Modeling Wood Fuel Production

Update to the Team of Specialists on Forest Product and Wood Energy Statistics
28 April 2022

Problem Statement

Why FAO? FAO is the custodian of a data series on wood fuel production that dates back to 1961. The data are reported by countries to FAO and our partners through the Joint Forest Products Questionnaire (JFSQ) and provided publicly via the FAOSTAT database.

Why estimate? The data series should not have gaps for countries so that totals can be estimated, for example, global production of wood fuel.

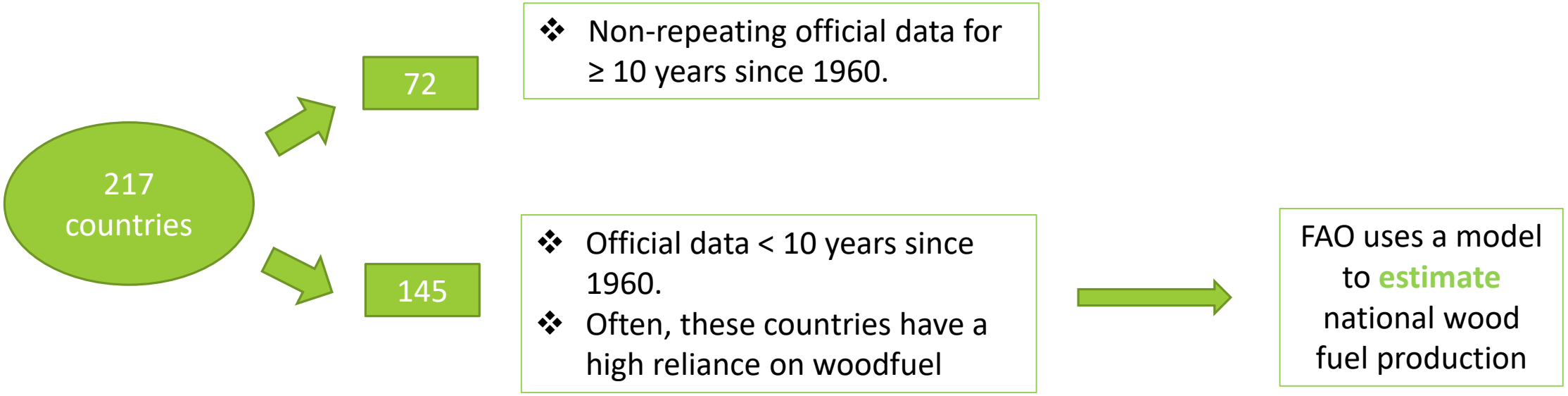
When do we need an estimate? If countries do not report data in a given year, FAO uses external information sources and/or a model to estimate wood fuel production for that year.

How will the model be implemented? There is a relatively short time window between when the country data are submitted (or not submitted) and when FAO must release an estimate for that year.

Why "now"? The model currently in use by FAO is a collection of linear and log linear equations based on work completed from approximately 1998-2002. With new information available and new statistical tools available, we would like to update the model used by FAO.

What we have*: FAOSTAT

- FAO's wood fuel data are based on figures reported by country officers.

