



**Collaboration
for Active
Mobility in
Africa CAMA
FINAL REPORT**



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Hochschule Karlsruhe
University of
Applied Sciences



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University of Applied Sciences Karlsruhe

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Makerere University

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Abstract

The project Collaboration for Active Mobility in Africa (CAMA) investigated walking and cycling as key components of everyday mobility in rapidly growing cities in Sub-Saharan Africa. The project aimed to generate user-centred knowledge on mobility behaviour, safety perceptions and infrastructural barriers, and to translate this knowledge into context-sensitive and practice-oriented solutions through participatory processes.

CAMA combined quantitative and qualitative research methods, including surveys, digital crowd mapping, video-based traffic and conflict analysis, and transdisciplinary formats such as Learning Alliances and Living Labs. Empirical work was carried out in the cities of Kampala (Uganda), Nairobi (Kenya) and Mekelle (Ethiopia) in close collaboration with local universities, city administrations, civil society organisations and other stakeholders.

The results show that walking is the dominant mode of transport in all three cities, while cycling has significant but largely underutilised potential. Safety concerns, inadequate infrastructure, conflicts with motorised traffic and institutional constraints were identified as major barriers to active mobility. Through Living Labs and alternative implementation formats, the project tested both physical and non-physical interventions, demonstrating that flexible, participatory and locally adapted approaches are essential for successful implementation.

By integrating research, practice and capacity building, CAMA provides transferable methods, empirical insights and lessons learned for promoting active mobility in cities with limited data availability and complex governance contexts. The project contributes to ongoing international debates on sustainable urban mobility, road safety and inclusive city development.



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1. Promotion of active mobility in Sub-Saharan Africa

The report is based on the experiences from the Project Collaboration for Active Mobility in Africa (CAMA) funded by the BMBF and DAAD, including 3 living labs from low and middle-income countries i.e. Kampala in Uganda, Nairobi, Kenya and Mekelle, Ethiopia. The project is being implemented in the period 2021 to 2025 in joint partnership with the Karlsruhe University of Applied Sciences, Makerere University, University of Nairobi, Mekelle University and University of Kassel Karlsruhe and other practical partners to promote sustainable active mobility.

1.1 Initial situation Promotion of active mobility in Sub-Saharan Africa

Due to rapid urbanization and changes in lifestyle, there is high pressure on the transportation systems of many cities in sub-Saharan Africa. Active mobility by walking and cycling has personal (good local accessibility, low costs) as well as social (emission-free, efficient, space-saving) and health (effect on rising non-communicable diseases, psychological stimuli) advantages and is therefore essential for sustainable mobility.

Active mobility will significantly reduce the greenhouse gases in cities and hence essential to achieve the climate goals. Transitioning to active mobility helps to boost health among different socio-economic groups. In the context of local supply, walking and cycling play a vital role in achieving financial savings by the population that could be used to increase access to food and other goods for daily needs. Walking and cycling also contributes to food security and the ability of especially women to access markets. In addition, walking and cycling is accessible for all social groups regardless of their social status, thus contributing to socially just mobility. It is anticipated that an increase in active mobility in everyday life will help sustain personal savings that would be spent on distances that are walkable/cyclable. Social and gender perspectives regarding cycling persist with cycling being perceived as an option for the poor and mainly for men and children. Active mobility users in cities like Kampala, Nairobi or Mekelle are not just pedestrians and cyclists as is the case in Europe. There are pedestrians and cyclists who carry wide loads or push handcarts and hence do not match the provided walkway and lane width. Additionally, some streets are not just streets for access; they are a source of livelihood, as there are several vending activities. This is at the same time an inconvenience to pedestrians and cyclists, and yet they are most likely the targeted customers by street vendors. Hence the efforts to achieve the SDGs requires a transformation in the transport sector towards active mobility.

The huge importance is illustrated by the fact that in most cities in Africa walking is the main mode. In Mekelle 62%, Kampala more than 60% and Nairobi 40% of daily trips are made on foot (Nairobi City County, 2014; MCCDPPP, 2011). However, infrastructure planning in cities has largely failed to address this user group.

Walking and cycling as active mobility have often been forgotten in research and planning in sub-Saharan Africa and only in recent years national and local authorities as well as international agencies are putting more effort on this topic. In recent years, cycling and walking as transport forms in low- and middle-income countries, have been increasingly investigated. There is still a lack of comparable data on the subject. This project can be used as a starting point to counteract this lack and to draw implications for improving the traffic situation for these road users.



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Local authorities in low- and middle-income countries as well as international agencies are putting more effort on the promotion of walking and cycling. Recommendations e.g. “Towards Sustainable Transport in Sub-Sahara Africa” (Share the Road Initiative und TEST Newtwork 2013) and “Design Guidelines for Non-Motorised Transport in Africa” (UNEP Transport Unit), have been published. In many sub-Saharan Africa countries like Kenya, Uganda or Ethiopia, national policies for walking and cycling exist (UNEP) and new road infrastructure are required to build cycling and walking lanes, but these are often not clearly marked and citizens are not adequately educated about their importance. In Kenya, the construction of roads and highways has been prioritized over non-motorized and mass transportation (Hagans, 2013; Klopp, 2012; Porter, 2016). Uganda, for instance, was supported by UNEP to develop a non-motorized transport policy, which was approved by the government (UNEP). A pilot project was initiated in Kampala’s busiest zone and its implementation is ongoing. Pedestrians and cyclists have been prioritized and allocated adequate space. In the capital city Nairobi, there have been efforts to promote walking by widening of streets and closing some from vehicle use (Omulo, 2020). These improvements have however largely concentrated within the cities and such provisions are lacking or not provided in residential areas where city residents commence their journeys, hence a disconnect. To create awareness on the need to promote cycling, annual place-making weeks organised jointly by UN Habitat, cyclists groups have been held since 2015 in partnership with the city authorities (Urban Pathways, 2018). There is also a newly published Ethiopian National NMT strategy in 2019. The strategy aims to increase the modal share of walking, cycling, and public transport, reduction in the use of personal motor vehicles (PMV), improved road safety and improved air quality (ITDP,2019).

Infrastructure walking and cycling in cities like Nairobi and Kampala or Mekelle are minimal in scope, have design inadequacies that make them unusable or unattractive, are not wide enough to meet walking space standards, and are in places that do not serve most of the people who need to access them. Mitullah & Opiyo (2017) note that despite existence of guidelines on integrated national transport policy, Non-Motorised Transport is not yet entrenched in overall planning and infrastructure development of cities. Instead, it is provided along motorised routes, depending on space available and most of the time without considering principles of directness, coherence, safety, comfort and attractiveness. At the same time, there is often encroachment of cycling and walking areas by traders and motorcycle users thus rendering the spaces unsafe or unusable. The absence of clearly marked and provided infrastructure for active mobility results in accidents involving pedestrians and cyclists. the lack of continuous infrastructure for non-motorised traffic has proved to be a further decisive barrier. Poor road safety is a major obstacle to cycling and walking. The Nairobi County Annual Development Plan (CADP) 2016/2017 noted challenges in poor status of roads, encroachment of access roads, accidents caused by lack of traffic calming measures (e.g., speed bumps), insecurity resulting from absence of street/public lighting and lack of drainage system.

The speed of the transition towards active mobility depends on the level of innovations, socio-economic status, stakeholder willingness and perceptions and available policy.

1.2 Starting point: Living Labs in sub-Saharan Africa

So far, the promotion of active mobility often has been based on the premise of "what do experts think, what users need"? In order to further develop active mobility an understanding of "what users really need" is required. The participation of stakeholders in municipal planning processes has become a natural planning practice in recent decades. Research with individual practice partners is also not



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uncommon in applied research. Real-world laboratories differ in that they involve a wider range of practitioners from civil society and a greater intensity of participation in the research process. Based on this premise several research projects are utilising living labs to test innovative solutions to promote active mobility. The claim of living labs is to carry out applied research not only for but rather together with the users and practitioners. In experiments in the field, solutions are implemented on site on a temporary basis and their effectiveness is evaluated. This enables to test novel solutions to promote active mobility as joint effort of scientists and stakeholders in order to establish new successful approaches.

There are numerous essentially comparable concepts and terms used for such transformative research, such as Intersectoral Governance, Quadruple Helix (Public Sector, Business, Third Sector and Academia), Learning Alliances, Living Labs, Real World Laboratories, tactical urbanism approach etc. The following therefore defines which terms are used in the CAMA project and how they are understood. The aim is to clarify the use of terms rather than to contribute to theorising.

