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Changes in Food and Nutrition Security in Malawi

Analysis of Recent Survey Evidence

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ABSTRACT

A large proportion of Malawian households are caught in a trap where poverty and food insecurity reinforce one another and where periods of food deficits and severe food crises are frequent occurrences. In recognition of this, the Malawian government has since 2005/06 implemented a large-scale Farm Input Subsidy Program (FISP), which supplies half of smallholder farmers with sufficient fertilizer and maize seeds to satisfy the maize consumption needs of an average-sized family. While the program boosted maize production and lowered maize prices, thus ensuring increased caloric availability at the household level, its effect on overall food consumption, dietary diversity, micronutrient deficiency, and child nutrition is less clear. This study evaluates household expenditure survey data to measure changes in nutrition outcomes between 2004/05 and 2010/11. While the study is not an evaluation of the nutritional impact of FISP per se, it does shed some light on the possible nutritional effects of the program. The results are disconcerting. For example, we find evidence of rising consumption inequality associated with a rise in extreme poverty and a significant increase in income among the urban non-poor. Although calorie deficiency declined—including among the rural poor, dietary diversity among the rural poor decreased and mineral and vitamin deficiencies increased nationwide, especially in rural areas. The various child nutrition indicators reveal mixed results. For example, chronic child malnutrition declined substantially, whereas acute malnutrition increased. The study also highlights several concerns related to data quality and inconsistencies in estimated changes in food and nutrition indicators when compared to results from alternative datasets.

Keywords: Agriculture, dietary diversity, farm input subsidy program (FISP), food security, mineral and vitamin deficiency, nutrition, Malawi, Sub-Saharan Africa.

1. INTRODUCTION

More than half of Malawi's population is classified as poor, and the vast majority of the poor make a living out of subsistence-oriented agricultural activities. The poor are most vulnerable to chronic and transitory food insecurity because of a limited capacity to cope with natural and economic shocks and a lack of resources to acquire the food needed to meet nutritional requirements. Food insecurity and malnutrition, in turn, deepen poverty through its effects on health and individual productivity, and because food insecure households may be forced to sell productive assets during periods of food deficits (Harrigan 2008).[1] A large proportion of Malawian households are caught in this trap where poverty and food insecurity reinforce one another, and where periods of food shortages (often seasonal) or more severe food crises are frequent occurrences. In the recent past, Malawi suffered from a famine in 2002 and a severe food crisis in 2005 (Denning et al. 2009; Ellis and Manda 2012; Menon 2007).

In the absence of subsidies, Malawian farm households have historically been unable to produce a sufficient surplus of staple food during good rainfall years to cover for food shortages during drought years. This is an important contributing factor to vulnerability and food insecurity in Malawi. Low and variable agricultural production has also been linked to the fact that production systems remain largely rain-fed, production technologies are primitive, landholdings are small, and poor smallholders are generally unable to purchase costly modern agricultural inputs required to raise productivity. In recognition of this, the Malawian government has provided free or subsidized inputs to boost food production since the 1990s. While the different input programs prior to 2005 have varied in terms of size and scope, Malawi was only able to produce a surplus of the staple crop maize in years when the programs were universally targeted (Harrigan 2008).[2] To prevent future food crises, the Malawian government launched the Farm Input Subsidy Program (FISP) during the 2005/06 cropping season. FISP targets more than 60 percent of all smallholders in Malawi (more than 1.5 million beneficiary households) and provides about three times more inputs per beneficiary than did earlier input programs. However, FISP comes at a considerable cost; it accounts for about 70 percent of the total agricultural budget, and, while it

1 "Poverty is pronounced deprivation in well-being […]. It includes low incomes and the inability to acquire the basic goods and services necessary for survival with dignity" (World Bank 2012, adapted from Haughton and Khandker 2009). Food security is a situation "when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996). Malnutrition is generally defined as a chronic condition which is a consequence of over- or under-consumption of any or several essential macro- or micronutrients relative to the individual physiological and pathological requirements. Four forms of malnutrition can be distinguished: Protein-energy (or protein-calorie) malnutrition, micronutrient malnutrition (that is, dietary mineral and vitamin deficiencies), secondary malnutrition (that is, malnutrition primarily caused by illness or disease), and over-nutrition (Mayer 1976). This paper is concerned with the first three forms of malnutrition that lead to a state of under-nutrition.

2 The most comprehensive subsidy program since the Drought Recovery Inputs Project during the 1992/93 cropping season was the Starter Pack during the 1998/99 and 1999/2000 cropping seasons. The Starter Pack distributed maize seed and fertilizer sufficient for about 0.1 hectares of land to 2.8 million beneficiaries. A scaled-down Targeted Input Program (TIP) reached about 1.5 million beneficiaries in the 2000/01 and 2001/02 cropping seasons. An "extended" TIP was implemented in 2002 in response to the food crisis, reaching 2.8 million beneficiaries in the 2002/03 cropping season. For the 2003/04 cropping season, the TIP was once again scaled back to 1.7 million beneficiaries, while a near-universal TIP was implemented at the last-minute for the 2004/05 cropping season, which was in an election year.

has not necessarily displaced other agricultural programs that were previously in place (World Bank 2013), its size does limit the government's ability to expand activities in new areas (Douillet et al. 2012; Dorward and Chirwa 2011; 2012).

Although FISP includes legume components and has subsidized tobacco production in the past, it was primarily designed to boost maize production among smallholder farmers, particularly the poor. Maize is Malawi's dominant staple food and is cultivated by virtually all subsistence farmers. Since poverty, food insecurity, and malnutrition are particularly widespread among the rural poor, FISP bestows benefits to a large proportion of the poor in the form of increased production for home consumption or sales. Inputs supplied under the program—including 100 kilogram (kg) fertilizer and between 7.5 and 10 kg hybrid maize seed—are sufficient to cultivate around 0.33–0.50 hectares (ha) of land at recommended input application rates (e.g., Benson 1999). Even at moderate maize yield levels, this is sufficient to satisfy an average household's maize needs.[3] Non-targeted households may also benefit indirectly from an increased supply of maize at reduced prices. FISP ultimately may free up resources for households to produce or to purchase more micronutrient-rich foods, such as animal products, pulses, and vegetables and fruits, and to meet non-food needs critical for people's nutritional status, such as hygiene products and health care.

Indeed, at least some analyses have found evidence that FISP beneficiaries tend to allocate less land to maize and to cultivate a more diverse range of crops (Holden and Lunduka 2010), even though overall crop diversification may have declined over time (Kankwamba et al. 2012). This suggests that the program could improve household dietary diversity and reduce micronutrient deficiencies, even though it principally targets a calorie-laden staple crop. Official statistics show that maize production almost tripled in the first two years of the FISP (MOAFS 2010), although more realistic evidence suggests production increases of around 800,000 metric tons (mt) (Carr 2014). FISP is also believed to have had some important economywide effects, contributing to an average annual gross domestic product (GDP) growth rate in excess of seven percent during 2005–2011 (GoM 2012; NSO 2012b).

The recently released third Integrated Household Survey (IHS3)—carried out in 2010/11 (NSO 2012a)—now provides us with an opportunity to consider, ex post, how Malawi's food security and nutrition situation has changed since 2004/05 when the previous household survey (IHS2) was conducted (NSO 2005). The main objective of this paper is to document changes in food security and nutrition between the two surveys. We also explore, in a very preliminary manner, whether these changes can be explained by the FISP, although a full impact assessment is beyond the scope of the study. In our analysis we use a comprehensive set of food security and nutrition indicators, including household expenditure and poverty, food consumption and dietary diversity, nutritional adequacy, and nutrition outcome indicators.

The paper is structured as follows. The next section describes the food security and nutrition indicators and the underlying datasets used in our analysis. The third section discusses the results of the analysis. The fourth section summarizes the main findings and concludes by outlining areas for future research.

2. METHODOLOGY AND DATA

Our analysis uses data from the second and third Integrated Household Surveys (IHS), carried out in 2004/05—shortly before the introduction of FISP—and 2010/11—five years after its implementation, respectively. The IHS2 and IHS3 sample designs and household questionnaires are identical for the variables used in the analysis, which allows for comparisons of representative estimates over time. The analysis provides estimates of various food security and nutrition indicators in levels, prevalence rates of insufficiencies, and changes over time at the national level, for urban and rural areas, and by rural region. Four classes of food security and nutrition indicators are analyzed: (1) household expenditure indicators as a proxy for household income, welfare, and monetary poverty indicators, which capture households' economic access to food; (2) food consumption and dietary diversity indicators, which provide information about the quantitative food composition of household diets and diet quality; (3) calorie and micronutrient consumption levels and deficiencies, which indicate the nutritional composition of household diets and the nutritional adequacy of diets relative to thresholds of minimum nutritional requirements for a healthy life; and (4) anthropometric nutritional status and deprivation indicators for young children, which measure the biophysical outcome of nutrient intake and absorption as well as the impact of diseases affecting child growth (Table 1).

[3] At a moderate yield of two metric tons per hectare (mt/ha), a FISP beneficiary household can produce up to 666 kg of maize on 0.33 ha land. With daily maize demand of around 381 gram (g) per capita and day (Ecker and Qaim 2011), the average household (4.6 persons) needs 640 kg per annum. The daily demand could loosely be interpreted as a "calorie requirement" in the sense that this is how much maize is needed every day, given the share of total calories obtained from maize in a typical Malawian diet.

Table 1—Overview of food security and nutrition indicators

Indicator class	Level indicator [unit of measurement]	Insufficiency prevalence indicator [%]
Expenditure & poverty	Total expenditure per capita [MK/day]	Poverty rate
	Food expenditure per capita [MK/day]	Extreme (or food) poverty rate
	Food group expenditure per capita [MK/day]	
Food consumption & dietary diversity	Food consumption per capita [g/day]	
	Household Food Variety Score (HFVS) [food items/week]	
	Household Dietary Diversity Score (HDDS) [food groups/week]	
	Micronutrient-sensitive HDDS (MsHDDS) [food groups/week]	
Nutritional adequacy	Calorie consumption per capita [kcal/day]	Calorie deficiency rate
	Iron consumption per capita [mg/day]	Iron deficiency rate
	Zinc consumption per capita [mg/day]	Zinc deficiency rate
	Vitamin A consumption per capita [RE mcg/day]	Vitamin A deficiency rate
	Folate consumption per capita [DFE mcg/day]	Folate deficiency rate
Nutrition outcome	Child height-for-age z-score (HAZ)	Child stunting or severe stunting rate
	Child weight-for-height z-score (WHZ)	Child wasting rate
	Child weight-for-age z-score (WAZ)	Child underweight rate

Source: Authors' representation.

Note: MK = Malawi Kwacha; g = grams, mg = milligrams, mcg = micrograms; kcal = kilocalories; RE = retinol equivalent, DFE = dietary folate equivalent.

2.1. Food consumption data and food conversion factors

The food security indicators—the first two classes in the table above—are derived entirely from data in the IHS food consumption module, with the exception of the total expenditure and poverty indicators, which also incorporate data from non-food consumption modules. The food consumption module reports household food purchases and consumption over seven days prior to the interview, covering more than 120 individual food items by expenditure or quantities. Food quantities are decomposed by source, i.e., purchased foods, own-production, and food received in-kind or donated. Each entry requires specification of the measurement unit from a list of 23 metric and non-metric units, including an "other" category.[4] Expenditures are reported for purchased foods only. In order to estimate household food and nutrient consumption, food quantities recorded in non-metric units must first be converted into metric units. The unit list includes 16 non-metric units of which the large majority are volume-based units requiring item-specific conversion factors. This is due to the fact that products differ in terms of their mass volume densities. In the IHS3 dataset, only about one-fifth of food items are reported in metric units, i.e., the vast majority of quantities are reported in volume- or count-based units, such as pails, plates, or bunches. A new feature in the IHS3 is to further distinguish several of the non-metric units by size, e.g., small, medium, and large, or heaped and flattened.

The Malawi National Statistical Office (NSO) and World Bank's Living Standard Measurement Study (LSMS) team conducted a survey in 48 retail markets across Malawi to measure actual weights of common food items typically traded in non-metric units (NSO and World Bank 2013). Results were published in the form of average weight conversion factors for Malawi's regions (north, center, and south). Unfortunately, a considerable share of non-metric units—17.8 percent of non-metric unit observations—were not surveyed. Moreover, comparisons of unit conversion factors and food and nutrient consumption levels and deficiency rates from the IHS2 and IHS3 data strongly suggest that the conversion factors for some units and subunits derived from the IHS3 market survey are implausible. Therefore, to obtain more credible food and nutrient consumption estimates, we construct a new complete set of food conversion factors for application to the IHS3 raw dataset. Our final conversion factors are food item-specific and are generated in a methodologically consistent manner, utilizing information from various sources which we combined in a systematic way. The applied methodology is described in detail in the Appendix.[5]

EXPENDITURE AND POVERTY INDICATORS

In this paper, we report trends in per capita household expenditure and trends in poverty based on Beck et al. (2014). Their estimates of food consumption are based on the conversion factors used in this study. Beck et al. (2014) adopt a refined method for estimating poverty by estimating regional poverty lines that are utility-consistent over space and time. In sharp contrast to the official estimates, which show a marginal rise in rural poverty between 2004/05 and 2010/11

[4] See Table A1 of the Appendix.

[5] The complete set of conversion factors can be obtained from the authors upon request.

(NSO 2012), Beck et al. (2014) estimate a significant decline in rural poverty. However, consistent with official estimates, they find that extreme rural poverty has increased. We therefore also report official poverty estimates for comparison purposes.

FOOD CONSUMPTION AND DIETARY DIVERSITY INDICATORS

In addition to estimates of total household expenditure and food consumption expenditure per capita, we report estimates of per capita food consumption quantities for five groups and 22 subgroups. Since food consumption data are reported at the household level, intra-household food allocation patterns are unknown. We thus assume that food is distributed equally among household members according to the relative physiological nutrient requirements of each individual household member. Moreover, food consumption recalls generally capture the total food amount entering the household, not all of which is actually consumed by the household members. Some proportions might be discarded, fed to animals, or served to guests or hired workers. We therefore use the term food (and nutrition) "consumption" rather than "intake", as the latter exclusively denotes food quantities actually ingested (by the individual).

We also report estimates of three dietary diversity indicators. The most common dietary diversity indicators include the Household Food Variety Score (HFVS)—sometimes also referred to as Household Dietary Diversity Index—and the Household Dietary Diversity Score (HDDS). The HFVS counts the number of food items that the household consumed during the seven-day recall period, and the HDDS the number of different food groups. The HDDS was developed by the Food and Nutrition Technical Assistance (FANTA) Project of the United States Agency of International Development (USAID) and has a maximum score of 12 food groups (Swindale and Bilinsky 2006a; 2006b). These food groups are cereals; roots and tubers; pulses/legumes and nuts; vegetables; fruits; meat (including offal) and poultry; fish and seafood; eggs; milk and dairy products; oil and fats; sugar, honey, and sweets; and miscellaneous, including condiments.

In addition to the HDDS, we create a micronutrient-sensitive HDDS (hereafter MsHDDS) that splits the group of vegetables in the HDDS into dark green leafy vegetables, vitamin A-rich (red/orange/yellow) vegetables, and other vegetables; the group of fruits into vitamin A-rich fruits and other fruits; and the group of meat into red meat and white meat (that is, mainly poultry). This adds up to a total number of 16 different food groups in the MsHDDS. This disaggregation serves to better account for the large differences in the bioavailable micronutrient contents between these groups and the combination of these food groups in meals. We calculate these dietary diversity scores for both IHS2 and IHS3. The HFVS for 2010/11 is estimated using the same method applied by Ecker and Qaim (2011).

NUTRITIONAL ADEQUACY INDICATORS

The nutritional adequacy indicators capture two dimensions of nutrition, namely dietary energy (calorie) adequacy and micronutrient adequacy.[6] Dietary energy is obtained mainly through starchy staple food consumption, while micronutrients are obtained mainly through the consumption of meat, fish, eggs, dairy products, pulses, vegetables, and fruits. We consider four key micronutrients, namely iron, zinc, vitamin A, and folate. We provide estimates of per capita calorie and micronutrient consumption levels and prevalence rates of calorie and micronutrient deficiencies. For reasons of comparability with the IHS2 estimates by Ecker and Qaim (2011), we apply their calculation approach to the IHS3 food consumption data, as follows: First, (some) reported food quantities are adjusted to subtract non-edible portions, e.g., cobs for maize and peels, skin or pits for certain vegetables and fruits. Next, food quantities are converted into calorie and micronutrient amounts using food composition tables from the World Food Dietary Assessment System (FAO 2010) and aggregated at the household level on a per-capita basis. Finally, household calorie and micronutrient consumption levels are related to age- and sex-specific calorie and micronutrient requirement levels to estimate the prevalence rates of deficiencies. The threshold levels are based on individual requirement levels available from FAO et al. (2001) and WHO and FAO (2004, 2006).