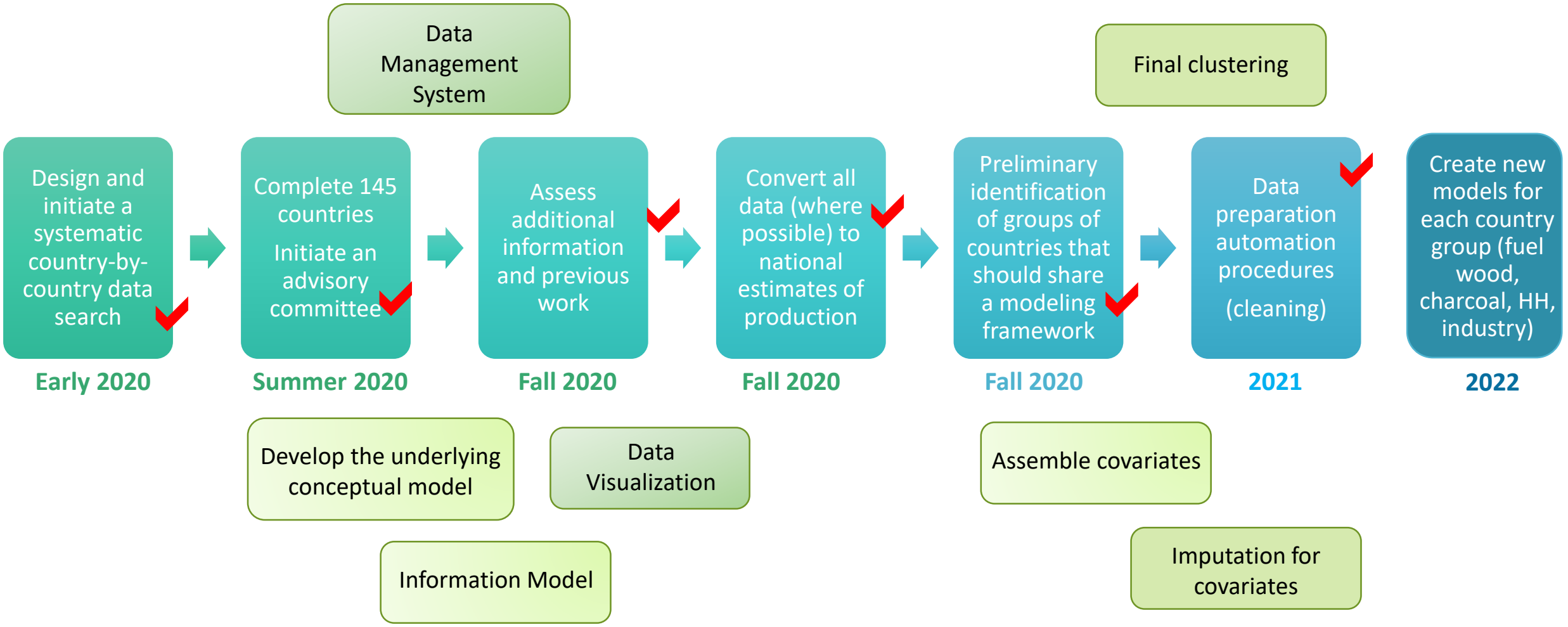


*in 2019

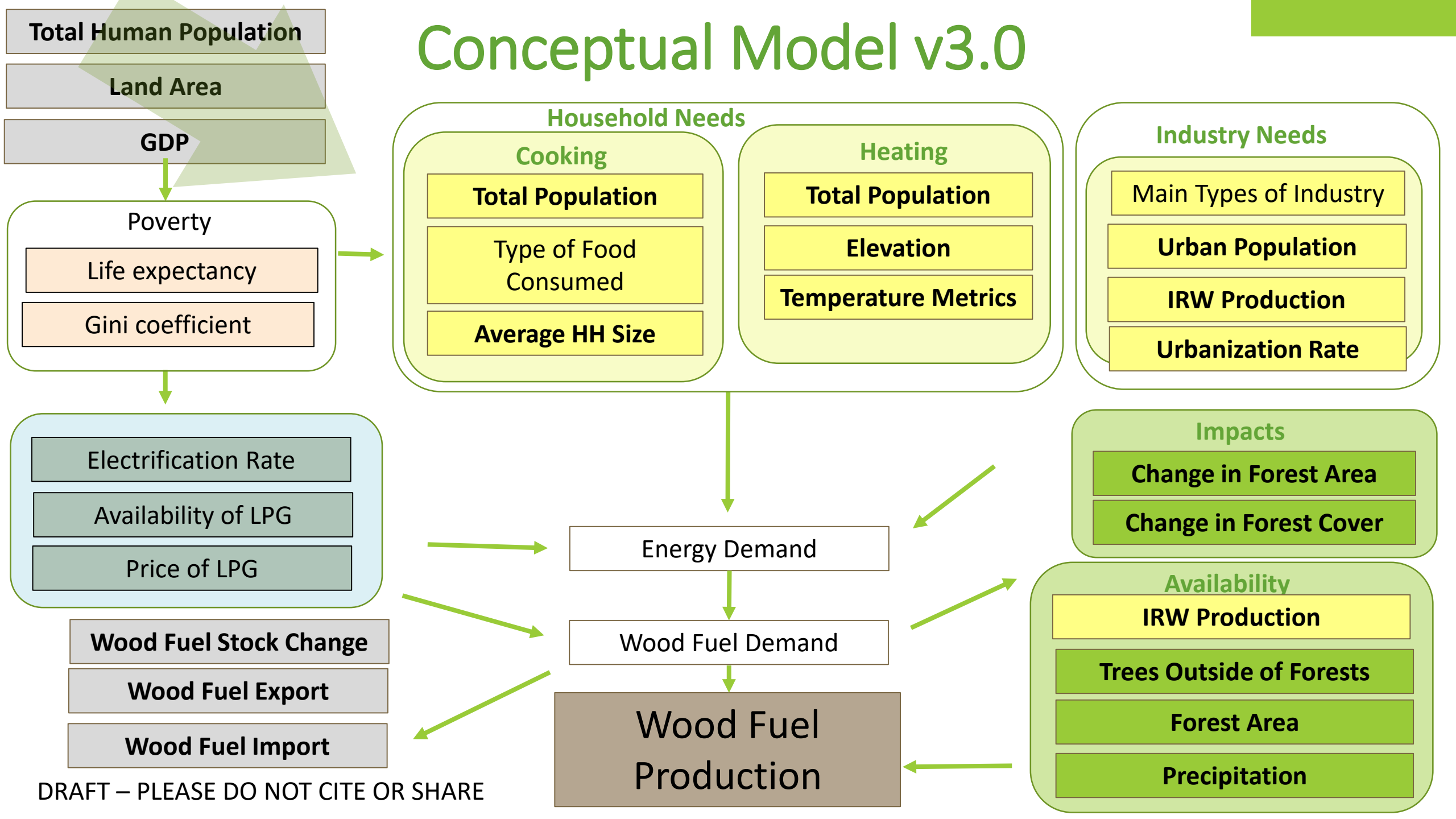
Problem Statement

We need a method for estimating wood fuel (and wood charcoal) in the “current” year for countries that do not submit data in that year.

Step by Step


Data Management System
Final clustering
Design and initiate a systematic country-by-country data search
Complete 145 countries
Initiate an advisory committee
Assess additional information and previous work
Convert all data (where possible) to national estimates of production
Preliminary identification of groups of countries that should share a modeling framework
Data preparation automation procedures
(cleaning)
Create new models for each country group (fuel wood, charcoal, HH, industry)
Early 2020
Summer 2020
Fall 2020
Fall 2020
Fall 2020
2021
2022
Develop the underlying conceptual model
Data Visualization
Assemble covariates
Information Model
Imputation for covariates

