Ghana

NUTRIENT ADEQUACY MAPS FOR TARGETED POLICY INTERVENTIONS

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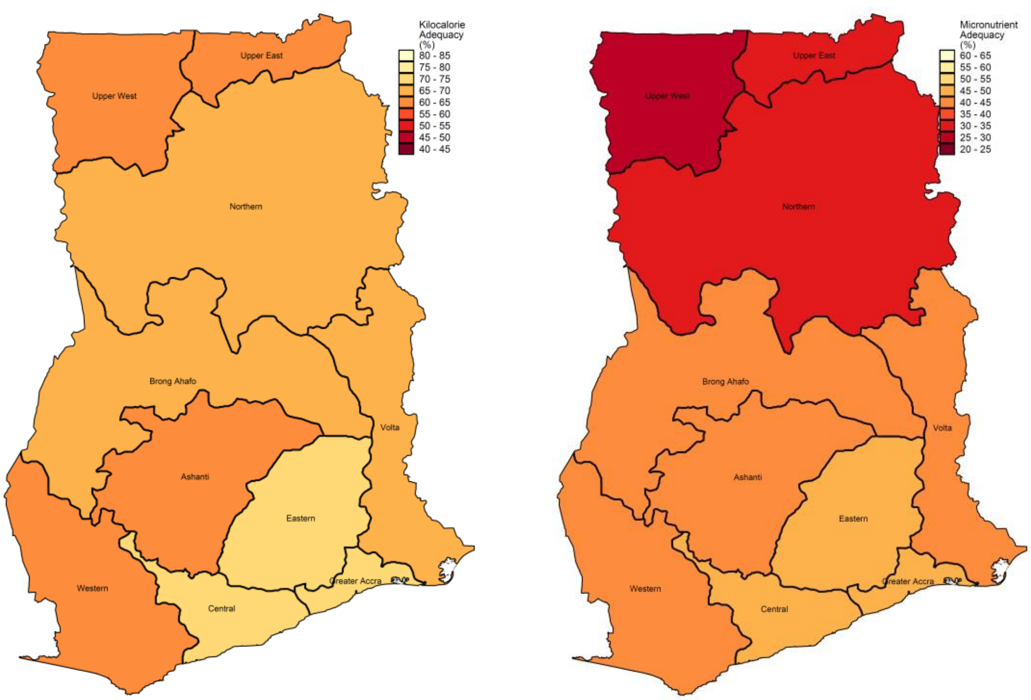
PROGRAM BRIEF|DECEMBER 2018

INTRODUCTION

This brief presents a series of nutrient adequacy maps to help understand, identify and locate the major challenges behind Ghana's insufficient and unbalanced food intake. The maps are obtained by converting food data into corresponding levels of calorie and key nutrients for both production and consumption, while comparing them with the nutritional requirements of each region's population. As such, our approach combines the comprehensive and sequential logic critical to system approaches recommended by researchers and development partners to fight malnutrition (Ericksen 2008; Gillespie and van den Bold 2017; Global Panel on Agriculture and Food Systems for Nutrition 2016; Jones and Ejeta 2015; Pinstrup-Andersen 2013; Stephens et al. 2018; Tendall et al. 2015).

In this brief, in addition to energy intake, we focus on a set of micronutrients including calcium, iron, zinc, folate, vitamin B12 and vitamin A; often used to describe "hidden hunger" in case of insufficient intake. Figure 1 presents the overall challenge of Ghana's undernutrition, expressed both in terms of diet quantity and quality. Whereas diet quantity refers to a sufficient intake of kilocalories, diet quality looks at intake of micronutrients. More precisely, we define kilocalorie adequacy at the household level as the number of actual kilocalories consumed divided by the recommended intake based on size and demographical structure of the family. Before averaging these ratios at regional level, we first truncate all values at 100%, indicating sufficient intake. For micronutrient adequacy, we apply the same procedure for each of six nutrients individually. Subsequently, we take the arithmetic mean of all micronutrient adequacy rates at the household level, also known as the mean adequacy ratio (MAR), before estimating its regional average.

Figure 1. Diet quantity and quality (Ghana 2016/17)



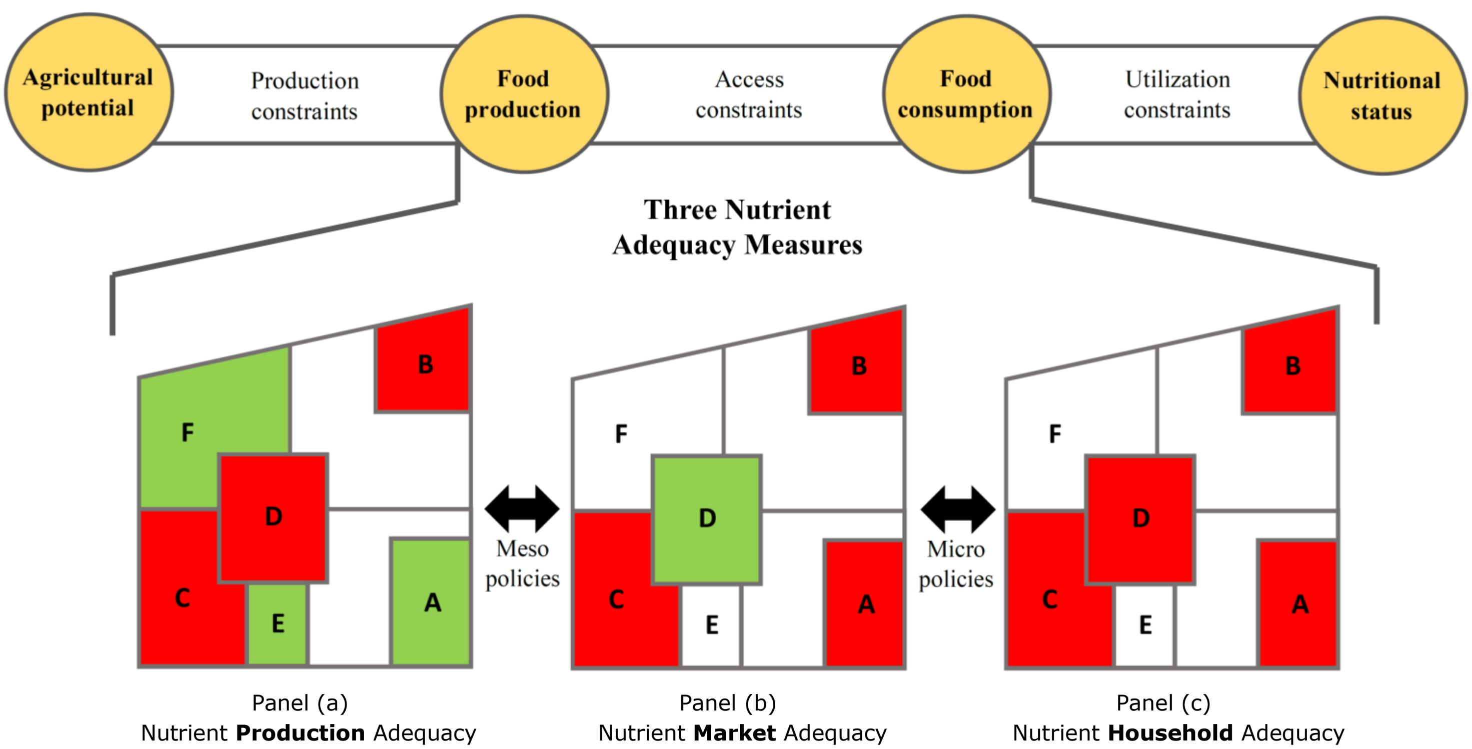
Source: Authors with data from GLSS7 (2016/17).

