

*Absolute Poverty: When Necessity Displaces Desire*  
online publication

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Notes on the linear programming

The following foods were represented in the objective function (equation 1) in the linear programs:

wheat flour, wheat bread, rice, maize flour, oatmeal, beans, eggs, cheese, chicken, milk, meat, fish, butter, margarine, vegetable oil, white sugar, potatoes, tomatoes, cucumbers, cabbage, sweet potatoes, carrots, onions, cauliflower, spinach, ginger, roasted peanuts, avocado, mushrooms, cassava, tofu, alcohol

In addition, the programs for Africa also included millet, millet flour, red sorghum grains, yellow maize grains, and white maize grains

When prices for items in this list were not available in a country, they were excluded from the choice options in the linear program.

Generally, the nutritional composition of foods are coded per 'edible portion.' In the requirement inequalities in the linear programs (equation 2), the nutritional compositions reported in the databases like the USDA *National Nutrient Database* were multiplied by the percentage of the food that is edible (ie allowing for bones, etc), so that the solution of the linear program was the weight of food purchased at the prices specified in ICP2011.

The ICP contains many foods, most of which are clearly too expensive to be chosen by the linear program. For instance, thirteen different kinds of fresh fish or seafood are listed in the core price list of ICP2011, although not all prices are available in all countries. The fish that was cheapest in terms of its nutritional content (allowing for losses in bones, fins, etc) was used in the linear program. This was usually mackerel or tilapia or carp. Similar selections were made for meat, bread, and alcohol in terms of alcohol content. The African regional price list contains a great variety of local alcoholic beverages, which were also investigated to find the cheapest source of alcohol.

Sometimes ICP2011 reported prices for goods that could not have been widely available. Thus, there is a price for mackerel in Zimbabwe. At that price, mackerel is included in the least cost diet. It is so implausible, however, that mackerel is widely available in Zimbabwe that it was excluded from the choice options for that country. Similar exclusions were made in some other cases when it was deemed that the food in question was not widely available.

## Online data sources

While the ICP is a tremendous achievement, it is not complete, so it was necessary to add missing variables derived from extraneous sources. Some important additions included:

- the price of wheat flour. Wheat flour is of great importance in poverty measurement, but it was curiously missing from the data for the United States. This was particularly important since conversion to US dollars is a key part of the World Bank's exercise. Why the price is missing is altogether puzzling since it is available on the US Bureau of Labor Statistics website.<sup>1</sup> That price was used in the calculations reported here. Wheat flour prices were also taken from the national online retail price databases for some other countries.
- the price of cabbage. This turns out to be important since it is the cheapest source of vitamin C in many places. It was also missing from the USA data in the ICP2011 and the price was taken from the BLS database. In the case of some countries like the UK, the price of cabbage in 2011, which was missing, was estimated from relative prices in 2015 taken from supermarket databases. The same relatives were assumed to obtain in 2011.
- some missing USA and UK prices (like toilette soap, maize flour, and oatmeal in the USA) were taken from data collected in 2011 from supermarket web sites for earlier investigations.
- the price of electricity. This was necessary for the non-food component of the problem. ICP2011 lacks electricity prices for many south and east Asian countries. These were taken from the online tariffs of their electricity suppliers<sup>2</sup>. Information for some countries in 2011 was provided by Mr. Beni Suryadi of the ASEAN Centre for Energy, and his help is gratefully acknowledged.
- The price of kerosene was missing for many OECD countries. Prices of kerosene or 'light fuel oil for households' were taken from IEA (2012).
- the rental price per square metre of housing. ICP 2011 inquired about rents, but data are available for only six countries in the sample (Algeria, Niger, Bangladesh, Indonesia, Sri Lanka, and Vietnam.) For these the price per square metre of a 'typical traditional dwelling,' generally supplied with electricity and indoor water, but no private toilet, private kitchen, or air conditioning, was used. For other countries, rents were obtained for low standard accommodation in poor districts in large or capital cities was obtained.

## **Food Composition web sites**

United States Department of Agriculture (USDA). *National Nutrient Database for Standard Reference Release 28*. Retrieved on 26 January 2016 from <http://ndb.nal.usda.gov/ndb/search>

Health Canada. *Canadian Nutrient File*. Retrieved on 26 January 2016 from <http://webprod3.hc-sc.gc.ca/cnf-fce/start-debuter.do?lang=eng>

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<sup>1</sup>[http://www.bls.gov/regions/mid-atlantic/data/AverageRetailFoodAndEnergyPrices\\_USandMidwest\\_Table.htm](http://www.bls.gov/regions/mid-atlantic/data/AverageRetailFoodAndEnergyPrices_USandMidwest_Table.htm)

<sup>2</sup>See appendix of online sources for websites consulted.

