

# Global Wood Fuel Production: A Simple Model?

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Forest Product Statistics Capacity Building Workshop  
25 October 2021



## **POLICIES AND DECISIONS**

**HUMAN HEALTH  
LIVELIHOODS  
HUMAN NUTRITION  
ECONOMIC OPPORTUNITY  
GENDER EQUITY  
FOREST HEALTH  
CLIMATE CHANGE**

Globally, about half the wood extracted from forests is used for energy, mostly for cooking and heating. In Africa, it is much higher.

The quantity of woodfuel produced (and consumed) has significant social, economic, and environmental impacts.



## OFFICIAL STATISTICS

## POLICIES AND DECISIONS

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# Wood Fuel and the SDGs



Photo by Lubomba Bwembelo

- Target 3.9 – Reduce the number of deaths and illnesses from hazardous chemicals and **air, water and soil pollution** and contamination.
- Target 5.4 – Recognize and value **unpaid domestic work**.
- Target 7.2 – Increase the share of **renewable energy** in the global energy mix.
- Target 12.2 – Achieve **sustainable management** and efficient use of natural resources.
- Target 15.2 – Promote the implementation of sustainable management of all types of forests, **halt deforestation**, restore degraded forests and substantially increase afforestation and reforestation globally.



# There are few data ...

- FAO's wood fuel data are based on figures reported to FAO, UNECE, or ITTO by country correspondents.



72

- ❖ Non-repeating official data for  $\geq 10$  years since 1960.

145

- ❖ Official data < 10 years since 1960.
- ❖ Often, these countries have a high reliance on wood fuel



FAO uses a model to **estimate** national wood fuel production

# There are few data ...

## ➤ Summer 2021 workshop hosted by AFREC on Bioenergy

### 1. Year of the last household energy **consumption** survey in your country: need to update or carry out surveys



Most data on household consumption are at least 5 years old and much is 20 years old.

### 7. Data quality

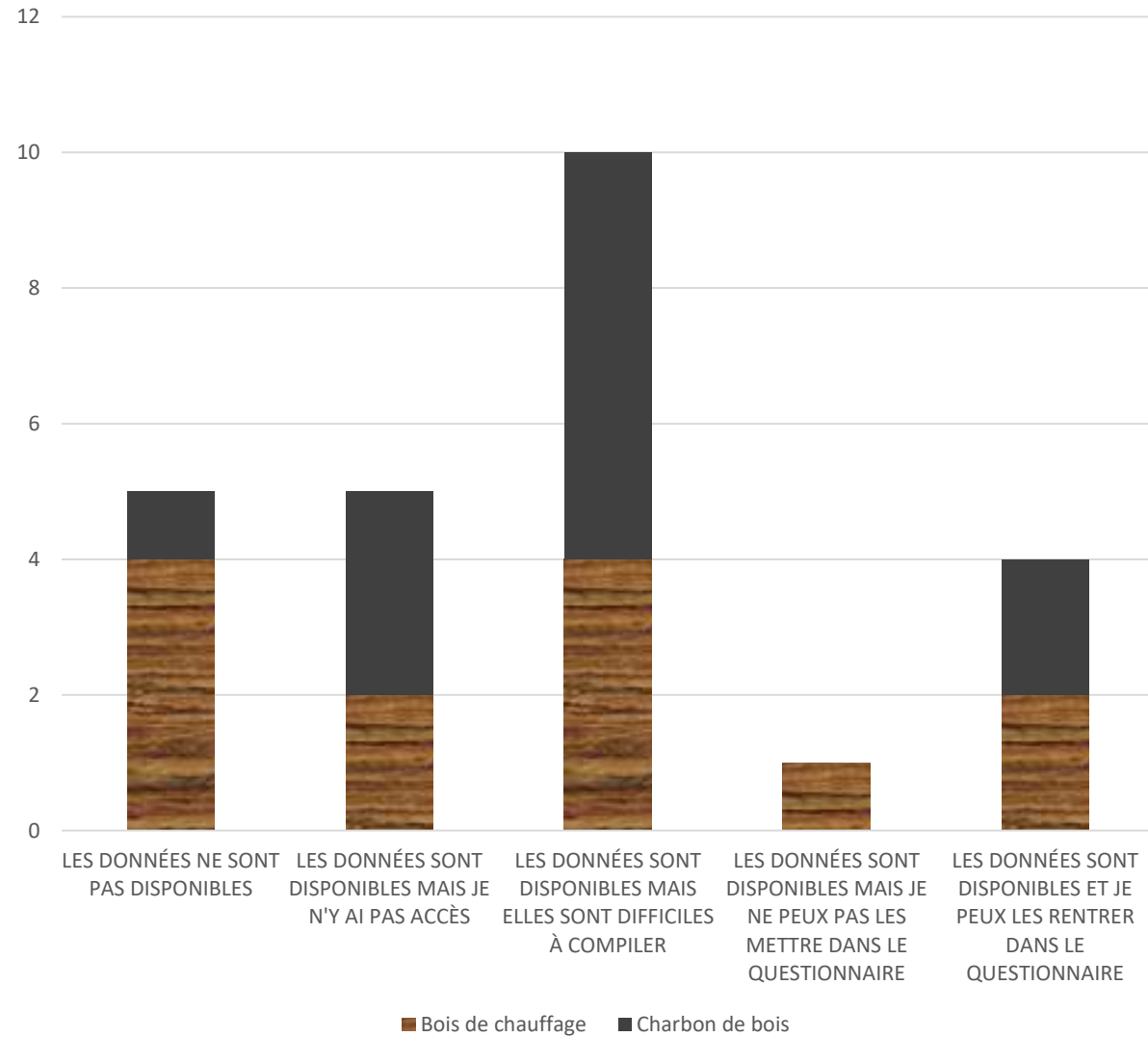
Etes-vous satisfait avec la couverture, le niveau de détails et la qualité des données de votre pays sur la bioénergie | Are you satisfied with the cover... detail and quality of your country's bioenergy data  
41 responses

43% of respondents were not happy with the quality data on bioenergy



# There are few data ...

➤ You!

