

Children's Food, Wild Food, and Health in Semiarid Tanzania: Differences Within Neighboring Schools in Chamwino, Dodoma

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Introduction

Children at the age of primary school are at a transition stage from being fed by family to independently obtaining food on their own. Going to school also increases their mobility to their access to varieties of food. In addition to their proactiveness, they also retain some vulnerability. Within the context of eliminating global hunger as part of the SDGs in the mist of changing food patterns influencing health (Sakamoto et al. 2023c), it is also important to understand the situation and perspective of the future generation.

1 Wild food intake by children

Numerous studies in sub-Saharan Africa have indicated that wild food intake is beneficial for nutrition intake. Some research has emphasized its importance, especially for children, with case studies from South Africa (Mbhenyane et al. 2020; Shackleton et al. 2002). Other studies have revealed children's preferences for wild food intake in Niger (Glew et al. 2004) and Malawi (Maseko et al. 2017).

Research on wild food utilization in the East Usambara Mountains in Tanzania also indicated various intakes of wild foods by mothers and children. Mothers consumed fewer wild foods in the dry season, but children did not show any decrease since children ate more wild fruits that are ripe in the dry season (Powell et al. 2013). Children's wild food intake is important and needs to be understood as different from that of adults.

2 Differences based on the environment

Regional differences influence food intake, wild food intake, and health. Research in Kenya has shown that agrobiodiversity, including crops and wild foods, increases food diversity (Oduor et al. 2019).

The availability of cultivated crops and wild food widely differs among geographical locations. Although some wild food may be common throughout the country, others are endemic to specific locations (e.g., in Tanzania: Sakamoto et al. 2023b) according to rainfall, weather, and conservation status.

Prior research in Tanzania has revealed wide differences in available wild foods in Lindi region (Sakamoto et al. 2020a, 2021a, b, 2023d), Dar es Salaam and Pwani (Sakamoto et al. 2023a), and semiarid Dodoma region (Sakamoto et al. 2021b, 2023b, c, d). Although the diversity of wild food is limited in semiarid areas, it plays an important role in people's diet.

3 Characteristics of semiarid areas

Semiarid areas are prone to food shortages of cultivated crops, but a review article on Sub-Saharan African drylands showed that children supplement their nutrition intake with wild food (Koffi et al. 2020). For example, research in semiarid regions enlists varieties of neglected and underutilized plants to enhance the resilience of communities (Masao et al. 2023).

In such an environment, the food pattern in the semiarid areas of Tanzania where leafy vegetables constitute a major relish is also evaluated as healthy in terms of BMI and preventing anemia (Keding et al.

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2011). The nutrition of leafy vegetables is generally acknowledged (Stuetz et al. 2019), but wild leafy herbal vegetables include especially high iron and calcium contents in semiarid Tanzania (Sakamoto et al. 2022a) compared to other areas in Tanzania with high rainfall (Msuya et al. 2009). This article will focus on the semiarid area of Dodoma region in central Tanzania with such characteristics.

4 Transition in food patterns

Even within the geographic area, changes in lifestyles make differences. Research in Tanzania of Hadza foragers in transition indicated that women living in villages (consuming mostly agricultural diet) exhibited more carriers due to increased consumption of maize, whereas men living in the bush (consuming mostly wild-food diet) had more carriers due to the heavy reliance on honey, and perhaps tobacco and marijuana (Crittenden et al. 2017). Hadza children living in villages associated with a mixed-subsistence diet had better growth in terms of weight-for-age, height-for-age, and BMI-for-age, but not weight-for-height, in comparison to those living in the bush (Pollom et al. 2021).

Modernization in food intake and lifestyle has mixed implications for people in different age groups. To understand the differences based on lifestyles, this article compares neighboring schools where there are differences in access to wild food.

I Research area and methods

1 Research area

The researched schools are in Chinangali district, Dodoma region located in central Tanzania (Figure 1-1, 1-2). The climate is semiarid, and frequent food shortages are prevalent. Dodoma region has relatively high stunting (37%, Tanzania 2015), but anemia in women is relatively low (24%, Tanzania 2019).

Pupils in Chinangali I and Mahata primary schools in Chinangali I village, Majeleko primary school in Majeleko village, and Mbelezungu and Manzilanzi schools in Mbelezungu village participated in the research. Manzilanzi and Mbelezungu are relatively remote compared to other schools. The locations of the researched schools are indicated in Figure 1-3.

2 Research methods

Pupils (80 to 100 each school) in the five schools, mainly in grades V and VI, were invited to participate in the questionnaire on 26, 27, 28, 29 Sept. 2022. As a result, a total of 400 pupils (80 from each school) participated, consisting of 166 boys (41.5%), 230 (57.5%) girls, and 4 no answer. Seven pupils (1.8%) were in grade III, 43 (10.8%) in grade IV, 162 (40.5%) in grade V, and 187 (46.8%) in grade VI. The mean age was 13.02 ± 1.491 (SD: standard deviation).

Questions related to their intake of food (including general and wild food) and health problems were asked.

Figure 1 Map of Tanzania, Dodoma region, and research schools in Chamwino

Figure 1-1 Tanzania



Figure 1-2 Dodoma region



Source: Created from Hakuchizu nurinuri <https://n.freemap.jp/> and Google earth

Figure 1-3 Research schools

Children were also requested to draw a picture of wild food, favorite food, commonly eaten food, and/or scenery when eating and asked questions related to drawing.

The weekly frequency of intake was asked for food groups in the rainy and dry seasons with reference to Japanese studies (Tsunoda et al. 2015; Mizoguchi et al. 2004). The scores for the frequency of intake content were as follows: for carbohydrates, vegetables, oil, salt, and sugar, a score of 4 was given for “more than twice a day,” 3 for “once a day,” 2 for “4 to 6 days a week,” 1 for “3 days a week or less” (Tsunoda et al. 2015; Mizoguchi et al. 2004), and 0 for “do not eat.” For meat, fish, milk, eggs, pulses, nuts, fruits, and wild foods, 4 points were given for “every day,” 3 points for “4-6 days a week,” 2 points for “2-3 days a week,” 1 point for “less than once a week” (Tsunoda et al. 2015; Mizoguchi et al. 2004), and 0 for “never eat”.

