ANALYSIS OF THE EFFECTS OF GEOGRAPHICAL, METHODOLOGICAL AND GENDER DATA GAPS ON THE RESPONSE AND RECOVERY OF TRANSPORT SYSTEMS IN SUB-SAHARAN AFRICA FROM GLOBAL SHOCKS

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ABSTRACT

The lack of high-quality transport data in Africa affects the ability to effectively respond to global externalities and therefore undermines the ability to create sustainable, just, and equitable transportation systems. The data gaps observed are characterised into gaps in the geographical or spatial coverage, gaps in the methodological design of data collection, and gender data gaps. It was found that although some data gaps are a result of lack of financial capacity to set up world-class data collection and monitoring systems, some gaps are a result of poor or inadequate research design, and lack of data sharing among stakeholders which may lead to wastage of resources in undertaking duplicate studies by different stakeholders. The study recommends institutional coordination amongst data owners to enable optimum utilisation of the financial resources available for data collection and intentionality in inclusive data collection to support the development transport systems for all. The study also recommends that transport planning adopts a multidisciplinary approach towards research and survey design including the fields of psychology, data science, and human geography to develop holistic data collection and analysis systems.

1. INTRODUCTION

The world as is known is undergoing manifold interconnected challenges; including but not limited to political unrest, gender discrimination and inequality, economic recession, public health crises, climate change and global warming, and the related extreme natural disasters such as floods, extreme drought, and earthquakes. The relevance of the discussion on the knock-on effects of these global phenomena, also known as global externalities, on African countries has been made more critical by the recent exponential advancement in technology and trade.

Externalities, also known as uncompensated interdependences (Cornes & Sandler, 1996), refer to the indirect effects of the consumption, production, and investment decisions of an entity on another entity which is not directly involved in the transaction (Helbling, 2010). Global or cross-border externalities occur when the actions of one country have consequences for another, unmediated by the classic competitive markets (Kanbur, 2003).

The global landscape is dynamic in nature. In addition to discrete events such as wars and pandemics, it is characterised by continuous population growth, urbanisation, globalisation, and global supply chains, which affect the capacity and demand for mobility and therefore necessitate planning transportation systems for resilience; both in adaptation to climate change, and other global shocks. As most recently illustrated by the Covid-19

pandemic, the economic, financial, and operational models of transportation systems worldwide are fragile and vulnerable to systemic shocks. Although this is true even for the most advanced systems, there is evidence that the negative effects of global phenomena like the Covid-19 pandemic or climate change are disproportionately experienced by different population groups.

However, planning sustainable and resilient transport and mobility systems is a complex endeavour. It is a multifaceted, public-private pursuit which is affected directly or indirectly by many social and economic factors. The complexity of transport planning is further increased by a myriad of public and private stakeholders with vested interests, which sometimes undermines the public ethos of the service and makes transformation of the sector much slower than desired.

The ambition of the transportation planning process to balance economic, social, and environmental sustainability goals also adds a facet of complexity to the process and therefore extra effort must be made to be inclusive. This includes but is not limited to issues of affordability of transport, access and accessibility, environmental impact, among other factors.

2. PROBLEM STATEMENT

The importance of high-quality data collection and analysis tools for short and long-term planning cannot be overstated. This is true for both the top-down and bottom-up planning approaches. The top-down planning paradigm is a system where technical experts and decision makers hold a lot of power and it is generally characterised by centralism and de-politicised decision making. On the other hand the bottom-up planning approach is characterised by more public participation in decision-making, accountability on the part of local politicians and decision makers, and increase in the criticism of technical expertise (Murray et al., 2009; Pissourios, 2014; Badiora, 2020).

In the top-down planning paradigm the virtuous circle of implementing resilient transportation systems starts with policy and legislation, with an emphasis on inclusive frameworks and targets for the whole community, including the historically marginalised groups of the population. However, inclusive policies and plans are underpinned by the availability of standardised, open, transparent, reliable, and most importantly inclusive data at the service of policy and decision makers. On the other hand, effective public participation in the bottom-up approach is also heavily reliant on the ability to collect reliable, representative data, and to make deliberate efforts communicate the outcomes from the populace to policy makers effectively. Either way, good data and research practice is key to solving, mitigating, or adapting to some of the most complex challenges.