The left-hand map of Figure 1 shows that food energy intake is slightly better in Greater Accra and two neighbouring regions, with adequacy levels above 70%, compared to the Ashanti and Western regions located to the west and the most northern Upper West and Upper East regions, where households only reach at best 65% of their recommended intake. In terms of micronutrient adequacy (right-hand map of Figure 1), the spatial discrepancy between the South and the North is more pronounced, with Upper West and Greater Accra being respectively the most and least affected.

CONCEPTUAL FRAMEWORK AND DATA

To generate in-depth evidence on the causes and related opportunities to address the spatial heterogeneity in food intake deficiency, we map three distinct nutrient adequacy measures for food energy and each key nutrient (for details, see Marivoet and Ulimwengu 2018). The first measure, nutrient production adequacy, quantifies the region's agricultural production capacity to meet the minimal energy and nutrient requirements of its population. The second measure, nutrient market adequacy, indicates the aggregate accessibility of the region's population to adequate amounts of calories and nutrients, while the third measure, nutrient household adequacy, also highlights the unequal access among households within each region. By spatially opposing these sets of adequacy maps and by relating nutrient deficiency levels back to actual food items, different food and nutrition security policies could be defined. This is illustrated by the maps in Figure 2, where the green colour points to surplus, red to deficit and white to self-sufficiency. At the meso level, based on production and market adequacy, areas can be classified either as suffering from insufficient food production (such as area B and C) and post-harvest losses (area A), or with potential for increased market integration with neighbouring areas (area C). At the micro level, when comparing the maps of market and household adequacy, areas suffering from an insufficient demand of food (such as area D) can be easily detected. The demand constraint could be related either to low real incomes, a condition which makes nutritious food simply unaffordable to households, or to a lack of knowledge on the nutritional value of certain food items. Whereas the former requires nutrition-sensitive social protection schemes, the latter might be addressed by behavioural change campaigns.

Figure 2. Three nutrient adequacy measures to identify and locate bottlenecks to food security



Source: Authors.

The data used in this brief come mostly from the latest round of Ghana's Living Standards Survey (GLSS7) conducted in 2016/17 (GSS 2018) combined with official statistics on agricultural production for year 2016 (ReSAKSS 2016). To assure consistency across both data sources, maps will be produced for each of the country's 10 regions. More specifically, for production adequacy, we combine the official production statistics of 4 main cereals (maize, rice, millet and sorghum), 4 tubers (cassava, yam, cocoyam and plantain), 3 pulses (groundnuts, cowpeas and soybeans) and fish (as a combination of inland, marine and aquaculture). In addition, we obtain estimates for the remaining crops and food items using the production modules of GLSS7

(2016/17), covering not only fruit and vegetables, but also milk and eggs, and a few other items[1]. Using a food composition table (FCT) compiled for West Africa (Stadlmayr et al. 2012), these production quantities are then converted into kilocalories and other nutritional equivalents, and aggregated by region. The ratio of production adequacy is then obtained by dividing these food energy and nutrient production levels by their respective required intakes as defined by each region's demographical structure. The same generic approach is followed for market adequacy, based on food *consumption* data (GLSS7 2016/17) as obtained either through purchases, own produce or food consumed away from home. In total, more than 200 food items are covered for which quantities are obtained through the imputation of regional food prices. Using the same FCT, we derive aggregate nutrient consumption by region, which is then divided by the region's required intake levels. Household adequacy is derived from the same household consumption survey; estimated at household level by considering the family's required intake and truncating all values above 100%, before averaging household ratios by region. The truncation function assures that households with a surplus intake for a particular nutrient can not compensate for deficient intakes observed in other households within the same region; therefore, household adequacy by construction can not exceed 100%. The required intake levels for each household and region are determined using the common approach of adult male equivalence scales combined with population sampling weights. Each of the three measures is a ratio, where 100% reflects adequacy and values below (above) 100% point to deficiency (surplus). The generic colour scheme applied throughout this brief is pale yellow for adequacy, green for surplus and red for deficiency.

NUTRIENT ADEQUACY

Table 1 provides an overview of absolute gaps in nutrient production and consumption as compared to recommended intake levels as well as the three nutrient adequacy measures. Apart from kilocalories, proteins and folate, for which production adequacies are substantially higher than 100%, Ghana is simply not producing enough micronutrients. Indeed, production adequacies amount to only 41% for calcium, 63% for iron and 83% for zinc. In addition to insufficient national food production, one can observe substantial leakages, be it in terms of food losses, wastes or exports: for all nutrients except vitamin A and B12, market adequacies are substantially lower than production adequacies, which is relatively significant for folate and iron where nutrient access is less than half of what is nationally produced. It is possible that the exceptional cases of vitamin A and vitamin B12 is due to a lack of sufficient information on meat and palm oil production; therefore, should be interpreted with caution.

