Exploration of CLEANED input files

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Contents

```
## Loading required package: pacman
```

Cleaned Data

Input data structure

The aim of this markdown document is to summarize the structure of the .json object that is required as an input for the R cleaned packages. It also explores any additional datasets that are used as inputs to create this input object, these include `cleaned/data/ghg_para.R`, `cleaned/data/stock_change_para.rda` and `qlands/cleaned-desktop/cleaned.sqlite`.

Load input json file into R Load the `qt_example.json` example input file stored in `cleaned/data`.

```
# Read in example json file #####
json_data <- fromJSON("qt_example.json")

# Summarize level 1 of the list
json_names<-data.table(field_name=names(json_data),
                       class=sapply(json_data,base::class),
                       length=sapply(json_data,length))

kable(json_names, caption = "Summary of Level 1 of the JSON Object")
```

Table 1: Summary of Level 1 of the JSON Object

field_name	class	length
annual_prec	integer	1
arable_tograssland	integer	1
climate_zone	character	1
climate_zone_2	character	1
cropland_orgmatter	character	1
cropland_orgmatter_ipcc	numeric	1

field_name	class	length
cropland_system	character	1
cropland_system_ipcc	numeric	1
cropland_tillage	character	1
cropland_tillage_ipcc	integer	1
database_code	character	1
et	integer	1
farm_code	character	1
farm_name	character	1
feed_basket	data.frame	2
feed_items	data.frame	65
fertilizer	data.frame	4
grassland_implevel	character	1
grassland_implevel_ipcc	integer	1
grassland_management	character	1
grassland_management_ipcc	integer	1
grassland_toarable	integer	1
livestock	data.frame	59
purchased_bedding	integer	1
purchased_compost	integer	1
purchased_manure	integer	1
purchased_organic_n	integer	1
rain_length	integer	1
region	character	1
seasons	data.frame	2
soil_bulk	integer	1
soil_c	integer	1
soil_clay	integer	1
soil_depth	integer	1
soil_description	character	1
soil_k_value	numeric	1
soil_n	numeric	1
waste_consume_meat	integer	1
waste_consume_milk	integer	1
waste_distribution_meat	integer	1
waste_distribution_milk	integer	1
waste_processing_meat	integer	1
waste_processing_milk	integer	1
waste_production_meat	integer	1
waste_production_milk	integer	1

```
simple_fields<-json_names[class!="data.frame" & length==1,field_name]
simple_fields<-json_data[json_names[class!="data.frame" & length==1,field_name]]
simple_fields<-data.table(field=names(simple_fields),
                          value=unlist(simple_fields),
                          class=json_names[class!="data.frame" & length==1,class])
```

Simple fields

Table 2: Summary of simple fields containing a single value

field	value	class
annual_prec	1500	integer
arable_tograssland	0	integer
climate_zone	Temperate	character
climate_zone_2	Warm Temperate Dry	character
cropland_orgmatter	Low, temperate/boreal, dry	character
cropland_orgmatter_ipcc	0.95	numeric
cropland_system	Long term cultivated, temperate/boreal, dry	character
cropland_system_ipcc	0.8	numeric
cropland_tillage	Full	character
cropland_tillage_ipcc	1	integer
database_code	base	character
et	1460	integer
farm_code	001	character
farm_name	test 3	character
grassland_implevel	Medium	character
grassland_implevel_ipcc	1	integer
grassland_management	Nominally managed	character
grassland_management_ipcc	1	integer
grassland_toarable	0	integer
purchased_bedding	0	integer
purchased_compost	0	integer
purchased_manure	0	integer
purchased_organic_n	0	integer
rain_length	5	integer
region	AFRICA	character
soil_bulk	6	integer
soil_c	12	integer
soil_clay	45	integer
soil_depth	2	integer
soil_description	Lixisol	character
soil_k_value	0.25	numeric
soil_n	3.5	numeric
waste_consume_meat	2	integer
waste_consume_milk	2	integer
waste_distribution_meat	3	integer
waste_distribution_milk	3	integer
waste_processing_meat	5	integer
waste_processing_milk	5	integer
waste_production_meat	3	integer
waste_production_milk	3	integer

Livestock The `json_data$livestock` of the json list is a data.table that contains information about livestock"]] herd structure and management, manure management and productivity.

Table 3: Transposed livestock herd data t(json_data$livestock)

	livetype_code_2	livetype_code_1	livetype_code_5
adult_weight	800	400	0
annual_growth	0	0	90

	livetype_code_2	livetype_code_1	livetype_code_5
annual_milk	3000	1500	0
annual_wool	0	0	0
birth_interval	1.166667	1.500000	0.000000
body_weight	600	350	200
body_weight_weaning	0	0	0
body_weight_year_one	0	0	0
carcass_fraction	0.48	0.00	0.48
cp_grazing	0	3	0
cp_growth	0.0	0.0	0.4
cp_lactation	5	2	0
cp_lactmilk	0.09	0.09	0.00
cp_maintenance	0.60	0.35	0.20
cp_pregnancy	12.21	9.64	0.00
distance_to_pasture	0.0	0.5	0.5
energy_eggcontent	0	0	0
energy_meatcontent	2200	2200	2200
energy_milkcontent	970	970	0
fat_content	4.3	5.8	0.0
grazing_displacement	0	2	0
herd_composition	2	5	0
ipcc_ef_category_t1	Dairy cattle	Other mature female	Other mature female-grazing
ipcc_ef_category_t2	Dairy cows	Dairy cows	Non-dairy
ipcc_meth_man_category	Dairy cows	Dairy cows	Other cattle
ipcc_n_exc_category	Dairy cattle	Dairy cattle	Other cattle
lactation_length	0	0	0
litter_size	0	0	0
livetype_code	2	1	5
livetype_desc	Cattle - Cows (improved)	Cattle - Cows (local)	Cattle - Steers/heifers
lw_gain	0	0	0
manure_in_field	0	0	0
manure_in_non_roofed_enclosure	0	0	0
manure_in_stable	1	0	0
manure_onfarm_fraction	1	0	0
manure_sales_fraction	0	0	0
manureman_non_roofed_enclosure	Solid storage	Solid storage	Solid storage
manureman_offfarm_grazing	Solid storage	Solid storage	Solid storage
manureman_onfarm_grazing	Solid storage	Pasture / range / paddock	Solid storage
manureman_stable	Solid storage	Solid storage	Solid storage
me_grazing	2.0	2.0	1.5
me_growth	0	0	50
me_lactation	5	2	0
me_lactmilk	5.5	5.5	0.0
me_maintenance	60.61547	40.45955	26.59148
me_pregnancy	1500	1260	0
meat_product	beef	beef	beef
milk_product	cow milk	cow milk	cow milk
n_content	0.029	0.029	0.029
piglets_relying_on_milk	0	0	0
proportion_growth	0	0	0

	livetype_code_2	livetype_code_1	livetype_code_5
protein_meatcontent	26	26	26
protein_milkcontent	3.7	3.2	0.0
time_in_non_roofed_enclosure	0	0	0
time_in_offfarm_grazing	0	0	0
time_in_onfarm_grazing	0	1	1
time_in_stable	1	0	0
water_requirement	140	120	80
work_hour	0	0	0

The `livestock` are linked to the `feed_basket$feeds` tables by the `livetype_code` keyfield.

```
json_data$livestock[,c("livetype_code","livetype_desc")] # Codes in the feed_items table
```

```
##   livetype_code            livetype_desc
## 1             2 Cattle - Cows (improved)
## 2             1    Cattle - Cows (local)
## 3             5  Cattle - Steers/heifers
```

```
lapply(json_data$feed_basket$feeds,"[[","livestock") # Codes in the feed_basket tables
```

```
## [[1]]
## [[1]][[1]]
##   allocation livetype_code
## 1         40             2
## 2         17             1
## 3         40             5
##
## [[1]][[2]]
##   allocation livetype_code
## 1         25             2
## 2         43             1
## 3         20             5
##
## [[1]][[3]]
##   allocation livetype_code
## 1         35             2
## 2         40             1
## 3         40             5
##
##
## [[2]]
## [[2]][[1]]
##   allocation livetype_code
## 1         40             2
## 2         17             1
## 3         40             5
##
## [[2]][[2]]
##   allocation livetype_code
## 1         25             2
```

```
## 2         43             1
## 3         20             5
##
## [[2]][[3]]
##   allocation livetype_code
## 1         35             2
## 2         40             1
## 3         40             5
```

Feed items The `json_data$feed_items` level of the json list is a data.table that contains information about the production management and context of feed production.

Table 4: Transposed feed item data t(json_data$feed_items)

	feed_item_code_65	feed_item_code_99	feed_item_code_18
ammonia	0	0	0
ammonium_nitrate	0	0	0
ammonium_sulfate	0	0	0
average_dbh25	0	0	0
average_dbh2550	0	0	0
average_dbh50	0	0	0
category	cereal	cereal	legume
cp_content	13.60	3.85	18.40
cultivation_period	0	0	0
cut_carry_fraction	0	0	0
dap	0	0	0
diameter_breast	0	0	0
dm_content	89.00	91.88	90.00
dry_yield	30	15	8
ecosystem_type			
energy	0	360	336
feed_item_code	65	99	18
feed_item_name	Oats (Avena sativa) - grain IP	Rice (Oryza sativa) - straw	Cowpea (Vigna unguiculata) - crop residue
feed_type_code	2	45	9
feed_type_name	Avena sativa	Rice	Cowpea
fraction_as_fertilizer	1	1	0
fraction_as_manure	NA	NA	NA
grassman	1	1	1
grassman_change_factor	1	1	1
grassman_desc	Nominally managed	Nominally managed	Nominally managed
increase_dbh25	0	0	0
increase_dbh2550	0	0	0
increase_dbh50	0	0	0
intercrop	0	0	0
intercrop_fraction	0	0	0
kc_initial	0.10	1.05	0.15
kc_late	0.55	0.75	0.60
kc_midseason	1.10	1.20	1.05
land_cover	7	7	1
land_cover_desc	Cereals	Cereals	Dense forest
landcover_c_factor	0.150	0.150	0.001
main_n	0.0176	0.0090	0.0380

	feed_item_code_65	feed_item_code_99	feed_item_code_18
main_product_removal	1	1	0
me_content	12.267324	5.640000	9.880848
n_content	0.2	0.2	0.0
n_fertilizer	NA	NA	NA
n_solutions	50	300	100
npk	0	0	0
organic_amendment			
residue_burnt	0	0	0
residue_dry_yield	0	0	6
residue_n	0.0	0.2	0.0
residue_removal	0.0	0.8	0.0
slope	1	1	1
slope_desc	Flat (0-5%)	Flat (0-5%)	Flat (0-5%)
slope_length	0	0	0
slope_p_factor	0.11	0.11	0.11
source_type	Main	Residue	Main
time_horizon	0	0	0
trees_dhb	0	0	0
trees_growth	0	0	0
trees_ha	0	0	0
trees_ha_dbh25	0	0	0
trees_ha_dbh2550	0	0	0
trees_ha_dbh50	0	0	0
trees_removal	0	0	0
urea	400	700	200
usda_value	0	20450	16062
water_content	0.00	12.89	11.95
water_regime			

The `feed_items` are linked to the `feed_basket$feeds` tables by the `feed_item_code` field.

```
json_data$feed_items[,c("feed_item_code","feed_item_name")] # Codes in the feed_items table
```

```
##   feed_item_code                          feed_item_name
## 1             65           Oats (Avena sativa) - grain IP
## 2             99              Rice (Oryza sativa) - straw
## 3             18 Cowpea (Vigna unguiculata) - crop residue
```

```
lapply(json_data$feed_basket$feeds,"[[","feed_item_code") # Codes in the feed_basket tables
```

```
## [[1]]
## [1] "65" "99" "18"
##
## [[2]]
## [1] "65" "99" "18"
```

Other keyfields include `feed_type_code` and `land_cover`:

```
json_data$feed_items[,c("feed_type_code","feed_type_name","land_cover","land_cover_desc")]
```

```
##   feed_type_code feed_type_name land_cover land_cover_desc
## 1              2   Avena sativa          7         Cereals
## 2             45           Rice          7         Cereals
## 3              9         Cowpea          1    Dense forest
```

Fertilizer The `json_data$fertilizer` level of the json list is a data.table that contains information about the production management and context of feed production.

Table 5: Fertilizer data input table (json_data$fertilizer)

fertilizer_code	fertilizer_desc	fraction	percentage_n
4	Ammonium nitrate	0	12
6	N solutions	0	10

The values in `fertilizer_code` field do not appear directly correspond to any fields in the feed basket or feed item tables. However columns with similar names do appear in the field item tables

```
fertilizers<-json_data$fertilizer$fertilizer_desc
fi_cols<-colnames(json_data$feed_items)

# Reformat fertilizer names to match column names in the feed_items table
(fertilizers<-gsub(" ","_",tolower(json_data$fertilizer$fertilizer_desc)))
```

```
## [1] "ammonium_nitrate" "n_solutions"
```

```
# Find matching columns
fi_cols[fi_cols %in% fertilizers]
```

```
## [1] "ammonium_nitrate" "n_solutions"
```

Seasons The `json_data$season` level of the input data is 2-column table that records the length of each season (adding up to 365 days max).

Table 6: Feed items data input table (json_data$season)

season_length	season_name
200	Wet season
165	Dry season

The `season_name` field is the key field that links to the feed basket.

```
json_data$feed_basket$season_name
```

```
## [1] "Wet season" "Dry season"
```

Feed basket The `json_data$feed_basket` level of the input data contains a futher 2 list levels called feeds and season_name. These sub-levels appear to be the same length: feeds = 2, season_name = 2.

Seasons The `json_data$feed_basket$season` object is simple, being a vector containing the names of the seasons:

Table 7: Feed basket/season data input table (json_data$feed_basket$season)

x
Wet season
Dry season

Feed Basket The `json_data$feed_basket$feed` object is the most structurally complex element of the input json data containing several levels of nesting.

```
str(json_data$feed_basket$feeds)
```

```
## List of 2
##  $ :'data.frame':    3 obs. of  3 variables:
##   ..$ feed_item_code: chr [1:3] "65" "99" "18"
##   ..$ feed_type_code: chr [1:3] "2" "45" "9"
##   ..$ livestock     :List of 3
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 40 17 40
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 25 43 20
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 35 40 40
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
##  $ :'data.frame':    3 obs. of  3 variables:
##   ..$ feed_item_code: chr [1:3] "65" "99" "18"
##   ..$ feed_type_code: chr [1:3] "2" "45" "9"
##   ..$ livestock     :List of 3
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 40 17 40
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 25 43 20
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
##   .. ..$ :'data.frame':  3 obs. of  2 variables:
##   .. .. ..$ allocation   : int [1:3] 35 40 40
##   .. .. ..$ livetype_code: chr [1:3] "2" "1" "5"
```

Each feed basket table (e.g., `json_data$feed_basket$feeds[[1]]`) is constructed using key fields that describe feed items found in the `json_data$feed_items table`, specifically `feed_item_code` and `feed_type_code`. The feeds are then allocated to the herd elements described in the `json_data$livestock table`.

