Land-use data harmonization

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This report explains the steps taken to correct the land-use data. The masterfile used is the version 1.8, as found on November 8th 2018. The sheet in Grassplot 1.8.xlsx containing the LU information is the sheet 'datasets' and was read and saved as a .rds file to ease the process (faster loading)

```
df <- readRDS(file.path(path_grassplot, 'Grassplot 1.8_Data.rds'))
df <- df %>%
        mutate_at(.vars = c(95:104), funs(ifelse(. %in% c('NA', '[NA]'), NA, .)))
```

The columns 98 (mowing frequency) and 100 (grazing intensity) are renamed:

```
names(df)[c(98,100)] <- c('mowing_frequency', 'grazing_intensity')
```

PRELIMINARY NOTE: there duplicated ID in the column `Grassplot ID of plot`. The following ID are duplicated PL_C_N198_10, TR_B_P01, DK_A_N001_0.25D, DK_A_N002_0.25D, DK_A_N003_0.25D, DK_A_N004_0.25D

Correction of the land use column

The file lookup_table_LU.xlsx contains two sheets:

- land_use_detail: lookup table between the column 96 and other column. This needs to be discussed further before I finalize the table.
- global_land_use: lookuptable matching the values in column 95 with a new classification. This new classification is a set of binary columns (allowing for mixed land-use) plus one declarative column. Each binary column correspond to a management practice (grazed, mown, burnt, fertilized, abandoned, natural_grassland), the declarative column stores additional information that cannot be put in one of the 6 columns (*i.e* trampled) and that will be used afterward. **NOTE** LAS, P, L were noted as land-use for the dataset PL_C and N was noted as land-use for the dataset RU_J. I could not find what these stand for. I assumed that these plots don't have a land-use but the info is still in the column 'other'.

```
lut <- read_excel(file.path(path_grassplot, "lookup_table_LU.xlsx" ),
                  sheet = 'global_land_use')
```

The global_land_use lookup table is used to harmonize the column 95 with the new binary columns:

```
df <- df %>%
    left_join(lut, by = c("Land use (5 standard categories: mown, grazed, abandoned, natural grassland,
```

Matching new binary columns and intensity columns (yet to be automatized)

In this step, we identify datasets with discrepancies between the new binary columns and the matching intensity column to:

- Manually check in the original datasets or publications
- Correct the discrepancies.

Mowing and mowing intensity

Datasets containing plots for which mowing intensity > 0 & mown != 1 (here and after, we refer to the new binary columns)

```
## [1] "EU_K" "CZ_J"
```

- EU_K contains resp. 4 and 4 plots classified as natural_grassland with a mowing frequency of resp. 0.03 and 4. Only the plots with a frequency >= 0.2 will be classified as mown (abandoned less than 5 years).
- EU_K contains resp. 12, 84, 30, 4 and 12 plots classified as abandoned with a mowing frequency of resp. 0.03, 0.05, 0.1, 0.2, 0.3. Only the plots with a frequency >= 0.2 will be classified as mown (abandoned less than 5 years).

```
df[df$`Dataset ID` == 'EU_K' & df$mowing_frequency %in% c('4', '1', '0.5', '0.3', '0.2'),] %<>%
  mutate(mown = 1)
```

- CZ_J contains plot classified as abandoned which have a mowing frequency == 0.05. These will not be classified as mown. (I could not find the original land-use information in CZ_J.xls)

Grazing and Grazing intensity

Datasets containing plots for which grazing intensity > 0 & grazed != 1:

```
## [1] "IR_A" "PL_D" "TR_B" "UA_G" "EU_K"
```

- IR_A contains 34 plots classified as mown which have a grazing_intensity == 0.1. These plots will be classified as grazed (and also remain mown as indicated in the original database IR_A.xls). **Note for Idoia** In the original DB, the grazing intensity is noted as 1, 2, 3. Is it correct that it stands for low, medium and high intensity, and hence translate as 0.1, 0.5, 1 in the master file?

```
df[df$`Dataset ID` == 'IR_A',] %<>%
  mutate(grazed = ifelse(grazing_intensity != '0', 1, 0))
```

- PL_D contains 39 plots classified as mown which have a grazing_intensity == 0.5. These plots will be classified as grazed. (No composition data, so I could not check the original dataset)

```
df[df$`Dataset ID` == 'PL_D' & df$grazing_intensity  %in% '0.5',] %<>%
  mutate(grazed = 1)
```

- TR_B contains 32 plots classified as abandoned which have a grazing_intensity == 0.1. These plots will be classified as grazed (no further info could be found in TR_B.xls)

```
df[df$`Dataset ID` == 'TR_B' & df$grazing_intensity  %in% '0.1',] %<>%
  mutate(grazed = 1)
```

