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## MAIZE, FISH, AND LEAFY GREENS: AGRICULTURAL DIVERSITY IN RURAL ZAMBIA

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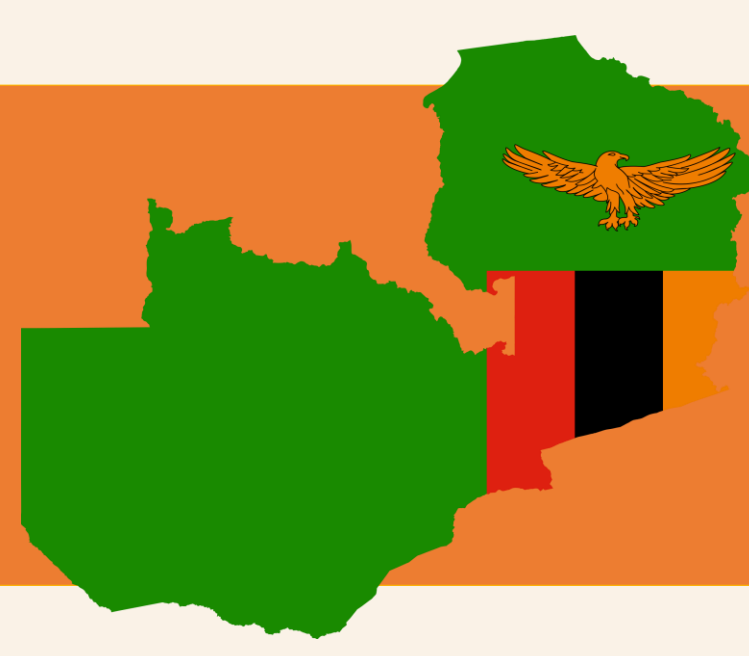


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## ABSTRACT

**PURPOSE:** Analyze food sourcing and crop diversity, including *Moringa oleifera*, among primary school children and smallholder farmers in Zambia's Southern and Eastern provinces.  
**METHODS:** Inventories in open-air markets, farms, and gardens. Interviews and observations in primary schools (n=790), households, and smallholder farms.  
**RESULTS:** Crops grown in Zambia belong to similar nutritional categories and lack nutritional diversity.  
**DISCUSSION:** School children in Zambia are lacking essential nutrients, however growing a home garden with crop diversity could prevent malnutrition in future generations.