For children's health, the questionnaire was designed to fit the actual situation in Tanzania, referring to the Health Examination Manual for Children of the Japan School Health Association and the Survey Manual for the

Report on Dietary Information of Pupils. For each health problem, 3 points were given for “always,” 2 points for “often,” 1 point for “rarely,” and 0 for “never.”

In this article, first, all the questions asked in the questionnaire are compiled to provide the picture of the situation pupils regarding food intake, wild food intake, and health. Second, the data from 5 schools will be compared to highlight differences between neighboring villages. The frequency of food intake and health problems are compared with box-and-whisker plots, showing the data distribution using the least value, the first quartile, the median (second quartile), the third quartile and the greatest value.

3 Ethics and permission

The objective of the questionnaire was explained to the pupils, and the pupils only participated if they agreed. The ethical procedures have been confirmed by a committee at Utsunomiya University (H22-0012). The research has also been granted permission by the Government of Tanzania (NA-2001-029).

II Food intake, wild food intake, and health

1 Food intake

The majority (381 pupils, 95.3%) eat at their home, but a substantial number also eat at relatives (153 pupils, 38.3%;

Table 1 Where children eat food

English (Swahili)	No.	%
Where do you eat food? (Unakula chakula wapi?)		
Home, household (Nyumbani/kaya)	381	95.3
Relative's house (Nyumba ya ndugu/familia)	153	38.3
Neighbor's (Jirani)	48	12.0
Friend's (Rafiki)	60	15.0
Shop (Dukani)	25	6.3

Source: Compiled from the questionnaire

Table 2 Major staple foods (QII1.1)

☆ English	Swahili	No.	%
1 Rice	Mchele	374	93.5
2 Maize	Mahindi	387	96.8
3 Sorghum	Mtama	289	72.3
4 Millet	Uwele/Ulezi	282	70.5
5 Wheat	Ngano	317	79.3
6 Cassava	Muhogo	331	82.8
7 Potatoes	Viazi	379	94.8
8 Bananas	Ndizi	368	92.0
9 Taro	Maghimbi	121	30.3
10 Other	Kingine	14	3.5

Note: Others mentioned are sweet potatoes (8 pupils), stiff porridge in general (5), noodles (1), peanuts (3), mango (5), orange (4), papaya (2), naumbe (1, unidentified), and uhemba (1, unidentified).

☆ Numbering is from the questionnaire for all tables.

Source: Compiled from the questionnaire

Table 4 Food group intake frequency mean (IIQ2&3)

☆	English	Swahili	Kiangazi n	Dry season		Rainy season		
				Mean	SD	Masika n	Mean	SD
0 *	Food	Chaluka	396	2.66	0.777	394	2.72	0.847
1 **	Cereals	Nafakara	389	2.57	1.159	384	2.04	1.212
2 **	Tubers/bananas	Mzizi/ndizi	383	2.45	1.136	381	2.18	1.058
3 **	Vegetables	Mboga mboga	380	2.37	1.138	385	2.32	1.087
4 ***	Meat	Nyama	391	1.93	0.987	387	2.00	0.956
5 ***	Fish	Samaki	389	2.19	1.083	388	2.16	1.012
6 ***	Milk	Maziwa	381	1.97	1.166	378	2.12	1.130
7 ***	Eggs	Mayai	383	1.60	1.054	389	1.58	0.983
8 ***	Pulses	Mikunde	383	1.93	0.983	377	2.03	0.966
9 ***	Nuts	Mbegu	380	2.10	1.222	382	2.28	1.115
10 ***	Fruits	Matunda	384	2.38	1.065	385	2.52	1.201
11 **	Oil	Mafuta	378	2.38	1.122	371	2.43	1.121
12 **	Salt	Chumvi	387	2.84	1.095	378	2.78	1.107
13 **	Sugar	Sukari	384	2.28	1.088	390	2.25	1.083

Note: SD = standard deviation

*0 = Do not eat, 1 = Once a day, 2 = Twice a day, 3 = 3 times a day, 4 = 4 times a day

**0 = Do not eat, 1 = Less than 3 days a week, 2 = 3, 4, 5 days a week, 3 = Once a day, 4 = more than 2 times a day

***0 = Do not eat, 1 = Less than once a week, 2 = 2, 3 days a week, 3 = 4, 5, 6 days a week, 4 = Every day

The actual range is also between 0 and 4.

Source: Compiled from the questionnaire

Table 3 Main relish (QIII.2)

☆ English	Swahili	No.	%
1 Meat	Nyama	365	91.3
2 Fish	Samaki	369	92.3
3 Milk	Maziwa	371	92.8
4 Pulses	Mikunde	333	83.3
5 Green vegetables	Mboga za majani	371	92.8
6 Other vegetables	Mboga mboga nyingine	181	45.3
7 Others	Kingine	14	3.5
Mushrooms	Uyoga	1	0.3
Unidentified	Chididia	1	0.3

Note: Many other examples were green vegetables counted as green vegetables in the table.

Source: Compiled from the questionnaire

Table 1). Some also eat at friends (60 pupils, 15.0%), neighbors (48 pupils, 12.0%), and shops (25 pupils, 6.3%).

Only 163 pupils (40.8%) ate breakfast, whereas 215 pupils (53.8%) did not.

As indicated in Table 2, the major staple food is maize (387 pupils, 96.8%), followed by potatoes¹ (379 pupils, 94.8%), rice (374 pupils, 93.5%), bananas (368 pupils, 92.0%), and cassava (331 pupils, 82.8%). Wheat (317 pupils, 79.3%), sorghum (289 pupils, 72.3%), and millet (282 pupils, 70.5%) are also commonly eaten. Taro (121 pupils, 30.3%) is also eaten by some.