We drop from our analytical sample households with biologically implausible calorie consumption levels. We apply lower- and upper-bound cutoff levels of 200 kilocalories (kcal) and 8,000 kcal per capita per day. Note that food records in food consumption recalls of standard household surveys—like the IHSs—are not itemized for individual meals, so that adjustments for the bioavailability of micronutrients due to the combination of different foods in meals cannot be made. Hence, our assumptions on meal-dependent bioavailability have to be based on common dietary patterns. For iron and zinc absorption where issues of bioavailability are of particular concern we assume low meal-dependent bioavailability, because staple food crops are the major source of these minerals in typical Malawian diets.

[6] This study looks at *dietary* micronutrient deficiencies. Micronutrient deficiencies can also occur as a result of disease, despite an individual having sufficient micronutrient intake. Data on individual health status in the IHSs are insufficient to capture disease-caused micronutrient malnutrition.

NUTRITION OUTCOME INDICATORS

The nutrition outcome indicators—the last indicator class in Table 1—measure the nutritional status of children aged 6-59 months. They are derived from individual anthropometric data recorded in the child anthropometry module of the IHS household survey. We calculate child height-for-age z-scores (HAZ), weight-for-height z-scores (WHZ), and weight-for-age z-scores (WAZ) from the IHS2 and IHS3 datasets using a Stata® command developed by Leroy (2011). The command applies the World Health Organization's Child Growth Standards released in 2006 (WHO 2006). We drop implausible HAZ, WHZ, and WAZ observations from the samples individually. The World Health Organization (WHO) defines the plausible range of the z-scores as $-6 \leq HAZ \leq 6$; $-5 \leq WHZ \leq 5$; and $-6 \leq WAZ \leq 5$.

Conventionally, z-score values are also used for identifying child malnutrition. A child is defined as stunted (i.e., too short for her age) if her $HAZ < -2$, and as severely stunted if her $HAZ < -3$. She is considered to be wasted (i.e., too light for her height) if her $WHZ < -2$, and severely wasted if her $WHZ < -3$. She is classified as underweight (i.e., too light for her age) if her $WAZ < -2$, and severely underweight if her $WAZ < -3$. Stunting indicates chronic malnutrition; wasting indicates acute malnutrition; and underweight is a result of stunting and/or wasting.

3. RESULTS AND DISCUSSION

3.1. Household expenditure and poverty

During the first two years of implementation of the FISP (2005/06 and 2006/07), maize productivity growth was a significant driver of agricultural GDP growth, which in turn contributed significantly to a national GDP growth rate of 6.2 percent per annum (Pauw and Thurlow 2014). In the following years (2007–2011), as maize yields reached a plateau, agricultural GDP growth slowed down, but national GDP continued to expand at 7.5 percent per annum thanks to strong growth in private services and the mining and industry sectors. Although a structural shift in the sources of GDP growth is evident, agricultural GDP still contributed 34.2 percent to overall growth during 2005–2011, which averaged 7.1 percent per annum (Pauw and Thurlow 2014), with FISP credited as a major contributor to Malawi's success (GOM 2012).

Given population growth of around 3.3 percent per annum and GDP growth of 7.1 percent, GDP per capita increased annually at 3.8 percent according to national accounts data. Per capita household expenditures estimated by Beck et al. (2014)—our preferred proxy indicator of household income—suggest a more conservative per capita expenditure growth estimate of 2.6 percent per annum between 2004/05 and 2010/11 (Table 2). The estimates in Table 2 also show how household expenditure growth was unequally distributed, benefiting mostly urban households and the richest quintile in particular. The poorest quintiles in both urban and rural areas experienced a decline in household expenditure over this period. Weak expenditure growth in rural areas, especially among poorer households, is somewhat surprising considering the purported contribution of FISP to national economic growth and its design to target poor smallholder farmers. Per capita expenditure growth varies somewhat across regions, with households in the rural north and rural south experiencing no growth, while a moderate increase was observed for rural households in the central region. Table 2 also reports changes in food expenditure, again based on the estimates by Beck et al. (2014). At the national level, the change in per capita food expenditure is similar to the change in total expenditure—2.7 percent per annum—although further analysis is required to determine whether this change reflects changes in food prices or diet quality, the quantity of food consumed, or shifts in preferences.

The estimates are population-weighted and based on the full samples with 11,280 households (9,840 in rural areas with 1,440 in the Northern, 3,840 in the Central, and 4,560 in the Southern region, and 1,440 in urban areas) in the IHS2 (2004/05) and 12,270 households (10,037 in rural areas with 1,758 in the Northern, 3,484 in the Central, and 4,795 in the Southern region, and 2,233 in urban areas) in the IHS3 (2010/11). All expenditure estimates are reported at 2004/05 price levels. The 2010/11 estimates are adjusted for inflation using the price deflators calculated by Beck et al. (2014).

Table 2—Per capita expenditure by expenditure quintile, residence, and region

	Total expenditure (MK/day)		Annual change (%)	Food expenditure (MK/day)		Annual change (%)
	2004/05	2010/11		2004/05	2010/11	
Total	**79.8**	**93.3**	**2.6**	**40.1**	**47.0**	**2.7**
Poorest quintile	23.4	21.9	*-1.1*	13.2	13.3	*0.2*
2nd	37.5	38.7	*0.5*	20.7	23.2	*1.9*
3rd	52.8	58.5	*1.7*	28.7	33.5	*2.6*
4th	77.6	88.9	*2.3*	40.7	49.3	*3.2*
Richest quintile	208.0	258.7	*3.7*	97.1	115.7	*3.0*
Residence						
Rural	69.7	73.6	0.9	38.0	42.0	1.7
Poorest quintile	23.3	21.9	*-1.1*	13.1	13.4	*0.3*
2nd	37.4	38.6	*0.5*	20.7	23.3	*2.0*
3rd	52.7	58.4	*1.7*	28.9	34.2	*2.9*
4th	77.6	88.4	*2.2*	41.1	50.5	*3.5*
Richest quintile	180.7	206.9	*2.3*	99.0	113.7	*2.3*
Urban	158.6	201.8	4.1	56.1	74.4	4.8
Poorest quintile	24.5	22.1	*-1.7*	13.4	11.7	*-2.3*
2nd	38.1	39.2	*0.5*	21.5	22.4	*0.7*
3rd	53.6	59.1	*1.6*	27.6	28.4	*0.5*
4th	77.7	91.5	*2.8*	38.2	43.5	*2.2*
Richest quintile	290.5	345.8	*2.9*	91.4	119.0	*4.5*
Rural areas by region						
Northern	64.2	64.9	0.2	38.2	38.1	-0.1
Poorest quintile	22.8	22.4	*-0.3*	13.0	13.8	*0.9*
2nd	37.6	38.6	*0.4*	22.8	24.0	*0.8*
3rd	52.4	57.5	*1.6*	31.5	35.7	*2.1*
4th	77.4	88.6	*2.3*	45.4	51.2	*2.0*
Richest quintile	181.4	187.5	*0.6*	108.6	102.7	*-0.9*
Central	78.0	86.9	1.8	40.8	50.0	3.5
Poorest quintile	24.4	21.8	*-1.9*	14.0	13.3	*-0.9*
2nd	37.5	39.2	*0.7*	20.8	23.5	*2.0*
3rd	52.8	58.9	*1.8*	29.2	34.2	*2.7*
4th	77.8	89.0	*2.3*	41.3	50.3	*3.3*
Richest quintile	164.7	214.8	*4.5*	82.3	123.0	*6.9*
Southern	63.3	63.4	0.0	35.4	35.5	0.1
Poorest quintile	23.0	21.8	*-0.9*	12.8	13.4	*0.8*
2nd	37.3	38.2	*0.4*	20.0	23.0	*2.3*
3rd	52.7	58.3	*1.7*	27.9	33.8	*3.3*
4th	77.3	87.5	*2.1*	39.6	50.6	*4.2*
Richest quintile	209.1	198.9	*-0.8*	126.1	100.9	*-3.6*

Source: Authors' calculation based on expenditure and poverty estimates by Beck et al. (2014) from IHS2 and IHS3 data.
Notes: MK = Malawi Kwacha.

Table 3 reports two sets of poverty estimates by NSO (2012a) and by Beck et al. (2014). Again, the latter study adopts a more refined approach to poverty estimation using regional poverty lines that are utility-consistent across space and time. Their poverty results are consistent with the trends in average expenditures (presented in Table 2). Beck et al. (2014) suggest that national poverty declined by 1.0 percentage points per annum between 2004/05 and 2010/11, thanks largely due to rural poverty reduction. Despite relatively high expenditure growth, urban poverty declined less rapidly compared to rural areas—by 0.4 percentage points per annum—partly because of rapid urban inflation. By contrast, the official statistics by NSO (2012a) suggest that poverty had declined only slightly nationwide from 52.4 percent in 2004/05 to 50.7 percent in 2010/11—at an annual rate of 0.3 percentage points, while the reduction is believed to have occurred only in urban areas. In fact, NSO (2012a) reports a slight increase in rural poverty by 0.1 percentage points per annum and a sharp decline in urban poverty by 1.4 percentage points per annum.

Table 3—Poverty and extreme poverty rate by residence and region

	Poverty (%)					
	Beck et al. (2014)			NSO (2012a)		
	2004/05	2010/11	*Annual change*	2004/05	2010/ 11	*Annual change*
Total	**55.2**	**49.0**	***-1.0***	**52.4**	**50.7**	***-0.3***
	(1.0)	(0.9)	*(±0.5)*	(1.0)	(0.9)	*(±0.4)*
Residence						
Rural	57.3	51.3	*-1.0*	55.9	56.6	*0.1*
	(1.0)	(1.0)	(±0.5)	(1.0)	(1.0)	(±0.5)
Urban	38.2	36.0	*-0.4*	25.4	17.3	*-1.4*
	(3.4)	(3.0)	(±1.5)	(2.8)	(2.5)	(±1.3)
Rural areas by region						
Northern	66.1	60.6	*-0.9*	56.3	59.9	*0.6*
	(2.3)	(2.1)	(±1.0)	(2.7)	(2.3)	(±1.2)
Central	49.7	46.0	*-0.6*	46.7	48.7	*0.3*
	(1.6)	(1.6)	(±0.8)	(1.6)	(1.6)	(±0.8)
Southern	62.3	53.6	*-1.4*	64.4	63.3	*-0.2*
	(1.6)	(1.5)	(±0.7)	(1.5)	(1.3)	(±0.7)
	Extreme poverty (%)					
	Beck et al. (2014)			**NSO (2012a)**		
	2004/05	**2010/ 11**	***Annual change***	**2004/05**	**2010/11**	***Annual change***
Total	**16.7**	**18.8**	***0.3***	**22.3**	**24.5**	***0.4***
	(0.7)	(0.7)	(±0.3)	(0.8)	(0.8)	(±0.4)
Residence						
Rural	18.2	21.5	*0.6*	24.2	28.1	*0.6*
	(0.8)	(0.8)	(±0.4)	(0.9)	(0.9)	(±0.4)
Urban	4.7	3.7	*-0.2*	7.5	4.3	*-0.5*
	(1.0)	(0.9)	(±0.4)	(1.4)	(1.0)	(±0.6)
Rural areas by region						
Northern	27.7	26.8	*-0.2*	25.9	29.0	*0.5*
	(2.3)	(2.2)	(±1.1)	(2.4)	(2.1)	(±1.1)
Central	12.1	17.8	*1.0*	16.1	21.5	*0.9*
	(1.0)	(1.1)	(±0.5)	(1.0)	(1.2)	(±0.5)
Southern	21.6	23.5	*0.3*	31.5	34.2	*0.4*
	(1.4)	(1.3)	(±0.6)	(1.5)	(1.4)	(±0.7)

Source: Authors' calculation based on expenditure and poverty estimates by Beck et al. (2014) from IHS2 and IHS3 data and NSO (2012a)

Notes: For (extreme) poverty rates, standard errors are reported in parenthesis; and for changes in (extreme) poverty rates, confidence intervals are reported in parenthesis (indicated by ±). The estimates are based on the full samples of both IHSs.

The NSO (2012a) and Beck et al. (2014) estimates for changes in extreme poverty are more consistent with one another. At the national level, the studies concur that extreme poverty had increased by around 0.3 percentage points per annum, although Beck et al. (2014) estimate the extreme poverty rate to be somewhat lower (their estimate for 2010/11 is 18.8 percent, compared to the 24.5 percent estimate by NSO (2012a)). At subnational level, the differences in the estimates by Beck et al. (2014) and NSO (2012a) are more distinct. For example, Beck et al. (2014) estimate a smaller decline in urban extreme poverty (by 0.2 percentage points per annum) as well as a decline in rural extreme poverty in the Northern region (by 0.2 percentage points per annum) compared to an increase (by 0.5 percentage points per annum) according to the official estimates.

Malawi's growing inequality is reflected in the increase of the country's Gini coefficient. At the national level, the Gini coefficient increased from 0.39 in 2005 to 0.45 in 2011—an increase by 15.4 percent (NSO 2012a). Beck et al.'s (2014) consumption estimates suggest a higher level of inequality, but a smaller increase in the Gini coefficient over time, i.e. from 0.46 to 0.50 (or 9.7 percent).

3.2. Household food consumption and dietary diversity

Changes in food consumption and dietary diversity patterns are largely consistent with those in food expenditure patterns. From 2004/05 to 2010/11, per capita food consumption both in terms of food quantity and in terms of household dietary diversity increased nationwide, and at a higher rate in urban areas than in rural areas (Table 4). Again, there are distinct differences between income quintiles. While the total food quantity and the diversity of the diet increased across almost all income quintiles in urban areas and among the middle-income and rich quintiles in rural areas, both declined among the poor quintiles in rural areas. Dietary diversity declined considerably among the poorest quintiles in all regions, although the food quantity increased among the poorest quintile in the Northern region.

There were also some critical shifts in the composition of the average Malawian diet (Figure 1). From 2004/05 to 2010/11, the per capita consumption of staple foods and animal products increased significantly nationwide, whereas the per capita consumption of pulses and vegetables and fruits declined.[7] The absolute change in maize consumption is substantial: the daily per capita quantity consumed increased by more than 40 grams in urban areas and by more than 60 grams in rural areas. Moreover, interesting substitution effects within the basic food groups occurred.[8] Within staples, the per capita consumption of maize, rice and other cereals, and potatoes increased, whereas cassava consumption declined. Interestingly, despite the FISP and the associated boost in maize availability, maize consumption increased at a significantly lower proportion than the consumption of rice, other cereals, and potatoes nationwide. Even in rural areas, the relative increase in maize consumption is slightly below the relative increase in the consumption of other staples, with the exception of cassava, and similar to the changes in rice consumption.

The per capita consumption of all pulses subgroups declined considerably in rural areas but not so in urban areas, where the total consumption quantity of pulses by urban households increased because of a high increase in the consumption of several pulses other than regular beans. These shifts are concerning and striking, particularly given that FISP has included—albeit inconsistently and at a very limited scale—a legume seed component; hence one would expect an improvement in consumption of pulses by rural households. Within the group of vegetables and fruits, the consumption of only some vegetable but all fruit groups increased nationwide. Within vegetables, the consumption of tomatoes and particularly green leafy vegetables declined considerably, and pumpkin consumption increased. Differences in the shifts of vegetable and fruit consumption patterns between urban and rural areas are rather marginal.

Within the group of animal products, fish consumption—along with the consumption of red meat and especially white meat (mostly poultry) and eggs—increased considerably nationwide, whereas the consumption of milk and dairy products—which are particularly important for child nutrition—declined substantially. These shifts in the consumption patterns of animal products are even more pronounced in rural areas. Overall, the shifts observed in dietary composition patterns between 2004/05 and 2010/11 have important implications for calorie and nutrient consumption and, hence, the prevalence of nutritional deficiencies, as the different foods provide different amounts of dietary energy and nutrients.

[7] See also Table A2 in the Appendix.

[8] See also Table A2-A4 in the Appendix.

