Transport Starter Data Kit: Historical socio-transport data for Botswana

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Abstract

Data on transport activity is an important element for the development of national transport decarbonisation strategies. By having freight and passenger transport information, the impacts on vehicle and fuel consumption changes from replacing internal combustion engine vehicles with electric vehicles can be calculated. The development of a national decarbonisation strategy requires significant efforts. However, access to data is often a barrier to starting transport system modelling in developing countries, thereby causing delays. This article provides data that can be used to support a model for Botswana, which may act as a starting point for further model development and scenario analysis. The data are collected entirely from publicly available and accessible sources, focusing on national reports, statistical yearbooks, and academia.

Keywords

U4RIA

Transport data

Transport modelling

MAED

Botswana

Specifications Table

Subject	Transport
Specific subject area	Transport Data
Type of data	Tables
	Graphs
How data were acquired	Literature survey (databases and reports from international organisations; journal articles)
Data format	Raw and analysed
Parameters for data collection	Data collected based on inputs required to create an energy system model for Botswana
Description of data collection	Data were collected from the websites, annual reports and databases of international organisations, as well as from academic articles and existing modelling databases.
Data source location	Not applicable
Data accessibility	With the article and in a repository. Repository name: Zenodo. Direct URL to data: https://doi.org/10.5281/zenodo.6539124

Value of the Data

- The data can be used to develop national transport demand models to inform national investment outlooks and decarbonisation strategies.
- The data are useful for country analysts, policy makers, and the broader scientific community, as a zero-order starting point for model development.
- This data could be used to examine a range of possible transport pathways, in addition to the examples given in this study, to provide further insights into the evolution of Botswana's transport system.
- The data can be used both for conducting an analysis of transport activity and emissions, but also for capacity building activities.
- The data can be used as a call to action in addressing transport data gaps and establishing parameters for data collection to improve the consistency of transport-climate research in these countries.

1. Data Description

The data provided in this paper can be used to support the development of a transport model for Botswana. The data provided were collected from publicly available sources, including statistical yearbooks, transport ministry reports, statistics from national authorities and affiliated research institutions, academia, and journal articles. Global datasets (primarily from the World Bank) were only consulted if severe data gaps existed. The dataset includes parameters on passenger and freight transport activity, disaggregated by

transport mode (road, rail, aviation, etc.) and geographic scale (inter-city or inner-city), if available. The dataset also covers the size of the vehicle fleet, disaggregated by vehicle types. The data coverage and subtypes vary among the parameters. The overall ambition is to include the most recent available year(s).

Item	Description of Content
Figure 1	A graph showing total population (million people), as well as the share of urban and rural population in Botswana.
Figure 2	A graph showing total GDP (million USD in 2015), as well as the share of the different sectors contributing to GDP in Botswana: agriculture, construction, mining, manufacturing, service, and energy.
Table 1	A table showing passenger transport activity in Botswana for the most recent year data was available. The data are curated from national statistics agencies or other government-affiliated agencies.
Table 2	An additional table showing passenger transport activity in Botswana based on UN DESA Statistics Division data (see explanation below). The data feature information for 2018.
Tables 3 and 4	Tables showing freight transport activity in Botswana for the most recent year data were available.
Table 5	An additional table showing freight transport activity in Botswana based on UN DESA Statistics Division data (see explanation below). The data feature information for 2018.
Table 6	A table showing vehicle fleet data in Botswana for the most recent year data were available.

For the parameters on passenger and freight transport activity, an additional dataset was included in Table 2 and Table 5. The UN DESA Statistics Division modelled passenger activity and freight activity for every country in support of SDG Indicator 9.1.2[1]. Passenger activity data provide information for road, rail, and air transport. Freight data cover road, rail and inland water, and aviation. The passenger-km and tonnes-km data originate from the Open SDG Data Hub. In this dataset, only the data for International Transport Forum (ITF) (representing mostly OECD countries) and UNECE countries (mostly European countries) are based on national reporting. For non-ITF/UNECE countries, the data are estimated using the ITF model, which uses several covariates such as GDP, population, and transport network coverage. A description of the model can be found in the ITF Transport Outlook 2017.

