment for actors in agri-food value chains for nutrition.

Evidence-gathering occurred in two stages: first, a scoping exercise was carried out using desk research and expert interviews to collect evidence on the potential of five product types identified by stakeholders. From these five product types, two were selected for in-depth value chain mapping, involving extensive literature reviews, stakeholder interviews and site visits. Section 3.1 describes how products were selected.

Table 1 Interviews conducted with stakeholders in research organisations, donor agencies, NGOs, businesses and public agencies

Type of informant	Count
research	25
donor or NGO	7
private sector actor	5
government agency	12

2 Undernutrition in Ghana

Although poverty rates have fallen substantially in Ghana over the past decade, and there have been reductions in levels of energy malnutrition, undernutrition remains a major problem. Rates of underweight children and stunting remain high, and micronutrient undernutrition is rife, especially deficiencies in iron and vitamin A. Pregnant women and children under two years old are especially impacted by undernutrition. There are major nutrition disparities between Ghana's relatively poor northern regions (Northern, Upper West and Upper East regions) and the wealthier south, with children in the north more likely to be stunted and underweight and to suffer from anaemia. Available data allow identification of populations affected by overall undernutrition, as well as differences in infant and child feeding practices. However they are less precise in disaggregating micronutrient deficiencies across geographic areas or social groups. Clearly though, pregnant and breastfeeding women and children under two years are in general the most vulnerable groups. For these reasons, this report focuses on how consumption of nutrient-dense foods can contribute to reducing micronutrient undernutrition – and especially iron and vitamin A deficiencies – for women of child-bearing age, infants under two and young children.

Reducing undernutrition requires addressing its underlying drivers. These are varied, and cover health (particularly freedom from infections that affect appetite and nutrient absorption) and care practices. Alongside these, food-based approaches are also important, particularly for children: 'children need to absorb sufficient energy, protein and fat as well as multiple micronutrients to grow properly' and to achieve this requires nutrition-sensitive interventions that ensure that 'diets are sufficient in their entirety' (DFID 2012: 12, 13). Increasing the availability and consumption of nutrient-dense foods is one important contributor to tackling undernutrition, although clearly not the only one (Simler *et al.* 2005). Available studies do not allow correlation of the consumption of particular foods in Ghana with indicators of nutritional status.[1] However, consumption of particular nutrient-dense foods can play a key role in key micronutrient deficiencies, especially vitamin A and iron. Poor infant and child feeding practices are especially crucial drivers of nutrient deficiencies in children (Infant and Young Child Nutrition Project 2011), and problems include use of insufficiently nutrient-dense foods and poor dietary diversity during weaning, insufficient breastfeeding during weaning and insufficiently frequent feeding. These problems are especially widespread in Ghana and feeding practices are insufficient to secure child health in both rural and urban areas, as well as across different wealth groups.

Available data indicate that food-based approaches should target particular vulnerable populations and should focus on foods containing particular micronutrients (especially iron and vitamin A) in order to best contribute to reducing undernutrition in Ghana. Stunting and anaemia rates are highest in the north, but anaemia is alarmingly prevalent in women and young children throughout the country. Populations in much of the north, especially the rural poor, continue to be highly vulnerable and lack access to sufficient quantity and diversity of foods.

Nutrient-sensitive programmes aimed at agriculture and the food system are needed to increase the consumption of diverse food types, with special attention to affordability, since these populations are already vulnerable to caloric malnutrition. While for Ghana as a whole diet diversity is considered adequate for the majority of the population (as defined by the Food and Agriculture Organization, or FAO), there is a particular problem with the consumption and

[1] Only one study has undertaken regression analysis of the impact of dietary diversity on nutrition in Ghana on the national scale (Van de Poel *et al.* 2007).

uptake of adequate quantities of iron and vitamin A in food. These deficiencies are estimated to cause enormous damage to child survival and development. Increasing consumption of foods rich in bio-available forms of iron and vitamin A – especially for women, weaning infants and young children – should be a key food-based strategy. Furthermore, complementary foods are a particular priority, because evidence shows that weaning is the point when Ghanaian infants suffer the greatest setbacks in nutrition. These setbacks stem from the inadequate nutrient content of complementary foods (Lartey *et al*. 1999) and poor infant feeding practices across social groups in Ghana (Infant and Young Child Nutrition Project 2011. Efforts are needed to enhance the use of nutrient-dense complementary foods and to promote good feeding and care practices.

2.1 Nutrition status and trends

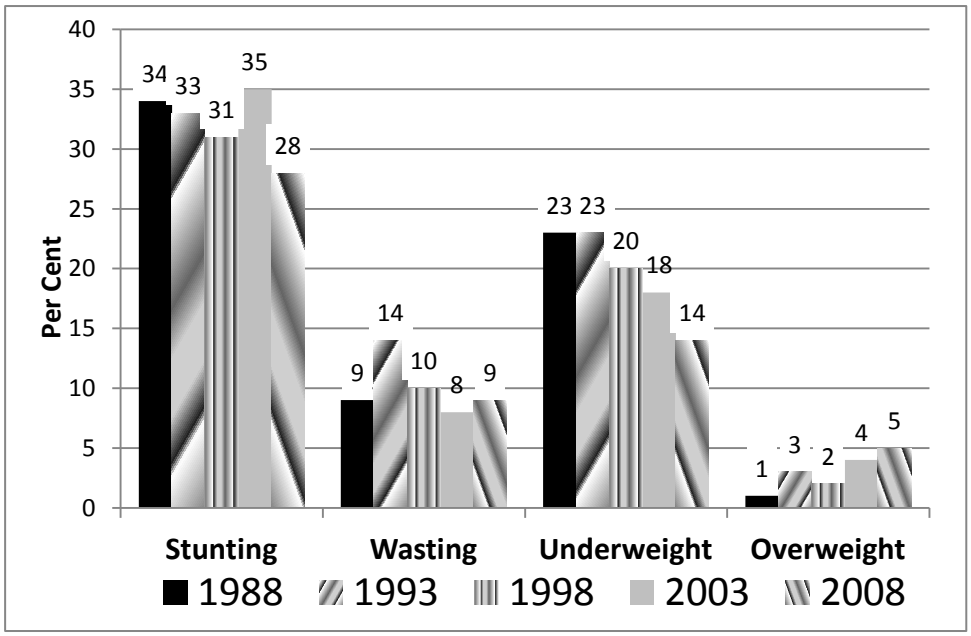
The latest Ghana Demographic Health Survey (DHS),[2] conducted in 2008 (Ghana Statistical Service 2009), continues to show improvements in the nutritional status of children under five. In 2008:

- **Stunting (low height for age)** prevalence was 28 per cent, with 10 per cent of children severely stunted. Stunting is a measure of chronic malnutrition.
- **Underweight (low weight for age)** prevalence was 14 per cent, with 3 per cent of children considered severely underweight. Underweight is a measure for chronic and acute malnutrition.
- **Wasting (low weight for height)** prevalence was 9 per cent, with 2 per cent of children severely wasted. Wasting is associated with acute malnutrition; it represents a failure to receive adequate nutrition in the period immediately preceding the survey.

Since 1988 there have been improvements in the nutritional status of Ghanaian children. Stunting and underweight ratios have steadily decreased, whereas wasting has remained stagnant at 9 per cent and obesity levels have increased to 5 per cent (Figure 2).

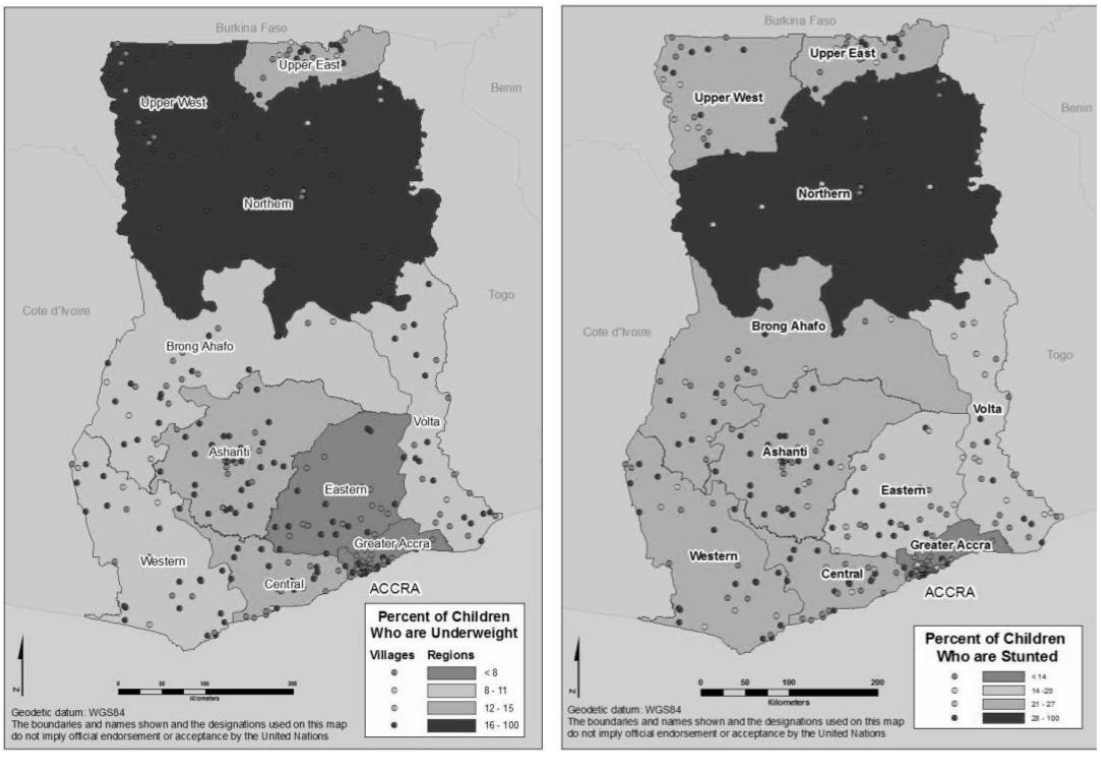
[2] There are significant discrepancies on nutrition indicators between the DHS and the CFSVA. The figures presented here come from the DHS, which has more rigorous sampling.

Figure 2 Prevalence of stunting, wasting, overweight and underweight, Ghana, 1988–2008 (%)



Source: Ghana Statistical Service (2009). Note: Based only on children whose mothers were interviewed.

Figure 3 Prevalence of child stunting (at left) and underweight (at right) by region



Source: World Food Programme (2009: 116).

The northern regions have greater rates of underweight and wasting, as shown in Figure 3, which are linked closely to food insecurity. Chronic malnutrition in these regions is linked to household poverty levels, ecological constraints, high disease burden (malaria, HIV/AIDS, intestinal worms, diarrhoeal diseases) inadequate health and sanitation facilities, and infant and young child feeding practices (Feed the Future 2011; Van de Poel *et al.* 2007) Children in rural areas are more likely to be stunted and underweight than urban children. Stunting rates are 32 per cent in rural areas, and only 21 per cent in urban areas. Children in rural areas are also more likely to be underweight than urban children, with 15 and 12 per cent of children underweight in rural and urban areas respectively (Ghana Statistical Service 2009). Rural areas also face higher rates of particular micronutrient deficiencies.

2.2 Micronutrient deficiencies

While indicators of overall nutrition have shown some improvement in recent years, undernutrition in the form of deficiencies in key micronutrients remains widespread, especially for children in the period from conception to two years old (the thousand days).

Iron

Anaemia is alarmingly high among pregnant women and young children across Ghana, and has seen little improvement in recent years[3] (Infant and Young Child Nutrition Project 2011). Seventy-eight per cent of children (six to 59 months) have some sort of anaemia, and 7 per cent of cases have severe anaemia (Birks 2012). Anaemia increased by two percentage points between 2003 and 2008, despite other health indicators having improved over the same period (Feed the Future 2011). Anaemia in children is associated with impaired mental and physical development and increased morbidity and mortality (Ghana Statistical Service 2009; Feed the Future 2011). Meanwhile, 59 per cent of women aged 15 to 49 suffer from anaemia. For pregnant women, the rate of anaemia is 70 per cent, while for breastfeeding mothers it is 62 per cent. Anaemia in women is associated with child mortality, maternal mortality, birth outcomes, morbidity, work productivity and child development (Stoltzfus *et al*. 2004). It must be emphasised that deficiency in dietary iron is only one factor in anaemia. Estimations suggest that malaria is also a major contributor to anaemia rates in Ghana (Ghana Health Service 2008). Iron deficiencies result from insufficient intake of bio-available iron, coupled with high requirements for iron during pregnancy and early years. Although iron is the most important nutrient deficiency contributing to anaemia, deficiencies of folates, vitamin B_{12} and protein can also cause anaemia. Increasing consumption in food of bio-available iron and other micronutrients are thus important elements of a national strategy to combat anaemia.

There are substantial disparities in rates of anaemia across social groups, although high rates of anaemia affect populations at all wealth levels. The prevalence in children is 87 per cent among children in the lowest wealth quintile, and 61 per cent among children in the highest quintile (Ghana Statistical Service 2009). Anaemia rates are also higher in rural areas; in these areas, 84 per cent of children and 62 per cent of women suffer from anaemia, compared to rates of 58 and 55 per cent in urban areas for children and women respectively (Ghana Statistical Service 2009). Anaemia in children is much higher in Upper East and Upper West regions (89 and 88 per cent respectively), while prevalence in the Greater Accra region is lower (62 per cent) (Ghana Statistical Service 2009). Anaemia rates among women range from 48 per cent in the Upper East region to 71 per cent in the Western region (Ghana Statistical Service 2009).

[3] Rates of anaemia are reported as a proxy for iron deficiency. It is estimated that iron deficiency is responsible for approximately 50 per cent of anaemia globally (Stoltzfus *et al*. 2004). Other important causes include malaria burden and intestinal worm infestation (Ghana Health Service 2003).

Vitamin A

About three-quarters of preschool aged children and one-fifth of pregnant women are deficient in vitamin A. It has been estimated that vitamin A deficiency contributes to one in three deaths of Ghanaian children between six and 59 months, or a total of 86,000 deaths between 2001 and 2005 (Simler *et al*. 2005). Vitamin A is an essential micronutrient necessary for the normal functioning of the eyes, resistance to diseases and proper functioning of the immune system (World Food Programme 2009). Vitamin A deficiency is the result of insufficient consumption of vitamin A-rich fruits and vegetables, green-leafy plants and animal proteins (Food Insecurity and Vulnerability Information and Mapping Systems 2009). The strategy to address Vitamin A deficiency includes supplementation for young children and dietary diversification. Surveys show that more than half of Ghanaian children receive vitamin A supplementation (Ghana Statistical Service 2009: 198).