Table 4—Changes between 2004/05 and 2010/11 in per capita food consumption and dietary diversity, by expenditure quintile and by residence and region

	Food quantity (g/day)			HFVS (food items/ wk)			HDDS (food groups/ wk; max = 12)			MsHDDS (food groups/ wk; max = 16)		
	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*
Total	***872***	***932***	***6.8***	***14.9***	***15.0***	***1.1***	***7.9***	***8.2***	***3.6***	***9.3***	***9.6***	***3.7***
Poorest	560	538	*-4.0*	10.6	9.9	*-6.7*	6.4	6.3	*-1.5*	7.5	7.3	*-2.3*
2nd	745	756	*1.5*	13.3	13.1	*-1.3*	7.4	7.6	*2.6*	8.7	8.9	*2.6*
3rd	889	935	*5.2*	15.2	15.6	*2.8*	8.1	8.6	*5.6*	9.5	10.1	*5.8*
4th	1,060	1,173	*10.6*	17.1	18.1	*5.7*	8.7	9.4	*7.2*	10.2	11.0	*7.7*
Richest	1,299	1,528	*17.7*	20.6	21.7	*5.1*	9.8	10.3	*5.1*	11.6	12.3	*6.0*
Residence												
Rural	862	903	4.7	14.3	14.2	-0.2	7.7	7.9	2.5	9.1	9.3	2.7
Poorest	548	518	*-5.4*	10.4	9.5	*-8.4*	6.3	6.1	*-3.0*	7.4	7.1	*-3.7*
2nd	735	715	*-2.7*	13.0	12.3	*-5.1*	7.3	7.4	*1.0*	8.6	8.6	*0.6*
3rd	879	902	*2.7*	14.6	14.8	*1.5*	7.9	8.2	*4.1*	9.2	9.7	*4.5*
4th	1,039	1,119	*7.7*	16.6	17.2	*4.1*	8.5	9.0	*6.2*	10.0	10.6	*6.4*
Richest	1,300	1,507	*16.0*	19.1	20.1	*5.3*	9.4	9.8	*4.6*	11.0	11.7	*6.0*
Urban	951	1,089	14.5	19.4	19.3	-0.5	9.6	9.9	3.0	11.2	11.6	3.0
Poorest	657	665	*1.2*	14.2	14.6	*3.5*	7.8	8.3	*6.1*	9.1	9.6	*5.8*
2nd	821	918	*11.9*	17.7	18.1	*1.9*	9.3	9.7	*4.4*	10.7	11.2	*4.2*
3rd	949	1,095	*15.4*	19.4	19.9	*2.6*	10.0	10.3	*3.3*	11.4	12.1	*5.5*
4th	1,080	1,271	*17.7*	21.5	21.7	*0.9*	10.5	10.7	*2.7*	12.3	12.7	*3.5*
Richest	1,372	1,772	*29.2*	26.3	24.8	*-5.6*	11.2	11.2	*0.3*	13.5	13.3	*-1.2*
Rural areas by region												
Northern	748	876	17.1	13.7	14.1	2.7	8.1	8.3	2.1	9.3	9.6	3.2
Poorest	451	563	*24.9*	10.2	9.8	*-4.2*	6.7	6.5	*-2.1*	7.6	7.6	*0.0*
2nd	602	706	*17.3*	12.9	12.7	*-1.0*	7.9	8.1	*2.7*	8.9	9.2	*3.0*
3rd	742	859	*15.8*	14.1	14.7	*4.2*	8.2	8.7	*6.5*	9.5	10.0	*5.5*
4th	908	1,090	*20.1*	15.7	17.0	*8.6*	9.1	9.4	*3.5*	10.4	10.9	*5.0*
Richest	1,241	1,503	*21.1*	17.8	20.0	*12.0*	9.6	9.9	*3.5*	11.0	11.8	*7.1*
Central	881	918	4.2	15.0	14.9	-0.9	7.7	7.9	3.2	9.1	9.4	3.8
Poorest	575	512	*-11.0*	10.8	9.6	*-11.0*	6.1	5.9	*-3.6*	7.3	7.0	*-3.4*
2nd	763	733	*-3.9*	13.6	13.1	*-3.8*	7.2	7.4	*3.2*	8.5	8.8	*3.6*
3rd	909	939	*3.3*	15.5	15.5	*-0.1*	7.9	8.3	*4.8*	9.3	9.8	*5.0*
4th	1,070	1,172	*9.5*	17.7	18.2	*2.8*	8.7	9.1	*5.5*	10.2	10.9	*6.7*
Richest	1,280	1,471	*14.9*	20.0	20.9	*4.4*	9.5	10.0	*4.9*	11.2	11.9	*6.1*
Southern	873	897	2.7	13.7	13.7	-0.2	7.6	7.8	1.7	9.0	9.1	1.3
Poorest	553	505	*-8.7*	10.1	9.3	*-7.9*	6.3	6.1	*-3.0*	7.4	7.0	*-4.8*
2nd	727	713	*-2.0*	12.6	12.1	*-4.5*	7.3	7.2	*-0.3*	8.6	8.5	*-0.9*
3rd	897	904	*0.8*	14.2	14.3	*0.6*	7.9	8.1	*2.4*	9.2	9.5	*2.6*
4th	1,059	1,114	*5.1*	15.9	16.7	*5.0*	8.4	8.9	*5.8*	9.9	10.4	*5.5*
Richest	1,398	1,580	*13.1*	18.4	19.3	*5.1*	9.2	9.6	*4.5*	10.8	11.4	*5.0*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: wk = week; g = gram. The estimates are population-weighted and based on the outlier-cleaned samples with 11,140 households (9,724 in rural areas with 1,427 in the Northern, 3,786 in the Central, and 4,511 in the Southern region, and 1,416 in urban areas) in the IHS2 (2004/05) and 12,015 households (9,858 in rural areas with 1,727 in the Northern, 3,428 in the Central, and 4,703 in the Southern region, and 2,157 in urban areas) in the IHS3 (2010/11).

Figure 1—Graphical representation of changes between 2004/05 and 2010/11 in the food sources of selected nutritional components of the average Malawian diet on a per capita basis

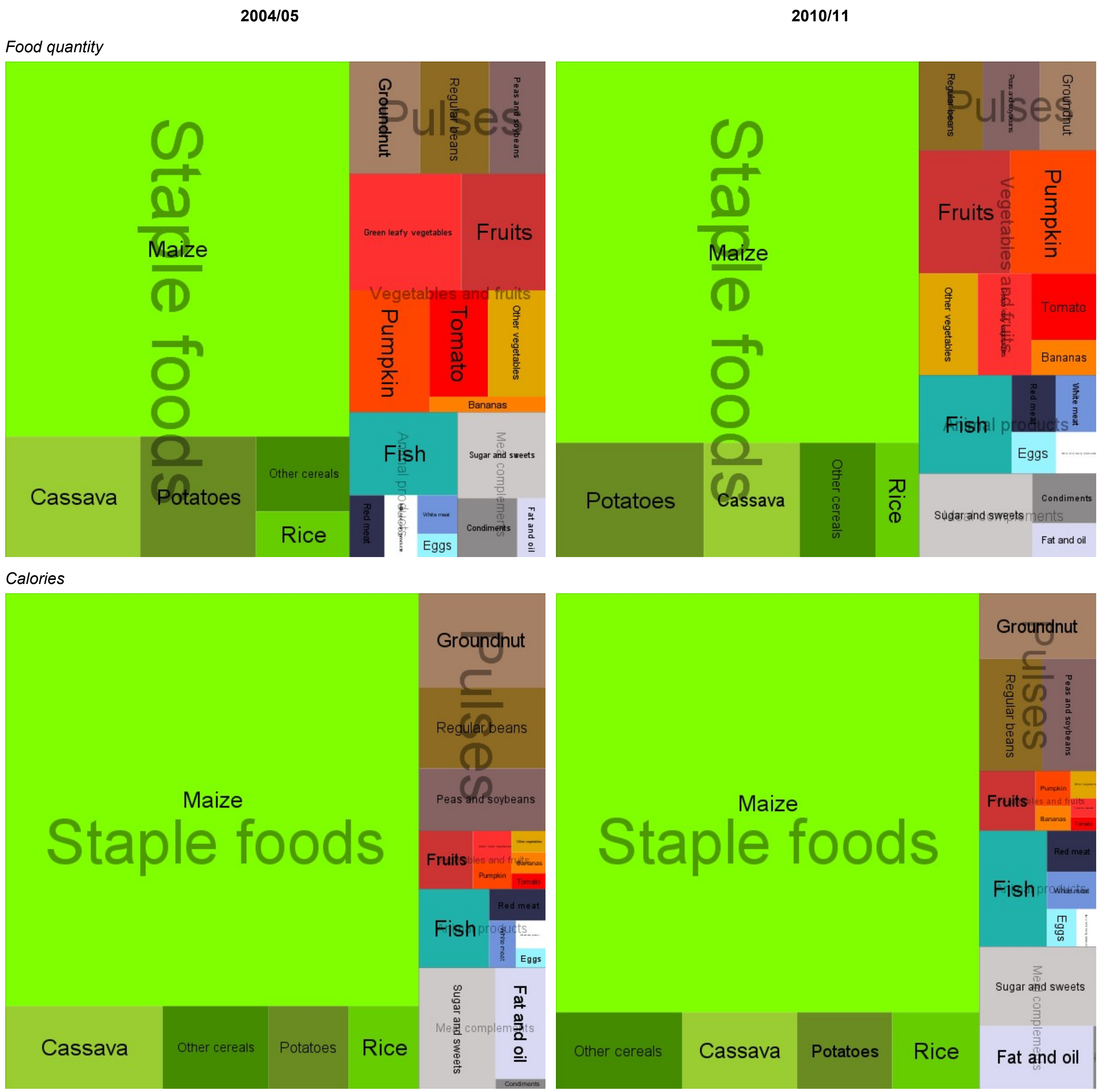


Figure 1—Continued.

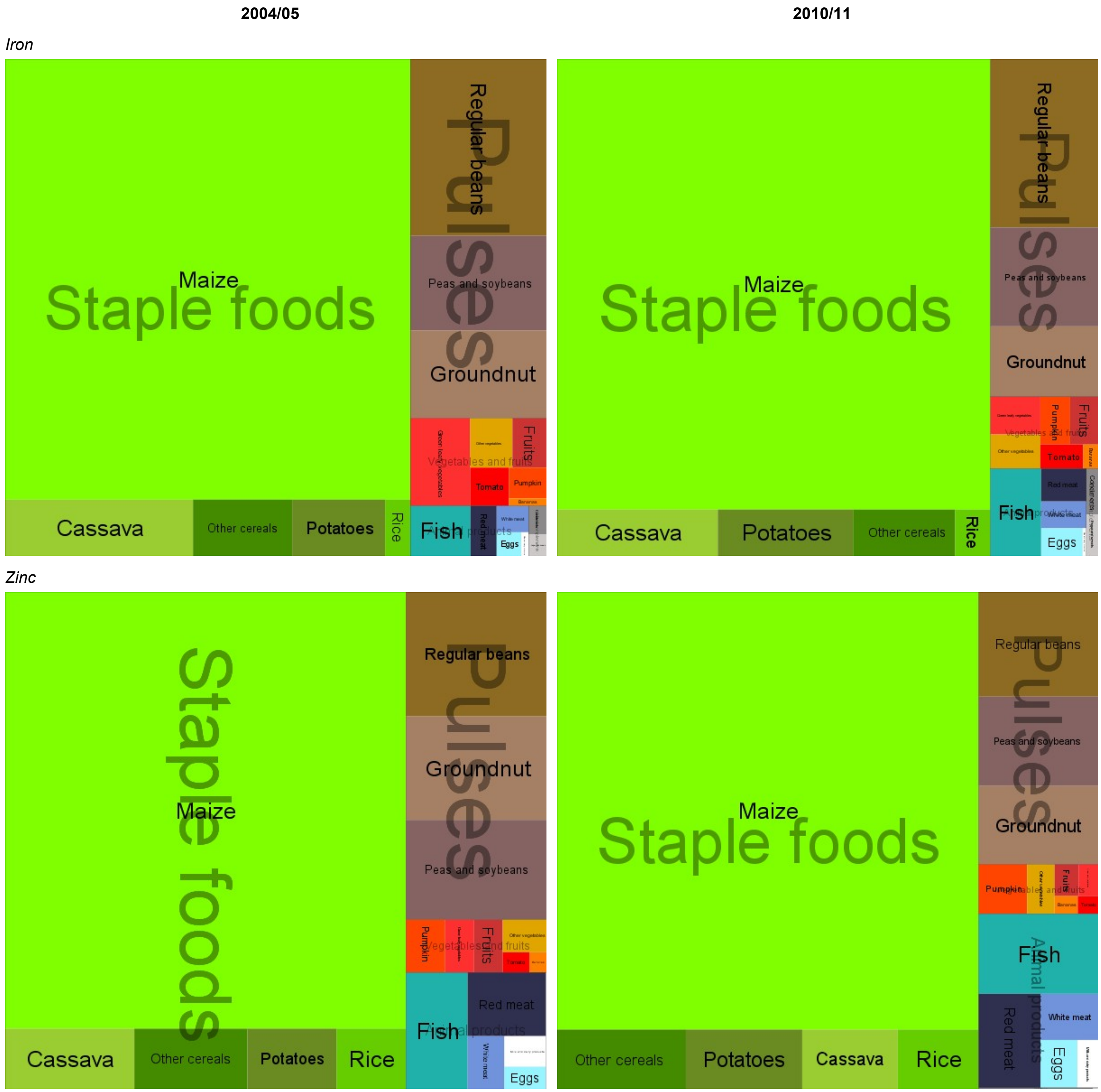


Figure 1—Continued.

Source: Authors' representation based on own estimates from IHS2 and IHS3 data.

Notes: Each entire block represents the composition of the average daily per capita consumption of the specified nutrient. The block is then broken up into sub-blocks for all food groups, while each sub-block corresponds to the proportion of the respective nutrient that was obtained from that food source. Food sub-groups that belong to the same major food group have shades of the same color. The estimates are population-weighted and based on the outlier-cleaned samples with 11,140 households (9,724 in rural areas with 1,427 in the Northern, 3,786 in the Central, and 4,511 in the Southern region, and 1,416 in urban areas) in the IHS2 (2004/05) and 12,015 households (9,858 in rural areas with 1,727 in the Northern, 3,428 in the Central, and 4,703 in the Southern region, and 2,157 in urban areas) in the IHS3 (2010/11).

3.3. Household calorie and micronutrient consumption and deficiencies

Although per capita consumption of food and calories increased across Malawi from 2004/05 to 2010/11, the per capita consumption of key micronutrients (with the exception of zinc) declined overall (Table 5). The patterns of the changes in calorie and micronutrient consumption are similar to the patterns of the changes in food expenditures and food consumption quantities, showing a high increase—or, at worst, only a moderate decline—in the consumption levels among the rich, and a decline—or, at best, only a moderate increase—among the poor, depending on the nutrient considered. Increases—or, at worst, only moderate declines—in calorie and nutrient consumption are observed predominantly among urban households.

In detail, per capita calorie consumption increased across all income quintiles in both rural and urban areas, but the highest increase occurred among the urban rich (Table 5). While the calorie consumption of the richest quintile in urban areas was already well above the recommended calorie consumption amount in 2004/05, it further increased by more than 12 percent until 2010/11, which increased the risk of overweight and obesity and associated diseases even more. Most of the increase in calorie consumption in rural areas occurred in the Northern region, whereas calorie consumption among the rural poor in the Central region declined. Interestingly, while in urban areas changes in iron and zinc consumption seem to have been income-dependent and correlated with changes in calorie consumption, this does not hold true for rural areas. In rural areas, iron and zinc consumption increased only among the poorest income quintile, while it decreased for all other rural income quintiles.

The consumption of vitamin A declined mainly as a result of a reduced consumption of green leafy vegetables, whereas the consumption of folate declined mainly as a result of reduced consumption of pulses (Figure 1). The reduction in vitamin A consumption was larger in rural areas than urban areas, although from a higher 2004/05 consumption amount in rural areas (Table 5). This reduction occurred predominantly in the Southern region, so that the average vitamin A consumption here converges to those in the rural areas of the Northern and Central region. The poorest in both rural and urban areas reduced their vitamin A consumption the most. Also, folate consumption declined by a larger proportion in rural areas than in urban areas, and predominantly in the Central and Southern regions.

Accordingly, the national prevalence rate of calorie deficiency declined moderately from 2004/05 to 2010/11, and the national prevalence rates of iron and zinc deficiency and, especially, of vitamin A and folate deficiency increased (Table 6).[9] Yet, differences in the changes between urban and rural areas and between rural regions are distinct for calories and all micronutrients (except for vitamin A consumption between urban and rural areas).

From 2004/05 to 2010/11, calorie deficiency declined by 0.9 percentage points per annum nationwide (from 39.4 percent to 34.3 percent), by 1.7 percentage points in urban areas (from 30.9 percent to 20.6 percent), and by only 0.6 percentage points in rural areas (from 40.5 percent to 36.7 percent). The rural areas in the Northern region experienced the largest decline in the prevalence of calorie deficiency (4.1 percentage points per annum), followed by those in Southern region (0.5 percentage points), whereas the prevalence of calorie deficiency increased in rural Central region (0.2 percentage points).