1.2.1 Learning Alliances

Learning alliances are an approach of applied research in which actors from science and practice do joint research and initiate transformation processes. In this project learning alliances for the promotion of walking and cycling were developed in Kampala, Nairobi and Mekelle. They bring together local and German researchers, community representatives, decision makers and expert. Learning Alliances have become widely accepted as a vehicle to drive socio-techno transitions. LA are a format of transdisciplinary research with a transformative aim - that is, to accelerate the identification, development, use and diffusion of solutions for changes in society oriented towards the common good. Real-world laboratories aim to initiate and perpetuate real transformation processes (practical objectives), generate generalisable knowledge about systems and their transformation (research objectives) and enable learning by practitioners in a protected environment (educational objectives) (Beecroft et al. 2018). Provide safe space for joint learning based on evidence provided by scientist, Creating 'knowledge for action' (Schneidewind 2014) Learning alliances are characterized by three features:

- Learning alliances are based on the idea of joint research between science and practitioners in order to develop socially relevant and needs-orientated solutions (Arnold/Piontek 2018). Real-world laboratories integrate numerous non-scientific stakeholders in particular, such as municipal administrations, those affected or the general public, into the research. Joint research and learning of scientist, professionals, business, administration, civil society and citizens from start to end
- Learning alliances in combination with living labs attempt to make research applicable to practice by temporarily testing solution knowledge through experimental applications in "real-world experiments" and analysing its potential transferability (Arnold/Piontek 2018). The Focus is on the how what is experimental with temporary testing and scientifically evaluating innovative and visible solutions in real city setting championed by stakeholders
- Learning alliances endeavour to accelerate the identification, development and diffusion of solutions for changes oriented towards the common good through the involvement of practitioners. By steering research priorities through practitioners and realising early demonstration projects, social transformation processes are to be promoted. Why Transformative = promoting and accelerating real changes in the field (not only scientific insights) Speed up transformation process by more relevant research and quicker communication to practitioners. Urgent need for action because of global challenges climate



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change, biodiversity, providing basic human need there is the need to better facilitate global transformation processes, Conventional research is not quick enough to address challenge

- Learning alliances can become a good method to faster test and develop own solutions instead of just copying them from abroad and need to convince and fix later. More local adapted solutions and solutions which are owned by the local stakeholders. This is very important for design standards and strategies for transport, where we have learned that a copy paste from other locations often does not lead to useful solutions.

Establishing local and international learning alliances, bringing together scholars, practitioners, and stakeholders to co-produce knowledge and practice, and provide expertise for the realization of safe, high-quality walking infrastructure and spaces in African cities and globally. The research objectives of living labs can be broken down into system knowledge about the genesis of the problem (which factors influence walking), target knowledge about the desired goals (what demands do pedestrians place on the quality of the system and infrastructure) and transformation knowledge about the options for action (how can the necessary change in walking be achieved) The bottom-up approach of LAs provides unique opportunity to extend the knowledge about walking compared with conventional research like gathering specific knowledge from practitioners and provides the foundation and opportunity to foster the required transformation process.

1.2.2 Living Labs

Living labs in the transport sector are temporary interventions in real urban space. The main characteristics of living labs should be emphasized:

- Exchange between research and practice Participatory development of proposed solutions, The learning alliances in Kampala, Nairobi and Mekelle will use the results from crowd mapping (WP2) and the behaviour survey (WP1) to develop possible solutions to promote walking and cycling in the respective cities.
- Temporary testing of proposed solutions, these proposed solutions can cover a range of different things from public relations to structural solutions to training. temporary measures can also be used to reflect conditions that would not have been introduced permanently due to possible concerns in the administration or citizens. In this way, gathering local experience can help to overcome resistance to new solutions and contribute to the faster dissemination of innovative measures in planning practice. cost-effective temporary structures are used that can be dismantled at short notice
- Setting in real city, Visible interventions. real experiments serve as an empirical research method to evaluate the effects of measures and concepts in a before-and-after comparison. Real experiments can be used to check whether measures and concepts are fully effective and whether unintended or even undesirable effects occur in addition to the desired effect. Ideally, transferable, generalizable insights can also be gained from real experiments.
- Scientific (before and after evaluation) of the effect of the solution. The duration of the real experiments should be long enough to change habits and thus enable an unbiased evaluation of the measure. In the GO Karlsruhe real laboratory, a period of three months has proven to be practical.
- Learning together to achieve results. Living labs are demonstration projects for the public and enable a wide range of actors to understand and experience solutions to promote transformation processes.



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The research methodology has already proven its worth in the context of promoting walking and cycling in Germany. The success of the real-world laboratories in Karlsruhe can be measured by the continuation of a real-world experiment is the permanent implementation of a solution for the redistribution of a traffic area that has been tested in a real-world experiment and that the city of Karlsruhe continues to use the real-world laboratory approach after the end of the real-world laboratory project.

The example of the solution that was stabilised in the street space after the real-life experiment deals with junctions that are difficult to cross from the citizens' point of view. Specifically, it is about the redistribution of traffic space at such a junction as part of the pedestrian connection between the town centre and a newly built local supermarket in a district of Karlsruhe. In the real-life experiment, yellow sticky dots were used to create protected spaces for pedestrians - deliberately deviating from the types of markings regulated in the German Road Traffic Regulations (StVO). A few years after the end of the real-life experiment, the city council installed markings that conformed to the German Road Traffic Act (StVO) and were closely modelled on the markings used in the experiment. This was done not only at one location, but at several places in the city.

The example of the city's adoption of the real-world laboratory approach involves the conversion of a street in the city centre. In 2022, a temporary closure and redesign of a main road tangent to the pedestrian zone in Karlsruhe took place. This temporary experimentation was scientifically accompanied, i.e. a real-life laboratory was set up. This real-life laboratory took place outside of "GO! Karlsruhe" and shows that the instrument of real-world laboratories is now being actively utilised by the city administration of Karlsruhe. It should be emphasised that this real-world laboratory was initiated and planned by the city administration - unlike in the "GO! Karlsruhe" project, where the initiative came from the researchers. The closure of the street was highly controversial in terms of local politics, but the prospect of a scientific evaluation of the effects on the quality of life in the street space, on the assessment of shop owners, on visitors and customers made the experiment possible. As a result, it was found that the effects of the trial contributed to most of the traffic and urban development objectives adopted by the city council. As a result, it was decided to implement this real-life experiment on a structural level, so that the city administration is currently (2025) tasked with planning the final remodelling of the street.

There are attempts to transfer the concept of living labs, which has been tried and tested in Germany, to low- and middle-income countries. However, great disparities exist across the characteristics of living labs regarding technology adoption support and uptake based on local characteristics and external driver mechanisms. Limited studies exist about the variation in living lab transformation processes in low- and middle-income countries. This study aims to identify the success factors and limitations for living labs based on case studies in the CAMA project.

1.3 Goal of the project

The goal of the study is to understand how exchange of knowledge in the promotion of active mobility between sub-Saharan Africa and Germany can be understood, implemented, and optimized. It is hypothesized that developing countries can build on experiences from German partners to promote the transition to walking and cycling. German LL provide a set of innovative tools (e.g. digital crowd-mapping application) as well as research methods (e.g. learning alliances and living labs) which can support applied research teaching and cities transition to active mobility. The goal of the cooperative project is also to combine the scientific goals, to better capture the requirements of the pedestrians

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and cyclists and to develop strategies for promoting transition to active mobility in developing countries. The insights from research support the planning approach of promoting walking and cycling as a system integrating infrastructure solutions, mobility management, governance and mobility culture as well as serve as a starting point to promote active mobility in cities in sub-Saharan Africa. Nevertheless, there is still the need to increase the understanding of the needs of the users, develop more tailor-made solutions and promote their uptake on the ground while using a socially just lens.

Five key questions are proposed that stimulate reflection on the specific requirements and design options for participation processes in real-world laboratories for sustainable mobility transformation:

- Is the Reallabore methodology suitable for promoting active mobility in Africa?
- What are the success factors for participation processes in learning alliances and living labs?
- What are the objectives of participation and goals of participation in learning alliances and living labs, which result from research, practical and educational goals with different weightings?
- Which actors should be involved in participation in learning alliances and living labs and what interests do they have?
- What can a participation process in learning alliances and living labs look like and how are external and internal challenges considered?



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2. Overview progress of the project

The following section provides an overview of the project's overall development, outlining the main phases that shaped its implementation over time.

2.1 Project launch and development of cooperation structures (2021)

The organisational and structural foundations for successful collaboration were laid at the start of the project in June 2021. This included setting up a digital project management system and regular online team meetings. A stakeholder analysis was launched in the three partner cities of Kampala, Nairobi and Mekelle. At the same time, the first learning alliances were established, in which local actors from administration, academia and civil society were involved.

A key milestone was the online summer school "Hands on Sustainable Mobility", which was attended by over 70 participants from eleven countries. International working groups discussed challenges and solutions for promoting active mobility (walking and cycling).

2.2 Research, tool development and stakeholder work (2022)

The year 2022 was characterised by the content and methodological preparation of the data collection. A digital crowd mapping tool was developed that allows citizens to assess the quality of local walking and cycling infrastructure. In addition, a comprehensive online survey was created to record individual mobility patterns, barriers and needs.

In Kampala, Nairobi and Mekelle, the Learning Alliances were further strengthened and specific topics were prioritised together with local partners. This also includes the continuation of a stakeholder analysis in the three partner cities of Kampala, Nairobi and Mekelle, including road safety, gender aspects in cycling and the availability of bicycles. In addition, a virtual library was set up and initial didactic materials for teaching and training were developed.

2.3 Data collection, analysis and international dissemination (2023)

In 2023, the tools developed were put into practice: The online survey was successfully conducted in all three cities (over 1300 participants), supplemented by systematic mapping activities along important routes and main roads. The results provided valuable insights into the subjective and objective conditions of active mobility. The data collected was jointly analysed, processed in publications and presented at international events such as the Walk21 conference in Kigali.

Several workshops with stakeholders were also held in Nairobi and Kampala, where the results were presented and discussed. In Mekelle, the physical implementation had to be postponed due to the pandemic and conflict.

2.4 Preparation and initial implementation of living labs(2024)

In the fourth year of the project, the focus shifted to concrete applications and integration of the real-world laboratories. This must be differentiated according to the various locations.