Table 3 indicates the main relish. They are green vegetables (371 pupils, 92.8%) and milk (371 pupils, 92.8%), followed by fish (369 pupils, 92.3%), meat (365 pupils, 91.3%), and pulses (333, 83.3%).

Table 4 indicates the mean and SD of food intake in general and of food groups. Although food in general is more frequently eaten in the rainy season, staple food (cereals, tubers/bananas) is consumed more in the dry season. This is likely related to the fact that cereals are normally harvested in the dry season. Apart from salt, oil, and staple foods, children consume fruits most frequently.

2 Wild food intake

Table 5 indicates the frequency of wild food intake. The majority eat wild food less than once a week (169 pupils, 42.3%) or 2 or 3 times a week (101 pupils, 25.3%) in the dry season. However, in the rainy season, pupils are divided into those who eat less than once a week (143 pupils, 35.8%) or every day (103 pupils, 25.8%).

Table 5 Frequency of wild food intake (Q11.1& 2.1)

☆ English (Swahili)	Dry season		Rainy season	
	No.	%	No.	%
0 None (Sili kabisa)	8	2.0	16	4.0
1 Less than once a week (Chini ya mara 1 kila wiki)	169	42.3	143	35.8
2 2 or 3 times a week (Siku 2, 3, kila wiki)	101	25.3	86	21.5
3 4, 5, 6 times a week (Siku 4, 5, 6 kila wiki)	26	6.5	38	9.5
4 Every day (Kila siku)	91	22.8	103	25.8
n.a. (Hamna jibu)	5	1.3	14	3.5
Total (Jumla)	400	100.0	400	100.0

Source: Compiled from the questionnaire

Table 6 indicates the frequency of wild food intake for baobab, the most commonly eaten wild food in this area. In the dry season, 104 pupils (26.0%) eat them every day, and 171 pupils (42.8%) eat them 2 or 3 times a week.²

Table 6 Frequency of baobab intake

☆ English (Swahili)	Dry season		Rainy season	
	No.	%	No.	%
0 None (Sili kabisa)	6	1.5	71	17.8
1 Less than once a week (Chini ya mara 1 kila wiki)	54	13.5	57	14.3
2 2 or 3 times a week (Siku 2, 3, kila wiki)	171	42.8	86	21.5
3 4, 5, 6 times a week (Siku 4, 5, 6 kila wiki)	30	7.5	46	11.5
4 Every day (Kila siku)	104	26.0	88	22.0
n.a. (Hamna jibu)	35	8.8	52	13.0
Total (Jumla)	400	100.0	400	100.0

Source: Compiled from the questionnaire

Table 7 indicates the wild food mentioned as consumed by pupils. A total of 83 varieties were identified. It consists of 24 fruits, 8 seeds, 20 vegetables, 22 animals, 7 insects, sap, and mushrooms. Among the fruits, baobab (*Adansonia digitata*) was most consumed, especially in the dry season (375 pupils, 93.8%), and its seeds were also consumed (239 pupils, 59.8%). Varieties of *Grewia* sp. and *Cordia* sp. were also consumed among other fruits. Seasonal availability may not have been captured in the questionnaire, since some of the fruits are only available in a limited season.

Various edible weeds available on the farms were also mentioned. The most commonly consumed were Mihilili (*Cleome hirta*) and Sagula Sagula (*Ipomoea obscura*), which have high iron and calcium contents (Sakamoto et al. 2022a, 2023b). Leafy vegetables are consumed in both seasons since many of them can be dried and stored. The list represents the commonly consumed wild leafy African vegetables in this area. No wild tubers were identified in their answers.

Animals are also consumed to some extent. Birds and rabbits are the most common.

Table 8 indicates where the pupils obtain wild food. Although the order is somewhat different between seasons, it is either obtained by themselves (55.8% in the dry season; 60.5% in the rainy season), by their family from the farm (56.0%; 53.0%) or the forest (53.3%; 51.8%). Others may also bring it (40.0%; 39.8%). However, buying it is less common either by themselves (37.3%; 34.0%) or by their family (32.5%; 32.8%).

Table 7 Wild food mentioned/consumed (I1&2)

