Table S1. Physico-chemical properties of the soil profiles and parameters of the bare soil**.**

Soil property	**Acronym in APSIM**	**Soil fertility type**		
		Upland low fertility	**Upland medium fertility**	**Valley-bottom soil**
		Fertility rank		
	(cm depth of soil layer)	*1*	*2*	*3*
Bulk Density	BD (0-15)	1.56	1.54	1.40
	BD (15-30)	1.58	1.53	1.40
Evaporation-dried SWC	AirDry (0-15)	0.023	0.027	0.054
	AirDry (15-30)	0.077	0.075	0.088
15 bar lower limit of SWC	LL15 (0-15)	0.046	0.054	0.049
	LL15 (15-30)	0.096	0.094	0.099
Drained upper limit SWC	DUL (0-15)	0.203	0.231	0.201
	DUL (15-30)	0.209	0.219	0.203
Saturated water content	SAT (0-15)	0.352	0.353	0.353
	SAT (15-30)	0.321	0.357	0.357
Soil Organic Matter	SOM % (0-15)	0.39	0.58	1.40
	SOM % (15-30)	0.36	0.56	0.95
Fraction of biomass carbon	FBiom (0-15)	0.015	0.020	0.020
	FBiom (15-30)	0.001	0.020	0.020
Fraction of inert carbon	FInert (0-15)	0.350	0.350	0.350
	FInert (15-30)	0.350	0.400	0.400
C:N ratio	C:N	12	12	10.7
pH	pH 1:5 H2O (0-30)	6.39	6.39	5.6
Labile Phosphorus	LabP mg kg^{-1} (0-15)	15.0	21.0	7.6
	LabP mg kg^{-1} (15-30)	5.2	6.2	7.6
	SWCON	0.6	0.6	0.3
Diffusivity Constant	*diffus_const*	170	170	145
Diffusivity Slope	*diffus_slope*	29	29	19
Bare soil albedo	*salb*	0.15	0.15	0.12
Runoff curve number	*CN2-bare*	68	68	73

Table S2. Management and cultivar data.

Crop	Cultivar	Sowing window	Sowing density	Row spacing
		date	*plants m-2*	*mm*
Groundnut	Virginia bunch	14th June – 13th July	8	700
Millet	CIVT[1]	20th May – 19th June	5.5	900
Sorghum	Medium	1st June – 1th July	5.5	900
Maize	Landrace [2]	10th June – 10th July	6.6	600
Rice	Local	7th July	75	-

Table S3. Energy (kcal) average Daily Recommended Intake per age and sex cohort, assuming medium activity levels diets of the population of Bolgatanga Municipal and Bongo districts. Based on data from [3–6].

Population group	Assumed body weight	Population	Percentage over total population	DRI person^{-1}
< 1 year males	6	2960.4	1%	639
< 1 year females	9	2760	1%	599
1 – 4 males	12	11841.6	5%	1110
1 – 4 females	17	11040	5%	1023
5 – 9 males	21	14367	7%	1641
5 – 9 females	21	14066	6%	1503
10 – 14 males	25	13917	6%	2456
10 – 14 females	47	13760	6%	2200
15 – 18 males	49	12256	6%	3225
15 – 18 females	55	12461	6%	2488
18 – 30 males	70	16093	7%	3050
18 – 30 females	60	19047	9%	2400
30 – 60 males	70	23814	11%	2950
30 – 60 females	60	29899	14%	2350
>60 males	70	7618	4%	2450
>60 females	60	11185	5%	1950
Total population		217,254	**Average kcal DRI**	**2,227**

Table S4. Iron (Fe) Daily Recommended Intake per age and sex cohort, assuming 10% bioavailability diets of the population of Bolgatanga Municipal and Bongo districts Based on data from [3–6].

Population group	Assumed body weight	Population	Percentage over total population	DRI person^{-1}
0-6 months		2,945	1%	-
7-12 months	9	2,945	1%	9.3
1-3 years	13	17,161	8%	5.8
4-6 years	19	17,094	8%	6.3
7-10 years	28	22,595	10%	8.9
11-14 males	45	11,134	5%	14.6
11-14 females	46	11,008	5%	23.4
15-17 males	64	7,354	3%	18.8
15-17 females	56	7,477	3%	31.0
18+ males	75	52,427	24%	13.7
18-50 females	62	47,115	22%	29.4
50+ females	62	18,000	8%	11
Total population		217,254	**Average Fe DRI**	**16.26**

Table S5. Zinc (Zn) Daily Recommended Intake per age and sex cohort, assuming moderate zinc bioavailability diets of the population of Bolgatanga Municipal and Bongo districts Based on data from [3–6].

Population group	Assumed body weight	Population	Percentage over total population	DRI person^{-1}
0-6 months	6	2,945	6%	2.8
7-12 months	9	2,945	9%	4.1
1-3 years	12	17,161	12%	4.1
4-6 years	17	17,094	17%	4.8
7-9 years	25	17,060	25%	5.6
10-19 females	47	26,221	47%	7.2
10-19 males	49	26,173	49%	8.6
20-65 females	55	51,811	55%	4.9
20-65 males	65	41,941	65%	7.0
65+ females	55	8,320	55%	4.9
65+ males	65	5,584	65%	7.0
Total population		217,254	**Average Zn DRI**	**6.02**

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