



ATSAF - CGIAR++ Junior Scientists Program Final Report

Name of student: Lara Elena Thiele

University: University of Kassel

Supervisor at University: Dr. Margareta Amy Lelea

International Agricultural Research Center: International Institute of Tropical Agriculture (IITA)

Country: Ghana

Supervisor at IARC: Dr. Fred Kizito

Start and end date of stay at IARC: -

Start and end date of remotely supervised project: 01 Nov 2020 - 30 Apr 2021

Title: Nutrition of Cowpea and Maize yields in Northern Ghana

Funded by the German Federal Ministry for Economic Cooperation and Development (BMZ)





University of Kassel
Faculty of Organic Agriculture
M.Sc. Ökologische Agrarwissenschaft

Junior Scholarship Report

Nutrition of Cowpea and Maize yields in Northern Ghana

1st Supervisor: Dr. Fred Kizito
IITA Tamale, Ghana

2nd Supervisor: Dr. Margareta Amy Lelea
German Institute for Tropical and Subtropical Agriculture
Section of Agricultural and Biosystems Engineering

Submitted by
Lara Elena Thiele (born on 26.03.1985, Kamen)

Witzenhausen, June 2021



1. Materials and Methods

1.1 Data

Data for this analysis was provided by Dr. Abdul Rahman Nurudeen and his team in Tamale, Ghana. The data was collected in the Upper West and Northern Region of Ghana. The treatment was either sole cowpea, 2 maize:4 cowpea, 2 maize:2 cowpea, or sole maize. The yield is shown in kg/ha. The data was collected from 109 female and male famers (59 female and 50 male). Forty-eight farmers live in the Northern Region and 61 farmers live in the Upper West Region. In the Northern Region, farmers come from the following communities: Salvelugu, Tolon and Kumbungu. Farmers in the Upper West Region come from the communities of Nadowli and Wa West.

The micronutrients selected for this study are protein, fibre, iron, zinc, folate, potassium, magnesium, phosphorus, calcium, beta-carotene, vitamin A RAE, and phytate.

1.2 Calculations

Various nutrient contents and calories of cowpea and maize was averaged from the INFOODS WAFCT list of 2019 of the dry and raw state of different varieties. The list is publically available online.

Table 1 shows the average g/100g for the selected nutrients based on the data available in the INFOODS list. The data on average g/100g was used to calculate grams of nutrient per hectare taking into account the data on yield as well.

The numbers used for the analysis were then first calculated on g/kg and then to g/ha. This includes the assumption that 100% of the nutrition of the dry and raw state is kept (100% NFH = Nutrition from harvest). The calculated nutrients are protein, fibre, iron, zinc, folate, potassium, magnesium, phosphorus, calcium, beta-carotene, vitamin A RAE, and the anti-nutrient phytate. There was no data on beta-carotene and vitamin A RAE for maize.

Table 1: Averaged data points for cowpea and maize per 100g

Species	Cowpea, dry, raw	Cowpea, white, dry, raw	Cowpea, black, dry, raw	Cowpea, brown, dry, raw	Average
Nutrient					
Calories	325	331	301	326	320,75
Protein (g)	22,6	23	20,5	23,6	22,425
Fibre (g)	12,6	10,6	21	12,8	14,25
Iron (mg)	6,2	6,7	5,8	6,8	6,375
Zinc (mg)	3,55	3,77	3,88	3,96	3,79
Folate (mcg)	420	420	410	420	417,5
Potassium (mg)	1120	1100	1380	1090	1172,5
Magnesium (mg)	249	218	202	310	244,75
Phosphorus (mg)	416	414	402	450	420,5
Calcium (mg)	82	75	80	78	78,75
Beta-Carotene (mcg)	14	8	19	7	12
Vitamin A RAE (mcg)	1	1	2	1	1,25
Phytate (mg)	779	26	595	792	548

Species	Maize, Gougba variety, whole kernel, dry, raw	Maize, Gbaévé variety, whole kernel, dry, raw	Maize, DMR-ESR-W variety, whole kernel, dry, raw	Maize, POZA - RICA 7843 - SR variety, whole kernel, dry, raw	Maize, TZPB-SR variety, whole kernel, dry, raw	Maize, Gnonli variety, whole kernel, dry, raw	Maize, combined varieties, whole kernel, dry, raw	Maize, white, whole kernel, dry, raw	Maize, yellow, whole kernel, dry, raw	Average
Nutrient										
Calories	333	335	340	333	339	330	335	346	350	337,89
Protein (g)	8,7	8,1	8,8	9	8,8	7,6	8,4	9,7	9,4	8,72
Fibre (g)	11,5	11,5	11,5	11,5	11,5	11,5	11,5	11,5	9,4	11,27
Iron (mg)	3,3	3,3	3,3	3,3	3,3	3,3	3,3	3,3	3,4	3,31
Zinc (mg)	2,2	2,2	2,2	2,2	2,2	2,2	2,2	2,2	1,99	2,17
Folate (mcg)	71	71	71	71	71	71	71	71	71	71
Potassium (mg)	316	316	316	316	316	316	316	316	319	316,33
Magnesium (mg)	89	89	89	89	89	89	89	89	89	89
Phosphorus (mg)	267	267	267	267	267	267	267	267	248	264,89
Calcium (mg)	23	23	23	23	23	23	23	23	21	22,78
Beta-Carotene (mcg)										0
Vitamin A RAE (mcg)										0
Phytate (mg)	646	646	646	646	646	646	646	646	630	644,22

Nutrition on household level was calculated by the amount per hectare divided by the amount of farmers.

