The Role of Price and Consumption Bundle Aggregation in Poverty Measurement: A Reassessment of Poverty in Uganda

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Abstract

Uganda has seen substantial poverty reduction, but reported measures are flawed because the official poverty line is based on a single national food poverty line that was constructed using 1993 data. We use regional consumption patterns to construct poverty lines that account for location specific diets and adjust these poverty lines such that they pass revealed preference tests. In doing so, we estimate poverty in Uganda using the 2005/06 and 2009/10 Uganda National Household Survey and the 2010/11 round of the Uganda National Panel Survey. We find poverty to be higher in general, and reductions in poverty were slower than official figures suggest. We also find that poverty is highest in regions that consume relatively more matooke and maize, while the North seems to enjoy cheap calories, making them less poor than officially reported. However, the figure from the North hides significant heterogeneity, and poverty reduction in the North is very slow.

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1 Introduction

During the past few decades, Uganda has seen substantial economic growth. Since 1986, when the National Resistance Movement (NRM) took over government, real GDP has grown at an annual rate of 6.8, making it one of the fastest growing economies in Africa. This growth has been attributed to the new government that has implemented a far-reaching economic reform agenda, transforming Uganda into one of the most liberal economies in Sub-Saharan Africa. With the liberalization of the exchange and trade regime, the abolition of the Industrial Licensing Act, the promulgation of a new investment code, and the gradual liberalization of agricultural pricing and marketing, the government has put in place some of the essential pre-conditions for sustainable growth.

This growth has been accompanied by equally impressive declines in the levels of poverty as reported by the government. While aggregate headcount poverty stood at about 57 percent in the early 1990s, the most recent estimate puts 24 percent of the population below the official poverty line. But despite these successes at the aggregate level, researchers warn that this growth has not been shared equally by the population at large. Marked spatial heterogeneity in baseline poverty and subsequent poverty reductions mean differences in the standard of living between locations are much higher now than what they used to be. In addition, some argue that the official poverty measures are too high if they are compared to non-monetary indicators and qualitative data from other countries. These observations have raised suspicion about the poverty lines used by the government of Uganda.

In light of this, we will reassess poverty in Uganda paying particular attention to spatial aspects in the construction of poverty lines. Uganda has been using the same Cost of Basic Needs (CBN) basket for over two decades now. In addition, this consumption basket is the same for the entire Ugandan population. However, it is well known that Uganda has an unusually large regional variation in diets within the country, with no less than six major food staples being eaten (Appleton, 2003). For instance, matooke, or cooking bananas, is mainly eaten in the West, and to a lesser extent in Central region. Households living in the dryer North, however, obtain a substantial share of their calories through sorghum and sesame. These diets are not only determined by custom, they are also related to the agro-geological characteristics. For instance, the dryer North is more suited for cassava than matooke, and the low value to weight ratio typical of staple foods essentially renders them

non-tradables. If these different diets result in different costs to obtain basic needs, this should be accommodated in the poverty measures.

More specifically, we will estimate poverty at three distinct points in time during the last decennium in Uganda. To account for differences in consumption patterns, we will construct regional poverty lines. For each of the four regions, we construct a food basket that produces a certain minimum of calories that reflects the diets of the poorest households in that region. These baskets are then multiplied by prices prevailing in that region to come to food poverty lines. An allowance for basic non-food necessities is than added to get four regional poverty lines. We then test these four poverty lines to see if they are utility consistent. The idea is that a basic needs bundle in a certain region A should always be cheaper than a bundle from any other region valued at prices of region A. If a bundle does not satisfy these revealed preference conditions, we use an information theoretic approach to adjust the bundles until they do.

The remainder of this paper is structured as follows. We first give an overview of poverty in the previous millennium and look at the present official poverty estimates. In section 3, we briefly explain the reasoning behind the use of regional poverty lines and the role of revealed preferences when constructing them. Section 4 presents our poverty estimates and compares them to poverty figures found in other studies. Section 5 concludes.