Table 8: Feed basket/feed data input table tablejson_data$feed_basket$feeds[[1]]

feed_item_code	feed_type_code	livestock
65	2	40, 17, 40, 2 , 1 , 5
99	45	25, 43, 20, 2 , 1 , 5
18	9	35, 40, 40, 2 , 1 , 5

The livestock field in the feed basket table contains a list with 3 elements, indicating a one-to-many relationship between the diet item and elements of the livestock herd. Each feed item represented by a row in the feed basket table is allocated to different herd elements, with the `livetype_code` field serving as the key field linking the two tables.

\begin{table} \caption{Feed basket/feed/livestock data input table tablejson_data$feed_basket$feeds[[1]]$livestock}

allocation	livetype_code	allocation	livetype_code	allocation	livetype_code
40	2	25	2	35	2
17	1	43	1	40	1
40	5	20	5	40	5

\end{table}

The first element of the livestock list contains no further nesting:

```
str(json_data$feed_basket$feeds[[1]]$livestock[[1]])
```

```
## 'data.frame':    3 obs. of  2 variables:
##  $ allocation   : int  40 17 40
##  $ livetype_code: chr  "2" "1" "5"
```

cleaned `cleaned/data` `.rda` files

```
rda_files<-list.files(".rda")
```

GHG parameters The ghg para object (`cleaned/data/ghg_para.rda`) is a list of tables that appear to refer to IPCC equations, livestock parameters and fertilizers.

```
load("ghg_para.rda")

# Summarize level 1 of the list
ghg_names<-data.table(field_name=names(ghg_para),
                      dim=sapply(ghg_para,dim))

kable(ghg_names,caption="Tables within ghg_names list")
```

Table 9: Tables within ghg_names list

field_name	dim
livestock_parameters	18, 7
Table_10.12	6, 2
table_10.17	3, 2
table_10.19	12, 3
table_10.21	3, 2
table_10.22	7, 4
table_10A_9	18, 3
table_11.1_&_table_11.3	10, 5
table_2.5	5, 2
fertilizer_table	5, 5
table_5.11	NULL
table_5.12	8, 4
table_5.13	5, 3
table_5.14	6, 2

The exception is `ghg_para$table_5.11` which is a list:

```
ghg_para$table_5.11
```

```
## $baseline_emission_factor
## [1] 1.3
##
## $soil_type_scaling_factor
## [1] 1
```

Livestock_parameters Note there is an invalid character in this table:

```
ghg_para$livestock_parameters$`IPCC Category - methane emissions enteric fermentation - Tier 2`[11]<-"O
```

```
kable(ghg_para$livestock_parameters,caption="ghg_para$livestock_parameters")
```

Table 10: ghg_para$livestock_parameters

livestock_category	Urinary_energy_fraction	Enteric_energy_fraction	IPCC Category - methane emissions enteric fermentation - Tier 1	IPCC Category - methane emissions enteric fermentation - Tier 2	IPCC Category - methane emissions manure - Tier 1	IPCC-Category - Default N-excretion rates Tier 1
Cows (local)	0.04	0.08	Other mature female	Dairy cattle	Dairy cows	Dairy cattle
Cows (improved)	0.04	0.08	Dairy cattle	Dairy cattle	Dairy cows	Dairy cattle

livestock_category	Urinary energy expression	Methane conversion factor	IPCC Category - methane emissions enteric fermentation - Tier 1	IPCC Category - methane emissions enteric fermentation - Tier 2	IPCC Category - methane emissions manure - Tier 1	IPCC-Category - Default N-excretion rates Tier 1
Cows (high productive)	0.04	0.08	Dairy cattle	Dairy cattle	Dairy cows	Dairy cattle
Adult cattle - male	0.04	0.08	Other draft bull	Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	Other cattle	Other cattle
Steers/heifers	0.04	0.08	Other Mature female-grazing	Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	Other cattle	Other cattle
Steers/heifers (improved)	0.04	0.08	Other Mature female-grazing	Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	Other cattle	Other cattle
Calves	0.04	0.08	Other young	Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	Other cattle	Other cattle
Calves (improved)	0.04	0.08	Other young	Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	Other cattle	Other cattle
Buffalo (dairy)	0.04	0.08	Other draft bull	Other Cattle or Buffalo - grazing	Buffalo	Other cattle
Buffalo steers/heifers	0.04	0.08	Other young	Other Cattle or Buffalo - grazing	Buffalo	Other cattle
Buffalo calves	0.04	0.08	Other young	Other Cattle or Buffalo - grazing	Buffalo	Other cattle
Sheep/Goats - Ewes/Does	0.04	0.08	Goats	Sheep	Sheep	Sheep
Sheep/Goats - Breeding Rams/Bucks	0.04	0.08	Goats	Sheep	Sheep	Sheep
Sheep/Goats - Fattening Rams/Bucks	0.04	0.08	Goats	Sheep	Sheep	sheep

livestock_category	Urinary_energy_fraction	energy_fraction	IPCC Category - methane emissions enteric fermentation - Tier 1	IPCC Category - methane emissions enteric fermentation - Tier 2	IPCC Category - methane emissions manure - Tier 1	IPCC-Category - Default N-excretion rates Tier 1
Sheep/Goats - Lambs/Kids	0.04	0.08	Goats	lambs (less 1 yr old)	Sheep	sheep
Pigs - lactating/pregnant sows	0.02	0.08	Pigs	N/A	Swine	pigs
Pigs - dry sows/boars	0.02	0.08	Pigs	N/A	Swine	pigs
Pigs - growers	0.02	0.08	Pigs	N/A	Swine	pigs

```
kable(ghg_para$fertilizer_table,caption="ghg_para$fertilizer_table")
```

Fertilizer table

Table 11: ghg_para$fertilizer_table

fertilizer_type	percent_N	emission_factor_kg_CO2eq_per_kg N	kg_N_per_1_kg_of_fertilizer	emission_factor_kg_CO2_eq_per_kg_fertilize
DAP	18	2.80	0.18	0.5040
CAN	27	8.66	0.27	2.3382
Urea	NA	NA	NA	0.7850
NPK	NA	NA	NA	1.2100
Lime-application	NA	NA	NA	NA

IPCC Tables Table_10.12

```
kable(ghg_para$Table_10.12)
```

animal_category_ipcc	methane_conversion_factor
Dairy cattle	6.5
Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	6.5
Other Cattle or Buffalo - grazing	6.5
sheep	6.5
lambs (less 1 yr old)	4.5
N/A	0.0

table_10.17

```
kable(ghg_para$table_10.17)
```

system	mcf_by_average_annual_temperature
Pasture / range / paddock	0.015
solid storage	0.040
dry lot	0.015

table_10.19

```
kable(ghg_para$table_10.19)
```

anaimal_category	Continent	n_rate
Dairy cattle	LATIN AMERICA	0.48
Dairy cattle	AFRICA	0.60
Dairy cattle	ASIA	0.47
Other cattle	LATIN AMERICA	0.37
Other cattle	AFRICA	0.63
Other cattle	ASIA	0.34
Sheep	LATIN AMERICA	1.17
Sheep	AFRICA	1.17
Sheep	ASIA	1.17
Pigs	LATIN AMERICA	1.64
Pigs	AFRICA	1.64
Pigs	ASIA	0.50

table_10.21

```
kable(ghg_para$table_10.21)
```

system	direct_nitrous_oxide_factor
Pasture / range / paddock	0.010
solid storage	0.005
dry lot	0.020

table_10.22

```
kable(ghg_para$table_10.22)
```

anaimal_category	system	fraction_n_loss_mms	range
Dairy cows	pit storage	0.28	(10-40)
Dairy cows	dry lot	0.20	(10-35)
Dairy cows	solid storage	0.30	(10-40)
Dairy cows	daily spread	0.07	(5-60)
Other cattle	dry lot	0.30	(20-50)

anaimal_category	system	fraction_n_loss_mms	range
Other cattle	solid storage	0.45	(10-65)
Other cattle	deep bedding	0.30	(20-40)

table_10A_9

```
kable(ghg_para$Table_10.12)
```

animal_category_ipcc	methane_conversion_factor
Dairy cattle	6.5
Other Cattle and Buffaloes that are primarily fed low quality crop residues and byproducts	6.5
Other Cattle or Buffalo - grazing	6.5
sheep	6.5
lambs (less 1 yr old)	4.5
N/A	0.0

table_11.1_&_table_11.3

```
kable(ghg_para$`table_11.1_&_table_11.3`)
```

emission_factors	unit	description	n2o_emissions_from_managed_soils	uncertainty_range
EF1	kg N2O-N (kg N input)-1	emission factor for N2O emissions from N inputs	0.0100	0.003-0.03
EF2	kg N2O-N ha-1 yr-1	emission factor for N2O emissions from drained/managed organic soils	16.0000	5 TO 48
EF3PRPCPP	kg N2O-N (kg N input)-1	emission factor for N2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals	0.0200	0.007-0.06
EF3PRPSO	kg N2O-N (kg N input)-1	emission factor for N2O emissions from urine and dung N deposited on pasture, range and paddock by grazing animals	0.0100	0.003-0.03
EF4	[kg N-N2O (kg NH3-N + NOx-N volatilised)-1]	emission factor for N2O emissions from atmospheric deposition of N on soils and water surfaces	0.0100	0.002-0.05
EF5	kg N2O-N (kg N leached and runoff)-1	emission factor for N2O emissions from N leaching and runoff	0.0075	0.005-0.025
EF1R	kg N2O-N (kg N input)-1	emission factor for N2O emission from N inputs for flooded rice	0.0030	0.000 - 0.006
FracGASF	kg N volatilised (kg of N applied)-1	fraction of synthetic fertilzer N that volatilises as NH3 and NOx	0.1000	0.03-0.3

emission_factors	unit	description	n2o_emissions_from_managed_soils	uncertainty_range
FracGASM	kg N volatilised (kg of N applied or deposited)-1	fraction of applied organic N fertiliser materials (FON) and of urine and dung N deposited by grazing animals (FPRP) that volatilises as NH3 and NOx	0.2000	0.05-0.5
FracLEACH (H)	kg N (kg of N additions)-1	fraction of all N added to/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff	0.3000	if sum of rain - sum of PE > soil water holding capacity during rainy season

table_2.5

```
kable(ghg_para$table_2.5)
```

ghg_gas	burnt_emission_factor
CO2	1515.00
CO	92.00
CH4	2.70
N2O	0.07
Nox	2.50

table_5.12

```
kable(ghg_para$table_5.12)
```

ecosystem	ecosystem_type	aggregated_scaling_factor_sa	aggregated_scaling_factor_w
irrigated	Irrigated-Continuously flooded	0.78	1.00
irrigated	intermittently flooded-single aeration	0.78	0.60
irrigated	Intermittently flooded-multiple aeration	0.78	0.52
Rain fed and deep water	Rainfed-regular rainfed	0.27	0.28
Rain fed and deep water	Rainfed-drought prone	0.27	0.25
Rain fed and deep water	Rainfed-deep water	0.27	0.31
Upland	Upland	0.00	0.00
None	None	0.00	0.00

table_5.13

```
kable(ghg_para$table_5.13)
```

water_regime	aggregated_scaling_factor	disaggregated_scaling_factor_p
non-flooded pre-season <180 days(often in double cropping of rice)	1.22	1.00
non-flooded pre-season >180 days (single rice crop following a dry fallow period)	1.22	0.68
flooded pre-season (>30 days)	1.22	1.90
flooded pre-season (<30 days)	1.22	0.00
None	0.00	0.00

table_5.14

```
kable(ghg_para$table_5.14)
```

organic_amendment	conversion_factor
straw incorporated in soil shortly (<30 days) before cultivation	1.00
straw incorporated in soil long (>30 days) before cultivation	0.29
Compost	0.05
Farm yard manure	0.14
green manure	0.50
None	0.00

Stock change The stock change object (`cleaned/data/stock_change_para.rda`) is a series of nested lists that describe: 1) landuse, management, and input factor_variables for grassland; and 2) landuse, tillage, and input input factor_variables for cropland.

```
load("stock_change_para.rda")
str(stock_change_para)
```

```
## List of 2
##  $ cropland :'data.frame':   1 obs. of  3 variables:
##   ..$ landuse:List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  10 variables:
##   .. .. .. .. ..$ Long term cultivated, temperate/boreal, dry                    : num 0.8
##   .. .. .. .. ..$ Long term cultivated, temperate/boreal, moist                  : num 0.69
##   .. .. .. .. ..$ Long term cultivated, tropical, dry                            : num 0.58
##   .. .. .. .. ..$ Long term cultivated, tropical, moist/wet                      : num 0.48
##   .. .. .. .. ..$ Long term cultivated, tropical montane, all                    : num 0.64
##   .. .. .. .. ..$ Paddy rice                                                     : num 1.1
##   .. .. .. .. ..$ Perennial/tree crop                                            : int 1
##   .. .. .. .. ..$ Set aside (< 20 years), temperate/boreal and tropical, dry     : num 0.93
##   .. .. .. .. ..$ Set aside (< 20 years), temperate/boreal and tropical, moist/wet: num 0.82
##   .. .. .. .. ..$ Set aside (< 20 years),tropical montane, all                   : num 0.88
##   ..$ tillage:List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  11 variables:
##   .. .. .. .. ..$ Full                           : int 1
```

```
##   .. .. .. .. ..$ Reduced, temperate/boreal, dry  : num 1.02
##   .. .. .. .. ..$ Reduced, temperate/boreal, moist: num 1.08
##   .. .. .. .. ..$ Reduced, tropical, dry          : num 1.09
##   .. .. .. .. ..$ Reduced, tropical, moist        : num 1.15
##   .. .. .. .. ..$ Reduced, tropical montane, all  : num 1.09
##   .. .. .. .. ..$ No-till, temperate/boreal, dry  : num 1.1
##   .. .. .. .. ..$ No-till, temperate/boreal, moist: num 1.15
##   .. .. .. .. ..$ No-till, tropical, dry          : num 1.17
##   .. .. .. .. ..$ No-till, tropical, moist/wet    : num 1.22
##   .. .. .. .. ..$ No-till, tropical montane, all  : num 1.16
##   ..$ input  :List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  12 variables:
##   .. .. .. .. ..$ Low, temperate/boreal, dry                                    : num 0.95
##   .. .. .. .. ..$ Low, temperate/boreal, moist                                  : num 0.92
##   .. .. .. .. ..$ Low, tropical, dry                                            : num 0.95
##   .. .. .. .. ..$ Low, tropical, moist                                          : num 0.92
##   .. .. .. .. ..$ Low, tropical montane, all                                    : num 0.94
##   .. .. .. .. ..$ Medium, all                                                   : int 1
##   .. .. .. .. ..$ High w/OUT manure, temperate/boral and tropical, dry      : num 1.04
##   .. .. .. .. ..$ High w/OUT manure, temperate/boral and tropical, moist/wet: num 1.11
##   .. .. .. .. ..$ High w/OUT manure, tropical montane                       : num 1.08
##   .. .. .. .. ..$ High with manure, temperate/boral and tropical, dry       : num 1.37
##   .. .. .. .. ..$ High with manure, temperate/boral and tropical, moist/wet : num 1.44
##   .. .. .. .. ..$ High with manure, tropical montane                        : num 1.41
##  $ grassland:'data.frame':   1 obs. of  3 variables:
##   ..$ landuse   :List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  1 variable:
##   .. .. .. .. ..$ All: int 1
##   ..$ management:List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  8 variables:
##   .. .. .. .. ..$ Nominally managed                                 : num 1
##   .. .. .. .. ..$ Moderately degraded grassland, temperate/boreal: num 0.95
##   .. .. .. .. ..$ Moderately degraded grassland, tropical        : num 0.97
##   .. .. .. .. ..$ Moderately degraded grassland, tropical montane: num 0.96
##   .. .. .. .. ..$ Severely degraded                                 : num 0.7
##   .. .. .. .. ..$ Improved grassland, temperate/boreal              : num 1.14
##   .. .. .. .. ..$ Improved grassland, tropical                      : num 1.17
##   .. .. .. .. ..$ Improved grassland, tropical montane              : num 1.16
##   ..$ input     :List of 1
##   .. ..$ :'data.frame':  1 obs. of  1 variable:
##   .. .. ..$ factor_variables:List of 1
##   .. .. .. ..$ :'data.frame':    1 obs. of  3 variables:
##   .. .. .. .. ..$ Medium: int 1
##   .. .. .. .. ..$ High  : num 1.11
##   .. .. .. .. ..$ none  : int 1
```

Grass factor variables Grassland: landuse

```
x<-unlist(stock_change_para$grassland$landuse[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
All	1

Grassland: management

```
x<-unlist(stock_change_para$grassland$management[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
Nominally managed	1.00
Moderately degraded grassland, temperate/boreal	0.95
Moderately degraded grassland, tropical	0.97
Moderately degraded grassland, tropical montane	0.96
Severely degraded	0.70
Improved grassland, temperate/boreal	1.14
Improved grassland, tropical	1.17
Improved grassland, tropical montane	1.16

Grassland: input

```
x<-unlist(stock_change_para$grassland$input[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
Medium	1.00
High	1.11
none	1.00

Cropland factor variables Cropland: landuse

```
x<-unlist(stock_change_para$cropland$landuse[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
Long term cultivated, temperate/boreal, dry	0.80
Long term cultivated, temperate/boreal, moist	0.69
Long term cultivated, tropical, dry	0.58
Long term cultivated, tropical, moist/wet	0.48
Long term cultivated, tropical montane, all	0.64
Paddy rice	1.10
Perennial/tree crop	1.00
Set aside (< 20 years), temperate/boreal and tropical, dry	0.93

variable	value
Set aside (< 20 years), temperate/boreal and tropical, moist/wet	0.82
Set aside (< 20 years),tropical montane, all	0.88

Cropland: tillage

```
x<-unlist(stock_change_para$cropland$tillage[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
Full	1.00
Reduced, temperate/boreal, dry	1.02
Reduced, temperate/boreal, moist	1.08
Reduced, tropical, dry	1.09
Reduced, tropical, moist	1.15
Reduced, tropical montane, all	1.09
No-till, temperate/boreal, dry	1.10
No-till, temperate/boreal, moist	1.15
No-till, tropical, dry	1.17
No-till, tropical, moist/wet	1.22
No-till, tropical montane, all	1.16

Cropland: input

```
x<-unlist(stock_change_para$cropland$input[[1]]$factor_variables)
kable(data.frame(variable=names(x),value=as.numeric(x)))
```

variable	value
Low, temperate/boreal, dry	0.95
Low, temperate/boreal, moist	0.92
Low, tropical, dry	0.95
Low, tropical, moist	0.92
Low, tropical montane, all	0.94
Medium, all	1.00
High w/OUT manure, temperate/boral and tropical, dry	1.04
High w/OUT manure, temperate/boral and tropical, moist/wet	1.11
High w/OUT manure, tropical montane	1.08
High with manure, temperate/boral and tropical, dry	1.37
High with manure, temperate/boral and tropical, moist/wet	1.44
High with manure, tropical montane	1.41

mufindi The mufindi object (`cleaned/data/mufindi.rda`) appears to be an input dataset similar to the `qt_example.json` file.