The estimates of subnational prevalence rates of calorie deficiency as well as the estimated changes in the prevalence rates are somewhat surprising, when comparing them with the estimates for poverty and particularly extreme poverty from both Beck et al. (2014) and NSO (2012a) (Table 3 and 6). Our estimates of calorie deficiency prevalence rates are more consistent with the poverty rates estimated by Beck et al. (2014) than with those estimated by the NSO (2012a). However, it should be noted that our national and subnational prevalence rates of calorie deficiency are much higher than the respective rates of extreme poverty from both Beck et al. (2014) and NSO (2012a), which may explain some of the rather minor inconsistencies in the comparison of the calorie deficiency rate and extreme poverty rate estimates. As expected, the estimated national and subnational prevalence rates of calorie deficiency are consistently lower than the respective poverty rates estimated by Beck et al. (2014), while NSO (2012a) reports urban poverty rates for 2004/05 and 2010/11 that are significantly lower than the urban prevalence rates of calorie deficiency (and Beck et al.'s (2014) urban poverty rates), which reinforce our doubt in the plausibility of NSO's (2012a) poverty estimates.

[9] Figure A2-A8 in the Appendix maps the prevalence rates of calorie and micronutrient deficiencies by district in 2004/05 and 2010/11.

Table 5—Changes between 2004/05 and 2010/11 in calorie and micronutrient consumption per capita, by expenditure quintile and by residence and region

	Calories (kcal/d)			Iron (mg/d)			Zinc (mg/d)			Vitamin A (RE mcg/d)			Folate (DFE mcg/d)		
	2004/ 05	2010/ 11	Change (%)	2004/ 05	2010/ 11	Change (%)	2004/ 05	2010/ 11	Change (%)	2004/ 05	2010/ 11	Change (%)	2004/ 05	2010/ 11	Change (%)
Total	**2,204**	**2,305**	***4.6***	**20.0**	**19.5**	***-2.5***	**10.8**	**10.8**	***0.6***	**417**	**373**	***-10.6***	**406**	**331**	***-18.7***
Poorest	1,421	1,492	*5.0*	13.8	14.2	*2.5*	7.1	7.4	*4.1*	312	224	*-28.2*	257	199	*-22.3*
2nd	1,890	1,967	*4.1*	17.9	17.9	*-0.3*	9.4	9.6	*1.9*	375	326	*-13.0*	354	283	*-19.9*
3rd	2,243	2,317	*3.3*	20.9	20.1	*-3.8*	11.0	11.0	*-0.7*	433	382	*-11.7*	426	343	*-19.4*
4th	2,693	2,782	*3.3*	24.4	23.0	*-5.9*	13.2	12.9	*-1.9*	463	480	*3.7*	515	421	*-18.4*
Richest	3,252	3,522	*8.3*	26.5	25.7	*-2.7*	15.2	15.4	*1.5*	566	542	*-4.1*	565	489	*-13.4*
Residence															
Rural	2,176	2,232	2.6	20.2	19.5	-3.5	10.8	10.7	-1.0	420	375	-10.7	414	330	-20.4
Poorest	1,387	1,441	*3.9*	13.5	13.8	*1.8*	7.0	7.2	*3.1*	304	219	*-27.9*	251	192	*-23.4*
2nd	1,857	1,895	*2.1*	17.8	17.4	*-2.0*	9.3	9.3	*0.0*	379	303	*-20.0*	349	267	*-23.6*
3rd	2,211	2,245	*1.6*	20.9	20.0	*-4.1*	11.0	10.8	*-1.9*	427	392	*-8.2*	429	337	*-21.3*
4th	2,632	2,642	*0.4*	24.3	22.6	*-7.3*	13.1	12.5	*-4.3*	467	468	*0.1*	516	414	*-19.8*
Richest	3,269	3,431	*5.0*	28.5	27.2	*-4.6*	15.9	15.7	*-0.9*	592	586	*-1.0*	620	522	*-15.9*
Urban	2,423	2,704	11.6	18.4	19.5	6.3	10.5	11.6	10.4	393	360	-8.5	347	335	-3.5
Poorest	1,712	1,838	*7.3*	15.5	15.6	*0.6*	8.0	8.4	*6.0*	350	210	*-40.1*	281	236	*-15.8*
2nd	2,104	2,387	*13.4*	17.6	18.7	*5.8*	9.5	10.6	*11.4*	365	311	*-14.8*	338	308	*-8.8*
3rd	2,457	2,791	*13.6*	19.1	20.5	*7.3*	10.6	12.1	*14.4*	375	392	*4.5*	345	355	*2.9*
4th	2,752	3,157	*14.7*	19.7	21.4	*8.3*	11.6	13.1	*12.9*	446	463	*3.8*	382	375	*-1.7*
Richest	3,385	3,867	*14.2*	21.0	23.6	*12.2*	13.9	15.5	*11.6*	451	503	*11.7*	415	457	*10.0*
Rural areas by region															
Northern	1,784	2,283	28.0	15.2	19.7	29.8	8.2	10.5	28.0	308	316	2.7	334	332	-0.6
Poorest	1,030	1,631	*58.4*	8.7	15.3	*75.1*	4.7	7.9	*68.4*	207	176	*-15.0*	183	210	*15.2*
2nd	1,453	1,967	*35.4*	12.7	17.4	*37.2*	6.8	9.2	*35.1*	244	223	*-8.2*	261	258	*-1.4*
3rd	1,743	2,289	*31.3*	15.5	19.5	*25.6*	8.3	10.4	*25.2*	342	294	*-13.9*	365	323	*-11.4*
4th	2,166	2,730	*26.0*	18.2	22.7	*24.5*	9.8	12.2	*24.3*	355	416	*17.1*	411	415	*1.0*
Richest	3,039	3,458	*13.8*	24.7	28.3	*14.7*	13.9	16.0	*14.8*	455	642	*41.0*	543	594	*9.5*
Central	2,309	2,258	-2.2	21.8	19.8	-9.3	11.6	10.8	-7.1	373	386	3.5	439	325	-25.9
Poorest	1,534	1,441	*-6.1*	15.3	13.8	*-9.5*	7.8	7.2	*-7.9*	249	216	*-13.5*	268	178	*-33.6*
2nd	2,003	1,946	*-2.9*	19.5	17.9	*-7.7*	10.1	9.5	*-6.0*	346	314	*-9.4*	379	269	*-28.9*
3rd	2,394	2,318	*-3.2*	23.0	20.5	*-10.8*	12.1	11.1	*-8.2*	381	398	*4.5*	473	341	*-27.8*
4th	2,803	2,722	*-2.9*	26.3	23.2	*-11.7*	14.2	12.8	*-9.8*	438	529	*20.7*	556	411	*-26.1*
Richest	3,301	3,332	*0.9*	28.6	26.4	*-7.7*	16.1	15.3	*-5.2*	524	567	*8.2*	618	508	*-17.8*
Southern	2,149	2,192	2.0	20.1	19.3	-4.0	10.6	10.6	-0.4	492	382	-22.4	411	333	-18.8
Poorest	1,394	1,402	*0.6*	13.7	13.6	*-1.1*	7.1	7.1	*0.3*	354	221	*-37.6*	254	197	*-22.7*
2nd	1,801	1,817	*0.9*	17.3	16.7	*-3.3*	9.0	9.0	*-0.7*	424	335	*-20.9*	347	270	*-22.0*
3rd	2,237	2,190	*-2.1*	21.2	19.7	*-7.0*	11.2	10.7	*-4.0*	485	431	*-11.2*	434	341	*-21.4*
4th	2,565	2,617	*2.0*	23.5	22.5	*-4.3*	12.5	12.5	*0.2*	564	456	*-19.1*	487	421	*-13.6*
Richest	3,376	3,618	*7.2*	29.7	28.4	*-4.4*	16.3	16.5	*1.7*	759	577	*-24.0*	657	549	*-16.4*

Source: Authors' estimation based on IHS2 and IHS3 data.

Note: d = day, mg = milligrams, mcg = micrograms; kcal = kilocalories; RE = retinol equivalent, DFE = dietary folate equivalent. The estimates are population-weighted and based on the outlier-cleaned samples with 11,140 households (9,724 in rural areas with 1,427 in the Northern, 3,786 in the Central, and 4,511 in the Southern region, and 1,416 in urban areas) in the IHS2 (2004/05) and 12,015 households (9,858 in rural areas with 1,727 in the Northern, 3,428 in the Central, and 4,703 in the Southern region, and 2,157 in urban areas) in the IHS3 (2010/11).

Table 6—Prevalence of calorie and micronutrient deficiencies by residence and region

	Calorie deficiency (%)			Iron deficiency (%)			Zinc deficiency (%)			Vitamin A deficiency (%)			Folate deficiency (%)		
	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*	2004/05	2010/11	*Change (%)*
Total	**39.4**	**34.3**	***-0.9***	**44.1**	**48.6**	***0.8***	**51.3**	**53.4**	***0.3***	**62.0**	**69.9**	***1.3***	**35.1**	**49.5**	***2.4***
Residence															
Rural	40.5	36.7	*-0.6*	42.6	47.7	*0.8*	50.7	54.3	*0.6*	61.8	69.8	*1.3*	34.2	50.2	*2.7*
Urban	30.9	20.6	*-1.7*	55.1	54.0	*-0.2*	56.2	48.2	*-1.3*	63.1	70.8	*1.3*	41.5	45.8	*0.7*
Rural areas by region															
Northern	56.6	32.1	*-4.1*	58.3	46.4	*-2.0*	65.2	54.6	*-1.8*	68.6	75.1	*1.1*	42.2	47.0	*0.8*
Central	34.9	36.3	*0.2*	35.9	46.7	*1.8*	43.2	52.7	*1.6*	65.8	68.5	*0.4*	31.6	51.7	*3.3*
Southern	41.7	38.6	*-0.5*	45.0	49.0	*0.7*	54.1	55.8	*0.3*	56.4	69.4	*2.2*	34.7	49.8	*2.5*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: The estimates are population-weighted and based on the outlier-cleaned samples with 11,140 households (9,724 in rural areas with 1,427 in the Northern, 3,786 in the Central, and 4,511 in the Southern region, and 1,416 in urban areas) in the IHS2 (2004/05) and 12,015 households (9,858 in rural areas with 1,727 in the Northern, 3,428 in the Central, and 4,703 in the Southern region, and 2,157 in urban areas) in the IHS3 (2010/11)

Generally, one would expect the calorie deficiency rate and the extreme poverty rate to be closely associated across space and time, since calorie-deficient ("hungry") people are typically extremely poor, so that a higher proportion of calorie-deficient people also means a higher proportion of extremely poor people. Another reason relates to the measurement of extreme poverty, which is based on household food expenditures relative to a poverty lined defined as an expenditure level needed to acquire a minimum diet (NSO 2012a). To avoid a feeling of hunger, people tend to satisfy their calorie needs first before diversifying their diet into higher-value micronutrient rich foods (Headey and Ecker 2013). However, as mentioned above, the prevalence rate of calorie deficiency in rural areas in Malawi declined significantly during 2004/05 and 2010/11 (by 0.6 percentage points per annum), whereas the extreme poverty rate increased significantly (by 0.6 percentage points per annum) (Table 3 and 6). Yet, at least there is consistency in the directions of the changes in our calorie deficiency rates and in the extreme poverty rates of Beck et al. (2014) in rural areas in the Northern and Central region (but not in the Southern region) as well as in urban areas.

Further inconsistencies are evident when comparing calorie deficiency rates with poverty and extreme poverty rates in rural areas across regions in 2010/11 (Table 3 and 6). In 2010/11, the prevalence of calorie deficiency was lowest in the rural areas of the Northern region, followed by the Central region and then the Southern region. According to Beck et al (2014), rural poverty and extreme poverty were least prevalent in the Central region, followed by the Southern region and then the Northern region. Finally, according to NSO (2012a), rural poverty and extreme poverty were least prevalent in the Central region, followed by the Northern region and then the Southern region. In 2004/05, these prevalence rate patterns were more consistent, at least for calorie deficiency and poverty and extreme poverty estimated by Beck et al. (2014); the prevalence rates were lowest in the Central region, followed by the Southern region and then the Northern region. Whether these inconsistencies are explained by the introduction of the FISP or are simply due to issues in measuring poverty or calorie deficiency is subject to further research.

The changes in the prevalence rates of micronutrient deficiencies are consistent with the shifts in the micronutrient consumption patterns described above. From 2004/05 to 2010/11, the prevalence of iron and zinc deficiency declined in urban areas, but increased in rural areas nationwide (Table 6). Within rural areas, the prevalence of both mineral deficiencies declined only in the Northern region but increased in the Southern region and—at higher rates—in the Central region. The prevalence rate of vitamin A and folate deficiency increased in both urban and rural areas, with vitamin A deficiency rates increasing at similar rates in rural and urban areas and folate deficiency rates increasing at a much higher rate in rural areas. Within rural areas, the prevalence of vitamin A deficiency increased the most in the Southern region (followed by the Northern region and then Central region), and the prevalence of folate deficiency increased the most in the Central region (followed by the Southern region and then Northern region).

3.4. Child malnutrition

The IHS data suggest a sharp reduction in chronic child malnutrition but a slight deterioration in acute child malnutrition between 2004/05 and 2010/11. The average height-for-age z-score (identifying chronic child malnutrition) increased substantially across all income quintiles, within both rural and urban areas, and across all regions (Table 7), indicating a reduction in child stunting. The average weight-for-age z-score (identifying acute malnutrition) declined across all income quintiles nationwide due to the declines in rural areas; it increased across (almost) all income quintiles in urban areas. Accordingly, the prevalence rates of child stunting and severe child stunting dropped nationwide and in both rural and urban areas, while the prevalence rate of wasting increased in rural areas but slightly declined in urban areas (Table 8).[10]

However, we have strong doubts in the reliability of these estimates. For at least three reasons, we believe that the IHS child anthropometry measurements are flawed.

1. In the context of Malawi, it appears quite unusual that the prevalence of chronic child malnutrition dropped at an annual rate of 2.2 percentage points nationwide and at even 2.4 percentage points in rural areas, whereas the prevalence of acute child malnutrition increased at an annual rate of 0.3 percentage points nationwide and in rural areas (Table 8).
2. The IHS2 and IHS3 estimates are inconsistent with estimates from other representative surveys (Table 9). These inconsistencies are most pronounced for the prevalence rate of child stunting estimated from the IHS3 data. The 2010 Demographics and Health Survey (DHS) and the 2009 National Micronutrient Survey (NMS) suggest a national prevalence rate of child stunting of between 47 and 49 percent, while our own estimates indicate a prevalence rate of only about 30 percent in 2010/11. Similarly, our 2004/05 estimate of the prevalence rate of child stunting based on the IHS2 data is about 9 percentage points below the prevalence rates from the 2004/05 DHS and the 2006 Multiple Indicator Cluster Survey (MICS).
3. Finally, we are unable to replicate official estimates of child malnutrition from the IHS3 data. The IHS3 report (NSO 2012a) suggests a prevalence rate of child stunting of about 48 percent in 2011—similar to the DHS- and MICS-based estimates (our estimate is about 30 percent). However, according to the IHS3 report, the prevalence rate of child wasting is two and a half times higher than the DHS- and MICS-based estimates; but our IHS3-based estimate is in the range of the DHS- and MICS-based estimates.[11] We find similar—though less distinct—inconsistencies for the 2004/05 estimates based on the IHS2. Note that we use a consistent method for all our estimates. Moreover, we are able to replicate the published DHS-based estimates (e.g., GOM 2009; NSO & ICF Macro 2011) using the DHS raw data. For the IHS2 and IHS3 data, the inconsistencies are found with all child anthropometric indicators (height-for-age, weight-for-height, and weight-for-age) so that we are unable to identify the possibly flawed variable(s)—height, weight, or age. Identifying the source of these inconsistencies should be a subject of further investigation.

[10] Figure A9-A11 in the Appendix maps the prevalence rates of child stunting, wasting, and underweight by district in 2005 and 2011.

[11] It is also not clear from the IHS3 report (NSO 2012a), which data underlie the estimates. The number of observations, for example, is not reported.