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In Mekelle, a living lab was implemented as a temporary intervention in the street space in October 2024. A corridor was marked out for pupils to cross safely and trialled with students, the administration and the local population. The measure also served as a practical use case for the crowd mapping tool and was comprehensively documented. The Urban October Events in Mekelle (18 to 21 October 2024) were one of the biggest events of the year. Real-life experiments were conducted here, in which researchers from Germany, Uganda and Kenya as well as local decision-makers took part.

In Kampala, conceptual preparations for a Living Lab were carried out over the course of the year together with the city administration and the Uganda Police. In May 2024, the CAMA team met with the leadership of the Kampala Capital City Authority (KCCA) to discuss pilot projects to improve pedestrian and cycling infrastructure. Initial plans for the redesign of Sir Apollo Kaggwa Road were presented. In Kampala, a detailed analysis of traffic patterns was carried out using video recordings and crowd mapping data. This served as the basis for the development of a pilot design for pedestrian crossings on Sir Apollo Kaggwa Road. Kampala Car-Free Day on 7 September 2024, where major roads were transformed into car-free zones. The event offered a variety of activities such as cycling, skating, yoga, street games and medical health checks.

In Nairobi, traffic analyses and pedestrian crossing studies were conducted on University Way to identify infrastructure improvement opportunities. These studies were carried out with the support of students in order to actively involve them in research work. In Nairobi, a round table was held on the feasibility of a living lab on University Way, at which the Director General of the Nairobi Metropolitan Area Authority (NAMATA) pledged his support for the project. In Nairobi, it was not possible to realise a physical living lab in the public space due to institutional hurdles. Instead, the focus was on developing a "Cycling Safety Training Manual" - a practical guide to safe cycling. This was developed and tested together with partners from Karlsruhe and disseminated via local networks.

At the same time, teaching materials on active mobility were revised at all partner universities and supplemented with content from the project. The crowd mapping tool was used in teaching and further developed in several final theses. In 2024, numerous events and workshops to promote active mobility were held in various African cities as part of the CAMA project. From April to October 2024, various workshops and expert discussions were organised in Mekelle, Kampala and Nairobi. These events served as platforms for the exchange of expertise, the presentation of research findings and the development of joint solutions.

2.5 Completion, stabilization and international networking (2025)

In 2025, the conclusion of the CAMA project was at the centre of activities at all four locations. The focus was on presenting the project results, passing on practical findings and establishing sustainable partnerships and training structures in the field of active mobility in African cities.

In Kampala (Makerere University), the focus was on the further development of the Living Lab activities. After analysing traffic data at the Uganda Management Institute and a stakeholder consultation with the Kampala Capital City Authority (KCCA), the Living Lab was relocated to Makerere Hill Road. Traffic-calming measures such as speed humps and temporary signage were implemented there to enable schoolchildren in particular to cross the road safely. The measure was actively supported by the city council and local schools.

In Nairobi (University of Nairobi), the project was concluded with a festive closing event and the official publication of the "Nairobi Cycling Training Manual" - a practical manual for the safe use of bicycles in

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urban areas, which was developed together with stakeholders and tested in a workshop. In addition, a preliminary technical review of the manual, a field visit to Murang'a County on pedestrian safety and participation in the International Summer School Programme at Karlsruhe University of Applied Sciences took place.

Overall, the course of the 2025 project shows a strong consolidation of content, the implementation of practical measures, transnational networking and the sustainable integration of research results into teaching and local planning practice. The objectives of the project with regard to co-design, training, dissemination and international cooperation were fulfilled and form a basis for possible follow-up initiatives.

3. Methods for data collection and analysis

The classic participation approach in mobility research and urban and transportation planning involves panels, discussions and workshops. These are mainly aimed at residents of urban districts and typically have a homogeneous, older audience. A large portion of the relevant population cannot be reached with these participation tools. The conventional tools of urban planning are not suitable to capture the needs and problems of pedestrians and cyclists in urban areas. New methods for analysing and collecting data were tried out. The survey methods each offer different insights.

3.1 Online Survey on mobility behavior

The main aim of the online survey 2022 is to gain a deeper insight into the backgrounds and motivations of cyclists and pedestrians, as well as the distances travelled by bike or on foot. This helps to better understand the individual motivations and obstacles to the use of active mobility. Understanding the preferences of users, their perceptions of active mobility and their experiences of walking or cycling is crucial to understanding how these attitudes can be positively influenced.

The questionnaire consists of four parts. The first part focuses on users' preferences and perceptions of active mobility and existing infrastructure; the second part seeks to explore users' experiences; the third part contains questions about respondents' recommendations; and the fourth part inquires about respondents' basic background and demographics. There are also some open questions to give respondents the opportunity to provide flexible answers.

The structure of the questionnaire was developed by the University of Kassel and later adapted to the circumstances of the individual partner cities. The questionnaire is available in English in Nairobi and Kampala, in Mekelle it was translated into the local language in order to address a larger interest group. Several workshops and meetings were held to discuss the survey questions. After in-depth discussion, the final version of the online survey was pretested in December 2022. Five junior researchers were trained to carry out the surveys on site. They will use a tablet to interview people on the street.

3.1.1 Introduction

Active mobility, particularly walking is the primary mode of travel for the majority (78%) of Africans and more than one billion people in African cities walk or cycle for more than 55 minutes every day to reach work, home, school, and other essential services. Many are dependent on walking as a primary means of transport, not by choice but as a necessity. Walking and active mobility in general have personal (good local accessibility, low costs) as well as social (emission-free, efficient, space-saving,



city-compatible) and health (effect on rising non-communicable diseases, psychological stimuli) advantages and is therefore essential for sustainable mobility.

3.1.2 Objective

The main objective of the mobility behavior survey was to gain a deeper understanding of active mobility users' perceptions, preferences, daily experiences, and individual barriers to active mobility. Additionally, the survey aimed to identify the motivating factors that encourage, and the obstacles that discourage, the use of active mobility modes. It collected data on route preferences, perceived safety, general attitudes toward walking and cycling, and infrastructural preferences related to different bicycle and pedestrian facilities. By offering a deeper understanding of how cyclists and pedestrians feel, along with the distances they travel, the survey provides valuable insights into individual motivators and barriers that influence everyday walking and cycling, thereby supporting efforts to promote more active modes of transport.

The survey consisted of 37 questions divided into four sections: sociodemographic details (e.g., gender, age, household size, vehicle availability, occupation, income, and education level); users' perceptions toward cycling; user experiences and preferences (e.g., preferred transport modes, reasons for preferences, cycling frequency, and purposes of use); and motivating factors and obstacles to cycling in daily commutes. The questions were developed based on literature review, combination of established sources and project-specific inputs such as "System repräsentativer Verkehrsbefragungen" / "Mobility in Cities – SrV" and "Active Travel Survey" (New South Wales, Australia). Some items were derived from previous mobility studies conducted by the project partners, and additional questions were developed specifically for this project and tailored to the local context. The survey was conducted in collaboration with all project partners, and was tailored to local circumstances. For the case of Mekelle–Ethiopia, the questionnaire was translated into the local language to better understand specific mobility conditions and needs. While the overall question set was kept consistent across the three cities to allow for comparisons, some questions were adapted to reflect local contexts, particularly those related to income categories, education level, and certain mobility modes (e.g., Bajaj/tricycles are mainly common in Mekelle, while Boda Boda/motorbikes are common in Nairobi and Kampala). After thorough discussions, all partners agreed on one structured questionnaire to support better comparative analysis, and each respective country customized specific elements according to their context. In addition, some open-ended questions were included to allow respondents to provide more detailed and flexible answers (full survey content attached in *Annex A*).

3.1.3 Data collection process

3.1.3.1 Preparation

The data collection process involved multiple preparatory steps carried out collaboratively by all project partners. An online workshop was first conducted to discuss the draft questionnaire and ensure a common structure aligned with the survey objectives. The partners agreed on a unified questionnaire, which was later customized to local contexts where necessary, including adaptation of income categories and mobility modes, and translation into the local language for the case of Mekelle–Ethiopia.

Enumerators from Nairobi, Mekelle, and Kampala were given training on online survey tool called Survey-ToGo since it was a tool that fits to the type of our questionnaire since it was a tool that fits to

the type of our questionnaire. Following the training, an average of 25 pretests were conducted with diverse groups of active mobility users in the three African cities. Based on feedback from respondents, the questionnaire was refined. Furthermore, several online and in person meetings were conducted to discuss the instrument in detail.

3.1.3.2 Survey implementation

The survey was carried out from December 2022 to March 2023 using a combination of online and in-person street surveys as shown in Fig.1. A systematic random sampling approach was applied along selected corridors in each city, while purposive sampling was used to ensure representation of key user groups, including women, elderly people, children, people with disabilities, private wheel drivers (PWDs), cyclists, pedestrians, and business owners.

Data were collected along selected major streets in each city: University Way, Muindi Mbingu Street, and Jogoo Road in Nairobi; Sir Apollo Kaggwa Road, Bombo Road, Hoima Road, and Masaka Road in Kampala (covering Central, Kawempe, and Rubaga divisions); and all seven sub-cities of Mekelle (Semen, Ayder, Kedamay Woyane, Hawelti, Adihaki, Quiha, and Hadinet). A total of 1,367 responses were collected, exceeding the planned target, with 463 respondents from Nairobi, 425 from Mekelle, and 479 from Kampala. The online survey was conducted from December 2022 to March 2023 in Nairobi (n = 463), Mekelle (N = 425), and Kampala (n = 479). A total sample size of 1,367 was collected, exceeding the planned target by over 10%. The selected target groups encompassed private wheel drivers (PWDs), cyclists, pedestrians, and business premises owners. During the data collection, we tried to include heterogeneous groups of society (women, elderly, children, and people with disability) as target groups.