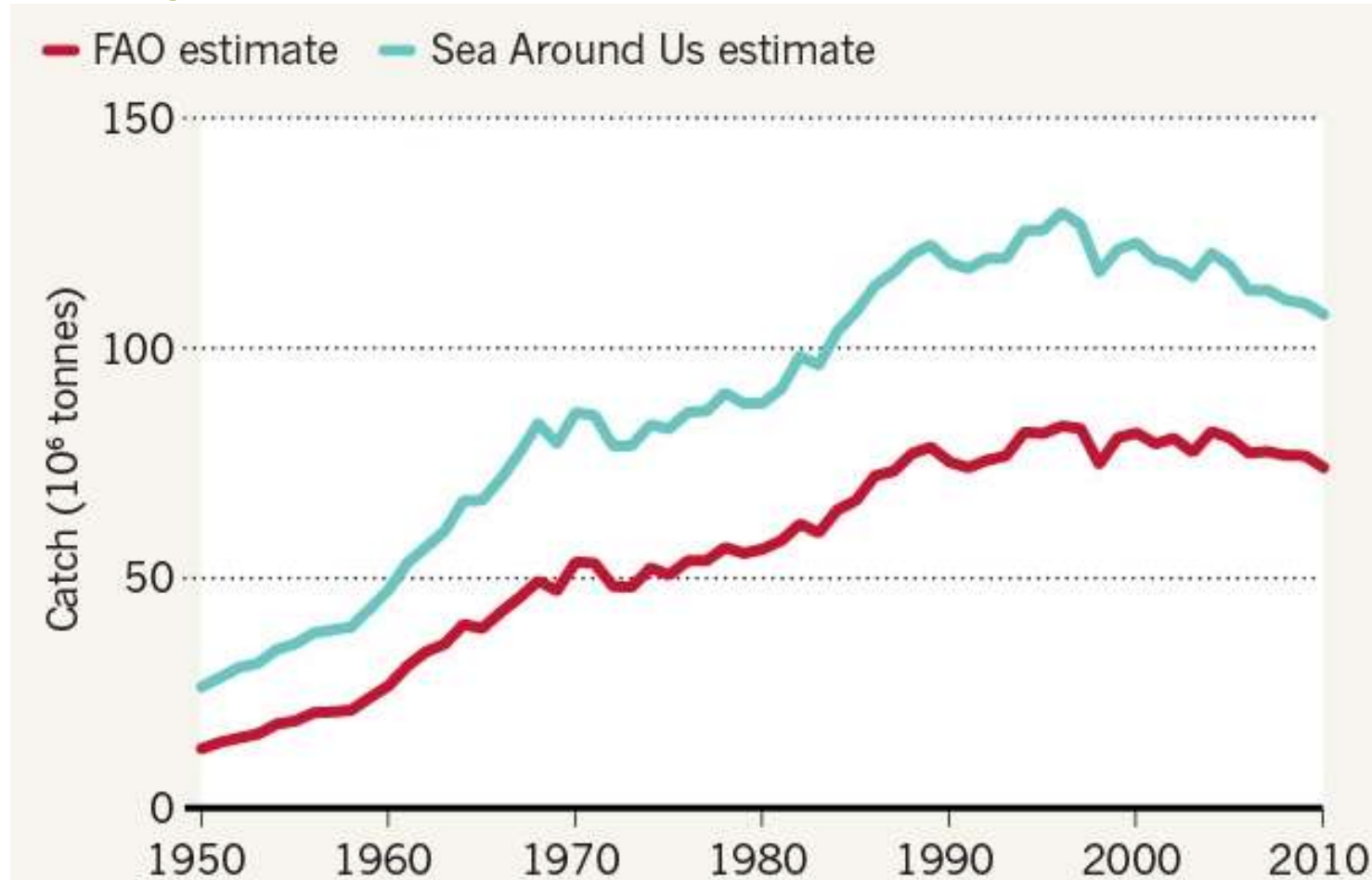




# POURQUOI LES DONNEES SONT-ELLES IMPORTANTES?

1. Donner une image réaliste de la situation
2. Analyse et des conclusions cohérentes et justes

PECHE



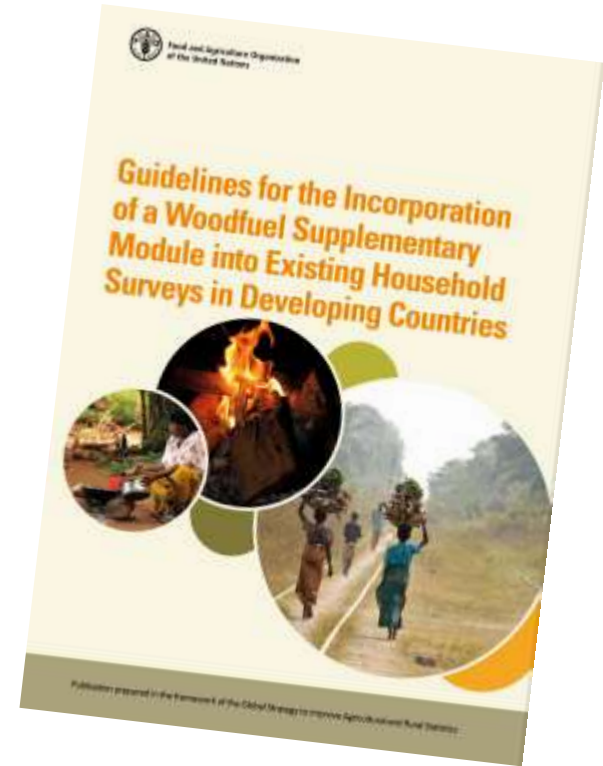


# Woodfuel Supplementary Module



Photo by Penias Banda

- **Goal:** Help countries collect reliable and comparable data on woodfuel production and consumption in the informal sector.
  - Incorporated into existing household surveys.
  - Intended outcome is improvement in the measurement and tracking of woodfuel production and consumption.



# Remotely-sensed data

- Wood charcoal production and export is a major activity supporting war regimes in southern Somalia
- Semi-automatic detection method to identify charcoal production sites from very high resolution (0.5 m) satellite imagery
- Estimates of likely ranges of kiln sizes and tree parameters based on literature- and local-knowledge.
- Based on the sites detected exclusively for 2013, they estimated an average production of 24,000 tonnes of charcoal and 2.7% tree loss for the two-year interval

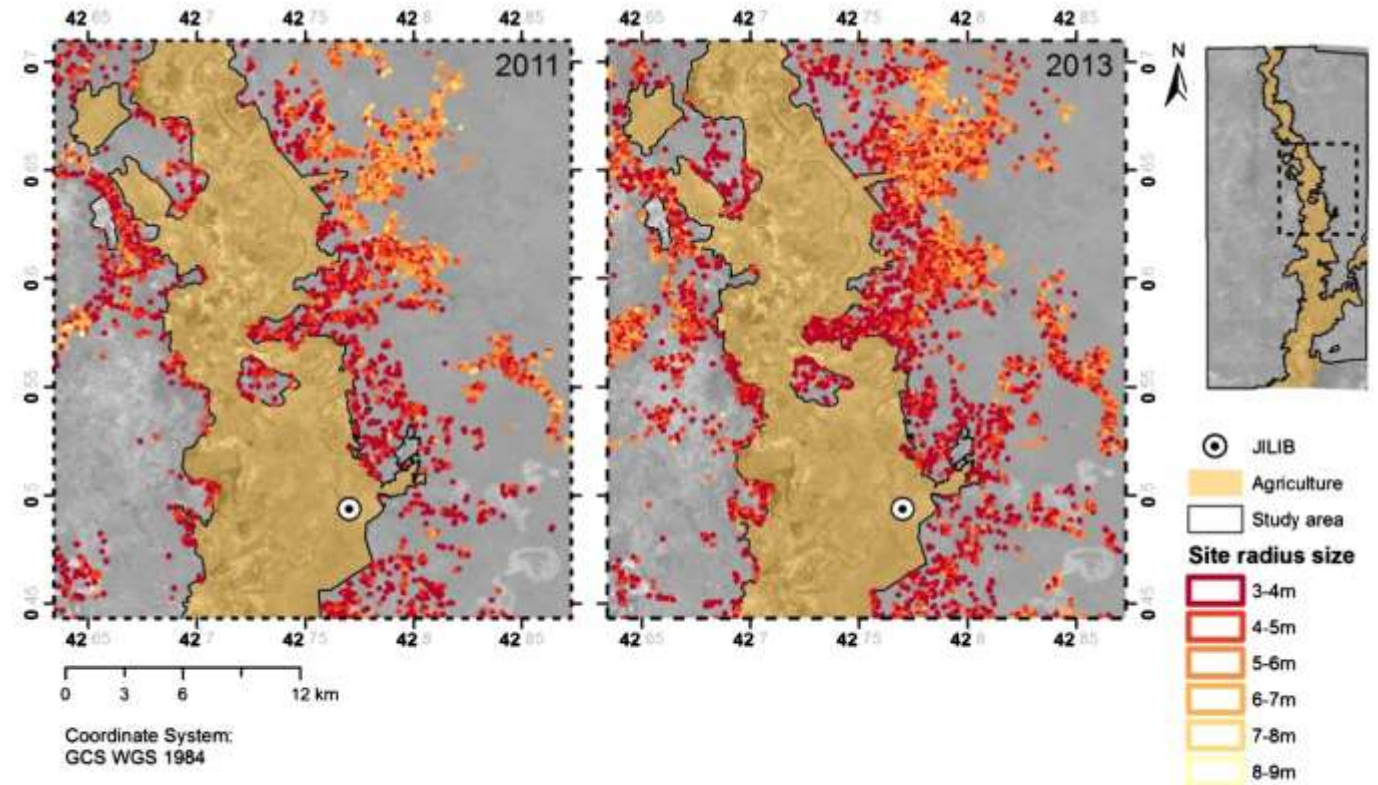
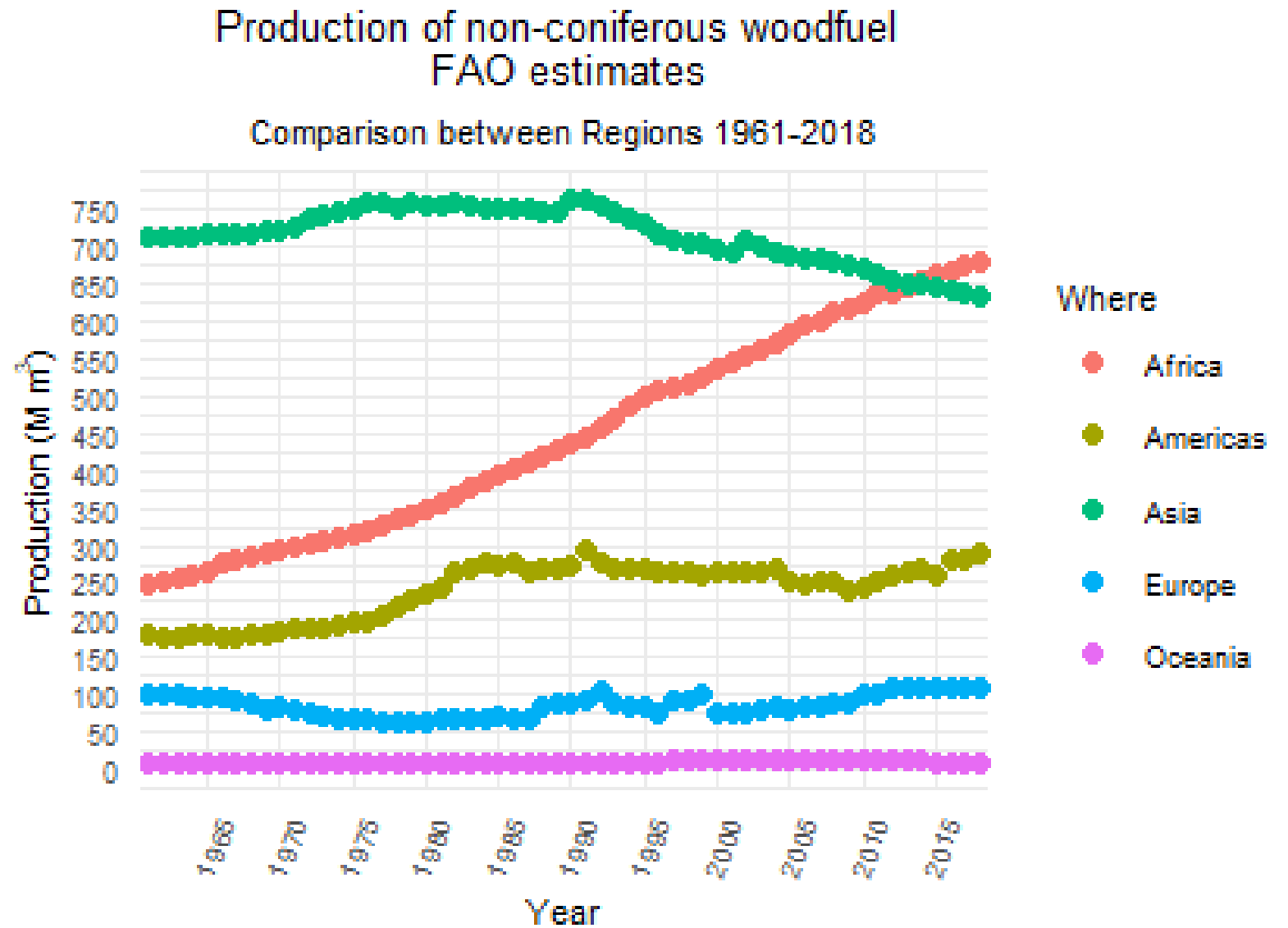