- UA_G contains reps. 12, 15, 30 and 3 plots classified as natural_grassland which have a grazing_intensity == 'high', 'low', 'middle' or 'overgrazing'. These plots will be classified as grazed (I could not find the original land-use information in UA_G.xls)

```
df[df$`Dataset ID` == 'UA_G' & df$grazing_intensity %in%
     c('high', 'low', 'middle', 'overgrazing'),] %<>%
  mutate(grazed = 1)
```

- EU_K contains 4 plots classified as natural_grassland which have a grazing_intensity == 0.5. These plots will be classified as grazed (no further info could be found in EU_K.xls)

```
df[df$`Dataset ID` == 'EU_K' & df$grazing_intensity %in% '0.5',] %<>%
  mutate(grazed = 1)
```

Matching new and old binary columns

In this step, we identify and correct discrepancies between the newly created and corrected binary column, and the former ones. Here, we consider that mown == 1 or grazed == 1 is always correct, since it is based on the above correction (based either on the broad land-use or on the mowing / grazing intensity). Thus, we

Table 1: Contingency table of columns mown and Mowing (1/0)

Mowing (1/0)	0	1	<NA>
?	NA	NA	6
0	6247	8	22
1	NA	620	NA
NA	150296	6810	16068

Table 2: Contingency table of columns mown and Mowing (1/0) after reclassification (check)

Mowing (1/0)	0	1	<NA>
?	NA	NA	6
0	6247	8	22
1	NA	620	NA
NA	150296	6810	16068

only identify (and potentialy correct) plots for which the new binary column is 0 or NA and the new one is not 0 or NA.

Mowing

Datasets with discrepancies between mown and Mowing (1/0) (automatic report):

```
## [1] "The dataset(s) PL_A contain(s) 6 plots with burnt = NA and Burning (1/0) = ?"
```

Manual verification of discrepancies (has to be updated manually if necessary for each version of the masterfile)

Datasets containing plots with mown = NA & Mowing (1/0) == ? (new vs former column):

The following plots in PL_A have mown = NA and Mowing (1/0) == '?'

```
## [1] "PL_A_N003_0.0001a" "PL_A_N003_0.001a"  "PL_A_N003_0.01a"
## [4] "PL_A_N003_0.1a"    "PL_A_N003_10a"     "PL_A_N003_1a"
```

No additional information could be found, so the plots are left with mown = NA

Check

Grazing

Datasets with discrepancies between grazed and Grazing (1/0) (automatic report):

Table 3: Contingency table of columns grazed and Grazing (1/0)

Grazing (1/0)	0	1	<NA>
?	NA	7	6
0	3238	NA	NA
1	6	5424	NA
2	NA	1	NA
probably	6	NA	NA
NA	126093	29223	16073

Table 4: Contingency table of columns grazed and Grazing (1/0) after reclassification (check

Grazing (1/0)	0	1	<NA>
?	NA	7	6
0	3238	NA	NA
1	NA	5430	NA
2	NA	1	NA
probably	6	NA	NA
NA	126093	29223	16073

```
## [1] "The dataset(s) PL_A contain(s) 6 plots with burnt = NA and Burning (1/0) = ?"
## [1] "The dataset(s) PL_A contain(s) 6 plots with burnt == 0 and Burning (1/0) = probably"
## [1] "The dataset(s) PL_A contain(s) 6 plots with burnt == 0 and Burning (1/0) = 1"
```

Manual verification of discrepancies (has to be updated manually if necessary for each version of the masterfile)

Datasets plots with grazed = NA & Grazing (1/0) == '?':

The following plots in PL_A have grazed = NA and Grazing (1/0) == '?'

```
## [1] "PL_A_N003_0.0001a" "PL_A_N003_0.001a"  "PL_A_N003_0.01a"
## [4] "PL_A_N003_0.1a"    "PL_A_N003_10a"     "PL_A_N003_1a"
```

No additional information could be found, so the plots are left as grazed = NA

Datasets plots with grazed == 0 & Grazing (1/0) == 'probably':

The following plots in PL_A have grazed == 0 and Grazing (1/0) == ''probably'

```
## [1] "PL_A_N004_0.0001a" "PL_A_N004_0.001a"  "PL_A_N004_0.01a"
## [4] "PL_A_N004_0.1a"    "PL_A_N004_10a"     "PL_A_N004_1a"
```

No additional information could be found, so the plots are left as grazed == 0.