1.1   Population

Population data including total population, population growth, and split by rural or urban was gathered from

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[1] Freight: https://www.sdg.org/datasets/undesa::indicator-9-1-2-freight-volume-by-mode-of-transport-tonne-kilometres/about ;
Passenger: https://www.sdg.org/datasets/undesa::indicator-9-1-2-passenger-volume-passenger-kilometres-by-mode-of-transport/about

The World Bank Open Data platform[2]. Figure 1 displays the total population disaggregated by urban and rural in Botswana.
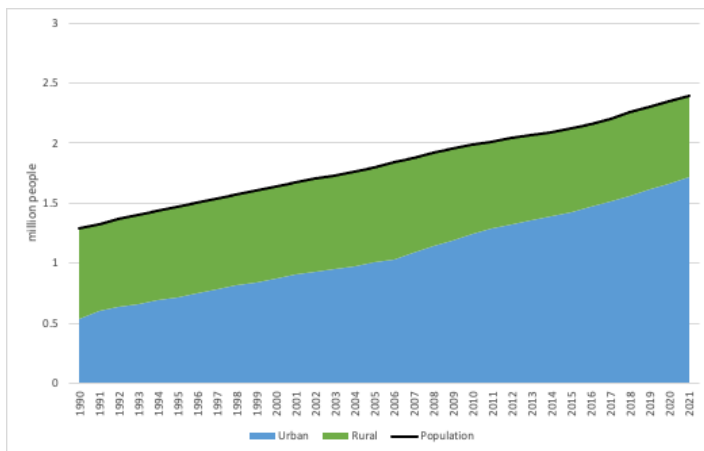

Figure 1: Total population (million people) disaggregated by urban and rural in Botswana

1.2 Gross domestic product (GDP)

GDP data including total GDP, GDP growth, and GDP share by sector (agriculture, manufacturing, service) was collected from The World Bank Open Data platform[2]. Where data was not available, data processing was done. Figure 2 shows the total GDP, as well as the share by sector, in Botswana.
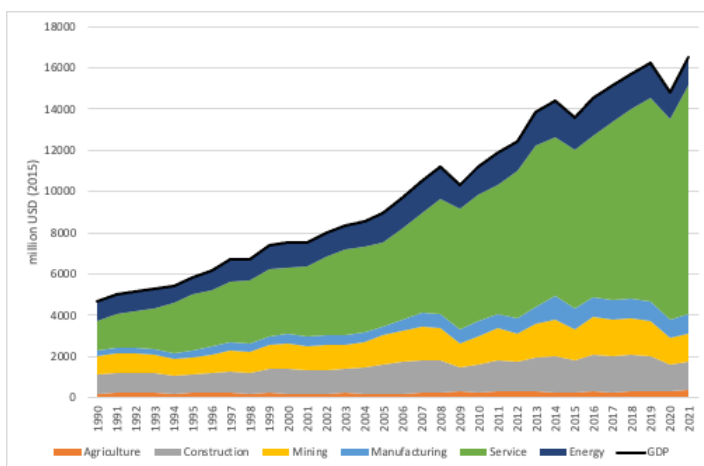

Figure 2: Total GDP (million USD in 2015) disaggregated by share in Botswana

1.3 Passenger transport activity

Botswana faces severe gaps in reporting and availability of data on passenger transport activity. No data is reported through country statistics. Information on passenger transport activity in Botswana is only

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[2] https://data.worldbank.org/

captured through rail transport by the World Bank (Table 1). For rail transport, the latest available passenger activity is 94 million passenger-km in 2006. An overall increase in rail passenger activity has been recorded between 1995 and 2003, then a decrease until 2006.

Table 1: Reported passenger transport activity (million passenger-km) in Botswana

Mode	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Rail	86	95.8	96	94	89	75	106	115	160	94	94	94

Source: World Bank, 2022, Railways, passengers carried (million passenger-km) - Botswana, https://data.worldbank.org/indicator/IS.RRS.PASG.KM?locations=BW

According to the UN DESA modelled data, it is estimated that the total passenger activity in Botswana surpassed 15000 million passenger-km in 2018. Most of the passenger activity is conducted through road transport recording 15166 million passenger-km. This is followed by aviation transport, which recorded much lower at 106 million passengers-km in the same year.

Table 2: Modelled passenger transport activity (million passenger-km) in Botswana

Mode	2018
Aviation	106.022
Rail	25.964039
Road	15166.75919

1.4 Freight transport activity

Information on freight activity for Botswana has been retrieved only for rail and aviation provided by the World Bank (Tables 3 and 4). Rail freight increased between 1995 and 1999 but decreased again until 2007 to similar levels of 1995.