Iodine

Recent data on iodine deficiencies in Ghana are not available. Goitre is a symptom of iodine deficiency, and it used as a proxy measure. A study of school children and mothers in 1994 showed that prevalence of total goitre was 20 per cent or more in 15 of the 27 surveyed districts. Several districts in the north of Ghana had rates above 50 per cent (Asibey-Berko and Orraca-Tetteh 1994). Iodine deficiency results from insufficient intake of iodine-rich foods, such as seafood and consumption of iodine-inhibiting foods, including some varieties of cassava. National fortification of salt with iodine is generally used to address these deficiencies. In Ghana, only a third (32 per cent) of households consumes iodised salt (FIVIMS 2009), with substantially higher coverage in urban areas, where households are twice as likely to have consumed iodised salt than rural households (FIVIMS 2009).[4]

2.3 Diets

Although the majority of the Ghanaian population consumes adequately diverse diets, according to the World Food Programme (WFP), there are at least three major problems concerning diets. First, dietary diversity is inadequate for substantial populations in the northern regions. Second, consumption of foods rich in particular micronutrients, especially iron and vitamin A, is too low throughout the country. Third, complementary feeding of infants after six months is severely inadequate across wealth groups. Complementary foods are deficient in key micronutrients, especially iron, and lack diversity. This problem compounds poor feeding and care practices, which are widespread across groups.

According to surveys, food consumption does not vary widely between different social groups. However, women in urban areas consume more grains, proteins and foods cooked with oil, fat or butter in comparison with women living in rural areas. Consumption of meat, fish, shellfish, poultry and eggs is particularly high among women in the Greater Accra region (96 per cent) (Ghana Statistical Service 2009). Women in rural areas consume more roots or tubers, legumes and vitamin A-rich foods. Consumption of vitamin A or iron is highest among children in the Upper East region (86 per cent) and lowest in the Northern region (77 per cent) (Ghana Statistical Service 2009). Recent consumption of iron-rich foods ranges from 67 per cent in the Upper West region to 83 per cent in the Accra region (Ghana Statistical Service 2009). Dietary diversity of pregnant and breastfeeding women is particularly important, as mothers' consumption affects infants' nutritional status. When surveyed, 61 per cent of mothers recalled

[4] Major efforts have gone into assuring universal salt iodisation in Ghana to address iodine deficiencies. These efforts are beyond the scope of this workstream, which focuses on agri-food value chains. For this reason, iodine deficiencies are not specifically covered in the mapping and options highlighted in this report. It is acknowledged, however, that the value chain approach can be useful in understanding the challenges faced by the salt iodisation programme and the options to address them.

eating a vitamin A-rich vegetable in the 24 hours preceding the interview (Ghana Statistical Service 2009).

The WFP's Comprehensive Food Security and Vulnerability Analysis for Ghana groups the population into four household food consumption groups: poor, borderline, acceptable-low and acceptable-high (World Food Programme 2009: 83).[5] The majority of the households have an adequate diet, but there are pockets of poor and borderline food consumption. Nationally, 2 per cent of the population has poor food consumption, while 4 per cent has borderline food consumption and 9 per cent has an 'acceptable low consumption', which is a diet that would not provide adequate micronutrients to support healthy child growth. Diets are poorer in rural areas, with poor and borderline food consumption almost three times greater in rural areas (8 per cent) than in urban (3 per cent) (World Food Programme 2009). There are also regional differences. The least diverse diets are to be found in rural areas of the Upper West region, where 34 per cent of households have low or borderline diets. This is followed by rural areas in the Upper East region, where 15 per cent have low or borderline diversity.

Even though dietary diversity remains low in the north and in rural areas, Ghana is undergoing a nutrition transition. Rapid urbanisation has modified food consumption patterns, shifting from traditional diets high in grains such as millet or sorghum, to an increasing demand for imported food, especially wheat and rice, along with greater consumption of processed and pre-prepared foods. This transition is highest in cities, and especially Accra (Agyei-Mensah and de-Graft Aikins 2010). Reflecting these trends, the prevalence of overweight and obesity is high among adult women, especially in urban areas (Food Insecurity and Vulnerability Information and Mapping Systems 2009). Urban women are twice as likely to be overweight (40 per cent) as rural women (20 per cent) (Ghana Statistical Service 2009).

2.3.1 Infant Feeding Practices

In addition to the diets of pregnant and breastfeeding mothers, infant feeding practices are a critical way that food influences the nutritional status of young children. WHO and UNICEF recommend exclusive breastfeeding for the first six months of life, and that children are given solid or semi-solid complementary foods in addition to continued breastfeeding until at least two years. Although progress has been made in Ghana on exclusive breastfeeding until six months, rates are still insufficient at 63 per cent (Ghana Statistical Service 2009). During the important transition period between six and nine months of age, only 36 per cent of all children are fed appropriately according to WHO Infant and Young Child Feeding Practices (Ghana Statistical Service 2009), while a quarter of infants are not fed appropriately with both breast milk and other foods (World Bank 2009).

Prevalence of appropriate infant feeding practices varies widely between regions, and is especially low in the Northern region. The percentage of breastfed children who receive appropriate complementary feeding ranges from 24 per cent in the Northern region to 72 per cent in the Volta region. However, prevalence of adequate feeding practices does not differ substantially between urban and rural settings, among wealth quintiles or among mothers with differing education levels. The adequacy of diets fed to infants and young children appears to vary substantially between regions; for example the percentage of breastfed children who are fed complementary foods from three or more food groups ranges from 24 per cent in the Northern region to 72 per cent in Volta.

[5] The WFP defines 'poor food consumption' as a diet dominated by starches eaten on a daily basis, complemented by vegetables three to four days per week. Sugar and oil are eaten about two days a week, while meat, dairy, fish, pulses and fruits are very rare. 'Borderline food consumption' is also dominated by starches but includes other food groups more often. Adequate dietary diversity is classed as 'acceptable low food consumption' which includes protein consumption in the form of meat and fish an average of four days per week, and 'acceptable high food consumption', with daily consumption of starches, meat and vegetables.

The quality of complementary foods during the weaning period is crucial. Among breastfed children aged six to 23 months, seven in ten were given foods from three or more food groups, and half were fed at least the minimum meal frequency, according to WHO guidelines. The most common weaning foods in Ghana after six months are made from grains; meat, fish, poultry and eggs; fruits and vegetables; and roots and tubers (Table 2). There is low use of legumes and nuts and dairy products, and a need to increase the consumption of vitamin A-rich foods. Fortified baby foods are used by a small percentage (less than 16 per cent) of households with children in weaning age (Ghana Statistical Service 2009). According to a survey conducted by USAID, complementary foods often use locally available products. However, use of animal-source proteins and dark green, leafy vegetables was low. Additionally, only a little more than one-third of respondents could adequately name examples of energy-rich, body-building and protective foods. (Infant and Young Child Nutrition Project 2011). One small-scale study in a rural district of Eastern Ghana (Nti and Lartey 2007) found that infant nutrient intake was far below WHO guidelines, especially for iron, of which infants under nine months received less than half recommended levels (Table 3).

Table 2 Percentage of mothers feeding food types to breastfeeding and non-breastfeeding children

Solid food groups	Percentage of breastfeeding children aged 6-23 months	Percentage of non-breastfeeding children aged 6-23 months
Fortified baby foods	13.1	15.7
Food made from grains (including fortified baby foods)	85.0	96.5
Fruits and vegetables rich in vitamin A	46.0	59.2
Other fruits and vegetables	52.9	62.0
Food made from roots and tubers	40.7	57.9
Food made from legumes and nuts	20.1	27.0
Meat, fish, poultry and eggs	64.6	85.4
Dairy products	6.2	14.5

Source: Ghana Statistical Service (2009).

Table 3 Mean nutrient intake as a percentage of WHO guidelines, among infants surveyed in one district in Eastern Ghana

Nutrients consumed		6-8 months	9-11 months	12-18 months
Energy	(kcal)	84%	90%	91%
Protein	(g)	89%	99%	88%
Calcium	(mg)	66%	69%	78%
Iron	(mg)	33%	44%	75%
Vitamin A[6]	(IU)	535%	663%	443%
Vitamin B1	(mg)	59%	67%	60%
Vitamin B2	(mg)	48%	50%	35%
Niacin	(mg)	53%	41%	44%

Source: Nti and Lartey 2007. Note: Data shown are mean values for a sample of 400 children in Eastern Ghana.

2.4 Other drivers of undernutrition

Consumption of sufficient quantity and quality of food is necessary but not sufficient to ensure adequate nutrition. Although this report focuses mainly on the food-based drivers of undernutrition, it is important to locate this analysis within the UNICEF 'conceptual framework on the causes of malnutrition', acknowledging the interrelation between mother and child nutritional outcomes and the interaction of disease and dietary intake. Food security, disease burden, access to water, sanitation and health services and infant care practices all play a role in shaping nutritional outcomes.

Poverty shapes a number of the central factors related to undernutrition. However, available evidence for Ghana shows that only a portion of the undernutrition burden can be directly linked to poverty levels. Overall, wealth status is responsible for only about one-third of inequality in malnutrition: poorer children are more likely to be malnourished because of their poverty, but there are other important drivers of malnutrition related to geography and use of health services that are unrelated to income (Van de Poel *et al*. 2007). Moreover, the high prevalence of stunting among children in high income quintiles shows that income is only one piece of the puzzle and highlights the importance of feeding practices and disease prevalence (World Bank 2009). In Ghana, the stunting rate among the wealthiest quintile is 14.4 per cent and the underweight rate is 8.6 per cent (DHS 2008 data).

Health and sanitation are especially important drivers of undernutrition. Access to health and sanitation tends to be lowest in the north, where rates of undernutrition are higher. While sanitation does not appear to have an impact on nutritional outcomes at the national level (Van de Poel *et al*. 2007), it does at a regional level. Access to health services is also an important contributor; children of women who accessed health services are less likely to be

[6] High mean levels of vitamin A intake among the infants studied were due to high consumption in the area of palm nut foods, which are rich in this micronutrient. National statistics show that despite local variation, vitamin A consumption on a national scale is insufficient, especially for children under one year (Ghana Statistical Service 2009: 197).

malnourished (Van de Poel *et al*. 2007). In addition to overall nutritional status, health factors also impact on indicators of individual micronutrient deficiencies. Furthermore, some key health indicators are driven by both nutrition and disease factors. Importantly, anaemia is driven by both iron deficiency and malaria: a recent study indicates that 7 per cent of cases of anaemia in Ghana can be attributed to iron deficiencies, whereas 22 per cent can be attributed to malaria (Ghana Health Service 2008).

2.5 Potential for food-based approaches to reduce undernutrition

The multiple drivers of undernutrition are widely acknowledged to mean that multiple approaches are needed to reduce the problem. Although available analyses do not allow attribution of undernutrition to its various drivers in Ghana, data showing the prevalence of micronutrient deficiencies, especially iron-linked anaemia and poor nutrition outcomes for infants during weaning, point to the role of food-based approaches as a key means of addressing the challenges of undernutrition. These approaches can contribute to addressing drivers linked to inadequate diversity of diets, low consumption of key micronutrients (especially iron and vitamin A), insufficient nutrient content of complementary foods and poor infant feeding practices. Identifying which micronutrient deficiencies are driving undernutrition outcomes and which specific populations are most vulnerable to undernutrition is a key step in assessing the potential of particular foods, as well as planning interventions to promote foods. The remainder of this report focuses on the potential of selected food types to address the specific undernutrition challenges of micronutrient deficiencies, especially in vitamin A and iron, and especially for women of child-bearing age and young children.

3 Mapping value chains for selected nutrient-dense food products

This section details the key value chain stages and actors for a set of food products that have potential for reducing undernutrition in Ghana. As described above, evidence-gathering for this report took place in two stages: an initial scoping exercise followed by detailed value chain mapping of two product types. This section first outlines the findings of the scoping exercise, which covered commodities that have attracted interest from development agencies, NGOs and the private sector. Based on a rapid assessment, these products were ranked for their potential to reduce undernutrition. Due to the limited time and resources available, two product types were selected for detailed value chain mapping: groundnut products and complementary foods.[7] These products were selected based on their potential to meet key conditions necessary for reducing undernutrition (as outlined in Section 1.2); and because they provided important opportunities for assuring uptake of this analysis in policy and programmes, as described in Section 3.1.

After explaining how groundnut products and complementary foods were selected, this section describes the value chains of these two product types, disaggregating them to particular products, actors, and supply and distribution systems. It characterises the nutritional qualities, consumer populations, supply chains, processing stages, distribution channels and levels of business interest for each product. The aim of mapping these value chains is to bring together evidence to allow for assessment of the particular products and interventions that have highest potential to address undernutrition through involvement of the private sector.

3.1 Scoping exercise: Selecting high-potential product types

The scoping exercise focused on seven food types identified by stakeholders in development agencies, research institutions, NGOs or private sector organisations. These were seen as having high potential to address undernutrition among key groups in Ghana. Six of these types corresponded to products derived from particular agricultural commodities, while one product type, complementary foods, incorporates a mix of ingredients (see footnote 6). The basic value chain characteristics of these product types are described in Box 3.

[7] Products are classified into these two groups to facilitate value chain analysis. Groundnut products share a common ingredient, as well as important issues relating to the 'upstream' end of their value chains. In contrast, complementary foods incorporate a variety of different ingredients, but they share a common target population (mothers with infants between the ages of six and 24 months). The analysis below shows that some of the key questions for market development of complementary foods relate to the 'downstream' or consumption end of the chain. Although products are grouped in this way, the analysis below covers elements of the entire value chains for each of these product types.

Box 3 Product types examined as part of scoping exercise

Cowpeas are widely-consumed as whole beans and traditional snacks and are also used to fortify breads and porridges. They provide a very good source of folates. In addition to being sold whole in supermarkets and open markets, cowpeas make an important nutritional contribution to the diets provided to students at widely-attended boarding schools in Ghana. The potential of cowpeas is reduced because they are more expensive than soybeans, a common substitute food. Cowpea flour is also less stable, inhibiting its use in some products. Cowpeas suffer high post-harvest losses as a result of susceptibility to insect infestation. These challenges are difficult to address due to the lack of traceable supply chains.

Groundnuts are consumed widely by poor and middle class consumers in Ghana, providing an important source of energy, protein and monounsaturated fats. Seven food products derived from groundnut were identified: whole, roasted groundnuts; recipes using groundnut paste; canned groundnut soup; traditional groundnut snacks; packaged groundnut snacks; groundnut-chocolate spread; and groundnut lipid drink. Food processors source groundnuts from traders who aggregate supplies from numerous small farmers. Due to this supply chain structure, it is difficult to trace supplies to their origin or achieve consistent quality supplies. Aflatoxin contamination of groundnuts is a serious food safety concern and inhibits the potential of groundnuts as nutrient-dense foods in Ghana. The lack of a traceable supply chain makes it difficult to obtain groundnuts with low aflatoxin levels, especially for processed foods.