Fig. 5. Example of semi-automatically detected charcoal sites grouped by radius size.

Looking  
closely at  
the data  
we do  
have

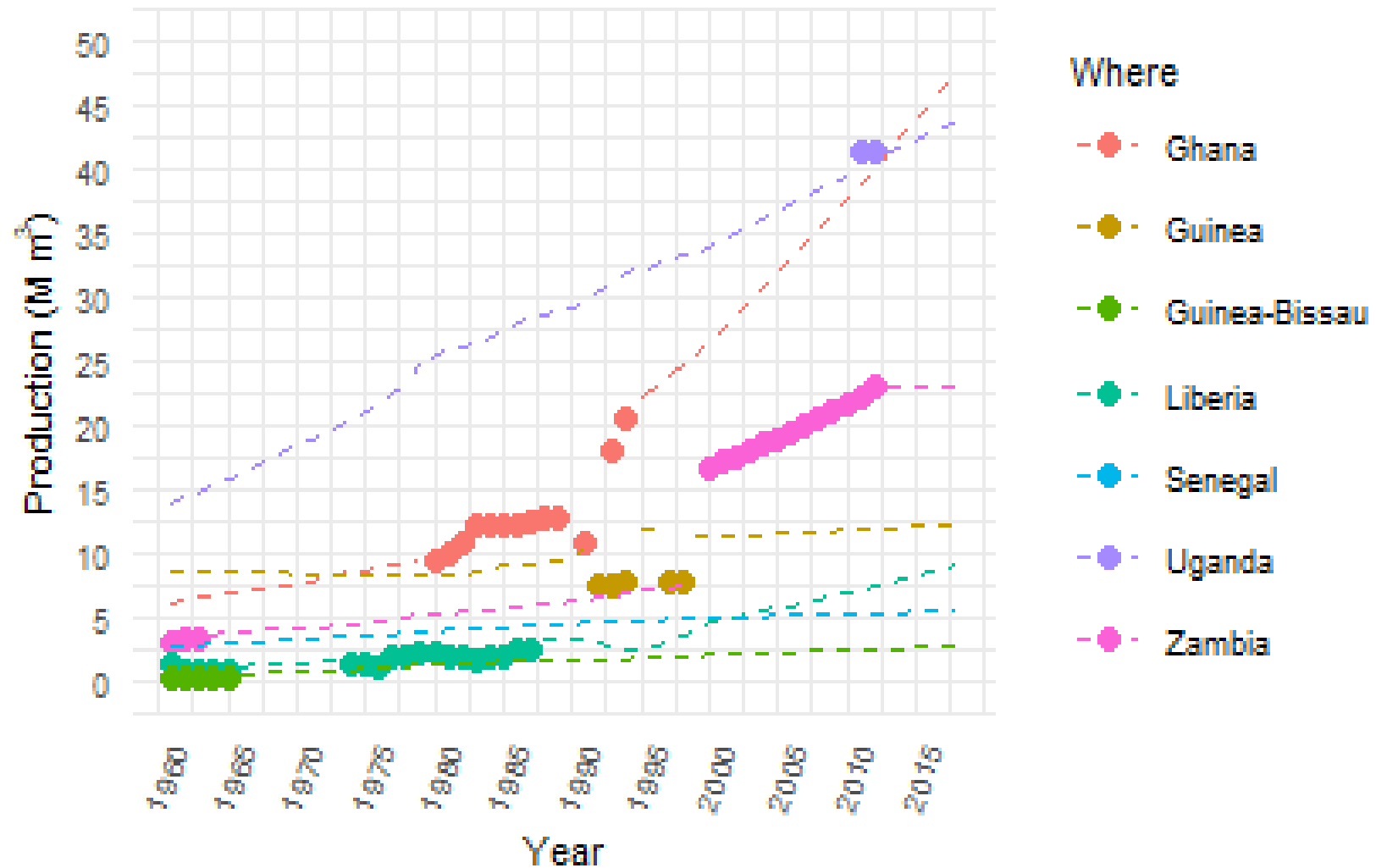


Data source: FAOSTAT

Graph by Ilaria Bombelli

# Production of non-coniferous woodfuel by country and type of data

Comparison Senegal-Other African Countries 1961-2018

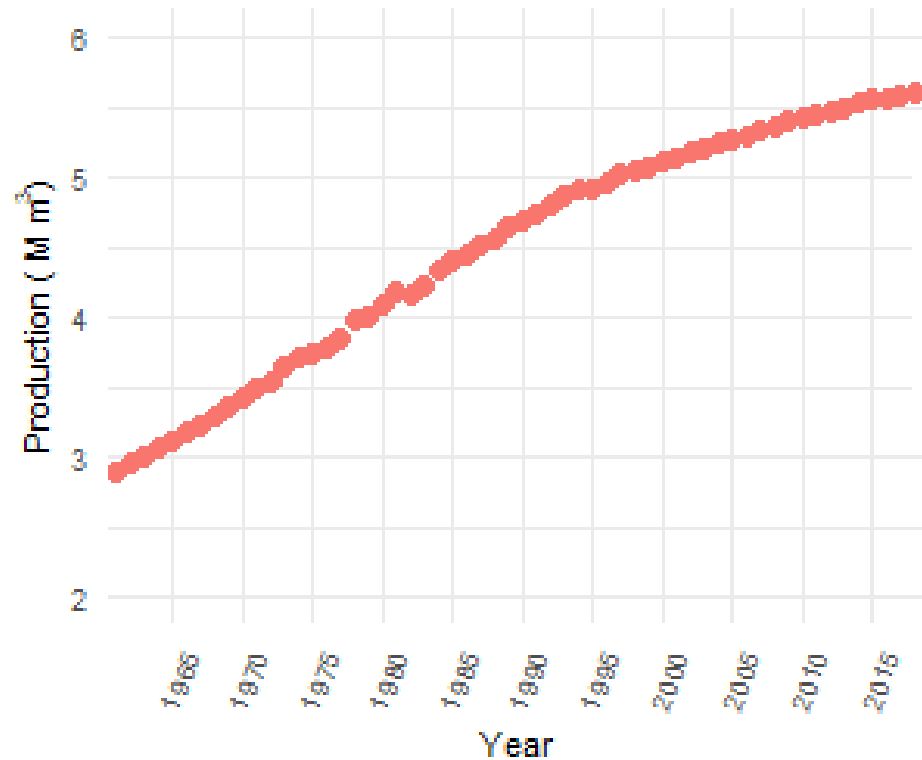


Data source: FAOSTAT

Graph by Ilaria Bombelli

Production of non-coniferous woodfuel  
by type of data

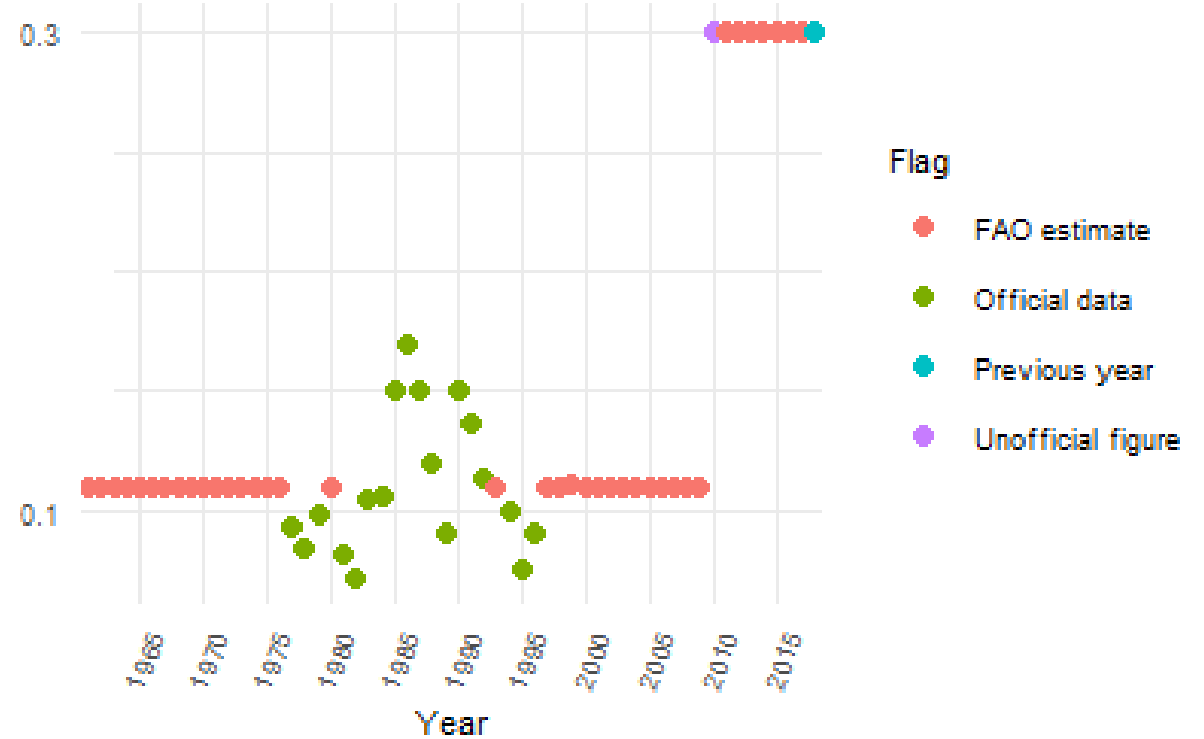
Senegal 1961-2018



Data source: FAOSTAT

Production of charcoal  
by type of data

Senegal 1961-2018



Data source: FAOSTAT

# Woodfuel Production in Senegal



We need to update the model,  
we are going to need  
understanding ...



**GETTING  
ORGANIZED**

# Estimating wood fuel production where official data do not exist

➤ The model (Broadhead, Bahdon and Whiteman, 2005) is based on woodfuel data up to 1998 and uses **multiple linear regressions** to estimate production with explanatory variables:

- total population,
- GDP (income),
- urbanization,
- average temperature,
- climate,
- land area,
- forest area and more



**Total Human Population**

**Land Area**

**GDP**

# Conceptual Model v4.0

## Household Needs

### Cooking

**Total Population**

**Average HH Size**

**Foods consumed**

### Heating

**Total Population**

**Elevation**

**Min. Temperature**

## Industry Needs

**Main Types of Industry**

**Urban Population**

**IRW Production**

**Urbanization Rate**

## Poverty

**Life Expectancy**

**Gini Coefficient**

## Alternatives to Wood

**Electrification Rate**

**Availability of LPG**

**Price of LPG**

**Energy Demand**

**Wood Fuel Demand**

**Wood Fuel Production**

## Availability

**IRW Production**

**Number of Trees**

**Treed Area**

**Precipitation**

## Impacts

**Change in Forest Area**

**Change in Forest Cover**

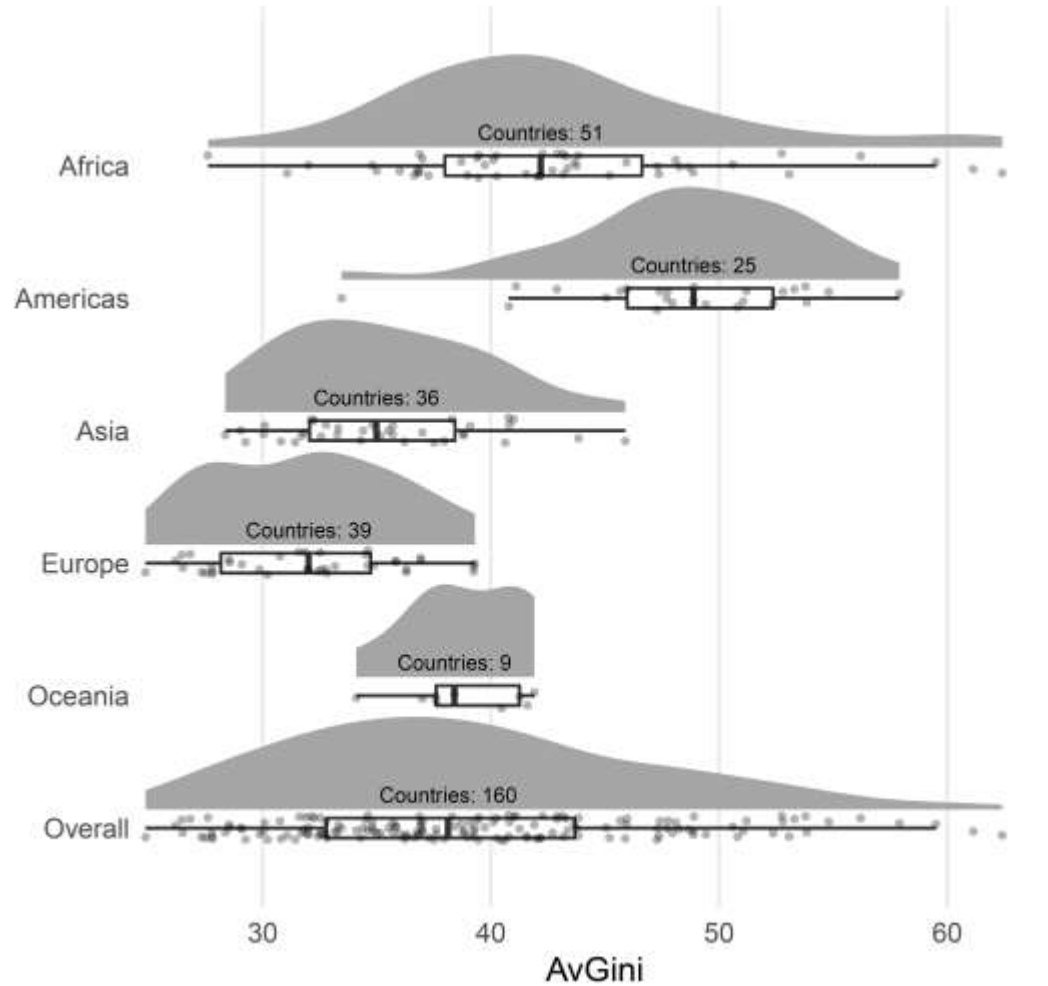
Converting from  
Consumption to  
Production