Table 3: Reported rail freight transport activity (million tonnes-km) in Botswana

Mode	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Rail	626	794	795	1111	1282	1037	747	715	893	674	674	674	674

Source: World Bank, 2022, good transported (million ton-km) - Bostwana, https://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6?locations=BW

Between 2010 and 2019, domestic air freight transport saw a spike in activity in 2019 transporting 0.675 million tonnes-km, in comparison to previous years where the recorded activity remained below 0.15 million tonnes-km.

Table 4: Reported air freight transport activity (million tonnes-km) in Botswana

Mode	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019

		0.121	0.121	0.13	0.141				0.146	0.114	0.675
Aviation											

Source: World Bank, 2022, Air transport, freight (million ton-km) - Botswana,
https://data.worldbank.org/indicator/IS.AIR.GOOD.MT.K1?locations=BW&start=1990

However, the availability of data in recent years (within the last decade) face major gaps. For example, no rail freight transport activity data is available after 2007; nor is there available data for aviation freight transport activity between the years of 2013-2016.

According to the UN DESA modelled data, freight activity for 2018 in Botswana recorded nearly 2414 million tonnes-km. Freight transport is mostly achieved through road transport, surpassing 2377 million tonnes-km. This is followed by rail transport at a significantly lower activity of 35 million tonnes-km.

Table 5: Modelled freight transport activity (million tonnes-km) in Botswana

Mode	2018
Aviation	0.113606
Rail	35.822253
Road	2377.856698

1.5 Vehicle fleets

Botswana has a total of 579,789 vehicles, as of 2020. Official records cover information from 2011 to 2020. During this period, the total vehicle fleet grew by 58%. The largest growth was recorded for passenger cars, which grew by 87% during this period. The vehicle fleet data is sourced from Statistics Botswana: a parastatal organisation charged with the responsibility of collecting and disseminating all official statistics for the country.

Table 6: Vehicle fleet numbers in Botswana

Mode	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Passenger cars	197,293	225,604	239,661	253,222	280,563	303,846	328,572	350,757	388,767	369,161
Vans	100,459	102,982	103,036	106,565	108,811	111,129	110,125	110,254	113,013	112,820
Trucks	23,413	24,435	24,991	25,412	26,995	29,207	46,729	32,389	35,681	35,956
Buses	13,875	14,757	15,666	16,616	17,944	19,624	4,541	21,109	22,316	19,953
Motorcycles	1,716	1,752	1,759	1,807	1,915	2,441	1,914	1,815	1,846	2,016
Tractors	5,708	6,020	6,101	6,478	6,812	6,855	7,152	6,766	6,773	6,952
Trailers	18,605	19,421	19,946	19,567	20,775	21,773	23,242	24,305	26,064	26,197
Tankers/ Horses	3,119	3,208	3,085	2,845	2,858	2,805	2,842	3,165	3,602	3,675
Others	2,967	2,694	2,770	3,238	2,991	2,636	2,784	3,088	3,128	3,059
Total	367,155	400,873	417,015	435,750	469,664	500,316	527,901	553,648	601,190	579,789

Source: Statistics Botswana, 2021, Transport and Infrastructure Statistics Report, https://www.statsbots.org.bw/sites/default/files/publications/2020%20Transport%20and%20Infrastrucutre%20Statistics%20Report.pdf

2. Methodology

The focus is on national data for passenger activity (passenger-km), freight activity (tonnes-km) and modes of transport (number of vehicles). The priority is to collect data released by national governments, government-affiliated organisations, or country-specific studies. The research identifies the most recent available data and any data available from 1990 onwards. The priority was for any data after 2010, because transport is a very dynamic growth sector and anything before 2010 adds limited value to understanding the current real-world situation.

Desk research is the main data collection approach for the Transport Starter Data Kits. The desk research examined annual yearbooks, transport statistics, country reporting, and any national statistical portals. Websites of the national government, transport ministries, statistical institutes and other related authorities were examined. Only when severe data gaps exist, global datasets are consulted. In some cases, World Bank data[3] on rail passenger and rail freight is included.