Complementary foods (especially cereal-legume mixes known as 'weanimix') are widespread in Ghana. They commonly contain maize, wheat, millet or rice, along with soybean, cowpea and/or groundnut. Weanimix products are produced by a range of food processors in the formal and informal sectors. Weanimix products have a wide distribution network in urban areas, and are sold in markets, supermarkets and near hospitals and health clinics. Development partners, including the Global Alliance for Improved Nutrition (GAIN), are supporting Ghanaian firms to undertake micronutrient fortification and develop instant products. The major challenges facing the weanimix value chain are differentiating the products with high nutritional content, generating consumer demand for nutritional value and selling at a price that the poor can afford.

Orange-fleshed sweet potato is eaten in some regions of Ghana, especially by poor consumers. It is a very good source of pro-vitamin A. Orange-fleshed sweet potato tends to be prepared in the home or purchased from street vendors. Sweet potatoes are considerably cheaper than other staples; however they have not attracted substantial business interest, even though they have been promoted in various African countries by development agencies. Development partners are funding projects on breeding and utilisation of orange-fleshed sweet potatoes in Ghana.

Soybeans, although not part of traditional foods, are increasingly eaten in Ghana, especially in the northern regions. They are also in high demand for poultry feed. Soybeans are aggregated by traders and sold wholesale and retail at open markets. There is interest from a number of firms and NGOs in developing traceable, high quality value chains for soybeans. High labour requirements for cultivation and processing of soybeans are the main value chain challenges.

Leafy green vegetables are cultivated by rural households, especially in the northern regions. The consumption of leafy vegetables seems to be decreasing with time due to low status and time-consuming preparation. If prepared appropriately, leafy green vegetables can be a good source of iron, however traditional cooking methods tend to degrade the nutrient value of these foods. The vegetables are available during few months of the year; methods for drying are available but their effect on nutrient quality is unclear. There are no examples of efforts to promote consumption post-farmgate.

Small ruminants and poultry are raised by households in small numbers. They are primarily consumed on-farm on special occasions or sold during periods of hardship. The markets for animals are localised. Projects have promoted animal-raising by women to increase on-farm consumption and incomes in the north. There are no examples of efforts to promote consumption post-farmgate.

Rapid assessment of the value chains for these products was carried out with the purpose of identifying one or two high-potential products for detailed value chain mapping. Foods were assessed against the key criteria in the value chains for nutrition framework, which is outlined in Section 1.2 above and described in detail in the accompanying policy guidelines. The framework prioritises five conditions that must be met in order for a particular food to successfully address undernutrition. These five conditions are highlighted below.

To provide clarity and transparency in the selection of high-priority products, the authors conducted a scoring exercise based on the expert and stakeholder perspectives collected. Individual products were scored according to how well they addressed each of the conditions in the value chain framework. The criterion of availability was not included in the scoring, since reliable information was not available for most products. Further, an additional criterion was added to measure the extent of business interest in the product. Existing business interest in the product (or closely related products) is a key indicator of the commercial viability of new products or initiatives. Assessing commercial viability is needed to assure that promoting a product does not require extensive support, which makes it susceptible to being derailed by unexpected interdependencies along the value chain. Scoring allowed the products to be ranked according to their average scores, and also assessed on individual criteria. The criteria used in scoring were the following:

- **Nutritional quality** – Does the product contain vitamins and protein needed to address undernutrition, especially vitamin A and iron deficiencies among the populations most vulnerable to undernutrition? (pregnant and lactating women, infants between six months and two years)
- **Affordability** – Is the product available at a price that could be affordable to poor consumers?
- **Acceptability** – Is there evidence that consumers (especially poor or vulnerable populations) want to consume this product? Is it part of existing diets?
- **Integrity and signalling –** Can consumers reliably assess the nutritional quality of the product? Can businesses capture a price premium to reflect nutritional value?
- **Business interest –** Is there evidence of existing business interest in producing and marketing the product?

While the scoring does not constitute a systematic evaluation of potential, it helps organise the input collected from stakeholder interviews and desk research and provides clarity on the reasoning that underlies selection. The scoring exercise informed the selection of two priority agri-food value chains for detailed investigation.

Table 17 (in Appendix A) shows the overall scores for the top ranked product types and identifies the key value chain challenges faced by each of these products. The overall scoring produced the following ranking for products: 1) tie between whole cowpea and orange-fleshed sweet potato, 3) complementary foods (fortified weanimix, fortified sprinkles), 4) tie between groundnuts, soymilk and small ruminants. This section provides a narrative explanation of what factors underlie this ranking; Table 18 disaggregates products' scores among the six criteria. The top ranked products, cowpea and orange-fleshed sweet potato, were scored highly because stakeholders considered these products to be affordable and acceptable to poor and vulnerable consumers, although both products are limited to particular regions in Ghana. Consumers can generally identify these products from alternatives, so they do not face substantial problems with signalling nutritional quality. However, businesses' interest in these products is very low. Complementary foods, especially weanimix products scored highly because they target weaning infants, a highly vulnerable group, because they can contain sufficient micronutrients when fortified, are widely acceptable and have attracted high levels of business interest. Complementary foods, however, suffer from important problems with integrity and signalling, as is discussed below. Groundnuts scored high on availability,

affordability, acceptability and business interest, but these products face serious value chain integrity and signalling problems related to aflatoxin contamination, as discussed below. Soymilk had average scores on nutrition quality, availability and affordability but acceptability seems to be limited to urban areas and wealthier consumers. Finally, small ruminants scored highly on acceptability and do not face integrity and signalling issues; however, business interest and affordability are low because value chains for these foods are highly localised.

After establishing a set of top-ranking products, the potential of the value chain mapping to contribute to policy and programmatic action was considered in order to produce the final selection of products. The scoping exercise identified where public-private partnerships, development agencies and NGOs were investing to upgrade the value chains for particular products and to enhance distribution of these products to key populations. These efforts were seen as key opportunities to respond to demand for evidence and assure uptake of the value chain analysis. Of the top scored products, substantial investments are underway to develop value chains for complementary foods, groundnuts and soybeans. The investments in groundnut products and complementary foods are described in the sections that follow; they include investment from multinational corporations and donor agencies including USAID, as well as intensive technical support from GAIN. These investments are targeted specifically to deliver these foods in nutrient-dense forms to populations affected by undernutrition. In contrast, investment in soybeans is focused towards increasing production to supply the domestic poultry industry, with little attention to human nutrition. Although there are efforts underway to promote other projects, including production and consumption of orange-fleshed sweet potato and small ruminants, these initiatives are directed at on-farm consumption, and operate on a small or regional scale. These product types do not have the national reach of groundnuts or complementary foods.[8] This assessment showed that analysis of the value chains for groundnut products and complementary foods would have the highest potential for uptake on programmes and in policies already under way to address undernutrition through food value chains.

Groundnut products and complementary foods were selected for detailed value chain mapping in stage 2. This was based on consideration of the scoring exercise, showing which products best met the conditions for addressing undernutrition and on consideration of which had strong potential for uptake of value chain analysis in existing policies and programmes. As will be shown in the sections that follow, particular groundnut and complementary food products have the potential to address the key micronutrient deficiencies, as well as to be available, acceptable and affordable to many of the populations who need them. Business interest exists – in the formal and informal sectors – in both types of product. Furthermore, key development actors, including GAIN and its partners, are investing in these product types, stimulating present demand for evidence on how to strengthen these value chains to reduce undernutrition.

3.2 Groundnut products

Products derived from groundnuts are consumed by different groups across Ghana, and include traditional cooked dishes, snacks and processed foods. They are regarded as especially important to diets in northern Ghana. Although detailed data on consumption levels are not available, it is likely that groundnuts make an important contribution to meeting energy and protein needs (C.M. Jolly *et al.* 2008: 675). However, fortification with micronutrients is necessary in order to address vitamin A or iron deficiencies. At present, there are no commercially distributed fortified groundnut products, although fortified products are under development or planned for introduction. The advantages of groundnut products are that they

[8] This does not imply that other product types are not worthy of investment or programmatic interventions. It simply means that assuring the uptake of the results of this analysis required focusing on the products and initiatives already under way.

are amenable to fortification and have acceptability with populations across Ghana. However, to effectively contribute to reducing undernutrition, any groundnut product will need to deal with concerns around aflatoxin contamination. Current groundnut product types are described in Table 4. The key opportunities for and challenges to using groundnut products to address undernutrition are discussed in Section 4.

Groundnuts are an important source of energy, protein and essential fatty acids. They contain a protein content of 15 to 35 per cent (De Waele and Swanevelder 2001) and are a good source of vitamin E, niacin, folate and manganese. Groundnut consumption is associated with improved lipid profiles (Gapasin *et al.* 2005: 4). When incorporated into processed foods, groundnuts can be readily fortified to provide a balanced level of key micronutrients. Further, properly processed groundnut foods can have low moisture content, allowing them to achieve long shelf life (Santini *et al.* 2012). These products can be processed and packaged in a way that requires no preparation by consumers, reducing the risk of microbial contamination. These properties are crucial in the case of ready-to-use therapeutic foods (RUTF), which are often distributed to remote areas through government or non-profit distribution systems.

Groundnuts are overwhelmingly consumed as unprocessed or simply processed products. The most commonly eaten products are whole groundnuts (raw, roasted, boiled) or groundnut soup, made with paste. These results are consistent across different populations in Ghana. Groundnut soup is by far the most commonly consumed product, with between 39 to 60 per cent of consumers in different populations eating this product (C.M. Jolly *et al*. 2008). Processed products are eaten by only 3 per cent of consumers. Several high-quality groundnut products have been developed with the intention of marketing to middle class Ghanaian consumers and export markets. These products are tailored to the preferences and lifestyles of these populations: they are processed for convenient preparation and packaged in high cost materials. In particular, two products were recently developed that use a sorting procedure to reduce aflatoxin contamination to non-detectable levels (canned groundnut soup, groundnut-chocolate spread).

Groundnut products are divided among those that target wealthier consumers and those that target the poor, even among relatively simple products, such as groundnut paste. The poor tend to consume products processed and retailed through the informal sector, while middle class consumers are more likely to purchase products made by medium- and large-scale food processors and to make purchases in supermarkets. The poor also process a substantial portion of groundnut products for their own consumption. In the available survey, 39 per cent of consumers themselves made all the groundnut paste they used, while 22 per cent acquired it through purchasing and 35 per cent used both purchasing and home processing (C.M. Jolly *et al.* 2008).

Groundnuts in Ghana are subject to high levels of aflatoxin contamination. Aflatoxins are toxic compounds produced by fungi that infect grains and legumes. They have serious negative health impacts when ingested, and are of special concern for young children. Box 4 outlines the impact of aflatoxin contamination in Ghana. The groundnut supply system in Ghana does not allow groundnut supplies to be traced and makes it difficult to incentivise farmers and other value chain actors to tackle aflatoxin levels. Low public awareness of the problem also makes it difficult to address. As will be seen, the aflatoxin problem is most acute with processed forms of groundnuts. Two new products are being trialled that partially address the problem. The aflatoxin issue is touched on in a number of the sections that follow; it is elaborated more completely in Annex B.

Table 4 Groundnut product types available in Ghana

Basic groundnut products	
Whole groundnuts	Whole groundnuts are available in various forms (shelled, salted, roasted), and are widely consumed throughout Ghana. In addition, roasted groundnut kernels are milled with cereal grains to make porridge-type foods including *koko* or weanimix complementary foods.
Groundnut paste	Groundnut paste is the most widely consumed groundnut product in Ghana. It is used to prepare a number of traditional Ghanaian dishes and is a key ingredient in processed foods and snacks.
Existing processed foods	
Traditional groundnut snacks	These snacks are produced by small, informal processors in urban areas and are commonly sold along roadsides and in open markets. Snacks include peanut brittle (*nkati-cake*) and *kuli-kuli*, made from groundnut paste and wheat flour.
Formal sector groundnut snack (*nkatie burger*)	Only one groundnut-based snack product is currently produced by a formal sector business: *nkatie burger*, a snack made of whole roasted groundnuts coated in sweetened flour mixture.
Products under trial	
Canned groundnut soup	A medium-size Ghanaian food processing business is trialling production of a canned groundnut soup base, processed for quick preparation. The product targets middle class consumers and export markets. Processing includes a sorting procedure to reduce aflatoxin contamination to non-detectable levels.
Groundnut-chocolate spread	A small-size Ghanaian food processing business is consumer testing a groundnut-chocolate spread product. The product is approximately 70 per cent groundnut paste. The product targets urban consumers. Processing includes a sorting procedure to reduce aflatoxin contamination to non-detectable levels.
Potential products Development agencies and public-private partnerships have expressed interest in supporting the introduction of new products to Ghana, based on models developed in other countries.	
Groundnut lipid drink	Researchers at the University of Ghana, Legon developed a micronutrient-fortified lipid drink. There are two versions of the product: one aimed for therapeutic use and one for commercial distribution. The researchers are seeking interest from processors to trial manufacturing and support consumer testing.
Ready-to-use therapeutic food (RUTF) (e.g. Plumpy'Nut)	For several years, development agencies have sought to initiate locally-sourced production of RUTF in Ghana. RUTF is presently imported for distribution through non-profit channels. At the time of writing, a partnership involving a multinational food processor and GAIN is undertaking scoping for a project to initiate local production. The product would be distributed through non-profit channels.
Groundnut supplemental food	Although not yet specified, the GAIN partnership is also interested in producing a fortified groundnut product for commercial distribution.

Box 4 Impacts of aflatoxin contamination in Ghana

Aflatoxins are highly toxic chemical compounds produced by species of fungus that infect grains and legumes. Maize and groundnuts are especially susceptible to infection. Aflatoxin ingestion is associated with liver disease, cancer and immune system suppression; it prolongs recovery from protein malnutrition and contributes to underweight status. There is also evidence that aflatoxin exposure inhibits nutrient uptake, although more rigorous studies are needed to confirm this (Williams *et al.* 2004). Evidence from Benin and Togo showed an association between aflatoxin exposure and reduced child growth, although the effect of aflatoxin could not be isolated from that of low nutrient content in complementary foods (Y.Y. Gong *et al.* 2002). Vulnerability to aflatoxin is most acute during the weaning period when infants are exposed to high levels of aflatoxin as they begin to eat solid foods (Y. Gong 2003). On a global scale, it is estimated that aflatoxin exposure, through its effects on immune function and undernutrition, contributes to health factors that account for 40 per cent of the total disease burden in developing countries (Williams *et al.* 2004).