2 Poverty in Uganda - Trends and Controversies

There is a substantial literature on poverty and its dynamics in the 1990s. This is due to the fact that there is relatively high quality data available for this period. Uganda has been conducting national household surveys since 1992, and has conducted six such surveys before the turn of the millennium. Some of these data sets form a panel. The first data set, the Integrated Household Survey conducted in 1992-3 can be linked to the last survey of the millennium, referred to as the first Uganda National Household Survey (UNHS 1999-0). In between these two surveys, a series four Monitoring Surveys (1993-4 up to 1999-0) have been carried out. More information on these data sets can be found in Lawson, Mckay, and Okidi (2006).

Table 1, taken from Appleton (2003), presents official headcount poverty

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Table 1: Official Poverty Headcounts 1992-2000

	1992-3	1993-4	1994-5	1995-6	1997-8	1999-0
national	55.7	51.2	50.2	49.1	44.4	35.1
urban	27.8	21.0	21.5	19.8	16.7	10.1
rural	59.7	55.6	54.3	53.7	48.7	39.0
Central	45.6	34.5	30.3	30.4	27.9	20.1
Eastern	58.5	57.6	65.3	58.4	54.3	37.3
Northern	72.2	69.3	63.5	70.2	59.8	64.8
Western	53.1	53.9	50.9	46.3	42.8	28.0

note: reproduced from Appleton (2003).

rates before the year 2000. As can be seen, poverty decreased substantially, falling by almost 40 percent at the national level. However, this table also shows significant spatial differences in both levels and changes in poverty. The urban areas and Central region reduce poverty fastest. The Northern region, already starting from high levels of poverty, are relatively unsuccessful in bringing down the number of people living below the poverty line. In addition, studies that exploit the panel nature of the data find that in some regions, poverty is particularly persistent (Deininger and Okidi, 2003).

One controversy which we will also address in this paper refers to the fact that the official poverty estimates are based on poverty lines that are rooted in a single consumption bundle. Appleton (2003) and Jamal (1998) argue that Uganda is unusual in that different regions have very different diets. This may not matter very much if the diets are equally cost effective in obtaining basic needs. However, the staple food of choice of a large part of the population, both in the West and the Central region, is matooke, a highly localized staple. Matooke appears to be a very expensive source of calories, compared to what people in for instance the North consume. When they account for this in their analysis, they come to the conclusion that poverty is much more pronounced in the Western region than in the North. Even after correcting for income difference, as regions that consume more expensive calories may do so simply because they have higher incomes, Appleton (2003) come to the conclusion that the Western region overtakes the North as the poorest region using 1993 data.

While the above refers to the nineties, progress in the first decade of the

Table 2: Official poverty headcounts 2002-2010

	2002/03	2005/06	2009/10
national	38.3	31.1	24.5
urban	14.4	13.7	9.1
rural	42.7	34.2	27.2
Central	22.3	16.4	10.7
Eastern	46.0	35.9	24.3
Northern	63.0	60.7	46.2
Western	32.9	20.5	21.8

new millennium is equally impressive. Table 2 shows that poverty at the national level kept falling at the same rate. At the same time, differential progress in poverty reduction in different regions leads to higher poverty differences between regions by 2009/10. For instance, by 2009/10, poverty is more than four times higher in the Northern region than in the Central region. In 2002/03, the North was 2.7 times poorer than the Central Region.

Daniels (2011) uses Demographic and Health Survey Data and methods related to poverty mapping and small area estimation to look at poverty trends across Uganda from 1995 to 2010. She uses the 2005/06 UNHS survey to estimate regressions that correlate poverty to a series of household characteristics that also appear in the DHS (four such surveys have been carried out between 1995 and 2009/10). She then uses the DHS surveys to predict poverty in each of the DHS survey years. She finds that poverty indeed reduced over time, but much slower than official figures suggest. While her national estimate of headcount poverty in 2006 is 33% and thus very close to the official estimate of 2005/6, the rates still stands as 30 percent using the 2009 DHS, about 6 percentage points higher then the 2009/10 UNHS estimate.

More in general, there is a view amongst publicists and opinion makers in Uganda that the poverty figures reported by the government of Uganda are too optimistic. Byekwaso (2010) calls official reported poverty changes "a fiction". Kakande (2010) admits that qualitative findings on poverty trends suggest there was a decrease in well-being despite the drop in poverty rates. Recently, an unpublished manuscript has been circulating that compares

Uganda to other African countries on six non-monetary poverty indicators, such as literacy rates and access to piped water. This admittedly partial analysis also points to a much higher incidence of poverty.