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French Agency for Food, Environmental and Occupational Health and Safety. *French Food Composition Table 2012*. Retrieved on 26 January 2016 from <http://www.afssa.fr/TableCIQUAL/>

ASEAN Food Composition Database (2014). Retrieved on 26 January 2016 from [https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjTi72Vv8fKAhWsn4MKHUH5ASIQFggiMAE&url=http%3A%2F%2Fwww.inmu.mahidol.ac.th%2Faseanfoods%2Fdoc%2FOnlineASEAN\\_FCD\\_V1\\_2014.pdf&usg=AFQjCNFNShKYTMVzGG0LPEhv-E\\_mbxfl6g&sig2=U436wr8h7O1dnK37dOFVzQ](https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwjTi72Vv8fKAhWsn4MKHUH5ASIQFggiMAE&url=http%3A%2F%2Fwww.inmu.mahidol.ac.th%2Faseanfoods%2Fdoc%2FOnlineASEAN_FCD_V1_2014.pdf&usg=AFQjCNFNShKYTMVzGG0LPEhv-E_mbxfl6g&sig2=U436wr8h7O1dnK37dOFVzQ)

### **Nutritional Requirements**

U.S. Food and Drug Administration. Guidance for Industry: A Food Labeling Guide (14. Appendix F: Calculate the Percentage Daily Value for the Appropriate Nutrients). Retrieved on 26 January 2016 <http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/LabelingNutrition/ucm064928.htm>

National Institute of Nutrition. Indian Council of Medical Research (2009). *Nutrient Requirements and Recommended Dietary Allowances for Indians*. Retrieved on 26 January 2016 from <https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjDkYPRmcfKAhVLuIMKHYYW0B08QFggbMAA&url=http%3A%2F%2Ficmr.nic.in%2Ffinal%2Frd-2010.pdf&usg=AFQjCNHrGPR00NBuF-gRaiqurV1ESqTriQ&sig2=PsbGjHhb6zPY7dtoHk9g>

United Nations. Department of Economic and Social Affairs. Population Division. Retrieved on 26 January 2016 <http://esa.un.org/unpd/wpp/Excel-Data/population.htm>

### **Vegetable (and other foods) consumption**

United States Department of Agriculture. *Daily Vegetable Chart*. Retrieved on 26 January 2016 from <http://www.choosemyplate.gov/vegetables>

Sachdeva, S., Sachdev, T. R., & Sachdeva, R. (2013). Increasing Fruit and Vegetable Consumption: Challenges and Opportunities. *Indian Journal of Community Medicine* :

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United States Department of Agriculture. *Profiling Food Consumption in America*. Retrieved on 26 January 2016 from [https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiM24CivcfKAhWMIoMKHSsaAAoQFgggMAE&url=http%3A%2F%2Fwww.usda.gov%2Ffactbook%2Fchapter2.pdf&usg=AFQjCNFBcXq4I5gn-vfY0ooT\\_Mormu0DqQ&sig2=TS4KqjedUUVrKj\\_-nCWv3Q](https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwiM24CivcfKAhWMIoMKHSsaAAoQFgggMAE&url=http%3A%2F%2Fwww.usda.gov%2Ffactbook%2Fchapter2.pdf&usg=AFQjCNFBcXq4I5gn-vfY0ooT_Mormu0DqQ&sig2=TS4KqjedUUVrKj_-nCWv3Q)

### **Food Fortification**

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*Future of Flour – A compendium of Flour Improvement* (2006). Retrieved on 26 January 2016 from <http://muelchenchemie.de/english/know-how/future-of-flour.html>

### **Electricity prices**

Abeberese, A. B. (2013). Electricity Cost and Firm Performance: Evidence from India, Columbia University Academic Commons, <http://hdl.handle.net/10022/AC:P:20773>.

Central Electricity Authority, Ministry of Power, Government of India. *Tariff & Duty of Electricity Supply in India*. Retrieved on 26 January 2016 from <http://www.slideshare.net/ashishverma061/tariff-and-duty-of-electricity-supply-in-various-state-of-indiaa-review-by-cea>

*Nepal Electricity Authority Annual Report*. Retrieved on 26 January 2016 from [https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjJlcS8scfKAhUJgYMKHV98DZ0QFgggMAA&url=http%3A%2F%2Fwww.nea.org.np%2Fimages%2Fsupportive\\_docs%2FAnnual%2520Report-2011.pdf&usg=AFQjCNFOIM6GXbxG0i5RD090hVaHANYhbQ&sig2=jy3s5HRsPM6Fu2MN0IUwPA&bvm=bv.112454388,d.cWw](https://www.google.ae/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjJlcS8scfKAhUJgYMKHV98DZ0QFgggMAA&url=http%3A%2F%2Fwww.nea.org.np%2Fimages%2Fsupportive_docs%2FAnnual%2520Report-2011.pdf&usg=AFQjCNFOIM6GXbxG0i5RD090hVaHANYhbQ&sig2=jy3s5HRsPM6Fu2MN0IUwPA&bvm=bv.112454388,d.cWw)