Table 1. National food energy and nutrient adequacy levels based on production, consumption and recommended intake, Ghana (2016/17)

	Production per day, AME	**Consumption** per day, AME	**Recommended intake** per day, AME	**National Production Adequacy** (%)	**National Market Adequacy** (%)	**National Household Adequacy** (%)
Kilocalories (kcal)	3651.9	2031.6	2750.0	132.8	73.9	66.9
Proteins (g.)	(70.1)	54.7	50.0	(140.3)	109.4	82.4
Calcium (mg.)	407.4	249.8	1000.0	40.7	25.0	25.1
Iron (mg.)	17.4	8.5	27.4	63.4	30.8	31.7
Zinc (mg.)	11.6	7.0	14.0	83.1	50.0	48.9
Folate (mcg.)	538.7	207.9	400.0	134.7	52.0	48.0
Vitamin B12 (mcg.)	(0.0)	1.2	2.4	(0.9)	50.4	42.3
Vitamin A (mcg.)	(425.5)	893.1	600.0	(70.9)	148.8	57.6

Notes: In absence of reliable statistics on meat and palm oil production, the corresponding values for proteins, vitamin B12 and vitamin A are put in brackets.
Source: Authors with data from GLSS7 (2016/17) and ReSAKSS (2016).

Market and household adequacies point to demand problems for kilocalories, proteins, vitamin B12 and vitamin A. For the latter nutrient, which is typically found in fruit and vegetables, a lack of knowledge on the nutritional value of vitamin A can explain why household intake is deficient. For proteins and vitamin B12, found mostly in more expensive food items such as meat and fish, unaffordability is a straightforward explanation behind their deficient intake. Remarkably, food energy adequacy is lower than expected – especially given the Lower-Middle Income status of the country. This rather dismal picture may be due to a

[1] Unfortunately and in line with observations made by Sumberg et al. (2016), we were unable to obtain reliable statistics for meat production, which will render the nutrient measures of protein and vitamin B12 much less accurate. And the same is true for palm oil and its negative effect on the accuracy of vitamin A related measures.

combination of underreporting of food consumption by GLSS7 combined with lower physical activity levels and thus lower recommended intakes of an increasingly urbanizing society.

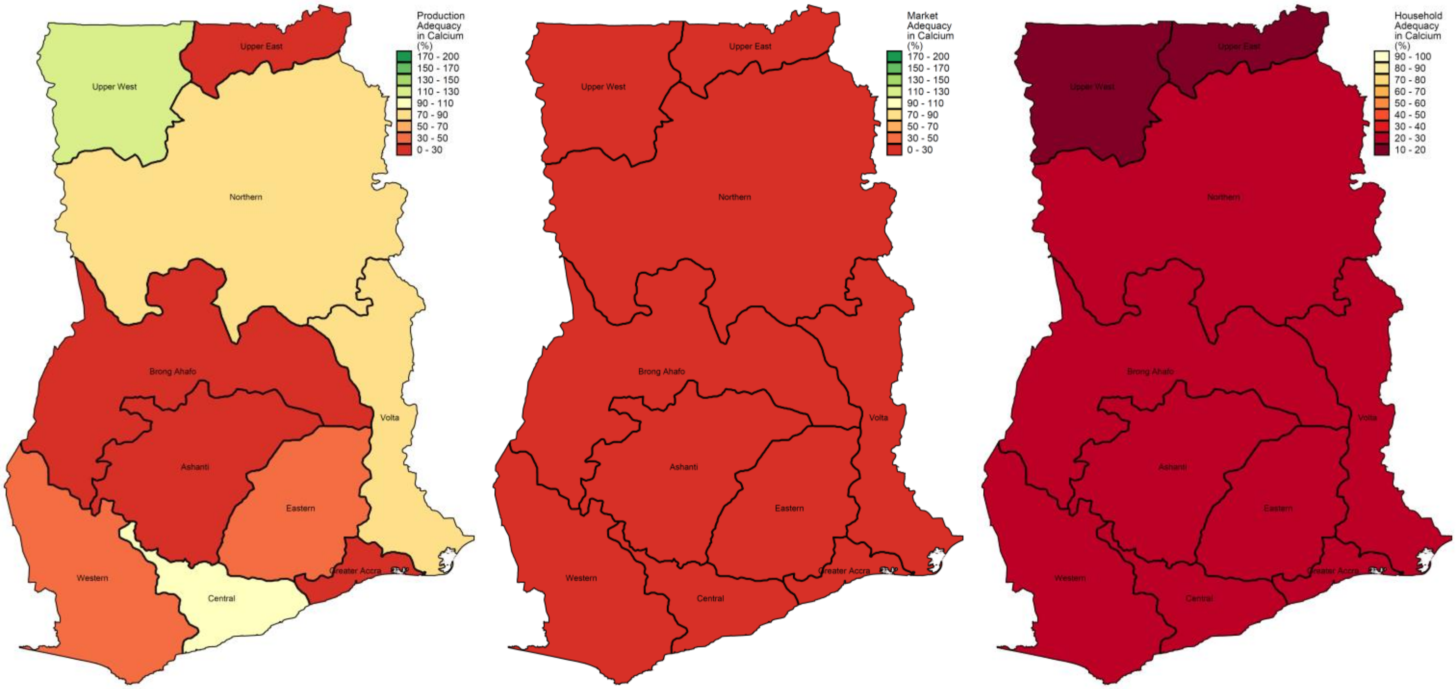
Figure 3 displays by region the same three adequacy measures for each of the 6 micronutrients covered in this brief. Throughout the country, calcium deficiency (see panel (a)) is the most important challenge faced by households in Ghana with those in Upper East and Upper West being hit the hardest. In the latter two regions, households reach less than 20% of their recommended intake (right-hand map). This poor performance is due to calcium-rich food items being largely unavailable through the market (middle map of panel (a)). However, from a production perspective (left-hand map), the picture is less dramatic: whereas the Central region produces roughly enough calcium for its own population, Upper West is generating a surplus. Likewise, production deficits in Northern and Volta are less pronounced compared to all other regions, such as Upper East, Brong Ahafo, Ashanti, Greater Accra, Eastern and Western where they are below 50%. Therefore, to address calcium deficiency in Ghana, the production of calcium-rich food items should increase, especially in the latter six regions. In addition, policies should address the important leakages of calcium observed in other regions. Assuming that calcium-rich food items are not traded to neighbouring countries, the contrast between production and market adequacy points to important food losses, especially in Upper west, which could be reduced by investing in local storage and processing capacity as well as educating farmers through improved extension services.

