

Calculations page

INPUT				
Feed parameters				
Utilization	Dry	Wet		
wheat	0.90	0.90		
barley	0.95	0.95		
maize	0.95	0.95		
zorghum	0.95	0.95		
Millet	0.95	0.95		
Napier	1.00	1.00		
Woodr	1.00	1.00		
Savannah	1.00	1.00		
Hay	1.00	1.00		
Grains				
	Dry	Wet		
	(fraction)			
wheat	1.30	1.30		
barley	1.30	1.30		
maize	1.30	1.30		
zorghum	4.00	4.00		
Millet	2.00	2.00		
wheat bran	0.05	0.05		
barley bran	0.05	0.05		
maize bran	0.05	0.05		
zorghum bran	0.05	0.05		
Millet bran	0.05	0.05		
wheat cake	0.00	0.00		
barley cake	0.00	0.00		
maize cake	0.00	0.00		
zorghum cake	0.00	0.00		
Millet cake	0.00	0.00		
ME				
	Dry	Wet		
	(MJ/kg)			
wheat	5.90	5.90		
barley	7.10	7.10		
maize	8.60	8.60		
zorghum	7.15	7.15		
Millet	7.15	7.15		
wheat bran	9.50	9.50		
barley bran	9.50	9.50		
maize bran	9.50	9.50		
zorghum bran	9.50	9.50		
Millet bran	9.50	9.50		
wheat cake	12.40	12.40		
barley cake	12.40	12.40		
maize cake	12.40	12.40		
zorghum cake	12.40	12.40		
Millet cake	12.40	12.40		
wheat grain	12.00	12.00		
barley grain	12.00	12.00		
maize grain	12.00	12.00		
zorghum grain	12.00	12.00		
Millet grain	12.00	12.00		
Napier	8.90	8.90		
Woodr	8.90	8.90		
Savannah	8.90	9.00		
Hay	7.00	7.00		
CWP				
	Dry	Wet		
	(kg/m ³)			
wheat	4.00	4.00		
barley	2.00	2.00		
maize	4.00	4.00		
zorghum	5.00	5.00		
Millet	5.00	5.00		
Napier	3.50	3.50		
Woodr	3.00	3.00		
Savannah	2.00	2.00		
Hay	2.00	2.00		
DM content				
	Dry	Wet		
	(fraction)			
wheat	0.90	0.90		
wheat grain	0.90	0.90		
wheat bran	0.90	0.90		
barley	0.90	0.90		
barley grain	0.90	0.90		
barley bran	0.90	0.90		
maize	0.90	0.90		
maize grain	0.90	0.90		
maize bran	0.90	0.90		
zorghum	0.90	0.90		
zorghum grain	0.90	0.90		
zorghum bran	0.90	0.90		
Millet	0.90	0.90		
Millet grain	0.90	0.90		
Millet bran	0.90	0.90		
Napier	0.60	0.70		
Woodr	0.50	0.60		
Savannah	0.80	0.60		
Hay	0.90	0.90		
Animals, activities & production				
Animal	Value			
TLU	(fraction)	0.70		
Live weight start	(year)	25		
Culling age	(year)	20		
body weight	(kg)	175		
Production				
	Dry	Wet	Unit	
Net energy in milk	3.50	3.50	ME/kg	
Milk production	1.0	4.0	kg/day	
Net energy BWG	11.50	11.50	ME/kg	
Body weight gain	0.021	0.021	Kg/day	
Method ME_u walking				
	porkm			
Activity	Dry	Wet	Unit	
Walking	0.50	0.20	fraction	
Stall fed	0.20	0.20	fraction	
Terrain	0.10	0.10	fraction	
Drought	0.00	0.00	fraction	
Energy				
EVALKING	horizontal	0.0020	0.002	MJ/BW
EVALKING	vertical	0.0280	0.028	MJ/BW
Distance		20.00	1.00	km
Hard composition				
	Dry	Wet	Unit	
Lactating animal	0.2	0.6	fraction	
Diet				
Category	Season		Unit	
	Dry	Wet		
wheat	Roriduo	10.0	0.0	%
	Bran	10.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	10.0	0.0	%
barley	Roriduo	10.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
maize	Roriduo	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
zorghum	Roriduo	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
Millet	Roriduo	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
Napier		20.0	0.0	%
Woodr		30.0	0.0	%
Savannah		10.0	100.0	%
Hay		0.0	0.0	%
Total percentage		100.0	100.0	%
Energy				
gross energy of the diet	18.4	18.4	MJ/kg	
gm	0.491	0.489		
Constraint on feed intake				
	Dry	Wet	Unit	
Climate	Dry	Wet	Unit	
LGP	245	120	Days	
Mean temperature	25	15	°C	
Sustainability				
POT	30	70	%	
Terrain				
Slope	5	5	°	
Accessibility	10	10	%	