```
load("mufindi.rda")
str(mufindi)
```

```
## List of 48
##  $ cba_discount_rate            : int 0
##  $ cba_years                    : int 0
##  $ cropland_orgmatter           : chr "High w/OUT manure, temperate/boral and tropical, moist/wet"
##  $ cropland_system              : chr "Long term cultivated, temperate/boreal, moist"
##  $ cropland_tillage             : chr "Reduced, tropical, moist"
##  $ farm_code                    : chr "ddd"
##  $ farm_name                    : chr "ooo"
##  $ feed_basket                  :'data.frame':   2 obs. of  2 variables:
##   ..$ feeds      :List of 2
##   .. ..$ :'data.frame':  4 obs. of  3 variables:
##   .. .. ..$ feed_item_code: chr [1:4] "16" "31" "51" "82"
##   .. .. ..$ feed_type_code: chr [1:4] "8" "17" "29" "40"
##   .. .. ..$ livestock     :List of 4
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 2 10
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 20 10
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 30 10
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 48 70
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. ..$ :'data.frame':  4 obs. of  3 variables:
##   .. .. ..$ feed_item_code: chr [1:4] "16" "31" "51" "82"
##   .. .. ..$ feed_type_code: chr [1:4] "8" "17" "29" "40"
##   .. .. ..$ livestock     :List of 4
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 70 50
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 20 5
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 5 5
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   .. .. .. ..$ :'data.frame':    2 obs. of  2 variables:
##   .. .. .. .. ..$ allocation   : int [1:2] 5 40
##   .. .. .. .. ..$ livetype_code: chr [1:2] "3" "6"
##   ..$ season_name: chr [1:2] "Dry season" "Wet season"
##  $ feed_items                    :'data.frame':   4 obs. of  64 variables:
##   ..$ ammonia               : int [1:4] 14 0 0 8
##   ..$ ammonium_nitrate      : int [1:4] 11 0 5 0
##   ..$ ammonium_sulfate      : int [1:4] 12 6 0 0
##   ..$ c_factor              : num [1:4] 0.05 0.117 0.05 0.027
##   ..$ category              : chr [1:4] "" "legume" "cereal" "grass"
##   ..$ cp_content            : num [1:4] 1.81 16.29 8.9 11
##   ..$ cp_fresh              : num [1:4] 1.61 15.17 7.3 1.65
##   ..$ crop_coefficient      : num [1:4] 0 0.633 0.533 0.917
##   ..$ cut_carry_fraction    : int [1:4] 2 0 0 0
##   ..$ dap                   : int [1:4] 10 0 0 4
```

```
##   ..$ de                    : num [1:4] 0.71 0.433 0.674 0.652
##   ..$ dm_content            : num [1:4] 88.8 93.1 82 15
##   ..$ dry_yield             : num [1:4] 5.04 1.16 8.6 6
##   ..$ emission_factor       : int [1:4] 0 0 0 0
##   ..$ energy                : int [1:4] 160 567 365 0
##   ..$ energy_dm             : num [1:4] 397 606 407 0
##   ..$ establishment_cost    : int [1:4] 0 0 0 20
##   ..$ establishment_labour  : int [1:4] 0 0 0 6
##   ..$ feed_item_code        : chr [1:4] "16" "31" "51" "82"
##   ..$ feed_item_name        : chr [1:4] "Cassava (Manihot esculenta) - tubers" "Groundnut (Arachis hy
##   ..$ feed_type_code        : chr [1:4] "8" "17" "29" "40"
##   ..$ feed_type_name        : chr [1:4] "Cassava" "Groundnut" "Maize" "Pennisetum purpureum"
##   ..$ fraction_as_fertilizer: int [1:4] 7 1 0 0
##   ..$ fresh_yield           : num [1:4] 12.5 1.22 10 20
##   ..$ grassman              : chr [1:4] "1" "1" "1" "1"
##   ..$ grassman_change_factor: int [1:4] 1 1 1 1
##   ..$ harvest_index         : num [1:4] 0.5 0.29 0.47 0.9
##   ..$ intercrop             : int [1:4] 1 0 0 1
##   ..$ intercrop_fraction    : int [1:4] 1 0 0 2
##   ..$ kc_initial            : num [1:4] 0 0.15 0.15 0.6
##   ..$ kc_late               : num [1:4] 0 0.6 0.3 1.05
##   ..$ kc_midseason          : num [1:4] 0 1.15 1.15 1.1
##   ..$ land_cover            : chr [1:4] "1" "1" "1" "1"
##   ..$ landcover_c_factor    : num [1:4] 0.001 0.001 0.001 0.001
##   ..$ main_n                : num [1:4] 0.004 0.037 0.017 0.023
##   ..$ main_product_removal  : int [1:4] 4 0 0 0
##   ..$ me_content            : num [1:4] 10.76 6.56 10.22 9.88
##   ..$ me_fresh              : num [1:4] 9.56 6.11 8.38 1.48
##   ..$ n_fertilizer          : int [1:4] 15 0 9 0
##   ..$ n_fixation            : num [1:4] 0 38.2 0 0
##   ..$ n_solutions           : int [1:4] 13 0 7 0
##   ..$ npk                   : int [1:4] 9 0 3 0
##   ..$ operational_cost      : int [1:4] 0 0 0 18
##   ..$ operational_labour    : num [1:4] 0 0 0.203 0.5
##   ..$ residue_burnt         : int [1:4] 6 0 0 0
##   ..$ residue_dm_content    : num [1:4] 0.403 0.935 0.896 0.85
##   ..$ residue_dry_yield     : num [1:4] 5.04 2.79 3 0
##   ..$ residue_fresh_yield   : num [1:4] 12.5 2.99 3.5 2.22
##   ..$ residue_n             : int [1:4] 0 0 0 0
##   ..$ residue_n_dm          : num [1:4] 0.003 0.012 0.007 0.023
##   ..$ residue_removal       : int [1:4] 5 0 0 0
##   ..$ slope                 : chr [1:4] "1" "1" "1" "1"
##   ..$ slope_length          : int [1:4] 3 0 0 0
##   ..$ slope_p_factor        : num [1:4] 0.11 0.11 0.11 0.11
##   ..$ trees_dhb             : int [1:4] 0 0 0 0
##   ..$ trees_growth          : int [1:4] 0 0 0 0
##   ..$ trees_ha              : int [1:4] 0 0 0 0
##   ..$ trees_removal         : int [1:4] 0 0 0 0
##   ..$ urea                  : int [1:4] 8 2 0 0
##   ..$ usda_value            : int [1:4] 11134 16067 20314 0
##   ..$ water_content         : num [1:4] 59.7 6.5 10.4 0
##   ..$ wfp_blue              : num [1:4] 0 0 0.002 0
##   ..$ wfp_green             : num [1:4] 0 0 0.199 0
##   ..$ wfp_grey              : num [1:4] 0 0 0.002 0
```

```
##  $ ferlitizer                   :'data.frame':   1 obs. of  5 variables:
##   ..$ cost           : int 2
##   ..$ fertilizer_code: chr "4"
##   ..$ fertilizer_desc: chr "Ammonium nitrate"
##   ..$ fraction       : int 3
##   ..$ quantity       : int 1
##  $ grassland_implevel           : chr "High"
##  $ grassland_management         : chr "Moderately degraded grassland, tropical montane"
##  $ land_oppcost                 : int 0
##  $ livestock                    :'data.frame':   2 obs. of  53 variables:
##   ..$ annual_growth                : int [1:2] 3 9
##   ..$ annual_milk                  : int [1:2] 2 10
##   ..$ birth_interval               : num [1:2] 1.17 0
##   ..$ body_weight                  : int [1:2] 600 300
##   ..$ carcass_fraction             : num [1:2] 0.45 0.49
##   ..$ cp_grazing                   : int [1:2] 0 0
##   ..$ cp_growth                    : num [1:2] 0 0.4
##   ..$ cp_lactation                 : int [1:2] 0 0
##   ..$ cp_lactmilk                  : num [1:2] 0.09 0
##   ..$ cp_maintenance               : num [1:2] 0.6 0.3
##   ..$ cp_pregnancy                 : int [1:2] 15 0
##   ..$ distance_to_pasture          : int [1:2] 8 4
##   ..$ energy_eggcontent            : int [1:2] 0 0
##   ..$ energy_meatcontent           : int [1:2] 2200 2200
##   ..$ energy_milkcontent           : int [1:2] 970 0
##   ..$ er_grazing                   : num [1:2] 2 1.5
##   ..$ er_growth                    : int [1:2] 0 50
##   ..$ er_lactation                 : int [1:2] 0 0
##   ..$ er_lactmilk                  : num [1:2] 5.5 0
##   ..$ er_maintenance               : num [1:2] 60.6 36
##   ..$ er_pregnancy                 : int [1:2] 2000 0
##   ..$ fat_content                  : int [1:2] 4 0
##   ..$ grazing_displacement         : int [1:2] 2 2
##   ..$ herd_composition             : int [1:2] 1 11
##   ..$ ipcc_meth_ef_t1              : int [1:2] 68 46
##   ..$ ipcc_meth_ef_t2              : num [1:2] 6.5 6.5
##   ..$ ipcc_meth_exc                : num [1:2] 0.47 0.34
##   ..$ ipcc_meth_man                : int [1:2] 19 1
##   ..$ lactation_length             : int [1:2] 0 0
##   ..$ litter_size                  : int [1:2] 0 0
##   ..$ livetype_code                : chr [1:2] "3" "6"
##   ..$ livetype_desc                : chr [1:2] "Cows (high productive)" "Steers/heifers (improved)"
##   ..$ lw_gain                      : int [1:2] 0 0
##   ..$ manure_in_field              : int [1:2] 11 1
##   ..$ manure_in_non_roofed_enclosure: int [1:2] 10 2
##   ..$ manure_in_stable             : int [1:2] 9 3
##   ..$ meat_price                   : int [1:2] 23 23
##   ..$ meat_product                 : chr [1:2] "beef" "beef"
##   ..$ milk_price                   : num [1:2] 1.04 1.04
##   ..$ milk_product                 : chr [1:2] "cow milk" "cow milk"
##   ..$ n_content                    : num [1:2] 0.029 0.029
##   ..$ oneoff_cost                  : int [1:2] 6400 3450
##   ..$ oneoff_labour                : int [1:2] 0 0
##   ..$ operational_cost             : int [1:2] 4000 1650
```

```
##   ..$ operational_labour            : num [1:2] 50.7 7.6
##   ..$ proportion_growth             : int [1:2] 0 0
##   ..$ protein_meatcontent           : int [1:2] 26 26
##   ..$ protein_milkcontent           : num [1:2] 3.7 0
##   ..$ time_in_non_roofed_enclosure  : int [1:2] 5 7
##   ..$ time_in_offfarm_grazing       : int [1:2] 7 5
##   ..$ time_in_onfarm_grazing        : int [1:2] 6 6
##   ..$ time_in_stable                : int [1:2] 4 8
##   ..$ water_requirement             : int [1:2] 160 100
##  $ manure_onfarm_fraction       : int 1
##  $ manure_sales_fraction        : int 2
##  $ manureman_pasture            : chr "Pasture / range / paddock"
##  $ manureman_stable             : chr "Solid storage"
##  $ manureman_yard               : chr "Dry slot"
##  $ purchased_bedding            : int 6
##  $ purchased_compost            : int 4
##  $ purchased_manure             : int 3
##  $ purchased_organic_n          : int 5
##  $ region                       : chr "ASIA"
##  $ seasons                      :'data.frame':   2 obs. of  2 variables:
##   ..$ season_length: int [1:2] 200 165
##   ..$ season_name  : chr [1:2] "Dry season" "Wet season"
##  $ txt_annual_prec              : int 1
##  $ txt_arable_tograssland       : int 16
##  $ txt_cropland_orgmatter_ipcc  : num 1.11
##  $ txt_cropland_system_ipcc     : num 0.69
##  $ txt_cropland_tillage_ipcc    : num 1.15
##  $ txt_et                       : int 9
##  $ txt_grassland_implevel_ipcc  : num 1.11
##  $ txt_grassland_management_ipcc: num 0.96
##  $ txt_grassland_toarable       : int 15
##  $ txt_rain_length              : int 2
##  $ txt_soil_bulk                : int 7
##  $ txt_soil_c                   : int 5
##  $ txt_soil_clay                : int 6
##  $ txt_soil_depth               : int 8
##  $ txt_soil_k_value             : num 0.25
##  $ txt_soil_n                   : int 4
##  $ waste_consume_milk           : int 0
##  $ waste_distribution_meat      : int 0
##  $ waste_distribution_milk      : int 0
##  $ waste_processing_meat        : int 0
##  $ waste_processing_milk        : int 0
##  $ waste_production_meat        : int 0
##  $ waste_production_milk        : int 0
```

cleaned-desktop `cleaned.sqlite` file

This sqlite database object is found in the qlands/cleaned-desktop github it contains several tables of look-up values.