Edible part *	Local name	Scientific name (English)	Dry season	Rainy season	Total	
Fruit	1 Ubuyu	<i>Adansonia digitata</i> (baobab)	375 93.8%	346 86.5%	721 90.1%	
	2 Ngwelu	<i>Grewia</i> sp. nov.	352 88.0%	358 89.5%	710 88.8%	
	3 Mtafuta	<i>Grewia burtii</i> , <i>G. similis</i>	348 87.0%	349 87.3%	697 87.1%	
	4 Mfulu	<i>Vitex payos</i>	335 83.8%	331 82.8%	666 83.3%	
	5 Mperemehe	<i>Grewia flavescens</i>	342 85.5%	318 79.5%	660 82.5%	
	6 Mtundwe	<i>Ximenia americana</i>	313 78.3%	313 78.3%	626 78.3%	
	7 Mkole	<i>Grewia bicolor</i>	310 77.5%	314 78.5%	624 78.0%	
	8 Mdawi	<i>Cordia sinensis</i>	319 79.8%	302 75.5%	621 77.6%	
	9 Msaka	<i>Maerua edulis</i>	300 75.0%	291 72.8%	591 73.9%	
	10 Teratera	<i>Opuntia ficus-indica</i>	234 58.5%	214 53.5%	448 56.0%	
	11 Mtumba	<i>Boscia coriacea</i>	223 55.8%	202 50.5%	425 53.1%	
	12 Mzabibu pori	<i>Cissus welcitschii</i> (wild grapes)	145 36.3%	141 35.3%	286 35.8%	
	13 Msena	<i>Cordia ovalis</i>	129 32.3%	136 34.0%	265 33.1%	
	14 Mpokore	<i>Grewia</i> sp.	47 11.8%	49 12.3%	96 12.0%	
	15 Mkwambe	<i>Cordia goetzei</i>	44 11.0%	41 10.3%	85 10.6%	
	16 Mdachi	<i>Commiphora ugogensis</i>	37 9.3%	42 10.5%	79 9.9%	
	17 Ngangaula	<i>Cordyla africana</i>	31 7.8%	29 7.3%	60 7.5%	
	18 Mtumbulu, Nhumbulu [Mnumbulu]	<i>Flacourtia indica</i>	2 0.5%	2 0.5%	4 0.5%	
	19 Mapera, Mpera	<i>Psidium guajava</i>	3 0.8%	1 0.3%	4 0.5%	
	20 Mzambarau	<i>Syzygium cumini</i>	2 0.5%	1 0.3%	3 0.4%	
	21 Ngandu	<i>Berchemia discolor</i> (birdplum)	2 0.5%	1 0.3%	3 0.4%	
	22 Ukwaju	<i>Tamarindus indica</i>	3 0.8%		3 0.4%	
	23 Msanze	<i>Clerodendrum pleiosciadium</i>	1 0.3%		1 0.1%	
	24 Mlumba	<i>Ficus sansibarica</i>	1 0.3%		1 0.1%	
	Mkobora	(unidentified)		1 0.3%	1 0.1%	
	Mlemche	(unidentified)	1 0.3%		1 0.1%	
	Mangurwa	(unidentified)		1 0.3%	1 0.1%	
	Muwele, Wele	(bulrush millet?)	1 0.3%		1 0.1%	
Sap	1 Malaka [Mlaka]	<i>Acacia nilotica</i>		1 0.3%	1 0.1%	
Seeds	1 Ndani ya mbegu za ubuyu	<i>Adansonia digitata</i> (baobab seed kernel)	239 59.8%	227 56.8%	466 58.3%	
	2 Ifungo	<i>Dactyloctenium giganteum</i>	58 14.5%	57 14.3%	115 14.4%	
	3 Mbegu ya mfulu	<i>Vitex payos</i>		1 0.3%	1 0.1%	
	4 Mdawi	<i>Cordia sinensis</i>		1 0.3%	1 0.1%	
	5 Mkungugu	<i>Acacia</i> sp.		1 0.3%	1 0.1%	
	6 Msele	<i>Delonix elata</i>		1 0.3%	1 0.1%	
	7 Mzasa	<i>Acacia senegal</i>		1 0.3%	1 0.1%	
	8 Mtinti [Mtinh]	<i>Erythrococca bongensii</i>		1 0.3%	1 0.1%	
		Kurwa	(unidentified)		1 0.3%	1 0.1%
		Nandara [Kunde]	(cowpea)	1 0.3%		1 0.1%
	Mbaazi	(pigeon peas)		1 0.3%	1 0.1%	
	Njegere	(pea)	1 0.3%		1 0.1%	
Vegetables	1 Muhilile	<i>Cleome hirta</i>	360 90.0%	356 89.0%	716 89.5%	
	2 Sagula sagula	<i>Ipomoea obscura</i>	346 86.5%	319 79.8%	665 83.1%	
	3 Mzole	<i>Corchorus olitorius</i>	322 80.5%	313 78.3%	635 79.4%	
	4 Mtulu	<i>Opilia celtidifolia</i>	300 75.0%	292 73.0%	592 74.0%	
	5 Maweza	<i>Ipomoea sinensis</i>	291 72.8%	299 74.8%	590 73.8%	
	6 Chapali	<i>Ipomoea obscura</i>	254 63.5%	282 70.5%	536 67.0%	
	7 Matembele pori	<i>Ipomoea</i> sp.	235 58.8%	266 66.5%	501 62.6%	
	8 Feune	<i>Amaranthus gracizans</i>	249 62.3%	240 60.0%	489 61.1%	
	9 Mnafu	<i>Solanum nigrum</i>	222 55.5%	217 54.3%	439 54.9%	
	10 Mlenda batata, Ilende, Mgulu	<i>Ceratotheca sesamoides</i>	219 54.8%	199 49.8%	418 52.3%	
	11 Mlenda Wima, Mzinze	<i>Sesamum augustifolium</i>	152 38.0%	153 38.3%	305 38.1%	
	12 Chunga	<i>Launaea cornuta</i>	129 32.3%	134 33.5%	263 32.9%	
	13 Mtango pori	<i>Cucumis dipsaceus</i>	136 34.0%	125 31.3%	261 32.6%	
	14 Mshona nguo	<i>Bidens pilosa</i>	62 15.5%	44 11.0%	106 13.3%	
	15 Kandajizi	<i>Waltheria indica</i>	54 13.5%	48 12.0%	102 12.8%	
	16 Mgagani, Mzimwe	<i>Cleome gynandra</i>	50 12.5%	48 12.0%	98 12.3%	
	17 Mtimba mwisi	<i>Alternanthera sessilis</i>	31 7.8%	28 7.0%	59 7.4%	
	18 Mgomwa, Mgomwe, Ingomwe	<i>Commiphora</i> sp.	15 3.8%	4 1.0%	19 2.4%	
	19 Mfunbulu [Mnhumbulu]	<i>Gewia burtii</i>	1 0.3%		1 0.1%	
20 Mchicha	<i>Amaranthus</i> sp.	1 0.3%	1 0.3%	2 0.3%		
	Mwelewele	(poisonous tree ... probably not eaten)	1 0.3%		1 0.1%	
	Kunde (majani) = Safwe	(cowpea)	2 0.5%	3 0.8%	5 0.6%	