Figure 2a: Eastern Province Farm

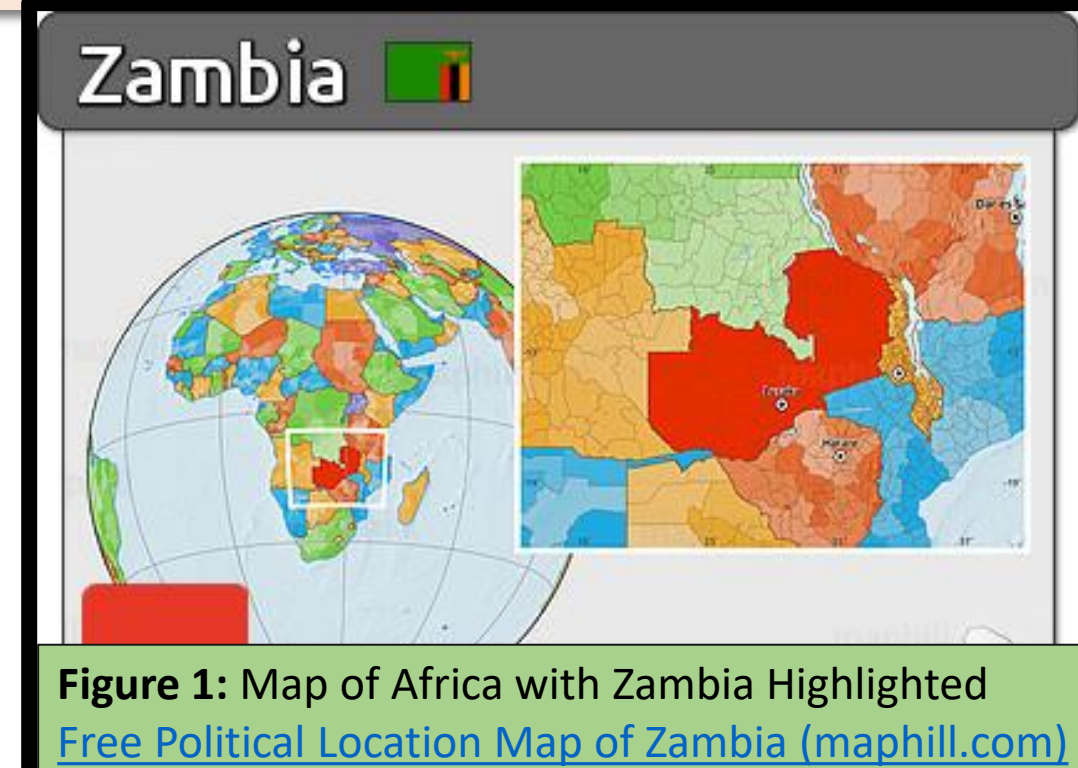


Figure 1: Map of Africa with Zambia Highlighted  
Free Political Location Map of Zambia (maphill.com)



Figure 2b: Southern Province Farm

## INTRODUCTION

Smallholder farms and household gardens are common food and income sources in rural Africa. Crop diversification in gardens and on farms and gathering indigenous foods can supplement a balanced diet and improve nutritional status (Harris 2012). Yet little is known about current food sourcing and crop diversification in Zambia. British colonization from 1888-1964 influenced crops which crops were grown; corn and sugarcane were promoted while indigenous crops were discouraged (Walfield 2009). Today, the following describes Zambian agriculture and nutritional status of children:

- Zambia's main crops include maize, tomatoes, groundnuts, leafy greens, pumpkins and sweet potatoes. Although maize is the staple, it lacks essential nutrients, and consumption impacts the growth and development of school children (reference) (Munthali et al. 2015).
- About 40% of Zambian children remain stunted and high rates of vitamin A, iron, zinc and iodine deficiency are common (Mzumara 2018).
- Cultivating plants such as *Moringa oleifera* could help to restore a balanced diet, adding iron, Vitamin A, protein, calcium, magnesium, zinc, iodine, and other essential minerals (Sánchez-Machado 2010).
- Zambia has great potential for agriculture development, including fertile land and water resources such as the Zambezi River, however, limited crop diversity leads to poor nutritional status and micronutrient deficiency (Sitko 2015).
- Limited research on food security in Zambia has been conducted, therefore this study addresses gaps on food availability and sourcing among rural school children, households, and smallholder farmers.

## METHODS

**PARTICIPANTS:** 6<sup>th</sup> – 7<sup>th</sup> graders between ages 8-18 from 6 different schools in Zambia. 4 different farmers from Southern & Eastern Provinces  
**ENVIRONMENT:** Data were collected in rural and urban sites within 1 hour radius of Chipata, Eastern Province, and 1 hour radius of Livingstone, Southern Province: Open air markets, primary schools, households, rural farms (Fig. 2,3,4,5,6,7)  
**EXPERIMENTAL DESIGN:**  
 → Research conducted under IRB #20150515251EP; Voluntary participation prior to data collection  
 → Inventories conducted in open air markets; Chipata Central Market and Livingstone Central Market (Fig. 4,5)  
 → Interviews, anthropometric, visual and dental data collected from over 781 students as part of a larger project on food security and nutrition (Fig. 5,6)  
 → Interviews made with 2 households, 4 local farmers on crops grown, including maize, *Moringa oleifera* (Fig 2,3,7)  
**STATISTICAL ANALYSES:**  
 → Data hand-written in composition notebooks  
 → Entered in an Excel spreadsheet and uploaded to *Statistica*  
 → Descriptive and correlational analyses conducted

## RESULTS

**MARKET:** Over 73 different types of foods were recorded in the open-air markets of the Eastern and Southern Provinces. FAO food groups were represented by freshwater fish, meat, vegetables, spices, roots/tubers, seeds/nuts, insects (grasshoppers in the Eastern and caterpillars in the Southern province) (Food groups and subgroups (fao.org)). No record of *Moringa oleifera* found in the markets.



Figure 3: Interview Livingstone



Figure 4: Leafy Greens



Figure 5: Open-air market

**SCHOOL INTERVIEWS/ANTHROPOMETRICS :** Of the 781 children interviewed, about 50% had a farm, garden, or both and maize, groundnuts, and leafy greens were the main crops. Livestock raised included goats, chickens, turkey, pigs, ducks, rabbits and cows.

