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Indicators of Affordability of Nutritious Diets in Africa (IANDA)

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Introduction

Impacts of high food price are likely to be greatest in low-income countries, where food accounts for a greater share of total expenditure and demand elasticity is higher comparing to the levels in middle/high-income countries, especially for more expensive nutrient-dense foods such as dairy, eggs, meats, fruits and vegetables. (Green et al., 2013)

However, existing food price indexes focus either on the prices of basic commodities traded on the world's markets (FAO Food Price Index), or all economic activity (a GDP deflator such as International Comparison Program (ICP)), market information systems (a producer price index, or PPI) or retail purchases (a consumer price index, or CPI), therefore may not directly reflect the prices of nutritious foods or diets.

In this paper, using monthly national average food prices in Ghana and Tanzania, we examined the cost of dietary diversity (CoDD) measured by the Minimum Dietary Diversity for Women of Reproductive Age (MDD-W) indicator, and the cost of nutrient adequacy (CoNA) applied linear programing (LP) algorithm. As defined, both CoDD and CoNA are novel inflation-adjusted price indexes measuring economic benchmarks of the minimum cost for diets meeting international nutritional standards.

Methods

Cost of Diet Diversity (CoDD):

- **The MDD-W indicator**, defined as whether or not women of reproductive age (15-49 years of age) consumed at least five out of 10 mutually exclusive defined food groups during the previous day or night, has been validated against the probability of consuming adequate amounts of 11 micronutrients (Arimond et al. 2016).

• Low-cost energy source:	Starchy staples (gorup1)
• Plant-based protein & fat:	Pulses; Nuts and seeds (group 2 and 3)
• Animal-based protein & fat:	Eggs; Meats; Dairy (group 4, 5 and 6)
• Micronutrient-rich foods:	Dark green leafy V; Vitamin A-rich F&V; Other V and Other F (group 7, 8, 9 and 10)

- $CoDD1 = min_5\{min\{p_{i1}\}, min\{p_{i2}\}, ..., min\{p_{im}\}\}$
- $CoDD2 = ave\{min\{p_{i1}\}, min\{p_{i2}\}, ... , min\{p_{im}\}\}$
  - ◊ Where min_5 denotes the 5^{th} lowest of all m food groups, and p_{ij} is the price of food item i in the j^{th} food group.

Cost of Nutrient Adequacy (CoNA):

- 17 Nutritional and 1 dietary constraints for CoNA

• Dietary energy intake (1): 2,000kcal per day
• Macronutrients (1): Protein
• Minerals (7): Calcium, Iron, Magnesium, Phosphorus, Zinc, Copper, and Selenium
• Vitamins (9): Vit-A, Vit-C, Vit-E, Thiamin, Riboflavin, Niacin, Vit-B6, Folate, Vit-B12

- $CoNA = minC = min\Sigma p_i \times q_i$, *where* $\Sigma a_{ij} \times q_i \geq EAR_j$ *and* $\Sigma a_{ie} \times q_i = E$
  - ◊ Where a_{ij} is nutrient content of food i of nutrient j
  - ◊ EAR_j is nutrient requirement of nutrient j
  - ◊ a_{ie} is the dietary energy of food I, and E is dietary energy - 2,000kcal per day
- $SPj = (\partial C^* / \partial EAR^+_j)$, $SP'j = (\partial C^* / \%\Delta EAR^+_j)$
  - ◊ SP_j is the shadow price of nutrient j
  - ◊ We focus on the total cost, disaggregated by food groups to show diet composition, or disaggregated by nutrients, derived from their shadow prices

Results

On a per-calorie basis, the five lowest-cost food groups typically include **starchy staples (maize/cassava)**, **pulses (soybeans)**, **nuts/seeds (groundnuts)**, **various fruits (mangoes, banana** in GHA and **avocado** in TZA**)**, **and fish/ meats (salted/smoked fish** in GHA and **beef** in TZA**)**.

Figure 1.CoDD indexes based on MDD-W criteria in Ghana (per 1,000kcal)

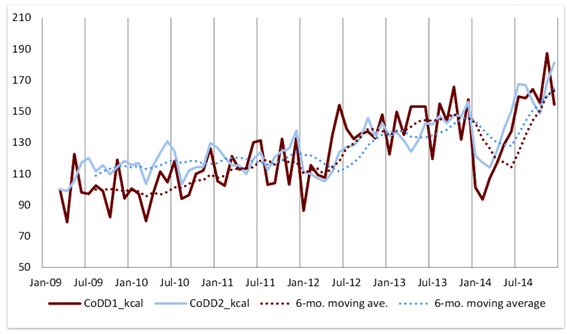
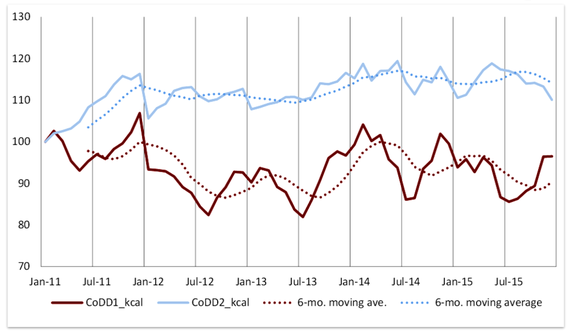


Figure 2.CoDD indexes based on MDD-W criteria in Tanzania (per 1,000kcal)



Mangoes and **soybeans** make the largest contributions to CoNA while **vitamin A** and **calcium** are the most expensive nutrients in Ghana.