Table 7 Wild food mentioned/consumed (I1&2) continued

Edible part *	Local name	Scientific name (English)	Dry season		Rainy season		Total		
Tuber	Mihogo, Mhogo	(cassava)	28	7.0%	26	6.5%	54	6.8%	
	Viazi vitamu	(sweet potatoes)	15	3.8%	20	5.0%	35	4.4%	
	Viazi, Ndage, Nyazi	(tuber)	8	2.0%	3	0.8%	11	1.4%	
	Viazi mviringo	(potatoes)	6	1.5%	3	0.8%	9	1.1%	
	Mzimi poli	(wild tuber)	1	0.3%			1	0.1%	
Animals	1 Ndege	(bird)	369	92.3%	356	89.0%	725	90.6%	
	2 Kanga	(Guinea fowl)	363	90.8%	355	88.8%	718	89.8%	
	3 Sungura	(rabbit)	347	86.8%	333	83.3%	680	85.0%	
	4 Ng'onde, Dikidiki	(dik-dik)	198	49.5%	189	47.3%	387	48.4%	
	5 Swala	(gazelle)	189	47.3%	190	47.5%	379	47.4%	
		Haruzi [Swala]	(gazelle)	4	1.0%	2	0.5%	6	0.8%
	6 Mbawala	(bushbuck)	45	11.3%	53	13.3%	98	12.3%	
	7 Fumbiri, Fumbili [Munhumbuli]	(mongoose)	16	4.0%	4	1.0%	20	2.5%	
	8 Panya	(rat)	11	2.8%	4	1.0%	15	1.9%	
		Fudi [panya]	(rat)	5	1.3%	3	0.8%	8	1.0%
		Mdele [panya]	(rat, thick-tailed galago)			1	0.3%	1	0.1%
	9 Kane	(cane rat?)	1	0.3%			1	0.1%	
	10 Nguruwe (pori)	(hog)	4	1.0%	4	1.0%	8	1.0%	
	11 Fisi	(hyena)	4	1.0%	2	0.5%	6	0.8%	
	12 Ngedele, Ngedere, Ngejele [Nyani]	(baboon)	5	1.3%			5	0.6%	
	13 Simba, Zimba, Nzimba	(lion)	4	1.0%	1	0.3%	5	0.6%	
	14 Nyani	(baboon)	2	0.5%	1	0.3%	3	0.4%	
	15 Kwale	(francolin, partridge)	1	0.3%	2	0.5%	3	0.4%	
	16 Njiwa	(pigeon)	2	0.5%	1	0.3%	3	0.4%	
	17 Dondoro	(Steinbruck)			3	0.8%	3	0.4%	
	18 Mbala	(heart beast)	1	0.3%	1	0.3%	2	0.3%	
	19 Msila	{a kind of a wild cat}	1	0.3%	1	0.3%	2	0.3%	
	20 Ngedere	(small black monkey)			2	0.5%	2	0.3%	
	23 Funa [Funu]	(sitatunga like bushbuck)			1	0.3%	1	0.1%	
	21 Mbweha	(wild dog)	1	0.3%			1	0.1%	
	22 Nhamu	(small animal, smaller than a cat)	1	0.3%			1	0.1%	
		Twiga	(giraffe [probably not eaten])			2	0.5%	2	0.3%
	Tembo	(elephant [probably not eaten])			1	0.3%	1	0.1%	
	Kuji	(unidentified)			1	0.3%	1	0.1%	
	Mbuzi	(goat)	8	2.0%	2	0.5%	10	1.3%	
	Kondoo	(sheep)	6	1.5%	3	0.8%	9	1.1%	
	Kuku	(chicken)	3	0.8%	3	0.8%	6	0.8%	
	Ng'ombe	(cattle)	5	1.3%	1	0.3%	6	0.8%	
	Bata	(duck)	1	0.3%			1	0.1%	
Insects	1 Kumbikumbi	(flying ants)	122	30.5%	134	33.5%	256	32.0%	
	2 Nyigu	(wasp, hornet)	5	1.3%	4	1.0%	9	1.1%	
	3 Nge	(scorpion)	3	0.8%	5	1.3%	8	1.0%	
	4 Nyuki	(bee)	5	1.3%	3	0.8%	8	1.0%	
	5 Panzi	(grasshopper)	1	0.3%	1	0.3%	2	0.3%	
	6 Vipepeo	(butterfly)	1	0.3%	1	0.3%	2	0.3%	
	7 Nyaumba	(white ant?)			1	0.3%	1	0.1%	
		Nyelevute	(unidentified)	3	0.8%	2	0.5%	5	0.6%
		Mende pori	(unidentified)	1	0.3%	1	0.3%	2	0.3%
		Nyawase	(unidentified)			1	0.3%	1	0.1%
Others	1 Uyoga	(mushrooms)	1	0.3%	1	0.3%	2	0.3%	
Total	83								

Note: *All identified wild food were counted, but cultivated crops, unidentified names, and doubtful answers were not counted.

Source: Compiled from the questionnaire. Most scientific names are obtained from the local name answered, based on prior collection by Sakamoto and identification by Mbago compiled in Sakamoto et al. (2023b). Unidentified wild food names were collected during 22-24 August 2023 and identified by Mbago. Some wild animals have been identified from the Swahili name by Tsuda Katsunori.

Table 8 How wild food is obtained (Q11.9&2.9)

English (Swahili)	Dry season		Rainy season	
	No.	%	No.	%
You obtain yourself (Unapata mwenyewe)	223	55.8	242	60.5
You buy from the store (Unanunua dukani)	149	37.3	136	34.0
Your family brings it from the forest (Familia yako wanakuletea kutoka porini)	213	53.3	207	51.8
Your family brings it from the farm (Familia yako wanakuletea kutoka shambani)	224	56.0	212	53.0
Your family buys from the store (Familia yako wanakununulia dukani)	130	32.5	131	32.8
Others bring it (Wengine wanakuletea)	160	40.0	159	39.8

Source: Compiled from the questionnaire

3 Health

Table 9 indicates the extent to which children experience each health problem. The most common problem was not having an appetite (mean 1.14 ± 0.937), followed by

Table 9 Health problems (QIII)

☆ English	Swahili	n	Mean	SD
1 I don't want to eat. I don't have an appetite.	Sitaki kula chakula. Sina hamu ya kula	384	1.14	0.937
2 I have a headache	Ninaumwa na kichwa	386	1.12	0.735
3 I have a stomachache	Ninaumwa na tumbo	386	0.93	0.926
4 I have diarrhea	Ninaharisha	386	0.65	0.772
5 I have constipation	Ninapata shida ya kupata choo	370	0.96	0.929
6 I can't see far away	Nina shida kuona mbali	381	0.82	0.863
7 I have a toothache	Ninaumwa na jino	379	0.79	0.841
8 I get dizzy	Ninapata kizunguzungu	389	0.60	0.801
9 I have problems waking up. I feel ill in the morning"	Sijisikii vizuri asubuhi. Ninapata shida kuamka asubuhi.	376	0.85	0.828
10 My body feels tired	Mwili unachoka bila sababu	385	0.99	0.827
11 I don't feel like doing anything	Sitaki kufanya kitu chochote	380	0.83	0.784
12 I feel mad	Ninahamaki mara kwa mara bila sababu	384	0.70	0.892

Note: SD = standard deviation; 0 = none of the time, 1 = sometimes, 2 = frequently, 3 = all of the time
The actual range is also between 0 and 3.