The second most important FNS challenge in Ghana is iron deficiency. Given their similar spatial outlook, we discuss the various adequacy measures of iron (see panel (b)) in combination with zinc's (see panel (c)). For both micronutrients, household adequacy is generally lower in the southern regions (except for Greater Accra), compared to those in the country's North; yet the difference between regions is less than 20% (right-hand maps). In terms of market adequacy, roughly the same level and geographical distribution apply with northern regions (and Greater Accra) being relatively better supplied by food items rich in iron and zinc (middle maps). As such, no real demand issues seem to be at play. Though, in terms of production adequacy (left-hand maps), all regions (except Greater Accra) are performing markedly better with the three most northern regions being self-sufficient or even generating surpluses in iron and zinc, while the regions of Volta and Eastern are equally producing enough zinc. For both micronutrients, Greater Accra, Ashanti and Western region are the worst performers in producing iron and zinc to meet the recommended intake levels of their respective populations. Like in the case of calcium, largely the same policy recommendations could be put forward: increasing the production of food items rich in iron and zinc, especially in the more southern regions of the country, while addressing the issue of food losses in the North. If addressing food losses/wastes is feasible but not so for increasing production due to biophysical constraints, improved market linkages between production sites in the North and consumption centres in the South could be pursued as a valid alternative.

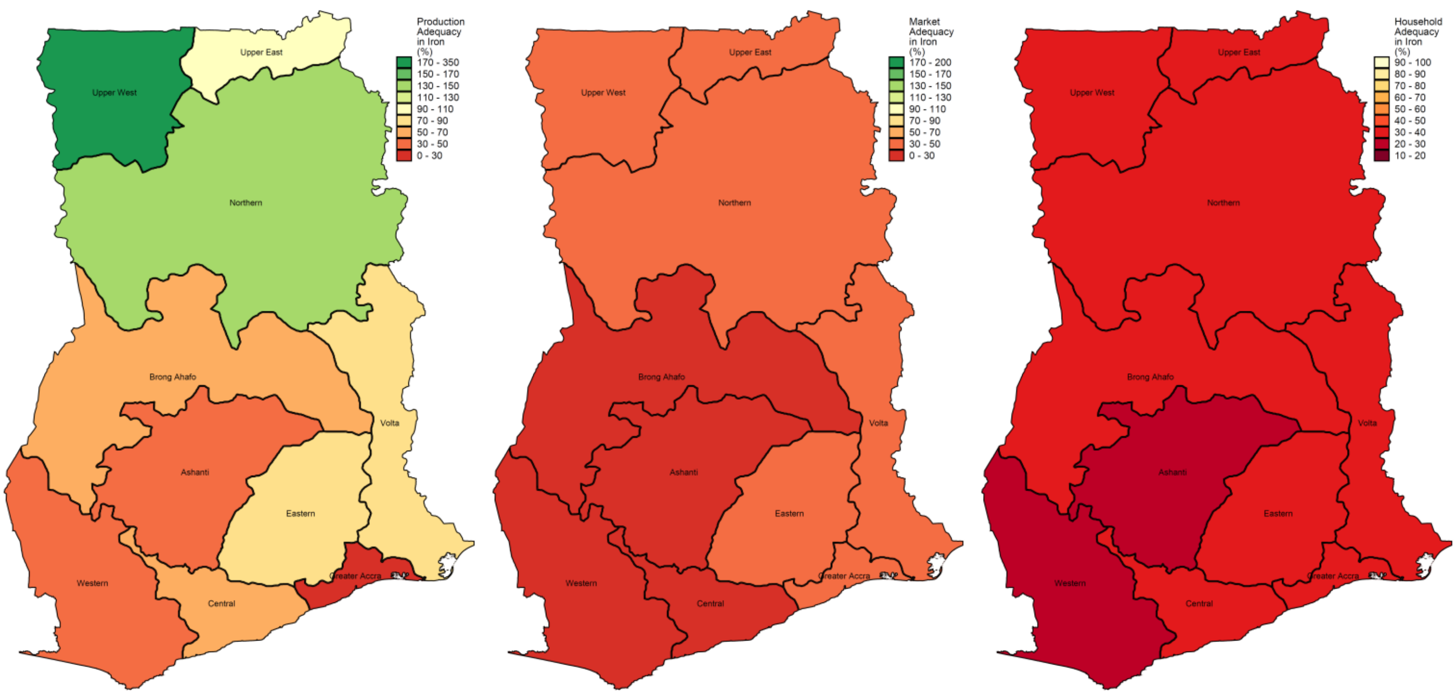
Folate deficiency is another major FNS problem of Ghana. To some extent, we observe a similar spatial heterogeneity in nutrient production, market and household adequacy as was the case for iron and zinc. However, two major exceptions apply. First, Upper West and Upper East join the southern regions as those characterized by the lowest market and household adequacies. Second, production adequacies are on average well beyond 100% with only two regions (Greater Accra and Ashanti) producing too little folate compared to required levels. As a result, policies to address folate deficiency should mainly focus on strengthening value chains of food items rich in folate as to reduce food losses and improve accessibility by Ghanaian households throughout the country.