At present, there is little quantitative evidence on the impact of aflatoxin contamination on human health in Ghana, although it is estimated that exposure is high. One study found that 71 per cent of groundnut supplies in Ghana contained aflatoxin levels above the Codex Alimentations recommendation for direct human consumption (Awuah and Kpodo 1996). Due to clear associations of aflatoxin exposure with negative health outcomes and probable effects exacerbating malnutrition and undernutrition (Williams *et al.* 2004), addressing aflatoxin contamination must be part of efforts to promote nutrient-dense foods. Not only are high-potential foods such as groundnut products at great risk of aflatoxin contamination, but current levels of consumption of these foods mean that aflatoxin already has important negative impacts on undernutrition and health status. It is of particular concern for products that target infants or young children, who are most vulnerable to negative health impacts.

3.2.1 Consumers and food acceptability

Unprocessed and processed groundnut products differ radically among the populations that consume them. Unprocessed, whole groundnuts and groundnut soup are by far the most commonly consumed forms of these foods, and appear to be eaten ubiquitously across groups. This indicates that unprocessed products are generally acceptable and affordable to the majority of consumers. In contrast, consumption of processed products is very low, although as listed above, a number of processed products are available in urban areas. The widespread availability of groundnut snacks from the informal sector – as well as *nkatie burger*, a formal product that seems to target low income consumers – suggests that affordability may be the primary constraint to processed products, rather than acceptability. Furthermore, anecdotal evidence suggests that groundnuts are among the more expensive ingredients to some common products in the informal sector. Further investigation would be needed to understand which consumer populations eat processed groundnut products, and to estimate price elasticity of demand. Consumers may consider these products to be snacks that are not a core purchasing priority. The two new products under trial (canned soup base, groundnut-chocolate spread) are sold at a high price point aimed at middle class consumers and export markets, and will not be affordable to the poor in their current form.

Consumption of groundnuts varies across Ghana, with populations in the north eating them more frequently than in the south. In a recent survey, 28 per cent of consumers in the northern regions reported eating groundnuts every day, compared to 11 per cent and 16 per cent of consumers in the southern and central zones respectively (C.M. Jolly *et al.* 2008). It is suggested that women are more likely to eat groundnuts in processed forms, while men are more likely to consume them whole (C.M. Jolly *et al.* 2008). Young children may consume groundnuts as sweet snacks and in cooked dishes. Importantly, infants often eat groundnuts, as they are a key ingredient in many weanimix complementary food products (see Section 3.3) and feature in common cooked dishes in the family diet that are fed to infants during weaning.

Table 5 Target consumer groups and regions for commercial groundnut products in Ghana.

Product	Consumed by children under two?	Consumed by women?	Consumed by the poor?	Consumed by the middle class?	Region of consumption
Whole groundnuts	Yes (in weanimix)	Yes	Yes	Yes	Throughout Ghana
Groundnut paste	Yes (part of family diet)	Yes	Yes	Yes	Throughout Ghana
Canned soup base	No	Yes	No	Yes	Urban / export
Traditional groundnut snacks	No	Limited	Limited	Yes	Urban
Nkatie burger	No	Limited	Limited	Yes	Throughout Ghana
Groundnut-chocolate spread	No	Limited	No	Yes	Urban / export
Groundnut lipid drink	N/A	N/A	N/A	N/A	Not currently available
Groundnut supplementary food	N/A	N/A	N/A	N/A	Not currently available

Source: Project interviews.

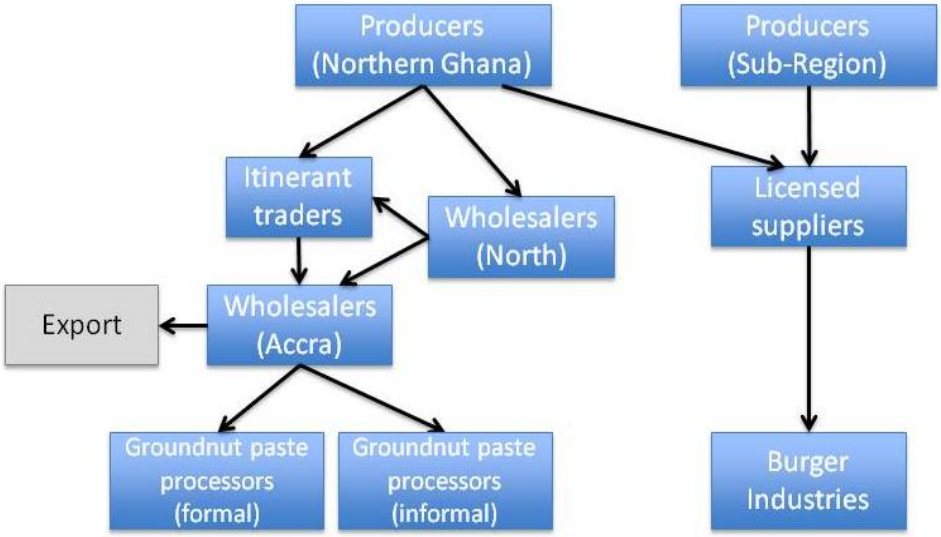
3.2.2 Supply chains

At present, all groundnuts are sourced through wholesalers in the conventional agri-food commodity system. The system poses problems because groundnut quality is variable and often poor. The absence of traceability of supplies means that farmers, transporters and traders have little incentive to upgrade practices to improve quality. As will be shown below, these steps are crucial to addressing the aflatoxin problem.

Under the conventional system, food processors purchase groundnuts from wholesalers in urban markets or from itinerant traders based in farming communities. In general, businesses dealing in larger volumes can secure higher quality supplies and lower prices by purchasing in northern Ghana or in neighbouring countries. Smaller-scale operations buy in urban wholesale markets in Accra and Kumasi. Groundnut supplies are highly seasonal in the main production zones in Ghana and neighbouring countries. Research indicates that groundnut markets across Ghana are poorly linked due to poor transport and storage infrastructure (Mockshell and Egyir 2010). Wholesalers buy and store groundnuts, but poor quality storage facilities coupled with high humidity and temperatures lead to rapid deterioration in the quality of groundnut supplies following harvest, exacerbating aflatoxin contamination. There are no known cases of value chain actors developing traceable supply chains for groundnuts, or of direct relationships between food processors and producers.

The formal sector processor involved in groundnut products, Burger Food Industries, uses registered suppliers who source from across the West Africa sub-region, including in Ghana, Burkina Faso, Mali and Senegal. In a good year they get about 50 per cent of their supply from Ghana and Burkina Faso. However, there have been a few years when they sourced all their groundnuts from Mali and Senegal.

Figure 4 Groundnut supply system in Ghana



Source: Adapted from Mockshell and Egyir (2010).

3.2.3 Processing of groundnut products

In general, processing of groundnuts in Ghana involves simple technology, largely shelling, sorting, grinding and roasting. Numerous informal micro-food processor businesses make simple groundnut snacks, including *nkati-cake* and *kuli-kuli* (Table 6). One packaged groundnut snack product, *nkatie burger*, is manufactured on an industrial scale. Groundnuts are sold whole, sometimes shelled, salted or roasted. They are milled into paste with small electric mills or with simple technology in the home and processed into crunches using the traditional pestle and mortar technique. Roasted groundnut kernels may be added to cereals and milled for porridges and gruels. The processing procedures used are outlined in Table 6.

Effects of sorting and grading on aflatoxin contamination

Groundnuts are graded to a limited extent according to their variety (relating to the region of origin). However within varieties, batches are generally not graded for quality. Roughly half of wholesalers sort and grade groundnut kernels, removing approximately 10 per cent of the kernels because they are visibly rotten or discoloured (Florkowski and Kolavalli 2012). A small number of food processors perform more intensive sorting to produce higher quality groundnut paste products targeted at middle class consumers. However, these sorting practices are insufficient to reduce aflatoxin to safe levels (Galvez *et al.* 2002). As discussed above, only two products produced in Ghana use the intensive sorting process capable of reducing aflatoxin below detectable levels. These products were developed with support of the USAID-funded Peanut Collaborative Research Support Programme. Given the current quality of groundnut supplies in Ghana, the intensive sorting procedure entails removing 25 per cent of the groundnut supply. At the time of writing, the two low-aflatoxin products are being trialled on a small scale.

Furthermore, regardless of the degree of sorting, this procedure alone does not address the prevalence of aflatoxin within the food system, because low-quality kernels removed during sorting generally remain in the food system. Most food processors resell them whole or mill into paste so that consumers cannot easily detect their poor quality (Florkowski and Kolavalli 2012). These low quality, high aflatoxin products are likely to be consumed by the poor.

At present, there is no technique that can remove or reduce aflatoxin once groundnuts have been milled into paste (Galvez *et al.* 2002). Trials of a food additive that can reduce aflatoxin absorption in the body were recently halted due to human subject concerns.

Table 6 Processing procedures for groundnut products and scale of production

Product	Scale of production	Processing
Groundnut paste	In-the-home / medium	Milled in markets using small mechanical mills or in the home using mortar and pestle.
Canned soup base	Industrial	Groundnuts are sorted to remove contaminated kernels. Groundnuts are hot-air blanched and milled into paste. Paste is heated a second time as part of canning.
Traditional groundnut snacks	Small	*Nkati-cake*: groundnuts are peeled and roasted, mixed with sugar, stir fried, rolled into a brittle. *Kuli-kuli:* groundnut cake (by-product of groundnut oil production) is mixed with sugar, flour and deep fried in groundnut oil.
Packaged groundnut snacks (*nkatie burger*)	Industrial	Groundnuts are peeled, roasted and rolled in a mixture of wheat flour and sugar.
Groundnut-chocolate spread	Medium	Groundnuts are sorted to remove contaminated kernels. Groundnuts are roasted and milled into paste, and mixed with chocolate and sugar.
Groundnut lipid drink	N/A	Commercial production has not begun. Micronutrient fortified.
Groundnut supplementary food	N/A	Commercial production has not begun. Micronutrient fortified.
Ready-to-use Therapeutic Food	N/A	(Currently no production in Ghana) Elsewhere: groundnuts are roasted and milled; mechanical mixing with milk powder, vegetable oil, sugar, micronutrient premix; product is packaged to avoid contamination and introduction of water.

3.2.4 Distribution channels

Groundnut products are distributed through a wide variety of channels, and are packaged and marketed in forms to appeal to different consumer groups. In general, these channels are split between formal sector channels (supermarkets, shops) and informal channels (open markets, roadside vendors and food stalls). The formal channels reach middle class consumers, while the informal channels reach poor and rural consumers, although roadside vendors appear to reach both.. Box 5 describes the distribution channels for the different products; Table 7 summarises these channels and the consumer groups they target.

Box 5 Description of distribution channels for groundnut products

Roasted groundnuts are sold as complements to banana, fried plantains and porridge, packaged in small quantities of about 50g and mostly packaged in plastic wrappers in both rural and urban communities. They are also sold in larger units of 200g and 400g in urban areas, aimed at middle class consumers.

Groundnut paste is retailed at both open markets and supermarkets. Higher quality groundnut paste is sold in supermarkets and larger shops and is targeted to middle class consumers. These products are sold at a price premium and packaged in larger quantities. Product packaging tends to be simply branded or unlabelled.

Processed groundnut snacks in the informal sector, including *nkati-cake* and *kuli-kuli*, are sold as a snack in markets and along roadsides, both in urban and rural areas.

Nkatie Burger, the packaged groundnut snack, is sold through an extensive network of distributors in Ghana, Nigeria, South Africa, the US and Europe. Their largest market is Nigeria. The product is packaged in small sealed packets (50g bag). In Ghana, the product is sold at roadsides and in shops and supermarkets. The small packet size and low price point (US$ 0.15) means the product is affordable as a small luxury to some lower income consumers. The fact that it is sold in factory-sealed packaging may appeal to middle class consumers concerned with the hygiene of street foods.

Low aflatoxin products have not yet established distribution channels. The manufacturers have indicated that they aim to target middle class consumers and international export markets.

Ready-to-use therapeutic foods are distributed to women and children suffering from severe acute malnutrition through non-profit distribution channels, including through Ghana Health Service clinics, the WFP and NGOs. Efforts are under way through the GAIN partnership to initiate local production to supply these distribution channels.

Groundnut supplemental food is being considered by the GAIN partnership as a product for commercial production and distribution. The project has not yet established distribution channels.

Table 7 Distribution channels for groundnut products and the consumer groups reached by these channels

Product	Distribution channel	Target consumers
Roasted groundnuts (small package)	Markets, roadside vendors (i.e. informal)	Poor, middle class
Groundnut paste (unpackaged)	Markets	Poor, some middle class
Groundnut paste (packaged)	Supermarkets	Middle class
Prepared groundnut dishes	Formal and informal restaurants, home preparation	Poor, middle Class
Groundnut soup base (canned)	Supermarkets, exports	Middle class
Traditional groundnut snacks (*nkati-cake, kuli kuli*)	Markets, bus stations, roadside vendors	Middle class, some lower income
Packaged groundnut snacks (*nkatie burger*)	Roadside retailers, small shops, supermarkets, export	Middle class, some lower income
Groundnut-chocolate spread	N/A	Middle class
Groundnut lipid drink	N/A	N/A
Groundnut supplementary food	N/A	N/A
Ready-to-use therapeutic food	Ghana Health Service clinics, NGOs, emergency relief infrastructure	Target groups suffering from severe acute malnutrition

3.2.5 Business interest

Generally, there is a high level of business interest in groundnut products, divided between the formal and informal sectors. Private sector actors in the informal sector include small-scale processors of groundnut paste and traditional snacks, and large numbers of retailers, creating a dense distribution network for whole groundnuts and prepared foods. A number of formal sector businesses of small and medium scale are producing groundnut paste aimed at middle class consumers. Two businesses are trialling low-aflatoxin products for middle class consumers, with an eye on the potential for export markets. Only one formal business, Burger Food Industries, is involved in groundnut snacks. This firm uses a unique model to target both low income and middle class consumers.

Groundnut paste: A range of businesses are involved in producing groundnut paste, ranging from individual women selling in open marketplaces to several medium-sized processing firms. These enterprises differentiate their products to a limited extent to appeal to different groups among the two-thirds of consumers who purchase at least a portion of their paste (C.M. Jolly *et al*. 2008). Retailers in the informal sector sell paste at a low price and in variable bag sizes (as small as 175 ml). Among formal sector firms, small- and medium-sized processors compete based on the quality of their paste (using fewer low quality groundnuts, consistent processing techniques) and hygienic packaging (plastic jars). These qualities appeal to middle class consumers and allow these products to achieve higher prices. Nkulenu Foods is trialling a canned instant groundnut soup, which is differentiated through its convenient preparation (requiring only heating), high quality paste, hygienic packaging and low aflatoxin content (reaching non-detectable levels). The processor believes these qualities will appeal to middle class consumers in Ghana and to Ghanaians living abroad.