Source: Compiled from the questionnaire

Table 10 About experience and preference drawing, reading, and watching (QIV)

☆ English	Swahili	Yes		No		n.a.		Total	
		No.	%	No.	%	No.	%	No.	%
2 Have you ever drawn pictures?	Umewahi kuchora picha?	355	88.8	9	2.3	36	9.0	400	100.0
3 Do you like to draw pictures?	Unapenda kuchora picha?	324	81.0	23	5.8	53	13.3	400	100.0
4 Do you read picture books?	Unasoma kitabu cha picha?	353	88.3	13	3.3	34	8.5	400	100.0
5 Do you like picture books?	Unapenda kitabu cha picha?	336	84.0	10	2.5	54	13.5	400	100.0
6 Do you watch video or TV?	Unaangalia video au TV?	263	65.8	94	23.5	43	10.8	400	100.0
7 Do you like video or TV?	Unapenda kuangalia video au TV?	247	61.8	100	25.0	53	13.3	400	100.0

Source: Compiled from the questionnaire

headache (1.12 ± 0.735), body feeling tired (0.99 ± 0.827), constipation (0.96 ± 0.929), and stomachache (0.93 ± 0.926).

4 Pictures

Within the questionnaire, the majority answered that they drew favorite food (222 pupils, 55.5%), followed by wild food (107 pupils, 26.8%), food frequently eaten (81 pupils, 20.3%), and scenes when eating food (78 pupils, 19.5%).³

Table 10 indicates the experiences and preferences of drawing pictures, reading picture books, and watching video/TV. The majority had experience drawing pictures (88.8%) / reading picture books (88.3%) and like them (picture: 81.0%, books: 84.0%), but not as much for video and TV (experience: 65.8%; like: 61.8%).

III Comparison between neighboring schools

1 Food group intake

Food group intake frequencies in the dry season and the rainy season were compared between the 5 schools by box-and-whisker plots. Among staple food and vegetable consumption frequencies in the dry season (Figure 2-1), pupils in Majeleko had higher consumption of vegetables. Among proteins, Manzilanzi had higher consumption of milk, and Majeleko and Mbelezungu had relatively higher consumption of meat (Figure 2-2). Comparing nuts and fruits, Majeleko has a higher consumption of both nuts and fruits compared to other schools (Figure 2-3). Salt is consumed indifferently between schools, but oil and sugar are most consumed in Majeleko (Figure 2-4).

Figure 2 Dry season food group intake (school comparison)

Figure 2-1 Staple foods and vegetables

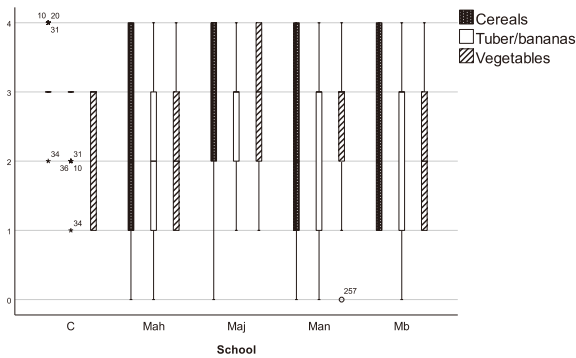


Figure 2-2 Protein

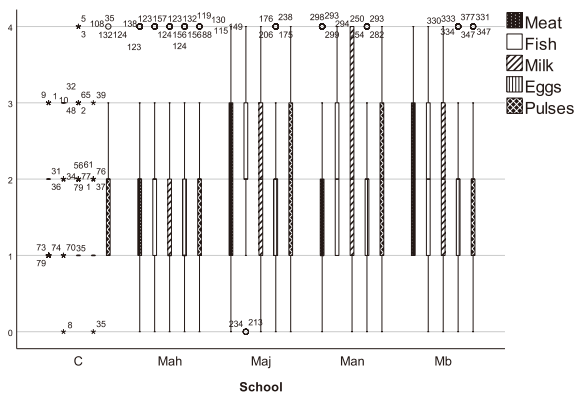


Figure 2-3 Nuts and fruits

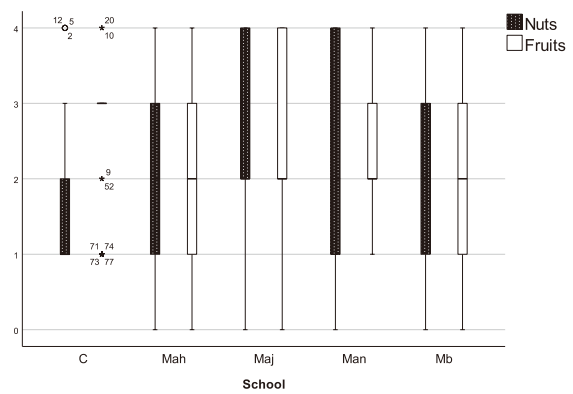
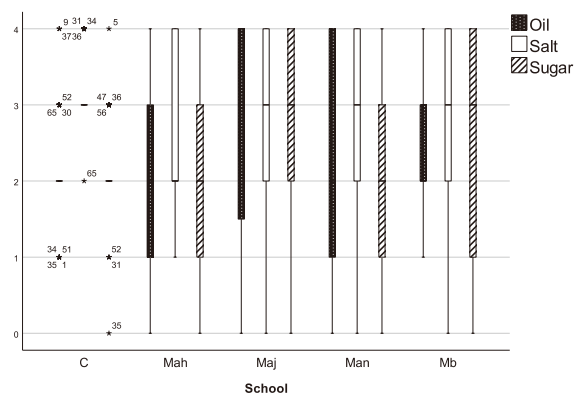