3   Utility Consistent Poverty Lines using Revealed Preferences

One of the main weaknesses of the official poverty measures is the fact that it is based on a poverty line that is constructed using a single food commodity bundle for the entire country. In addition, this food basket was constructed in 1993 and has not been updated since, apart from simple inflation by the consumption price index. However, it is well known that in many instances - for example, if relative prices of basic commodities vary by region (or through time) and preferences permit substitution - the use of a single consumption bundle may yield inconsistent poverty comparisons (Tarp, Simler, Matusse, Heltberg, and Dava, 2002). While difference in prices in different locations have always been incorporated by adjusting local prices to the prices used in the construction of the poverty line, it becomes more and more common to also account for spatial heterogeneity in consumption bundles (e.g. Ravallion and Lokshin, 2006, Mukherjee and Benson, 2003).

While differences in consumption baskets are interesting in its own right, they only become relevant in the context of poverty measurement and analysis when we evaluate the cost of these basic needs. Indeed, what matters for poverty comparisons is that different diets may provide the same basic needs (usually a given amount of kilo-calories per day per adult equivalent) at significantly different cost. It is especially in this regard that Uganda is an interesting case. Matooke, the main ingredient in the diet of households in the West is a very expensive source of food energy, almost three times as expensive as sorghum that is consumed in the North. As such, to compare the West to the North on the basis of the same daily nutritional requirements, the West will need a much higher poverty line.

But how can we be sure that two different consumption bundles provide the same basic needs? Or, in the language of Ravallion and Bidani (1994), how do we assure consistency[1]? CBN poverty lines can be viewed as the

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[1]A poverty measure is consistent if two individuals at the same welfare level are considered equally poor.

expenditure needed to acquire a specific bundle of goods. Different CBN poverty lines will be utility consistent if the underlying bundles of goods are on the Hicksian utility-compensated demand functions and hence yield the same level of utility. But this only passes the question down. How can we be sure the underlying bundles yield the same utility? As Arndt and Simler (2010) argue, the theory of revealed preferences provides a framework for countering these difficulties.

The idea uses the rationality assumption that economic agent that derive utility from consumption always preferred consuming more to less. Let us assume that a representative agent living in spatial domain ($r \in R$) derives utility from a set of consumption goods ($i \in I$). We will then instruct each representative consumer in each spatial domain r to spend a minimum to attain an arbitrary (but constant across spatial domains) level of utility. As such, each individual will spend $\sum p_{i,r} q_{i,r}$ on a consumption bundle, with $p_{i,r}$ the price of good i in spatial domain r and $q_{i,r}$ the quantity of good i in spatial domain r. Revealed preference conditions will then imply that:

$$\sum p_{i,r} q_{ir'} \geq \sum p_{i,r} q_{i,r} \ \forall r, r' \tag{1}$$

This is so because the representative consumer in spatial domain r will choose only that bundle that minimizes expenditure. Thus, any other bundle that yields the same level of utility (such as for instance the one chosen by the representative consumer in region r') should be equally or more expensive than the chosen bundle. There can be no bundle that costs less than the chosen one yet yields that same utility, because then the rational consumer should have chosen that one. The above condition (1) should hold for all possible pairs of spatial domains.

In practice, however, it will be hard to construct a set of poverty lines that meet revealed preference conditions for all possible pairs of spatial domains. We use a minimum cross-entropy approach to adjust expenditure shares such that they meet revealed preference conditions. This approach uses the expenditure shares of the original bundles as prior information (in the form of probabilities that an arbitrarily small amount of money will be devoted to the purchase of the particular good) and the revealed preference conditions as constraints on the values that the parameters can take. The end result will be a set of adjusted expenditure shares that are as closely as possible to the original shares, yet that obey a minimal set of conditions such that the estimated bundles are consistent with some arbitrary unknown

preference set (Arndt and Simler, 2010).

4   A Reassessment of Poverty in Uganda

We look at data taken from three different surveys. The oldest is the Uganda National Household Survey conducted in 2005/06. The second is the Uganda National Household survey conducted in 2009/10. Finally, we also run the analysis on the second wave of the Uganda National Panel Survey (2010/11). Unfortunately, this last survey is much smaller than the previous surveys, so this survey is designed to be representative only up to the regional level.