A systematic random sampling approach was employed to gather respondents for the study. Enumerators approached every available person along the selected streets in each city. Given the exploratory nature of the research and the aim to capture diverse mobility behavior of cyclists and pedestrians across the three case cities, the sampling focused on streets located within central business districts (CBDs). These streets were intentionally selected because respondents in such areas are more likely to represent the majority of city residents and reflect varied travel patterns.

Following the compilation of raw data, preliminary analyses were conducted for each country, along with a comparative analysis. The data collected was analyzed based on the objectives of the survey to understand active mobility users' perceptions, preferences, daily experiences, and individual barriers to active mobility.



Fig. 1: Data collection in Mekelle, Ethiopia (Source: CAMA enumerators Mekelle and Nairobi)

3.1.4 Survey results

3.1.4.1 Basic information and demography

This section presents the basic sociodemographic characteristics of the survey respondents, including gender, age, household structure, occupation, and related attributes. These variables help provide context for understanding differences in mobility behavior across user groups.

Gender

Among the 1,367 participants, on average, 29.1% represent women, while 70.9% are men. In Kenya, the proportion of women is slightly higher at 30.1%, whereas in Ethiopia, it is lower at 27.8%.

Table 1: Gender groups of respondents (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

City	Male	Female
Kampala	70.9%	29.1%
Nairobi	69.9%	30.1%
Mekelle	72.2%	27.8%

Age

The majority of participants, accounting for 36.3% of the total, fall within the age range of 26 to 35 years. Nairobi recorded the highest percentage (37.2%) of participants who indicated their age to be between 26 and 35 years as demonstrated in Fig.1. In Mekelle, there were very few respondents above the age of 65 (0.9%) as well as the highest number of respondents between the ages of 56 and 65 (6.1%) as shown in Fig.2.

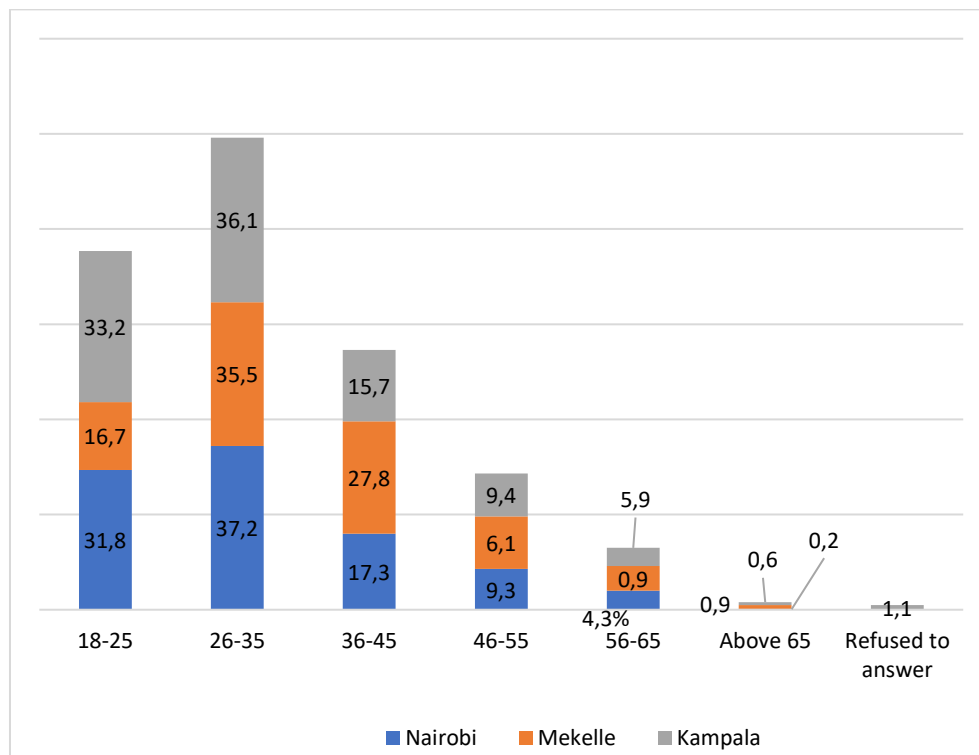


Fig. 2: Respondents age group (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %



Number of household members

The most frequently reported response to the question regarding the number of household members among all the participants was "one," with 19.8% of the participants. Conversely, the least commonly given response was "two" (13.6%), and a small proportion of participants (0.9%) declined to provide an answer. Mekelle exhibited different response patterns compared to the other cities. In Mekelle, the most frequently reported answer was "Four," accounting for 21.9% of responses. The least common response in Mekelle was also "two" (7.8%) as shown in Table 2.

Table 2 : Household size distribution by city (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Household Size	Nairobi	Mekelle	Kampala
One	23.5	12.7	22.3
Two	16.9	7.8	15.7
Three	20.3	16.5	14.0
Four	15.2	21.9	15.2
Five	14.3	19.8	12.3
More than 5	9.9	21.4	17.9
Refused to answer	—	—	2.5

Number of children aged 17 and below

According to the results, the majority of people do not have any children. A total of 32.2% of participants responded with "none" when asked about the number of children they have. Only a small percentage, specifically 2.1% of the participants, indicated having more than five children. More results on the number of children in the household of the respondents is shown in Table 3.

Table 3: Number of children per respondent (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Number of Children	Nairobi	Mekelle	Kampala
One	27.9	25.6	18.3
Two	21.5	22.1	22.3
Three	11.3	13.2	13.7
Four	2.3	5.7	6.2
Five	1.6	2.1	2.2
More than Five	0.9	2.1	4.3
None	35.3	30.7	30.7
Refused to Answer	—	—	2.9

4.1.1. Occupation

Most of the respondents are entrepreneurs or business owners. The occupation of "pensioner" was the least frequently reported response. In Kampala, the highest proportion of individuals (22.8%) work as employees in companies. Similarly, in Nairobi, the most commonly selected category was "employee



in a company," with 29.6% of participants providing this response. However, the primary occupation in Mekelle differs from the other two locations. In Mekelle, the majority of participants (27.1%) work as civil servants. Interestingly, in both Kampala and Nairobi, the category of "civil servants" received the least number of responses, with only 3.3% and 2.8% of participants selecting this option, respectively. Most of the respondents who chose 'other' described their job described as 'housewife', daily laborer, bicycle rental, self-employed and unemployed.

Table 4: Occupation distribution by city (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Occupation	Nairobi	Mekelle	Kampala
Civil servant	2.8	27.1	3.3
Entrepreneur / Company owner	19.9	25.9	21.5
Employee in a company	29.6	12.2	22.8
Small retailing	13.4	13.1	19.0
Unemployed	9.1	7.8	3.8
Student	9.5	4.5	4.6
Pensioner	1.4	—	—
Other	15.8	8.0	22.8
Refused to answer	—	—	2.30%

3.1.4.2 Users' preference and perception towards walking and cycling

This section presents findings on the frequency of use of active mobility modes, particularly walking and cycling, across the three cities. It focuses on how often respondents use active mobility modes for daily travel, the purposes, their modal preferences, and the key reasons for choosing specific mode of transport. In addition, perceptions on the benefits of active mobility, including economic, environmental, health-related, and social advantages are also addressed.

Frequency of use of active mobility for commuting

Walking

The most frequently used mode for the majority (73.2%) of the respondents is walking. Out of the three countries, respondents from Nairobi (83,8 %) walk daily more than Mekelle's (66,1 %). The least number of respondents for the frequency of use of walking as a mode is 1-2 times per year as shown in Table 5.

Table 5: Frequency of walking for commute (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Frequency	Kampala	Mekelle	Nairobi
Daily	69.7	66.1	83.8
3-4 days a week	6.7	11.8	3.5
1-2 days a week	5.2	11.5	6.9
1-3 days a month	2.5	3.5	1.1
Once a month	0.3	3.1	0.9
1-2 times a year	2.3	—	—



Frequency	Kampala	Mekelle	Nairobi
Never	10.2	4.0	3.9

Cycling

There is a high contrast in the frequency of use of a bicycle in the three countries. In Kampala (14.4%), Mekelle (20.0%) and Nairobi (19.0%) use cycling as a daily mode respectively. The majority of respondents (61.3%) reported that they never cycle to work, while in contrast 20% reported cycling daily. Users either use bicycles as a daily mode or never use a bicycle at all. There is not much frequency of use in between Cycling is more used as a daily mode in Nairobi in comparison with the other cities.

Table 6: Frequency of Cycling (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Frequency	Kampala	Mekelle	Nairobi
Daily	14.4	20.0	10.4
3–4 days a week	4.6	6.1	19.0
1–2 days a week	3.2	4.0	3.1
1–3 days a month	1.9	3.5	3.7
Once a month	4.6	2.8	1.9
1–2 times a year	4.8	2.1	3.0
Never	66.6	60.7	68.5

Purpose of using active mobility

Modal preference and primary reason for preferring any mode of travel

Perceptions about the benefits of active mobility

3.1.4.3 Users` experience on active mobility

Modal change in the last 2 years

Respondents were asked to state if they had changed their mode of transport in the last two years. The highest modal shift is observed in case of Mekelle where 69.4% of the respondents in Mekelle have shifted from motorised transport to walking between the years 2021-2023. They used the modes more often than before. Details on the respondents' use of the new mode in the three cities is illustrated in Fig. 6.