Figure 2-4 Oil, salt, and sugar



Note: C = Chinangali, Mah = Mahata, Maj = Majeleko, Man = Manzilanzi, Mb = Mbelezungu
Source: Analyzed from the questionnaire

Figure 3 further compares the seasonal differences in food groups that had differences between schools. Vegetables are consumed more in Majeleko even in the rainy season, although consumption decreases. Consumption increases in the rainy season in Manzilanzi (Figure 3-1). Consumption of milk was higher in Manzilanzi during the dry season but not as much in the rainy season (Figure 3-2). The consumption of nuts was high in Majeleko and Manzilanzi during the dry season but indifferent in the rainy season (Figure 3-3). Consumption of fruits was also high in Majeleko not only in the dry season but also in the rainy season (Figure 3-4). Oil, which was highly consumed in Majeleko and Manzilanzi, is joined by Mbelezungu in the rainy season (Figure 3-5). Sugar was highly consumed in Majeleko and Mbelezungu in the dry season but only in Majeleko in the rainy season (Figure 3-6).

2 Wild food intake

Figure 4-1 indicates the wild food consumption frequency in both seasons in the 5 schools. Manzilanzi has a high consumption throughout the year, and Mbelezunguo to some extent, although a slight decline in the rainy season is observed. Majeleko and Mahata have slight increases in the rainy season. For baobab, Majeleko, Mahata, and Mbelezungu have frequent consumption in the dry season, but Majeleko decreases in the rainy season (Figure 4-2).

3 Comparing health problems

Looking into health problems (Figure 5-1), constipation is frequently reported in Chinangali⁴ in comparison to other schools. Lack of appetite is also common in Chinangali and Mahata and to some extent Mbelezungu.

Regarding health problems in Figure 5-2, headache is more often experienced in Majeleko and Mbelezungu in comparison to other schools. Health problems indicated in Figure 5-3 did not have visible differences, except that Chinangali may be relatively frequent.

Figure 3 Seasonal differences in food group intake (school comparison)