For each data set, we start by constructing new food bundles in each spatial domain. For Uganda, we use the four regions as spatial domains. In each poverty line region, a basket of food products that satisfied basic calorie needs (WHO 1985)[2] was identified using information on the age and sex composition of the household and the recorded consumption patterns of poorer households. The cost of this basket, valued at prices prevailing within each region, is the food poverty line in each region. A nonfood poverty line was obtained for each region by calculating the share of food expenditures for households whose total food and nonfood consumption per capita was near the food poverty line. The total poverty line is obtained as the sum of the food and the nonfood poverty lines. Finally, if the bundles do not satisfy revealed preference tests, we adjust expenditure shares until they do using the entropy approach outlined above.

It will be instructive to have a closer look at the poverty lines. After all, poverty lines are not only useful to separate the rich from the poor,or but also as cost-of-living indexes, permitting interpersonal welfare comparisons when the cost of acquiring basic needs varies over time or space (Ravallion, 1998). Table 3 shows that the cost to satisfy basic needs is highest in the Central region and lowest in the Northern region. The fact that Northern region has the lowest cost of basic needs is due to the fact that the diet in this region consists mainly of sweet potatoes, cassava, sorghum and sesame. These four commodities are cheap sources of calories. Both sweet potatoes and cassava cost only UGX0.088 per kilo-calorie. Sorghum costs UGX0.064 and sesame only UGX0.037 per kg. In the West, and to a lesser extent in the Central region, sweet potatoes is eaten together with matooke (UGX0.174 per kg)

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[2]This is how we fix the utility level.

Table 3: Evolution of cost of basic needs

	2005/06		2009/10		2010/11	
	poverty line	food share	poverty line	food share	poverty line	food share
Central	635.93	72.95%	1387.87	73.16%	1111.45	75.61%
Eastern	626.07	75.90%	788.26	68.69%	755.15	79.10%
Northern	269.54	72.03%	609.38	70.75%	622.03	74.60%
Western	735.84	75.73%	834.79	72.95%	967.00	80.09%

and cassava. In the East, sweet potatoes and cassava is supplemented with maize (UGX0.128) and millet (UGX0.143)[3].

We can also compare our poverty lines to the official poverty lines. As said before, official poverty lines are based on a single food basket, derived from the 1993/1994 data. In particular, the food basket was identified with 28 of the most frequently consumed food items by households with less than the median income. These food items were then converted into their caloric equivalent and scaled to generate 3000 calories per adult equivalent per day using as reference the WHO estimates for an 18-30 year old male. Next, a non-food allowance is added. Non-food requirements are estimated as the average non-food expenditure of those households whose total expenditure is just equal to the food poverty line. The non-food allowance does allow for spatial heterogeneity, as separate averages are calculated for urban/rural location interacted with the four regions. This is a conservative estimate of the poverty line, as one could also opt to estimate the average non-food expenditure of those households with food expenditure equal to the food poverty line. Official poverty lines for the 2005/06 and 2009/10 surveys are presented in table 4.

Comparing the official poverty lines to the utility consistent poverty lines underscores the importance of the cost of diets in different regions to attain a certain amount of kilo-calories. The most striking case is again the North. According to official estimates, it will cost a person UGX700 to obtain his/her daily calorie requirements. However, if we allow this person to have his/her own specific regional diet, he/she will extract energy from staples that are potentially more or less cost effective in obtaining basic needs. In the North,

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[3]These figures are taken from table 4 in Appleton (2003) and are median 1993-4 prices calculated from the first monitoring survey. While these prices will certainly be higher in the 2005/06 to 2010/11 period due to inflation, we think the price differences will be largely preserved.

Table 4: Official poverty lines

	2005/06		2009/10	
	poverty line	food share	poverty line	food share
Central	728.65	70.12%	1014.90	69.82%
Eastern	692.24	73.81%	959.96	73.81%
Northern	700.15	72.97%	969.02	73.12%
Western	680.28	75.10%	943.21	75.12%

this results in much higher shares of cassava, sorghum and sim-sim (sesame), all crops that are relatively cheap in obtaining a given amount of kilo-calories. In 2005/06, the cost of basic needs of an individual for one day in the North appears to be less than half of the official cost once we take into account this region specific diet. In 2009/10, the difference is less dramatic, but still considerable.

