

## The Final Frontier - Meeting the Challenges of Linear Infrastructure in Africa

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The environmental and infrastructure sectors in Africa are at the early stages of adopting a meaningful collaborative agenda for developing ecologically sustainable linear infrastructure. There are efforts, lessons and knowledge emerging from various parts of the continent which highlight a pressing need to move this agenda forward. African countries have a very limited timeline to ensure ecological sustainability in the face of rapid and expansive linear development across the continent. It is imperative that this sustainability planning be implemented prior to the initiation of any prospective development planning.



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### THE NEED FOR LINEAR INFRASTRUCTURE

African economies are currently among the world's fastest growing, with linear infrastructure, which refers to a man-made structure such as roads and highways, electric power lines, railway lines, canals, pipelines, and fences, all strongly related to socio-economic drivers. These linear linkages are integral components of human society, allowing for the safe and efficient transport of people, goods, and commodities, and are intended to meet immediate and long-term needs. There are few places on earth that are not currently traversed or impacted by the vast networks of linear infrastructure that are essential for society functioning.

In many ways, Africa represents the final frontier for infrastructure development. Africa's linear infrastructure systems all serve to link cities, developments, and resources, as well as energy and water supplies. Its population has doubled in the last three decades and currently stands at 1.3 billion. Most experts agree that if it continues at its current rate, Africa's population will double again by 2050. This means that about two-thirds of the world's population growth is expected to take place on the continent, and by 2050, Africa will be home to more than a quarter of

the world's people. In the forthcoming decades, as African populations and economies grow, substantial investments in linear infrastructure are imperative to meet the escalating requirements of emerging African economies.

### IMPACTS OF LINEAR INFRASTRUCTURE

The demand for linear infrastructure has increased globally, while associated biodiversity loss accelerates; this creates conflict between economic development and nature conservation and has been given the status of a "global infrastructure tsunami". By crisscrossing landscapes, linear infrastructure fragments ecosystems (illustration 1), isolates populations, and reduces natural flows. Roads and railways also pose direct threats to species from collisions (illustration 2), and indirect threats by increasing access by people to previously untapped resources in formerly wilderness areas [1], linked with this, they may facilitate pathways of invasion for alien flora and fauna, with significant ecological consequences. The challenge of addressing the threats to biodiversity from linear infrastructure is not isolated to the African continent but is a global challenge; however, the threats are particularly acute in Africa [2].



Illustration 1 - Elephant crossing a railway line in the Balule Nature Reserve, South Africa  
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The African continent holds over a quarter of the world's biodiversity,

with eight biodiversity hotspots, and the most significant assemblages of megafauna remaining on earth. Its diverse ecosystems contribute both to planetary health and provide the goods and services upon which 62% of Africa's population depends directly for basic social, cultural, and economic well-being.

## INFORMING SUSTAINABLE DEVELOPMENT

Governments have committed to global targets to slow biodiversity loss and sustain ecosystem services and while human infrastructure systems expand in Africa [2], there has been an emphasis on ensuring that development is more sustainable (usually defined as having impacts mitigated sufficiently to allow natural systems to persist for future generations. In light of the massive societal transformations needed to mitigate and adapt to climate change, contemporary infrastructure conversations frequently focus on sustainable development and green infrastructure [3]. The international community has formulated policy focused on sustainable infrastructure through 17 Sustainable Development Goals (SDGs), with SDG9 («Industry, Innovation and Infrastructure») being especially relevant to sustainable linear infrastructure development. The 17 Goals are interconnected, apply to all countries, and need to be carried out by all stakeholders in a collaborative partnership. However, Siddig [4] argues that “ongoing conflicts and political instability in many biodiversity-rich African countries, absence of regular and policy-driven monitoring programs, lack of capacity, and irregular or insufficient funding”, are all reasons why African biodiversity is falling short of the SDGs. Ensuring that linear infrastructure development is sustainable and safe for both humans and biodiversity is a challenge, requiring urgent action at multiple scales by a wide range of public and private sector stakeholders.

There are proposals to radically extend and expand the existing extensive



Illustration 2 - Gathering roadkill data on a road in The Greater Mapungubwe Transfrontier Conservation Area, South Africa

infrastructure networks in Africa [2]. The Belt and Road Initiative (BRI) is perhaps the largest infrastructure development project in history [5] and has purported aspirations to contribute to the SDGs and boost bilateral and multilateral trade and foreign direct investment projects. The application of such actions to ensure sustainability across international parts of the BRI, have not been evident. For example, although the Nairobi-Mombasa railway has wildlife underpasses to enable animal migration, the choice of route is far from the best from an ecological perspective [6]. Implementation of environmental standards is often superficial and does not make the best use of available data to avoid and minimise environmental damage. Thus, although the data and information exist to enable sustainable choices, in practice normally only country-level restrictions are applied, often favouring the best economic rather than environmental outcome [7]. This is very often the same issue for other linear infrastructure.