```
conn <- dbConnect(RSQLite::SQLite(), "cleaned.sqlite")
tables <- dbListTables(conn)
print(tables)
```

Load sqlite file into R

```
##  [1] "lkp_climate"          "lkp_climate2"         "lkp_croplandsystem"
##  [4] "lkp_feeditem"         "lkp_feedtype"         "lkp_grassinputlevel"
##  [7] "lkp_grasslandman"     "lkp_landcover"        "lkp_livetype"
## [10] "lkp_manureman"        "lkp_organicmatter"    "lkp_orgfertilizer"
## [13] "lkp_region"           "lkp_slope"            "lkp_soil"
## [16] "lkp_tillageregime"
```

```
sq_tables<-lapply(tables,FUN=function(TAB){
  query<-paste0("SELECT * FROM ",TAB)
  data <- dbGetQuery(conn,query)
  data
})
names(sq_tables)<-tables
```

Climate

climate_code	climate_desc
Temperate	Temperate
Warm	Warm

Climate2

climate_code	climate2_code	climate2_desc
Temperate	Warm Temperate Moist	Warm Temperate Moist
Temperate	Warm Temperate Dry	Warm Temperate Dry
Warm	Tropical Montane	Tropical Montane
Warm	Tropical Wet	Tropical Wet
Warm	Tropical Moist	Tropical Moist
Warm	Tropical Dry	Tropical Dry

Region

region_code	region_desc
AFRICA	AFRICA
LATIN	LATIN AMERICA
ASIA	ASIA

Cropland system

sys_code	sys_desc	change_factor
1	Long term cultivated, temperate/boreal, dry	0.80
2	Long term cultivated, temperate/boreal, moist	0.69
3	Long term cultivated, tropical, dry	0.58
4	Long term cultivated, tropical, moist/wet	0.48
5	Long term cultivated, tropical montane, all	0.64
6	Paddy rice	1.10
7	Perennial/tree crop	1.00
8	Set aside (< 20 years), temperate/boreal and tropical, dry	0.93
9	Set aside (< 20 years), temperate/boreal and tropical, moist/wet	0.82
10	Set aside (< 20 years),tropical montane, all	0.88

Feeds Item

```
##     feed_type_code feed_item_code
## 1                1              1
## 2               34              2
## 3               34              3
## 4               21              4
## 5               23              5
## 6               22              6
## 7               22              7
## 8               11              8
## 9               11              9
## 10              50             10
## 11               5             11
## 12               6             12
## 13               7             13
## 14               8             14
## 15               8             15
## 16               8             16
## 17              43             17
## 18               9             18
## 19               9             19
## 20               9             20
## 21               9             21
## 22              10             22
## 23              11             23
## 24              12             24
## 25              49             25
## 26              54             26
## 27              54             27
## 28              15             28
## 29              17             29
## 30              17             30
## 31              17             31
## 32              19             32
## 33              24             33
## 34              25             34
## 35              28             35
## 36              28             36
## 37              28             37
```

```
## 38            26            38
## 39            26            39
## 40            26            40
## 41            27            41
## 42            32            42
## 43            32            43
## 44            32            44
## 45          <NA>            45
## 46          <NA>            46
## 47          <NA>            47
## 48            43            48
## 49            29            49
## 50            30            50
## 51            29            51
## 52            31            52
## 53            29            53
## 54            29            54
## 55            33            55
## 56          <NA>            56
## 57          <NA>            57
## 58          <NA>            58
## 59          <NA>            59
## 60          <NA>            60
## 61            35            61
## 62            36            62
## 63            36            63
## 64            36            64
## 65             2            65
## 66             3            66
## 67             3            67
## 68             3            68
## 69             2            69
## 70            43            70
## 71             3            71
## 72             2            72
## 73          <NA>            73
## 74          <NA>            74
## 75          <NA>            75
## 76            38            76
## 77            38            77
## 78            39            78
## 79          <NA>            79
## 80          <NA>            80
## 81          <NA>            81
## 82            40            82
## 83            41            83
## 84            42            84
## 85            42            85
## 86            42            86
## 87          <NA>            87
## 88          <NA>            88
## 89          <NA>            89
## 90          <NA>            90
## 91            43            91
```

```
## 92            <NA>            92
## 93            <NA>            93
## 94            <NA>            94
## 95            <NA>            95
## 96            <NA>            96
## 97              43            97
## 98              45            98
## 99              45            99
## 100           <NA>           100
## 101           <NA>           101
## 102           <NA>           102
## 103             46           103
## 104             47           104
## 105             46           105
## 106             47           106
## 107             16           107
## 108             16           108
## 109             16           109
## 110             16           110
## 111           <NA>           111
## 112           <NA>           112
## 113              4           113
## 114             43           114
## 115             48           115
## 116             48           116
## 117             43           117
## 118             48           118
## 119             48           119
## 120             20           120
## 121             43           121
## 122           <NA>           122
## 123           <NA>           123
## 124           <NA>           124
## 125           <NA>           125
## 126             14           126
## 127           <NA>           127
## 128             53           128
## 129             52           129
## 130             51           130
## 131             51           131
## 132           <NA>           132
##                                        feed_item_name dm_content me_content
## 1                          Andropogon gayanus (forage)     27.800   7.100000
## 2                                       Banana (fruit)     22.000  12.300000
## 3                                        Banana leaves     16.000  10.000000
## 4                                     Barley (forage)     34.000   8.690000
## 5                                  Barley (grains) IP     87.100  12.400000
## 6                                 Barley (grains) OFC     87.100  12.400000
## 7                                      Barley (straw)     87.000   5.880000
## 8    Bermuda grass (Cynodon dactylon) - forage     30.300   9.671508
## 9       Bermuda grass (Cynodon dactylon) - hay     93.000   7.410636
## 10                                    Berseem clover     11.000  12.390000
## 11                       Brachiaria brizantha (forage)     26.000   7.254795
## 12                         Brachiaria hybrid (forage)     26.000   7.254795
```

```
## 13                      Canavalia brasiliensis (forage)     30.000  12.100000
## 14            Cassava (Manihot esculenta) - crop residue     16.100  10.006452
## 15          Cassava (Manihot esculenta) - fresh peelings     27.900   4.312400
## 16                 Cassava (Manihot esculenta) - tubers     88.840  10.760000
## 17                             Concentrate (commercial)     90.000  12.100000
## 18             Cowpea (Vigna unguiculata) - crop residue     90.000   9.880848
## 19                   Cowpea (Vigna unguiculata) - forage     12.280  10.450000
## 20                    Cowpea (Vigna unguiculata) - grain     89.830  13.210000
## 21                     Cowpea (Vigna unguiculata) - meal     90.170  14.000000
## 22                            Cratylia argentea (forage)     30.000   9.400000
## 23                         Cynodon nlemfuensis (forage)     30.300   9.671508
## 24                       Dichanthium aristatum (forage)     33.000   7.250000
## 25                     Digitaria swazilandensis (forage)     24.000   9.700000
## 26                                   Fava bean (grain)     86.600  13.300000
## 27                                   Fava bean (straw)     89.700   6.400000
## 28                          Gliricidia sepium (forage)     30.000  11.500000
## 29           Groundnut (Arachis hypogaea) - crop residue     89.530   7.990000
## 30                 Groundnut (Arachis hypogaea) - Kernel     92.700  21.185200
## 31            Groundnut (Arachis hypogaea) - seed hulls     93.120   6.560000
## 32                          Guazuma ulmifolia (forage)     30.000  11.000000
## 33                         Hyparrhenia rufa  (forage)     26.000   6.129315
## 34                        Ischaemum ciliare  (forage)     24.000   6.003836
## 35                          Italian ryegrass (forage)     19.000   8.700000
## 36                             Italian ryegrass (hay)     85.000   8.360000
## 37                          Italian ryegrass (silage)     33.500   9.070000
## 38                   Lablab (Lablab purpureus) - forage     18.300  11.430000
## 39                      Lablab (Lablab purpureus) - hay     90.000   9.290000
## 40                   Lablab (Lablab purpureus) - silage     27.830   7.440000
## 41          Leucaena (Leucaena leucocephala) - forage     26.200   9.500000
## 42                  Lucerne (Medicago sativa) - forage     21.000  10.080000
## 43                     Lucerne (Medicago sativa) - hay     85.000   8.360000
## 44                  Lucerne (Medicago sativa) - silage     44.100   9.545904
## 45        Lupins (Lupinus angustifolius) - crop residue     93.850   5.570000
## 46               Lupins (Lupinus angustifolius) - grain     90.000  19.000000
## 47                Lupins (Lupinus angustifolius) - pods     91.890   7.360000
## 48                     Maize (Zea mays) - bought stover     87.000   9.127224
## 49                       Maize (Zea mays) - cobs ground     90.100   7.578108
## 50                Maize (Zea mays) - cracked grains IP     89.000  13.020948
## 51                           Maize (Zea mays) - forage     82.000  10.215792
## 52                           Maize (Zea mays) - silage     30.000  10.790000
## 53                           Maize (Zea mays) - stover     87.000   9.127224
## 54                       Maize (Zea mays) - whole grain     90.000  15.000000
## 55                            Moringa oleifera (forage)     26.200  10.600000
## 56                    Mucuna (Mucuna pruriens) - forage     20.967  10.800000
## 57              Mucuna (Mucuna pruriens) - green fodder     20.967  10.800000
## 58                       Mucuna (Mucuna pruriens) - hay     90.600  10.890000
## 59                      Mucuna (Mucuna pruriens) - seed     92.370  14.193000
## 60                                Mulberry (Morus alba)     28.400  10.000000
## 61                                                 N/A      0.000   0.000000
## 62                  Naturally occuring pasture - grazing     60.000   5.000000
## 63               Naturally occuring pasture - grazing OFR     60.000   5.000000
## 64              Naturally occuring pasture - green fodder     60.000   5.000000
## 65                       Oats (Avena sativa) - grain IP     89.000  12.267324
## 66                     Oats (Avena sativa) - green fodder     31.000   8.360000
```

```
## 67                              Oats (Avena sativa) - hay     85.000   7.480000
## 68                          Oats (Avena sativa) - hay OFR     85.000   7.480000
## 69                            Oats (Avena sativa) - hulls     92.400   5.317236
## 70          Oats (Avena sativa) - meal/cereal by-product     91.000  15.281820
## 71                          Oats (Avena sativa) - silage     36.400   8.917884
## 72                           Oats (Avena sativa) - straw     88.000   6.470000
## 73      Orchard grass (Dactylis glomerata) - green fodder     27.400   8.624808
## 74               Orchard grass (Dactylis glomerata) - hay     90.600   8.164260
## 75       Orchard tree (Bauhinia variegata) - green leaves     42.850   7.494370
## 76                              Panicum maximum (forage)     26.000   7.543014
## 77                         Panicum maximum (green fodder)     26.000   7.580000
## 78                              Paspalum notatum (forage)     28.000   7.543014
## 79       Pearl Millet (Pennisetum glaucum) - crop residue     86.000   9.462168
## 80              Pearl Millet (Pennisetum glaucum) - grain     90.340  12.430000
## 81       Pearl Millet (Pennisetum glaucum) - green fodder     25.000   8.550000
## 82                         Pennisetum purpureum - forage     15.000   9.880848
## 83                         Pennisetum purpureum - silage     19.500   7.500000
## 84              Pigeon Pea (Cajanus cajan) - crop residue     91.690   7.996788
## 85                       Pigeon Pea (Cajanus cajan) - meal     89.400  11.080000
## 86                       Pigeon Pea (Cajanus cajan) - seed     68.700  11.500000
## 87              Pineapple (Ananas comosus) - crop residue     20.600  11.513700
## 88               Pineapple (Ananas comosus) - leaf silage     35.120   8.220000
## 89                  Potato (Solanum tuberosum) - peelings     15.440  10.250000
## 90                     Potato (Solanum tuberosum) - tuber     16.340  12.990000
## 91                                          Poultry litter     78.700   8.164260
## 92                     Pumpkin (Cucurbita maxima) - fruit     22.730   9.910000
## 93        Red clover (Trifolium pratense) - green fodder     19.600  10.425132
## 94                  Red clover (Trifolium pratense) - hay     88.400   8.331732
## 95                 Rhodes grass (Chloris gayana) - forage     28.060   7.540000
## 96                    Rhodes grass (Chloris gayana) - hay     92.400   9.100000
## 97                Rice (Oryza sativa) - bran (with germs)     91.000  10.425132
## 98                             Rice (Oryza sativa) - hulls     92.000   1.423512
## 99                             Rice (Oryza sativa) - straw     91.880   5.640000
## 100             Sesbania (Sesbania sesban) - green fodder     28.900   8.540000
## 101          Smooth Broome (Bromus inermis) - green fodder     26.100  11.220624
## 102                  Smooth Broome (Bromus inermis) - hay     92.600   8.038656
## 103              Sorghum (Sorghum bicolor) - crop residue     85.000   7.033824
## 104                    Sorghum (Sorghum bicolor) - forage     27.000   8.570000
## 105                     Sorghum (Sorghum bicolor) - grain     90.000  12.392928
## 106                    Sorghum (Sorghum bicolor) - silage     30.000   8.570000
## 107                  Soybean (Glycine max) - crop residue     88.000   6.322068
## 108                           Soybean (Glycine max) - meal     89.000  13.188420
## 109                     Soybean (Glycine max) - seed coats     90.300  12.476664
## 110                  Soybean (Glycine max) - whole seed IP     86.400  14.235120
## 111                                   Stipa (grazing) OF     72.000   5.600000
## 112              Stylo (Stylosanthes guianensis) - forage     19.420   9.545904
## 113                                 Sugar beet (pulp) OFR     89.000  11.400000
## 114           Sugarcane (Saccharum officinarum) - BOUGHT     29.000   6.900000
## 115       Sugarcane (Saccharum officinarum) - crop residue     96.270   7.440000
## 116             Sugarcane (Saccharum officinarum) - forage     23.200   9.000000
## 117          Sugarcane (Saccharum officinarum) - molasses     74.300  10.885680
## 118     Sugarcane (Saccharum officinarum) - tops (forage)     29.000   6.900000
## 119        Sugarcane (Saccharum officinarum) - tops (hay)     85.000   7.000000
## 120                                               Sulla     12.300   9.700000
```

```
## 121             Sunflower (Helianthus annuus) - seed cake     94.900   9.127224
## 122              Sweet potato (Ipomoea batatas) -  leaves     10.800  10.010000
## 123      Sweet potato (Ipomoea batatas) -  tubers (fresh)     59.000  13.580000
## 124 Sweet potato (Ipomoea batatas) -  tubers meal (dried)     87.100  11.350000
## 125               Sweet potato (Ipomoea batatas) -  vines     10.800  10.010000
## 126                                          Tall fescue     21.000   9.110000
## 127       Tomato (Lycopersicon esculentum) - waste fruits     44.080   7.430000
## 128                                     Wheat (bran) IP     87.000  11.000000
## 129                                    Wheat (bran) OFC     87.000  11.000000
## 130                                       Wheat (straw)     88.000   5.630000
## 131                                    Wheat (straw) OFR     88.000   5.630000
## 132    White sweet clover (Melilotus alba) - green fodder     15.000   9.100000
##     cp_content establishment_cost operational_cost establishment_labour
## 1     6.254795                0.0               18                    6
## 2     5.200000                0.0                0                    0
## 3     9.500000                0.0                0                    0
## 4     4.500000                0.0                0                    0
## 5    11.800000                0.0                0                    0
## 6    11.800000                0.0                0                    0
## 7     0.300000                0.0                0                    0
## 8    12.600000                0.0               18                    6
## 9     7.600000                0.0               18                    6
## 10   26.000000                0.0                0                    0
## 11    7.254795               20.0               31                    8
## 12    8.254795               20.0               31                    8
## 13   22.000000              100.0                6                    6
## 14   19.940000                0.0                0                    0
## 15    5.450000                0.0                0                    0
## 16    1.810000                0.0                0                    0
## 17   16.000000                0.3                0                    0
## 18   18.400000                0.0                0                    0
## 19   20.560000              100.0                6                    6
## 20   23.880000                0.0                0                    0
## 21   22.530000                0.0                0                    0
## 22   24.000000                0.0               18                    6
## 23   12.600000              100.0                6                    6
## 24    8.000000                0.0               18                    6
## 25    9.900000               20.0               31                    8
## 26   29.000000                0.0                0                    0
## 27    7.400000                0.0                0                    0
## 28   22.300000              100.0                6                    6
## 29    6.520000                0.0                0                    0
## 30   33.200000                0.0                0                    0
## 31   16.290000                0.0                0                    0
## 32   15.000000                0.0                0                    0
## 33    6.000000                0.0               18                    6
## 34    6.000000                0.0               18                    6
## 35    7.000000                0.0                0                    0
## 36    6.010000                0.0                0                    0
## 37    5.300000                0.0                0                    0
## 38   22.940000              100.0                6                    6
## 39   16.600000               50.0               10                   10
## 40   17.510000               50.0               10                   10
## 41   19.930000              100.0                6                    6
```