The reverse holds for the Western region. There, the cost of meeting basic needs of an individual increases if we allow them to assemble their own diet. This is as expected, as this regions relies heavily on matooke, the most expensive staple[4] in terms of energy conversion. The official poverty line that relies on a single consumption basket for the entire country therefore averages out this expensive diet over the entire country. The Eastern region, where cassava and sweet potatoes is supplemented with maize, the utility consistent poverty line is slightly lower than the official line in 2005/06.

It is also interesting to look at the evolution over time. For the official poverty line, the consumption bundle has simply been re-weighted by the food prices that prevail in 2009/10. Then the non-food allowance is re-estimated using the method presented above. This means that the increase in the cost of living is largely the same in each region, about UGX300. The only exception is Central, which is heavily urbanized and included Kampala. The story is different when using revealed preferences. The cost of living changes little in the West, reflecting the fact that matooke is a very localized commodity whose price evolved somewhat independent from the food prices of other staples that surged during 2008/09. The Central region saw a more than UGX500 increase in the cost of living. This is partly due to the fact that prices have increased more in urban areas during the 2008/09 food price

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[4]Irish potatoes and rices are even less cost effective than matooke, but these crops are rarely consumed in Uganda, especially in rural Uganda.

crisis. Also in the North, there was a doubling of the cost of basic needs.

Table 5 reports poverty measures based on the regionally differentiated poverty lines using the FGT index (Foster, Greer, and Thorbecke, 1984). We have aggregated the measures at the national, the rural/urban and the regional level for all surveys. We have added the district level for the UNHS surveys. Unfortunately, the UNPS 2010/11 is only representative up to the regional level. The figures presented in

At the national level, we find that poverty stood at about 33 percent in 2005/06, less than 2 percentage points higher than the official figure. Contrary to official figures, our estimates suggest that poverty has stayed virtually the same. In fact, we find that poverty increased in 2009/10. It is easy to see why we find this pattern. A cost of basic needs approach rooted in regional caloric requirements and differentiated consumption bundles would be expected to shift poverty lines upward if prices of commodities increase. Our poverty measure is likely to better reflect the impact of the food price crisis than the national poverty measure based on (consumer price index adjusted) poverty lines. This explanation is supported by the fact that poverty increases disproportionally for the urban poor (from 9 to 16.3 percent) between 2005/06 and 2009/10, and the poorest of the poor (the North Eastern province), two groups that are likely to be especially hit by food price surges (Van Campenhout, Pauw, and Minot, 2013).

If we aggregate by region, we find that, in 2005/06, poverty is lowest in the Northern region, a region that has always been regarded as the poorest in Uganda (see table 2). However, these figures mask significant heterogeneity in the North. Despite the fact that the North as a region is not ranked as the poorest region, we find nevertheless that North East is consistently ranked as the poorest province. The North East is also known as the Karamajong region, a dry and conflict prone area inhabited by a nomadic people that rely on livestock herding as their main livelihood activity. It is well known that these people are among the most marginalized groups in Uganda and vulnerable to frequent food and water shortages. In addition, the Northern region is also the only one where poverty seems to be on the rise over time. This fact corresponds to the feeling that the North has been neglected, or at best, that the North has not benefited much from government policies to eradicate growth. A last contributing factor to the pattern may be due to sampling bias. Conflicts in the North meant that, often, substantial parts of the area were not included in the survey. Since conflict affected area are likely to be poorer, leaving them out bias poverty downwards. When stability

returned around 2006, subsequent surveys added areas that were previously affected by conflict, sharply increasing headcount poverty.

We also find that the Western region was the poorest in 2010/11. This is consistent with the analysis of Jamal (1998) and Appleton (2003). They both argue that a single consumption basket can not represent the varied diets Ugandans in different parts of the country enjoy. They therefore construct poverty lines that are different by spatial domains, much as what we have been doing here. Their conclusion is in line with our conclusion. Due to the fact that Northerners consume much more calorie efficient staple foods (such as cassava and sorghum), their cost of basic needs is lower, leading to a lower poverty line than the national one. In contrast, in the Western region, people tend to rely much more on matooke, which is a very expensive source of calories. They both conclude that, when using region specific cost of basic needs poverty lines, the Western Region was the poorest in the 1990s.