More recently, public-private partnerships have expressed interest in purchasing supplies of aflatoxin-safe groundnut paste, in order to supply manufacturing of micronutrient 'sprinkles' (see Section 3.3 on complementary foods) and potential production of RUTF and fortified groundnut products in Ghana. Thus far, these projects have not been able to identify a reliable supply that meets industry standards.

Groundnut snacks: The majority of groundnut snacks are made by micro-processors in the informal sector and are sold by individual retailers in markets and along roadsides. There is limited differentiation in this segment of the market. For roadside vendors, product appearance is important for attracting consumers' attention. At small scales, relationships of trust with clients may be important. In the formal sector, one medium-sized food processor, Burger Food Industries, produces the packaged product *nkatie burger*. The product is currently unique in the marketplace; it is similar to traditional roast groundnuts, but with a sweet, crunchy coating. The company uses a unique model that combines packaging the product to be affordable to low income consumers, while also selling in regional and global export markets.

Low aflatoxin products: As previously mentioned, two medium-sized businesses are trialling new products that employ a sorting procedure proven to reduce aflatoxin contamination to non-detectable levels. Nkulenu Foods is trialling canned groundnut soup base and CBA Foods is trialling groundnut-chocolate spread. Both businesses are still assessing consumer response to the products, and it is unclear whether commercial scale production will be viable. Both businesses intend to target products to middle class consumers in Ghana, as well as export markets. These businesses' products have the potential to reach markets in the EU and North America where there are strict standards for aflatoxin content.

Table 8 Businesses involved in production of groundnut products and qualities used to differentiate products

Product	Businesses involved	Product differentiation
Groundnut paste (unpackaged)	Micro-processors (i.e. individuals)	Small quantity, low cost
Groundnut paste (packaged)	Small- and medium-sized processors	Medium product quality, hygiene
Groundnut soup base (canned)	Nkulenu Foods (medium-sized processor)	Convenient preparation, high product quality, low aflatoxin
Roasted groundnuts (small package)	Informal sector retailers (roadside vendors)	Low cost, convenience
Roasted groundnuts (large package)	Informal sector retailers (roadside vendors)	Hygiene, low cost, convenience
Traditional groundnut snacks (*nkati-cake, kuli kuli*)	Micro-processors	Convenience, taste, appearance
Packaged groundnut snack, *nkatie burger*	Burger Food Industries	Convenience, hygiene, small quantity, low cost
Groundnut-chocolate spread	CBA Foods (medium-sized processor)	Convenience, high product quality, hygiene
Groundnut lipid drink	Potential interest	N/A
Groundnut supplementary food	Potential interest from GAIN partnership	N/A
Ready-to-use therapeutic food	Potential interest from GAIN partnership	Must meet WFP standards

3.3 Complementary food products

A number of complementary food products are available in urban and rural areas in Ghana, including varieties often referred to as 'weanimix'. Because weaning is the period when infants suffer major setbacks in nutrition status, enhancing complementary foods is a key strategy to addressing child undernutrition (World Bank 2009). However, evidence shows that, despite efforts to improve on traditional weaning foods, the majority of available complementary food products do not contain sufficient protein or micronutrient levels to support healthy infant development, and they are lacking in the key micronutrients vitamin A and iron (Lartey *et al*. 1999; W.A. Masters *et al*. 2011). Fortification with micronutrient premixes or other nutrient-dense foods is required. There are a large number of products and private sector actors in the marketplace for complementary foods. Central to enhancing the contribution of these products to reducing undernutrition will be introducing measures to assure value chain integrity and signal nutrient-dense products to consumers. The key opportunities for and challenges to complementary food products are discussed in Section 4.

The marketplace for complementary foods in Ghana can be traced back to the 1980s when UNICEF and the Ghana Health Service introduced weanimix, as an attempt to address infant malnutrition and undernutrition by improving on traditional cereal-based weaning foods. What was novel about this formulation was that it combined cereals with locally available sources of vegetable protein such as soybeans, cowpeas and groundnuts. During the 1980s and 1990s, various government agencies promoted local production of weanimix throughout Ghana. These efforts led to the emergence of a large number of small businesses, generally run by women who began to produce and sell weanimix products. These businesses developed many different cereal-protein mixes to appeal to infants' different tastes. Today, some of these businesses have grown into medium-sized enterprises that market a variety of products. Notwithstanding the presence of businesses selling weanimix in certain urban areas, the availability of Ghana-produced complementary foods is patchy, as detailed in section 3.3.4.

Achieving sufficient nutrient levels in cereal-based complementary foods requires fortification with micronutrients or nutrient-dense inputs. Traditional cereal-only complementary foods such as *koko* provide insufficient energy, protein, fat and micronutrients to support child growth, development and health, and consumption of these foods has been linked with poor nutritional status among Ghanaian infants (Appoh and Krekling 2005). Although an improvement, the standard formulation of weanimix[9] also fails to provide sufficient protein, fat and micronutrients (Lartey *et al*. 1999; Amagloh *et al*. 2012). A variety of formulations have been proposed to address the nutrient deficiencies of weanimix, using ingredients including fish powder, milk powder, orange-flesh sweet potato and micronutrient premix. One trial of a micronutrient-fortified weaning food found that consumption was associated with increased vitamin A and iron profiles in blood, but not improved infant growth (Lartey *et al*. 1999). The major international brand products (e.g. Nestlé Cerelac) generally meet international guidelines for nutrition content (Al-Othman *et al*. 1997), provided they are consumed in the recommended quantities, prepared under hygienic circumstances and form part of a diverse diet.

Guaranteeing nutritional quality and signalling it to consumers is a major challenge for complementary food products in Ghana. Consumers do not have access to information to assess the nutritional quality of complementary food products. Choosing a product that is nutritionally adequate is difficult because nutrient content varies dramatically between products, even between those classified as weanimix (W.A. Masters *et al*. 2011). Some products provide levels of protein, fat and micronutrients equivalent to that of international brand complementary foods, while others have insufficient nutritional value. A second challenge for nutritional quality is that poor infant feeding practices mean that even a nutritionally sufficient product, if used incorrectly, will not provide adequate nutrients to the infant. Misuse of complementary food products appears to be common in Ghana, and is linked to the affordability of products. Many consumers purchase international brands because they believe they are of high quality, but cannot afford sufficient quantities. As a result, they over-dilute products when preparing them, leading to insufficient nutrient densities (Masters *et al*. 2011).

[9] The standard formula is often given as four parts cereal to ½ part groundnuts and ½ part soybean or cowpea, although as mentioned a variety of different formulations are commercially marketed under the label 'weanimix'.

Table 9 Complementary food products available in Ghana

Traditional weaning foods	
Traditional cereal porridges	Unfortified cereal porridges referred to as *koko* are still the most widely used weaning foods in Ghana (Nagai *et al*. 2009). Most are produced at home or purchased from roadside vendors.
Cereal-legume 'weanimix' products	
Informal sector weanimix products	Weanimix products are produced by small enterprises and individuals, using a wide variety of ingredients and formulas. They are packaged using simple techniques (tying or stapling sachets). Some are labelled while others are simply unlabelled bags of flour. The majority of these products are outside the formal sector and are not registered with the Ghana Food and Drugs Authority. All local weanimix products require cooking by consumers prior to use.
Formal sector weanimix products	Another class of weanimix is made up of products with more sophisticated packaging and labelling, often sold in supermarkets and more expensive than informal sector products. These products are more likely to be registered with the Ghana Food and Drugs Authority.
Micronutrient-fortified weanimix product	There is currently only one non-instant weanimix product that is fortified with added micronutrients, which is branded as 'MaiSoyForte'. This product is produced by the Ghanaian food processor Yedent Agro Industries.[10] Yedent has been supported by GAIN to upgrade its processing facilities, introduce micronutrient fortification and increase its distribution network.
Other complementary food products	
International brand complementary foods	A number of international brand complementary food products are sold in Ghana. Of these, the market leader is Nestlé Cerelac. It is also the only international brand product manufactured in Ghana. Production of Cerelac incorporates sophisticated quality control and supply chain management. Cerelac is currently the only instant product with substantial market share in Ghana.
Micronutrient-fortified sprinkles for porridges	A public-private partnership including multinational food enterprise Ajinomoto, Yedent Agro Industries and several development partners is piloting a micronutrient sprinkles product. The product is designed to be added by consumers to traditional complementary foods. Two distribution and marketing approaches are being tested: one based on conventional radio advertising; the other based on recruiting women to sell the product in their communities.

[10] Yedent has plans to change the brand name from MaiSoyForte to 'KidiMix'. Yedent Agro Industries, the sole Ghanaian producer of a micronutrient-fortified food product, has been highly sought after by development agencies and public-private partnerships to enhance consumption of nutrient-dense foods. In such high demand, time and energy are limited for feeding into policy analysis efforts like this report. As part of evidence-gathering, the authors met briefly with the owner of Yedent Agro to discuss the business model. The fact that Yedent is targeted by a number of different initiatives indicates the engagement of this business with nutrition issues, while also highlighting that there are relatively few private sector actors deeply engaged in this area.

3.3.1 Consumer populations

In general, complementary food products have high acceptability among consumers in Ghana; the challenge is in making the nutritionally adequate products available and affordable to poor consumers. Within this general trend, sparse and somewhat conflicting evidence makes it difficult to fully assess the acceptability and affordability of various products. All products have high acceptability in terms of taste, sensory characteristics and preparation methods; they are essentially porridges, a food familiar to consumers. However, available evidence indicates that consumers have low awareness of the 'weanimix' products and that these products' availability is restricted to urban markets and supermarkets, with low presence in small shops. This low availability suggests that there are barriers to more widespread consumption of weanimix. Some analysts have suggested that these barriers relate to the lack of integrity and signalling of nutritional quality in the value chains for these products. This issue will be taken up in Section 4.2, which outlines options for strengthening value chains for complementary foods. What is clear is that nutritionally adequate weanimix products could be made much more widely available and affordable to the poor (see Section 4.2).

Evidence on the consumption and awareness of complementary food products in Ghana is sparse and limited to consumer surveys with small sample sizes. Anecdotal evidence suggests that consumer awareness of weanimix in Accra and other urban centres is patchy. Mothers are more likely to be familiar with Nestlé Cerelac than with local weanimix products (Nagai *et al*. 2009). A survey in Brong Ahafo Region found that 24 per cent of mothers had used Cerelac, while 29 per cent had used some form of local weanimix (Infant and Young Child Nutrition Project 2011). The remaining 47 per cent of consumers may either have used traditional complementary foods or used weanimix without knowing that it was different from traditional complementary foods. Low consumer awareness appears to reflect patchy availability of weanimix in urban areas. A survey in the Accra metropolitan area found that locally produced weanimix was available in only 10 per cent of shops, and was present in only 67 per cent of neighbourhood zones, while Cerelac was available in 84 per cent of retail shops (W.A. Masters *et al*. 2011). This means that although weanimix products are readily available in certain locations, especially open markets and near maternal health centres, they are available only to a limited extent in many residential areas, and this may contribute to low awareness. There is almost no evidence about the availability and awareness of weanimix in rural areas. Although the Infant and Young Child Nutrition Project survey covered both rural and urban areas, it did not disaggregate results areas across these categories. Based on knowledge of food distribution networks in Ghana, it is reasonable to assume that awareness and availability in rural areas is lower than in urban areas.

As with differences in rural and urban areas, there is a lack of evidence on the use of complementary foods across classes of consumers. Anecdotal reports suggest that middle class and wealthy consumers tend to use international brands of complementary foods, especially Nestlé Cerelac (W.A. Masters *et al*. 2011). Poor consumers are unable to afford sufficient quantities of Cerelac, but its high level of availability in urban shops suggests that the poor still purchase the product (W.A. Masters *et al*. 2011). Poor consumers are likely to over-dilute the product or alternate it with cheaper, locally produced weanimix or traditional complementary foods like *koko*. Low consumer awareness and availability suggests that more poor consumers are opting to dilute Cerelac or use *koko* than are using weanimix products. It should be mentioned that not all consumption of complementary foods is for infants; adults often eat weanimix products or Cerelac as a breakfast food, alongside other porridges.

Table 10 Target consumer groups and regions for weanimix products in Ghana

Product	Consumer price (cedis)[11]	Consumed by children under 2?	Consumed by women?	Consumed by the poor?	Consumed by the middle class?	Region of consump-tion
Traditional porridges	0.3	Yes	Yes	Yes	Yes	Through-out Ghana
Informal sector weanimix	0.4-0.5	Yes	Yes	Yes	Yes	Urban, some rural
Formal sector weanimix	0.5-1.0	Yes	Yes	No	Yes	Urban
Micronutrient-fortified weanimix (MaiSoyForte)	0.8	Yes	Yes	Yes	Yes	Urban, some rural
International brand	1.6	Yes	Yes	Yes (insufficient quantities)	Yes	Urban, some rural
Micronutrient-fortified sprinkles	0.3 + cost of porridge[12]	N/A	N/A	N/A	N/A	Trial planned in two rural districts

3.3.2 Supply chains

Most complementary foods in Ghana source inputs through conventional wholesalers and markets, with two exceptions that use more focused supply chains. As was explained for groundnut products, the conventional system does not provide traceability and raises important problems for addressing supply quality issues, including aflatoxin contamination. (The cross-cutting challenges of aflatoxin contamination and traceable supply chains are discussed in detail in Section 5.) In addition to agricultural commodities, an important supply chain for –nutritionally-adequate complementary food products is for micronutrient premix. Premix supplies in Ghana, and efforts to improve their quality, are examined in Box 6.

Complementary foods use many different formulations derived from basic agricultural commodities: the key ingredients tend to be maize, wheat, rice and/or millet, along with soybean, cowpea and/or groundnut. The majority of small- and medium-sized processors source these commodities by purchasing them in whole, unprocessed form from urban wholesalers. Small-scale processors may also purchase commodities pre-roasted and/or pre-milled into flour. Anecdotal evidence suggests that in rural areas, women source locally available commodities from their household production or from neighbours. In addition to the primary cereal and legume ingredients, a minority of weanimix products, especially in the

[11] The prices are shown in Ghanaian cedi (GHS) per 100g of dry weight product.

[12] The price of micronutrient-fortified sprinkles is calculated as follows: at time of writing, the KokoPlus sprinkles product is being sold for 0.2 Ghanaian cedis per single-serving sachet. Since a single serving of complementary food is approximately 65g of porridge (Solomon 2005), the table shows the price of a quantity of KokoPlus sufficient to fortify 100g of porridge.

informal sector, contain secondary additives, most commonly fish powder. Fish powder is purchased in small quantities at open markets.

