EU Farm Fish CEA - 1. Consumption Prep File

Sagar Shah, Rethink Priorities

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This file brings together estimates of per country EU consumption of Sea bream, Sea bass, Carp, Salmon and Rainbow Trout into a single dataset in long format.

Preparation

Clear environment

```
rm(list=ls())
```

Load packages

```
library(readxl)
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.2     v readr     2.1.4
v forcats   1.0.0     v stringr   1.5.0
v ggplot2   3.4.2     v tibble    3.2.1
v lubridate 1.9.2     v tidyr     1.3.0
v purrr     1.0.1
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to becor
```

```
library(scales)
```

```
Attaching package: 'scales'

The following object is masked from 'package:purrr':

    discard

The following object is masked from 'package:readr':

    col_factor
```

```
library(DT)
```

Session Info

```
sessionInfo()
```

```
R version 4.3.0 (2023-04-21)
Platform: aarch64-apple-darwin20 (64-bit)
Running under: macOS 14.3

Matrix products: default
BLAS:   /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/lib/libRblas.0.dylib
LAPACK: /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/lib/libRlapack.dylib;  L

locale:
[1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8

time zone: Europe/London
tzcode source: internal

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods   base

other attached packages:
 [1] DT_0.28         scales_1.2.1    lubridate_1.9.2 forcats_1.0.0
 [5] stringr_1.5.0   dplyr_1.1.2     purrr_1.0.1     readr_2.1.4
```

```
 [9] tidyr_1.3.0     tibble_3.2.1    ggplot2_3.4.2   tidyverse_2.0.0
[13] readxl_1.4.2

loaded via a namespace (and not attached):
 [1] gtable_0.3.3      jsonlite_1.8.4    compiler_4.3.0    tidyselect_1.2.0
 [5] yaml_2.3.7        fastmap_1.1.1     R6_2.5.1          generics_0.1.3
 [9] knitr_1.43        htmlwidgets_1.6.2 munsell_0.5.0     pillar_1.9.0
[13] tzdb_0.4.0        rlang_1.1.1       utf8_1.2.3        stringi_1.7.12
[17] xfun_0.39         timechange_0.2.0  cli_3.6.1         withr_2.5.0
[21] magrittr_2.0.3    digest_0.6.31     grid_4.3.0        rstudioapi_0.14
[25] hms_1.1.3         lifecycle_1.0.3   vctrs_0.6.2       evaluate_0.21
[29] glue_1.6.2        cellranger_1.1.0  fansi_1.0.4       colorspace_2.1-0
[33] rmarkdown_2.22    tools_4.3.0       pkgconfig_2.0.3   htmltools_0.5.5
```

Open data files

This file contains data on:

- EU country codes (from Eurostat)
- EUFOMA apparent consumption estimates (live weight equivalent) in various EU countries of Seabass (2016), Seabream (2019) and Carp(2018)
- Portion trout and large trout estimates come from the EUFOMA large trout in the EU (2020) study, using apparent consumption estimates for large trout and all trout respectively
- Salmon consumption estimates are extracted from the chart from page 42 of the Mowi (2023) industry report for France, Germany, Italy, Spain and Sweden only.
- Population data for EU27 countries to estimate salmon consumption (from Eurostat)

```
xl_data <-"../1_input_data/EUFOMA_consumption_data.xlsx"
country_codes <- read_excel(xl_data,sheet = "country_codes")
bass <- read_excel(xl_data,sheet = "seabass_2016")
bream <- read_excel(xl_data,sheet = "seabream_2019")
carp <- read_excel(xl_data,sheet = "carp_2018")
trout <- read_excel(xl_data,sheet = "trout_2020")
salmon <- read_excel(xl_data,sheet = "salmon_2022_raw")
population <- read_excel("../1_input_data/country populations.xlsx",sheet = "EU27populatio
```

Salmon consumption estimates

Mowi industry report only provides salmon consumption estimates for 5 EU countries. For other countries, we need estimate salmon consumption. I do this by assuming:

- per capita consumption in the Denmark and Finland is equal to per capita consumption in Sweden
- per capita consumption in Netherlands, Belgium, Austria, Luxembourg and Ireland is equal to per capita consumption in Germany
- per capita consumption in Portugal, Greece, Cyprus and Malta is equal to per capita consumption in Italy
- the remainder is equally distributed across the rest of the EU

I also assume that the Mowi industry reports estimate for EU+UK market size actually excludes the UK, based on comparisons with EUFOMA balance sheet data (https://www.eumofa.eu/supply-balance).

I first extract aggregate EU consumption of salmon…

```
EU_salmon <- salmon %>% filter(Country=="EU27") %>% pull(Tons) %>%mean()
EU_salmon
```

```
[1] 1141000
```

I then estimate per capita consumption of salmon (in Tons) for the three reference countries, Sweden, Italy and Germany.

```
per_capita_salmon <-
  salmon %>%
  filter(Country %in% c("Sweden","Germany","Italy")) %>%
  left_join(population,by="Country") %>%
  mutate(per_capita=Tons/pop) %>%
  select(Country,per_capita) %>%
  rename(ref_country=Country)

per_capita_salmon
```

```
# A tibble: 3 x 2
  ref_country per_capita
  <chr>            <dbl>
```

```
1 Germany        0.00285
2 Italy          0.00235
3 Sweden         0.00555
```

I then assign these per capita consumption values to selected other countries, and calculate aggregate consumption in those countries.

```
#Assign country groups
nordic <- c("Denmark","Finland")
germanic <- c("Austria","Netherlands","Belgium","Luxembourg","Ireland")
italian <- c("Portugal","Greece","Malta","Cyprus")

#Estimate salmon consumption in these countries
salmon_ref_countries <- population %>%
  filter(Country %in% c(nordic,germanic,italian)) %>%
  mutate(
    ref_country=
    case_when(
      Country %in% nordic ~ "Sweden",
      Country %in% germanic ~ "Germany",
      Country %in% italian ~ "Italy",
      TRUE ~ "Error"
    )) %>%
  left_join(per_capita_salmon,by="ref_country") %>%
  mutate(
    Tons=pop*per_capita,
    Estimate=str_c("ref country per capita - ",str_to_lower(ref_country))) %>%
  select(Country,Tons,Estimate)

salmon_ref_countries
```

```
# A tibble: 11 x 3
   Country       Tons Estimate
   <chr>        <dbl> <chr>
 1 Belgium     33079. ref country per capita - germany
 2 Denmark     32592. ref country per capita - sweden
 3 Ireland     14407. ref country per capita - germany
 4 Greece      24630. ref country per capita - italy
 5 Cyprus       2130. ref country per capita - italy
 6 Luxembourg   1838. ref country per capita - germany
 7 Malta        1227. ref country per capita - italy
 8 Netherlands 50086. ref country per capita - germany
```

```
 9 Austria     25566. ref country per capita - germany
10 Portugal    24376. ref country per capita - italy
11 Finland     30787. ref country per capita - sweden
```

I then estimate consumption in the remainder of EU countries, by assuming per capita consumption in these countries is equal.

```
#Estimate residual aggregate salmon consumption
salmon_residual_aggregate<- EU_salmon*2-sum(salmon$Tons)-sum(salmon_ref_countries$Tons)

#Calculate consumption in each country by multiplying aggregate by their population share
salmon_residual_countries <- population %>%
  filter(!(Country %in% c(salmon$Country,germanic,italian,nordic))) %>%
  mutate(
    Tons=pop/sum(pop)*salmon_residual_aggregate,
    Estimate="residual EU per capita"
    ) %>%
  select(-pop)

salmon_residual_countries
```

```
# A tibble: 11 x 3
   Country     Tons Estimate
   <chr>      <dbl> <chr>
 1 Bulgaria   4549. residual EU per capita
 2 Czechia    6995. residual EU per capita
 3 Estonia     886. residual EU per capita
 4 Croatia    2569. residual EU per capita
 5 Latvia     1248. residual EU per capita
 6 Lithuania  1866. residual EU per capita
 7 Hungary    6444. residual EU per capita
 8 Poland    25045. residual EU per capita
 9 Romania   12666. residual EU per capita
10 Slovenia   1402. residual EU per capita
11 Slovakia   3615. residual EU per capita
```