OUTPUT		Results for:	dry season	&	TLU		
Energy requirements TLU							
Variables	Season	Wet	Unit	Annual	Unit		
ME maintenance	23.9	33.9	MJ/day	12394	MJ/yr		
ME activity	23.9	7.9	MJ/day	8040	MJ/yr		
ME milk	8.4	33.8	MJ/day	6130	MJ/yr		
ME BWG	0.9	0.9	MJ/day	317	MJ/yr		
Total ME TLU	72.2	76.5	MJ/day	26871	MJ/yr		
Dry matter requirements / TLU / day							
Breakdown FDM (kg/day) for the dry season			Breakdown PDM (kg/day) for the dry season				
crop	roriduo	bran	grain	nat. veg.	Total		
wheat	1.38	0.68	0.54		2.60		
barley	0.96				0.96		
maize							
zorghum							
Millet							
Napier				1.46	1.46		
Woodr				2.19	2.19		
Savannah				0.74	0.74		
Hay							
Total	2.34	0.68	0.54	4.39	7.95		
Feed intake			Feed intake				
	Dry	Wet	Unit	Annual	Unit		
FDM TLU	38.27	8.51	Kg/day	11460	kg/yr		
FDM TLU	7.95	8.51	Kg/day	4032	kg/yr		
Water requirements							
Water for food			Drinking water				
	Season (m ³ /d)	Wet	Annual (m ³ /yr/TLU)		Season (l/d/TLU)	Annual (m ³ /yr/TLU)	
Maximum	11.36	4.25	3294	Maintenance	37.78	33.60	12.29
-double count	10.42	4.25	3064	Milk	0.87	3.48	0.63
+roriduo	1.82	4.25	660	Water from food	2.18	2.40	0.94
+POT+roriduo	11.28	14.18	4465	Total	36.46	33.67	12.97
Water productivity (milk production/depleted water)							
Average LWP for lactating animals			Average LWP per animal at herd level				
Variable	Result	Unit	Variable	Result	Unit		
Milk production	1036	l	Milk production	481	l		
LWP (maximum)	0.31	l/m ³	LWP (maximum)	0.16	l/m ³		
LWP (-double count)	0.34	l/m ³	LWP (-double count)	0.18	l/m ³		
LWP (+roriduo)	1.06	l/m ³	LWP (+roriduo)	0.21	l/m ³		
LWP (+POT+roriduo)	0.23	l/m ³	LWP (+POT+roriduo)	0.12	l/m ³		

Page consists of two components for the

- The input interface
- The results

Input

- Numbers / text in blue can be changed
- Numbers / text in gray can not be changed

INPUT

Feed parameters

Feed parameters		
Utilization	Dry	Wet
wheat	0.80	0.80
barley	0.95	0.95
maize	0.95	0.95
sorghum	0.95	0.95
Millet	0.95	0.95
Napier	1.00	1.00
Weeds	1.00	1.00
Savannah	1.00	1.00
Hay	1.00	1.00
Grain to	Dry	Wet
	(fraction)	
wheat residue	1.30	1.30
barley residue	1.30	1.30
maize residue	1.30	1.30
sorghum residue	4.00	4.00
Millet residue	2.00	2.00
wheat bran	0.05	0.05
barley bran	0.05	0.05
maize bran	0.05	0.05
sorghum bran	0.05	0.05
Millet bran	0.05	0.05
wheat cake	0.00	0.00
barley cake	0.00	0.00
maize cake	0.00	0.00
sorghum cake	0.00	0.00
Millet cake	0.00	0.00
ME	Dry	Wet
	(MJ / kg)	
wheat residue	5.90	5.90
barley residue	7.10	7.10
maize residue	8.60	8.60
sorghum residue	7.18	7.18
Millet residue	7.18	7.18
wheat bran	9.50	9.50
barley bran	9.50	9.50
maize bran	9.50	9.50
sorghum bran	9.50	9.50
Millet bran	9.50	9.50
wheat cake	12.40	12.40
barley cake	12.40	12.40
maize cake	12.40	12.40
sorghum cake	12.40	12.40
Millet cake	12.40	12.40
wheat grain	12.00	12.00
barley grain	12.00	12.00
maize grain	12.00	12.00
sorghum grain	12.00	12.00
Millet grain	12.00	12.00
Napier	8.90	8.90
Weeds	8.90	8.90
Savannah	8.80	9.00
Hay	7.00	7.00