We already made the case above that poverty measures based on region specific and utility consistent poverty lines are to be preferred to poverty lines based on a single consumption basket from a theoretical point of view. In addition, there is widespread skepticism amongst researchers and observers about the official poverty figures disclosed by the government. Our estimates are closer to what qualitative data suggests, and are also in line with studies by independent researchers, such as Daniels (2011) and Appleton (2003).

5   Conclusion

In this paper, we re-assess the evolution of poverty over the past 10 years in Uganda. Official figures suggest substantial poverty reduction, but independent researchers note that the benefits of economic growth have been shared unequally. In addition, casual observation does not correspond to the rosy picture that official figures suggest. Other indicators that define well being in a broader way, such as adult literacy and maternal health, also put Uganda at a much lower level than what would correspond to the disseminated poverty levels.

One possible explanation for this divergence lies in the poverty line. The poverty line that is currently in use to estimate official poverty in Uganda has been constructed over a decade ago, using data from a 1993/1994 survey. In addition, this poverty line relies on a single food consumption basket for Uganda, despite the fact that Uganda consists of a diverse set of regions,

Table 5: Utility Consistent Poverty Measures

	2005/06			2009/10			2010/11		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
National	32.88	9.12	3.65	36.03	10.67	4.49	31.36	10.36	4.88
Urban	9.11	2.12	0.78	16.35	4.34	1.74	9.94	2.66	1.32
Rural	37.34	10.43	4.19	39.03	11.63	4.91	35.25	11.73	5.52
Central	22.70	6.02	2.31	33.54	9.80	4.09	21.70	8.48	5.03
Eastern	47.26	12.80	5.03	40.22	11.48	4.59	32.46	9.39	3.96
Northern	15.62	3.32	1.02	33.07	10.40	4.69	31.25	9.91	4.26
Western	43.71	13.52	5.84	35.29	10.65	4.58	41.14	13.89	6.26
Kampala	3.74	0.97	0.43	17.91	4.63	1.48	6.37	1.14	0.67
Central 1	25.73	6.69	2.45	30.23	9.47	4.12			
Central 2	28.76	7.76	3.07	43.55	12.32	5.16			
East Central	43.69	11.04	4.20	36.08	10.26	4.12			
Eastern	48.29	13.91	5.59	43.60	12.47	4.98			
Mid Northern	15.37	3.00	0.84	26.66	8.21	3.77			
North East	56.60	15.99	6.28	70.56	28.10	13.84			
West Nile	9.01	1.88	0.63	24.60	5.17	1.66			
Mid Western	41.71	12.80	5.64	37.79	12.21	5.59			
South Western	44.98	13.98	5.97	32.64	9.00	3.51			

each with their own diets. These diets are also exceptional in their difference in cost to obtain a certain level of kilo-calories (or utility of that matter). Lumping all regions together and assuming they require the same amounts of each commodity disregards the cultural and agro-climatic diversity that typifies Uganda.

We therefore follow Arndt and Simler (2010), who propose an information-theoretic approach to constructing utility consistent poverty lines. The idea is to construct different poverty lines by spatial (or temporal) domain that yield a minimal amount of kilo-calories given the demographic make-up of the region. These poverty lines are then tested to check if they obey revealed preference conditions. In particular, we check if the food baskets chosen in all other regions are less expensive than the food basket chosen in a particular region. If not, the individual could have chosen a cheaper basket that yields the same utility. This violates the revealed preference condition. We apply an information-theoretic approach that adjusts consumption shares such that this revealed preference condition is satisfied, while keeping the original diets in tact as much as possible.

Applying the above to three nationally representative surveys for Uganda, we find that national poverty has been and remains higher than the official figures suggest. Also somewhat controversial, we find that not the North, but the East and more recently the West are the regions that are poorest. This can be re-conciliated by the fact that households living in the West are disproportionally dependent on matooke for their caloric requirements, while the North prefers (or has to rely on because of climatic conditions) cassava and sorghum. Matooke is at least twice as expensive as cassava, and three times as expensive as sorghum to obtain a given amount of kilo-calories. This results in a much lower poverty line for the North than the one for the West. Still, digging deeper, we find that the figure for the North still veils quite some differences. The karamajong region in the North remains the poorest of all districts.

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