Table 7—Nutritional status of children (6-59 months), by residence and region

	Height-for-age z-score (HAZ)			Weight-for-height z-score (WHZ)			Weight-for-age z-score (WAZ)		
	2004/ 05	2010/ 11	*Change (%)*	2004/ 05	2010/ 11	*Change (%)*	2004/ 05	2010/ 11	*Change (%)*
Total	**-1.82**	**-1.34**	***26.2***	**0.44**	**0.40**	***-9.4***	**-0.73**	**-0.47**	***35.1***
Poorest	-1.80	-1.39	*23.0*	0.36	0.19	*-47.4*	-0.78	-0.64	*18.0*
2nd	-1.93	-1.36	*29.6*	0.41	0.40	*-2.9*	-0.82	-0.51	*38.1*
3rd	-1.80	-1.39	*22.9*	0.47	0.39	*-16.0*	-0.71	-0.52	*26.4*
4th	-1.84	-1.23	*33.1*	0.54	0.40	*-25.1*	-0.67	-0.39	*41.0*
Richest	-1.73	-1.35	*22.1*	0.44	0.65	*48.3*	-0.67	-0.28	*57.7*
Residence									
Rural	*-1.83*	*-1.34*	*26.7*	*0.45*	*0.35*	*-21.7*	*-0.73*	*-0.51*	*30.5*
Poorest	-1.79	-1.39	*22.5*	0.38	0.17	*-55.3*	-0.77	-0.66	*14.0*
2nd	-1.88	-1.35	*28.5*	0.39	0.33	*-15.7*	-0.81	-0.53	*35.0*
3rd	-1.83	-1.35	*26.2*	0.49	0.37	*-23.7*	-0.70	-0.52	*26.4*
4th	-1.86	-1.29	*30.6*	0.52	0.43	*-17.4*	-0.69	-0.44	*35.7*
Richest	-1.80	-1.34	*25.3*	0.47	0.47	*-0.1*	-0.70	-0.40	*43.3*
Urban	*-1.72*	*-1.34*	*22.1*	*0.38*	*0.71*	*84.8*	*-0.70*	*-0.25*	*64.9*
Poorest	-2.04	-1.44	*29.1*	0.36	0.71	*97.3*	-0.98	-0.42	*57.6*
2nd	-1.65	-1.20	*27.5*	0.34	0.33	*-2.6*	-0.69	-0.41	*40.5*
3rd	-1.84	-1.48	*19.5*	0.43	0.70	*61.6*	-0.73	-0.25	*66.2*
4th	-1.81	-1.49	*17.7*	0.40	1.06	*163.1*	-0.70	-0.05	*93.2*
Richest	-1.30	-1.08	*16.6*	0.38	0.83	*116.4*	-0.44	-0.05	*88.6*
Rural areas by region									
Northern	*-1.78*	*-0.71*	*60.2*	*0.45*	*0.18*	*-59.6*	*-0.69*	*-0.28*	*58.9*
Poorest	-2.15	-0.97	*54.8*	0.51	0.12	*-76.1*	-0.84	-0.46	*45.2*
2nd	-1.64	-0.74	*55.0*	0.47	0.12	*-74.3*	-0.60	-0.36	*40.5*
3rd	-1.73	-0.65	*62.1*	0.46	0.27	*-40.9*	-0.64	-0.22	*66.0*
4th	-1.77	-0.57	*68.1*	0.43	0.31	*-26.6*	-0.68	-0.08	*87.9*
Richest	-1.64	-0.58	*64.4*	0.40	0.08	*-78.5*	-0.69	-0.28	*59.8*
Central	*-1.99*	*-1.48*	*25.3*	*0.49*	*0.45*	*-7.7*	*-0.82*	*-0.52*	*36.3*
Poorest	-1.98	-1.60	*19.2*	0.36	0.35	*-1.7*	-0.95	-0.63	*34.2*
2nd	-2.12	-1.53	*27.7*	0.52	0.58	*11.9*	-0.88	-0.54	*38.3*
3rd	-2.02	-1.41	*30.1*	0.56	0.29	*-49.5*	-0.79	-0.61	*23.0*
4th	-1.91	-1.41	*25.9*	0.47	0.44	*-6.2*	-0.74	-0.46	*36.8*
Richest	-1.90	-1.44	*24.1*	0.52	0.60	*15.0*	-0.72	-0.36	*50.9*
Southern	*-1.70*	*-1.40*	*18.0*	*0.42*	*0.31*	*-24.6*	*-0.66*	*-0.56*	*15.1*
Poorest	-1.73	-1.36	*21.4*	0.33	0.07	*-77.8*	-0.70	-0.68	*3.9*
2nd	-1.64	-1.40	*14.9*	0.35	0.15	*-56.5*	-0.71	-0.66	*6.5*
3rd	-1.82	-1.45	*20.4*	0.43	0.41	*-4.6*	-0.72	-0.56	*22.6*
4th	-1.69	-1.48	*12.4*	0.46	0.49	*6.7*	-0.62	-0.48	*22.9*
Richest	-1.63	-1.30	*20.4*	0.50	0.46	*-7.8*	-0.54	-0.41	*24.0*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: The estimates are based on the outlier-cleaned samples. The HAZ estimates are based on 6,610 children (5,916 in rural areas with 946 in the Northern, 2,407 in the Central, and 2,563 in the Southern region, and 694 in urban areas) in the IHS2 (2004/05) and 7,524 children (6,356 in rural areas with 1,139 in the Northern, 2,312 in the Central, and 2,905 in the Southern region, and 1,168 in urban areas) in the IHS3 (2010/11). The WHZ estimates are based on 6,388 children (5,710 in rural areas with 902 in the Northern, 2,385 in the Central, and 2,423 in the Southern region, and 678 in urban areas) in the IHS2 (2004/05) and 7,342 children (6,194 in rural areas with 1,098 in the Northern, 2,255 in the Central, and 2,841 in the Southern region, and 1,148 in urban areas) in the IHS3 (2010/11). The WAZ estimates are based on 6,449 children (5,761 in rural areas with 911 in the Northern, 2,404 in the Central, and 2,446 in the Southern region, and 688 in urban areas) in the IHS2 (2004/05) and 7,490 children (6,312 in rural areas with 1,102 in the Northern, 2,307 in the Central, and 2,903 in the Southern region, and 1,178 in urban areas) in the IHS3 (2010/11).

Table 8—Prevalence of malnutrition among children (6-59 months), by residence and region

	Stunting (%)			Severe stunting (%)			Wasting (%)			Underweight (%)		
	2004/05	2010/11	*Annual Change (%)*	2004/05	2010/11	*Annual Change (%)*	2004/05	2010/11	*Annual Change (%)*	2004/05	2010/11	*Annual Change (%)*
Total	**43.8**	**30.4**	***-2.2***	**19.8**	**13.8**	***-1.0***	**2.1**	**3.6**	***0.3***	**10.9**	**6.4**	***-0.7***
Residence												
Rural	44.2	29.8	*-2.4*	20.2	13.5	*-1.1*	2.1	4.0	*0.3*	11.0	7.0	*-0.7*
Urban	40.3	34.4	*-1.0*	16.9	16.0	*-0.1*	1.8	1.2	*-0.1*	9.8	3.0	*-1.1*
Rural areas by region												
Northern	40.5	11.6	*-4.8*	19.6	1.9	*-2.9*	2.6	2.0	*-0.1*	10.3	1.7	*-1.4*
Central	48.5	37.3	*-1.9*	23.3	17.9	*-0.9*	2.0	4.9	*0.5*	12.7	9.1	*-0.6*
Southern	41.2	28.2	*-2.2*	17.4	12.6	*-0.8*	2.0	3.8	*0.3*	9.4	6.5	*-0.5*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: The child malnutrition estimates are based on the WHO Child Growth Standards (released in 2006) and on the outlier-cleaned IHS samples. The child stunting and severe stunting estimates are based on 6,610 children (5,916 in rural areas with 946 in the Northern, 2,407 in the Central, and 2,563 in the Southern region, and 694 in urban areas) in the IHS2 (2004/05) and 7,524 children (6,356 in rural areas with 1,139 in the Northern, 2,312 in the Central, and 2,905 in the Southern region, and 1,168 in urban areas) in the IHS3 (2010/11). The child wasting estimates are based on 6,388 children (5,710 in rural areas with 902 in the Northern, 2,385 in the Central, and 2,432 in the Southern region, and 678 in urban areas) in the IHS2 (2004/05) and 7,342 children (6,194 in rural areas with 1,098 in the Northern, 2,255 in the Central, and 2,841 in the Southern region, and 1,148 in urban areas) in the IHS3 (2010/11). The child underweight estimates are based on 6,449 children (5,761 in rural areas with 911 in the Northern, 2,404 in the Central, and 2,446 in the Southern region, and 688 in urban areas) in the IHS2 (2004/05) and 7,490 children (6,312 in rural areas with 1,102 in the Northern, 2,307 in the Central, and 2,903 in the Southern region, and 1,178 in urban areas) in the IHS3 (2010/11).

Table 9—Comparison of child malnutrition prevalence rates for Malawi from different representative surveys and sources

Time period	2004 – 2006					2009 – 2011				
Survey	IHS2	IHS2	DHS3	DHS3	MICS3	IHS3	IHS3	DHS4	DHS4	NMS2
Survey year	2004/05	2004/05	2004/05	2004/05	2006	2010/11	2010/11	2010	2010	2009
Child age (months)	6-59	6-59	0-59	0-59	0-59	6-59	6-59	0-59	0-59	0-59
Growth references	WHO	NCHS/ WHO	NCHS/ WHO	WHO	WHO	WHO	WHO	WHO	WHO	WHO
Source	Own esti-mates	NSO (2005)	NSO & ORC Macro (2005)	WHO GDCGM	WHO GDCGM	Own esti-mates	NSO (2012)	NSO & ICF Macro (2011)	WHO GDCGM	GOM (2009)
Stunting										
Total	**43.8**	**43.2**	**47.8**	**52.5**	**53.2**	**30.4**	**48.1**	**47.1**	**47.8**	**48.8**
Rural	44.2	43.2	49.2	53.9	54.7	29.8	48.6	48.2	49.1	50.2
Urban	40.3	41.0	37.8	42.5	44.8	34.3	44.8	40.7	40.6	38.0
Severe stunting										
Total	**19.8**	**17.8**	**22.2**	**27.0**	**26.9**	**13.8**	**14.0**	**19.6**	**20.9**	**17.9**
Rural	20.2	18.2	23.1	28.1	28.0	13.5	13.8	20.3	21.6	18.0
Urban	16.9	12.5	15.8	19.4	20.8	16.0	15.4	15.5	16.8	17.0
Wasting										
Total	**2.1**	**4.6**	**5.2**	**6.3**	**4.2**	**3.6**	**11.4**	**4.0**	**4.1**	**4.9**
Rural	2.1	4.7	5.1	6.9	5.9	4.0	12.0	4.3	4.4	4.9
Urban	1.8	4.8	5.9	6.2	3.8	1.2	7.7	2.4	2.3	4.8
Underweight										
Total	**10.9**	**22.2**	**22.0**	**18.4**	**15.5**	**6.4**	**30.6**	**12.8**	**13.8**	**12.1**
Rural	11.0	22.2	22.8	19.2	15.8	7.0	31.8	13.3	14.3	13.2
Urban	9.8	20.4	16.8	13.1	14.0	3.0	22.9	10.1	11.1	3.9

Source: See table.

Notes IHS = Integrated Household Survey, DHS = Demographics and Health Survey, MICS = Multiple Indicator Cluster Survey, NMS = National Micronutrient Survey; NCHS = National Center for Health Statistics of the United States; WHO = World Health Organization; GDCGM = Global Database on Child Growth and Malnutrition.

Before releasing international child growth standards in 2006, WHO recommended using the child growth standards published by the NCHS. The NCHS growth standards are based on a reference population of North American well-nourished children, whereas the 2006 WHO growth standards are based on reference population of well-nourished children from several countries around the world. Therefore, the comparability of the estimates based on different reference populations is limited.

The IHS2 and IHS3 child malnutrition estimates are based on the outlier-cleaned samples. The child stunting and severe stunting estimates are based on 6,610 children (5,916 in rural areas with 946 in the Northern, 2,407 in the Central, and 2,563 in the Southern region, and 694 in urban areas) in the IHS2 (2004/05) and 7,524 children (6,356 in rural areas with 1,139 in the Northern, 2,312 in the Central, and 2,905 in the Southern region, and 1,168 in urban areas) in the IHS3 (2010/11). The child wasting estimates are based on 6,388 children (5,710 in rural areas with 902 in the Northern, 2,385 in the Central, and 2,432 in the Southern region, and 678 in urban areas) in the IHS2 (2004/05) and 7,342 children (6,194 in rural areas with 1,098 in the Northern, 2,255 in the Central, and 2,841 in the Southern region, and 1,148 in urban areas) in the IHS3 (2010/11). The child underweight estimates are based on 6,449 children (5,761 in rural areas with 911 in the Northern, 2,404 in the Central, and 2,446 in the Southern region, and 688 in urban areas) in the IHS2 (2004/05) and 7,490 children (6,312 in rural areas with 1,102 in the Northern, 2,307 in the Central, and 2,903 in the Southern region, and 1,178 in urban areas) in the IHS3 (2010/11)

4. CONCLUSIONS

In this paper we present estimates of various food security and nutrition indicators for 2010/11 and their changes from 2004/05 based on a new, complete, and consistent set of food conversion factors for the IHS3. Reliable and consistent conversion factors are critical in the estimation of food, calorie, and nutrient consumption levels and deficiency rates, and hence also for the assessment of Malawi's food and nutrition security situation and trends in time.

Our results from the comparative analysis of the IHS2 and IHS3 data suggest that on average between 2004/05 and 2010/11, per capita food and calorie consumption and dietary diversity in Malawi increased nationwide and in both rural and urban areas. However, mean per capita consumption of vitamin A and folate declined in rural and urban areas and mean per capita consumption of iron and zinc declined in rural areas. These changes in average diets are consistent with increased consumption of staples—particularly maize—and reduced consumption of green leafy vegetables, pulses, and milk and dairy products.

Moreover, per capita calorie consumption increased across all income quintiles in both rural and urban areas, although at higher rates among the urban population and the rich in particular. Changes in vitamin A and folate consumption, as well as in iron and zinc consumption in urban areas, show clear income-dependent patterns with (greater) deterioration among the poor and improvement (or smaller deterioration) among the rich and increasing disparity between rural areas and urban areas. In rural areas, there is no clear income-dependent pattern in the changes in iron and zinc consumption, but it is striking that average iron and zinc consumption increased only among the poorest income quintile. A possible explanation is that staple foods—the main providers of these minerals—became more accessible to the rural poor, possibly as a result of FISP. Our results also show that the poor in rural areas suffered from significant reductions in total real income and dietary diversity scores between 2004/05 and 2010/11. Hence, the shift in food consumption from nutrient- to calorie-rich foods among the rural poor is likely part of a coping strategy against falling real incomes. At the other extreme, dietary diversity and nutrient consumption among the urban rich further improved. For some individuals in rich urban households, calorie consumption is in excess and adds to the growing problem of urban obesity. Thus, our analysis suggests growing inequality in food and nutrition security from 2004/05 to 2010/11 that reflects an unequal distribution of gains from economic growth and the dramatic increase in maize production reported in official statistics for that period.

The poor translation of economic growth into a reduction in extreme poverty and improved food and nutrition security, in particular, can be explained by a rapid increase in inequality. In short, the economic growth predominantly benefited the urban rich and bypassed the extreme poor in both urban and rural areas. Other government interventions and policies such as the exchange rate policy during the Bingu wa Mutharika era (2005–2012) also predominantly favored the (urban) non-poor at the expense of the rural farming sector (Pauw et al. 2013). There are also several evaluations of the FISP that show how the rural poor have been largely excluded from the program (see Lunduka et al. (2014) for a review).[12] Our results do not fully support the skeptical evaluation of FISP in some previous studies. In rural areas, calorie consumption increased significantly among the poorest income quintiles, and calorie deficiency declined, despite the decline in total household expenditures among the poorest income quintile. However, dietary diversity declined and micronutrient deficiencies increased. This suggests that substitution effects in food consumption may have indeed contributed to reduce the vulnerability to severe food insecurity, but also contributed to an increased risk of (micronutrient) malnutrition and related health consequences. Importantly, however, this study has not attempted to attribute nutritional outcomes to FISP or other government policies. This is an area for further analysis.

We also find critical inconsistencies in the child nutrition estimates from the child anthropometry records in the IHS3 which require further investigation. Child anthropometrics are extremely important nutrition indicators in the sense that they add a dimension of food and nutrition security that cannot be captured by other available household-level indicators (including intra-household food allocation, individual disease burden, and care provided by adults). Hence, explaining the discrepancies we find is important in order to determine the reliability of the IHS3 child anthropometry measurements and, thus, the quality of future studies using these data.

[12] Which does not necessarily mean that the rural poor did not benefit indirectly from FISP, such as through sharing fertilizer and maize donations within the community.