For vitamin B12 and vitamin A, a different spatial typology emerges. For both of these micronutrients, household and market adequacies are highest in the most southern regions and gradually decreases towards the northern part of the country with levels as low as 30% of the recommended intake in Upper West, Upper East and Northern region. On the other side, not only the southern regions perform relatively better, but market adequacies in these regions are also distinctively higher than household adequacies. The difference between market and households adequacies, which is most pronounced for vitamin A, points to limited demand for food items containing these vitamins. For vitamin B12 which is solely found in animal products, non affordability may explain why household adequacies are lower than market adequacies. For vitamin A on the contrary, which is found in orange and red coloured vegetables and fruit, rather cheaper food items, a lack of knowledge may explain their absence from the daily food basket. With respect to production adequacy, one should be very cautious in interpreting the corresponding maps given the methodological issues mentioned above.

Figure 3. Micronutrient production, market and household adequacies at regional level, Ghana (2016/17)

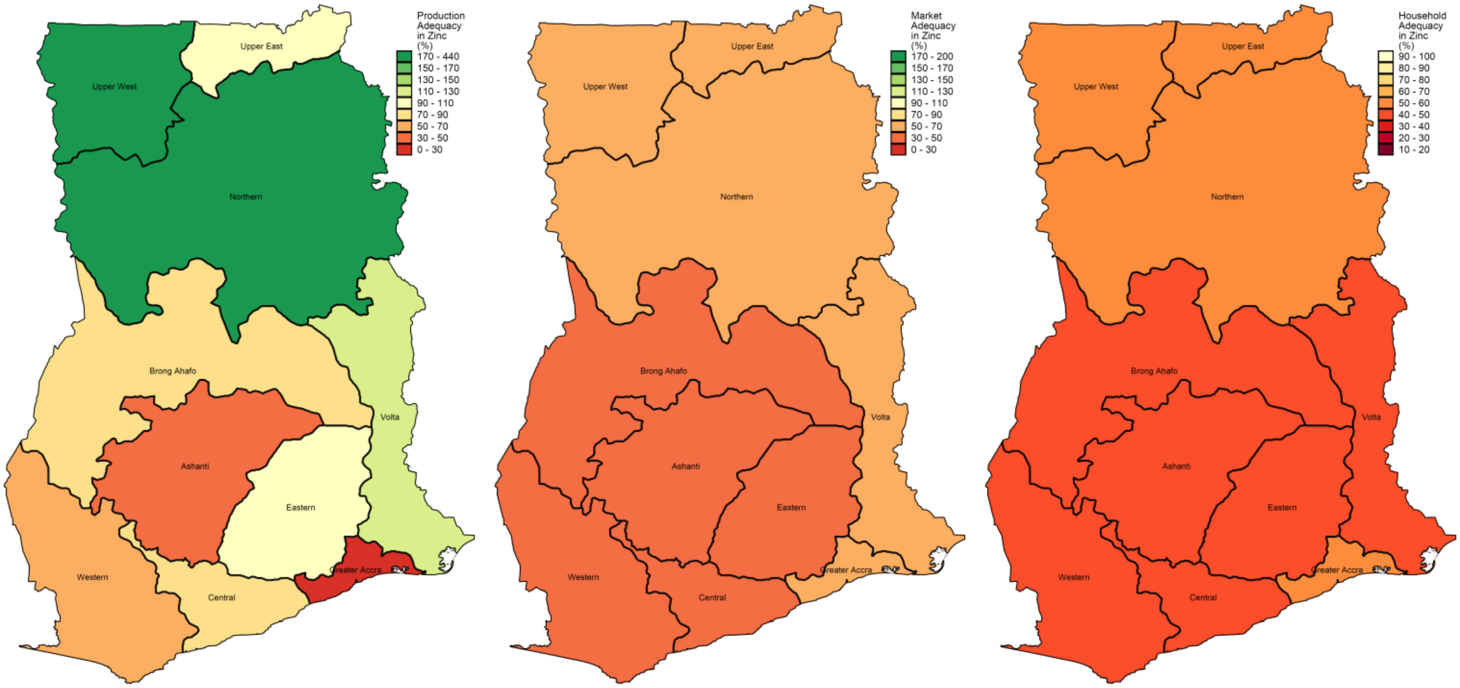


Panel (a): Calcium adequacy

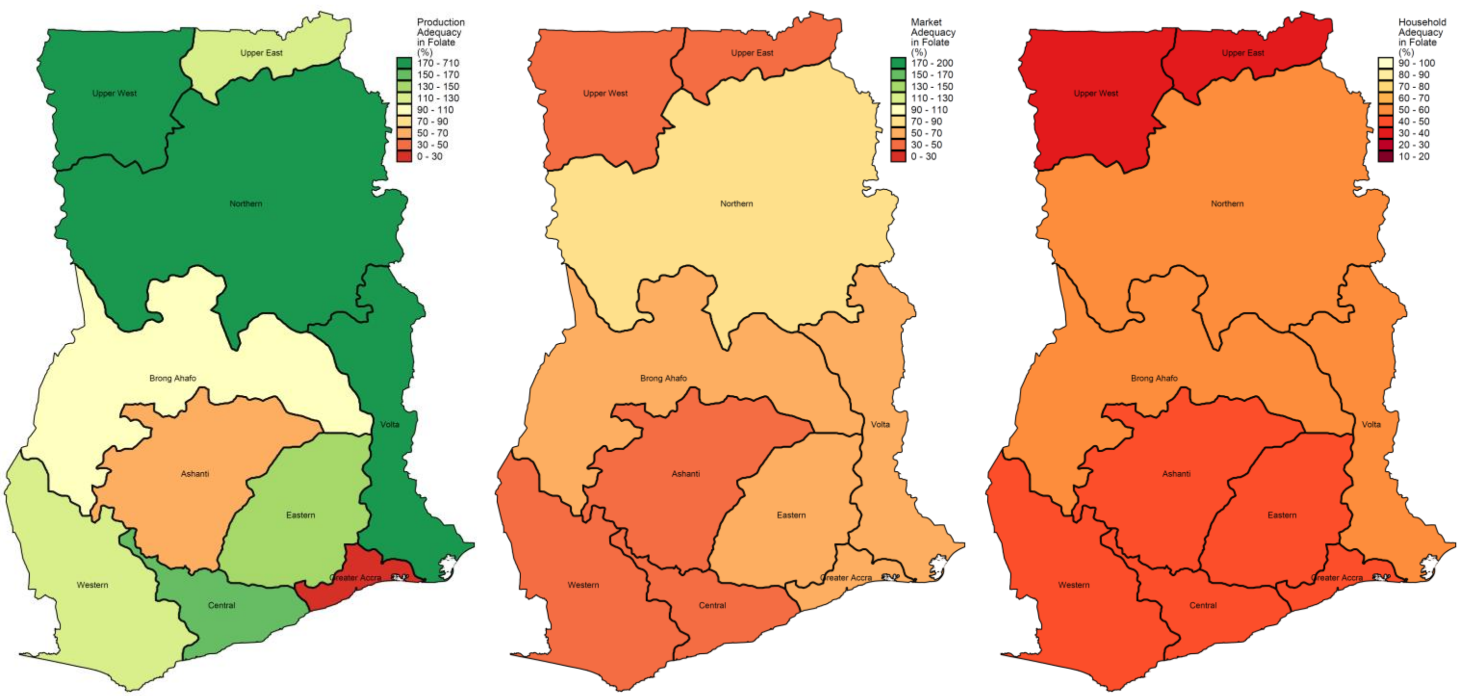


Panel (b): Iron adequacy

Figure 3. Continued

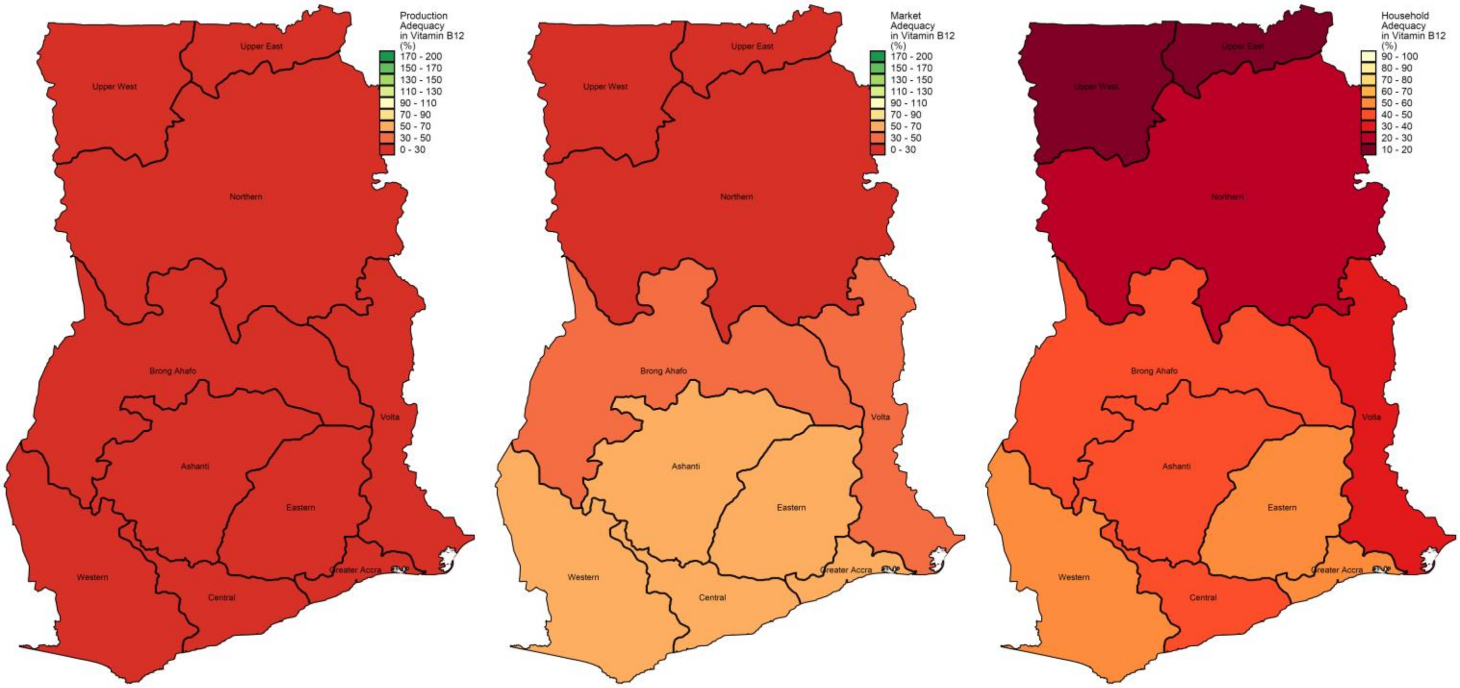


Panel (c): Zinc adequacy

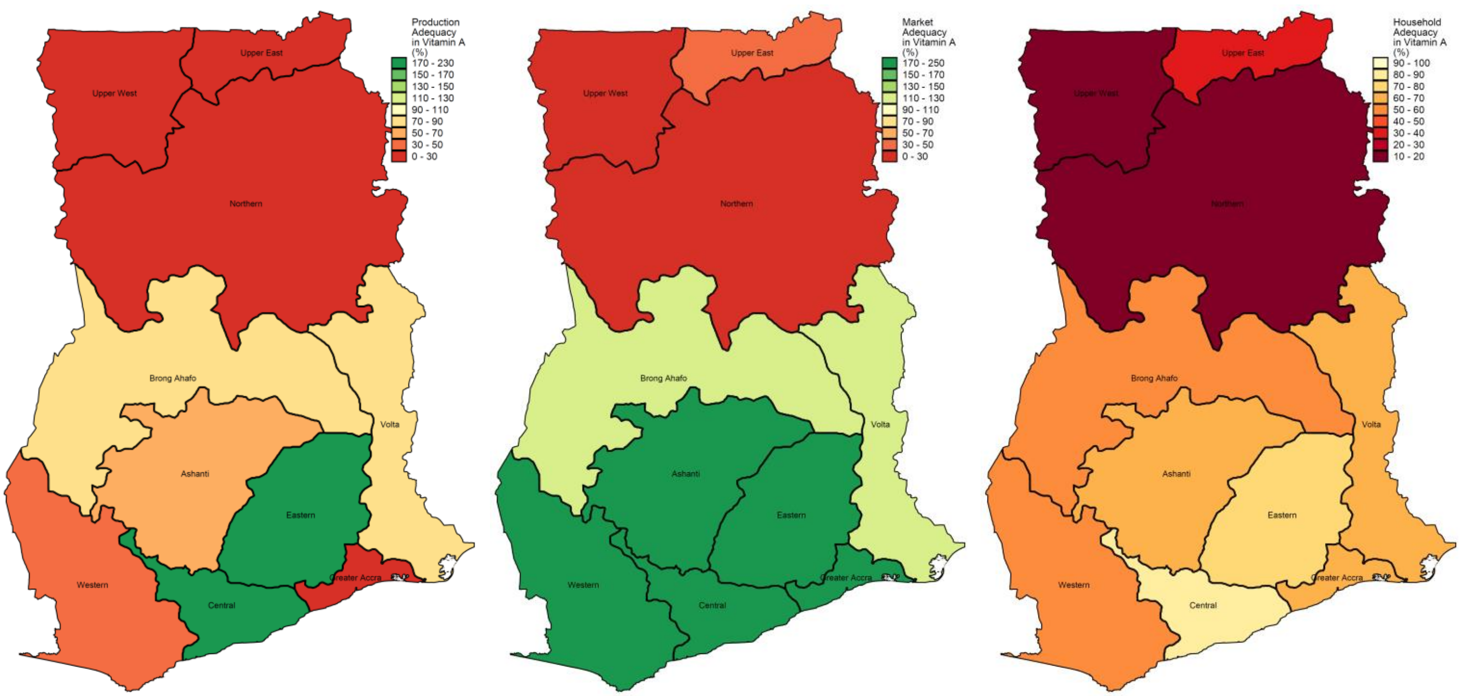


Panel (d): Folate adequacy

Figure 3. Continued



Panel (e): Vitamin B12 adequacy



Panel (f): Vitamin A adequacy

Source: Authors with data from GLSS7 (2016/17) and ReSAKSS (2016).

FROM NUTRIENT DEFICIENCIES BACK TO FOOD AND TARGETED POLICIES

