

23_Botswana

October 8, 2025

1 How has access to clean fuels and technologies for cooking evolved in rural versus urban areas of Botswana between 2000 and 2022?

1.1 Abstract

Using World Bank World Development Indicators (WDI), this study examines the evolution of access to clean cooking fuels and technologies in rural and urban areas of Botswana from 2000 to 2022. Over this twenty-two-year period, access in urban areas remained consistently high—over 50 percentage points higher than rural areas—and increased moderately over time, reflecting steady improvements in urban infrastructure and household energy adoption. In contrast, rural access grew slightly until around 2010, after which it began to decline modestly, highlighting persistent structural and geographic disparities. The divergence between rural and urban trends underscores the challenges of achieving equitable energy access across populations. These patterns emphasize the importance of targeted rural energy policies and investments to ensure sustainable, inclusive progress in household energy transitions.

1.2 1. Question

How has access to clean fuels and technologies for cooking evolved in rural versus urban areas of Botswana between 2000 and 2022?

- **Rural proxy:** Access to clean fuels and technologies for cooking, rural (% of rural population)
- **Urban proxy:** Access to clean fuels and technologies for cooking, urban (% of urban population)

1.3 2. Data

- **Source:** World Bank World Development Indicators (WDI)
- **Indicators:**
 - Access to clean fuels and technologies for cooking, rural (% of rural population)
 - Access to clean fuels and technologies for cooking, urban (% of urban population)
- **Coverage:** Botswana, 2000–2022
- **Notes:** National-level data only

1.4 3. Method

1. Filtered dataset for Botswana.
2. **Selected relevant columns:** Year, Indicator Name, Value.

3. Pivoted rural and urban access indicators into separate columns and sorted by year.
4. Produced a dual-axis line graph comparing rural and urban trends in access to clean cooking fuels.

(Analysis is descriptive; no causal inference applied.)

1.5 4. Results

- **Urban access (% of urban population):** Remained consistently high, over 50 percentage points above rural access, with moderate growth from 2000 to 2022.
- **Rural access (% of rural population):** Increased slightly until 2010, then experienced a modest decline over the remaining period.
- **Comparison:** Urban access consistently outpaced rural access, highlighting a persistent and widening rural–urban gap in clean cooking fuel availability.

(Figure 1. Access to Clean Fuels and Technologies for Cooking, Rural vs Urban, Botswana 2000–2022)

(Table 1. Pivoted dataset)

1.6 5. Interpretation

- Botswana’s experience highlights the persistent divide between rural and urban areas in accessing modern cooking fuels and technologies.
- Urban households benefit from infrastructure, market availability, and higher incomes, while rural households face geographic, economic, and logistical constraints.
- The decline in rural access after 2010 may reflect challenges such as fuel cost, supply chain limitations, or reliance on traditional biomass.
- These patterns underscore the need for targeted rural energy programs, subsidies, and infrastructure improvements to close the gap and ensure equitable access.
- Policymakers should consider integrated energy planning that accounts for both urban expansion and rural sustainability to support national clean energy goals.

1.7 6. Limitations

- Data may not capture informal or self-collected fuel usage in rural areas.
- National-level estimates mask subnational variation and community-specific challenges.
- Descriptive analysis limits causal inference; further studies could explore the impact of policy interventions or economic shocks on rural and urban access.

1.8 7. Next Steps / Extensions

- Investigate district-level access to identify hotspots of rural energy insecurity.
- Examine connections between clean cooking access, health outcomes, and environmental impact.
- Compare Botswana’s rural–urban disparities with neighboring Southern African countries.
- Explore the role of subsidies, energy programs, and market interventions in promoting sustainable adoption of clean fuels in rural areas.

```
[1]: # How has access to clean fuels and technologies for cooking evolved in rural
      ↪versus urban areas of Botswana between 2000 and 2022?

import pandas as pd
import matplotlib.pyplot as plt
import os

# Folders
data_raw_folder = "data_raw/"
data_clean_folder = "data_clean/"
figures_folder = "figures/"

# Load CSV
filename = "environment_bwa_filtered.csv" # Filtered dataset with only
      ↪relevant rows
df = pd.read_csv(os.path.join(data_raw_folder, filename))

# Keep only needed columns
df = df[["Year", "Indicator Name", "Value"]]

# Convert Year and Value to numeric, drop invalid rows
df["Year"] = pd.to_numeric(df["Year"], errors="coerce")
df["Value"] = pd.to_numeric(df["Value"], errors="coerce")
df = df.dropna(subset=["Year", "Value"])

# Pivot indicators into separate columns
df_pivot = df.pivot(index="Year", columns="Indicator Name", values="Value").
      ↪reset_index()
df_pivot = df_pivot.sort_values("Year")

print("Pivoted Batswana dataset:")
display(df_pivot)

# Interpolate missing values for smooth plotting (optional)
df_plot = df_pivot.interpolate(method='linear')

# Plot the two indicators
plt.figure(figsize=(10,6))
plt.plot(df_plot["Year"], df_plot["Access to clean fuels and technologies for
      ↪cooking, rural (% of rural population)"],
         marker='o', linestyle='-', label="Access to clean fuels and
      ↪technologies for cooking, rural (% of rural population)")
plt.plot(df_plot["Year"], df_plot["Access to clean fuels and technologies for
      ↪cooking, urban (% of urban population)"],
         marker='o', linestyle='-', label="Access to clean fuels and
      ↪technologies for cooking, urban (% of urban population)")
```

```

plt.title("Botswana: Rural vs Urban access to clean fuels and technologies for
↳cooking (%) (2000-2020)")
plt.xlabel("Year")
plt.ylabel("Percentage")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.savefig(os.path.join(figures_folder,
↳"botswana_rural_vs_urban_access_to_clean_fuels_and_technologies_for_cooking.
↳png"))
plt.show()

# Save cleaned CSV
df_pivot.to_csv(os.path.join(data_clean_folder,
↳"botswana_rural_vs_urban_access_to_clean_fuels_and_technologies_for_cooking"),
↳index=False)

```

Pivoted Botswana dataset:

Indicator Name	Year	\
0	2000	
1	2001	
2	2002	
3	2003	
4	2004	
5	2005	
6	2006	
7	2007	
8	2008	
9	2009	
10	2010	
11	2011	
12	2012	
13	2013	
14	2014	
15	2015	
16	2016	
17	2017	
18	2018	
19	2019	
20	2020	
21	2021	
22	2022	

Indicator Name	Access to clean fuels and technologies for cooking, rural (% of ↳rural population)	\
0		19.4

1	21.2
2	22.4
3	24.0
4	25.2
5	26.3
6	27.5
7	28.0
8	28.4
9	28.7
10	28.4
11	28.2
12	28.1
13	27.5
14	27.5
15	27.3
16	26.8
17	26.6
18	26.5
19	26.1
20	25.9
21	26.1
22	25.3

Indicator Name Access to clean fuels and technologies for cooking, urban (% of urban population)

0	69.8
1	71.8
2	73.3
3	74.8
4	76.0
5	77.4
6	78.6
7	79.6
8	80.5
9	81.3
10	82.0
11	82.5
12	83.1
13	83.7
14	84.0
15	84.4
16	84.9
17	85.2
18	85.3
19	85.7
20	86.2
21	86.6