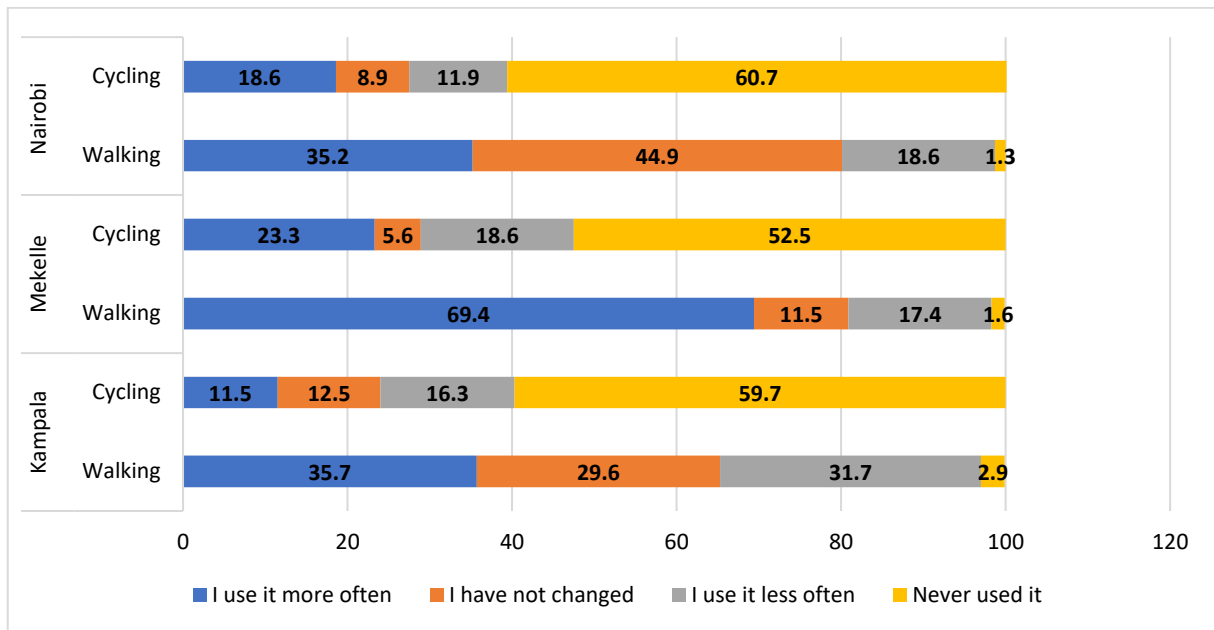


Fig. 6: Modal change to walking and cycling in the last two years, (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Main reasons for modal change

Conditions hindering users from using active mobility in the respective city

These questions explored the main barriers to cycling and walking in terms of various factors listed in Fig. The major hindering factor/ barrier is that the respondents believe cycling is too dangerous, for the 25.1% of respondents in Kampala, 22.9% in Mekelle, and 30.9% in Nairobi, highlighting widespread safety concerns. Other challenges include long or inconvenient travel times, particularly in Kampala (11.2%) and Mekelle (5.1%), as well as distance-related difficulties, where 9.7% of respondents in Kampala and 12.2% in Nairobi found destinations too far to access actively.

Environmental and physical barriers also affect cycling use. Heat and sweating were significant in Kampala (10.2%), while windy and dusty conditions were more prominent in Mekelle (18.1%). A smaller number of respondents (11.2%), especially in Nairobi mentioned not being fit enough for active travel. Access-related issues such as lack of bicycles or high cost of bicycle (around 3% across cities) and cultural norms restricting cycling mainly to women and girls were also mentioned. Additionally, lack of secure bicycle parking (11.7% in Mekelle) and steep terrain (7.5%) further discourage cycling. Overall, safety risks, environmental conditions, distance, and accessibility constraints remain the dominant factors limiting the use of walking and cycling across the three cities.

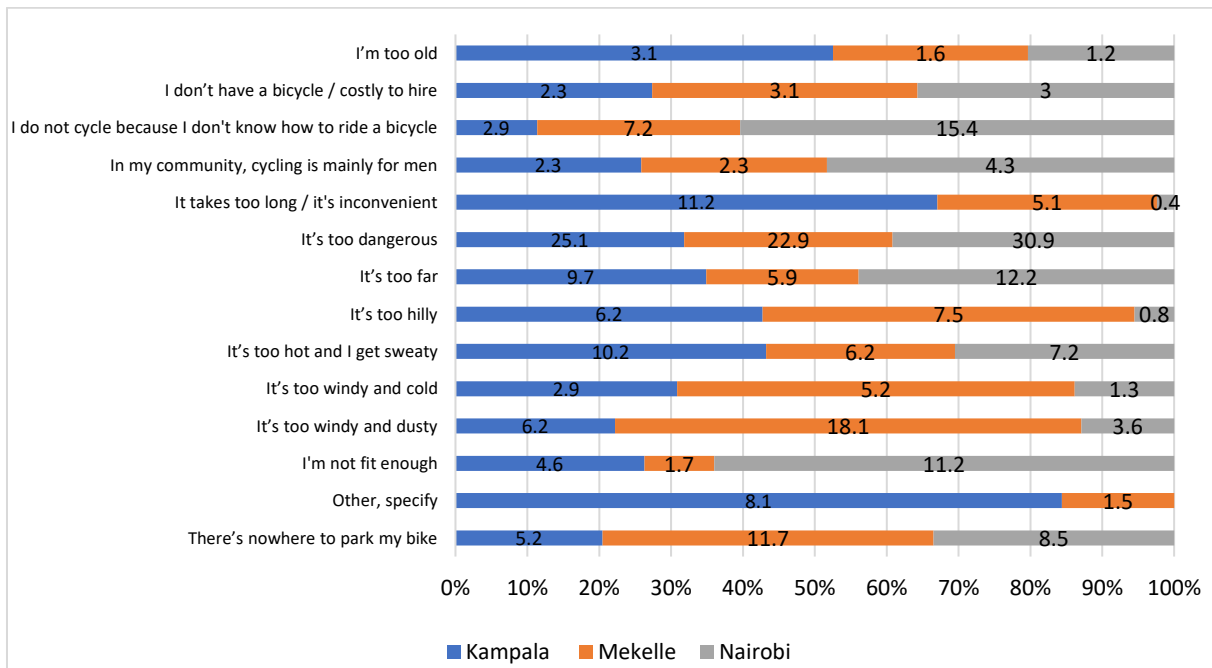


Fig. 9: Factors hindering users from using active mobility in the respective city, (Nairobi: n=463, Mekelle: n=425 and Kampala: n=479) in %

Major obstructions

Emerging mobility challenges

3.1.4.4 Preconditions to enhance walking and cycling environment

3.1.5 Discussion

The findings of this study reveal significant differences and similarities in active mobility behavior, preferences, and challenges across Nairobi, Mekelle, and Kampala. Walking remains the dominant mode of travel across all three cities, with particularly high daily usage in Nairobi (83.8%), suggesting that walking is not only a necessity but also an established travel habit. Cycling, however, presents a contrasting pattern, while it is increasingly used in Mekelle (20.0%) and Kampala (14.4%) as a daily mode, it remains lower in Nairobi (10.4%). In many small towns and secondary cities in Ethiopia, such as Bahir Dar, Hawassa, Adama, and Dire-Dawa, cycling makes up a large percentage of trips whereas cycling is not common and culture as a daily mode in Mekelle. The low-to-moderate uptake of cycling indicates a substantial untapped potential for active mobility, especially where infrastructure and safety conditions are improved.

Active mobility is primarily associated with essential/necessity activities, especially commuting to work, which was the main purpose for both walking and cycling across all cities. While recreational walking and cycling are present, they constitute a smaller share, emphasizing that active mobility is largely utilitarian rather than leisure driven. Furthermore, there is a limited usage bicycle for carrying goods which may be attributed to the relative scarcity of cargo bikes in most African countries. Overall, the data indicates that active mobility modes are primarily utilitarian modes of transport, particularly for commuting to work, but it also serves recreational and social purposes.

Modal preference patterns further reinforce the distinctions among the three cities mobility context. Walking is highly preferred in Mekelle (28.7%) and Nairobi (26.1%), whereas motorized two-wheelers (Boda-Bodas) dominate in Kampala (37.2%), reflecting varied transport cultures and availability of



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mobility options. Affordability and convenience were the primary drivers of preference for walking and cycling, highlighting economic motivations rather than lifestyle choices.

When it comes to perceptions about the benefits of walking and cycling are largely positive, with high agreement on health, affordability, and environmental advantages. Health benefits received the strongest endorsement, particularly in Kampala ($M = 4.72$, $SD = 0.63$) and Mekelle ($M = 4.64$, $SD = 0.62$), suggesting strong awareness of the personal and public health value of active mobility. However, perceptions of social inclusivity displayed greater variation, with lower support and higher dispersion in Kampala, indicating social or cultural limitations to adopting active mobility.