- 35.6% owned chickens while 12% raised goats
- 87.7% eat *kapenta* fish but 80% also indicated their families do not fish.
- 27.8% grew maize and 7.4% groundnuts (Table 1)
- 37.3% of students answered “Yes” to eating *Moringa oleifera*.
- Primary schools often had chickens and small gardens in the courtyards and meals were provided to approximately 45.4% of the students interviewed (Figure 6).
- All 6 schools supplied a maize porridge that contains low levels of protein and essential nutrients.
- Education and food sourcing are correlated in Zambia and food sourcing skills are instilled in children as young as 10 years old.
- 18.8% of students said “Yes” to missing school to forage for wild foods.
- 61.1% students said “Yes” to helping in the garden or family farm.
- 83.4% of the students interviewed get their food from the market (Table 2).
- 58.2% of children do not wish to farm as adults

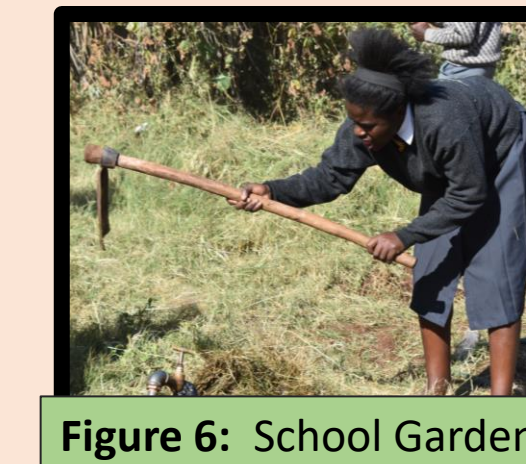


Figure 6: School Garden

**ANTHROPOMETRICS:** Although the differences are not significant, students who have a home garden are less short in stature for their age as compared to students whose families did not plant a garden. About 75% of the children are shorter than expected for their age. With height for age scores ranging from -4.66 to 2.82 (Table 3).  
**FARM VISITS:** Home gardens and small holder farms grew a total of 42 different crops, including leafy greens of spinach, rape, cabbage, pumpkin, and sweet potato. Soybeans, pigeon beans, peanuts, and pole beans were also farmed. Smallholders have limited technology using handmade tools and rainfed agriculture, resulting in limited production.

TABLE 1: COMMON CROPS	% YES
LEAFY GREENS	34.9%
MAIZE	27.8%
TOMATOES	18.8%
SWEET POTATOES	9.7%
PUMPKINS	9.3%
BEANS	8.3%
GROUNDNUTS	7.4%
EGGPLANTS	4.0%
CASSAVA	2.2%



Figure 7: Farm Chipata Cabbage

TABLE 2: FOOD SOURCES	% YES
FARM	55.1%
GARDEN	52.8%
FORAGE WILD FOOD	52.2%
RAISED LIVESTOCK	44.5%
FISHING	17.6%

TABLE 3: Does your family have a home garden?	HAZ Mean	HAZ (n)	HAZ Standard Deviation
Yes	-0.65	414	1.14
No	-0.81	344	1.12
N/A	-0.27	3	0.32
All Groups	-0.72	761	1.13

## DISCUSSION

Population size in sub-Saharan Africa is increasing as uncertainty in the global food system mounts. Yet Sub-Saharan Africa is seen as the “last frontier of global agriculture” and crop diversification will be essential for a healthy future (Sitko, et al., 2015). In Zambia, where 40% of children are stunted, there is limited interest in farming among primary school children as they consider their future. As grocery stores replace open-air markets, access to indigenous foods will become more difficult. Although 73 different types of foods were found in open-air markets, Zambian diets tend to be monotonous. Maize is the staple food and maize-based foods such as *nshima* are consumed daily, perpetuating low nutritional intake. Increasing crop diversity can increase balanced diets in Zambian school children and better support a growing population. One plant with potential for improving nutrition is *Moringa oleifera* which contains high amounts of protein, essential vitamins, amino acids. *Moringa oleifera* is drought resistant, can be grown in home gardens/farms, and can reduce malnutrition in children if added to daily dietary intake. Although correlation does not mean causation, children who had home gardens were closer to the HAZ average than children without. Thus, food access matters. A random sample was not possible for this study; research was conducted in only 2 of Zambia's 10 provinces, permission for data collection was not granted by every school, not every student was present during research period, language may have prevented some student participation, and the study was of short duration. Nevertheless, the overall health of the Zambian population will depend upon a new approach to agriculture and conservation of wild foods, with more sites for food production, from schools to home gardens, more education about diversifying agricultural crops for children and adults, and promotion of the link between nutrition, micronutrient deficiency, and overall health.

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