Datasets plots with grazed == 0 & Grazing (1/0) == '1':

The following plots in PL_A have grazed == 0 and Grazing (1/0) == 1

```
## [1] "PL_A_N005_0.0001b" "PL_A_N005_0.001b"  "PL_A_N005_0.01b"
## [4] "PL_A_N005_0.1b"    "PL_A_N005_10b"     "PL_A_N005_1b"
```

- PL_A contains 6 plots (PL_A_N005_xxxxb) noted as abandoned with 'occasionally grazed or trampled' in the detailed column (column 96). These plots will be classified as grazed in the new binary column.

```
df[df$`grazed` %in% '0' & df$`Grazing (1/0)` %in% '1',]%<>%
    mutate(grazed = 1)
```

Check

Burning

Datasets with discrepancies between burnt and Burning (1/0) (automatic report):

```
## [1] "The dataset(s) BY_A, IR_A, RS_A, RU_J, TJ_A, UA_G, UA_I, UA_J, CH_E, RU_L contain(s) 134 plots
## [1] "The dataset(s) BY_A contain(s) 3 plots with burnt = NA and Burning (1/0) = 1"
## [1] "The dataset(s) PL_A contain(s) 6 plots with burnt == 0 and Burning (1/0) = ?"
```

Table 5: Contingency table of columns burnt and Burning (1/0)

Burning (1/0)	0	1	<NA>
?	6	NA	NA
0	6363	NA	62
1	134	NA	3
NA	157439	39	16031

Manual verification of discrepancies (has to be updated manually if necessary for each version of the masterfile)

Datasets with burnt == 0 and Burning (1/0) == 1

The following plots have burnt = 0 and Burning (1/0) == '1':

```
##   [1] "BY_A_P003"          "BY_A_P004"          "BY_A_P005"
##   [4] "IR_A_N004_0.0001a" "IR_A_N004_0.0001b" "IR_A_N004_0.001a"
##   [7] "IR_A_N004_0.001b"  "IR_A_N004_0.01a"   "IR_A_N004_0.01b"
##  [10] "IR_A_N004_0.1a"    "IR_A_N004_0.1b"    "IR_A_N004_1000"
##  [13] "IR_A_N004_100a"    "IR_A_N004_100b"    "IR_A_N004_10a"
##  [16] "IR_A_N004_10b"     "IR_A_N004_1a"      "IR_A_N004_1b"
##  [19] "IR_A_N004_25a"     "IR_A_N004_25b"     "RS_A_N010_100"
##  [22] "RS_A_N011_0.0001a" "RS_A_N011_0.0001b" "RS_A_N011_0.001a"
##  [25] "RS_A_N011_0.001b"  "RS_A_N011_0.01a"   "RS_A_N011_0.01b"
##  [28] "RS_A_N011_0.1a"    "RS_A_N011_0.1b"    "RS_A_N011_100"
##  [31] "RS_A_N011_10a"     "RS_A_N011_10b"     "RS_A_N011_1a"
##  [34] "RS_A_N011_1b"      "RU_J_P020"         "RU_J_P021"
##  [37] "TJ_A_N004_0.001a"  "TJ_A_N004_0.001b"  "TJ_A_N004_0.01a"
##  [40] "TJ_A_N004_0.01b"   "TJ_A_N004_0.1a"    "TJ_A_N004_0.1b"
##  [43] "TJ_A_N005_0.001a"  "TJ_A_N005_0.001b"  "TJ_A_N005_0.01a"
##  [46] "TJ_A_N005_0.01b"   "TJ_A_N005_0.1a"    "TJ_A_N005_0.1b"
##  [49] "TJ_A_N011_0.001a"  "TJ_A_N011_0.001b"  "TJ_A_N011_0.01a"
##  [52] "TJ_A_N011_0.01b"   "TJ_A_N011_0.1a"    "TJ_A_N011_0.1b"
##  [55] "TJ_A_N011_100"     "TJ_A_N011_10a"     "TJ_A_N011_10b"
##  [58] "TJ_A_N011_1a"      "TJ_A_N011_1b"      "TJ_A_N012_0.0001a"
##  [61] "TJ_A_N012_0.0001b" "UA_G_N008_100"     "UA_G_N009_1"
##  [64] "UA_G_N009_10"      "UA_G_N009_100"     "UA_G_N010_1"
##  [67] "UA_G_N010_10"      "UA_G_N010_100"     "UA_G_N011_1"
##  [70] "UA_G_N011_10"      "UA_G_N011_100"     "UA_G_N012_1"
##  [73] "UA_G_N012_10"      "UA_G_N012_100"     "UA_I_N005_0.001a"
##  [76] "UA_I_N005_0.001b"  "UA_I_N005_0.01a"   "UA_I_N005_0.01b"
##  [79] "UA_I_N005_0.1a"    "UA_I_N005_0.1b"    "UA_I_N005_100"
##  [82] "UA_I_N005_10a"     "UA_I_N005_10b"     "UA_I_N005_1a"
##  [85] "UA_I_N005_1b"      "UA_I_N006_0.0001a" "UA_I_N006_0.0001b"
##  [88] "UA_J_N005_0.01a"   "UA_J_N005_0.1a"    "UA_J_N005_1a"
##  [91] "UA_J_N005_10a"     "UA_J_N005_0.0001b" "UA_J_N005_0.001b"
##  [94] "UA_J_N005_0.01b"   "UA_J_N005_0.1b"    "UA_J_N005_1b"
##  [97] "UA_J_N005_10b"     "UA_J_N005_100"     "UA_J_N006_0.0001a"
## [100] "UA_J_N006_0.001a"  "UA_J_N006_0.01a"   "UA_J_N006_0.1a"
## [103] "UA_J_N006_1a"      "UA_J_N006_10a"     "UA_J_N006_0.0001b"
## [106] "UA_J_N006_0.001b"  "UA_J_N006_0.01b"   "UA_J_N006_0.1b"
## [109] "UA_J_N006_1b"      "UA_J_N006_10b"     "UA_J_N006_100"
## [112] "UA_J_N007_0.0001a" "UA_J_N007_0.001a"  "UA_J_N009_1b"
## [115] "UA_J_N009_10b"     "UA_J_N010_0.1b"    "UA_J_N010_10b"
```