Conceptual Model v3.0



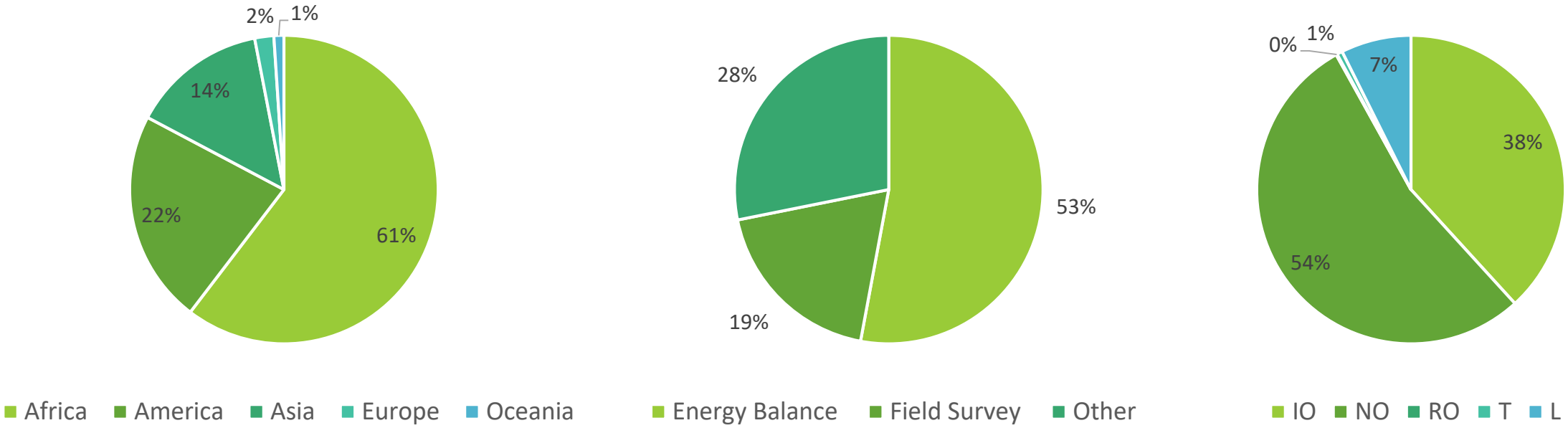
DRAFT – PLEASE DO NOT CITE OR SHARE

Data found as of 30 June 2021

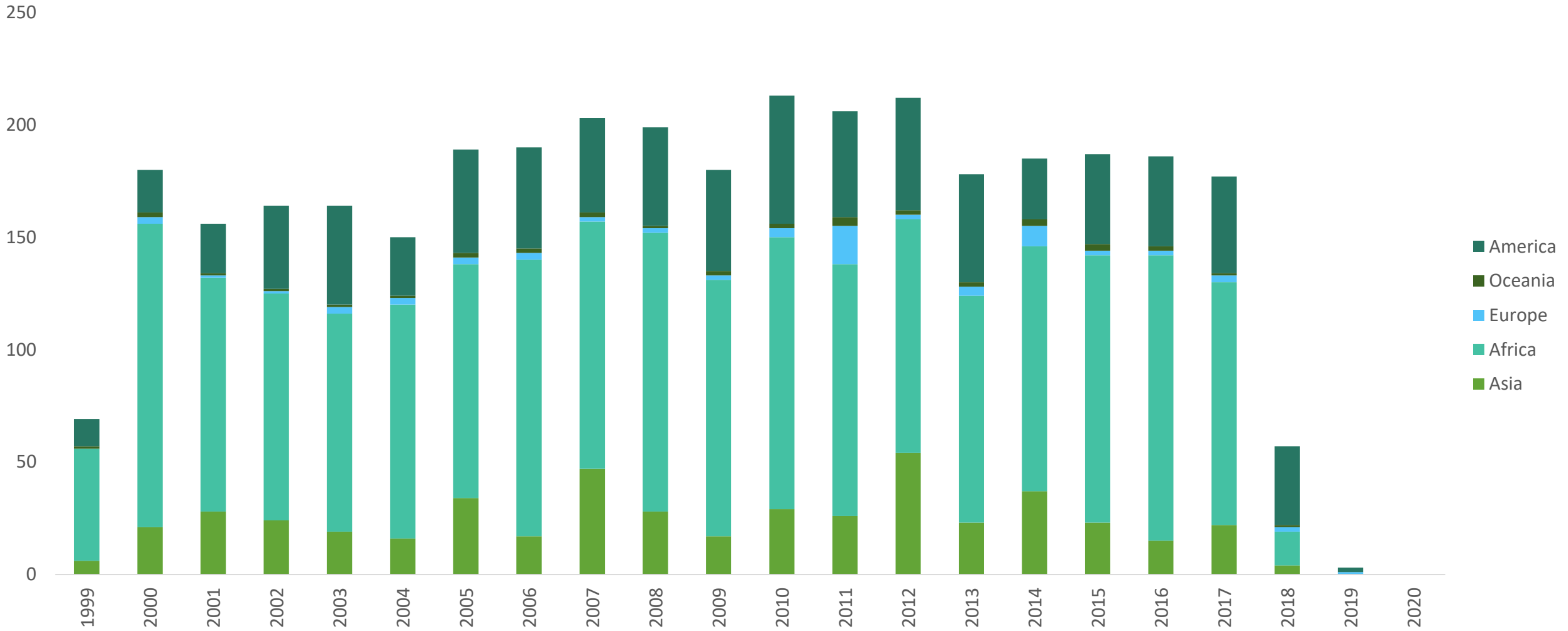
DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE

Number of countries search and number of data points found

Continent	Number of countries with >10 years FAOSTAT data	Number of countries searched	Countries for which we "found" data	Countries with no data	Number of data points found	Number of Countries with AFREC data	Number of AFREC data points	Total number of additional data points
Africa	8	49	46	3	943	44	1139	2082
America	8	33	15	18	771	0	0	771
Asia	9	41	23	18	490	0	0	490
Europe	37	8	5	3	69	0	0	69
Oceania	1	14	2	12	36	0	0	36
	63	**145**	**91**	**54**	**2309**	**44**	**1139**	**3448**