## IMAGINING THE FUTURE

In Africa, there is an opportunity to build on lessons from elsewhere in the globe – to find the sweet spot between economic growth and ecological resilience before irreversible damage is done [8, 9]. There is a pathway to ensure that development contributes to greater environmental and societal sustainability, and it builds on five key elements.

First, primary knowledge generation is necessary to understand the impacts of linear infrastructure development and how these vary across landscapes and ecosystems. What are the key gaps preventing us from making informed decisions? [1]. This information needs to encompass more than simply the monitoring of biodiversity impacts, but crucially to inform the business case for sustainable infrastructure development [10, 11]. Second, integrated policy and planning are essential to bringing the latest knowledge and science into long-term decision-making about infrastructure design and routing [12]. This will inform how we optimise land-use choices to support economic growth and human development while ensuring that irreplaceable biodiversity is protected, and essential ecosystem services are upheld. Third, responsible finance and investment provide powerful levers to ensure good governance and the development and implementation of robust and sustainable plans [13]. Fourth, we need efficient and effective implementation of strategies and solutions to mitigate the impacts of linear infrastructure [1]. There is a need to rigorously test the effectiveness of our mitigation strategies, so that they may be continuously fine-tuned [14, 15]. How can we devise more agile systems that can adapt to a changing world? How do we design feedback loops within infrastructure projects that are inherently long-term? The answers to these questions are especially important in the face of climate change.

And finally, the cross-cutting element of capacity building is crucial to ensure that the four core elements are undertaken effectively and optimally. What governance structures will equip policymakers to make better, more robust, and transparent decisions? How do we set up platforms for knowledge exchange and learning among the African community of practice?

## CONCLUSION

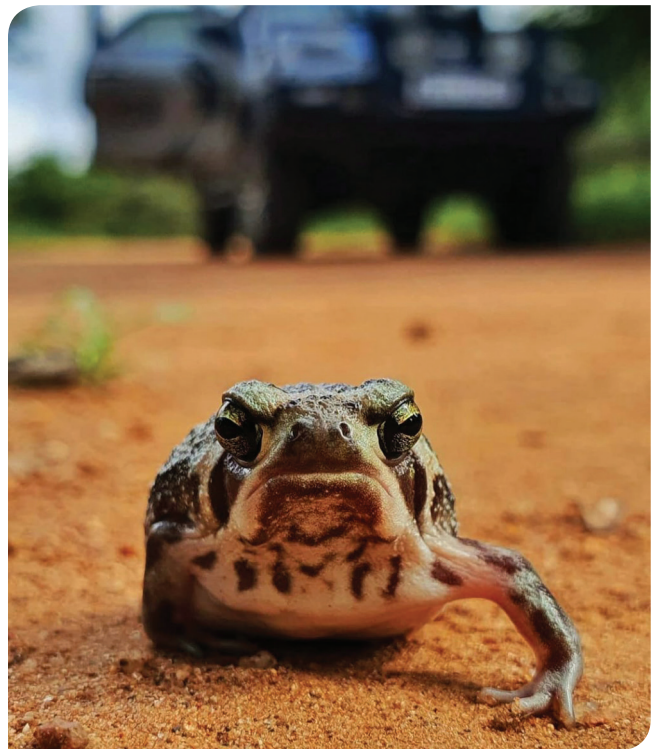
The challenges of addressing the environmental threats as a result of linear infrastructure in Africa are broad, and there is a need to develop and compare analytical and planning policy approaches across borders. It is apparent that several countries in the world are working in parallel and undertaking the same processes (i.e., evaluating the ecological impacts; developing, implementing, and evaluating mitigation



*Illustration 3 - Nairobi National Park, located six miles from the city centre. Image shows the railway and city in the background*



approaches; and adopting changes into policy). This has not always been the case for the African continent, and we propose a more collaborative approach, where international forums across the continent provide discussion and debate. One such forum, the African Conference on Linear Infrastructure and Ecology (ACLIE, <https://aclie.org>), intends to foster and build on African cross-sectoral engagement and the exchange of solutions, promote a safe and ecologically sustainable pan-African transport infrastructure, and provide networking opportunities that facilitate communication and exchange of knowledge, ideas, and news.#



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