For policy recommendations, we convert the above findings back to the food dimension to guide the selection of food items to be targeted for increased production, trade or consumption, and their specific locations. Indeed, policies can not be designed and implemented based on nutrient deficiency information alone, given their elusive nature as compared to actual food items. Indeed, no one grows or goes to the market to buy micronutrients. For each nutrient covered in this brief, Table 2 presents the five most important national food items following two distinct criteria.

Table 2. Most important food items by nutrient according to nutrient share and price, Ghana (2016/17)

	Food item	Nutrient intake share	Price per nutrient (Gp)	Nutrient content 100gr	Food budget share	Food item	Nutrient intake share	Price per nutrient (Gp)	Nutrient content 100gr	Food budget share
Calorie	Rice - Imported	14.5%	0.15	349.0	11.2%	Sweet apple	0.2%	0.01	91.0	0.0%
	Corn dough	12.3%	0.04	352.0	2.8%	Coconut (fresh)	2.0%	0.03	389.0	0.3%
	Maize (dried, white grains)	11.4%	0.04	349.0	2.2%	Maize (dried, white grains)	11.4%	0.04	349.0	2.2%
	Vegetable oil	7.4%	0.09	900.0	3.4%	Palm kernel oil	0.1%	0.04	900.0	0.0%
	Cassava (fresh)	6.4%	0.08	153.0	2.6%	Corn dough	12.3%	0.04	352.0	2.8%
Protein	Smoked fish	14.2%	5.95	38.5	10.0%	Sweet apple	0.1%	0.52	1.4	0.0%
	Corn dough	14.0%	1.66	9.5	2.8%	Maize (dried, white grains)	12.6%	1.45	9.2	2.2%
	Maize (dried, white grains)	12.6%	1.45	9.2	2.2%	Guinea corn/sorghum grains	0.7%	1.50	10.5	0.1%
	Rice - Imported	12.0%	7.87	6.9	11.2%	White beans (cowpea)	3.4%	1.55	19.2	0.6%
	Rice - Local	4.6%	5.14	6.9	2.8%	Corn dough	14.0%	1.66	9.5	2.8%
Calcium	Cassava dough	18.5%	0.12	137.5	1.6%	Sweet apple	0.4%	0.03	23.5	0.0%
	Cassava (fresh)	12.8%	0.29	42.8	2.6%	Cassava dough	18.5%	0.12	137.5	1.6%
	Cassava - Gari	6.0%	0.28	137.5	1.2%	Cassava - Kokonte	5.1%	0.20	137.5	0.7%
	Cassava - Kokonte	5.1%	0.20	137.5	0.7%	Cassava - Gari	6.0%	0.28	137.5	1.2%
	Yam - Puna	4.7%	1.50	25.8	4.9%	Cassava (fresh)	12.8%	0.29	42.8	2.6%
Iron	Corn dough	18.9%	4.68	3.4	2.8%	Sweet apple	0.2%	1.09	0.7	0.0%