Finally I combine the data into final table

```
#Combined table
salmon<-salmon %>%
  filter(Country!="EU27") %>%
```

```
    mutate(Estimate="mowi industry report") %>%
    rbind(salmon_ref_countries,salmon_residual_countries)

  salmon
```

```
# A tibble: 27 x 3
   Country    Tons Estimate
   <chr>     <dbl> <chr>
 1 France  269000  mowi industry report
 2 Germany 237000  mowi industry report
 3 Italy   139000  mowi industry report
 4 Spain   130000  mowi industry report
 5 Sweden   58000  mowi industry report
 6 Belgium  33079. ref country per capita - germany
 7 Denmark  32592. ref country per capita - sweden
 8 Ireland  14407. ref country per capita - germany
 9 Greece   24630. ref country per capita - italy
10 Cyprus    2130. ref country per capita - italy
# i 17 more rows
```

And check that the values look reasonable (TRUE means working ok).

```
  #Check
  near(EU_salmon,sum(salmon$Tons))
```

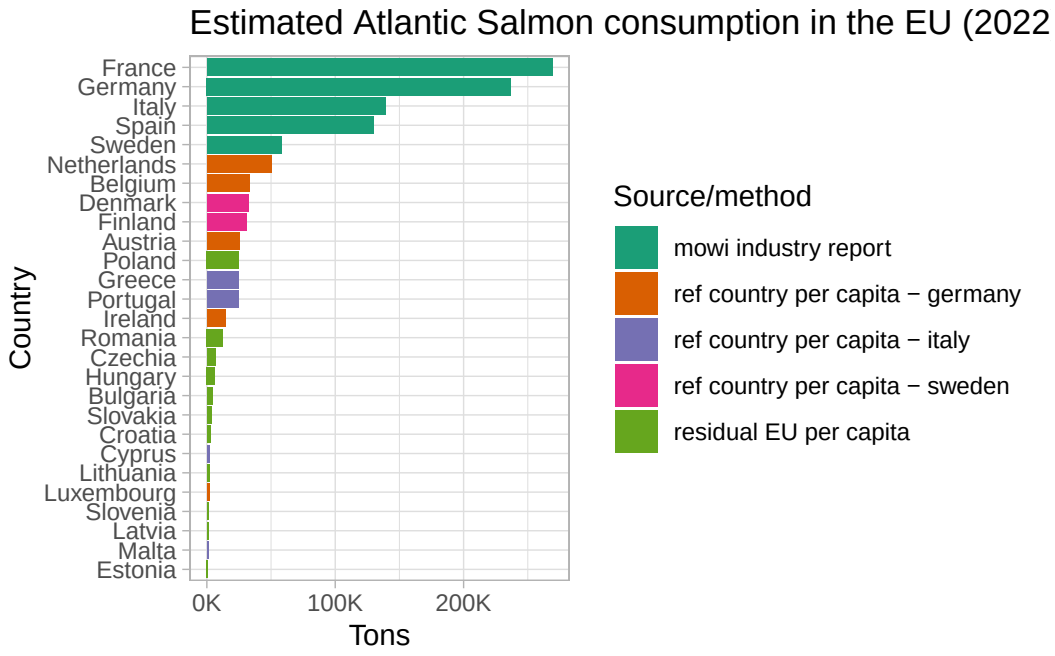
```
[1] TRUE
```

Finally I plot some charts for reference.