**Wood Fuel Stock Change**

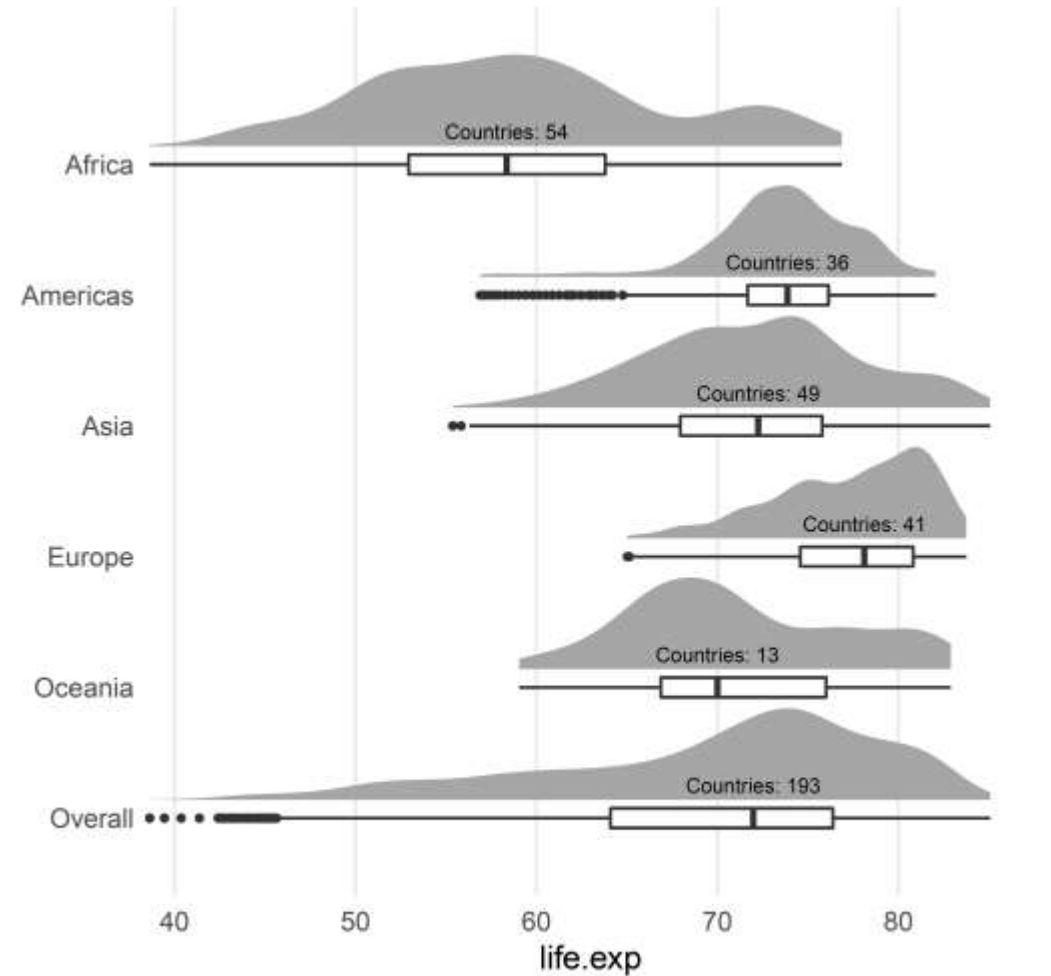
**Wood Fuel Export**

**Wood Fuel Import**

# Poverty Metrics: Inequality and Life Expectancy



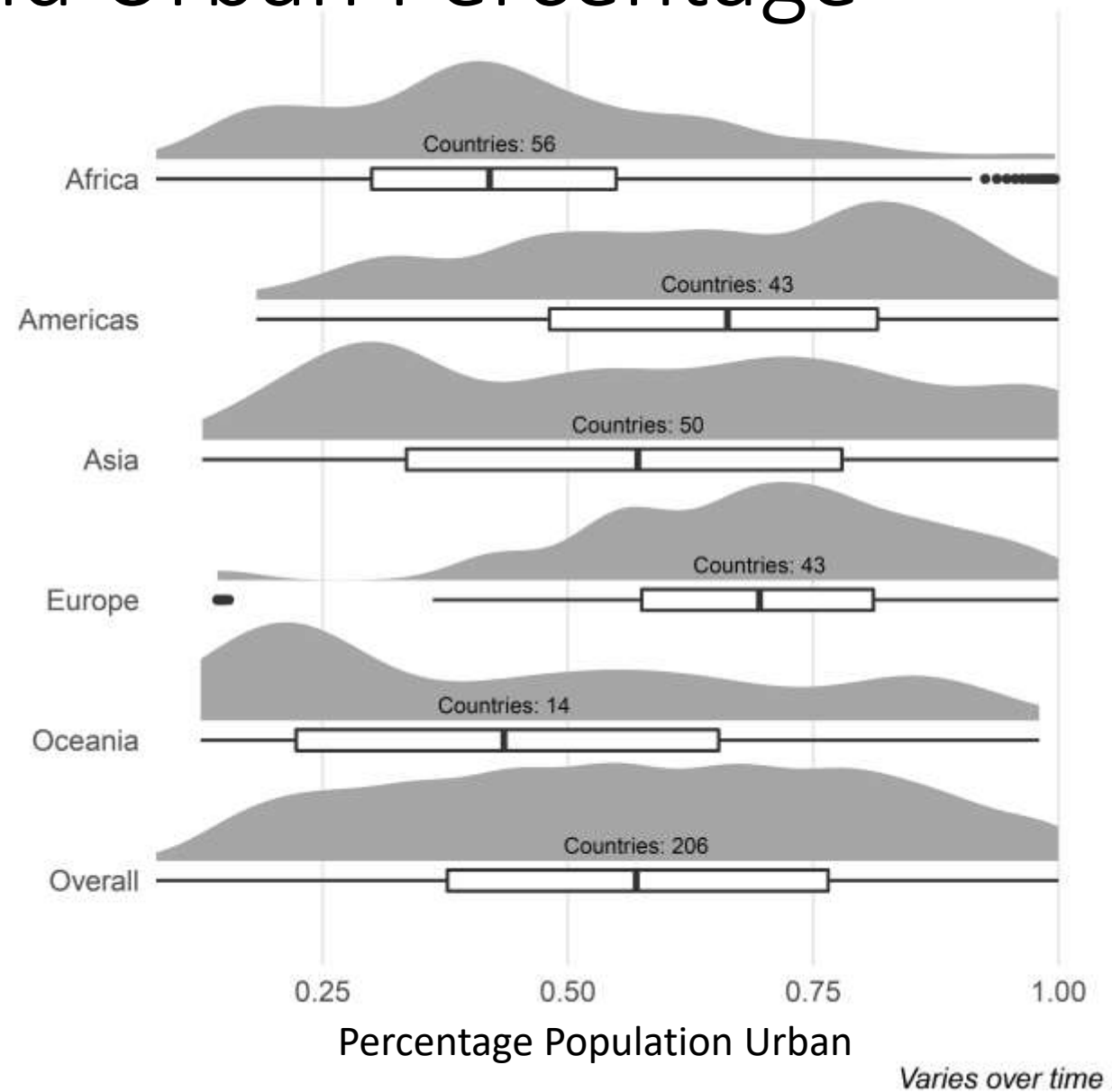
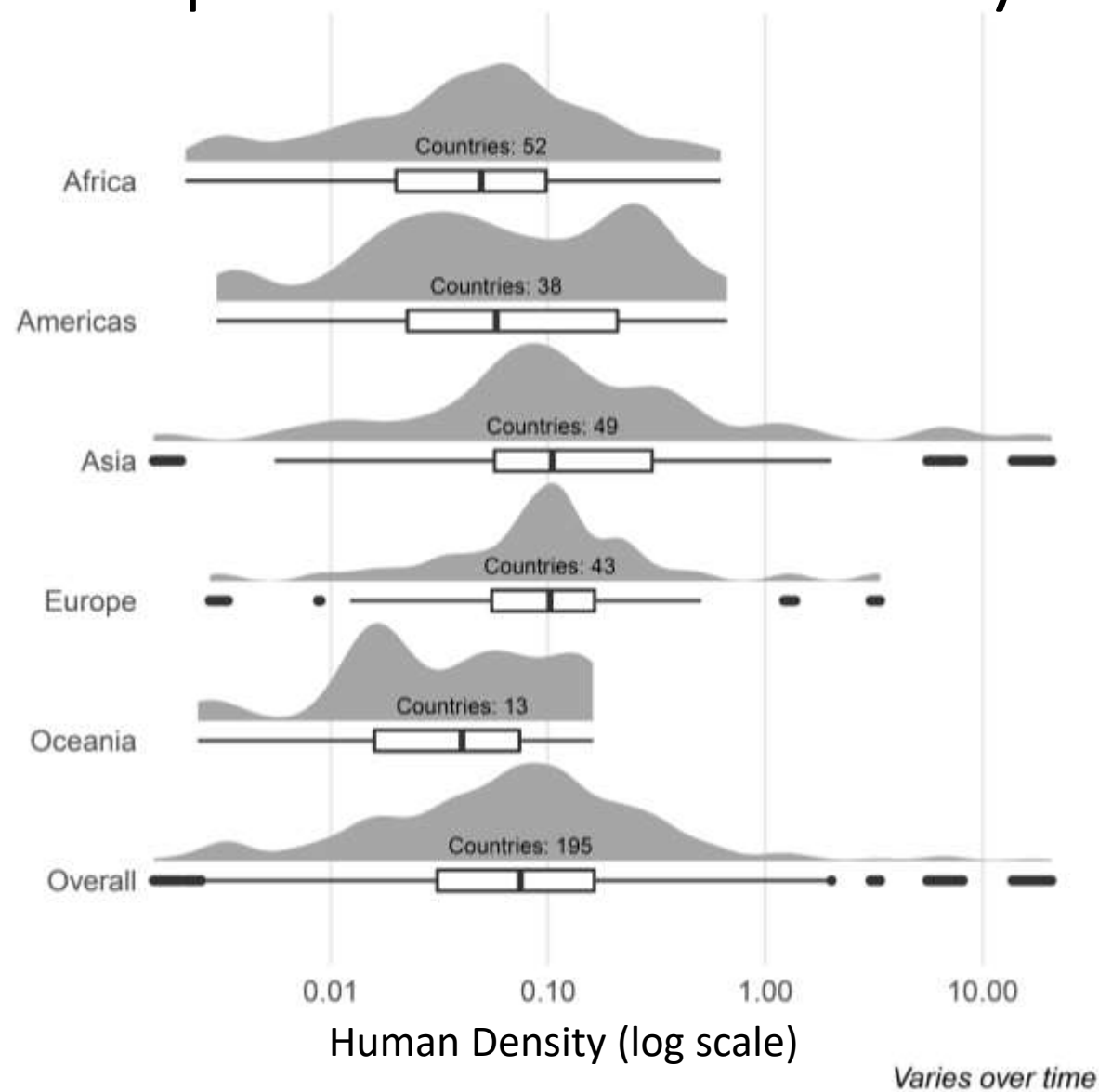
*Does not vary over time*