APPENDIX

Methodology for calculating the new IHS3 food conversion factors

The principle assumption underlying our approach is that IHS3-implicit conversion factors are reliable conversion rates if they are derived from sufficient observations. Naturally, conversion factors for purely metric units and some standard, non-metric count and volume units—including piece, cup, and few standard volume units for processed foods such as cans (tins) of soft drinks and sachets of vegetable oil (whose conversion factors are intuitive or can be directly derived from the United States Department of Agriculture National Nutrient Database for Standard References, USDA-NNDSR)—are trusted, too. The implicit conversion factors for non-metric units serve as benchmark conversion factors against which other conversion factors are compared. Food item- and unit-specific implicit conversion factors are computed as the ratio of the median unit value of the non-metric unit over the median unit value of the metric unit, which is usually kilogram (or liter for drinks). The unit value is the reported expenditure per one unit, which is available for purchased foods only.

We further consider an implicit conversion factor as principally reliable if it is based on at least 50 joint observations of the metric and non-metric unit values (across all sample households). The implicit conversion factors can significantly vary across households due to local or seasonal measurement differences, differences in retailers' marketing practices and container sizes, and so on. We assume that these variations cancel out when averaging at the national level and over the whole survey year (considering that the IHS3 sampling design accounts for spatial and seasonal representativeness). We use median values instead of mean values in order to minimize potential biases due to right hand-side outlier observations.

Before we apply conversion factors, we clean the raw data from the IHS3 food consumption module for any obvious coding errors, correct all obviously miscoded unit entries, and impute missing unit entries by applying a sequential procedure in three steps: First, we correct miscoded units and impute missing units individually for each household, food item, and measurement unit. For example, in several cases the unit for total food quantity consumed is missing or incorrectly specified, but it is available for at least one entry of its quantity breakdown by source and the sum of the quantities by source equals the total food quantity consumed; hence, the unit for the total food quantity consumed should coincide with the unit reported in the quantity breakdown. Second, we reclassify all miscoded units and impute units for unspecified unit entries with the likely unit, implied by correctly specified records of other surveyed households. Third, we delete all remaining miscoded units and impute the likely correct unit using triangulation and conversion factors that are implicit in the IHS3 data or available from other sources as benchmarks.

Our final set of conversion factors are composed of conversion factors from various sources using a food item-specific, iterative replacement procedure in the following order (reflecting declining reliability):

a. Metric unit conversion factors;
b. Conversion factors for standard, non-metric count and volume units that are intuitive or available from the USDA-NNDSR;
c. IHS3-implicit conversion factors, if derived from at least 50 joint observations for the nominator and denominator units;
d. IHS3 market survey conversion factors;
e. IHS2-implicit conversion factors, if derived from at least 50 joint observations for the nominator and denominator units;
f. IHS3-implicit conversion factors derived from less than 50 joint observations, if they are similar to conversion factors from other sources—mainly IHS2-implicit conversion factors and conversion factors used by Ecker and Qaim (2011)—where 'similar' means that the deviation is within a range of 5 percent;
g. Conversion factors used by Ecker and Qaim (2011).

In some cases, one of these steps produces a valid conversion factor for one subunit but not for another subunit of the same unit. To avoid having subunit conversion factors from different sources and potential inconsistencies, we use the inter-unit ratio of the subunit conversion factor to impute the missing subunit conversion factor, instead of proceeding to the next step. This ratio is calculated from the (sub)unit-specific median conversion factors averaged over all food items reported in this unit and subunits (assuming that the used vessels are independent of the sold food items). We apply this subunit imputation at each step by default.

This iterative procedure is consistently applied across all food items and units in the IHS3 dataset, with very few exceptions. The only exceptions include some common staple foods often traded in bulk and measured in pails and plates, such as maize grain, maize flour, and cassava flour. Subunits of pails are small, medium, and large, and subunits of plates are heaped and flattened. The estimated IHS3-implicit conversion factors appear to be systematically biased for the larger subunits due to quantity discount. Therefore, we apply conversion factors instead that are derived based on the common size of pails and plates and the mass volume density of the food items. These are validated by comparisons with conversion factors from other sources.

Moreover, despite such a comprehensive approach, conversion factors for a few food items remain missing. These are foods that are rarely consumed in Malawi. In these few cases, we apply conversion factors for other food items that are similar in their mass volume density.

Table A1—IHS3 food item units and observations

Unit name	Unit code	Subunit code	Observations
Kilogram	1		22,975
50 kg bag	2		81
90 kg bag	3		4
Pail (small), unspecified	4		563
small		4A	5,919
medium		4B	4,359
large		4C	2,358
Pail (large)	5		799
No. 10 plate, unspecified	6		694
flattened		6A	9,730
heaped		6B	9,455
No. 12 plate	7		1,114
Bunch, unspecified	8		422
small		8A	2,912
medium		8B	5,214
large		8C	4,870
Piece, unspecified	9		26,892
small		9A	7,422
medium		9B	10,912
large		9C	6,082
Heap, unspecified	10		2,627
small		10A	8,353
medium		10B	12,597
large		10C	12,846
small*		10D*	806
medium*		10E*	1,405
large*		10F*	949
Bale	11		6
Basket (*dengu*), shelled	12		43
Basket (*dengu*), unshelled	13		44
Ox cart, unshelled	14		4
Liter	15		6,646
Cup	16		3,082
Tin	17		284
Gram	18		10,725
Milliliter	19		4,268
Teaspoon	20		1,024
Basin	21		1,946
Sachet/tube, unspecified	22		1,919
small		22A	742
medium		22B	1,401
large		22C	1,334
Other (specify)	23		1,519
Misspecified/missing			389
Total			**197,736**

Source: IHS3 household survey questionnaire.
Notes: * for small fish only.

Table A2—Composition of the average Malawian diet on a per capita basis (nationwide)

	Quantity (g/d)		Change (%)	Calories (kcal/d)		Change (%)	Iron (mg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	556	626	*13*	1,688	1,807	*7*	15.0	15.6	*4*
Maize	421	482	*14*	1,406	1,528	*9*	13.3	14.2	*7*
Rice	14	17	*23*	48	57	*19*	0.1	0.1	*12*
Other cereals	23	30	*32*	72	83	*16*	0.4	0.3	*-17*
Cassava	53	38	*-28*	107	76	*-30*	0.8	0.5	*-31*
Potatoes	45	59	*29*	55	62	*15*	0.4	0.5	*17*
Pulses	72	55	*-23*	247	179	*-28*	3.6	2.6	*-27*
Regular beans	25	20	*-22*	84	61	*-28*	1.8	1.3	*-26*
Peas and soybeans	21	18	*-14*	65	52	*-20*	1.0	0.8	*-19*
Groundnut	26	17	*-33*	98	66	*-33*	0.9	0.6	*-38*
Vegetables and fruits	152	139	*-9*	61	60	*-1*	0.9	0.6	*-37*
Tomato	20	15	*-26*	4	3	*-31*	0.1	0.1	*-32*
Pumpkin	32	37	*16*	9	11	*24*	0.1	0.1	*20*
Green leafy vegetables	42	19	*-55*	10	4	*-58*	0.4	0.1	*-65*
Other vegetables	20	21	*5*	6	6	*1*	0.2	0.1	*-21*
Bananas	6	8	*35*	6	7	*25*	0.0	0.0	*24*
Fruits	32	39	*23*	26	29	*12*	0.1	0.1	*-23*
Animal products	51	61	*19*	82	116	*42*	0.4	0.6	*39*
Eggs	3	6	*112*	5	10	*102*	0.0	0.1	*92*
Fish	29	32	*9*	46	67	*48*	0.2	0.3	*44*
Red meat	7	9	*23*	15	17	*19*	0.1	0.1	*11*
White meat	5	8	*59*	10	16	*53*	0.1	0.1	*41*
Milk and dairy products	7	6	*-12*	7	6	*-7*	0.0	0.0	*-40*
Meal complements	42	51	*24*	126	143	*14*	0.1	0.1	
Fat and oil	5	7	*39*	46	62	*35*	0.0	0.0	
Sugar and sweets	25	33	*33*	76	80	*5*	0.0	0.0	
Condiments	11	11	*-4*	4	1	*-63*	0.0	0.0	
Total	**872**	**932**	***7***	**2,204**	**2,305**	***5***	**20.0**	**19.5**	***-3***
Standard deviation	467	537	*15*	1,113	1,157	*4*	10.8	9.9	*-8*
Requirement				*1,701*	*1,728*	*2*	*17.2*	*17.5*	*2*

Table A2—Continued.

	Zinc (mg/d)		Change (%)	Vitamin A (RE mcg/d)		Change (%)	Folate (DFE mcg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	8.0	8.4	*6*	40	42		171	168	*-2*
Maize	7.0	7.4	*6*	1	1		139	138	*-1*
Rice	0.2	0.2	*15*	0	0		1	1	*9*
Other cereals	0.3	0.3	*13*	2	1		7	9	*30*
Cassava	0.3	0.2	*-27*	9	8		14	10	*-32*
Potatoes	0.2	0.3	*29*	29	32		10	10	*5*
Pulses	1.8	1.3	*-29*	6	5		155	109	*-29*
Regular beans	0.7	0.5	*-28*	0	0		72	53	*-27*
Peas and soybeans	0.6	0.4	*-23*	6	5		53	41	*-23*
Groundnut	0.6	0.4	*-35*	1	0		29	16	*-46*
Vegetables and fruits	0.3	0.2	*-20*	347	292	*-16*	71	40	*-44*
Tomato	0.0	0.0	*-33*	35	30	*-14*	4	2	*-34*
Pumpkin	0.1	0.1	*17*	49	48	*-4*	5	6	*18*
Green leafy vegetables	0.1	0.0	*-59*	210	129	*-39*	45	15	*-65*
Other vegetables	0.1	0.1	*-4*	13	12	*-6*	6	5	*-16*
Bananas	0.0	0.0	*20*	1	2	*48*	1	2	*26*
Fruits	0.1	0.0	*-49*	38	71	*86*	11	9	*-14*
Animal products	0.7	0.8	*29*	23	33	*44*	9	13	*42*
Eggs	0.0	0.1	*94*	11	22	*99*	2	3	*84*
Fish	0.3	0.4	*34*	6	4	*-38*	6	9	*43*
Red meat	0.2	0.2	*18*	0	0	*29*	0	0	*3*
White meat	0.1	0.1	*38*	2	4	*82*	0	0	*41*
Milk and dairy products	0.1	0.0	*-21*	4	3	*-12*	1	1	*-25*
Meal complements	0.0	0.0		0	0		0	0	
Fat and oil	0.0	0.0		0	0		0	0	
Sugar and sweets	0.0	0.0		0	0		0	0	
Condiments	0.0	0.0		0	0		0	0	
Total	**10.8**	**10.8**	***1***	**417**	**373**	***-11***	**406**	**331**	***-19***
Standard deviation	5.7	5.5	*-5*	593	523	*-12*	321	245	*-24*
Requirement	*9.9*	*10.0*	*2*	*375*	*380*	*1*	*266*	*272*	*2*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: d = day; g = grams, mg = milligrams, mcg = micrograms; kcal = kilocalories; RE = retinol equivalent, DFE = dietary folate equivalent. The estimates are population-weighted and are based on the outlier-cleaned samples with 11,140 households in the IHS2 (2004/05) and 12,015 households in the IHS3 (2010/11).

Table A3—Composition of the average urban Malawian diet on a per capita basis

	Quantity (g/d)		Change (%)	Calories (kcal/d)		Change (%)	Iron (mg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	578	684	*18*	1,745	1,914	*10*	13.9	14.9	*7*
Maize	395	438	*11*	1,345	1,424	*6*	12.4	13.1	*6*
Rice	36	43	*22*	125	148	*19*	0.2	0.3	*16*
Other cereals	45	70	*57*	133	189	*42*	0.4	0.5	*12*
Cassava	41	26	*-36*	64	41	*-36*	0.4	0.3	*-34*
Potatoes	61	106	*74*	78	112	*43*	0.5	0.7	*63*
Pulses	45	53	*19*	155	175	*13*	2.7	2.8	*3*
Regular beans	28	28	*-2*	90	84	*-6*	2.0	1.8	*-6*
Peas and soybeans	6	9	*41*	21	28	*32*	0.3	0.4	*32*
Groundnut	10	17	*64*	44	63	*41*	0.4	0.5	*28*
Vegetables and fruits	160	154	*-4*	61	69	*15*	0.9	0.6	*-30*
Tomato	34	23	*-32*	7	5	*-35*	0.2	0.1	*-34*
Pumpkin	14	20	*51*	3	5	*50*	0.0	0.0	*48*
Green leafy vegetables	49	27	*-44*	10	6	*-47*	0.4	0.1	*-59*
Other vegetables	29	30	*6*	8	9	*6*	0.1	0.1	*-27*
Bananas	8	13	*57*	8	12	*52*	0.0	0.0	*51*
Other fruits	26	39	*49*	24	34	*43*	0.1	0.2	*16*
Animal products	94	113	*21*	158	214	*35*	0.8	1.1	*36*
Eggs	8	14	*62*	13	21	*60*	0.1	0.2	*54*
Fish	4	54	*27*	67	109	*63*	0.3	0.5	*74*
Red meat	16	16	*-3*	37	35	*-6*	0.2	0.2	*-4*
White meat	9	13	*46*	18	25	*40*	0.1	0.1	*27*
Milk and dairy products	18	17	*-4*	24	25	*5*	0.0	0.0	*-47*
Meal complements	75	85	*13*	303	331	*9*	0.2	0.2	
Fat and oil	16	20	*25*	137	170	*24*	0.0	0.0	
Sugar and sweets	46	51	*12*	161	157	*-2*	0.0	0.1	
Condiments	13	13	*3*	5	4	*-11*	0.1	0.2	
Total	**951**	**1,089**	***15***	**2,423**	**2,704**	***12***	**18.4**	**19.5**	***6***
Standard deviation	487	592	*22*	1,094	1,232	*13*	8.2	9.2	*12*
Requirement				*1,744*	*1,779*	*2*	*18.2*	*18.7*	*3*

Table A3—Continued.

	Zinc (mg/d)		Change (%)	Vitamin A (RE mcg/d)		Change (%)	Folate (DFE mcg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	7.8	8.6	*9*	39	54		149	160	*7*
Maize	6.6	6.9	*5*	0	0		112	114	*1*
Rice	0.4	0.5	*18*	0	0		3	3	*12*
Other cereals	0.4	0.6	*44*	0	0		15	22	*43*
Cassava	0.2	0.1	*-37*	6	4		8	5	*-33*
Potatoes	0.3	0.5	*70*	33	49		11	16	*42*
Pulses	1.2	1.3	*6*	2	3		111	108	*-3*
Regular beans	0.8	0.7	*-6*	0	0		82	74	*-10*
Peas and soybeans	0.2	0.2	*15*	2	3		17	20	*17*
Groundnut	0.3	0.4	*32*	0	0		11	13	*18*
Vegetables and fruits	0.3	0.2	*-8*	300	241	*-20*	70	44	*-38*
Tomato	0.0	0.0	*-35*	57	36	*-36*	6	4	*-37*
Pumpkin	0.0	0.0	*51*	22	29	*34*	2	3	*57*
Green leafy vegetables	0.1	0.0	*-47*	179	108	*-40*	44	17	*-61*
Other vegetables	0.1	0.1	*-6*	13	9	*-32*	7	6	*-13*
Bananas	0.0	0.0	*49*	1	2	*50*	2	3	*47*
Other fruits	0.1	0.1	*-1*	28	56	*103*	10	12	*14*
Animal products	1.2	1.5	*26*	52	61	*18*	15	23	*47*
Eggs	0.1	0.1	*57*	31	41	*30*	4	6	*44*
Fish	0.4	0.6	*60*	6	5	*-18*	8	13	*68*
Red meat	0.5	0.4	*-4*	0	0	*36*	1	1	*-11*
White meat	0.1	0.2	*31*	4	6	*35*	0	1	*34*
Milk and dairy products	0.1	0.1	*5*	10	9	*-5*	2	2	*-4*
Meal complements	0.0	0.0		1	1		1	1	
Fat and oil	0.0	0.0		0	0		0	0	
Sugar and sweets	0.0	0.0		0	0		0	0	
Condiments	0.0	0.0		1	1		1	1	
Total	**10.5**	**11.6**	***10***	**393**	**360**	***-9***	**347**	**335**	***-3***
Standard deviation	4.7	5.4	*15*	426	474	*11*	201	188	*-6*
Requirement	*10.0*	*10.2*	*2*	*379*	*387*	*2*	*272*	*281*	*3*

Source: Authors' estimation based on IHS2 and IHS3 data.

Notes: d = day; g = grams, mg = milligrams, mcg = micrograms; kcal = kilocalories; RE = retinol equivalent, DFE = dietary folate equivalent. The estimates are population-weighted and are based on the outlier-cleaned samples with 1,416 urban households in the IHS2 (2004/05) and 2,157 urban households in the IHS3 (2010/11).