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Tarif Tenaga Listrik Untuk Keperluan Pelayan Sosial Berlaku Mulai 1 Mei 2014. Retrieved on 26 January 2016 from <http://www.pln.co.id/dataweb/Permen-09-2014.pdf>

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Historical Electricity Tariff 2010-2014. Singapore. Retrieved on 26 January 2016 from <http://www.singaporepower.com.sg/irj/go/km/docs//wpccontent/Sites/SP%20Services/Site%20Content/Tariffs/documents/Historical%20Electricity%20Tariff.xls>

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International Institute for Sustainable Development (2014). *Indonesia Energy Subsidy Review*. Issue 1, Vol. 1, March. Retrieved on 26 January 2016 from [https://www.iisd.org/gsi/sites/default/files/ffs\\_indonesia\\_review\\_i1v1.pdf](https://www.iisd.org/gsi/sites/default/files/ffs_indonesia_review_i1v1.pdf)

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### **National food consumption data**

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### **Prices**

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Food and Agricultural Organization, *Food Price Monitoring and Analysis Tool*, retrieved on

29 January 2016, <http://www.fao.org/gIEWS/pricetool/>

India [www.indiastat.com](http://www.indiastat.com)

## Housing rents

The rental price per square metre of housing was needed to compute the cost of the subsistence requirement for housing of 3 square metres per person.

For Algeria, Niger, Bangladesh, Indonesia, Sri Lanka, and Vietnam, rents were calculated from ICP2011 core price list. The core list indicates rental prices for a variety of units. I used the price per square metre of a 'typical traditional dwelling,' generally supplied with electricity and indoor water, but no private toilet, private kitchen, or air conditioning. These are apparently 'nationally representative.'

Rents for other countries were derived from other sources. The aim was to find rents for low quality accommodation in poor districts in large or capital cities. It was not always possible to find 2011 rents, in which case, a rental price index was used to work out a 2011 value. The following sources were consulted:

Zimbabwe—*African Housing Finance Yearbook* 2015, p. 213. Rent is for 2014 and was assumed to apply to 2011 due to overall price stability.

Gambia—assumed to be \$.50/sq metre/month, which is typical of such a poor country.

Liberia—Oshodi (2011, p. 7) Single room without sanitation facilities rents for \$10 per month at low end of distribution. Assumed to be 10 square metres.

Egypt—Sabry (2010).

India—rent per square foot of a shanty in Dharavi slum, Siddiqui (2015)

China—Logan, Fang, and Zhang (2009, p. 921) average cost per square metre at 'market rental' in eight largest cities in China from 2000 census. Adjust to 2011 prices with urban housing rental index component of Chinese consumer price index from [www.stats.gov.cn](http://www.stats.gov.cn)

Thailand—Aichholz (2016, p.7) deflated with index on page 5.

Myanmar—assumed to be \$.50/sq metre/month, which is typical of such a poor country.

Deflated to 2011 with the housing component of India consumer price index.

Turkey—price per square metre from rent of 120 sq metre apartment in Kadikoy district in Istanbul in 2016 from [www.globalpropertyguide.com/Europe/Turkey/Rental-Yields](http://www.globalpropertyguide.com/Europe/Turkey/Rental-Yields)  
Deflated to 2011 with rental price index for Istanbul in numbeo.com.

Mexico—assumed to be \$5 per square metre per month.

Lithuania—rent per square metre in Paneriai district of Vilnius, the most impoverished, from [vddv.library.lt](http://vddv.library.lt)

USA—rent taken to be \$1250 per month for a one bedroom slum apartment of 750 square feet (Godanho 2014). The rent is very close to that given in US Department of Housing, Fair Market Rent database for New York County, NY in fiscal year 2011.

UK—rent for one bedroom flat, lower quartile, in Bexley, the cheapest London district, in 2011 from [www.gov.uk/government/statistics/private-rental-market-statistics-england-only](http://www.gov.uk/government/statistics/private-rental-market-statistics-england-only)  
Flat assumed to be 45 square metres following Roberts-Hughes (2011, pp. 23).

France—rent per square metre in 2015 from cheapest category apartment in 18<sup>th</sup>

arrondissement in Paris from [www.lacoteimmo.com/prix-de-l'immo/location/ile-de-france/paris/paris-18eme/750118.htm](http://www.lacoteimmo.com/prix-de-l'immo/location/ile-de-france/paris/paris-18eme/750118.htm) Deflated from 2011 with price index for one bedroom flat outside of city centre for Paris in [numbeo.com](http://numbeo.com)