*Varies over time*



# People: Human density and Urban Percentage



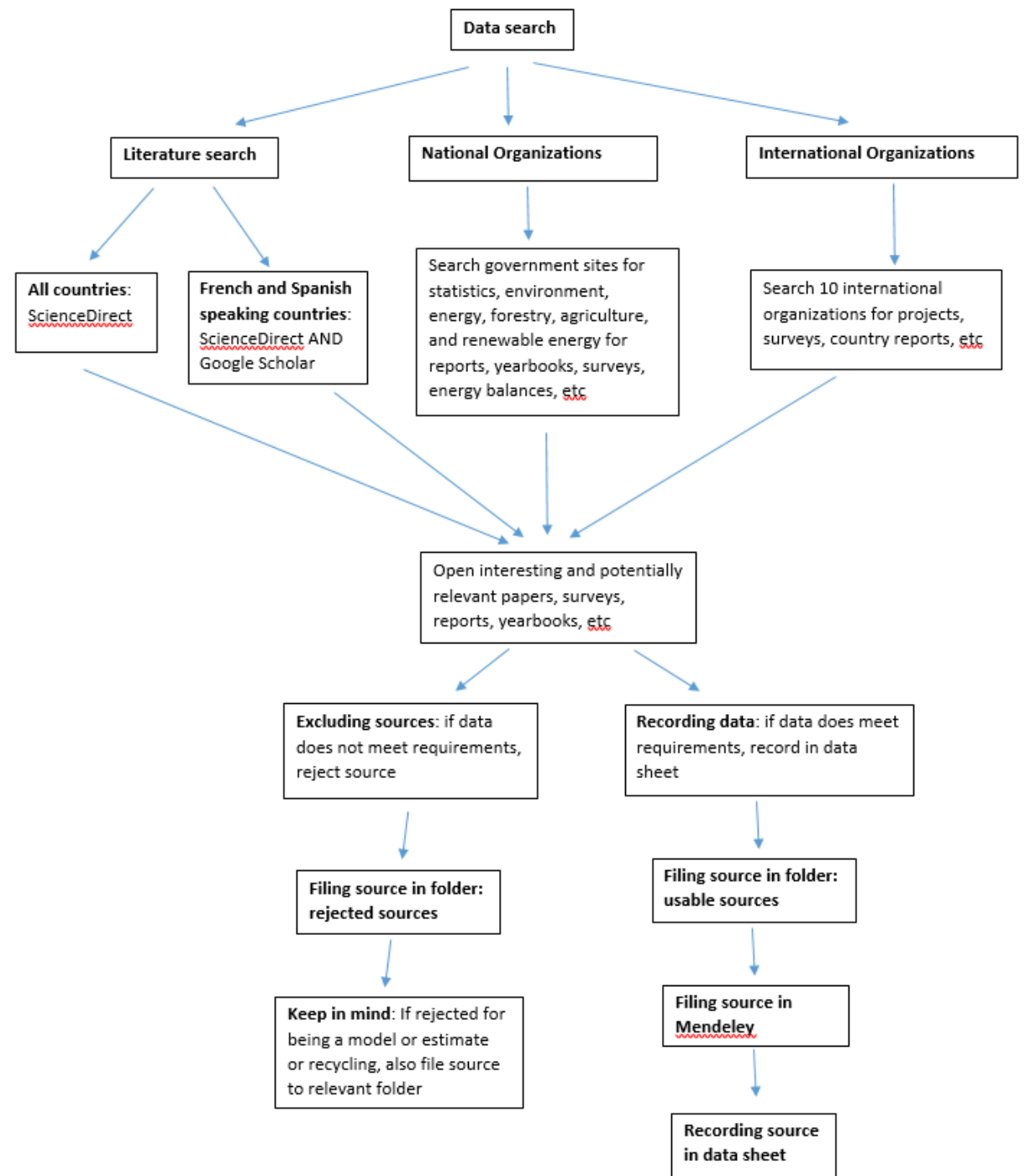
We need to update the model,  
we are going to need data ...



**GETTING  
ORGANIZED**

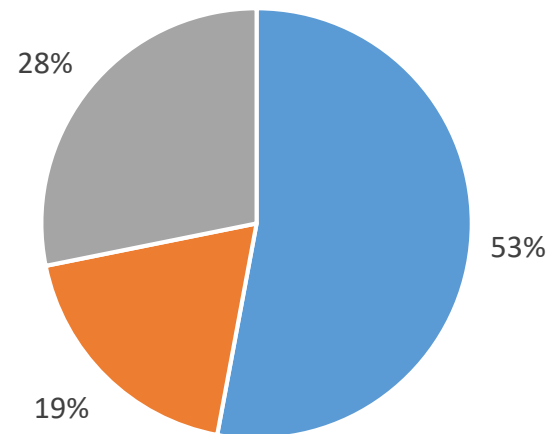
# Year-long, systematic data search!