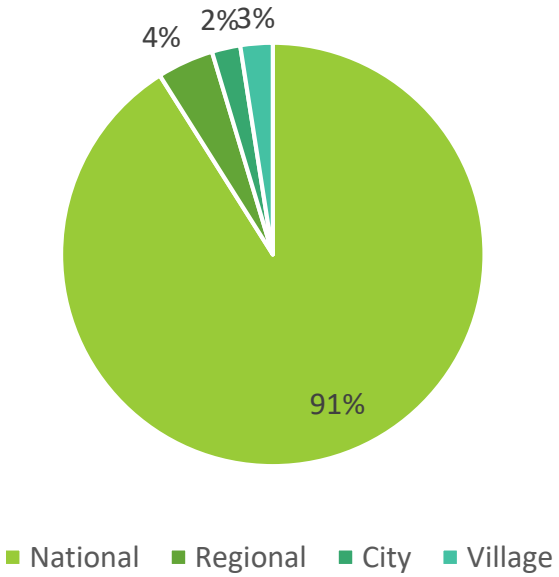


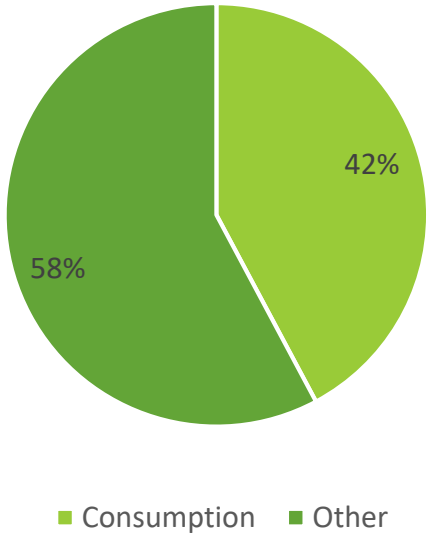
How are data distributed in time?

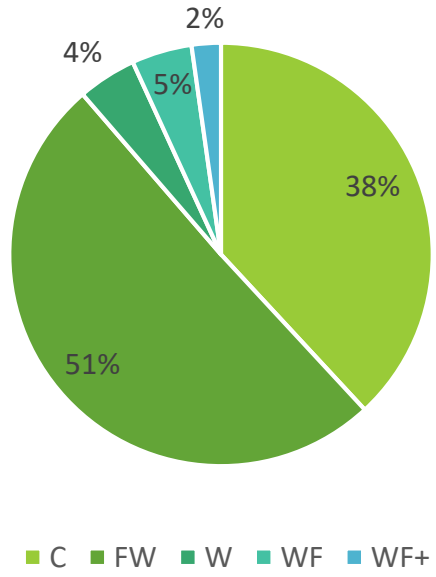


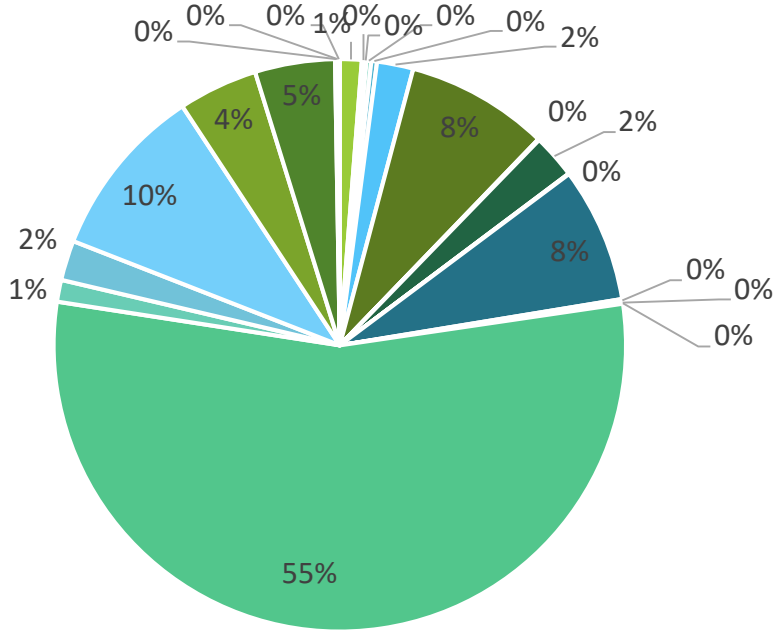
DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE

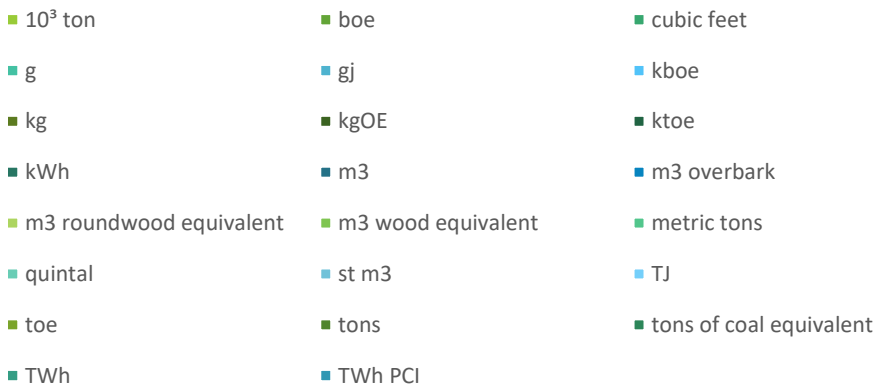
Conversions needed to scale up to national estimates of total production (m^3) …