Figure 3.CoNA for least-cost diet by food groups in Ghana

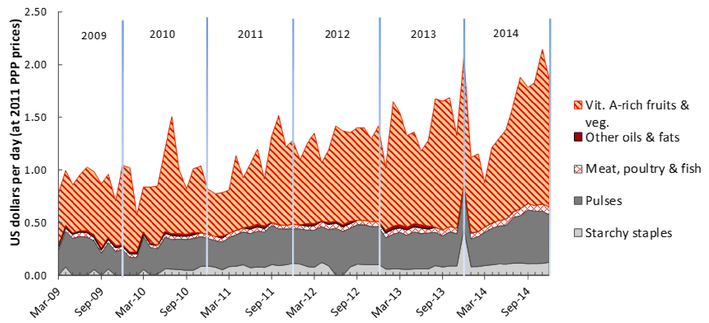
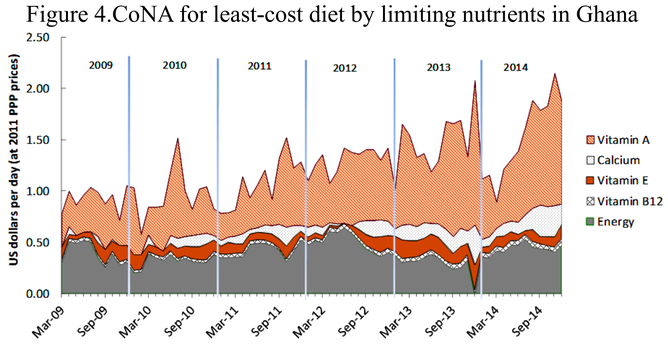


Figure 4.CoNA for least-cost diet by limiting nutrients in Ghana



Soybeans, **starchy staples (white maize grains, cassava flour** or **fresh cassava)** and **spinach** contributed the most in CoNA, and **Calcium**, **Vitamin C** and **Vitamin E** are the most expensive nutrients in Tanzania.

Results (cont'd)

Figure 5.CoNA for least-cost diet by food groups in Tanzania

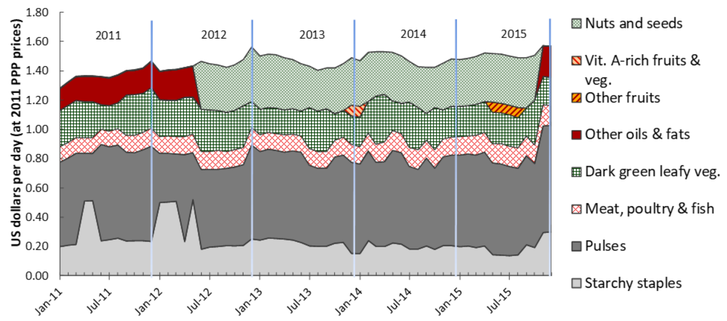
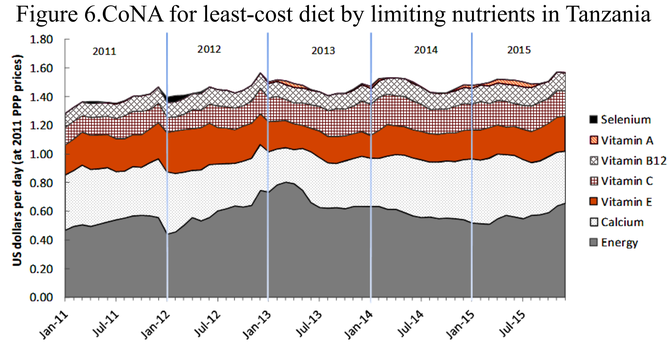


Figure 6.CoNA for least-cost diet by limiting nutrients in Tanzania



Conclusions

The real cost of nutritious diets relative to normal costs of living in Ghana experienced significant increase between 2009 and 2014 with a range from 54% to 139%, referring the affordability of nutritious diets measured by diet diversity and nutrient adequacy was quickly deteriorating. However, we could not find similar trends in Tanzania, where the real cost of nutritious diets changed by -3% to 22%.

The CoNA analyses also provided economic relevance of different food items and nutrients. We found that starchy staples and pulses, and dark green leafy vegetables, and vitamin A-rich fruits/vegetables, made the largest contributions to CoNA. Vitamin A and Calcium are the most expensive nutrients in Ghana and Tanzania, respectively.

Key limitations of the study are related to what is covered in the data. First, some food groups are not represented. Furthermore, some food groups are represented by only 1-3 food items. Second, the markets represented in these data are national averages, so may not represent the cost in locations where those most at risk of low dietary diversity and nutrient deficiency actually obtain these foods. The Tanzania data in particular has an urban bias.

These limitations notwithstanding, this analysis is a major improvement upon previous food price indexes for the purpose of understanding the cost of minimally nutritious diets measured by dietary diversity and nutrient adequacy. With more diverse and more locally representative data, this method can be used to track the cost of nutritious diets across seasons as a way of characterizing local food environments.

References

Green, R. et al. (2013) 'The effect of rising food prices on food consumption: systematic review with meta-regression', The BMJ, 346. doi: 10.1136/bmj.f3703.

Arimond, M.; Ballard, T.; Deitchler, M.; Kennedy, G.; Martin-Prével, Y. (2016) Minimum Dietary Diversity for Women-A Guide to Measurement. FAO.

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