```
## 42   19.700000              0.0              0                0
## 43   12.500000              0.0              0                0
## 44   19.500000              0.0              0                0
## 45    6.440000              0.0              0                0
## 46   30.000000              0.0              0                0
## 47    5.540000              0.0              0                0
## 48    5.900000              0.0              0                0
## 49    2.800000              0.0              0                0
## 50   10.000000              0.0              0                0
## 51    8.900000              0.0              0                0
## 52    4.400000           1680.0              0                0
## 53    5.900000              0.0              0                0
## 54    9.000000              0.0              0                0
## 55   24.300000              0.0              0                0
## 56   15.770000              0.0              0                0
## 57   15.770000              0.0              0                0
## 58   14.800000              0.0              0                0
## 59   27.300000              0.0              0                0
## 60   19.400000              0.0              0                0
## 61    0.000000              0.0              0                0
## 62    6.000000             20.0             18                6
## 63    6.000000             20.0             18                6
## 64    6.000000            840.0             18              100
## 65   13.600000              0.0              0                0
## 66    4.000000              0.0              0                0
## 67    3.500000              0.0              0                0
## 68    3.500000              0.0              0                0
## 69    4.100000              0.0              0                0
## 70   16.200000              0.0              0                0
## 71   12.700000              0.0              0                0
## 72    0.000000              0.0              0                0
## 73   10.100000              0.0              0                0
## 74    8.400000              0.0              0                0
## 75   16.150000              0.0              0                0
## 76    9.882192             20.0             31                8
## 77   10.000000             20.0             31                8
## 78    8.254795             20.0             31                8
## 79    6.400000              0.0              0                0
## 80   13.880000              0.0              0                0
## 81   13.810000              0.0              0                0
## 82   11.000000             20.0             18                6
## 83    6.500000             20.0             18                6
## 84   16.300000              0.0              0                0
## 85   19.390000              0.0              0                0
## 86   21.600000              0.0              0                0
## 87    9.100000              0.0              0                0
## 88    7.940000              0.0              0                0
## 89    6.960000              0.0              0                0
## 90   14.130000              0.0              0                0
## 91   17.780000              0.0              0                0
## 92   15.440000              0.0              0                0
## 93   20.800000              0.0              0                0
## 94   15.000000              0.0              0                0
## 95   14.100000              0.0              0                0
```

```
## 96    7.700000              0.0               0                   0
## 97   14.000000              0.0               0                   0
## 98    3.100000              0.0               0                   0
## 99    3.850000              0.0               0                   0
## 100  21.300000              0.0               0                   0
## 101  21.300000              0.0               0                   0
## 102   6.000000              0.0               0                   0
## 103   4.900000              0.0               0                   0
## 104   3.700000            200.0               0                  10
## 105  12.600000              0.0               0                   0
## 106   3.700000              0.0               0                   0
## 107   5.200000              0.0               0                   0
## 108  49.600000              0.0               0                   0
## 109  12.200000              0.0               0                   0
## 110  40.300000              0.0               0                   0
## 111   5.000000              0.0               0                   0
## 112  18.690000              0.0               0                   0
## 113   8.900000              0.0               0                   0
## 114   5.900000              0.0               0                   0
## 115   3.690000              0.0               0                   0
## 116   4.300000            200.0              18                 200
## 117   5.800000              0.3               0                   0
## 118   5.900000            100.0               0                 100
## 119   5.500000            100.0               0                 100
## 120  20.200000              0.0               0                   0
## 121  17.900000              0.0               0                   0
## 122  19.400000              0.0               0                   0
## 123   5.100000              0.0               0                   0
## 124   4.600000              0.0               0                   0
## 125  19.400000              0.0               0                   0
## 126   8.900000              0.0               0                   0
## 127  21.000000              0.0               0                   0
## 128  17.300000              0.0               0                   0
## 129  17.300000              0.0               0                   0
## 130   4.200000              0.0               0                   0
## 131   4.200000              0.0               0                   0
## 132  22.500000              0.0               0                   0
##     operational_labour  me_fresh  cp_fresh         de wfp_green wfp_blue
## 1                0.203  2.528124  1.738833 0.46860000    0.1990   0.0020
## 2                0.970  2.706000  1.144000 0.81180000    0.6600   0.0970
## 3                0.970  1.600000  1.520000 0.66000000    0.6600   0.0970
## 4                0.203  2.954600  1.530000 0.57354000    0.1990   0.0020
## 5                1.423 10.800400 10.277800 0.81840000    1.2130   0.0790
## 6                1.423 10.800400 10.277800 0.81840000    1.2130   0.0790
## 7                1.423  5.115600  0.261000 0.38808000    1.2130   0.0790
## 8                0.203  2.930467  3.817800 0.63831953    0.1990   0.0020
## 9                0.203  6.891891  7.068000 0.48910198    0.1990   0.0020
## 10               0.203  1.362900  2.860000 0.81774000    0.1990   0.0020
## 11               0.203  1.886247  1.886247 0.47881644    0.1990   0.0020
## 12               0.203  1.886247  2.146247 0.47881644    0.1990   0.0020
## 13               0.203  3.630000  6.600000 0.79860000    0.1990   0.0020
## 14               0.000  1.611039  3.210340 0.66042583    0.0000   0.0000
## 15               0.000  1.203160  1.520550 0.28461840    0.0000   0.0000
## 16               0.000  9.559184  1.608004 0.71016000    0.0000   0.0000
```

```
## 17              0.000 10.890000 14.400000 0.79860000    0.0000   0.0000
## 18              0.000  8.892763 16.560000 0.65213597    0.0000   0.0000
## 19              0.203  1.283260  2.524768 0.68970000    0.1990   0.0020
## 20              0.000 11.866543 21.451404 0.87186000    0.0000   0.0000
## 21              0.000 12.623800 20.315301 0.92400000    0.0000   0.0000
## 22              0.000  2.820000  7.200000 0.62040000    0.0000   0.0000
## 23              0.203  2.930467  3.817800 0.63831953    0.1990   0.0020
## 24              0.203  2.392500  2.640000 0.47850000    0.1990   0.0020
## 25              0.203  2.328000  2.376000 0.64020000    0.1990   0.0020
## 26              0.203 11.517800 25.114000 0.87780000    0.1990   0.0020
## 27              0.203  5.740800  6.637800 0.42240000    0.1990   0.0020
## 28              0.000  3.450000  6.690000 0.75900000    0.0000   0.0000
## 29              0.203  7.153447  5.837356 0.52734000    0.1990   0.0020
## 30              0.000 19.638680 30.776400 1.39822320    0.0000   0.0000
## 31              0.000  6.108672 15.169248 0.43296000    0.0000   0.0000
## 32              0.000  3.300000  4.500000 0.72600000    0.0000   0.0000
## 33              0.203  1.593622  1.560000 0.40453479    0.1990   0.0020
## 34              0.203  1.440921  1.440000 0.39625315    0.1990   0.0020
## 35              0.203  1.653000  1.330000 0.57420000    0.1990   0.0020
## 36              0.203  7.106000  5.108500 0.55176000    0.1990   0.0020
## 37              0.203  3.038450  1.775500 0.59862000    0.1990   0.0020
## 38              0.203  2.091690  4.198020 0.75438000    0.1990   0.0020
## 39              0.203  8.361000 14.940000 0.61314000    0.1990   0.0020
## 40              0.203  2.070552  4.873033 0.49104000    0.1990   0.0020
## 41              0.000  2.489000  5.221660 0.62700000    0.0000   0.0000
## 42              0.378  2.116800  4.137000 0.66528000    0.2070   0.1710
## 43              0.378  7.106000 10.625000 0.55176000    0.2070   0.1710
## 44              0.378  4.209744  8.599500 0.63002966    0.2070   0.1710
## 45              0.000  5.227445  6.043940 0.36762000    0.0000   0.0000
## 46              0.000 17.100000 27.000000 1.25400000    0.0000   0.0000
## 47              0.000  6.763104  5.090706 0.48576000    0.0000   0.0000
## 48              1.222  7.940685  5.133000 0.60239678    0.9470   0.0810
## 49              1.222  6.827875  2.522800 0.50015513    0.9470   0.0810
## 50              1.222 11.588644  8.900000 0.85938257    0.9470   0.0810
## 51              0.203  8.376949  7.298000 0.67424227    0.1990   0.0020
## 52              0.203  3.237000  1.320000 0.71214000    0.1990   0.0020
## 53              1.222  7.940685  5.133000 0.60239678    0.9470   0.0810
## 54              1.222 13.500000  8.100000 0.99000000    0.9470   0.0810
## 55              0.000  2.777200  6.366600 0.69960000    0.0000   0.0000
## 56              0.203  2.264436  3.306496 0.71280000    0.1990   0.0020
## 57              0.203  2.264436  3.306496 0.71280000    0.1990   0.0020
## 58              0.203  9.866340 13.408800 0.71874000    0.1990   0.0020
## 59              0.000 13.110074 25.217010 0.93673800    0.0000   0.0000
## 60              0.203  2.840000  5.509600 0.66000000    0.1990   0.0020
## 61              0.000  0.000000  0.000000 0.00000000    0.0000   0.0000
## 62              0.203  3.000000  3.600000 0.33000000    0.1990   0.0020
## 63              0.203  3.000000  3.600000 0.33000000    0.1990   0.0020
## 64              0.203  3.000000  3.600000 0.33000000    0.1990   0.0020
## 65              1.788 10.917918 12.104000 0.80964338    1.4790   0.1810
## 66              0.400  2.591600  1.240000 0.55176000    0.3920   0.0040
## 67              0.400  6.358000  2.975000 0.49368000    0.3920   0.0040
## 68              0.400  6.358000  2.975000 0.49368000    0.3920   0.0040
## 69              0.000  4.913126  3.788400 0.35093758    0.0000   0.0000
## 70              0.000 13.906456 14.742000 1.00860012    0.0000   0.0000
```

```
## 71              0.203  3.246110  4.622800 0.58858034    0.1990   0.0020
## 72              1.788  5.693600  0.000000 0.42702000    1.4790   0.1810
## 73              0.000  2.363197  2.767400 0.56923733    0.0000   0.0000
## 74              0.000  7.396820  7.610400 0.53884116    0.0000   0.0000
## 75              0.000  3.211338  6.920275 0.49462842    0.0000   0.0000
## 76              0.203  1.961184  2.569370 0.49783890    0.1990   0.0020
## 77              0.203  1.970800  2.600000 0.50028000    0.1990   0.0020
## 78              0.203  2.112044  2.311342 0.49783890    0.1990   0.0020
## 79              1.644  8.137464  5.504000 0.62450309    0.0000   0.0000
## 80              0.000 11.229262 12.539192 0.82038000    0.0000   0.0000
## 81              0.203  2.137500  3.452500 0.56430000    0.1990   0.0020
## 82              0.500  1.482127  1.650000 0.65213597    0.0000   0.0000
## 83              0.500  1.462500  1.267500 0.49500000    0.0000   0.0000
## 84              0.000  7.332255 14.945470 0.52778801    0.0000   0.0000
## 85              0.000  9.905520 17.334660 0.73128000    0.0000   0.0000
## 86              0.000  7.900500 14.839200 0.75900000    0.0000   0.0000
## 87              0.000  2.371822  1.874600 0.75990420    0.0000   0.0000
## 88              0.000  2.886864  2.788528 0.54252000    0.0000   0.0000
## 89              0.000  1.582600  1.074624 0.67650000    0.0000   0.0000
## 90              0.000  2.122566  2.308842 0.85734000    0.0000   0.0000
## 91              0.000  6.425273 13.992860 0.53884116    0.0000   0.0000
## 92              0.000  2.252543  3.509512 0.65406000    0.0000   0.0000
## 93              0.203  2.043326  4.076800 0.68805871    0.1990   0.0020
## 94              0.203  7.365251 13.260000 0.54989431    0.1990   0.0020
## 95              0.203  2.115724  3.956460 0.49764000    0.1990   0.0020
## 96              0.203  8.408400  7.114800 0.60060000    0.1990   0.0020
## 97              0.000  9.486870 12.740000 0.68805871    0.0000   0.0000
## 98              0.000  1.309631  2.852000 0.09395179    0.0000   0.0000
## 99              1.644  5.182032  3.537380 0.37224000    0.0000   0.0000
## 100             0.000  2.468060  6.155700 0.56364000    0.0000   0.0000
## 101             0.000  2.928583  5.559300 0.74056118    0.0000   0.0000
## 102             0.000  7.443795  5.556000 0.53055130    0.0000   0.0000
## 103             3.048  5.978750  4.165000 0.46423238    2.8570   0.1030
## 104             0.203  3.626526  0.999000 0.56562000    0.1990   0.0020
## 105             0.000 11.153635 11.340000 0.81793325    0.0000   0.0000
## 106             0.203  2.571000  1.110000 0.56562000    0.1990   0.0020
## 107             0.000  5.563420  4.576000 0.41725649    0.0000   0.0000
## 108             0.000 11.737694 44.144000 0.87043572    0.0000   0.0000
## 109             0.000 11.266428 11.016600 0.82345982    0.0000   0.0000
## 110             2.145 12.299144 34.819200 0.93951792    2.0370   0.0700
## 111             0.000  4.032000  3.600000 0.36960000    0.0000   0.0000
## 112             0.203  1.853815  3.629598 0.63002966    0.1990   0.0020
## 113             0.033 10.146000  7.921000 0.75240000    0.0205   0.0065
## 114             0.000  2.001000  1.711000 0.45540000    0.0000   0.0000
## 115             0.210  7.162488  3.552363 0.49104000    0.1390   0.0570
## 116             0.197  2.088000  0.997600 0.59400000    0.0000   0.0000
## 117             0.000  8.088060  4.309400 0.71845488    0.0000   0.0000
## 118             0.210  2.001000  1.711000 0.45540000    0.1390   0.0570
## 119             0.210  5.950000  4.675000 0.46200000    0.1390   0.0570
## 120             0.203  1.193100  2.484600 0.64020000    0.1990   0.0020
## 121             0.000  8.661736 16.987100 0.60239678    0.0000   0.0000
## 122             0.000  1.081080  2.095200 0.66066000    0.0000   0.0000
## 123             0.000  8.012200  3.009000 0.89628000    0.0000   0.0000
## 124             0.000  9.885850  4.006600 0.74910000    0.0000   0.0000
```