By virtue of the fact that externalities arise when the actions of one economic agent directly affect another economic agent, it may be possible to anticipate some events and their negative effects through analysis of historic data and projections for the future, as is commonly done in engineering practice. This is however limited to the scope of data that is readily available and used during planning processes.

Despite the known importance of data, there are still large deficiencies in the availability of data in Africa which inevitably affects the ability to respond to different challenges effectively. It is said that the world is producing data at a much faster rate than can possibly be fully utilised. However, it can be argued that a vast majority of the big datasets referred to in this expression are biased by geographical location, socioeconomic status,

or gender and therefore incomplete for transport planning where inclusiveness and equity are a priority.

The main objective of this essay is to analyse the nature of data gaps in Sub-Saharan Africa (SSA), and the potential effects of lack of high-quality transport data and information from incomplete data on achieving resilient, equitable, and sustainable mobility solutions.

3. DESKTOP ANALYSIS

The analysis of the extent of data availability and coverage in Sub-Saharan Africa was done through a desktop analysis of the open transport-related datasets, and the negative effects of lack of data or the use of biased data. The different forms of data inequity observed can be categorised into geographical/spatial data gaps, gender data gaps, and methodological data gaps as described in the sections below.

3.1 Geographical Data Gaps

According to the United Nations Economic and Social Council (2009), Africa is stricken by the lack of well-developed transport information systems where transport data, at best, is limited, unstandardised, and poorly organised, or completely non-existent. The region has also not yet fully harnessed the technology advancement in high-performance computing which enables rapid data processing, storing, retrieving and transfer. This challenge has mostly been attributed to lack of financial capacity to set up high-quality monitoring systems (Chason & Ombuor, 2021; Kinyondo & Pelizzo, 2018). Outside transportation systems, the lack of data is also apparent in other sectors such as meteorology where Africa has only 12.5% of the recommended density of weather stations by World Meteorological Organisation (Chason & Ombuor, 2021), which leads to inaccurate weather forecasts, and more significantly, lack of early warning systems for extreme weather events such as the recent flooding events in Sierra Leone, KwaZulu-Natal in South Africa, and Eastern Democratic Republic of Congo (DRC) which result in loss of lives and infrastructure.

This glaring lack of data limits transportation engineers' ability to adequately design systems that are more resilient to natural disasters through the 'hard' or technical approaches such as load estimation, drainage design, material design, but also the 'soft' approaches of effective information dissemination to communities to enable them to work together, prepare, and respond to such events accordingly.

Recently, there have been efforts to set up monitoring systems to fill some of the transport data gaps on the continent. One such initiative is the Digital Transport for Africa (DT4A) initiative launched by the World Resources Institute (WRI) Ross Center for Cities to promote open-source, standardised, and ethical data on urban transport. The objective of this initiative is to support and improve access to public transport in cities Africa by mapping their public transport routes. The coverage of the database includes Maputo, Harare, Lubumbashi, Nairobi, Kigali, Kampala, Cairo, Freetown among others (DigitalTransport4Africa, 2023).

The Transport Data Commons Initiative hosted by the United Nations Economic Commission for Europe (UNECE) and other global stakeholders is also underway and is aimed at curating data for stakeholders in sustainable low carbon transport, with a focus on countries with poor data systems. The currently defined data needs of the initiative

include vehicle stock, fuel carbon intensity, and passenger activity including passenger distance, vehicle distance, modes, mode share, and vehicle type.

Other global efforts which include data from African countries include the Global Database of Greenhouse Gas Emissions by Climate TRACE, the Transportation Energy Data Book by the U.S. Department of Energy which tracks data such as vehicle trends and efficiency indicators, the Global Electric Vehicle Outlook by the International Energy Agency (IEA), the Renewables in Transport Global Status Report by REN21, among others. However, many such global databases are based on secondary resources and are therefore still highly limited by the lack of primary national data monitoring efforts and databases.