For each country (N=145)  
without 10 years of non-repeating,  
official data for both wood fuel and  
charcoal production

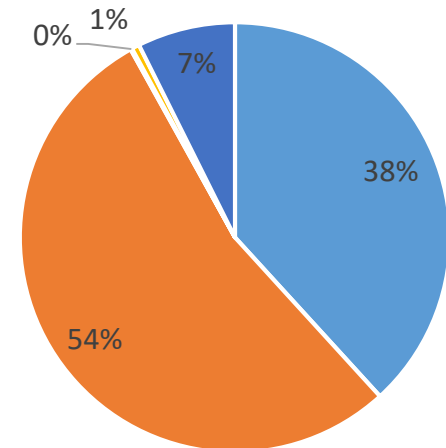


# Data found as of 30 June 2021

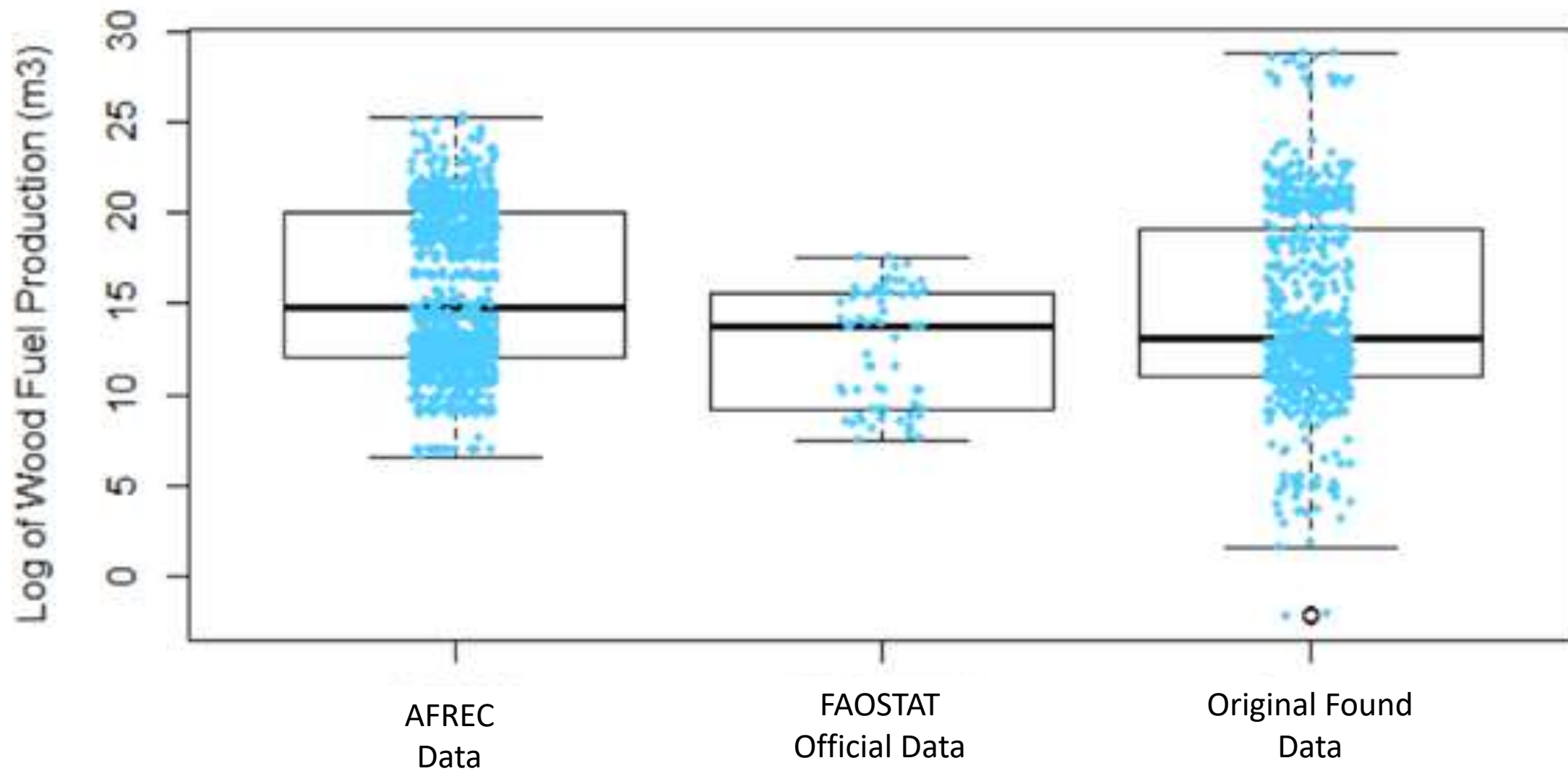
Continent	Number of countries searched	Countries for which we "found" data	Countries with no data	Number of data points found	Number of Countries with AFREC data	Number of AFREC data points	Total number of additional data points
Africa	49	46	3	943	44	1139	2082
America	33	15	18	771	0	0	771
Asia	41	23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