```
## 125             0.000  1.081080  2.095200 0.66066000    0.0000   0.0000
## 126             0.203  1.913100  1.869000 0.60126000    0.1990   0.0020
## 127             0.000  3.275144  9.256800 0.49038000    0.0000   0.0000
## 128             1.828  9.570000 15.051000 0.72600000    1.2780   0.3420
## 129             1.828  9.570000 15.051000 0.72600000    1.2780   0.3420
## 130             1.828  4.954400  3.696000 0.37158000    1.2780   0.3420
## 131             1.828  4.954400  3.696000 0.37158000    1.2780   0.3420
## 132             0.203  1.365000  3.375000 0.60060000    0.1990   0.0020
##     wfp_grey emission_factor                associated_crop
## 1    0.00200             0.00              Andropogon gayanus
## 2    0.03300             0.00                       Musa spp.
## 3    0.03300             0.00                       Musa spp.
## 4    0.00200             0.00        Hordeum vulgare (forage)
## 5    0.13100             0.50            Hordeum vulgare (IP)
## 6    0.13100             0.50          Hordeum vulgare (grain)
## 7    0.13100             0.00          Hordeum vulgare (grain)
## 8    0.00200             0.00              Cynodon nlemfuensis
## 9    0.00200             0.00              Cynodon nlemfuensis
## 10   0.00200             0.00           Trifolium alexandrinum
## 11   0.00200             0.00             Brachiaria brizantha
## 12   0.00200             0.00                Brachiaria hybrid
## 13   0.00200             0.00           Canavalia brasiliensis
## 14   0.00000             0.00                          Cassava
## 15   0.00000             0.00                          Cassava
## 16   0.00000             0.00                          Cassava
## 17   0.00000             0.00                        Purchased
## 18   0.00000             0.00                           Cowpea
## 19   0.00200             0.00                           Cowpea
## 20   0.00000             0.00                           Cowpea
## 21   0.00000             0.00                           Cowpea
## 22   0.00000             0.00                         Cratylia
## 23   0.00200             0.00              Cynodon nlemfuensis
## 24   0.00200             0.00            Dichanthium aristatum
## 25   0.00200             0.00                            Swazi
## 26   0.00200             0.00              Vicia faba (grain)
## 27   0.00200             0.00              Vicia faba (grain)
## 28   0.00000             0.00                      Gliricidia
## 29   0.00200             0.00                       Groundnut
## 30   0.00000             0.00                       Groundnut
## 31   0.00000             0.00                       Groundnut
## 32   0.00000             0.00               Guazuma ulmifolia
## 33   0.00200             0.00                Hyparrhenia rufa
## 34   0.00200             0.00               Ischaemum ciliare
## 35   0.00200             0.00              Lolium multiflorum
## 36   0.00200             0.00              Lolium multiflorum
## 37   0.00200             0.00              Lolium multiflorum
## 38   0.00200             0.00                          Lablab
## 39   0.00200             0.00                          Lablab
## 40   0.00200             0.00                          Lablab
## 41   0.00000             0.00                        Leucaena
## 42   0.00000             0.00                  Medicago sativa
## 43   0.00000             0.00                  Medicago sativa
## 44   0.00000             0.00                  Medicago sativa
## 45   0.00000             0.00                           Lupins
```

```
## 46   0.00000           0.00                      Lupins
## 47   0.00000           0.00                      Lupins
## 48   0.19400           0.00                   Purchased
## 49   0.19400           0.00                       Maize
## 50   0.19400           0.50                    Maize IP
## 51   0.00200           0.00                       Maize
## 52   0.00200           0.00                  Maize-silage
## 53   0.19400           0.00                       Maize
## 54   0.19400           0.50                       Maize
## 55   0.00000           0.00              Moringa oleifera
## 56   0.00200           0.00                      Mucuna
## 57   0.00200           0.00                      Mucuna
## 58   0.00200           0.00                      Mucuna
## 59   0.00000           0.00                      Mucuna
## 60   0.00200           0.00                    Mulberry
## 61   0.00000           0.00                         N/A
## 62   0.00200           0.00              Natural pasture
## 63   0.00200           0.00              Natural pasture
## 64   0.00200           0.00              Natural pasture
## 65   0.12800           0.50                 Avena sativa
## 66   0.00400           0.00           Avena sativa-forage
## 67   0.00400           0.00           Avena sativa-forage
## 68   0.00400           0.00           Avena sativa-forage
## 69   0.00000           0.00                 Avena sativa
## 70   0.00000           0.00                    Purchased
## 71   0.00200           0.00           Avena sativa-forage
## 72   0.12800           0.50                 Avena sativa
## 73   0.00000           0.00                Orchard grass
## 74   0.00000           0.00                Orchard grass
## 75   0.00000           0.00                Orchard grass
## 76   0.00200           0.00              Panicum maximum
## 77   0.00200           0.00              Panicum maximum
## 78   0.00200           0.00             Paspalum notatum
## 79   0.00000           0.00                 Pearl Millet
## 80   0.00000           0.00                 Pearl Millet
## 81   0.00200           0.00                 Pearl Millet
## 82   0.00000           0.00         Pennisetum purpureum
## 83   0.00000           0.00  Pennisetum purpureum-silage
## 84   0.00000           0.00                   Pigeon pea
## 85   0.00000           0.00                   Pigeon pea
## 86   0.00000           0.00                   Pigeon pea
## 87   0.00000           0.00                    Pineapple
## 88   0.00000           0.00                    Pineapple
## 89   0.00000           0.00                       Potato
## 90   0.00000           0.00                       Potato
## 91   0.00000           0.00                    Purchased
## 92   0.00000           0.00                      Pumpkin
## 93   0.00200           0.00                  Red clover
## 94   0.00200           0.00                  Red clover
## 95   0.00200           0.00                       Rhodes
## 96   0.00200           0.00                       Rhodes
## 97   0.00000           0.05                    Purchased
## 98   0.00000           0.00                         Rice
## 99   0.00000           0.00                         Rice
```

```
## 100  0.00000           0.00                       Sesbania
## 101  0.00000           0.00                  Smooth Broome
## 102  0.00000           0.00                  Smooth Broome
## 103  0.08700           0.00         Sorghum bicolor (grain)
## 104  0.00200           0.00 Sorghum bicolor (forage/silage)
## 105  0.00000           0.50         Sorghum bicolor (grain)
## 106  0.00200           0.00 Sorghum bicolor (forage/silage)
## 107  0.00000           0.00                    Glycine max
## 108  0.00000           0.00                    Glycine max
## 109  0.00000           0.00                    Glycine max
## 110  0.03700           0.40                    Glycine max
## 111  0.00000           0.00              Stipa tenacissima
## 112  0.00200           0.00                          Stylo
## 113  0.00625           0.00                 Beta vulgaris
## 114  0.00000           0.00                     Purchased
## 115  0.01300           0.00                     Sugarcane
## 116  0.00000           0.00                     Sugarcane
## 117  0.00000           0.00                     Purchased
## 118  0.01300           0.00                     Sugarcane
## 119  0.01300           0.00                     Sugarcane
## 120  0.00200           0.00           Hedysarum coronarium
## 121  0.00000           0.00                     Purchased
## 122  0.00000           0.00                  Sweet potato
## 123  0.00000           0.00                  Sweet potato
## 124  0.00000           0.00                  Sweet potato
## 125  0.00000           0.00                  Sweet potato
## 126  0.00200           0.00            Fustuca arundinacea
## 127  0.00000           0.00                        Tomato
## 128  0.20800           0.05                   Triticum IP
## 129  0.20800           0.05                   Triticum OF
## 130  0.20800           0.00                      Triticum
## 131  0.20800           0.00                      Triticum
## 132  0.00200           0.00             White sweet clover
```

Type

```
##    feed_type_code              feed_type_name feedtype_concentrate
## 1               1          Andropogon gayanus                    0
## 2               2                Avena sativa                    0
## 3               3           Avena sativa-forage                    0
## 4               4                 Beta vulgaris                    0
## 5               5          Brachiaria brizantha                    0
## 6               6             Brachiaria hybrid                    0
## 7               7       Canavalia brasiliensis                    0
## 8               8                     Cassava                    0
## 9               9                      Cowpea                    0
## 10             10                    Cratylia                    0
## 11             11          Cynodon nlemfuensis                    0
## 12             12        Dichanthium aristatum                    0
## 13             13                 Fodder maize                    0
## 14             14          Fustuca arundinacea                    0
## 15             15                   Gliricidia                    0
## 16             16                  Glycine max                    0
## 17             17                    Groundnut                    0
```

```
## 18             18                          Guava                     0
## 19             19                Guazuma ulmifolia                   0
## 20             20              Hedysarum coronarium                  0
## 21             21          Hordeum vulgare (forage)                  0
## 22             22           Hordeum vulgare (grain)                  0
## 23             23              Hordeum vulgare (IP)                  0
## 24             24                  Hyparrhenia rufa                  0
## 25             25                 Ischaemum ciliare                  0
## 26             26                            Lablab                  0
## 27             27                           Leucaena                 0
## 28             28               Lolium multiflorum                   0
## 29             29                            Maize                   0
## 30             30                          Maize IP                  0
## 31             31                       Maize-silage                 0
## 32             32                   Medicago sativa                  0
## 33             33                  Moringa oleifera                  0
## 34             34                         Musa spp.                  0
## 35             35                               N/A                  0
## 36             36                   Natural pasture                  0
## 37             37                     Natural trees                  0
## 38             38                   Panicum maximum                  0
## 39             39                  Paspalum notatum                  0
## 40             40              Pennisetum purpureum                  0
## 41             41       Pennisetum purpureum-silage                  0
## 42             42                          Pigeon pea                0
## 43             43                           Purchased                0
## 44             44                          Red pepper                0
## 45             45                                Rice                0
## 46             46           Sorghum bicolor (grain)                  0
## 47             47 Sorghum bicolor (forage/silage)                    0
## 48             48                           Sugarcane                0
## 49             49                               Swazi                0
## 50             50            Trifolium alexandrinum                  0
## 51             51                            Triticum                0
## 52             52                         Triticum OF                0
## 53             53                         Triticum IP                0
## 54             54                  Vicia faba (grain)                 0
##    fresh_yield dm_fraction dry_yield harvest_index residue_fresh_yield
## 1        0.000      0.0000  8.882192        0.0000           0.0000000
## 2        0.400      0.8800  0.352000        0.0000           3.0000000
## 3       35.000      0.2600  9.100000        0.0000           0.0000000
## 4       55.000      0.1900 10.450000        0.0000           2.7500000
## 5        0.000      0.2600 15.646575        0.0000           0.0000000
## 6        0.000      0.2600 13.764384        0.0000           0.0000000
## 7        0.000      0.0000  4.000000        0.0000           0.0000000
## 8       12.500      0.4032  5.040000        0.5000          12.5000000
## 9        0.950      0.8990  0.854050        0.2199           3.3701455
## 10       0.000      0.0000 12.000000        0.0000           0.0000000
## 11       0.000      0.0000 10.000000        0.0000           0.0000000
## 12       0.000      0.0000 10.000000        0.0000           0.0000000
## 13       1.330      0.8000  1.064000        0.4700           1.4997872
## 14      60.000      0.2100 12.600000        0.0000           0.0000000
## 15       0.000      0.0000  5.000000        0.0000           0.0000000
## 16       3.500      0.8870  3.104500        0.0000           0.0000000
```

```
## 17       1.220      0.9500  1.159000        0.2900           2.9868966
## 18       0.000      0.0000  0.000000        0.0000           0.0000000
## 19       0.000      0.0000 17.000000        0.0000           0.0000000
## 20       0.000      0.8700  5.000000        0.0000           0.0000000
## 21      20.000      0.3400  6.800000        0.0000           0.0000000
## 22       0.700      0.8700  0.609000        0.0000           1.8000000
## 23       5.000      0.8700  4.350000        0.0000           1.8000000
## 24       0.000      0.0000 10.136986        0.0000           0.0000000
## 25       0.000      0.0000  8.000000        0.0000           0.0000000
## 26       1.843      0.8800  1.621840        0.5000           1.8430000
## 27       0.000      0.0000 14.000000        0.0000           0.0000000
## 28      60.000      0.1900 11.400000        0.0000           0.0000000
## 29      10.000      0.8600  8.600000        0.4700           3.5000000
## 30      10.000      0.8600  8.600000        0.4700           3.5000000
## 31      60.000      0.3000 18.000000        1.0000           1.0000000
## 32      40.000      0.0000 12.000000        0.0000          40.0000000
## 33       0.000      0.0000 20.000000        0.0000           0.0000000
## 34      10.000      0.0000  5.000000        0.0000          10.0000000
## 35       0.000      0.0000  0.000000        0.0000           0.0000000
## 36       2.000      0.0000 10.000000        0.9500           0.1052632
## 37       0.000      0.0000  0.000000        0.0000           0.0000000
## 38       0.000      0.0000 17.019178        0.0000           0.0000000
## 39       0.000      0.0000  6.882192        0.0000           0.0000000
## 40      20.000      0.3000  6.000000        0.9000           2.2222222
## 41      20.000      0.3000  6.000000        0.0000           0.0000000
## 42       0.950      0.9030  0.857850        0.2600           2.7038462
## 43       0.000      0.0000  0.000000        0.0000           0.0000000
## 44       7.800      0.0800  0.624000        0.9000           0.8666667
## 45       2.000      0.8000  1.600000        0.4200           2.7619048
## 46       4.300      0.9300  3.999000        0.3000          10.0333333
## 47      50.000      0.2700 13.500000        0.0000           0.0000000
## 48      55.000      0.2000 11.000000        0.0000           0.0000000
## 49       0.000      0.2400 15.000000        0.0000           0.0000000
## 50      45.000      0.1100  4.950000        0.0000           0.0000000
## 51       1.800      0.8700  1.566000        0.4500           2.2000000
## 52       1.800      0.8700  1.566000        0.0000           0.1800000
## 53       5.000      0.8700  4.350000        0.4500           6.1111111
## 54       2.000      0.8700  1.740000        0.0000           2.0000000
##    residue_dm_content residue_dry_yield  main_n residue_n c_factor energy
## 1              0.0000        0.00000000 0.01040         0    0.000      0
## 2              0.8800        2.64000000 0.01760         0    0.000      0
## 3              0.0000        0.00000000 0.01600         0    0.000      0
## 4              0.0000        2.75000000 0.01250         0    0.000      0
## 5              0.0000        0.00000000 0.01760         0    0.000      0
## 6              0.0000        0.00000000 0.02240         0    0.000      0
## 7              0.0000        0.00000000 0.03520         0    0.000      0
## 8              0.4032        5.04000000 0.00400         0    0.050    160
## 9              0.8805        2.96741313 0.03800         0    0.117    336
## 10             0.0000        0.00000000 0.03840         0    0.000      0
## 11             0.0000        0.00000000 0.02000         0    0.000      0
## 12             0.0000        0.00000000 0.01280         0    0.000      0
## 13             0.8963        1.34425930 0.01700         0    0.050    365
## 14             0.0000        0.00000000 0.01400         0    0.000      0
## 15             0.0000        0.00000000 0.03560         0    0.000      0
```

```
## 16            0.0000        0.00000000 0.06400         0    0.000      0
## 17            0.9350        2.79274828 0.03700         0    0.117    567
## 18            0.1920        0.00000000 0.00200         0    0.146     68
## 19            0.0000        0.00000000 0.02400         0    0.000      0
## 20            0.8800        0.00000000 0.03200         0    0.000      0
## 21            0.0000        0.00000000 0.00720         0    0.000      0
## 22            0.8800        1.58400000 0.01888         0    0.000      0
## 23            0.8800        1.58400000 0.01888         0    0.000      0
## 24            0.0000        0.00000000 0.01000         0    0.000      0
## 25            0.0000        0.00000000 0.01000         0    0.000      0
## 26            0.8941        1.64782630 0.00400         0    0.000    343
## 27            1.0000        0.00000000 0.03400         0    0.000      0
## 28            0.0000        0.00000000 0.01200         0    0.000      0
## 29            0.8963        3.00000000 0.01700         0    0.050    365
## 30            0.8963        3.00000000 0.01700         0    0.050    365
## 31            0.2500        0.00000000 0.00700         0    0.050      0
## 32            0.0000        0.00000000 0.03200         0    0.000      0
## 33            0.0000        0.00000000 0.03800         0    0.000      0
## 34            0.1600        1.60000000 0.00800         0    0.000      0
## 35            0.0000        0.00000000 0.00000         0    0.000      0
## 36            1.0000        0.00000000 0.01000         0    0.027      0
## 37            1.0000        0.00000000 0.00500         0    0.730      0
## 38            0.0000        0.00000000 0.01920         0    0.000      0
## 39            0.0000        0.00000000 0.01600         0    0.000      0
## 40            0.8500        0.00000000 0.02300         0    0.027      0
## 41            0.0000        0.00000000 0.01000         0    0.000      0
## 42            0.8941        2.41750885 0.03500         0    0.116    343
## 43            0.0000        0.00000000 0.00000         0    0.000      0
## 44            0.0779        0.06751333 0.00900         0    0.100     31
## 45            0.8711        2.40589524 0.00900         0    0.000    360
## 46            0.8760        8.78920000 0.02000         0    0.050    329
## 47            0.0000        0.00000000 0.00600         0    0.000      0
## 48            0.0000        1.38433613 0.00100         0    0.171      0
## 49            0.0000        0.00000000 0.01600         0    0.000      0
## 50            0.0000        0.00000000 0.04160         0    0.000      0
## 51            0.9100        2.00200000 0.02020         0    0.000      0
## 52            0.8800        0.15840000 0.02020         0    0.000      0
## 53            0.8800        5.37777778 0.02020         0    0.000      0
## 54            0.9000        1.80000000 0.04600         0    0.000      0
##    water_content usda_value kc_initial kc_midseason kc_late residue_n_dm
## 1           0.00          0       0.30         0.75    0.75       0.0104
## 2           0.00          0       0.10         1.10    0.55       0.0000
## 3           0.00          0       0.10         1.10    0.55       0.0000
## 4           0.00          0       0.72         1.04    0.70       0.0125
## 5           0.00          0       0.60         1.10    1.05       0.0176
## 6           0.00          0       0.60         1.10    1.05       0.0224
## 7           0.00          0       0.15         1.10    0.25       0.0352
## 8          59.68      11134       0.00         0.00    0.00       0.0030
## 9          11.95      16062       0.15         1.05    0.60       0.0230
## 10          0.00          0       1.05         1.10    1.10       0.0384
## 11          0.00          0       0.30         0.75    0.75       0.0200
## 12          0.00          0       0.30         0.75    0.75       0.0000
## 13         10.37      20314       0.15         1.15    0.30       0.0070
## 14          0.00          0       0.30         0.75    0.75       0.0000
```