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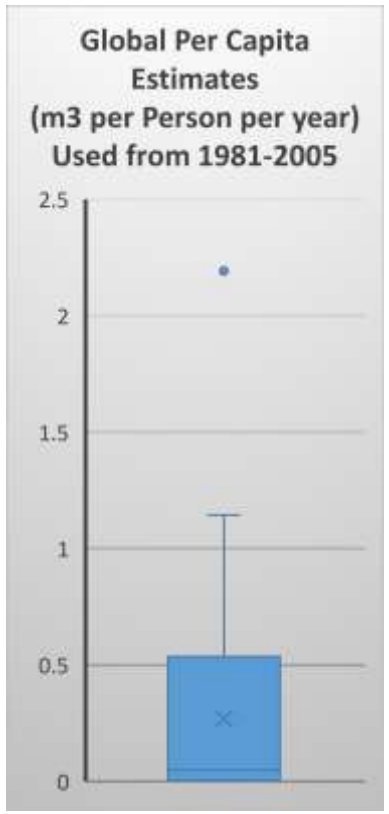
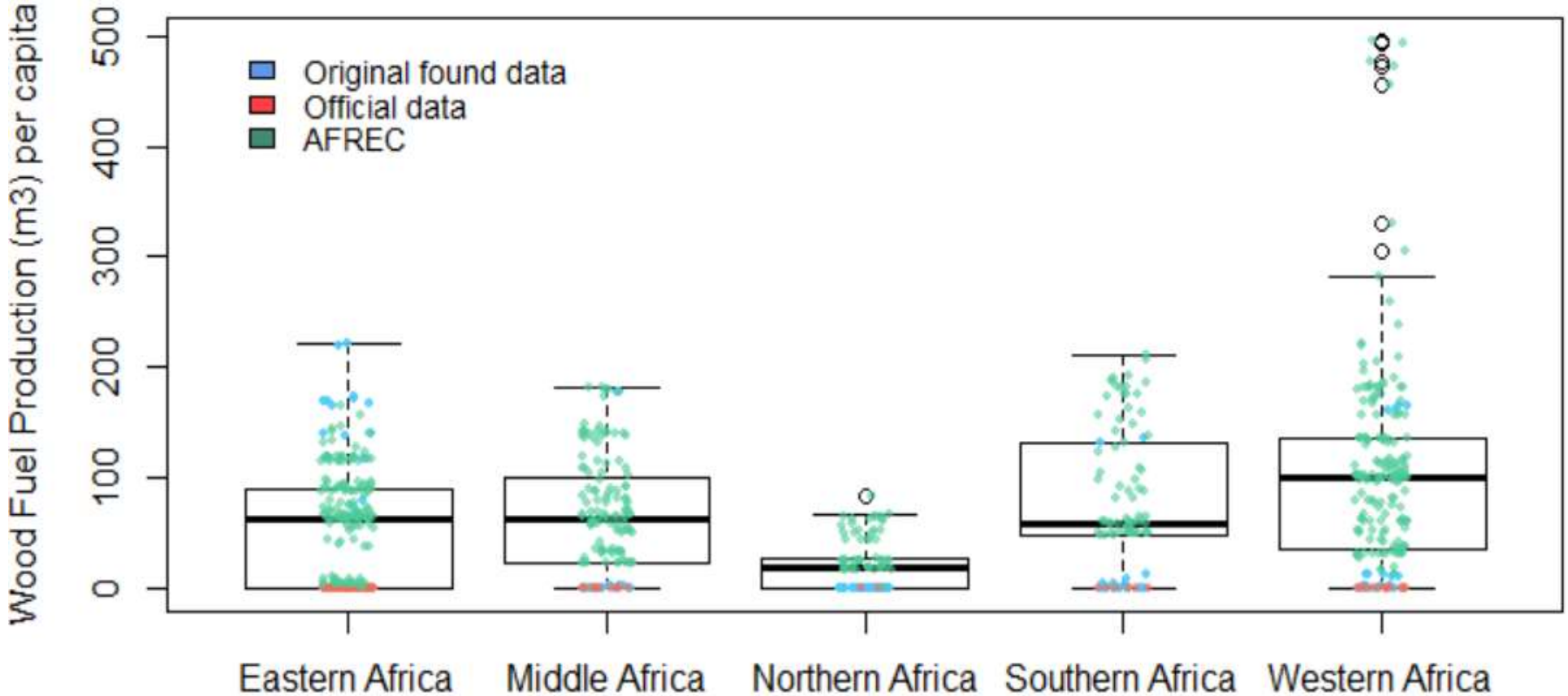




DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE

The Simple Model

MODELED

1) Calculate per capita WF demand (in volume)

Per Capita Consumption WF = (Production WF + Import WF - Export WF) / Total Population

2) Model per capita WF demand (conceptual model)

Per Capita Consumption WF ~ Poverty Indicators + Forest Indicators + Climate Indicators + Landform Indicators + Social Indicators + Industry Indicators

3) Calculate national charcoal demand (in weight)