Table 2 shows that the average household size in the Northern Region is 10.2 people and the average land size 2 ha. The numbers for the Upper West Region are slightly lower with 8.1 and 1.7 ha household and land size respectively. This data is from the end line survey provided by Dr. Abdul Rahman Nurudeen and was used to estimate the nutrition by average land and household size.

Table 2: Data on household and land size from the end line survey conducted by IFPRI in 2020.

Region	Household size			Land size (ha)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Northern	2	38	10.2	0.2	21.3	2.0
Upper West	2	30	8.1	0.2	4.4	1.7

2. Result

Based on the calculations mentioned in 3.2 the average nutrition is presented in this chapter. Table 3 shows an overview of the results of the average nutrition per ha based on yield kg/ha for cowpea.

Table 3: Calculated average nutrition per ha based on yield kg/ha for cowpea.

Nutrient	Average nutrition by yield per ha
Calories	1554576,82
Protein (g)	108662,86
Iron (mg)	415737,882
Zinc (mg)	18368,96695
Folate (mcg)	2023494,38
Phytate (mg)	2655987,833
Potassium (mg)	5682747,69
Magnesium (mg)	1186228,142
Phosphorus (mg)	2038034,459
Calcium (mg)	381677,0836
Fibre (g)	69065,37704
RAE (mcg)	6058,366407

Table 4 shows an overview of the results of the average nutrition per ha based on yield kg/ha for maize.

Table 4: Calculated average nutrition per ha based on yield kg/ha for maize.

Nutrient	Average nutrition by yield per ha
Calories	3480958,012
Protein (g)	89833,83309
Iron (mg)	34099,76921
Zinc (mg)	22458,45827
Folate (mcg)	731445,2006
Phytate (mg)	6634517,031



Potassium (mg)	3255446,245
Magnesium (mg)	916882,012
Phosphorus (mg)	2730041,946
Calcium (mg)	234886,6278
Fibre (g)	116104,048
RAE (mcg)	-

The complete excel document with data on each farm can be found in the appendix.

Farmers in the Northern Region achieved generally higher calories with 540,20 kg/ha and 1194,19 kg/ha for cowpea and maize respectively, compared to 397,27 kg/ha and 772,12 kg/ha in the Upper West Region. Table 5 and 6 show estimations for possible nutrition by average land and household size based on the data from table 3.

<i>Table 5: Calculated average nutrition per ha for the Northern Region by average land and household size.</i>		
Nutrient	Estimation of nutrition by average land size	Divided by average household size
Calories	3109153,64	304818,9843
Protein (g)	217325,72	21306,44314
Iron (mg)	831475,764	81517,23176
Zinc (mg)	36737,9339	3601,758225
Folate (mcg)	4046988,76	396763,6039
Phytate (mg)	5311975,666	520781,928
Potassium (mg)	11365495,38	1114264,253
Magnesium (mg)	2372456,284	232593,7533
Phosphorus (mg)	4076068,918	399614,5998
Calcium (mg)	763354,1672	74838,64384
Fibre (g)	138130,7541	13542,23079
RAE (mcg)	12116,73281	1187,914982
Note: There is insufficient information about how much is sold by each individual household and how much input is needed to achieve this yield.		

Table 6: Calculated average nutrition per ha for the Upper West Region by average land and household size.

Nutrient	Estimation of nutrition by average land size	Divided by average household size
Calories	5917628,62	730571,4346
Protein (g)	152717,5163	18854,01435
Iron (mg)	57969,60766	7156,741686
Zinc (mg)	38179,37906	4713,503588
Folate (mcg)	1243456,841	153513,1902
Phytate (mg)	11278678,95	1392429,5
Potassium (mg)	5534258,617	683241,8045
Magnesium (mg)	1558699,42	192432,0272
Phosphorus (mg)	4641071,308	572971,7664
Calcium (mg)	399307,2673	49297,19349
Fibre (g)	197376,8816	24367,51625
RAE (mcg)	-	-

Note: There is insufficient information about how much is sold by each individual household and how much input is needed to achieve this yield.

The WHO states that persons with a healthy body weight need about 2000 calories per day varying with sex, age, and activity level. The average amount of calories received from the cowpea yield therefore would feed about 25 people in a month and that received from maize about 58 people in a month. However, people usually don't eat only cowpea or maize, even though maize is a staple food in Ghana. Cowpea for example is usually prepared in stews or mixed with rice in the traditional dish of Waakye. Wu (2016) states that "*dietary intake of 1.0, 1.3, and 1.6 g protein per kg body weight per day is recommended for individuals with minimal, moderate, and intense physical activity, respectively.*" Especially cowpea with a relatively high amount of protein can significantly contribute to achieving that.