Table 6: Contingency table of columns burnt and Burning (1/0) after reclassification (check)

Burning (1/0)	0	1	<NA>
?	6	NA	NA
0	6363	NA	62
1	NA	137	NA
NA	157439	39	16031

Table 7: Contingency table of columns fertilized and Fertilized (1/0)

Fertilized (1/0)	0	<NA>
0	5112	37
0.3	24	NA
0.5	112	NA
1	196	NA
NA	158537	16059

```
## [118] "UA_J_N011_0.01a"   "UA_J_P010"          "UA_J_P046"
## [121] "UA_J_P058"         "CH_E_N003_0.01a"    "CH_E_N003_0.1a"
## [124] "CH_E_N003_1a"      "CH_E_N003_10a"      "CH_E_N003_0.0001b"
## [127] "CH_E_N003_0.001b"  "CH_E_N003_0.01b"    "CH_E_N003_0.1b"
## [130] "CH_E_N003_1b"      "CH_E_N003_10b"      "CH_E_N003_100"
## [133] "RU_L_N001_0.0001a" "RU_L_N001_0.0001b"
```

No other information are found. These plots are reclassified with burnt == 1

```
df[df$burnt %in% 0 & df$`Burning (1/0)` %in% '1',]%<>%
    mutate(burnt = 1)
```

Datasets with burnt = NA and Burning (1/0) == 1

The following plots have burnt = NA and Burning (1/0) == '?':

```
## [1] "BY_A_P006" "BY_A_P007" "BY_A_P009"
```

No other information are found. These plots are reclassified with burnt == 1

```
df[is.na(df$burnt) & df$`Burning (1/0)` %in% '1',]%<>%
    mutate(burnt = 1)
```

Datasets with burnt = NA and Burning (1/0) == ?

The following plots have burnt == 0 and Burning (1/0) == '?':

```
## [1] "PL_A_N005_0.0001a" "PL_A_N005_0.001a"  "PL_A_N005_0.01a"
## [4] "PL_A_N005_0.1a"    "PL_A_N005_10a"     "PL_A_N005_1a"
```

No additional information could be found, so the plots are left as burnt == 0.

Check

Fertilization

This field seems to be a fertilization intensity rather than a binary variable. We should discuss it before making a decision.

Making use of the Column 96 (Land use detail)

The column 96 provide a lot of information that is so far not fully exploited. To make use of it, it requires to manually check each of the value in this column, to fill other columns. After the discussion with Anne and Monika, I propose the following columns:

Land-use columns

Already explained above, these are binary columns mown, grazed, burnt, fertilized, abandoned, natural (*i.e. no land-use past or present). There is one extra column that contains verbal information not found in these five columns.
NOTE This should be discussed, but these columns could also be viwed as management columns.

Land-cover columns

This columns (binary) could be used to provide a clearer view on the land-use. After having briefly browsed the column 96, a first proposal is: grassland, moorland, heathland, fallowland, meadow, pasture (not entirely sure about this one).
NOTE Monika was suggesting to find a way to separate primary and secondary grasslands. I'm not sure how this fits in this proposal, so it's open to discussion.

Time since abandonment

Self explanatory. This column already exists, we shoud make sure there is no information about this unexploited in the column 96.

Grazing animal

Type of animal grazing the land. So far, we have five categories in mind: cow, sheep, goat, horse, other. I am not sure wether grazing by wild animal should be considered, as it is not necessarily linked with land-use.