Table A4—Composition of the average rural Malawian diet on a per capita basis

	Quantity (g/d)		Change (%)	Calories (kcal/d)		Change (%)	Iron (mg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	553	614	*11*	1,679	1,781	*6*	15.1	15.8	*4*
Maize	423	486	*15*	1,412	1,536	*9*	13.4	14.4	*7*
Rice	11	13	*15*	39	43	*11*	0.1	0.1	*3*
Other cereals	20	24	*18*	65	67	*3*	0.4	0.3	*-22*
Cassava	54	40	*-27*	112	80	*-28*	0.8	0.6	*-30*
Potatoes	44	51	*18*	52	55	*6*	0.4	0.4	*6*
Pulses	75	55	*-27*	258	178	*-31*	3.8	2.6	*-31*
Regular beans	25	18	*-26*	83	57	*-32*	1.8	1.2	*-31*
Peas and soybeans	22	19	*-15*	70	55	*-21*	1.0	0.8	*-20*
Groundnut	28	17	*-37*	105	66	*-37*	1.0	0.6	*-42*
Vegetables and fruits	151	136	*-10*	61	59	*-3*	0.9	0.6	*-38*
Tomato	19	14	*-27*	4	3	*-32*	0.1	0.1	*-34*
Pumpkin	34	39	*15*	9	12	*25*	0.1	0.1	*21*
Green leafy vegetables	42	18	*-58*	10	4	*-60*	0.4	0.1	*-66*
Other vegetables	19	19	*3*	6	6	*-2*	0.2	0.1	*-19*
Bananas	6	7	*27*	6	7	*17*	0.0	0.0	*15*
Other fruits	33	39	*20*	26	28	*8*	0.1	0.1	*-30*
Animal products	46	52	*14*	73	101	*38*	0.4	0.5	*35*
Eggs	2	5	*121*	4	8	*107*	0.0	0.1	*100*
Fish	28	28	*3*	43	61	*41*	0.2	0.3	*35*
Red meat	6	8	*27*	12	15	*22*	0.1	0.1	*12*
White meat	5	7	*58*	9	14	*52*	0.1	0.1	*41*
Milk and dairy products	5	4	*-24*	5	4	*-27*	0.0	0.0	*-41*
Meal complements	38	46	*22*	105	114	*8*	0.1	0.1	
Fat and oil	4	5	*33*	35	45	*29*	0.0	0.0	
Sugar and sweets	22	30	*35*	66	68	*2*	0.0	0.0	
Condiments	11	11	*-6*	4	1	*-73*	0.0	0.0	
Total	**862**	**903**	***5***	**2,176**	**2,232**	***3***	**20.2**	**19.5**	***-4***
Standard deviation	464	521	*12*	1,113	1,127	*1*	11.1	10.0	*-9*
Requirement				*1,695*	*1,718*	*1*	*17.1*	*17.3*	*1*

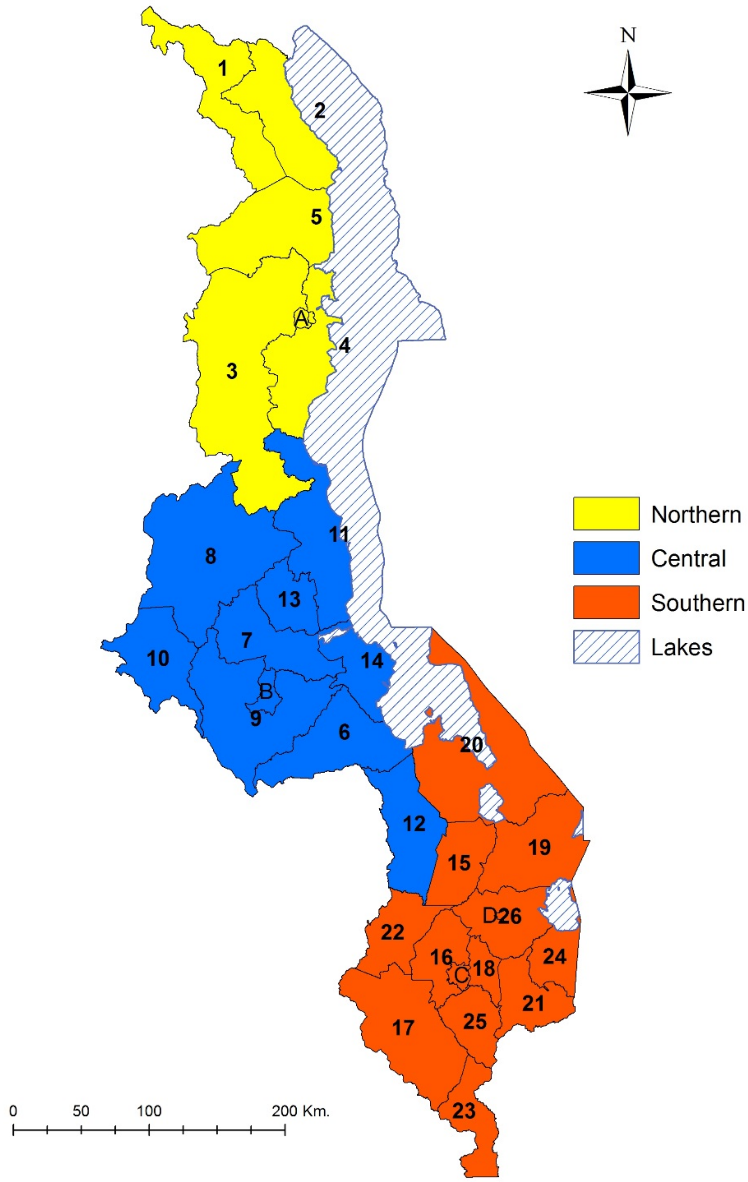
Table A4—Continued.

	Zinc (mg/d)		Change (%)	Vitamin A (RE mcg/d)		Change (%)	Folate (DFE mcg/d)		Change (%)
	2004/05	2010/11		2004/05	2010/11		2004/05	2010/11	
Staple foods	8.0	8.4	*5*	41	40		174	169	-2
Maize	7.1	7.5	*6*	1	1		143	142	*0*
Rice	0.1	0.1	*7*	0	0		1	1	*4*
Other cereals	0.2	0.3	*1*	2	2		6	7	*20*
Cassava	0.3	0.2	*-25*	10	8		15	10	*-31*
Potatoes	0.2	0.2	*19*	28	29		9	9	*-4*
Pulses	1.9	1.3	*-32*	7	5		161	110	*-32*
Regular beans	0.7	0.5	*-32*	0	0		70	49	*-31*
Peas and soybeans	0.6	0.5	*-24*	6	5		59	45	*-23*
Groundnut	0.6	0.4	*-39*	1	0		32	16	*-49*
Vegetables and fruits	0.3	0.2	*-21*	353	301	*-15*	71	39	*-45*
Tomato	0.0	0.0	*-34*	32	29	*-9*	3	2	*-34*
Pumpkin	0.1	0.1	*17*	53	51	*-4*	6	7	*18*
Green leafy vegetables	0.1	0.0	*-61*	214	133	*-38*	44	15	*-66*
Other vegetables	0.1	0.1	*-4*	13	13	*-1*	6	5	*-17*
Bananas	0.0	0.0	*12*	1	1	*46*	1	1	*19*
Other fruits	0.1	0.0	*-57*	39	74	*87*	11	9	*-18*
Animal products	0.6	0.7	*25*	19	28	*46*	8	11	*38*
Eggs	0.0	0.1	*99*	8	18	*123*	1	3	*100*
Fish	0.3	0.3	*26*	6	3	*-42*	6	8	*36*
Red meat	0.2	0.2	*21*	0	0	*30*	0	0	*6*
White meat	0.1	0.1	*37*	2	4	*92*	0	0	*41*
Milk and dairy products	0.0	0.0	*-39*	3	2	*-25*	1	0	*-39*
Meal complements	0.0	0.0		0	0		0	0	
Fat and oil	0.0	0.0		0	0		0	0	
Sugar and sweets	0.0	0.0		0	0		0	0	
Condiments	0.0	0.0		0	0		0	0	
Total	**10.8**	**10.7**	***-1***	**420**	**375**	***-11***	**414**	**330**	***-20***
Standard deviation	5.8	5.5	*-7*	612	532	*-13*	333	254	*-24*
Requirement	*9.9*	*10.0*	*1*	*375*	*379*	*1*	*265*	*270*	*2*

Source: Authors' estimation based on IHS2 and IHS3.

Notes: d = day; g = grams, mg = milligrams, mcg = micrograms; kcal = kilocalories; RE = retinol equivalent, DFE = dietary folate equivalent. The estimates are population-weighted and are based on the outlier-cleaned samples with 9,724 rural households in the IHS2 (2004/05) and 9,858 rural households in the IHS3 (2010/11).

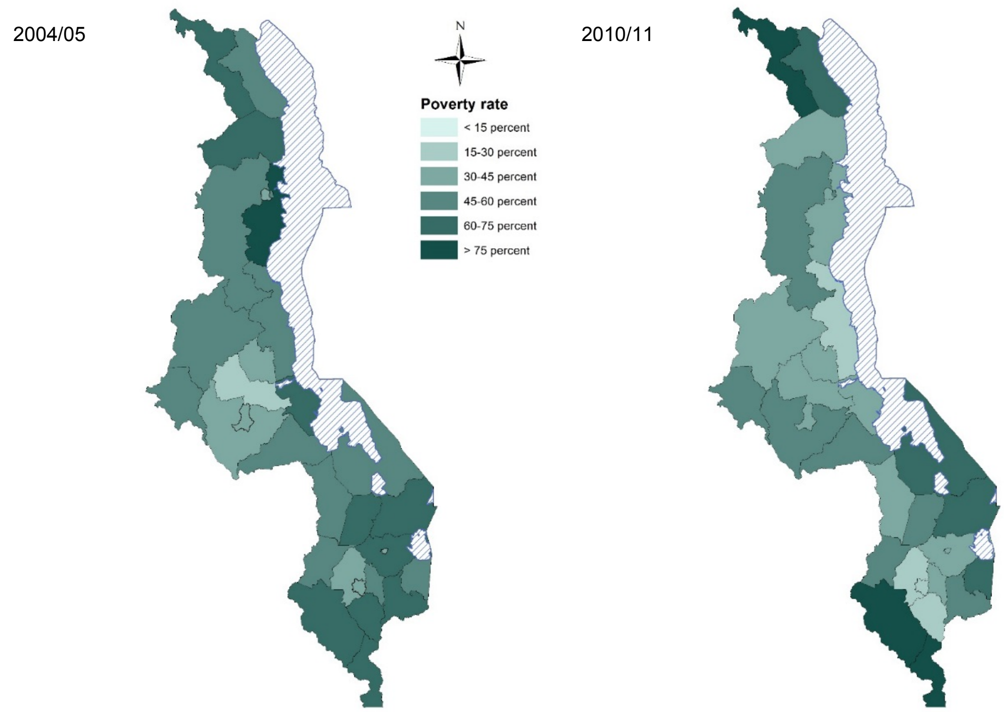
Figure A1—Malawi political map



Source: Own representation.

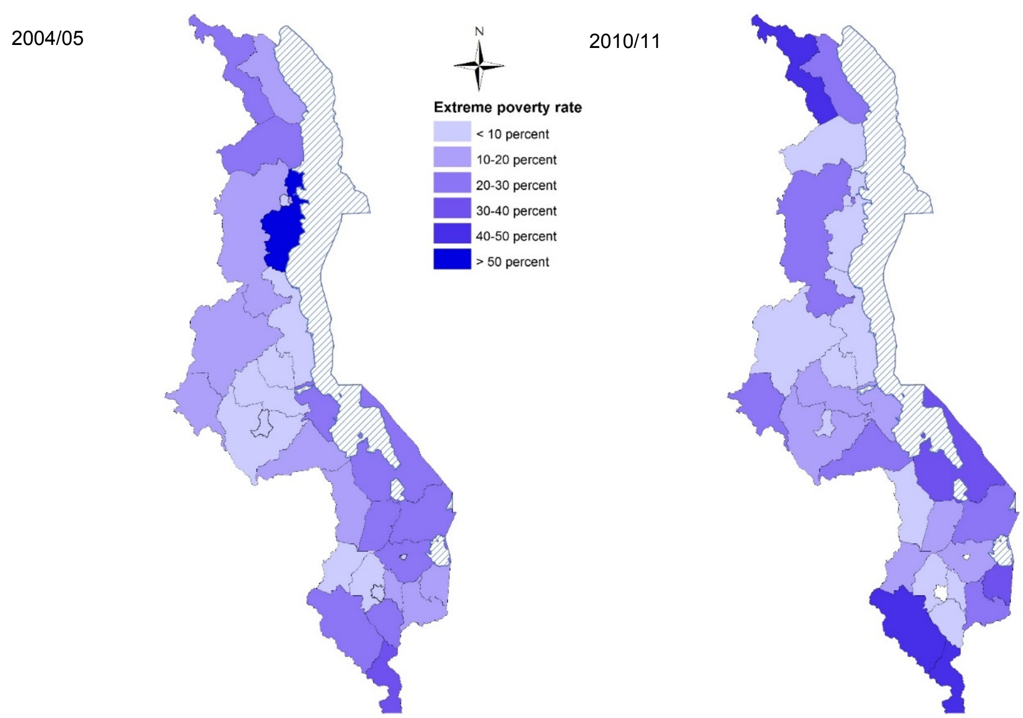
Notes: Districts: Northern region: (1) Chitipa, (2) Karonga, (3) Mzimba, (4) Nkhata Bay, (5) Rumphi; Central region: (6) Dedza, (7) Dowa, (8) Kasungu, (9) Lilongwe, (10) Mchinji, (11) Nkhotakota, (12) Ntcheu, (13) Ntchisi, (14) Salima; Southern region: (15) Balaka, (16) Blantyre, (17) Chikwawa, (18) Chiradzulu, (19) Machinga, (20) Mangochi, (21) Mulanje, (22) Mwanza (incl. Neno), (23) Nsanje, (24) Phalombe, (25) Thyolo, (26) Zomba. Urban areas: (A) Muzu City, (B) Lilongwe City, (C) Blantyre City, (D) Zomba City.

Figure A2—Malawi poverty maps, 2004/05 and 2010/11, by district



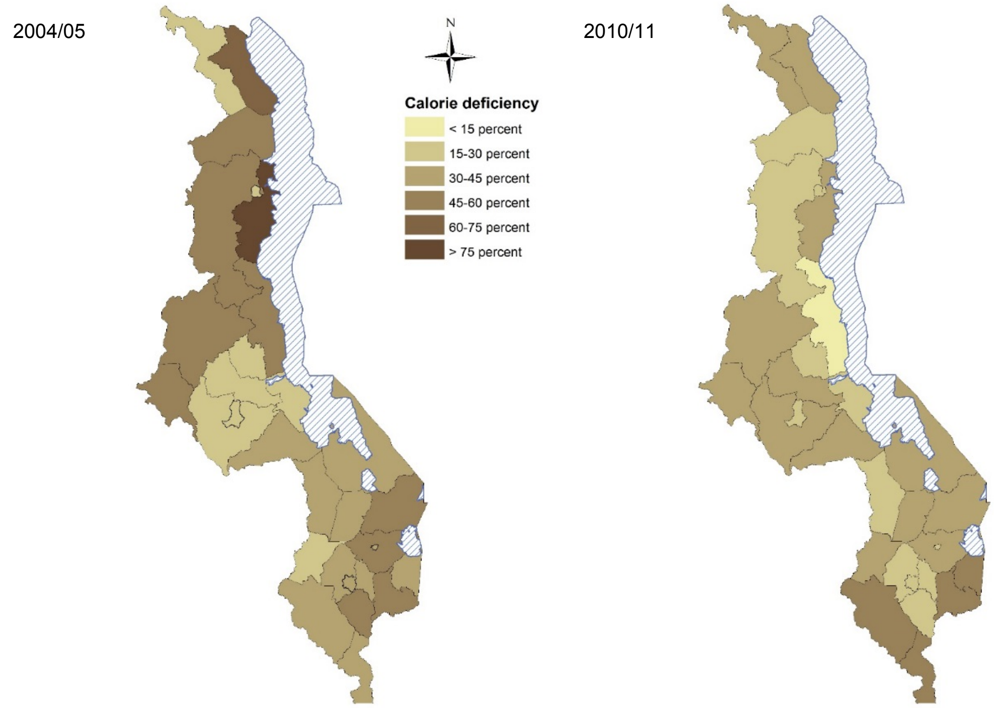
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A3—Malawi extreme poverty maps, 2004/05 and 2010/11, by district