	Maize (dried, white grains)	16.0%	4.33	3.1	2.2%	Millet	2.1%	2.00	9.5	0.1%
	Rice - Imported	9.3%	38.53	1.4	11.2%	White beans (cowpea)	5.8%	3.48	8.5	0.6%
	White beans (cowpea)	5.8%	3.48	8.5	0.6%	Guinea corn/sorghum grains	0.9%	4.25	3.7	0.1%
	Cassava (fresh)	4.7%	17.57	0.7	2.6%	Maize (dried, white grains)	16.0%	4.33	3.1	2.2%
Zinc	Corn dough	16.9%	9.14	1.7	2.8%	White beans (cowpea)	5.4%	6.47	4.6	0.6%
	Maize (dried, white grains)	14.1%	8.55	1.6	2.2%	Maize (dried, white grains)	14.1%	8.55	1.6	2.2%
	Rice - Imported	13.4%	46.50	1.2	11.2%	Guinea corn/sorghum grains	0.7%	8.79	1.8	0.1%
	White beans (cowpea)	5.4%	6.47	4.6	0.6%	Corn dough	16.9%	9.14	1.7	2.8%
	Rice - Local	5.1%	30.34	1.2	2.8%	Millet	0.6%	12.93	1.5	0.1%
Folate	White beans (cowpea)	16.1%	0.07	409.8	0.6%	White beans (cowpea)	16.1%	0.07	409.8	0.6%
	Cassava (fresh)	9.4%	0.51	24.0	2.6%	Cassava dough	8.2%	0.36	47.0	1.6%
	Cassava dough	8.2%	0.36	47.0	1.6%	Cocoyam leaves	3.3%	0.38	126.0	0.7%
	Maize (dried, white grains)	7.9%	0.51	26.0	2.2%	Groundnut (shelled/roasted)	1.0%	0.40	108.9	0.2%
	Rice - Imported	7.7%	2.70	20.0	11.2%	Coconut (fresh)	1.3%	0.49	27.0	0.3%
Vitamin B12	Smoked fish	31.4%	129.45	1.8	10.0%	Canned Mackerel	14.2%	22.07	6.9	0.8%
	Canned Mackerel	14.2%	22.07	6.9	0.8%	Canned sardines	6.0%	25.21	8.9	0.4%
	Kpala (Starvids) frozen	13.5%	54.13	2.4	1.8%	Bushmeat (Grasscutter)	3.5%	34.43	18.3	0.3%
	Beef with bones	9.5%	157.32	1.1	3.7%	Kpala (Starvids) frozen	13.5%	54.13	2.4	1.8%
	Canned sardines	6.0%	25.21	8.9	0.4%	Mutton mixed cut	1.2%	65.36	2.9	0.2%
Vitamin A	Palm oil (red oil)	78.1%	0.01	5720.0	1.6%	Palm kernel oil	1.5%	0.01	5720.0	0.0%
	Cocoyam leaves	3.2%	0.13	375.7	0.7%	Palm oil (red oil)	78.1%	0.01	5720.0	1.6%
	Tomatoes (fresh)	3.0%	1.12	52.0	5.6%	Carrot	1.3%	0.11	713.3	0.3%
	Plantain (green)	2.0%	1.03	43.0	3.5%	Cocoyam leaves	3.2%	0.13	375.7	0.7%
	Palm kernel oil	1.5%	0.01	5720.0	0.0%	Margarine	0.2%	0.14	819.0	0.0%