Despite these positive attitudes, major barriers continue to restrict the uptake of walking and cycling. Lack of safe pedestrian walkways and inadequate and in some cases non-existent cycling facilities emerged as common challenges, with strong agreement across cities, especially in Nairobi and Mekelle. Poorly managed on-street parking was a critical active mobility challenge in Mekelle ($M = 4.6$, $SD = 0.6$), while safety concerns were most pronounced in Nairobi (60.7% strongly agreed). The absence of bicycle rental and sharing systems further limits access for individuals without personal bicycles. The results emphasize that infrastructure gaps, weak policy execution, and poorly managed urban spaces are the most prominent barriers to active mobility across the three case cities. Though the three case countries have a commitment to promote active mobility, the implementation still lags behind. In this study policy and implementation gaps were consistently highlighted, showing that existing strategies lack enforcement and operationalization.

Finally, respondents identified several preconditions for creating a positive impression towards active mobility. Improving infrastructure particularly sidewalks, cycling lanes, and safe crossings was the most strongly recommended requirement in all cities. Better connectivity with public transport received particularly high support in Nairobi and Mekelle, emphasizing the importance of integrated transport networks. Law enforcement, traffic management, policy framework improvement, and awareness creation were additionally seen as key enablers, demonstrating that infrastructural measures alone are insufficient without governance and behavioural change.



3.2 Mapping Tool

A concept was developed for the digital "crowd mapping tool" to survey the infrastructure of walking and cycling in Africa. This is based on the mapping tool developed in the predecessor project "Reallabor Go-Karlsruhe". The tool to be developed here was adapted to the specific framework conditions in sub-Saharan Africa, such as the use of open street maps, liking contributions or adding a surveyor ID.

The concept for the tool was further concretised and elaborated in a joint workshop with the African partners at the end of February 2022. The framework conditions such as the language, user profile, reporting categories and content as well as the technical requirements for recording users were discussed and defined. In December 2022, the tool could be tested in Nairobi and Kampala in a large pretest. For this, 6-10 students and young researchers were selected in each country to evaluate different streetscapes. The pretest was important to analyze and adjust final problems in the application of the tool. Specific problems like the display of the web application on older smartphone models could be adjusted. The joint development process could be completed in December 2022.

The goal of the application is to enable pedestrians and cyclists to rate a street based on predefined criteria. All that is required is to call up a web page. The collection of data serves as a research basis to identify missing, unnecessary or wrongly placed infrastructure. For the research teams in Nairobi, Kampala and Mekelle, this data serves as a basis for the implementation of the real laboratory experiments.

For planning living labs, the project now includes the evaluation of various streetscapes previously defined in the plenary. The streetscapes were selected based on relevance in terms of requirements for pedestrians and cyclists, with a focus on possibly conducting real-lab experiments there at the end of the evaluations. The results will be discussed with the members of the learning alliance in Nairobi, Kampala and Mekelle in 2023 and will form the basis for the planned development of real lab experiments. The results will then be discussed with the members of the learning alliance in Nairobi, Kampala and Mekelle and form the basis for the planned development of real-life laboratory experiments.

3.2.1 Findings from Nairobi, Kenya

The digital crowd-mapping exercise undertaken in May 2023 generated 252 responses across three priority corridors—University Way, Jogoo Road, and Muindi Mbingu Street. The tool captured user-reported challenges, spatially referenced problem areas, and proposed improvements to walking and cycling infrastructure. The results provide a critical evidence base for assessing existing conditions, identifying risk hotspots, and shaping pedestrian-focused Living Lab interventions in Nairobi.

Across all three corridors, respondents consistently highlighted challenges related to pedestrian safety, encroachment on walking and cycling space, poor maintenance, and inadequate supporting facilities. However, the specific nature and severity of these challenges varied markedly by corridor, reflecting differences in road typology, traffic dynamics, land-use intensity, and enforcement gaps.

University Way—an 8-lane urban highway adjacent to the University of Nairobi—was identified as one of the most hazardous pedestrian environments in the CBD. Respondents overwhelmingly pointed to unsafe at-grade crossings, particularly opposite the university's main gate, where most pedestrians continue to cross despite the presence of a footbridge located more than 200 metres away. Users called for a formal pedestrian crossing at this desire line, supported by traffic-control measures and



speed management infrastructure. Additional concerns included obstruction of walkways by construction materials at the roundabout, discontinuous footpaths, and poor drainage. Users also proposed the creation of dedicated cycling and boda boda lanes and improved awareness on shared mobility. Overall, the mapping results portray University Way as a high-speed corridor where crossing safety, infrastructure continuity, and temporary obstructions are the foremost concerns.

Jogoo Road, a heavily trafficked arterial corridor with intense commercial activity, presented the most acute challenges among the three sites. Respondents reported extensive encroachment onto walkways and cycling lanes by vendors, parked vehicles, and boda bodas. Users requested clear separation of walking and cycling spaces, designated vendor zones, and the installation of bollards or other physical measures to restrict motorcycle intrusion. In addition to encroachment, respondents flagged poor environmental management—including dumping, inconsistent drainage, and general clutter—and stressed the need for properly marked pedestrian crossings, particularly at junctions. While the footbridge on the corridor exists, users emphasized the need for enforcement of footbridge usage due to unsafe informal crossings. Jogoo Road mapping results indicate that spatial stressors, unmanaged commercial activities, and weak enforcement are the dominant constraints on safe and orderly pedestrian movement.

Muindi Mbingu Street, which has benefitted from previous improvements aimed at enhancing walkability, exhibited more moderate but persistent challenges. Users highlighted continued encroachment by boda bodas and roadside parking despite the existence of designated NMT facilities. Frequent requests to remove roadside parking, improve enforcement, and maintain clear pedestrian and cycling lanes reflected concerns about declining infrastructure discipline. Respondents also identified the need for additional pedestrian crossings—particularly at junctions—better street lighting, more greenery, and provision of basic amenities such as waste bins. These findings suggest that while Muindi Mbingu Street has a stronger foundation of pedestrian-friendly design, its effectiveness is undermined by limited maintenance and insufficient regulation of street-level activities.

Across the three corridors, the mapping tool results reveal several cross-cutting themes:

- Crossing safety is the most prominent concern, with users requesting safe, well-marked, and conveniently located pedestrian crossings.
- Encroachment—by vendors, boda bodas, construction works, and parked vehicles—consistently disrupts walking and cycling spaces.
- Infrastructure quality issues, including poor drainage, uneven pavements, and obstructed walkways, limit accessibility and comfort.
- Lighting deficiencies compromise safety during evening and early-morning travel.
- Users proposed not only infrastructural upgrades but also stronger enforcement, better management of street activities, and improved environmental conditions.

In summary, the mapping results provide a clear, user-driven diagnostic of walking and cycling challenges across Nairobi's diverse street typologies. University Way requires engineered solutions to manage speed and provide safe crossing; Jogoo Road demands strong enforcement and reorganization of street uses; and Muindi Mbingu Street needs sustained regulation and maintenance to protect existing NMT infrastructure. These insights form a robust foundation for designing targeted, evidence-



based Living Lab interventions and advancing Nairobi's broader agenda for safe, inclusive, and sustainable active mobility.

3.2.2 Findings from Kampala, Uganda

The results presented below refer to the case study of **Kampala, Uganda**, where the CAMA digital crowd-mapping tool was implemented alongside the other partner cities to assess walking and cycling environments.

B.1. Tool Development and Adaptation

From early 2022 to December 2022, the project team undertook a multi-stage adaptation process aimed at ensuring contextual appropriateness, usability, and methodological robustness of the mapping tool within SSA settings. Several key outcomes emerged from this phase:

Contextual Adaptation

The tool's architecture was re-designed to incorporate features suitable for African urban environments, including:

- Integration of OpenStreetMap as the primary basemap to support data collection in regions with limited proprietary mapping coverage.
- Simplified and locally relevant reporting categories, enabling consistent classification of infrastructure and perceived conditions.
- Inclusion of functionalities such as "liking" contributions and assigning surveyor IDs, which enhanced user engagement and traceability of observations.

B.2. Co-Creation with African Partners

A co-design workshop held in February 2022 with project partners from East Africa was instrumental in refining the conceptual and technical parameters of the tool. Discussions addressed: Language requirements and interface accessibility, User profiles for field deployment, Appropriate infrastructure and experience categories for NMT assessment, technical requirements for capturing, processing, and exporting user-generated data. This participatory approach ensured that the tool aligned with local mobility realities, technological capacities, and research needs.

B.3. Iterative Improvement and Validation

An iterative refinement process guided tool development:

- An initial prototype was introduced in April 2022 during technical sessions at Makerere University.
- Subsequently, more than five pretests were conducted in Kampala to identify context-specific usability barriers, such as display performance on older smartphone models, challenges in menu navigation, and ambiguities in category interpretation.
- Findings from these tests informed three major revisions, culminating in a stable and fully conceptualised version by December 2022.
- The concluding testing cycle was conducted between January and March 2023, ensuring readiness for full-scale deployment.