CWP	Dry	Wet
	(kg / m ³)	
wheat	4.00	4.00
barley	2.00	2.00
maize	4.00	4.00
sorghum	5.00	5.00
Millet	5.00	5.00
Napier	3.50	3.50
Weeds	3.00	3.00
Savannah	2.00	2.00
Hay	2.00	2.00
DM content	Dry	Wet
	(fraction)	
wheat residue	0.90	0.90
wheat grain	0.90	0.90
wheat bran	0.90	0.90
barley residue	0.90	0.90
barley grain	0.90	0.90
barley bran	0.90	0.90
maize residue	0.90	0.90
maize grain	0.90	0.90
maize bran	0.90	0.90
sorghum residue	0.90	0.90
sorghum grain	0.90	0.90
sorghum bran	0.90	0.90
Millet residue	0.90	0.90
Millet grain	0.90	0.90
Millet bran	0.90	0.90
Napier	0.60	0.70
Weeds	0.50	0.60
Savannah	0.80	0.60
Hay	0.90	0.90

Feed parameters for 9 crop components. Values in blue can be changed. Changes will be directly reflected in the results.

- Utilization: fraction of the plant that can be used by livestock
- Grain to: conversion factor to calculate per crop the amount of given feed component (residue, bran or cake) that is produced per kg of grain
- ME: energy content per feed component
- CWP: crop water productivity per species / vegetation type, i.e., amount of plant biomass produced per m³ of water
- DM content: dry matter content

INPUT

Animals, activities & production

Four main groups of parameters:

- Animal parameters
- Production parameters
- Activity
- Herd composition

- TLU: The weight of the animal need to be given in TLU's, with one TLU = 250 kg
- Live weight start: weight at birth
- Culling age
- Body weight: calculated automatically

Animals, activities & production			
Animal		Values	
TLU	(fraction)	0.70	
Live weight start	(years)	25	
Culling age	(years)	20	
body weight	(kg)	175	
Production		Dry	Wet
Net energy in milk		3.50	3.50
Milk production		1.0	4.0
Net energy BwG		11.50	11.50
Body weight gain		0.021	0.021
			Unit
			ME / kg
			kg/day
			ME / kg
			Kg / day
Method ME_walking		per km	
Activity		Dry	Wet
Walking		0.50	0.20
Stall fed		0.20	0.20
Terrain		0.10	0.10
Draught		0.00	0.00
			Unit
			fraction
			fraction
			fraction
			fraction
E_{walking}	horizontal	0.0020	0.002
E_{walking}	vertical	0.0280	0.028
Distance		20.00	1.00
			Unit
			MJ / Bw
			MJ / Bw
			km
Herd composition		Dry	Wet
Lactating animals		0.2	0.6
			Unit
			fraction

- Net energy milk: default value should be OK
- Milk production: Give average milk production over dry and wet season
- Net energy BWG: default value should be OK
- Body weight gain: average value over lifespan animal, calculation uses live weight at birth and culling age
- Her composition: percentage of lactating animals. Used to calculate livestock water use and productivity at herd level
- The activities stalled and draught are always expressed as fraction of the maintenance energy
- Estimate energy for walking can be expressed as fraction of maintenance energy (A) or calculated directly based on daily walking distances (B)

(A)

- Energy for walking is expressed as fraction of the maintenance energy
- One can use the terrain parameter to increase energy requirements (as fraction of maintenance energy) to take into account more difficult terrain conditions.

(B)

- Calculate energy demand for walking based on average daily walking distance (uses E_{walking} horizontal and vertical, the average daily walking distance per season and the slope). When selecting this option the parameters 'walking' and 'terrain' above are ignored. This is the method used for the spatial analyses

Method ME_walking		per km	
Activity		Dry	Wet
Walking		0.50	0.20
Stall fed		0.20	0.20
Terrain		0.10	0.10
Draught		0.00	0.00
			Unit
			fraction
			fraction
E_{walking}	horizontal	0.0020	0.002
E_{walking}	vertical	0.0280	0.028
Distance		20.00	1.00
			Unit
			MJ / Bw
			MJ / Bw
			km
Herd composition		Dry	Wet
Lactating animals		0.2	0.6
			Unit
			fraction

INPUT

Diet & environment

Diet				
Category		Season		Unit
		Dry	Wet	
wheat	Residue	10.0	0.0	%
	Bran	10.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	10.0	0.0	%
barley	Residue	10.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
maize	Residue	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
sorghum	Residue	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
Millet	Residue	0.0	0.0	%
	Bran	0.0	0.0	%
	Oil cake	0.0	0.0	%
	Grain	0.0	0.0	%
Napier		20.0	0.0	%
Weeds		30.0	0.0	%
Savannah		10.0	100.0	%
Hays		0.0	0.0	%
Total percentage		100.0	100.0	%
gross energy of the diet		18.4	18.4	MJ/kg
qm		0.491	0.489	
Constrain on feed intake		10.0	0.0	%