There are **two examples of more focused supply chains** among complementary food manufacturers. Yedent Agro Industries sources maize, sorghum and soybean for its product from a private agricultural commodity aggregator[13] that sources from farmers' organisations in northern Ghana. Yedent also employs buying agents in the farming communities who purchase on their behalf. At present, this system does not provide traceability back to specific sources. In addition to its main complementary food product, MaiSoyForte, Yedent is supplying soy powder for production of fortified sprinkles under the Good Growth Project. Soybeans are sourced using Yedent's existing supply chain. The project initially intended to use groundnut powder in the product, but was unable to find a reliable supplier, so had to settle for soy powder.

The second focused supply chain for complementary food is Nestlé Ghana, which has established a bespoke traceable supply chain for the 700 tons of maize used to produce Cerelac. Nestlé uses community-based suppliers who source from local farmers. Nestlé trains the farmers and employs standards for crop production, pricing and transportation. Nestlé's agents regularly visit farms to monitor conditions during the growing season. Each batch of supply is traceable back to the community where it was produced. Using this system, Nestlé Ghana meets its corporate traceability requirements. The system comes at a substantial cost, which is incorporated into the high price of Cerelac. Nestlé also imports certain Cerelac ingredients from international markets: wheat, skimmed milk, bifidus and micronutrient premix.

[13] The aggregator, Savanna Farmers Marketing Company, sells commodities on contract to agri-food processors in Ghana and internationally. It provides credit, inputs and extension services to farmers' organisations that supply it. The company was established by ACDEP, a Dutch NGO with which it continues to work on extension services (Kroezen 2007; Monitor Group 2012).

Table 11 Supply chains for complementary food products

Product	Agricultural commodities	Source	Traceable supply chain?
Traditional porridges	Maize, sorghum, millet, rice, groundnuts	Urban wholesale markets, some imports (maize, rice) Rural self-provision	No
Informal sector weanimix	Maize, sorghum, millet, rice, wheat, cowpeas, soybean, groundnuts, fish powder	Urban wholesale markets, some imports (maize, wheat, rice) Rural self-provision	No
Formal sector weanimix	Maize, sorghum, millet, rice, wheat, cowpeas, soybean, groundnuts	Urban wholesale markets, some imports (maize, wheat, rice) Rural self-provision	No
Micronutrient-fortified weanimix (Yedent MaiSoyForte)	Maize, sorghum, soybean, micronutrient premix	Private aggregator, community-based suppliers, premix from GAIN-managed facility	No
International brand (Nestlé Cerelac)	Maize, wheat, rice, milk, sugar, palm oil, micronutrient premix, flavouring	Community-based suppliers (maize), imports (other ingredients)	Yes
Micronutrient-fortified sprinkles	Soybean, micronutrient premix, flavouring	Private aggregator, community-based suppliers, premix from GAIN-managed facility	No

Box 6 Supply of micronutrient premix in Ghana

Micronutrient premixes are blends of compounds containing micronutrients in forms that are bio-available and can be easily incorporated into processed food products. Premix is an input to both fortified groundnut and complementary food products and is key to addressing micronutrient deficiencies in Ghana, especially iron. Micronutrient fortification is especially crucial for weaning mix products, since they target infants during the period when they are especially vulnerable to undernutrition. In Ghana there are two distinct channels for the supply of premixes for the fortification of foods: the GAIN Premixes Facility and private sector supply channels. The GAIN Premixes Facility has three characteristics to ensure the consistent supply of high quality premixes and micronutrients for food fortification in developing countries such as Ghana.

The GAIN Premixes Facility was established to address the difficulties that food processors faced in securing reliable supplies of premix on the conventional market, since they were often not able to test premix supplies. The GAIN Facility pre-certifies premix manufacturers to guarantee their products are nutritionally-adequate, using stringent on-going supplier certification and testing of every shipment to ensure compliance to industry standards such as the Global Food Safety Initiative (GFSI) Standards. The Facility provides procurement services, sourcing supplies through a central competitive procurement process. It also provides a credit facility, using a global revolving fund established by GAIN to allow specific food producers and projects to delay payment for premix supplies.

The GAIN Premixes Facility dominates the supply channel for potassium iodate for the Ghana Universal Salt Iodization (USI) Program, using a consignment model with Environmental Processing Associates Limited (EPA) as the local distributors. Under this model, EPA imports commercial quantities of potassium iodate in 25kg drums, repackages it into smaller quantities and distributes to small-scale salt processors at a competitive price. Yedent Agro Industries and the four major flour mills also source micronutrient premix through the GAIN facility.

The major private sector suppliers of premixes and micronutrients are DSM Nutritional Products South Africa (Pty) Ltd and Fortitec from Europe. The main consumers of micronutrient premixes are Nestlé Ghana Ltd, Unilever Ghana Ltd, nutrition and food science departments of the universities and research institutions, and commercial vegetable oil processors

3.3.3 Processing of complementary foods

The technologies involved in processing weanimix are simple, widely available and similar to those used in processing many other common Ghanaian cereal foods. The process involves sorting and grading, roasting and milling the grains. As discussed in the introduction to this product, many individuals, overwhelmingly women, operate as micro-processors of complementary food products. These enterprises often process and package weanimix in private homes, relying on private grain millers and/or roasters located in urban markets. Medium-scale processors tend to have small factories with their own milling, roasting, mixing and packaging equipment. Yedent Agro Industries has actively sought to produce an instant version of its product MaiSoyForte; GAIN has provided funding to purchase equipment including an extruder. However, at the time of writing, no instant product was yet available.

Table 12 Processing procedure for complementary food products and scale of production

Product	Scale of production	Processing
Traditional porridges	–Small or micro	Limited sorting, milling, roasting, mixing
Informal sector weanimix	–Small or micro	Limited sorting, milling, roasting, mixing, packaging by hand
Formal sector weanimix	Small or medium, industrial	Limited sorting, milling, roasting, mixing, packaging
Micronutrient-fortified weanimix (MaiSoyForte)	Medium industrial	Sorting, milling, roasting, mixing, packaging
International brand	Large industrial	Sorting, milling, roasting, mixing, extrusion, packaging
Micronutrient-fortified sprinkles	Large industrial	Not yet produced commercially

3.3.4 Distribution channels

The distribution channels used for complementary foods have important consequences for their availability and affordability, and for how nutritional quality is assured and signalled to consumers. Available complementary food products use several different distribution models, with many weanimix products distributed by informal retailers, while international brands market through small shops and supermarkets. Some products, notably Nestlé Cerelac and Yedent MaiSoyForte, combine distribution to formal retailers and supermarkets with distribution in small shops (Cerelac) or informal retail (MaiSoyForte). Actors are exploring other potential models for new products, notably using community social networks and non-commercial channels. As discussed in Section 3.3.1 (Consumer Populations), availability of complementary foods differs importantly between products, with the dominant international brand (Nestlé Cerelac) more widely available than locally produced weanimix products. Box 7 describes the distribution channels for the different products; Table 13 summarises these channels and the consumer groups they target.

Box 7 Description of distribution channels for complementary food products

Existing products and channels

Home production: Anecdotal evidence suggests that in rural areas, women produce mixes at home, using locally available inputs. Women in low income urban areas also produce weanimix and other complementary foods at home.

Informal retail*:* Many 'weanimix' type products – both those produced by formal and informal processors – are sold by individual informal retailers in particular locations, especially open markets and near health centres. There is little detailed evidence on these distribution channels. Casual examination of products in urban markets indicates that many are produced in nearby neighbourhoods or cities. While these channels reach many cities, they tend to be concentrated in particular locales. Weanimix products are only available in a small percentage of retail shops (W.A. Masters *et al*. 2011).

Retail through supermarkets: A number of 'weanimix' products made in the formal sector are distributed through supermarkets and larger shops. Again, the brand of weanimix available tends to be manufactured in the local area. Yedent MaiSoyForte is sold in supermarkets and shops in six regions. Nestlé Cerelac is also marketed in supermarkets, including both its large and small package sizes.

Retail through small shops**:** Nestlé Cerelac is marketed through Nestlé's existing distribution channels to small shops. As a result, it is the most extensively available complementary food product in urban neighbourhoods.

Potential products and channels

Retail through community networks: At the time of writing, the Good Growth Project is planning trials of two marketing channels for the fortified sprinkles product KokoPlus: 1) conventional commercial retail using radio and billboard advertising; and 2) trained women retailers marketing the product in their communities through social networks. CARE International is implementing the social network model, and will manage the supply chain linking the manufacturer and the women retailers. Trials of the social network model will begin in a number of villages in northern Ghana in early 2013, while the conventional model will be trialled in districts in the Volta region.

Non-commercial distribution**:** In addition to commercial channels, the WFP has expressed interest in purchasing large quantities of fortified complementary food products for distribution through emergency relief systems. This distribution channel requires that products are sold at a very low price. Thus far, no Ghanaian producer has found the price offered through this channel to be commercially viable. There may also be potential to distribute weanimix and other fortified cereals through the school feeding programme to target school-aged children, rather than infants.

Table 13 Distribution channels for complementary food products and consumer groups

Product	Distribution channel	Target consumers
Traditional porridges	Informal retailers, prepared by street food vendors	Poor, middle class
Informal sector weanimix	Informal retailers (in markets, near health clinics)	Lower income, middle class
Formal sector weanimix	Informal retailers (in markets), supermarkets	Middle class
Micronutrient-fortified weanimix (MaiSoyForte)	Informal retailers (in markets), supermarkets, small shops	Lower income, middle class
International brand	Small shops, supermarkets	Lower income, middle class
Micronutrient-fortified sprinkles	Small shops, social networks	Poor and low income

3.3.5 Business interest

Substantial business interest in complementary food products among small- and medium-scale food processors, alongside multinational corporations, is an indicator of the potential of this market. Products using a variety of distribution models have established markets. Understanding the present composition of this marketplace should help inform efforts to address the challenges it faces, in order to assure these efforts are ultimately commercially viable.

Ghanaian businesses: Interest among Ghanaian private sector actors began with marketing of mixes for traditional weaning foods, and grew rapidly with the diffusion of weaning mix production to many women's groups and small enterprises during the 1980s and 1990s. Interest is also strong among medium-scale processing firms, which often include a weanimix product in their portfolio. The largest Ghanaian food processor that makes complementary foods is Yedent Agro Industries. It is also the only firm manufacturing micronutrient-fortified weaning mix product. Support from GAIN has been important in allowing Yedent to acquire the technical capacity, equipment and supplies to undertake micronutrient fortification. Several Ghana-based processing businesses are interested in upgrading production to make an instant weaning mix product. This is perceived as key in increasing market share and competing with the international brand product, which is instant. GAIN is providing US$ 1.75 million to Yedent Agro Industries for purchasing equipment to produce an instant weanimix product, and for conducting market research, testing product distribution, and conducting consumer awareness-raising (Atkinson 2011).

Multinational corporations: Among the multinational food processors selling complementary foods in Ghana, Nestlé dominates, as it does in a number of other West African countries (W. Masters and Sanogo 2002). Nestlé's dominance is driven by its brand: consumers associate Cerelac as an aspirational product and an indicator of status. Consumers also perceive the

brand to be an assurance of high product and nutrition quality.[14] In addition, as the dominant instant product, Cerelac meets the needs of consumers looking for convenient preparation. Recently, Nestlé has increased its investment in Cerelac[15] and aimed to make the product more accessible to consumers with lower incomes through a new 50g sachet packet size.

USAID Ghana, through Feed the Future, is looking for opportunities to promote nutrient-dense complementary food products that have attracted existing investment from private or non-profit sources.

Table 14 Businesses involved in production of complementary food products and qualities used to differentiate products

Product	Businesses involved	Product differentiation
Traditional porridges	Micro-processors and street food vendors selling pre-prepared product	Low cost Convenient location
Informal sector weanimix	Micro- and small-scale processors	Low cost
Formal sector weanimix	Small- and medium-scale processors	Hygienic packaging Low cost Product quality
Micronutrient-fortified weanimix	Yedent Agro Industries	Hygienic and attractive packaging Micronutrient-fortified Low cost Product quality
International brand	Nestlé Ghana (other international brands are present with limited market share)	Instant preparation Product quality Convenient location Hygienic and attractive packaging Micronutrient-fortified
Micronutrient-fortified sprinkles	Ajinomoto Corporation, Yedent Agro Partners: Care International, GAIN, USAID Ghana	Low cost Micronutrient-fortified

[14] Other international brands have a very limited presence in Ghana, being generally sold in a small number of supermarkets or pharmacies. These include: Bokomo Cereals (South Africa), Bledina (France), Nutrilon (Brazil), ABIDO (Lebanon) and Cow & Gate (UK) (W. A. Masters *et al.* 2011).

[15] In 2010, Nestlé Ghana completed a GHC 47.8 million (US$ 32.9 million) facility for manufacturing Cerelac, bringing its production capacity to 16,000 tons per year. The plant has the potential to scale up to add an additional 9,000 tons per year. The plant is designed to supply Cerelac to Ghana and other West African countries, especially Nigeria.

4 Options to address the challenges in selected nutrient-dense foods

Having examined key stages in the value chains for groundnut products and complementary foods, this section analyses the key challenges preventing these products from having a greater impact in reducing undernutrition in Ghana. It then considers options available to private sector actors, public agencies, NGOs and partnerships for enhancing the potential of groundnut and complementary food products to address undernutrition. Throughout, it draws on the value chains framework described in the Introduction (see Section 1.2), assessing to what degree products meet the key conditions of availability, affordability, accessibility and nutritional quality. This report does not provide recommendations on which products should be targeted for investment; such recommendations would require a detailed market assessment and business case. Instead, it presents the most promising options, and points out where these options require investigation in order to demonstrate they can meet the conditions for enhancing consumption of nutrient-dense foods through value chains.

4.1 Groundnut products

Groundnut products – especially soup and whole groundnuts – currently make substantial contributions to the energy and protein needs of many populations in Ghana. New products have potential to contribute to reducing micronutrient undernutrition through fortification – especially the key deficiencies in vitamin A and iron. Groundnuts are widely acceptable and are eaten across Ghana. They provide an important source of proteins and fatty acids, and are amenable to micronutrient fortification. When properly processed, they can achieve a long shelf life, which facilitates distribution. However, at present, major challenges face these products: these relate to creating traceable value chains, assuring integrity and signalling quality to consumers and above all to the health risks associated with aflatoxin. These challenges affect every stage of the value chain for groundnut products, and solutions will require a 'whole value chain' approach. These challenges and the options for addressing them are detailed below.