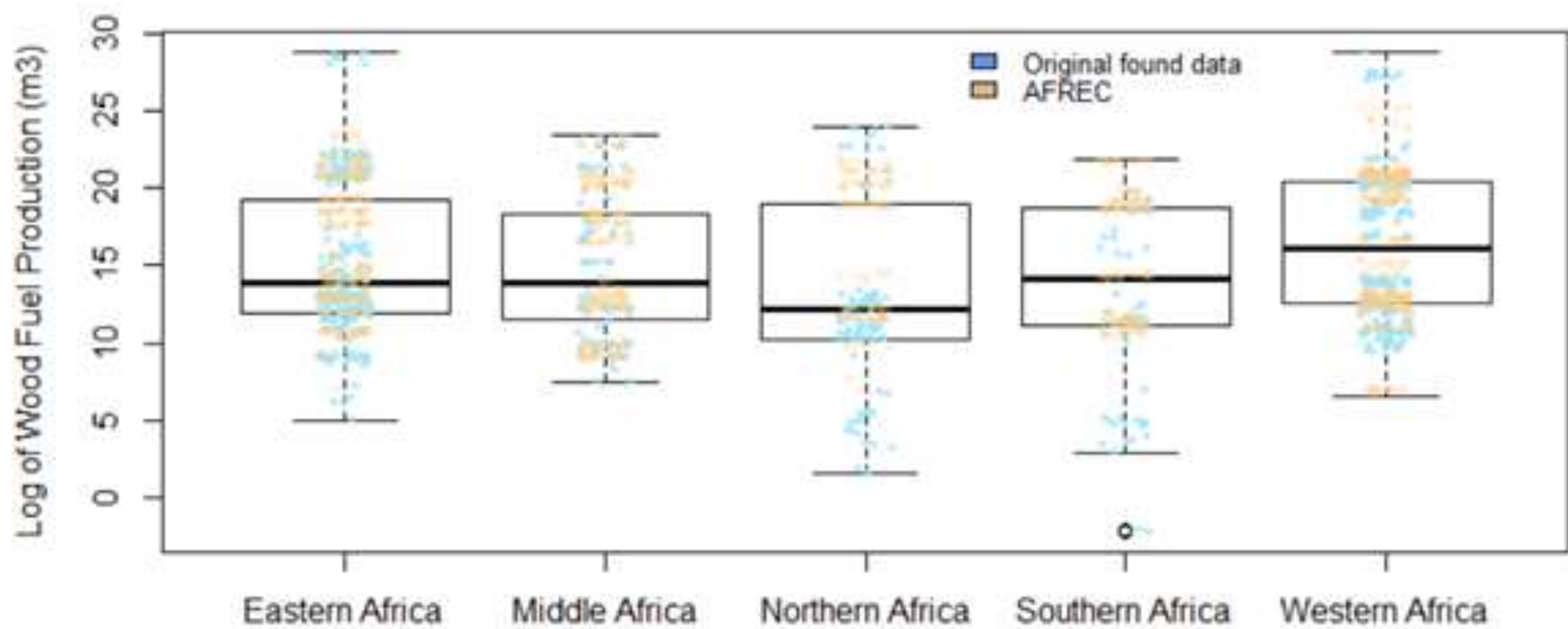
■ Energy Balance ■ Field Survey ■ Other



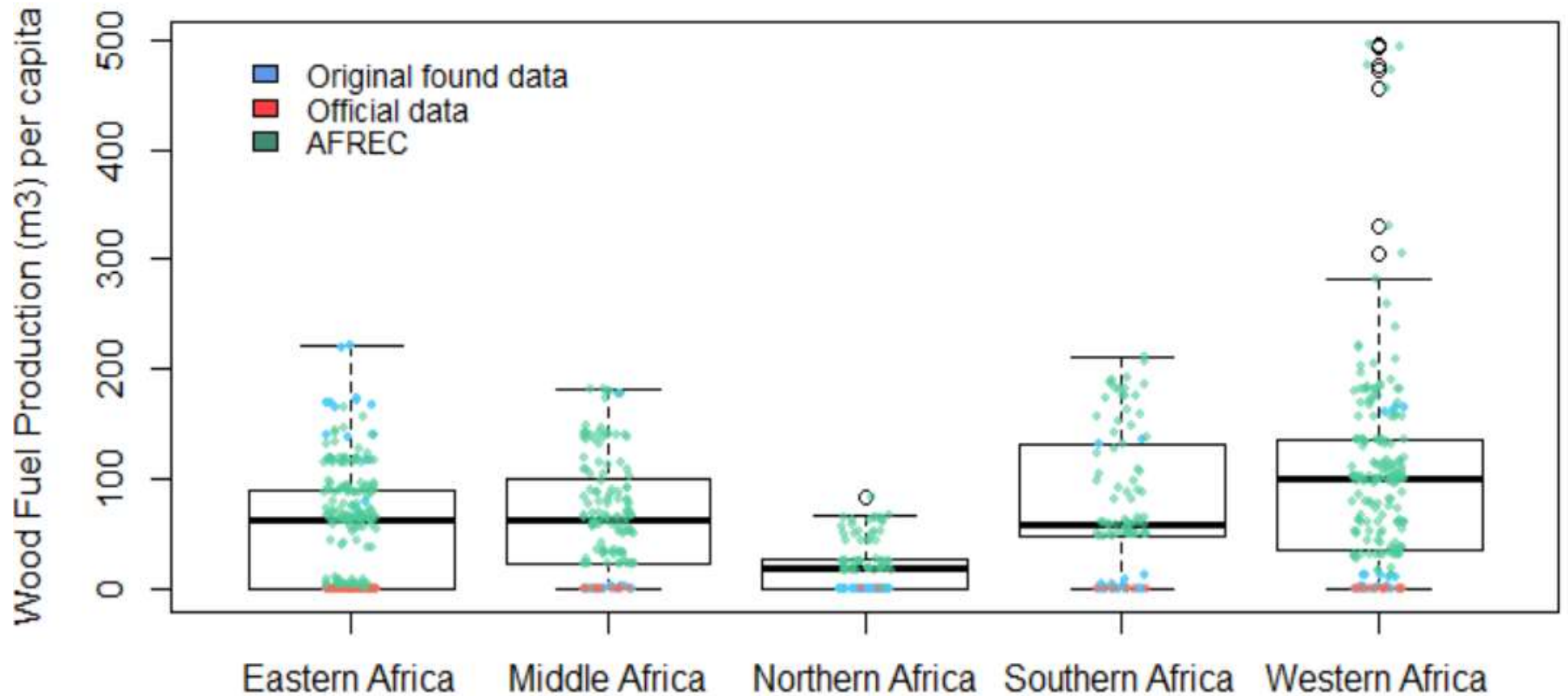
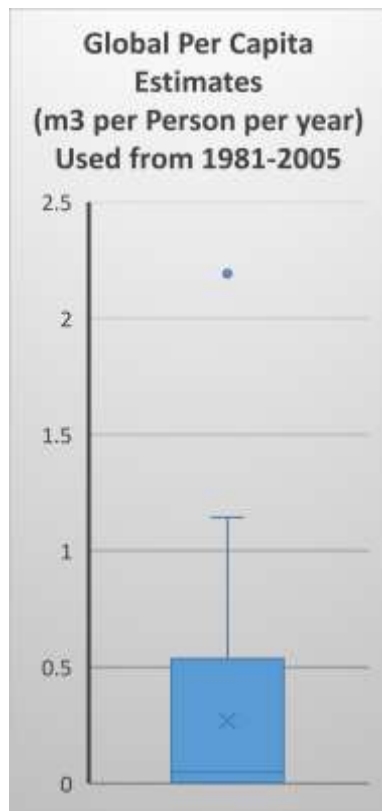
■ IO ■ NO ■ RO ■ T ■ L



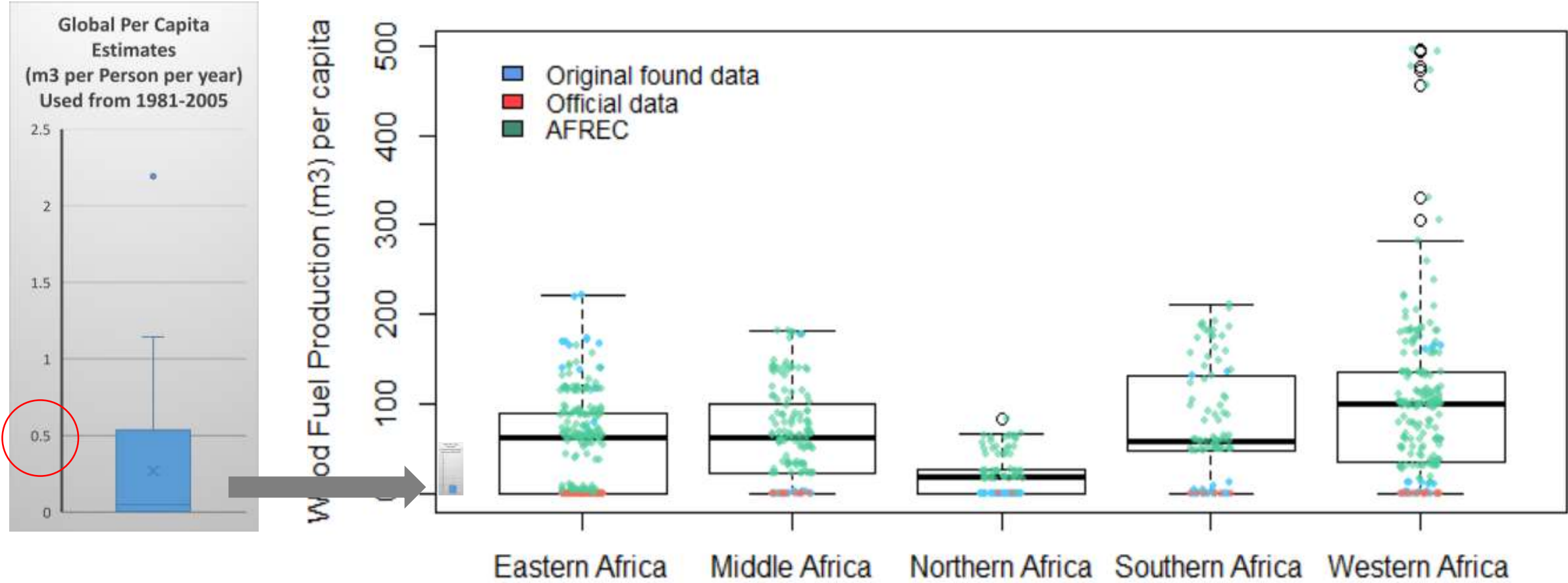




Looking at per capita estimates we see a somewhat different story



Looking at per capita estimates we see a somewhat different story



# Statistical Modelling Plan

MODELED

## 1) Calculate per capita WF demand

$$\boxed{\text{Per Capita Demand / Consumption WF}} = \boxed{\text{Production WF}} + \boxed{\text{Import WF}} - \boxed{\text{Export WF}} / \boxed{\text{Total Population}}$$

## 2) Model per capita WF demand (Random Forest based on conceptual model)

$$\boxed{\text{Per Capita Demand / Consumption WF}} \sim \boxed{\text{Poverty Indicators}} + \boxed{\text{Forest Indicators}} + \boxed{\text{Climate Indicators}} + \boxed{\text{Landform Indicators}} + \boxed{\text{Social Indicators}} + \boxed{\text{Industry Indicators}}$$

## 3) Calculate national charcoal demand (in weight)

$$\boxed{\text{Demand / Consumption C}} = \boxed{\text{Production C}} + \boxed{\text{Import C}} - \boxed{\text{Export C}}$$

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

$$\boxed{\text{Proportion of WF Demand met with Charcoal}} \sim \boxed{\text{Prop of Population Urban}} + \boxed{\text{GDP/Person}} + \boxed{\text{Other wood energy production}}$$

## 5) Convert back to production of WF and charcoal.

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# Questions?