Consumption C = Production C + Import C - Export C

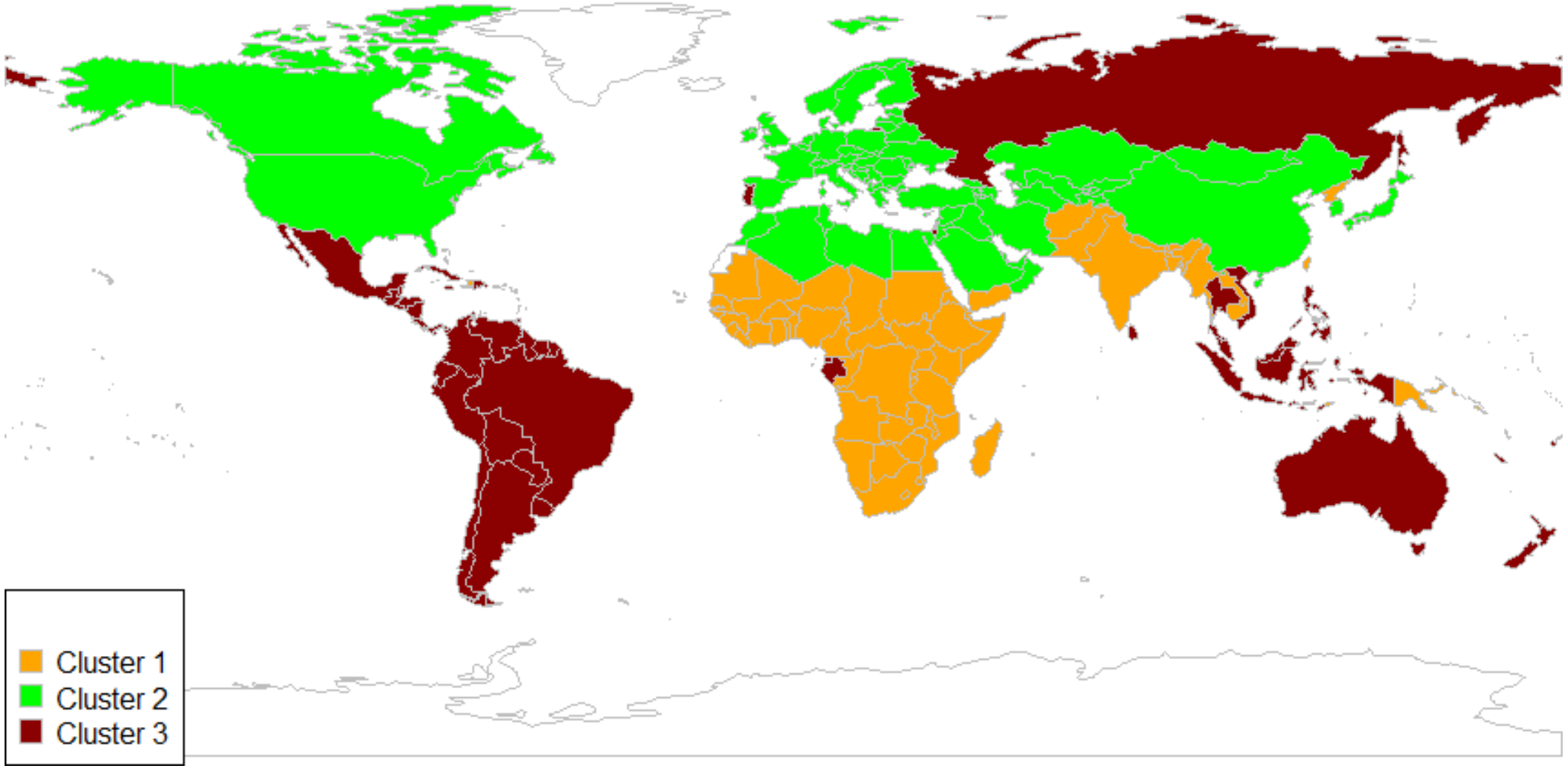
4) Model the proportion of WF demand met with charcoal.

Proportion of WF Demand met with Charcoal ~ Prop of Population Urban + GDP/Person + Other wood energy production

5) Convert back to production of WF (volume) and charcoal (weight).