3.2 Methodological Data Gaps

The focus of the data initiatives described in the previous section is largely quantitative data, possibly because qualitative data has the additional complexity of cultural and social nuances which vary between individuals, regions, and countries and therefore make a national database, much less a global monitoring system, a complex undertaking.

This is however not a new challenge, quantitative data has historically been more predominant in transport planning because models have largely been aimed at minimising the dimensions of reality to reduce complexity (Książkiewicz, 2012). However according to McCray and Brais (2007), transport planning focused on quantifying and forecasting demand and capacity, with limited emphasis on the “why of demand”, unsatisfied demand, or the constraints to desired trips perpetuates social exclusion, which ultimately works against the target for just and equitable transportation systems. The richer combination of qualitative and quantitative data will enlighten policy makers on a broader list of factors which affect people’s mobility choices or lack thereof. The negative effects of limited data insights in South Africa are demonstrated in a policy and practice evaluation by Jennings et al. (2017) to assess the inadequacy of bicycle lanes in increasing the mode share of cycling in Cape Town for the past 10 years. This study identified the lack of evidence to direct the effective allocation of resources by the city authorities, and inadequate attention to the softer, social science approaches such as behavioural change programmes, as critical shortfalls of the infrastructure approaches which have previously been prioritised.

The recommended innovative, multidisciplinary approaches of collecting qualitative data in transport research are heavily reliant on the traditional methods of using questionnaires, focus group discussions and key informant interviews (Książkiewicz, 2012; Shay et al., 2016). These are supported by other tools such as self-mapping of individual space, in combination with Geographic Information Systems (GIS) to visually represent individuals’ accessibility and understand how people carry out their personal spatial-temporal design or the space-time constraints of different social classes (McCray & Brais, 2007).

3.3 Gender Data Gaps

The gender data gap is introduced and/or perpetuated by the limited qualitative data described in the previous section as women traditionally experience more space-time constraints than men (Kwan, 2000). In addition to the differences in the traditional gender roles and travel patterns, there are significant differences in the physical nature of men and women which heighten the risks associated with research outputs from male-biased data. The negative effects of such bias can range from inconvenience to more significant health and safety or injury risks while interacting with different elements of a transportation system (Madeira-Revell et al., 2021).

The sustainable mobility and gender assessment for South Africa notes that although the challenges of transport-related poverty, inequity and social exclusion affect all South Africans, the effects are more significant for women as they reinforce already existing gender inequity and hinder women's development. The study recommends collection of gender-disaggregated data, based on gender-specific indicators and provision of easier accessibility to the data collected by different institutions such as transport service providers, academic institutions, and provincial or city authorities (Sustainable Mobility for All, 2022).

One of the negative impacts of gender insensitive data is seen from an analysis of bike sharing programs in the United States where only 25% of users are women and the gender cycling gap was attributed to, among other reasons, "data needs and bias" (Hosford & Winters, 2019) for example difficulty to identify trip chains (which are typical to women) in travel diaries which treat each component of a trip chain as a separate trip (Schoner et al., 2014). Such relatively simple impacts can have more detrimental and longer-term negative effects such as women being left behind in the transformation to zero-emission travel.

According to Madeira-Revell et al. (2021), conducting more gender-sensitive research, and closing this data gap requires, at the very least, more intentional and better research practice because even with gender-balance data, women are not a homogeneous group and therefore one solution rarely addresses all their challenges (Lailvaux et al., 2022).

4. CONCLUSION

The three broad categories of data gaps described in this essay constitute a fundamental limitation of development in many sectors. The findings of this desktop study indicate that the alternative, data insights, and information from up-to-date and inclusive datasets, can be used to support evidence-based policy making, improve the quality of long-term planning through more holistic forecasting approaches, and incentivise private and public investment as a driver for economic growth either by attracting new investment or avoiding wastage of limited resources on partially researched or non-priority projects.

In conclusion, there is need for more concerted efforts to invest in collection of robust, reliable, and all-inclusive data for gender mainstreaming and radical climate action, to underpin truly resilient transport and mobility systems.