```
## 15          0.00          0       1.05         1.10    1.10       0.0000
## 16          0.00          0       0.15         1.15    0.60       0.0000
## 17          6.50      16067       0.15         1.15    0.60       0.0120
## 18         80.80       9139       1.05         1.10    1.10       0.0280
## 19          0.00          0       1.05         1.10    1.10       0.0000
## 20          0.00          0       0.15         1.10    0.25       0.0000
## 21          0.00          0       0.10         1.10    0.55       0.0000
## 22          0.00          0       0.10         1.10    0.55       0.0005
## 23          0.00          0       0.10         1.10    0.55       0.0005
## 24          0.00          0       0.30         0.75    0.75       0.0100
## 25          0.00          0       0.30         0.75    0.75       0.0100
## 26         10.59      16101       0.15         1.10    0.25       0.0400
## 27          0.00          0       1.05         1.10    1.10       0.0340
## 28          0.00          0       0.30         0.75    0.75       0.0000
## 29         10.37      20314       0.15         1.15    0.30       0.0070
## 30         10.37      20314       0.15         1.15    0.30       0.0070
## 31          0.00          0       0.15         1.15    0.30       0.0120
## 32          0.00          0       0.15         1.10    0.25       0.0320
## 33          0.00          0       1.05         1.10    1.10       0.0380
## 34          0.00          0       0.15         1.20    0.70       0.0152
## 35          0.00          0       0.00         0.00    0.00       0.0000
## 36          0.00          0       0.30         0.75    0.75       0.0100
## 37          0.00          0       1.05         1.10    1.10       0.0050
## 38          0.00          0       0.60         1.10    1.05       0.0192
## 39          0.00          0       0.30         0.75    0.75       0.0160
## 40          0.00          0       0.60         1.10    1.05       0.0230
## 41          0.00          0       1.00         1.00    1.00       0.0100
## 42         10.59      16101       0.00         0.00    0.00       0.0180
## 43          0.00          0       0.00         0.00    0.00       0.0000
## 44         92.21      11821       0.00         0.00    0.00       0.0030
## 45         12.89      20450       1.05         1.20    0.75       0.0060
## 46         12.40      20067       0.10         1.10    0.55       0.0060
## 47          0.00          0       0.10         1.10    0.55       0.0000
## 48         68.00          0       0.15         1.20    0.70       0.0010
## 49          0.00          0       0.30         0.75    0.75       0.0160
## 50          0.00          0       0.15         1.10    0.25       0.0000
## 51          0.00          0       0.10         1.10    0.55       0.0060
## 52          0.00          0       0.10         1.10    0.55       0.0280
## 53          0.00          0       0.10         1.10    0.55       0.0280
## 54          0.00          0       0.15         1.10    0.25       0.0120
##    n_fixation crop_coefficient    category trees_ha trees_dhb trees_growth
## 1     0.00000        0.6000000       grass        0         0            0
## 2     0.00000        0.5833333     cereal         0         0            0
## 3     0.00000        0.5833333     cereal         0         0            0
## 4     0.00000        0.8200000                    0         0            0
## 5     0.00000        0.9166667       grass        0         0            0
## 6     0.00000        0.9166667       grass        0         0            0
## 7    70.40000        0.5000000     legume         0         0            0
## 8     0.00000        0.0000000                    0         0            0
## 9    50.35220        0.6000000     legume         0         0            0
## 10  230.40000        1.0833333 tree legume      400        18            2
## 11    0.00000        0.6000000       grass        0         0            0
## 12    0.00000        0.6000000       grass        0         0            0
## 13    0.00000        0.5333333     cereal         0         0            0
```

```
## 14    0.00000        0.6000000                    0         0            0
## 15   89.00000        1.0833333 tree legume     3000        18            2
## 16   99.34400        0.6333333      legume        0         0            0
## 17   38.19799        0.6333333      legume        0         0            0
## 18    0.00000        1.0833333                   25        20            0
## 19  204.00000        1.0833333 tree legume    10000         0            0
## 20   80.00000        0.5000000      legume        0         0            0
## 21    0.00000        0.5833333      cereal        0         0            0
## 22    0.00000        0.5833333      cereal        0         0            0
## 23    0.00000        0.5833333      cereal        0         0            0
## 24    0.00000        0.6000000       grass        0         0            0
## 25    0.00000        0.6000000       grass        0         0            0
## 26   36.20021        0.5000000      legume        0         0            0
## 27  238.00000        1.0833333 tree legume      400        18            3
## 28    0.00000        0.6000000       grass        0         0            0
## 29    0.00000        0.5333333      cereal        0         0            0
## 30    0.00000        0.5333333      cereal        0         0            0
## 31    0.00000        0.5333333      cereal        0         0            0
## 32  192.00000        0.5000000      legume        0         0            0
## 33  380.00000        1.0833333 tree legume    80000         0            0
## 34    0.00000        0.6833333                    0         0            0
## 35    0.00000        0.0000000                    0         0            0
## 36    0.00000        0.6000000       grass        0         0            0
## 37    0.00000        1.0833333                    0         0            0
## 38    0.00000        0.9166667       grass        0         0            0
## 39    0.00000        0.6000000       grass        0         0            0
## 40    0.00000        0.9166667       grass        0         0            0
## 41    0.00000        0.0000000       grass        0         0            0
## 42   36.76995        0.0000000 tree legume     5000        10           25
## 43    0.00000        0.0000000                    0         0            0
## 44    0.00000        0.0000000                    0         0            0
## 45    0.00000        1.0000000      cereal        0         0            0
## 46    0.00000        0.5833333      cereal        0         0            0
## 47    0.00000        0.5833333      cereal        0         0            0
## 48    0.00000        0.6833333       grass        0         0            0
## 49    0.00000        0.6000000       grass        0         0            0
## 50  102.96000        0.5000000      legume        0         0            0
## 51    0.00000        0.5833333      cereal        0         0            0
## 52    0.00000        0.5833333      cereal        0         0            0
## 53    0.00000        0.5833333      cereal        0         0            0
## 54   50.82000        0.5000000      legume        0         0            0
##    trees_removal energy_dm trees_ha_dbh25 average_dbh25 increase_dbh25
## 1              0    0.0000              0            0              0
## 2              0    0.0000              0            0              0
## 3              0    0.0000              0            0              0
## 4              0    0.0000              0            0              0
## 5              0    0.0000              0            0              0
## 6              0    0.0000              0            0              0
## 7              0    0.0000              0            0              0
## 8              0  396.8254              0            0              0
## 9              0  381.6014              0            0              0
## 10             0    0.0000              0            0              0
## 11             0    0.0000              0            0              0
## 12             0    0.0000              0            0              0
```

```
## 13             0  407.2297             0             0             0
## 14             0    0.0000             0             0             0
## 15             0    0.0000             0             0             0
## 16             0    0.0000             0             0             0
## 17             0  606.4171             0             0             0
## 18             0  354.1667             0             0             0
## 19             0    0.0000             0             0             0
## 20             0    0.0000             0             0             0
## 21             0    0.0000             0             0             0
## 22             0    0.0000             0             0             0
## 23             0    0.0000             0             0             0
## 24             0    0.0000             0             0             0
## 25             0    0.0000             0             0             0
## 26             0  383.6260             0             0             0
## 27             0    0.0000             0             0             0
## 28             0    0.0000             0             0             0
## 29             0  407.2297             0             0             0
## 30             0  407.2297             0             0             0
## 31             0    0.0000             0             0             0
## 32             0    0.0000             0             0             0
## 33             0    0.0000             0             0             0
## 34             0    0.0000             0             0             0
## 35             0    0.0000             0             0             0
## 36             0    0.0000             0             0             0
## 37             0    0.0000             0             0             0
## 38             0    0.0000             0             0             0
## 39             0    0.0000             0             0             0
## 40             0    0.0000             0             0             0
## 41             0    0.0000             0             0             0
## 42             0  383.6260             0             0             0
## 43             0    0.0000             0             0             0
## 44             0  397.9461             0             0             0
## 45             0  413.2706             0             0             0
## 46             0  375.5708             0             0             0
## 47             0    0.0000             0             0             0
## 48             0    0.0000             0             0             0
## 49             0    0.0000             0             0             0
## 50             0    0.0000             0             0             0
## 51             0    0.0000             0             0             0
## 52             0    0.0000             0             0             0
## 53             0    0.0000             0             0             0
## 54             0    0.0000             0             0             0
##    trees_ha_dbh2550 average_dbh2550 increase_dbh2550 trees_ha_dbh50
## 1                 0               0               0              0
## 2                 0               0               0              0
## 3                 0               0               0              0
## 4                 0               0               0              0
## 5                 0               0               0              0
## 6                 0               0               0              0
## 7                 0               0               0              0
## 8                 0               0               0              0
## 9                 0               0               0              0
## 10                0               0               0              0
## 11                0               0               0              0
```

```
## 12                0                0                0              0
## 13                0                0                0              0
## 14                0                0                0              0
## 15                0                0                0              0
## 16                0                0                0              0
## 17                0                0                0              0
## 18                0                0                0              0
## 19                0                0                0              0
## 20                0                0                0              0
## 21                0                0                0              0
## 22                0                0                0              0
## 23                0                0                0              0
## 24                0                0                0              0
## 25                0                0                0              0
## 26                0                0                0              0
## 27                0                0                0              0
## 28                0                0                0              0
## 29                0                0                0              0
## 30                0                0                0              0
## 31                0                0                0              0
## 32                0                0                0              0
## 33                0                0                0              0
## 34                0                0                0              0
## 35                0                0                0              0
## 36                0                0                0              0
## 37                0                0                0              0
## 38                0                0                0              0
## 39                0                0                0              0
## 40                0                0                0              0
## 41                0                0                0              0
## 42                0                0                0              0
## 43                0                0                0              0
## 44                0                0                0              0
## 45                0                0                0              0
## 46                0                0                0              0
## 47                0                0                0              0
## 48                0                0                0              0
## 49                0                0                0              0
## 50                0                0                0              0
## 51                0                0                0              0
## 52                0                0                0              0
## 53                0                0                0              0
## 54                0                0                0              0
##    average_dbh50 increase_dbh50 time_horizon diameter_breast
## 1              0              0            0               0
## 2              0              0            0               0
## 3              0              0            0               0
## 4              0              0            0               0
## 5              0              0            0               0
## 6              0              0            0               0
## 7              0              0            0               0
## 8              0              0            0               0
## 9              0              0            0               0
## 10             0              0            0               0
```

```
## 11          0           0           0           0
## 12          0           0           0           0
## 13          0           0           0           0
## 14          0           0           0           0
## 15          0           0           0           0
## 16          0           0           0           0
## 17          0           0           0           0
## 18          0           0           0           0
## 19          0           0           0           0
## 20          0           0           0           0
## 21          0           0           0           0
## 22          0           0           0           0
## 23          0           0           0           0
## 24          0           0           0           0
## 25          0           0           0           0
## 26          0           0           0           0
## 27          0           0           0           0
## 28          0           0           0           0
## 29          0           0           0           0
## 30          0           0           0           0
## 31          0           0           0           0
## 32          0           0           0           0
## 33          0           0           0           0
## 34          0           0           0           0
## 35          0           0           0           0
## 36          0           0           0           0
## 37          0           0           0           0
## 38          0           0           0           0
## 39          0           0           0           0
## 40          0           0           0           0
## 41          0           0           0           0
## 42          0           0           0           0
## 43          0           0           0           0
## 44          0           0           0           0
## 45          0           0           0           0
## 46          0           0           0           0
## 47          0           0           0           0
## 48          0           0           0           0
## 49          0           0           0           0
## 50          0           0           0           0
## 51          0           0           0           0
## 52          0           0           0           0
## 53          0           0           0           0
## 54          0           0           0           0
```

Grass input level

grassinputlevel_code	grassinputlevel_desc	change_factor
1	Medium	1.00
2	High	1.11
3	None	1.00

```
kable(sq_tables$lkp_grasslandman)
```

Grassland management

management_code	management_desc	change_factor
1	Nominally managed	1.00
2	Moderately degraded grassland, temperate/boreal	0.95
3	Moderately degraded grassland, tropical	0.97
4	Moderately degraded grassland, tropical montane	0.96
5	Severely degraded	0.70
6	Improved grassland, temperate/boreal	1.14
7	Improved grassland, tropical	1.17
8	Improved grassland, tropical montane	1.16

Landcover

landcover_code	landcover_desc	c_factor
1	Dense forest	0.001
2	Other forest	0.050
3	Badlands hard	0.050
4	Badlands soft	0.400
5	Sorghum	0.100
6	Maize	0.100
7	Cereals	0.150
8	Pulses	0.150
9	Dense grass	0.010
10	Degraded grass	0.050
11	Fallow hard	0.050
12	Fallow plouged	0.600
13	Ethiopian teff	0.250
14	Continuous fallow	1.000

Livestock type

```
##    livetype_code                      livetype_desc body_weight litter_size
## 1              1              Cattle - Cows (local)         350           0
## 2              2           Cattle - Cows (improved)         600           0
## 3              3    Cattle - Cows (high productive)         600           0
## 4              4                Cattle - Adult male         580           0
## 5              5            Cattle - Steers/heifers         200           0
## 6              6 Cattle - Steers/heifers (improved)         300           0
## 7              7                     Cattle - Calves          90           0
## 8              8         Cattle - Calves (improved)          90           0
## 9              9                       Buffalo - Cows         450           0
## 10            10           Buffalo - Steers/heifers         270           0
## 11            11                    Buffalo - Calves         110           0
## 12            12                       Sheep - Ewes          53           0
## 13            13              Sheep - Breeding Rams          30           0
```