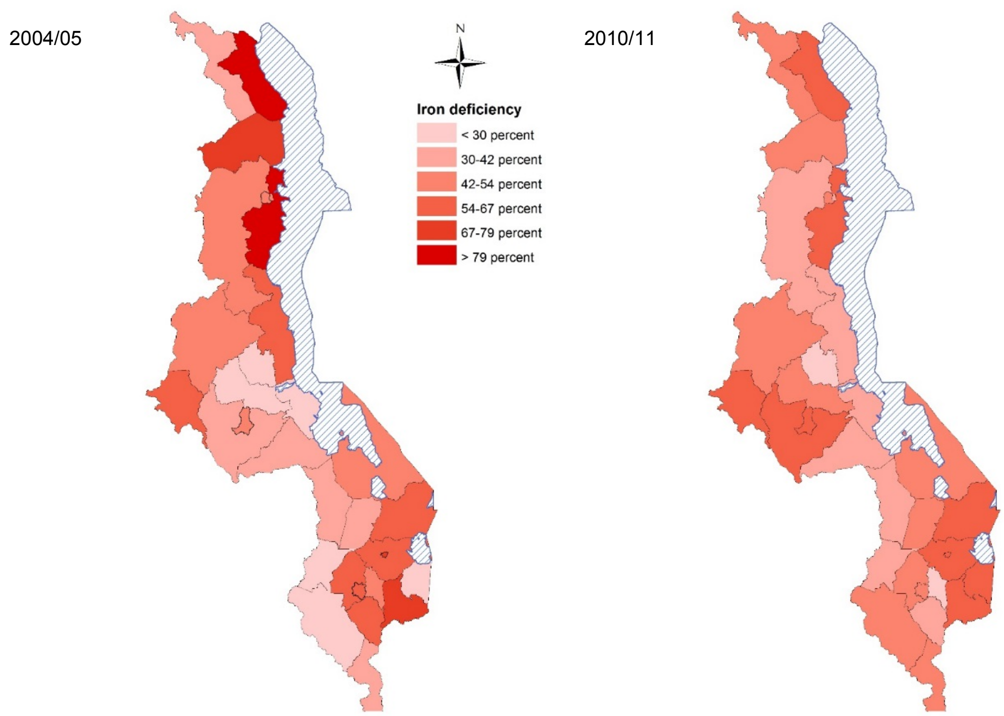
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A4—Malawi calorie deficiency maps, 2004/05 and 2010/11, by district



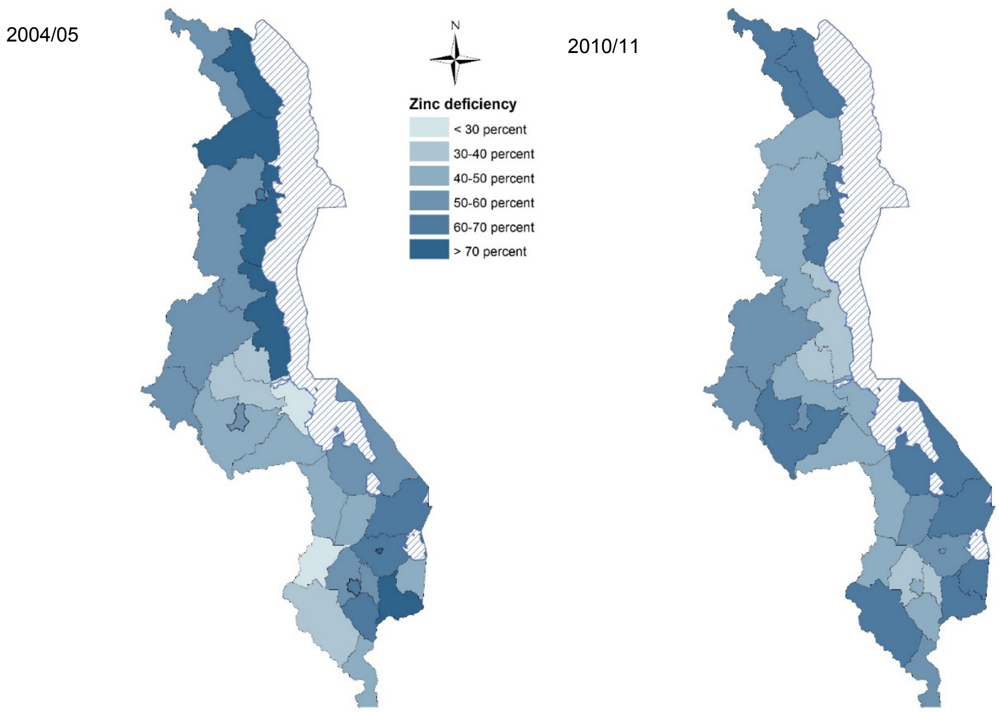
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A5—Malawi iron deficiency maps, 2004/05 and 2010/11, by district



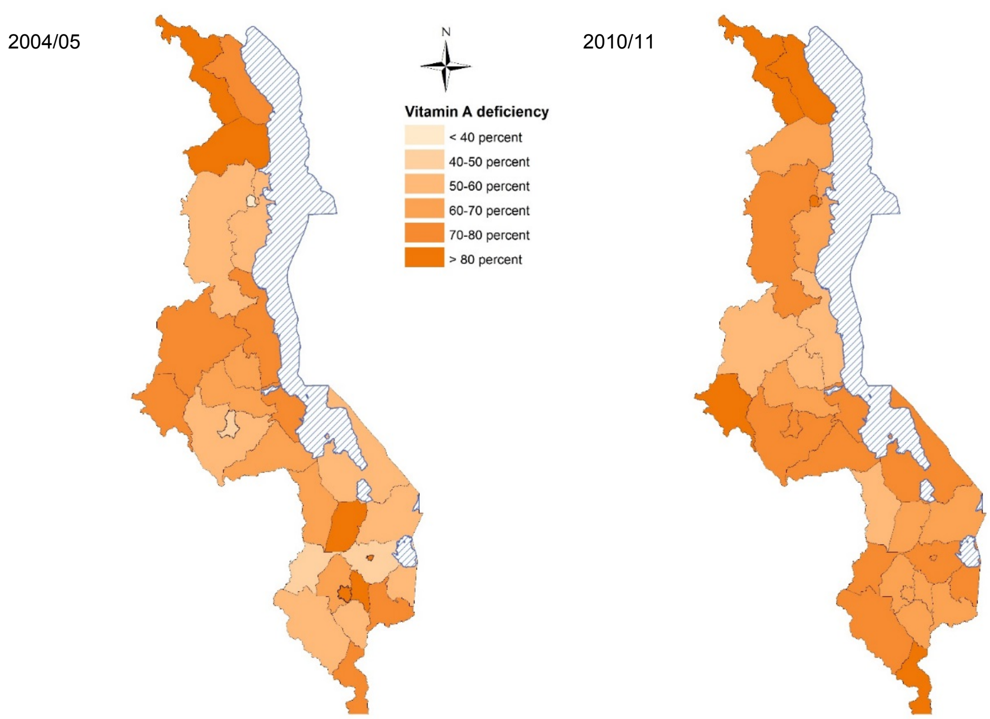
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A6—Malawi zinc deficiency maps, 2004/05 and 2010/11, by district



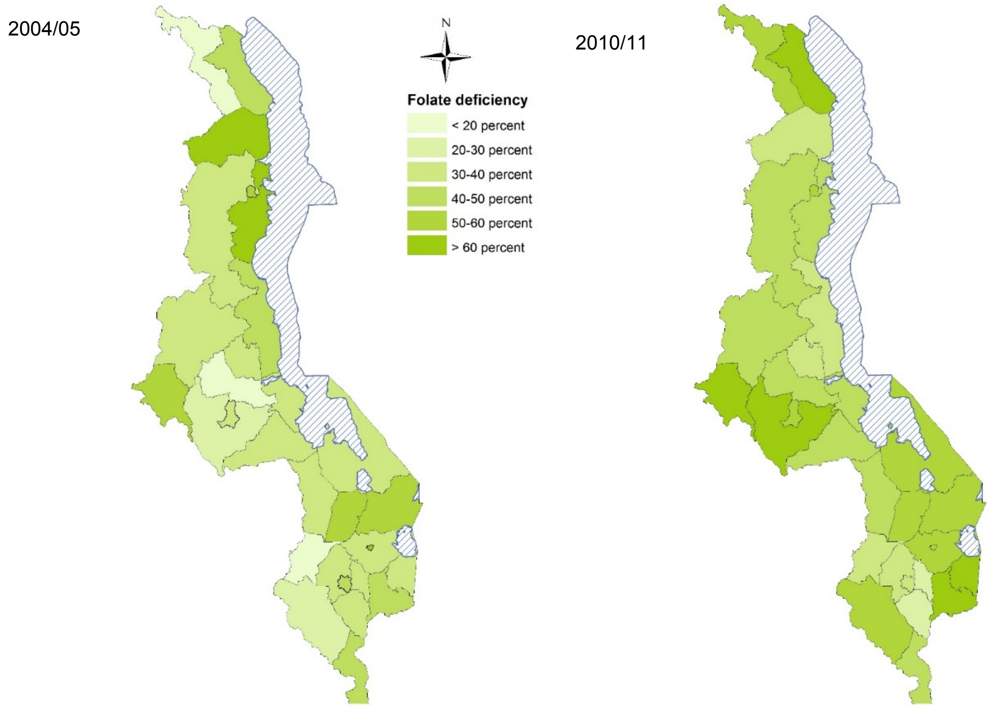
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A7—Malawi vitamin A deficiency maps, 2004/05 and 2010/11, by district



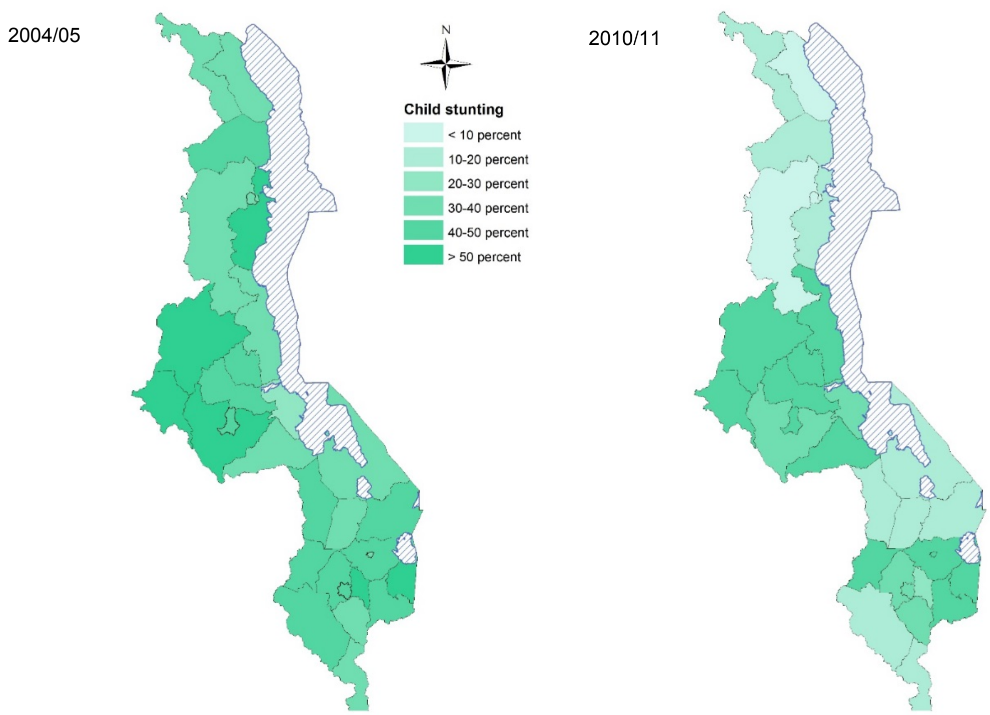
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A8—Malawi folate deficiency maps, 2004/05 and 2010/11, by district



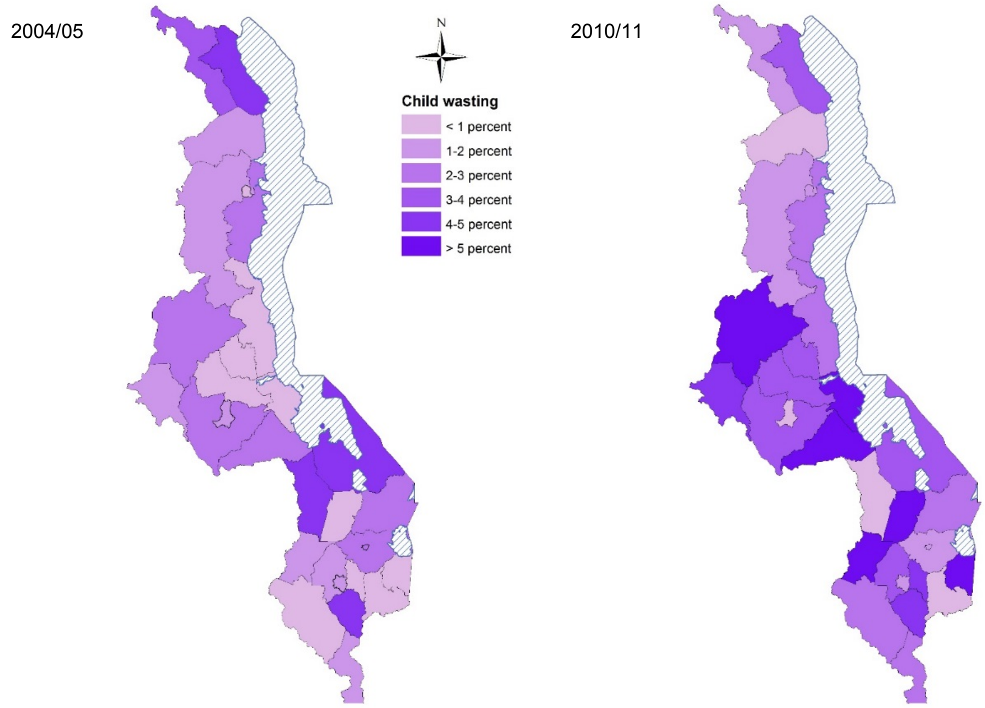
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A9—Child stunting maps, 2004/05 and 2010/11, by district



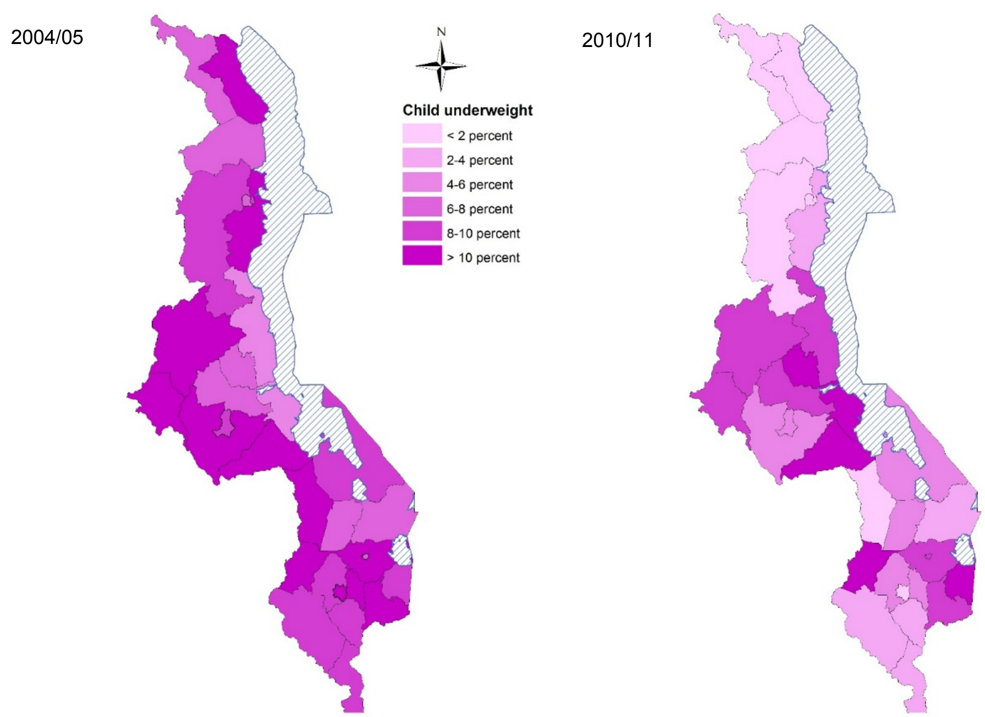
Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A10—Child wasting maps, 2004/05 and 2010/11, by district



Source: Own representation based on own estimates from IHS2 and IHS3 data.

Figure A11—Child underweight maps, 2004/05 and 2010/11, by district



Source: Own representation based on own estimates from IHS2 and IHS3 data.

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