DRAFT PLAN – PLEASE DO NOT CITE OR SHARE

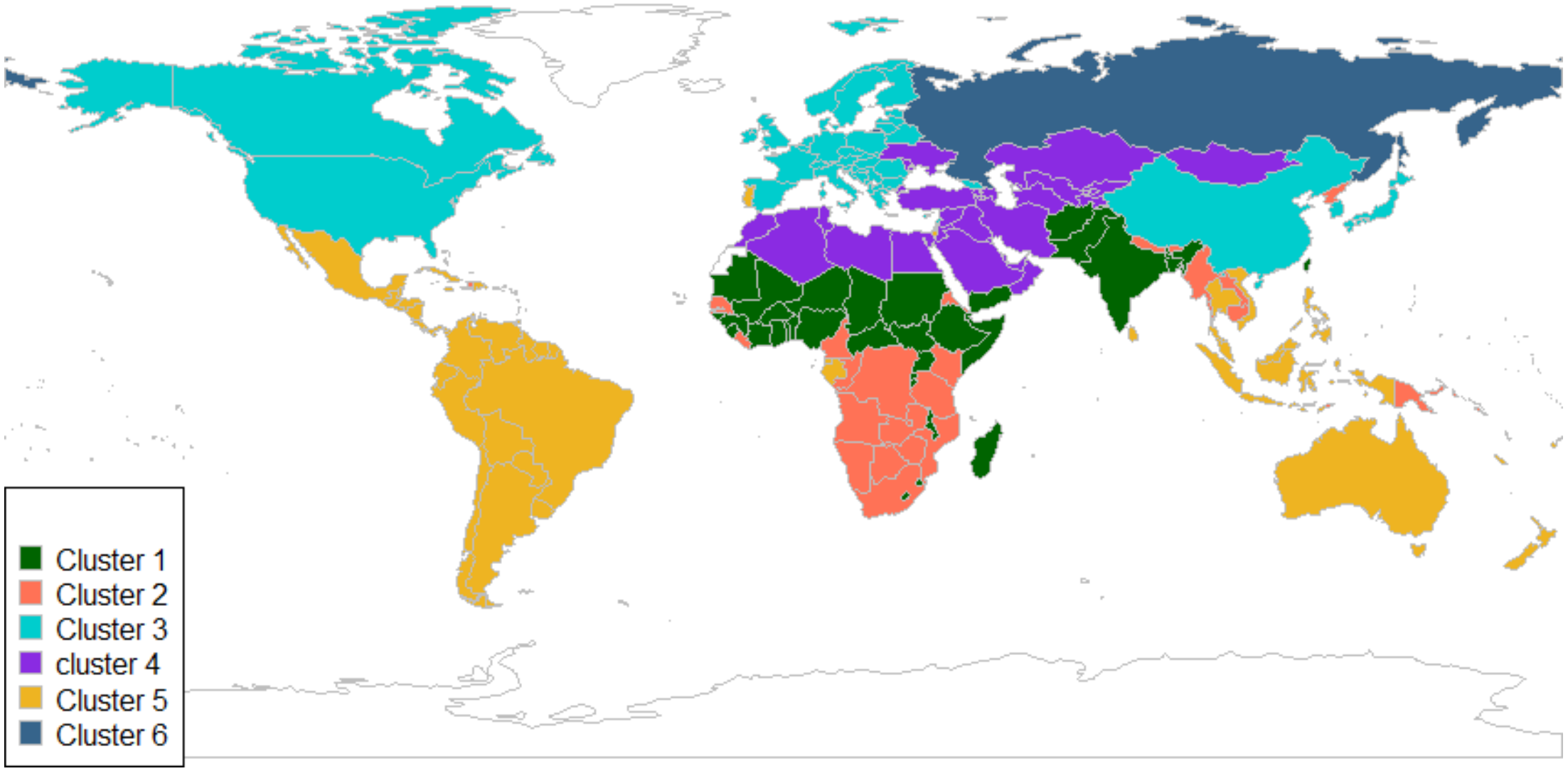
First level clustering



Time series clustering using tsclust in the package dtwclust (Sarda, Espinosa, 2019)

DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE

Second level clustering



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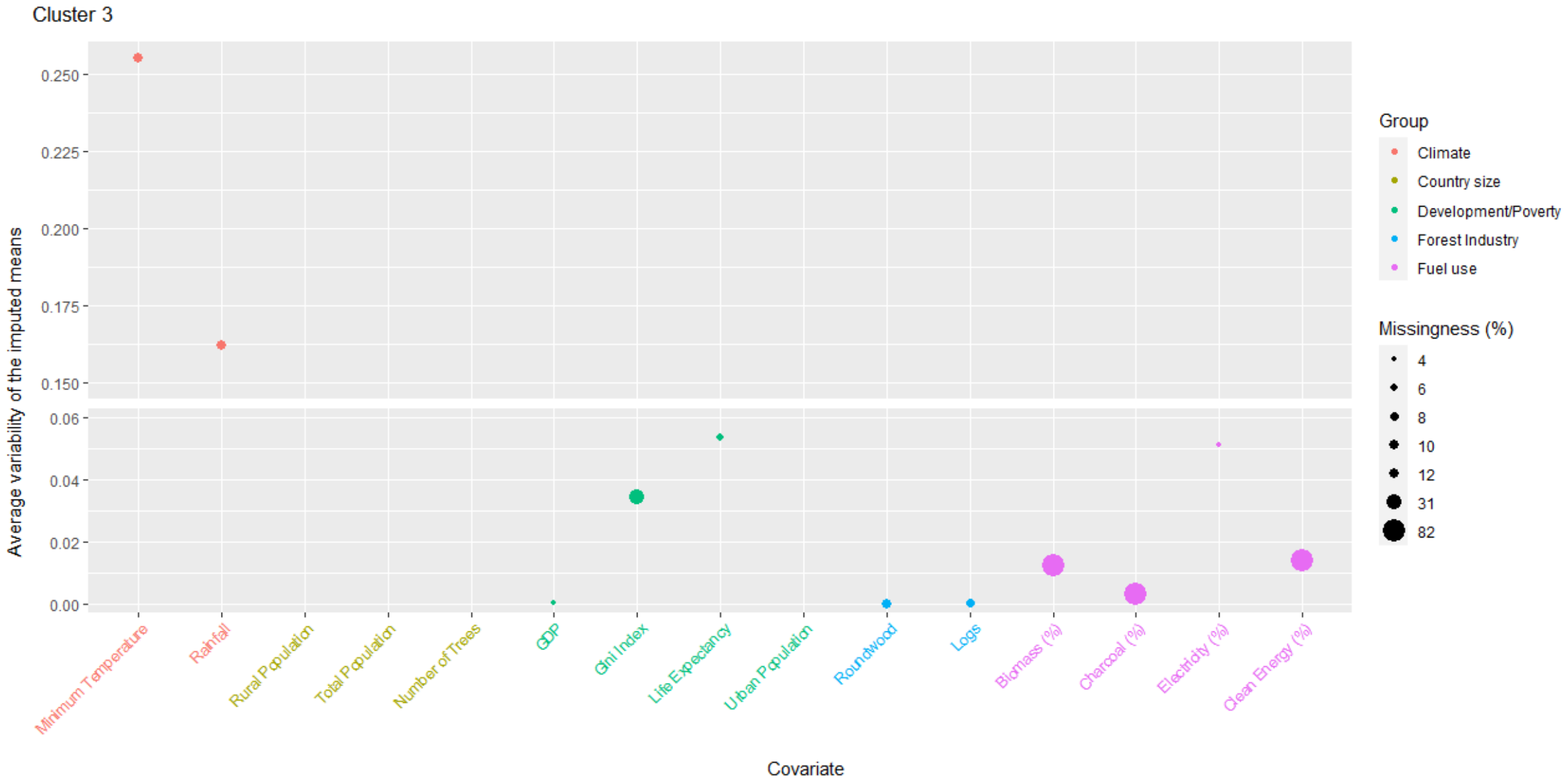
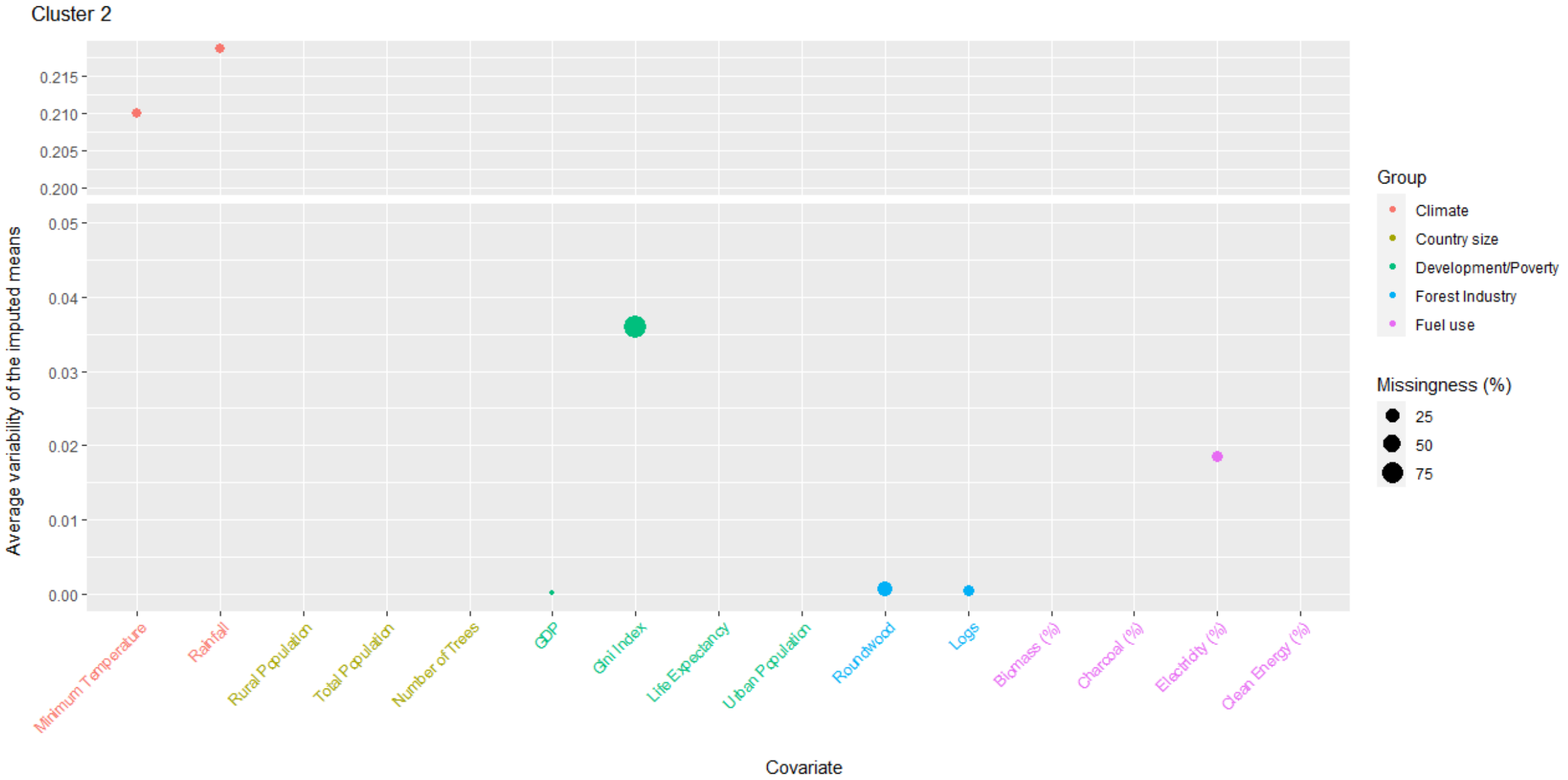