4.1.1 Challenges facing groundnut products

4.1.2 The major challenges to enhancing the contributions of groundnut products to reducing undernutrition are listed in Box 8, and the extent to which groundnut products address these challenges is outlined in Options for strengthening value chains for groundnut products

Key to enhancing the potential of groundnut products are raising consumption of new products that are fortified with key micronutrients; targeting specific and vulnerable groups (pregnant women, school children and the poor); and addressing the problem of aflatoxin. Doing so will require coordinated interventions across the value chain, from farmers and aggregators to retailers and consumers. This report argues that small-scale approaches to promote a particular product in the absence of efforts at other stages of the value chain are less likely to successfully address the challenges above in a manner that is sustainable. There are multiple options for assuring effective action at certain stages of the chain: distribution of a supplementary food, for example, could be achieved through commercial retailers or through non-commercial mechanisms. Risks are involved in all of these interventions. One of the main recommendations of this report is that interventions should take steps to *avoid exacerbating the aflatoxin problem* by causing contaminated nuts to be re-directed towards the poor. Some

strategies, such as promoting low cost, processed products, entail higher risks of exacerbating this problem. **Box 9** outlines key options for addressing the challenge of aflatoxin throughout groundnut value chains.

Table 15.

Box 8 Challenges to enhancing the potential of groundnut products reduce undernutrition

Aflatoxin contamination affects all groundnut products, and especially processed ones. There is no reliable supply of aflatoxin-safe groundnuts at present. Testing indicates that contaminated groundnuts tend to be used in processed foods, including groundnut paste and snacks, where consumers cannot detect the presence of low quality kernels (Florkowski and Kolavalli 2012). At present, the only procedure used to address aflatoxin contamination in groundnuts is sorting to remove poor quality kernels. (See Section 5.1 for a list of the potential approaches for reducing aflatoxin.) The commercial viability of the sorting process is being trialled by two food processing businesses. However, the poor quality of groundnut supplies in wholesale markets means this procedure entails high costs due to labour costs and the loss of up to 25 per cent of the supply. Since potential micronutrient-fortified products will need to be processed, measures will need to consider how to **ensure value chain integrity and signal safe aflatoxin content** to consumers (see value chain integrity and signalling, below).

Unsafe groundnuts are diverted towards the poor. At present, businesses re-sell poor quality groundnuts after sorting. This highly contaminated supply is directed towards the foods consumed by the poor. The risk of new products that include the more rigorous sorting procedure required to reduce aflatoxin to safe levels is that even more low quality nuts will be diverted towards the poor.

Failure to target women and children. Groundnut products do not specifically target pregnant and breastfeeding women and children under the age of two, the populations most vulnerable to undernutrition. Instead, groundnut soup and whole groundnuts have very broad coverage of the general population. Investments in groundnut products will require specific targeting towards vulnerable populations in order to produce direct reductions in child stunting.

Targeting the poor through the private sector is a challenge for aflatoxin-safe products. Currently, businesses are differentiating their aflatoxin-safe foods as high quality products targeted at middle class and export markets in order to cover the costs of aflatoxin removal. Similarly, formal sector businesses may be avoiding groundnut products for the poor due to a fear of investing in products affected by aflatoxin. Burger Foods Industries is the exception, by using higher quality sources (including imports) to produce a high quality product and market it to both lower income and wealthier consumers.

4.1.3 Options for strengthening value chains for groundnut products

Key to enhancing the potential of groundnut products are raising consumption of new products that are fortified with key micronutrients; targeting specific and vulnerable groups (pregnant women, school children and the poor); and addressing the problem of aflatoxin. Doing so will require coordinated interventions across the value chain, from farmers and aggregators to retailers and consumers. This report argues that small-scale approaches to promote a particular product in the absence of efforts at other stages of the value chain are less likely to successfully address the challenges above in a manner that is sustainable. There are multiple options for assuring effective action at certain stages of the chain: distribution of a supplementary food, for example, could be achieved through commercial retailers or through non-commercial mechanisms. Risks are involved in all of these interventions. One of the main recommendations of this report is that interventions should take steps to *avoid exacerbating the aflatoxin problem* by causing contaminated nuts to be re-directed towards the poor. Some strategies, such as promoting low cost, processed products, entail higher risks of exacerbating

this problem. **Box 9** outlines key options for addressing the challenge of aflatoxin throughout groundnut value chains.

Table 15 Extent to which commercial groundnut products address key challenges

Product	Sufficient micro-nutrients	Targets women and children	Targets poor	Safe aflatoxin levels	Avoids diverting aflatoxin to the poor
Roasted groundnuts			x		
Groundnut paste			x		
Soup base (canned)				x	
Traditional snacks			x		
Nkatie Burger (snack)			x		
Groundnut-chocolate spread				x	
Lipid drink	x	x			
Supplementary food	x	?		?	
Ready-to-use therapeutic food	x	x	x	required[16]	

Among the challenges described above, the aflatoxin problem in particular requires action along the entire value chain as part of efforts to promote fortified groundnut products. (The full set of approaches for addressing aflatoxin in general are described in Annex B; this section of the report concentrates on those measures currently available for groundnut value chains.) At the supply end, securing low aflatoxin inputs requires incentivising farmers, transporters and aggregators to use appropriate technologies and practices that reduce contamination, but which entail higher costs to these actors. Efforts to promote on-farm bio-control technologies are promising because they may help reduce these costs to farmers. However, incentives will still be needed to assure that these technologies are used. At the consumer end, in order to overcome issues of value chain integrity and signalling, interventions are needed to guarantee that a product is aflatoxin-safe, and to differentiate the product from comparators that have high aflatoxin levels. These integrity and signalling efforts not only affect consumers, but are key to providing incentives to businesses to produce aflatoxin-safe products. Developing these control systems at both the supply and consumer ends of the value chain will require the involvement of multiple actors; either businesses coordinating across their different roles (aggregation, processing, certification services) or public-private partnerships. The evidence suggests that, in order to promote an aflatoxin-safe product that addresses undernutrition, project partners would need to invest in building capacities and strengthening institutions at

[16] Ready-to-use therapeutic foods need to meet the strict standard for aflatoxin content employed by WFP.

multiple points in the value chain. Efforts to create an enabling policy environment (for example, support for food regulation or certification schemes) would also contribute to value chain integrity. The policy actions that can help promote nutrient-dense foods are discussed in the accompanying policy guidelines. An early stage of any efforts to support fortified groundnut products for nutrition should be to collect and assess evidence to demonstrate how the challenges at different stages in the value chain can be overcome, especially the risk that any intervention exacerbates the steering of contaminated groundnuts towards the poor.

Box 9 Options for addressing value chain challenges related to aflatoxin in groundnuts

Create a traceable supply chain that provides incentives to prevent mycobiological infection of groundnuts. Improved technologies and practices for growing, harvesting and storage that prevent or reduce mould infection of groundnuts are available and new biological control methods are being developed for conditions in Ghana. Interventions to produce traceable supply chains can incentivise farmers to use these technologies. Business alliances or public-private partnerships could develop a traceable supply chain with specific aggregators and farmer organisations, providing inputs and training to farmers and guaranteeing a premium price for aflatoxin-free supplies. These supplies could be channelled into a specific aflatoxin-safe product. Efforts could learn from examples in Ghana of focused value chains, including the Yedent Agro-Savanna Farmers' system or Nestlé Ghana's supply system for grains. One important consideration is how to reduce the costs of securing high quality, traceable supplies, since experience has shown that these can be high. At present, there is potential demand for low aflatoxin supplies of groundnuts from public-private partnerships seeking to develop safe groundnut products in Ghana, including as inputs to micronutrient sprinkles and RUTF.

Establish non-food value chains for contaminated groundnuts. Identifying an alternative market for aflatoxin-contaminated groundnuts could reduce the recirculation of contaminated groundnuts in the food system. This approach was successful in several small-scale groundnut value chains in Malawi, which channelled discarded groundnuts into animal feed (rendered safe by adding NovaSil) or into generation of bio-energy (Emmott and Stephens 2012).

Support national awareness campaign on the risks and effects of aflatoxin. Raising consumer awareness and concern is a long-term approach to generating the incentives needed to create an aflatoxin-free groundnut supply. Consumer awareness could both increase demand for aflatoxin-safe products and raise public support for efforts to introduce controls in the value chain (Florkowski and Kolavalli 2012). At present, government agencies in Ghana have been reluctant to promote warnings about the safety of widely consumed foods such as groundnut. Lessons could be drawn from broader nutrition awareness campaigns that have been undertaken by NGOs and the Ghana Health Service.

4.2 Complementary food products

Complementary food products in Ghana, including weanimix, have high potential to address undernutrition among children between six months and two years old. In addition to targeting a vulnerable population, these products have distribution systems in most cities, are already acceptable to consumers and have attracted business interest from micro-enterprises, the formal sector and multinational corporations. The key to enhancing their impact on nutrition is assuring their nutrition quality through integrity and signalling measures, achieving a price that is affordable to low income consumers and promoting their appropriate use as part of infant feeding. Because value chains are already established for these products and populations, there may be opportunities to overcome the barriers to these products through targeted programmes and policies.

4.2.1 Challenges facing complementary food products

Although complementary food products currently make a contribution to child nutrition in Ghana, a number of barriers restrict their potential, especially their affordability and nutrition content. These barriers are described in Box 10; the extent to which current products address these barriers is outlined in Table 16.

Box 10 Barriers to enhancing the potential of complementary food products to reduce undernutrition

Many complementary food products do not deliver sufficient nutrient content to support healthy infant growth and development. Additional fortification with micronutrients or other nutrient-dense products is required (Lartey *et al.* 1999; Amagloh *et al*. 2012). For weanimix, nutrient content varies widely, and some products are far from providing sufficient levels (W. A. Masters *et al*. 2011). In part, low nutrition levels reflect the **lack of value chain integrity and nutrition value signals** to consumers. As a result, products are not differentiated based on their nutrient content.

Most formal sector businesses do not market products for the poor. As is the case with groundnut products, most formal sector businesses producing weanimix focus on products targeted to middle class consumers. Small, informal enterprises provide products to lower income consumers. The exception to this trend is Yedent Agro Industries which, with support from GAIN, explicitly aims to sell its weanimix product to consumers in the 20 to 60 per cent wealth quintiles. In addition, Nestlé Ghana has adopted a strategy to reach lower income consumers by distributing its product in small packet sizes. However, Nestlé's product is sold at more than double the price of Ghanaian-produced weanimix products.

Aflatoxin contamination affects complementary foods, especially those using maize and/or groundnut. Like all agricultural commodities in Ghana, ingredients in complementary foods are likely to contain unsafe levels of aflatoxin, especially maize and groundnuts. This is especially concerning since these products target infants who are at greatest risk of negative health and development impacts from aflatoxin, and because the many traditional weaning foods and weanimix products use maize as a primary ingredient (Y.Y. Gong *et al*. 2002). At present, the only strategy used by Ghanaian businesses for assuring safe aflatoxin levels is to exclude maize and groundnuts. Nestlé employs a strict standard on aflatoxin content in its products. It uses a traceable value chain to control on-farm practices.

The sector is difficult to organise or regulate due to the large number of small businesses. Strategies to enhance the nutrition value of complementary foods include introducing certification programmes and building the capacity and knowledge of businesses. However, implementing these strategies is difficult because roughly half of complementary food manufacturers in Ghana are outside the reach of Ghana's regulatory and standards agencies. At present, the complexity and high cost of product registration and certification processes makes it difficult for small businesses to comply with standards. Yet it is these small businesses that are currently supplying much of complementary foods to the poor.

Table 16 Extent to which complementary food products have potential to address the key challenges

Product	Sufficient micro-nutrients	Targets women and infants	Targets poor	Safe aflatoxin levels[17]	Signal of nutrition content
Traditional porridges		x	x		None
Informal sector weanimix	Some products	x	x	By excluding maize and groundnut	Individual trust between producer and consumer
Formal sector weanimix	Some products	x		By excluding maize and groundnut	High product quality, packaging
Micronutrient-fortified weanimix (Yedent MaiSoyForte)	x	x	x		Packaging, nutrition label, high quality, brand value
International brand (Nestlé Cerelac)	x	x		x	Very high brand value, packaging, nutrition label
Micronutrient-fortified sprinkles (KokoPlus)	x	x		Must be added to food that is aflatoxin-safe	Not yet distributed

4.2.2 Options for strengthening value chains for complementary foods

The key to enhancing the potential of complementary food products to address undernutrition is to tackle the current lack of integrity and signalling of the nutritional quality of these products, and to create incentives for businesses to market products with adequate nutrient content. Addressing the integrity and signalling challenge would help to make nutrient-dense products more affordable by providing alternatives to international brand products. It is estimated that nutritionally adequate weanimix products can be marketed at half the price of international brands. Detailed business plans must be developed in order to assess the viability of models selling at a price that is affordable to low income consumers. Addressing integrity and signalling issues for complementary foods would contribute to on-going efforts to promote appropriate feeding practices by public agencies, NGOs and development agencies; these efforts can also contribute to addressing complementary food challenges by creating awareness and demand for products. Donor agencies and public-private partnerships have options for how to engage with businesses in the complementary foods sub-market; further investigation will be needed to determine whether the best opportunities lie in partnering with individual businesses or building the capacity of small and informal enterprises.

[17] There are no aflatoxin control procedures in place for maize or groundnut supplies to complementary food products. Therefore the only products that assure safe aflatoxin levels are those that exclude these ingredients. Micronutrient sprinkles can only be safe if they are added to foods that are not themselves contaminated.

Policy engagement is critical to addressing value chain integrity and signalling challenges for complementary foods – and indeed for other types of foods. Box 11 outlines several options for development agencies, NGOs and public-private partnerships. These issues are discussed in greater detail and in relation to the Ghanaian policy context in the accompanying policy guidelines.

Box 11 Options for addressing value chain challenges in complementary foods

Develop a certification scheme to guarantee nutrition quality to consumers. This would trigger investment in upgrading nutrition quality. Such a scheme would require two components: 1) a system to get product certification and ensure products meet both safety and nutritional standards; and 2) a process to signal to consumers using a certified logo approach. The product is already being used and can be easily directed to a target group.

Support particular food processors to produce and market micronutrient-fortified weanimix. Non-profit and government agencies could contribute by linking nutrition education campaigns and messages to promote purchasing nutrient-fortified food products. This is the approach currently being pursued by GAIN in its partnership with Yedent Agro Industries. Promoting particular businesses or products can pose a problem for development or government agencies. In Ghana, the Ministry of Health does not support using education programmes to promote particular kinds of products.