Figure 3-1 Vegetables

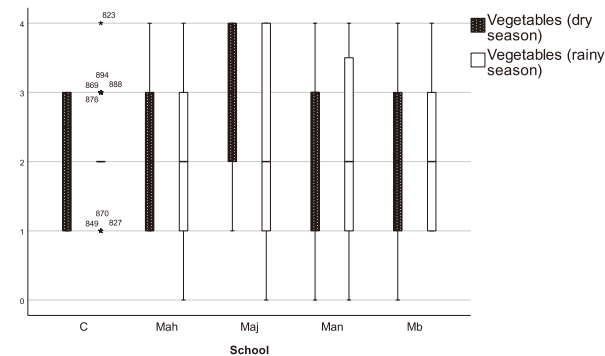


Figure 3-2 Milk

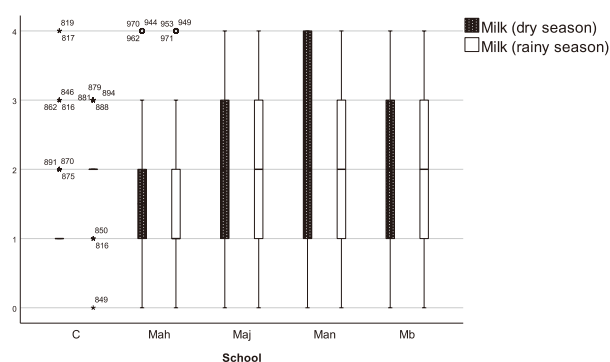


Figure 3-3 Nuts

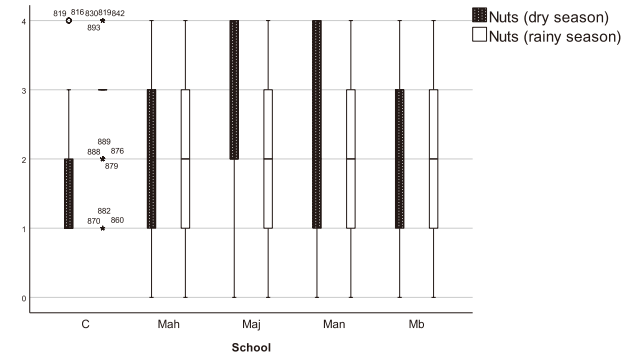


Figure 3-4 Fruits

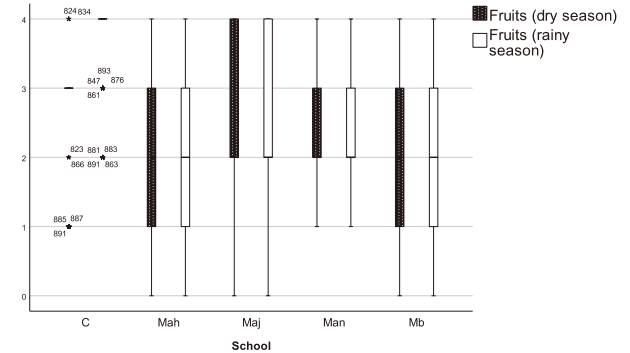


Figure 3-5 Oil

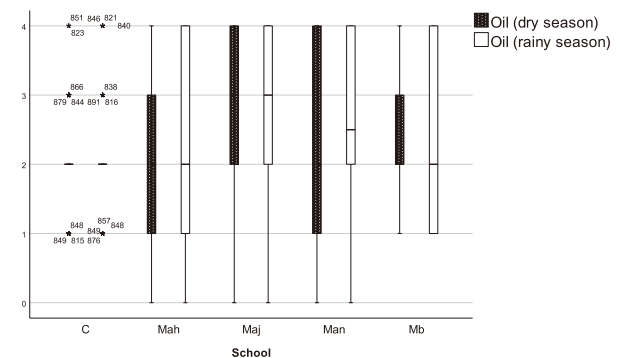
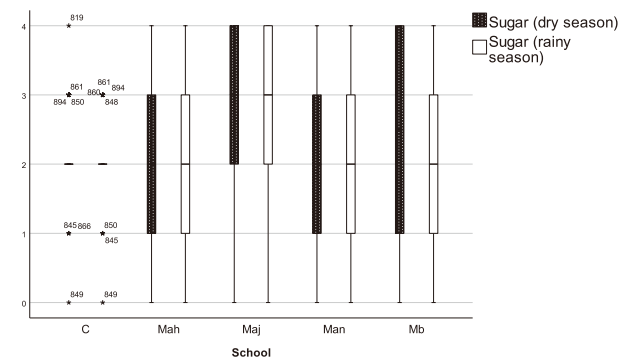


Figure 3-6 Sugar



Note: C = Chinangali, Mah = Mahata, Maj = Majeleko, Man = Manzilanzi, Mb = Mbelezungu
 Source: Analyzed from the questionnaire

Analyzing neighboring school pupils' situations, clear differences were seen between central and remote areas even within similar climatic areas. The article provides evidence that loss of biodiversity leads to changing eating habits and less opportunity to access wild food and dairy products. Since the most remote school, Manzilanzi, had the least health problems, modernization in food intake and a decrease in biodiversity may be one of the reasons for pupils' health decline. While further research to understand the causal relationship is necessary, actions to restore biodiversity and lifestyle may be necessary to maintain children's health.

Role of Authors and Acknowledgment

Sakamoto is responsible for writing the initial manuscript, editing and confirming the final manuscript, overall conceptualization, data collection, final questionnaire data input check, and supervision of data analysis. Kikuchi coordinated and checked the data insert, and checked the data and reference agreement of the manuscript. Chimosa coordinated and collected the data from the schools, scanned the questionnaires, and translated the summary to Swahili. Mbago identified wild plants and confirmed the scientific names. Sato inserted the data, and checked the data and reference agreement of the manuscript. Ohmori provided conceptualization for children's health evaluation and food intake frequency, and checked the data analysis. All authors have confirmed and agreed with the final manuscript.

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number will be reconfirmed when analyzing the drawings.

⁴ The results of Chianangali may not be reliable. Figures 2 to 5 indicate that answers concentrate on one answer except for a few outliers, and the teacher may have indicated the pupils to answer specifically. The results of Chinagali may be omitted in further analysis due to the discrepancy in the data.

⁵ Seasonal differences, especially in milk, contradict previous research on adults (Sakamoto et al. 2020b). Since this analysis is based on information collected in the dry season, the results need to be verified with additional information collected in the rainy season.

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¹ Viazi was indicated to be meant as Irish potatoes, but may also include sweet potatoes.

² There is a contradiction between Table 5 and 6 considering that baobab is a wild food.

³ Answers that they ticked as drawn and actual drawing at times had inconsistencies. Further confirmation of actual

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Children's Food, Wild Food, and Health in Semi-arid Tanzania:

Differences Within Neighboring Schools in Chamwino, Dodoma

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Abstract

Food intake and wild food access are important for children's health and achieving zero hunger in the semi-arid Africa, but evaluations of changing diets are mixed. This article consolidates questionnaires participated by 400 pupils mainly in grades V and VI (mean age 13.02 ± 1.491) in 5 schools in semi-arid central Tanzania, Chamwino district, Dodoma region collected in September 2022. Food group, wild food intake frequency, and health problems were compared between 5 schools. The pupils in relatively urbanized villages ate vegetables, fruits, and sugar more frequently, whereas those in remote areas ate wild food and milk more frequently. More health problems were frequently claimed in urbanized villages than in remote villages. Sustaining the environment and lifestyle for children to access wild food may be beneficial for children's health.

要約 子どもたちの健康や飢餓ゼロを達成する上で、アフリカ半乾燥地における食料摂取や野生食物アクセスは重要であるが、食生活の変化に対する評価は賛否がある。本論文は、2022年9月に収集したタンザニア中部ドドマ州チャムウィノ県の半乾燥地5校の、主に5～6年生の児童400人（平均年齢 13.02 ± 1.491 歳）が参加したアンケートを集約し、食品群・野生食物の摂取頻度や健康問題について5校を比較した。比較的都市化された村の生徒たちは野菜・果物・砂糖を、遠隔地の生徒たちは野生食物や牛乳をより頻繁に食べた。遠隔地の村よりも都市化された村の方が、より多くの健康問題を訴える傾向があった。子どもたちが野生食物を利用できる環境とライフスタイルを維持することは、健康に有益である可能性がある。

MUHTASARI Ulaji wa chakula na upatikanaji wa chakula cha porini ni muhimu kwa afya ya watoto na kumaliza tatizo la njaa katika Afrika yenye ukame, lakini tathmini ya mabadiliko ya lishe ni mchanganyiko. Makala haya yanajumuisha dodoso zilizoshirikisha wanafunzi 400 hasa wa darasa la V na VI (wastani wa umri 13.02 ± 1.491) katika shule 5 za eneo la kati mwa Tanzania lenye hali ya ukame, wilayani Chamwino, mkoani Dodoma zilizokusanywa Septemba 2022. Makundi ya chakula na ulaji wa vyakula pori na matatizo ya kiafya yalikuwa yakilinganishwa kati ya shule 5. Wanafunzi katika vijiji vilivyo kwenye miji walikula mboga mboga, matunda na sukari mara kwa mara, wakati wale wa maeneo ya mbali walikula chakula cha porini na maziwa mara kwa mara. Matatizo zaidi ya kiafya yalijitokeza mara kwa mara katika vijiji vya mijini kuliko vijiji vya mbali. Kudumisha mazingira na mtindo wa maisha kwa watoto kupata chakula cha porini kunaweza kuwa na manufaa kwa afya ya watoto.

(2023年10月31日受理)