Each Transport Data for Starter Data Kit set contains an additional dataset, which is sourced from the United Nations Department of Economic and Social Affairs (UN DESA) Statistics Division. It is included as a secondary priority because this dataset is the result of a modelling exercise and covers every country. The UN DESA modelled passenger activity and freight activity has the purpose to support the Sustainable Development Goal Indicator 9.1.2[4]. The passenger activity provides information for road, rail, and air transport. Freight data covers the road, rail and inland water, and aviation. The passenger-km and tonnes-km data originate from the Open Sustainable Development Goals (SDG) Data Hub. In the UN DESA dataset, only the data for countries participating in the International Transport Forum (ITF) (representing mostly member countries of the Organisation for Economic Co-operation and Development (OECD)) and the United Nations Economic Commission for Europe (UNECE) (mostly European countries) are based on national reporting. For non-ITF/UNECE countries, data are estimated using the ITF model, which uses several covariates such as gross domestic product, population, and transport network coverage. A description of the model can be found in the ITF Transport Outlook 2017[5]. The UN DESA dataset is included in the Transport Data for Starter Data Kits as additional tables to fill in the incomplete picture that most countries present. The UN DESA modelled data is less accurate and it shall only be regarded as offering the wider picture of transport activity in the country.

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[3] Rail passenger data: World Bank, 2022, Railways, passengers carried (million passenger-km), https://data.worldbank.org/indicator/IS.RRS.PASG.KM; rail freight data: World Bank, 2022, Railways, goods transported (million ton-km), https://data.worldbank.org/indicator/IS.RRS.GOOD.MT.K6
[4] UN DESA, 2021, Indicator 9.1.2: Freight volume by mode of transport (tonne kilometres): https://www.sdg.org/datasets/undesa::indicator-9-1-2-freight-volume-by-mode-of-transport-tonne-kilometres/about ;
UN DESA, 2021, Indicator 9.1.2: Passenger volume (passenger kilometres) by mode of transport: https://www.sdg.org/datasets/undesa::indicator-9-1-2-passenger-volume-passenger-kilometres-by-mode-of-transport/about
[5] ITF, 2017, ITF Transport Outlook 2017, https://www.itf-oecd.org/transport-outlook-2017

The collected data have been shared with a group of relevant SLOCAT partners to validate and explore any additional sources. The SLOCAT partners were selected based on their actions to lead projects in the region and their involvement in data-focused knowledge products or projects. The consultation involved ten anonymous organisations.

Desk research is an approach that limits the research to material available on the internet, accessible through search engines and linked to government and statistical institutes' websites. However, this does not pose a major limitation to obtaining data. Nearly every country has functional websites for statistics and transport authorities. In a few cases, websites are not well maintained, resulting in missing or broken hyperlinks to reports. By using services that provide access to archived websites, some of these broken pages can be retrieved. The collected information has been shared with partners and no additional information has been received.

While over 1,500 languages are spoken across Sub-Saharan Africa, government datasets are generally published in a smaller subset of languages including English, French, Portuguese and others. Nonetheless, language is not a barrier to navigating through the material and identifying the relevant parameters. The involved team members can navigate through reports in such languages. If needed, automatic translation tools were used.

Due to missing values in the country's historical GDP data, extrapolation between available years was done by the authors to address this. The World Bank's data platform provided GDP share by sector for agriculture, manufacturing, and services. However, GDP share by construction, mining, and energy was also needed to align the data structure with the MAED tool. To address the lack of data available for these sectors, the authors assumed that construction, mining, manufacturing, and energy all fall within the industry sector. Thus, to obtain data for the three remaining sectors, the remaining percentage after considering agriculture, manufacturing, and services from The World Bank's data platform, was divided by three. It is therefore assumed that the GDP share of the construction, mining, and energy sectors are the same.

3. Ethics Statement

Not applicable.

4 CRediT Author Statement

Naomi Tan: Investigation, Conceptualisation, Methodology; Data Collection; Visualization, Writing and Editing; **Robert Ambunda:** Data Collection; Investigation; Writing and Editing; **Nikola Medimorec:** Conceptualisation; Methodology; Data Collection; Investigation; Writing, Review & Editing; Supervision; **Angel Cortez:** Data Collection; **Agustina Krapp:** Data Collection; **Erin Maxwell:** Data Collection; **John Harrison:** Supervision; **Mark Howells:** Supervision

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Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.