```
## 14            14             Sheep - Fattening Rams          20           0
## 15            15                      Sheep - Lambs          15           0
## 16            16                       Goats - Does          53           0
## 17            17             Goats - Breeding Bucks          30           0
## 18            18            Goats - Fattening Bucks          20           0
## 19            19                      Goats - Kids          15           0
## 20            20     Pigs - lactating/pregnant sows         200          10
## 21            21              Pigs - dry sows/boars         200           0
## 22            22                     Pigs - growers          80           0
##    lactation_length proportion_growth lw_gain grazing_displacement
## 1                 0                 0     0.0                    0
## 2                 0                 0     0.0                    0
## 3                 0                 0     0.0                    2
## 4                 0                 0     0.0                    0
## 5                 0                 0     0.0                    0
## 6                 0                 0     0.0                    2
## 7                 0                 0     0.0                    0
## 8                 0                 0     0.0                    2
## 9                 0                 0     0.0                    0
## 10                0                 0     0.0                    0
## 11                0                 0     0.0                    0
## 12               60                 0     0.0                    0
## 13                0                 0     0.0                    0
## 14                0                 0     0.0                    0
## 15                0                 0     0.0                    0
## 16               60                 0     0.0                    0
## 17                0                 0     0.0                    0
## 18                0                 0     0.0                    0
## 19                0                 0     0.0                    0
## 20               21                60     0.2                    0
## 21                0                 0     0.0                    0
## 22                0                 0     0.0                    0
##    me_maintenance me_grazing me_pregnancy me_lactation me_lactmilk me_growth
## 1       40.459549        2.0    1260.0000       0.0000         5.5         0
## 2       60.615465        2.0    1500.0000       0.0000         5.5         0
## 3       60.615465        2.0    2000.0000       0.0000         5.5         0
## 4       59.093675        2.0       0.0000       0.0000         0.0         0
## 5       26.591479        1.5       0.0000       0.0000         0.0        50
## 6       36.042171        1.5       0.0000       0.0000         0.0        50
## 7       14.610056        1.0       0.0000       0.0000         0.0        50
## 8       14.610056        1.0       0.0000       0.0000         0.0        50
## 9       48.851667        2.0    1260.0000       0.0000         5.5         0
## 10      33.303726        1.5       0.0000       0.0000         0.0        50
## 11      16.983004        0.0       0.0000       0.0000         0.0        50
## 12       8.642902        0.0     518.5741    1296.4353         5.5         0
## 13       5.640188        0.0       0.0000       0.0000         0.0        46
## 14       4.161263        0.0       0.0000       0.0000         0.0        46
## 15       3.353676        0.0       0.0000       0.0000         0.0        46
## 16       8.642902        0.0     518.5741    1296.4353         5.5         0
## 17       5.640188        0.0       0.0000       0.0000         0.0        46
## 18       4.161263        0.0       0.0000       0.0000         0.0        46
## 19       3.353676        0.0       0.0000       0.0000         0.0        46
## 20      23.400502        0.0     170.0000     656.7372         0.0         0
## 21      23.400502        0.0       0.0000       0.0000         0.0         0
```

```
## 22      11.769829        0.0       0.0000       0.0000         0.0        45
##    cp_maintenance cp_grazing cp_pregnancy cp_lactation cp_lactmilk cp_growth
## 1      0.35000000          0      9.64000       0.0000        0.09      0.00
## 2      0.60000000          0     12.21000       0.0000        0.09      0.00
## 3      0.60000000          0     15.00000       0.0000        0.09      0.00
## 4      0.58000000          0      0.00000       0.0000        0.00      0.00
## 5      0.20000000          0      0.00000       0.0000        0.00      0.40
## 6      0.30000000          0      0.00000       0.0000        0.00      0.40
## 7      0.09000000          0      0.00000       0.0000        0.00      0.40
## 8      0.09000000          0      0.00000       0.0000        0.00      0.40
## 9      0.45000000          0      9.64000       0.0000        0.09      0.00
## 10     0.27000000          0      0.00000       0.0000        0.00      0.40
## 11     0.11000000          0      0.00000       0.0000        0.00      0.40
## 12     0.10600000          0      8.37400      12.7200        0.09      0.00
## 13     0.06000000          0      0.00000       0.0000        0.00      0.45
## 14     0.04000000          0      0.00000       0.0000        0.00      0.45
## 15     0.03000000          0      0.00000       0.0000        0.00      0.45
## 16     0.10600000          0      8.37400      12.7200        0.09      0.00
## 17     0.06000000          0      0.00000       0.0000        0.00      0.45
## 18     0.04000000          0      0.00000       0.0000        0.00      0.45
## 19     0.03000000          0      0.00000       0.0000        0.00      0.45
## 20     0.02978246          0      0.33396       1.2348        0.00      0.00
## 21     0.02978246          0      0.00000       0.0000        0.00      0.00
## 22     0.01497978          0      0.00000       0.0000        0.00      0.05
##    milk_production live_weight_gain birth_interval protein_milkcontent
## 1                0                0       1.500000                 3.2
## 2                0                0       1.166667                 3.7
## 3                0                0       1.166667                 3.7
## 4                0                0       0.000000                 0.0
## 5                0                0       0.000000                 0.0
## 6                0                0       0.000000                 0.0
## 7                0                0       0.000000                 0.0
## 8                0                0       0.000000                 0.0
## 9                0                0       1.200000                 3.7
## 10               0                0       0.000000                 0.0
## 11               0                0       0.000000                 0.0
## 12               0                0       1.000000                 3.2
## 13               0                0       0.000000                 0.0
## 14               0                0       0.000000                 0.0
## 15               0                0       0.000000                 3.2
## 16               0                0       1.000000                 3.2
## 17               0                0       0.000000                 0.0
## 18               0                0       0.000000                 0.0
## 19               0                0       0.000000                 3.2
## 20               0                0       0.500000                 0.0
## 21               0                0       0.000000                 0.0
## 22               0                0       0.000000                 0.0
##    fat_content energy_milkcontent energy_meatcontent protein_meatcontent
## 1          5.8               970               2200                  26
## 2          4.3               970               2200                  26
## 3          4.0               970               2200                  26
## 4          0.0                 0               2200                  26
## 5          0.0                 0               2200                  26
## 6          0.0                 0               2200                  26
```

```
## 7          0.0                 0              2200                 26
## 8          0.0                 0              2200                 26
## 9          4.3               970              2200                 26
## 10         0.0                 0              2200                 26
## 11         0.0                 0              2200                 26
## 12         5.8               970              2200                 25
## 13         0.0                 0                 0                  0
## 14         0.0                 0                 0                  0
## 15         5.8               970              2200                 25
## 16         5.8               970              2200                 25
## 17         0.0                 0                 0                  0
## 18         0.0                 0                 0                  0
## 19         5.8               970              2200                 25
## 20         0.0                 0              2580                 21
## 21         0.0                 0              2580                 21
## 22         0.0                 0              2580                 21
##    carcass_fraction energy_eggcontent n_content water_requirement meat_product
## 1              0.00                 0     0.029               120         beef
## 2              0.48                 0     0.029               140         beef
## 3              0.45                 0     0.029               160         beef
## 4              0.48                 0     0.029               100         beef
## 5              0.48                 0     0.029                80         beef
## 6              0.49                 0     0.029               100         beef
## 7              0.49                 0     0.029                50         beef
## 8              0.52                 0     0.029                50         beef
## 9              0.00                 0     0.029               140      buffalo
## 10             0.58                 0     0.029               100      buffalo
## 11             0.58                 0     0.029                50      buffalo
## 12             0.50                 0     0.027                14       mutton
## 13             0.00                 0     0.000                14       mutton
## 14             0.00                 0     0.000                10       mutton
## 15             0.50                 0     0.029                 5       mutton
## 16             0.50                 0     0.027                14         goat
## 17             0.00                 0     0.000                14         goat
## 18             0.00                 0     0.000                10         goat
## 19             0.50                 0     0.029                 5         goat
## 20             0.00                 0     0.040                40         pork
## 21             0.00                 0     0.040                15         pork
## 22             0.60                 0     0.040                10         pork
##    milk_product oneoff_cost operational_cost oneoff_labour operational_labour
## 1      cow milk        6200             4200             0               46.0
## 2      cow milk        1300             1200             0                5.0
## 3      cow milk        6400             4000             0               50.7
## 4      cow milk        5800             3400             0                5.0
## 5      cow milk         200               40             0                5.0
## 6      cow milk        3450             1650             0                7.6
## 7      cow milk         100               30             0                5.0
## 8      cow milk        1100             1500             0               15.2
## 9  buffalo milk        1500               20             0                8.0
## 10 buffalo milk        1000               10             0                2.0
## 11 buffalo milk         400               10             0                2.0
## 12   sheep milk         460              210             0               15.2
## 13   sheep milk           0                0             0                0.0
## 14   sheep milk           0                0             0                0.0
```

```
## 15   sheep milk         180              150            0               3.0
## 16    goat milk         460              210            0              15.2
## 17    goat milk           0                0            0               0.0
## 18    goat milk           0                0            0               0.0
## 19    goat milk         180              150            0               3.0
## 20          N/A           0                0            0               0.0
## 21          N/A           0                0            0               0.0
## 22          N/A           0                0            0               0.0
##    meat_price milk_price            ipcc_meth_ef_t1 ipcc_meth_ef_t2
## 1           0      1.045         Other mature female      Dairy cows
## 2           0      1.045                Dairy cattle      Dairy cows
## 3           0      1.045                Dairy cattle      Dairy cows
## 4           0      1.045            Other draft bull       Non-dairy
## 5           0      1.045 Other mature female-grazing       Non-dairy
## 6           0      1.045 Other mature female-grazing       Non-dairy
## 7           0      1.045                 Other young       Non-dairy
## 8           0      1.045                 Other young       Non-dairy
## 9          21      1.045 Other mature female-grazing      Dairy cows
## 10         21      1.045                 Other young       Non-dairy
## 11         21      1.045                 Other young       Non-dairy
## 12         25      0.000                       Goats           Sheep
## 13         25      0.000                       Goats           Sheep
## 14         25      0.000                       Goats           Sheep
## 15         25      0.000                       Goats           Sheep
## 16         25      0.000                       Goats           Goats
## 17         25      0.000                       Goats           Goats
## 18         25      0.000                       Goats           Goats
## 19         25      0.000                       Goats           Goats
## 20          0      0.000                        Pigs             N/A
## 21          0      0.000                        Pigs             N/A
## 22          0      0.000                        Pigs             N/A
##    ipcc_meth_man ipcc_meth_exc
## 1     Dairy cows  Dairy cattle
## 2     Dairy cows  Dairy cattle
## 3     Dairy cows  Dairy cattle
## 4   Other cattle  Other cattle
## 5   Other cattle  Other cattle
## 6   Other cattle  Other cattle
## 7   Other cattle  Other cattle
## 8   Other cattle  Other cattle
## 9     Dairy cows  Dairy cattle
## 10  Other cattle  Other cattle
## 11  Other cattle  Other cattle
## 12         Sheep         Sheep
## 13         Sheep         Sheep
## 14         Sheep         Sheep
## 15         Sheep         Sheep
## 16         Sheep         Sheep
## 17         Sheep         Sheep
## 18         Sheep         Sheep
## 19         Sheep         Sheep
## 20         Swine          Pigs
## 21         Swine          Pigs
## 22         Swine          Pigs
```

Manure management

manureman_code	manureman_desc	emission_factor
pasture	Pasture / range / paddock	0.010
storage	Solid storage	0.005
drylot	Dry lot	0.020
Uncovered anaerobic lagoon	Uncovered anaerobic lagoon	0.000
Liquid/Slurry Pit below animals 1 Month	Liquid/Slurry Pit below animals 1 Month	0.000
Liquid/Slurry Pit below animals 3 Month	Liquid/Slurry Pit below animals 3 Month	0.000
Liquid/Slurry Pit below animals 4 Month	Liquid/Slurry Pit below animals 4 Month	0.000
Liquid/Slurry Pit below animals 6 Month	Liquid/Slurry Pit below animals 6 Month	0.000
Liquid/Slurry Pit below animals 12 Month	Liquid/Slurry Pit below animals 12 Month	0.000
Cattle and swine deep bedding < 1 month	Cattle and swine deep bedding < 1 month	0.000
Cattle and swine deep bedding > 1 month	Cattle and swine deep bedding > 1 month	0.000
Solid storage	Solid storage	0.000
Solid storage - Covered/compacted	Solid storage - Covered/compacted	0.000
Solid storage - Bulking agent addition	Solid storage - Bulking agent addition	0.000
Solid storage - Additives	Solid storage - Additives	0.000
Daily spread	Daily spread	0.000
Composting - In-vessel	Composting - In-vessel	0.000
Composting - Static pile (forced aeration)	Composting - Static pile (forced aeration)	0.000
Composting - Intensive windrow	Composting - Intensive windrow	0.000
Composting - Unfrequent turning	Composting - Unfrequent turning	0.000
Pasture/Range/Paddock	Pasture/Range/Paddock	0.000
Poultry manure with and without litter	Poultry manure with and without litter	0.000
Aerobic treatment	Aerobic treatment	0.000
Burned for fuel	Burned for fuel	0.000
Anaer digester, Low leak, HQ stor, HQ tec.	Anaer digester, Low leak, HQ stor, HQ tec.	0.000
Anaer digester, Low leak, HQ stor, LQ tec	Anaer digester, Low leak, HQ stor, LQ tec	0.000
Anaer digester, Low leak, open stor, HQ tec	Anaer digester, Low leak, open stor, HQ tec	0.000
Anaer digester, High leak, open stor, HQ tec	Anaer digester, High leak, open stor, HQ tec	0.000
Anaer digester, High leak, LQ stor, LQ tec	Anaer digester, High leak, LQ stor, LQ tec	0.000
Anaer digester, High leak, open stor, LQ tec	Anaer digester, High leak, open stor, LQ tec	0.000

Organic matter

orgmatter_code	orgmatter_desc	change_factor
1	Low, temperate/boreal, dry	0.95
2	Low, temperate/boreal, moist	0.92
3	Low, tropical, dry	0.95
4	Low, tropical, moist	0.92
5	Low, tropical montane, all	0.94
6	Medium, all	1.00
7	High w/OUT manure, temperate/boral and tropical, dry	1.04
8	High w/OUT manure, temperate/boral and tropical, moist/wet	1.11
9	High w/OUT manure, tropical montane	1.08
10	High with manure, temperate/boral and tropical, dry	1.37
11	High with manure, temperate/boral and tropical, moist/wet	1.44

orgmatter_code	orgmatter_desc	change_factor
12	High with manure, tropical montane	1.41

Organic fertilizer

fertilizer_code	fertilizer_desc
1	Urea
3	DAP
2	NPK
4	Ammonium nitrate
5	Ammonium sulfate
6	N solutions
7	Ammonia
8	Manure
9	Compost
10	Other organic N additions
11	Bedding material

Slope

slope_code	slope_desc	p_factor
1	Flat (0-5%)	0.11
2	Hilly (5-20%)	0.13
3	Steep (20-30%)	0.22
4	Extremely steep (30%+)	0.37
5	Non-agricultural (all slope categories)	1.00

Soil

soil_code	soil_desc	k_value
andosol	Andosol	0.15
cambisol	Cambisol	0.20
lixisol	Lixisol	0.25
fluvisol	Fluvisol	0.30
vertisol	Vertisol	0.15
phaeozem	Phaeozem	0.20
nitosol	Nitosol	0.25
xerosol	Xerosol	0.30

Tillage regime

tillage_code	tillage_desc	change_factor
1	Full	1.00
2	Reduced, temperate/boreal, dry	1.02
3	Reduced, temperate/boreal, moist	1.08
4	Reduced, tropical, dry	1.09

tillage_code	tillage_desc	change_factor
5	Reduced, tropical, moist	1.15
6	Reduced, tropical montane, all	1.09
7	No-till, temperate/boreal, dry	1.10
8	No-till, temperate/boreal, moist	1.15
9	No-till, tropical, dry	1.17
10	No-till, tropical, moist/wet	1.22
11	No-till, tropical montane, all	1.16

cleaned-desktop `energy_parameters.json` file

The energy_parameters.json object is found in the qlands/cleaned-desktop github it contains a single table **Table 10.4** that does not seem to appear in the `cleaned/data/ghg_para.rda` object.

```
json_data <- fromJSON("energy_parameters.json")
json_data
```

```
## $`Table 10.4`
##                 animal_category maintenance_cfi
## 1                Cattle_Buffalo           0.322
## 2 Cattle_Buffalo_lactating_cows           0.386
## 3          Cattle_Buffalo_bulls           0.370
## 4         Sheep_lamb_to _1_year           0.236
## 5       Sheep_older_than_1_year           0.217
## 6                         Goats           0.315
## 7                          Pigs           0.440
##                                                                                 comments
## 1                                        All non-lactating cows, steers, heifers and calves
## 2                           Maintenance energy requirements are 20% higher during lactation
## 3 Maintenance energy requirements are 15% higher for intact males than non lactating females
## 4                                    This value can be increased by 15%  for intact males
## 5                                    This value can be increased by 15% for intact males.
## 6                                                                                      NA
## 7                                                                                      NA
```