Environment			
Climate			
LGP	245	120	Days
Mean temperature	25	15	°C
Sustainability			
POT	30	70	%
Terrain			
Slope	5	5	°
Accessibility	10	10	%

- Diet compositions, given per season, is expressed as the percentage that each feed component contributes to the total feed energy demand of the animal. So this is not as some might expect in terms of dry matter intake (the dry matter intake is calculated based on the given diet composition and given in the 'Results' section).
- Gross energy of the diet: default value should be OK
- Qm value is calculated based on diet composition, feed parameters and gross energy value
- One can define a constrain on the feed intake as percentage of the required maintenance energy.
- LGP: length of growing period
- Mean temperature: per season, used to calculate drinking water demand
- POT: permissible off take as percentage of total consumable plant biomass production in a given area (used for forage only) – the inverse is thus the portion of the consumable biomass that is off limit for grazing in order for the system to remain sustainable. One could argue that at the system level water used in the production of this biomass should be included in the LWP equation.
- Slope (in degrees) is used in the calculation of the energy requirements for walking (steeper slopes = more energy per km)
- Accessibility: not implemented yet.

OUTPUT

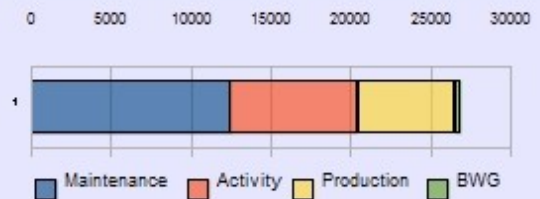
A

OUTPUT

Results for: dry season & TLU

Energy requirements TLU

Variable	Season		Unit	Annual	Unit
	Dry	Wet			
ME maintenance	33.9	33.9	MJ/day	12384	MJ/yr
ME activity	28.9	7.9	MJ/day	8040	MJ/yr
ME milk	8.4	33.8	MJ/day	6130	MJ/yr
ME BWG	0.9	0.9	MJ/day	317	MJ/yr
Total ME TLU	72.2	76.5	MJ/day	26871	MJ/yr



Dry matter requirements / TLU / day

Breakdown FDM (kg/day) for the dry season					
crop	residue	bran	grain	nat. veg.	Total
wheat	1.38	0.68	0.54		2.60
barley	0.96				0.96
maize					
sorghum					
Millet					
Napier				1.46	1.46
Weeds				2.19	2.19
Savannah				0.74	0.74
Hay					
Total	2.34	0.68	0.54	4.39	7.95

Breakdown PDM (kg/day) for the dry season					
residue	bran	grain	nat. veg.	Total	
2.49	32.14	1.27		35.90	
1.74				1.74	
4.23	32.14	1.27	4.39	42.03	

Feed intake	Dry	Wet	Unit	Annual	Unit
PDM / TLU	38.27	8.51	Kg / day	11460	kg/yr
FDM / TLU	7.95	8.51	Kg / day	4032	kg/yr

D

Water requirements

Water for feed	Season (m ³ / d)		Annual (m ³ / yr / TLU)
	Dry	Wet	
Maximum	11.36	4.25	3294
- double count	10.42	4.25	3064
- residues	1.83	4.25	960
+ POT + residues	11.28	14.18	4465

E

Drinking water	Season (l / d / TLU)		Annual (m ³ / yr / TLU)
	Dry	Wet	
Maintenance	37.78	33.60	13.29
Milk	0.87	3.48	0.63
Water from food	2.18	3.40	0.94
Total	36.46	33.67	12.97

Water productivity (milk production/depleted water)

Average LWP for lactating animals			
Variable	Result	Unit	
Milk production	1036	l	
LWP (maximum)	0.31	l/m ³	
LWP (- double count)	0.34	l/m ³	
LWP (-residues)	1.06	l/m ³	
LWP (+POT + residues)	0.23	l/m ³	

F

Average LWP per animal at herd level			
Variable	Result	Unit	
Milk production	481	l	
LWP (maximum)	0.16	l/m ³	
LWP (- double count)	0.18	l/m ³	
LWP (-residues)	0.21	l/m ³	
LWP (+POT + residues)	0.12	l/m ³	

E-F

- Maximum: sum of water required to produce all feed components separately,
- -double count: using the assumption that grains and stover from a given crop come from the same plant / field.
- -residue: Water for residue production does not enter the equation (i.e., only water for grains is taken into account)
- +POT +residues: Water requirements of the portion of the consumable vegetation biomass (or rather biomass production) that is off limit for grazing in order for the system to remain sustainable is included in the equation.