Transport planners, economists, engineers, and all stakeholders in pursuit of sustainable, equitable, and efficient transportation systems should prioritise national and regional level high-quality and open databases and improve the ability to harness the advances in high-performance computing and data mining to identify patterns and implicit relationships. This initiative can start as simply a collation of the myriad of project level datasets owned by many different stakeholders and possibly covering smaller geographical areas.

It is also recommended that transportation research adopts, within the boundaries of research ethics, innovative data collection and analysis methods from other disciplines of study such as human geography, psychology, and data science. An example of a low-cost data collection technique that can be harnessed is web scraping, adopted from the field of data science. This can be more specific, such as Twitter scraping to obtain some insights and qualitative data of people's opinions on specific transport related interventions and topics.

REFERENCES

Badiora, AI. 2020. Stakeholders' perspectives of public participation in landuse policy: The Nigeria experience. *Public Administration and Policy,* 23:315-326.

Chason, R & Ombuor, R. 2021. *A lack of weather data in Africa is thwarting critical climate research.* The Washington Post. Available at: https://www.washingtonpost.com/world/2021/09/24/africa-climate-weather-data/. Accessed 5 May 2023.

Cornes, R & Sandler, T. 1996. *The theory of externalities, public goods, and club goods*, Cambridge University Press.

Digitaltransport4africa. 2023. *An Open Resource Center for Mapping Public Transit across Africa*. Available at: https://digitaltransport4africa.org/. Accessed 5 May 2023.

Helbling, T. 2010. What are externalities? *Finance & Development,* 47:198.

Hosford, K & Winters, M. 2019. Quantifying the Bicycle Share Gender Gap. *Findings*, 10802.

Jennings, G, Petzer, B & Goldman, E. 2017. When bicycle lanes are not enough: growing mode share in Cape Town, South Africa: an analysis of policy and practice. *Non-motorized transport integration into urban transport planning in Africa.* Routledge.

Kanbur, R. 2003. Cross-Border Externalities and International Public Goods. *Global tensions: Challenges and opportunities in the world economy***,** 54.

Kinyondo, A & Pelizzo, R. 2018. Poor quality of data in Africa: What are the issues? *Politics & Policy,* 46:851-877.

Książkiewicz, S. 2012. Quantitative or qualitative transport planning? An interdisciplinary geographic perspective. *Prace Geograficzne*, 131-139.

Kwan, MP. 2000. Gender differences in space-time constraints. *Area,* 32:145-156.

Lailvaux, C, Ribet, L & Lunt, T. 2022. Decoding women's transport experiences: A study of Nairobi, Lagos and Gauteng.

Madeira-Revell, KM, Parnell, KJ, Richardson, J, Pope, KA, Fay, DT, Merriman, SE & Plant, KL. 2021. How can we close the gender data gap in Transportation Research? *Ergonomics SA: Journal of the Ergonomics Society of South Africa,* 32:19-26.

Mccray, T & Brais, N. 2007. Exploring the Role of Transportation in Fostering Social Exclusion: The Use of GIS to Support Qualitative Data. *Networks and Spatial Economics,* 7:397-412.

Murray, M, Greer, J, Houston, D, Mckay, S & Murtagh, B. 2009. Bridging top down and bottom up: Modelling community preferences for a dispersed rural settlement pattern. *European Planning Studies,* 17:441-462.

Pissourios, I. 2014. Top-down and bottom-up urban and regional planning: Towards a framework for the use of planning standards. *European Spatial Research and Policy,* 21:83-99.

Schoner, J, Lindsey, G & Levinson, DM. 2014. Factors associated with the gender gap in bicycling over time.

Shay, E, Combs, TS, Findley, D, Kolosna, C, Madeley, M & Salvesen, D. 2016. Identifying transportation disadvantage: Mixed-methods analysis combining GIS mapping with qualitative data. *Transport Policy,* 48:129-138.

Sustainable Mobility for All. 2022. Sustainable Mobility in South Africa: Gender and Mobility Assessment and Roadmap for Action. Washington DC.

United Nations Economic and Social Council. 2009. Africa Review Report on Transport: A Summary. Addis Ababa, Ethiopia: Economic Commission for Africa.