B.4. Implementation of Crowd Mapping in Kampala (March – May 2023)

Between March and May 2023, the refined CAMA mapping tool (developed by Hochschule Karlsruhe) was deployed for systematic data collection across four strategic corridors in Kampala. Mapping was conducted by five field researchers on 26–27 May 2023. The corridors were chosen due to their high pedestrian and vehicular activity, history of safety incidents, and suitability for integration into upcoming Living Lab experiments. The activity generated a substantial dataset, with sample sizes as follows:

Table 1: Crowd Mapping Number of Responses Kampala

Corridor / Route	Number of Responses
Jinja / Kampala / Bombo Road	101
Sir Apollo Kaggwa / Bombo Road	106
Masaka Road	113
Hoima Road	113

B.5. Major Challenges Reported by Pedestrians

Pedestrians identified several recurrent barriers to safe and comfortable walking:

- Encroachment by boda bodas, which represented the most frequently cited challenge
- 41% at Sir Apollo Kaggwa Road;
- 18% at Bombo Road.
- Dust and mud, indicative of poor pavement maintenance and inadequate drainage.
- Potholes, further degrading walkability and contributing to unsafe conditions.
- Absence or poor condition of pedestrian crossings, especially along high-demand corridors.
- Obstructions on walkways, including illegally parked vehicles and utility poles.

These findings underscore the spatial vulnerability of pedestrians within mixed-traffic environments.

B.6. Major Challenges Reported by Cyclists

Cyclists reported infrastructure and operational barriers that significantly compromised safety:

- Competition with motorised traffic, particularly in congested sections, where lack of segregation increased conflict potential.
- Absence of dedicated cycling lanes, forcing cyclists to share narrow carriageways with fast or unpredictable vehicle streams.
- Poor pavement conditions, including potholes and debris, which reduced manoeuvring stability.
- Inconsistent or unsafe crossing opportunities, especially at intersections or where traffic flows merged. For example, 20% of cyclists on Bombo Road identified crossing as a primary difficulty.

Collectively, these findings indicate that current road designs do not accommodate cycling as a safe or viable mode.

3.2.3 Findings from Mekelle, Ethiopia

The digital crowd-mapping tool was also applied in Mekelle to capture user-based assessments of walking and cycling infrastructure under challenging contextual conditions. Despite the impacts of



political instability, post-conflict recovery and constrained local resources, the mapping exercise provided valuable insights into everyday mobility patterns and infrastructure deficiencies from the perspective of pedestrians and cyclists.

Data collection focused on key urban corridors and neighbourhood streets with high pedestrian activity, including areas around schools, markets and residential zones. Walking clearly emerged as the dominant mode of transport, while cycling played a more limited but locally relevant role, particularly for utilitarian trips. The mapping results highlighted a strong reliance on informal movement patterns and a high degree of spatial interaction between pedestrians, cyclists and motorised traffic.

Key challenges reported by pedestrians

- Pedestrians in Mekelle consistently identified several barriers affecting safety, comfort and accessibility:
- Lack of continuous pedestrian infrastructure, with sidewalks frequently absent, narrow or discontinuous.
- Unsafe crossing conditions, particularly near schools and along wider streets, where formal crossing facilities were missing or poorly marked.
- Encroachment into pedestrian space, including informal parking, street trading and vehicle stopping.
- Poor pavement conditions, such as uneven surfaces, dust and drainage problems, which particularly affect children, elderly pedestrians and persons with reduced mobility.
- Limited traffic calming, resulting in perceived risk even at moderate vehicle speeds.
- These findings indicate that pedestrian movement in Mekelle is largely accommodated informally, with users adapting their behaviour to infrastructure gaps rather than being supported by deliberate design.

Key challenges reported by cyclists

- Although cycling volumes were lower than walking volumes, cyclists reported a range of infrastructure-related and operational challenges:
- Absence of dedicated cycling infrastructure, forcing cyclists to share space with motorised traffic.
- Limited visibility and recognition of cyclists within the traffic system, contributing to feelings of vulnerability.
- Surface quality issues, including potholes and debris, which reduce riding stability and safety.
- Insecure crossing opportunities, particularly at intersections and along multi-lane streets.
- The mapping results suggest that while cycling has potential in Mekelle, current street design does not actively support it as a safe or attractive mode of transport.

Spatial patterns and implications for Living Labs

The spatial distribution of mapped issues revealed clear hotspots of pedestrian risk, particularly in school environments and along streets with higher traffic volumes. These locations were characterised by a combination of high pedestrian demand, limited crossing infrastructure and insufficient traffic management.



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The crowd-mapping results played a central role in prioritising intervention areas for the Living Lab in Mekelle. They directly informed the selection of the Living Lab site and supported the design of temporary measures aimed at improving pedestrian crossings, reallocating street space and enhancing visibility and predictability of movement, especially for schoolchildren.

Overall, the Mekelle mapping exercise demonstrates that the digital crowd-mapping tool is applicable and informative even in constrained and post-conflict urban contexts. While data volumes were lower than in Nairobi or Kampala, the qualitative and spatial insights generated were highly relevant for local decision-making. The findings underline the importance of low-threshold, user-centred data collection tools for identifying priority areas, supporting participatory planning processes and developing context-sensitive interventions for active mobility.

3.3 Video-based traffic conflict analysis

Within the CAMA project, video-based traffic conflict analysis (TCA) was applied as a complementary empirical method to assess pedestrian and cyclist safety in complex urban traffic environments. Originally developed and widely applied in European contexts, the method was adapted to the conditions of Sub-Saharan African cities and utilised in Nairobi (Kenya) and Kampala (Uganda). Due to contextual and logistical constraints, video-based conflict analysis was not systematically implemented in Mekelle.

Video-based TCA provides an evidence-based approach for the planning, monitoring and evaluation of Living Labs, allowing the analysis of dynamic interactions between pedestrians, cyclists and motorised traffic under real-world conditions. The method focuses on observable interactions and near-conflict events that occur before actual accidents, based on the assumption that frequent minor conflicts are reliable indicators of underlying safety risks. This proactive perspective enables targeted interventions beyond reactive accident statistics.

3.3.1 Methodological approach and relevance for Living Labs

Video recordings were conducted at selected high-risk locations over continuous observation periods of up to 12 hours. The footage was analysed to capture pedestrian and cyclist volumes, traffic composition, vehicle speeds, crossing behaviour, waiting times, gap acceptance and observable conflict situations.

Video-based TCA offers several advantages, particularly in data-scarce urban environments. It allows the collection of detailed behavioural data within relatively short timeframes and supports before-and-after comparisons for Living Lab interventions. The method provides both quantitative indicators and qualitative insights into behavioural patterns, although it requires substantial analytical effort for video processing and interpretation.

In addition to scientific analysis, video material proved to be a powerful communication tool. Recorded situations could be used to visualise safety problems and to support discussions with planners, decision-makers and community stakeholders. This dual analytical and communicative function makes video-based TCA a valuable methodological component within the Living Lab framework.



3.3.2 Key Findings: University Way, Nairobi

The video-based traffic conflict analysis on University Way provided a detailed and evidence-based understanding of pedestrian–vehicle interactions along one of Nairobi’s busiest and most hazardous urban corridors. Over a continuous 12-hour observation period (07:00–19:00), the analysis documented real-world crossing behaviour and quantified safety risks previously identified through crowd mapping.

A total of 7,102 at-grade pedestrian crossings were recorded on this eight-lane, high-speed corridor. This exceptionally high number highlights the critical pedestrian function of University Way and confirms a substantial demand for safe crossing facilities. Pedestrian flows were consistently high throughout the day, with pronounced peaks during morning and afternoon periods associated with university schedules and CBD activities.

A central finding was the prevalence of unsafe crossing behaviour, largely driven by the absence of formal crossing facilities aligned with pedestrian desire lines. Most pedestrians crossed directly opposite the main gate of the University of Nairobi, despite the presence of a footbridge more than 200 metres away. Pedestrians frequently accepted very small traffic gaps, often stopping on narrow medians or between lanes and progressively accepting smaller gaps as they advanced across the carriageway.

Vehicle speeds were consistently high, limiting safe crossing opportunities and intensifying risk exposure. The analysis identified a substantial number of minor conflicts, particularly during the afternoon peak around 16:00, involving last-second braking, swerving or sudden acceleration by drivers or pedestrians. One major conflict, a collision between a pedestrian and a boda boda at 17:45, further illustrated the severity of risk and the unpredictable behaviour of motorcycle taxis.

Conflict events were spatially concentrated at the informal crossing point opposite the university gate, where pedestrian demand, high speeds and lack of refuge space converged. Overall, the findings confirm a fundamental mismatch between pedestrian needs and existing infrastructure, resulting in an inherently unsafe corridor. The evidence strongly supports the need for self-enforcing and pedestrian-oriented design solutions such as raised or signalised crossings, refuge islands, speed reduction measures and improved geometric design.

Although a Living Lab intervention was developed collaboratively with stakeholders, it was ultimately not implemented due to a lack of institutional approval by the Kenya National Highways Authority (KeNHA). Instead, the later installation of a roadside barrier by KeNHA created an unintended real-world experiment, demonstrating that pedestrians continue to cross informally when formal solutions do not align with everyday mobility needs—thereby introducing new safety risks.

3.3.3 Key Findings: Kampala Case Studies

Video-based traffic conflict analysis was conducted at two contrasting locations in Kampala: Sir Apollo Kaggwa Road and the Jinja Road–Uganda Management Institute (UMI) crossing. Together, these sites represent two distinct but equally critical pedestrian risk typologies.

B.1 Traffic conditions and pedestrian demand

Sir Apollo Kaggwa Road is characterised by high pedestrian volumes linked to Makerere University and persistent congestion. Vehicle speeds were extremely low (mean \approx 5.7 km/h), with boda bodas moving



slightly faster than other vehicles. Despite the low speeds, the environment remains complex due to dense queues and unpredictable motorcycle movements.