Estimated salmon consumption in each EU country

```
  salmon %>%
    ggplot(
      aes(
        x=Tons,
        y=reorder(Country,Tons),
        fill=Estimate
          )) +
     geom_col()+
     labs(
       title = "Estimated Atlantic Salmon consumption in the EU (2022)",
```

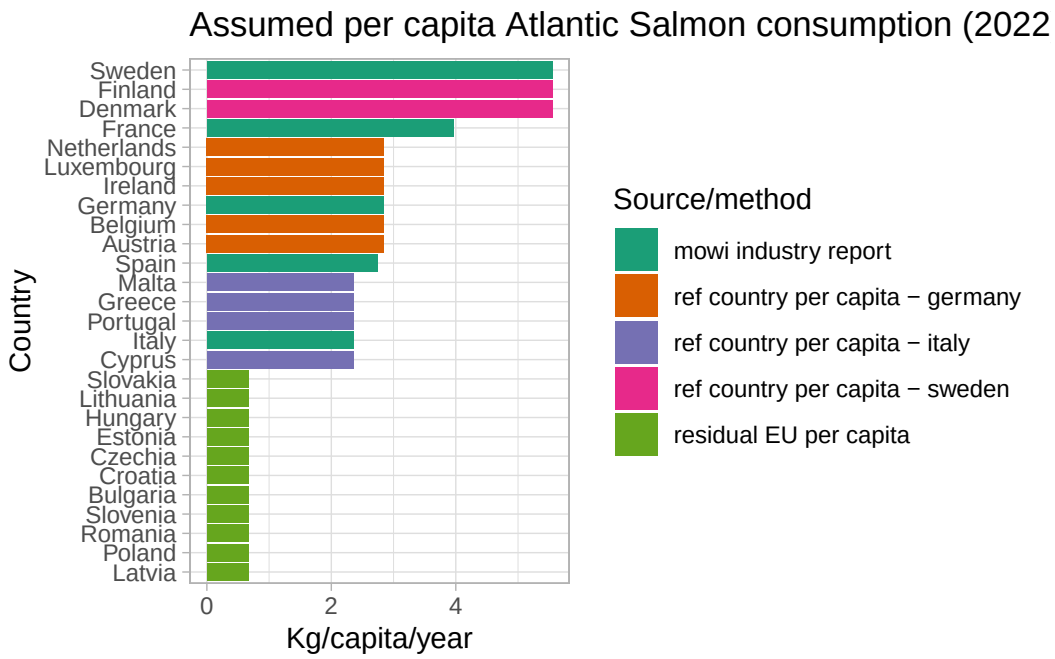
```
    y="Country",
    fill="Source/method") +
  scale_fill_brewer(palette="Dark2") +
  theme_light() +
  scale_x_continuous(labels = label_number(suffix = "K", scale = 1e-3))
```



Per capita Atlantic salmon production

```
salmon %>%
  left_join(population,by="Country") %>%
  mutate(per_capita=Tons*1000/pop) %>%
  ggplot(
    aes(
      x=per_capita,
      y=reorder(Country,per_capita),
      fill=Estimate
        )) +
   geom_col()+
   labs(
     title = "Assumed per capita Atlantic Salmon consumption (2022)",
     y="Country",
     x="Kg/capita/year",
```

```
   fill="Source/method") +
scale_fill_brewer(palette="Dark2") +
theme_light()
```



Combine data into single file

We now prepare/clean the country species consumption data and assemble to into a "long" dataframe. Steps involved are:

1. linking country code and country code data
2. adding species names
3. apportioning consumption by portion trout and large trout share (iv) combining the species data into a single data frame
4. making column names lower case for ease of matching

```
# Add country codes and species name
bream<- left_join(bream,country_codes,by="Code") %>% mutate(Species="Sea Bream")
bass<- left_join(bass,country_codes,by="Country") %>% mutate(Species="Sea Bass")
carp<- left_join(carp,country_codes,by="Code") %>% mutate(Species="Carp")
```

```
salmon<- left_join(salmon,country_codes,by="Country") %>% mutate(Species="Atlantic Salmon"

# Add country codes and fish size and separate into two observations
trout<- trout %>%
        left_join(country_codes,by="Code") %>%
        pivot_longer(
          cols=c("Rainbow Trout (Small)","Rainbow Trout (Large)"),
          names_to="Species",values_to="Tons"
        ) %>%
        select(-Notes,-Total)

# combine into single dataframe
cons_data <- bind_rows(bream,bass,carp,trout) %>%
             mutate(Estimate="EUFOMA") %>%
             bind_rows(salmon)


# make column names lower case and reorder
names(cons_data) <- str_to_lower(names(cons_data))
cons_data <- relocate(cons_data, species, country, code, tons)
```

We do a simple plot of the data to make sure it looks reasonable.

```
cons_data <- cons_data %>%
  group_by(country) %>%
  mutate(total_cons=sum(tons)) %>%
  ungroup()
```

```
cons_data %>%
  ggplot(
    aes(
      x=tons,
      y=reorder(country,total_cons),
      fill=species
      )) +
  geom_col() +
    labs(
    title = "Annual consumption of salmon, carp, trout and seabream/bass in EU",
    x = "Metric tons (live weight equivalent)",
    y = "",
    fill = "Species"
```

```
) +
scale_x_continuous(labels = label_number(suffix = "K", scale = 1e-3)) +
scale_fill_brewer(palette = "Dark2") +
theme_light() +
theme(legend.position = "top")
```

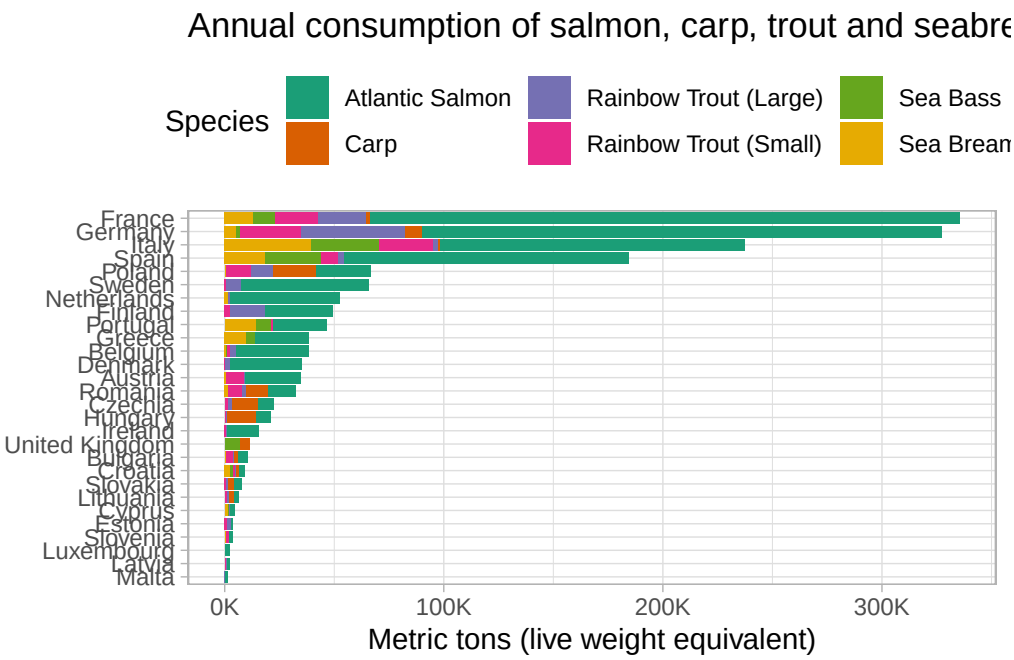


Figure 1: Annual consumption of selected species in the EU (kg)

Save output file

```
saveRDS(cons_data,file= "../3_intermediate_data/cons_data.rds")
```