Note: The grey-shaded columns represent the two ranking variables used to derive top-5 lists of food items for each nutrient.
Source: Authors with data from GLSS7 (2016/17).

The first criterion ranks food items according to their actual share in overall nutrient intake; and the second lists the five cheapest food items based on their prices per nutrient (expressed in pesewas (Gp)). In addition to the two ranking variables, Table 2 also provides for each food item the nutritional content per 100 gr edible portion (Stadlmayr et al. 2012) and its food budget share.

To address calcium deficiency in Ghana, Table 2 indicates that a focus on cassava and its derived products is most warranted as more than 40% of the overall nutrient intake is obtained from this tuber and because we could not find an economically better alternative[2]. Therefore, where calcium production is most deficient and food losses are highest, policies could aim at promoting the cultivation of cassava while improving the efficiency of its food value chain to generate derived products such as *Gari* and *Kokonte*.

For iron and zinc characterized by a similar profile of insufficient production combined with market leakages, the focus should rather be on maize, rice and cowpeas given that these crops are currently providing the majority of overall intake. However, it is worth noting that there are two economically interesting alternatives in the form of millet and sorghum, which have very low nutrient prices for iron and zinc compared to the dominant staple (rice). Indeed, 1 mg of iron is almost 20 (10) times cheaper through the consumption of millet (sorghum) compared to rice, and a similar (but less pronounced) observation could be made for zinc.

To address folate deficiency, the focus should be less on increased production but more on a reduction of losses in food containing this particular nutrient. Based on findings in Table 2, the government should pay attention to the food chain of cowpeas as it accounts for 16% of overall folate intake. As an alternative, households could also consider consuming more cocoyam leaves and groundnuts given their advantageous nutrient price, which is more than 6 times cheaper than rice.

Regarding the demand problems associated with vitamin A and vitamin B12, only a few economically viable alternatives exist given that both top-5 lists contain largely the same food items. For the first nutrient, carrots is a cheap vegetable rich in vitamin A; and for the second, it might be advisable that households consume more canned fish products, such as mackerel and sardines, compared to smoked fish, given the very low nutrient price and despite being perhaps less tasty.

Apart from the changes in food preferences to increase the intake of both vitamins, Table 2 also points to another important nutrition-smart option, which is the consumption of *less* rice. Representing on average (local and imported rice combined) 14% of the food budget, rice is the most dominant food staple in Ghana. By default, the nutritional importance resulting from the consumption of rice mainly stems from its high budget share, rather than from its nutritional density or cheap prices. Indeed, for calcium, zinc and iron we already identified cassava, millet and sorghum as more cost-efficient alternatives, but compared to rice, these alternatives have in most instances lower nutrient prices for calories, proteins and folate as well[3]. Therefore, additional studies are needed to further investigate to what extent Ghanaians might be receptive to changing their daily food bowl in favour of more cassava, millet and sorghum and to reducing their overreliance on rice. In a similar vein, the country should also explore the possibility of smart diets that mix economically viable options with the main staple that is rice.

[2] For this and other nutrients, we do observe however the presence of sweet apple. Though, given its low nutritional density overall, the low nutrient prices are most probably due to an erroneously derived metric price for this particular fruit item.
[3] The latter observations can not all be retrieved from Table 2, but stem from a more detailed inspection of the food budget data.

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The **ReSAKSS Country eAtlases** (RCeA) is a GIS-based mapping tool designed to help policy analysts and policymakers access and use high quality and highly disaggregated data on agricultural, socio-economic and bio-physical indicators to guide agricultural policy and investment decisions.

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This publication has been prepared as a program output for the Voice for Change Partnership Programme. It has not been peer reviewed. Any opinions stated herein are those of the authors and are not necessarily representative of or endorsed by the International Food Policy Research Institute.