Enhance the capacity of small-scale processors to upgrade the nutritional quality of weanimix. Small processors are present in certain locales in most cities and in some rural areas, but their products vary widely in nutritional content. Actors such as the National Board for Small Scale Industries could organise weanimix manufacturers in a business association and provide business and technical training, emphasising the importance of producing products that are nutritionally adequate. The association could use a 'name and shame' approach to pressure members to produce high quality products. This approach has the advantage of drawing on relationships of trust between low income consumers and small entrepreneurs, and it would be complementary to a nutrition certification scheme.

Advocate for market leaders to pursue a 'bottom of the pyramid' business model. Nestlé is the market leader for complementary foods in Ghana, with a distribution network that reaches the majority of urban areas. Nestlé is investing in small packet sizes in order to market to consumers in lower income brackets. Working with Nestlé to achieve a lower price point for a new low cost complementary food product could leverage Nestlé's strong distribution system and increase affordability. The new product could incorporate novel formulations (substituting for high cost ingredients), low cost packaging and new marketing messages that target poor consumers.

5 Conclusion

This report has analysed the value chains for two types of foods (groundnut and complementary food products) in order to identify their potential for addressing undernutrition in Ghana, the challenges facing efforts to promote consumption of these products as a way to address undernutrition and the options for overcoming these challenges. After scoping an initial set of seven potential commodities, groundnut products and complementary foods were selected based on their capacity to meet the necessary conditions of availability, affordability, acceptability and nutrition quality, as well as signalling quality to consumers. These products were selected in response to interest from development agencies, businesses and public-private partnerships in promoting these products. The purpose of this analysis is to inform these and future efforts to promote the consumption of nutrient-dense foods and develop new products. To this end, the report highlights how these efforts can address the current challenges, as well as the risks they face in doing so. Before pursuing a particular option or product, a detailed business case will be needed. The detailed information and costing in such a case are beyond the scope of this report. However the evidence presented here should provide important input and recommendations for business cases.

Key findings for each of the product types are reviewed below.

Groundnut products: Introducing fortified groundnut products could contribute to addressing the key micronutrient deficiencies in Ghana. However major challenges face these products, especially stemming from high rates of aflatoxin contamination. There are few incentives along the value chain to reduce aflatoxin and price differentiation means that contaminated groundnuts tend to be steered towards poor consumers. Efforts to address aflatoxin entail additional costs and thus new products are aimed at wealthier consumers. Aflotoxins can be addressed by creating separate traceable value chains that provide incentives to multiple actors to reduce contamination; whole value chain approaches are needed. Using non-commercial distribution models can provide more control of the value chain in order to assure low aflatoxin levels. Finding non-food uses for groundnuts can help avoid directing contaminated products to the poor. Consumer awareness and willingness to pay are important to create incentives for businesses. Above all, new initiatives should ensure that they do not exacerbate the steering of aflatoxin-contaminated foods to the poor.

Complementary food products: Complementary food products have very high potential to address undernutrition; they target infants at a crucial period for nutrition and have existing distribution networks and business interest. Enhancing the contribution of these foods to reducing undernutrition requires introducing mechanisms to assure that consumers are aware of their nutrition quality and that they are sold at a price that is affordable to the poor. Existing initiatives to promote complementary foods focus on building the capacity of particular businesses, expanding reach at the bottom of the pyramid and promoting good infant feeding practices. To strengthen the sector, initiatives such as certification schemes or franchise systems are needed to guarantee the products' nutrition quality. Further investigation is needed to determine the best models for addressing this challenge. The key policy issues and options for supporting these initiatives are examined in more detail in the accompanying policy guidelines.

Further cross-cutting challenges can be identified that affect the environment for promoting consumption of nutrient-dense foods more broadly. These broader challenges are discussed in greater detail in the accompanying policy guidelines, which introduce policy and programme approaches to addressing them. They are:

Targeting poor consumers through the private sector. Developing a viable commercial business in selling nutrient-dense food products to bottom of the pyramid consumers is a challenge across the products examined in this report. Safe nutritious foods are mostly targeted at middle income consumers. The policy challenge is to enable businesses to target the poor and ensure products reach populations affected by undernutrition, especially those in the north and in rural areas. Approaches to encourage businesses to do this are discussed in the policy guidelines.

Nutrition awareness is low. Awareness of nutritional needs is generally low in Ghana, as is awareness of the foods that provide essential nutrients and those that pose a risk of aflatoxin contamination. This is especially true for bottom of the pyramid populations. Low awareness means that nutrition is often not taken into consideration in purchasing decisions, and that there are few incentives for businesses to produce nutrient-dense foods. Policy approaches to awareness can include both public and private sector mechanisms for communicating messages to consumers.

Addressing aflatoxin and food safety. As has been discussed throughout this report, nutrient-dense foods in Ghana are widely affected by aflatoxin contamination. Policy approaches must seek to prevent this outcome. In doing so, they must take account of low awareness, weak enforcement of regulations and the prevalence of informal markets in Ghana.

Assuring nutritional quality through value chain integrity and signalling. This report has shown that the lack of mechanisms to guarantee nutritional quality and to signal this to consumers leads to low nutritional quality and availability of particular products. This is a problem in many developing countries regarding nutrient-dense foods and food safety. A large body of evidence shows that assuring access to accurate information about product quality and safety is key to the efficient operation of markets (Dranove and Jin 2010), and that consumers face major barriers to acquiring accurate information about certain product traits, including nutrient content and levels of contamination with harmful substances. A variety of policy approaches can address the problem of signalling nutritional quality; the most appropriate approach depends on the characteristics of the value chain in question. In Ghana, options include formal certification schemes, franchising to increase control over retailers and upgrading capacity among businesses in the informal sector to meet and enforce standards.

The policy guidelines that accompany this report provide greater detail on these value chains for nutrition framework, on the cross-cutting challenges facing the provision of nutrient-dense foods and on the policy approaches to tackle these challenges in the Ghanaian context. They complement and extend the analysis of specific value chains provided in this report.

Annex A: Product scores

Table 17 Mean scores assigned by authors to various products as part of scoping exercise

Product	Mean score	Value chain challenges	Notes
Cowpea, whole	2.3	High post-harvest losses; low business interest.	Not for infants
Orange-flesh sweet potato	2.3	Acceptability is limited to a few regions.	Not for infants
Weanimix, micronutrient-fortified	2.2	Consumers are unaware of recommended nutritional content for complementary foods; integrity and signalling problems.	
Micronutrient sprinkles	2.2	New product type, and acceptability is unclear; integrity and signalling problems.	No aflatoxin in product, but contamination is likely if it is added to *koko* prepared with aflatoxin-contaminated maize.
Groundnut, roasted	2.0	Insufficient micronutrient content; aflatoxin contamination is relatively low.	Not for infants
Weanimix, conventional	2.0	Insufficient micronutrient content; consumers are unaware of recommended nutritional content for complementary foods; integrity and signalling problems.	
Small ruminants	2.0	Limited business interest; local-scale value chains.	Not for infants
Dawa-dawa (soybean)	2.0	Insufficient micronutrient content; acceptability limited to certain regions and groups.	Not for infants
Soymilk	2.0	Insufficient micronutrient content; acceptability low outside areas where it has been promoted.	Not for infants; good for children.
Groundnut paste	1.9	Insufficient micronutrient content; aflatoxin contamination is very high; integrity and signalling problems.	Not for infants
Groundnut-cowpea lipid drink	1.6	New product; acceptability is unclear; business interest is unclear; may face integrity and signalling problems.	Includes child formula; early product development phase.

Table 18 Product scores on value chain conditions assigned based on stakeholder interviews

Product	Scores: Henry Anim-Somuah						Scores: Ewan Robinson					
	Mean score	nutrition quality 1-low 3-high	business interest 1-low 3-high	affordable to poor 1-low 3-high	acceptable for poor 1-low 3-high	integrity & signalling 1-low 3-high	Mean score	nutrition quality 1-low 3-high	business interest 1-low 3-high	affordable to poor 1-low 3-high	acceptable for poor 1-low 3-high	integrity & signalling 1-low 3-high
Groundnut paste	**2**	2	2	2	3	1	**1.8**	2	1	2	3	1
Groundnut, roasted	**2**	2	1	2	2	3	**2**	2	1	2	2	3
Groundnut-cowpea lipid drink	**1.6**	2	2	1	2	1	**1.6**	2	2	1	2	1
Cowpea, whole	**2.4**	2	1	3	3	3	**2.2**	2	1	2	3	3
Weanimix, conventional	**1.8**	2	2	2	2	1	**2**	2	3	2	2	1
Weanimix, micronutrient-fortified	**2.2**	3	3	2	2	1	**2.2**	3	3	2	2	1
Micronutrient-fortified sprinkles	**2.2**	3	2	2	1	3	**2.2**	3	2	2	1	3
Orange-fleshed sweet potato	**2.4**	2	1	3	3	3	**2.2**	2	1	3	2	3
Small ruminants	**2**	2	1	1	3	3	**2**	2	1	1	3	3
Dawa-dawa (soybean)	**2**	1	1	3	3	2	**2**	1	1	3	3	2
Soymilk	**2.2**	2	2	2	3	2	**1.8**	2	2	2	1	2

Annex B: Approaches to addressing aflatoxin contamination throughout value chains

As described in Box 4, aflatoxin exposure is associated with negative health outcomes, including those related to malnutrition and undernutrition status. This section focuses on the existing approaches for addressing aflatoxin contamination in foods at various stages in the value chain. These challenges affect foods of critical importance to the nutritional status of populations in Ghana: especially complementary foods that incorporate maize or groundnut, as well as commonly consumed foods that affect pregnant and breastfeeding women. Thus, aflatoxin contamination must be taken into consideration as part of efforts to promote the provision of nutrient-dense foods. This section reviews current approaches in Ghana and highlights the need for integrated approaches that address multiple stages in the value chain.

The main approaches to reducing aflatoxin contamination are listed in Box 12, and include techniques used on-farm, during transport and storage, and in food processing. In Ghana, various development projects have promoted on-farm measures to reduce aflatoxin contamination, but these have not led to reductions on a large scale. Research indicates that actors in agricultural value chains have little incentive to implement storage measures (which are costly) to reduce aflatoxin (Florkowski and Kolavalli 2012; N'dede *et al*. 2012). Low incentives are compounded by very low consumer awareness of aflatoxin and weak regulation.

Box 12 Approaches to reducing aflatoxin in agricultural commodity value chains

On-farm application of biological control agents. Products such as Aflasafe can reduce aflatoxin levels by as much as 90 per cent when properly applied to crops in the field (Bankole and Adebanjo 2004: 261). These products contain strains of the fungus *Aspergillus* that do not produce aflatoxin and which out-compete the toxic varieties. Commercial distribution has begun in Nigeria and there are plans to scale out the project to other West African countries. The Partnership for Aflatoxin Control in Africa (PACA) has begun initial phases of work with institutions in Ghana to produce locally specific strains of *Aspergillus.* PACA states that it plans to test, produce, and market these products, and distribute them in a way that makes them affordable for small farmers. The long-term commercial viability of these products remains unclear.

Good agricultural and storage practices. Early harvesting and storage with proper temperature and ventilation can reduce *Aspergillus* infections throughout the value chain. In general, farmers and agricultural traders in Ghana have not yet adopted these best practices.

Removing contaminated supplies during processing. Manual sorting to remove poor quality or discoloured kernels has been shown to be highly effective at reducing aflatoxin levels in groundnuts (Galvez *et al*. 2002). A high quality supply is important for making sorting economically viable for businesses, as sorting and discarding substantially increases the costs of inputs.

Using additives in processing that prevent aflatoxin being taken up in the body. A food additive made from clay (brand name NovaSil^{TM}) has been developed (Afriyie-Gyawu *et al*. 2008). When eaten with food containing aflatoxin, the clay prevents the toxin being absorbed into the human body. Human subject testing of this product began in Ghana, but was abandoned because of negative public perceptions about human consumption of a product derived from clay.

However, some businesses are investing in systems that reduce the level of aflatoxins in their branded products, based on the logic that safe aflatoxin levels will support their brand reputation, allowing them to capture added value. This strategy forms part of a focus on middle class consumers with spending power for branded products. For example, Nestlé Ghana Ltd has invested substantially in developing traceable value chains for the supply of aflatoxin-safe maize for the production of the Cerelac brand of complementary foods. The food processing that is trialling low aflatoxin groundnut products hopes to benefit from a certification system that allows them to use a 'safe aflatoxin levels' logo on their products.

In Ghana, the only case of aflatoxin management in a supply chain is Nestlé Ghana. As with Cerelac, Nestlé has a bespoke supply chain, including training farmers and monitoring on-farm conditions.[18] Examples from elsewhere in Africa, including Malawi, have focused on reducing aflatoxin in order to access export markets with strict standards for aflatoxin content. In Malawi, the NGO Twin developed a traceable supply chain for a branded groundnut product aimed at the EU market, which provided incentives for small farmers to upgrade their practices. In Ghana, efforts to reduce aflatoxin have concentrated on the processing stage of the value chain. The Peanut Collaborative Research Support Program promoted sorting groundnuts during processing to reduce aflatoxin contamination (see the section on groundnut products, below) and funded research into the NovaSil food additive. As discussed above, the challenge of aflatoxin faces both groundnut and complementary food products, and has different implications for each of these food types.

Efforts to reduce aflatoxin during processing notwithstanding, it is clear that changes at the processing stage alone are insufficient to address the challenge of aflatoxin in foods consumed by the poor, and can even risk exacerbating the problem. There are two reasons for this:

- **Sorting entails high costs given the poor quality of supplies.** For example, at present the quality of groundnut supplies in Ghana is such that approximately 25 per cent of supply by volume is removed to achieve low aflatoxin levels. This increases the cost of labour and supplies for food processors, and these higher prices will be passed on to consumers. As a result, guaranteed low aflatoxin products are unlikely to be affordable for poor consumers.
- **There is a risk that promotion of low aflatoxin products will lead to contaminated groundnut supplies being steered towards the poor**, as long as aflatoxin management relies on sorting procedures**.** The incentive for businesses is to re-sell contaminated kernels to actors in the informal sector, who use them in low quality products. For this reason, promotion of low aflatoxin products based on sorting is likely to result in further steering contaminated supplies towards poor consumers.

For these reasons, aflatoxin management during processing alone is insufficient. Addressing aflatoxin requires creating traceable value chains and incentivising farmers, traders and other value chain actors to implement good practices. It would entail paying a substantial price premium for supplies, and would therefore create a challenge for affordability (Florkowski and Kolavalli 2012).

[18] Nestlé has a policy of enforcing a strict aflatoxin standard on its products, set at the European Union standard of four parts per billion. Nestlé is investing in research and development of techniques to reduce aflatoxin contamination in maize value chains in West Africa.

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