MiceRanger for imputation

DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE



DRAFT RESULTS – PLEASE DO NOT CITE OR SHARE

Per Capita WF Demand 4 Modeling

Wood Charcoal % 4 Modeling

BASE FOUND
PART I -> PART IV

Found4Modeling.csv

Create base datasets

- Widen data set: change name of Area.Code, remove excess columns, create separate columns for WF and C, fill flag columns with "DC"
- UserProducerType and then with Element and then average remaining
- Filter out high values of per capita consumption
- Create per capita consumption dividing by population from covariates.csv

FinalFoundData.csv

BrunoConversionCode.R

- Remove 25 rows (non-countries and AFREC errors)

WOODFUEL
- Scale data up to full year, all users in a country, from regional to national, and from households to people
- Conver FAOSTAT requires prop C and NC

CHARCOAL
- Scale data up to full year, all users in a country, from regional to national, and from households to people
- Convert to tonnes

Conversion Factors for Found Data Updated 16AUG21.xlsx

f no other data for that CountryxYear (new countries added!)
- Country Code added for new countries
- Associated indicators filled in for every new AFREC point

AFREC

FoundData.xlsx

Some countries and years

COMPLETE BASE COVARIATES

FullCovariates.csv

- ImputeCovaroates.R – to be ctreated

BASE COVARIATES
PART II

Covariates.csv

Create base datasets

- Create totals for wood production and flag for total
- Fill in population data for countries missing from World Bank
- Fill in land areas for China

LandAreatoFill.csv

ExampleCodeCovariates.R

- Create 5 new variables (sums or ratios)
- Go to sources as in CovariateDataDescription.docx and bring in data
- Additional data from FAOSTAT on wood production with flag

World Bank, FAO, FRA interpolated data, Our World in Data, Stoner article

Annual_2020_10_15.csv (FRA DATA) or direct from FRA

- Merge all the country codes from all agencies to enable efficient download from non-FAO sites

Look-up table.csv

master_country_year.csv

All countries and years

create_full_timeseries.R

BASE FAO
PART III -> PART V

FAOstrong.csv

Create base datasets

- Remove extraneous country x year
- Keep only flags 1 and 2 for WF and C
- Set select 0 values to NA (if there must be production)– code in notes)
- Remove values repeated exactly 3 times in a row and replace with NA
- If Prod+Imp-Exp < 0, then Prod == NA
- Remove NAs

BASE CLUSTER

clusters.csv

DRAFT PLAN – PLEASE DO NOT CITE OR SHARE

newflaggingsystem.csv

ExampleCodeFAO1.R

- Download data
- Remove China
- Merge coniferous and non-coniferous data and create correct flag for aggregate
- Ensure encoding is UTF-8

FAOSTAT

Some countries and years

"*There is nothing new except what has been forgotten*."

~ Marie Antoinette

Ostia Antica, Photo by Bill Richards