In contrast, the UMI–Jinja Road crossing represents a high-speed, high-volume arterial environment, with average vehicle speeds of approximately 50 km/h and traffic volumes of around 3,780 vehicles per hour per lane. Pedestrian demand was lower (≈ 60 pedestrians/hour) but highly concentrated around the zebra crossing and adjacent informal crossing points.

B.2 Pedestrian behaviour and risk exposure

At Sir Apollo Kaggwa Road, pedestrians adopted adaptive strategies to navigate slow-moving traffic. While 69 % walked at normal speed, 24 % ran during crossings, often in response to unpredictable boda boda movements or limited gap availability. Crossing decisions were largely opportunistic.

At the UMI crossing, pedestrian behaviour reflected high stress levels and risk exposure. Average waiting time was approximately 20 seconds, while average crossing time reached 32 seconds—resulting in prolonged exposure to fast-moving traffic. Observed crossing speeds averaged 2.2 m/s, nearly double standard design assumptions, indicating compensatory behaviour under perceived danger.

B.3 Gap acceptance and conflict potential

Gap acceptance patterns differed markedly between the two sites. On Sir Apollo Kaggwa Road, pedestrians accepted smaller gaps in the uphill approach lane compared to the downhill lane, reflecting differences in perceived speed and risk. Congestion forced pedestrians to evaluate both lanes simultaneously.

At the UMI crossing, pedestrians frequently accepted critically small gaps (≈ 1.8 seconds), particularly in interactions with boda bodas. Long waiting times and high approach speeds created strong psychological pressure, resulting in hazardous crossing decisions.

While no formal conflicts were recorded at Sir Apollo Kaggwa Road according to standard conflict indicators—largely due to low speeds—the latent safety risk remained high. At the UMI crossing, high speeds and wide carriageway widths indicated substantial potential for severe conflicts, even if not directly observable within the recording period.

B.4 Implications for Living Lab design

The Kampala analyses highlight the need for self-enforcing infrastructure that protects pedestrians independently of rule compliance. Recommended measures include raised zebra crossings, refuge islands, speed-management elements tailored to boda bodas, lane narrowing, improved markings and pedestrian-activated warning systems. These findings provided a strong empirical basis for the design of Living Lab interventions and informed later implementation efforts.

3.3.4 Key Findings: Mekelle Case Studies

In Mekelle, video recordings were conducted at selected street sections to capture traffic flows and general interaction patterns between pedestrians, non-motorised vehicles and motorised traffic. Due to contextual constraints, including limited technical resources, security considerations and interruptions caused by the political situation and its aftermath, a full video-based traffic conflict analysis following established conflict coding techniques could not be carried out.



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Nevertheless, the video material provided valuable descriptive insights into traffic dynamics and mobility patterns and was used as a complementary observational method to support findings from the crowd-mapping activities and stakeholder discussions.

A preliminary screening of the recordings indicates that overall traffic volumes peak around midday, followed by morning (approximately 8:30–9:00 a.m.) and evening periods. Pedestrians constitute the dominant user group across all observation periods, reflecting the high reliance on walking as a primary mode of transport in Mekelle. The second most frequent road users observed were three-wheeled rickshaws (locally known as Bajajs), which play a central role in local mobility.

The recordings further revealed frequent informal crossing movements, limited pedestrian refuge space, and a high degree of spatial interaction between pedestrians and motorised vehicles. While overt high-speed conflicts were less prominent than in larger metropolitan contexts, the observed interactions underline persistent exposure risks, particularly for children and elderly pedestrians.

Although the Mekelle case did not allow for a systematic conflict classification, the video material contributed to a qualitative understanding of local traffic behaviour and supported the identification of priority areas for intervention. These insights directly informed the design and implementation of the Living Lab in Mekelle, particularly with regard to safer pedestrian crossings, spatial reallocation and traffic calming measures.

3.3.5 Contribution of video-based conflict analysis to the CAMA project

Across both cities, video-based traffic conflict analysis proved to be a crucial link between user perceptions, spatial mapping and Living Lab interventions. The method enabled detailed diagnosis of safety problems, supported evidence-based prioritisation of intervention sites and strengthened communication with stakeholders. Combined with surveys, crowd mapping and participatory processes, video-based TCA significantly enhanced the project's ability to develop and evaluate context-appropriate solutions for promoting active mobility.

3.4 Drone imagery and IA based analysis

The application of drone imagery was limited to the case study city of Mekelle (Ethiopia). Due to contextual constraints in the other partner cities, including regulatory restrictions, institutional approval processes and local safety considerations, the use of drones was not feasible in Kampala and Nairobi. Mekelle provided a suitable setting that allowed for the controlled and legally compliant deployment of drone-based observations within the Living Lab framework.

To complement the survey results, crowd mapping data and video-based traffic analyses, drone imagery was applied as an additional observational method within the Living Lab in Mekelle, Ethiopia. The use of aerial imagery enabled a detailed, spatially explicit analysis of pedestrian and cyclist behaviour before, during and after the implementation of the Living Lab intervention. This approach allowed for a comprehensive assessment of how temporary street design measures influence movement patterns, space use and safety-related behaviour in real urban settings.



3.4.1 Methodological approach

Drone footage was recorded at the Living Lab site prior to the intervention, during the implementation phase, and after the completion of the temporary measures. The aerial perspective allowed for continuous observation of the street segment and its functional zones, including sidewalks, zebra crossings, cycling lanes, carriageways and areas used by street vendors.

To enable automated detection and tracking of road users, an AI-based image analysis workflow was developed. As no suitable open-source training datasets for pedestrian detection from aerial imagery in comparable urban contexts were available, a custom training dataset was created. Pedestrians were manually annotated using the Roboflow platform to generate a training library tailored to the local conditions.

Initial model training using Roboflow's standard tools achieved a detection accuracy of approximately 65%, which was considered insufficient for reliable behavioural analysis. Following several iterations and testing of alternative AI-based approaches, the FLOW-Data from Sky model was selected. This significantly improved detection accuracy to approximately 95%, enabling robust identification and tracking of pedestrians and cyclists. While a small margin of error remains, the resulting model proved suitable for detailed quantitative analysis.

The final model allows for:

- tracking pedestrian and cyclist movements,
- analysing street-crossing behaviour (e.g. use of zebra crossings),
- generating density maps of pedestrians and cyclists,
- distinguishing movement patterns across different street zones.

3.4.2 Preliminary results

Although the full analysis of the drone imagery is still ongoing, several clear trends have already been identified. Following the Living Lab intervention, an increase in pedestrian volumes was observed, alongside a more structured use of sidewalks and designated crossing points. Zebra crossings were used more consistently, and pedestrian movements appeared more predictable and less dispersed across the carriageway.

Additionally, the spatial redistribution of street space resulted in reduced congestion and a clearer separation between different user groups. Pedestrians made more effective use of the expanded walking areas, while conflicts between pedestrians, cyclists and motorised traffic were reduced. These observations suggest that even relatively simple and low-cost interventions can lead to measurable improvements in the functionality and safety of street environments.

3.4.3 Ongoing and future analysis

The next steps of the drone imagery analysis focus on a more detailed quantification of behavioural changes. This includes:

- measuring pedestrian and cyclist volumes before and after the intervention,
- analysing dwelling time and waiting behaviour,
- assessing gap acceptance at crossing points,
- evaluating changes in movement speed and flow patterns,
- identifying both positive and unintended effects of the Living Lab measures.



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Once completed, the analysis will provide comprehensive indicators such as cumulative pedestrian dwelling time, accurate counts of pedestrians and cyclists, and detailed insights into the use of specific interventions (e.g. sidewalks, zebra crossings and cycling lanes).

3.4.4 Contribution to Living Lab evaluation

The drone imagery analysis demonstrates the added value of combining aerial observation with participatory and survey-based methods. It provides an objective, high-resolution dataset that complements subjective user perceptions and stakeholder feedback. In the context of CAMA, this approach proved particularly valuable for evaluating short-term interventions under real-world conditions and for generating evidence that can inform future planning and policy decisions.

Overall, the application of drone imagery and AI-based analysis within the Living Lab illustrates how innovative, data-driven methods can support the evaluation of active mobility interventions in cities with limited existing data and complex urban dynamics.



4. Insights promotion active mobility

This section summarises the generalisable results obtained from the project to promote walking and cycling. The results are based on the multi-method approach consisting of a survey, mapping, evaluation of the real-world laboratories and discussion in the learning alliance. The promotion of walking and cycling faces a particular challenge:

Walking is still very widespread, but less as a choice than because for many there is no other alternative. There is a danger that people will walk less as soon as there are attractive alternatives. Cycling, on the other hand, is usually a voluntary decision and one option among others. Therefore, the tasks are different. To promote walking, it is necessary to make life safer and more comfortable for those who have to walk anyway in order to prevent them from switching to another alternative at the first available opportunity. Cycling is more about encouraging people to try it in the first place and to feel safe and comfortable doing so. Anchoring the promotion of walking and cycling in national guidelines etc. is important. Some successes have already been achieved. However, this alone does not seem to be enough. For example, this usually only applies to new construction, which takes place a lot, but not to the remodelling of existing buildings. The rules also need to be brought to life. It is not individual isolated factors but a broad mixture of different factors. Therefore, the promotion of pedestrian traffic as well as the promotion of cycling in the system is necessary, from infrastructure to cycling courses, public relations, etc.

4.1 Priorities for the promotion of active mobility

The challenges of determining where to begin promoting walking and cycling are immense. Developing even a basic infrastructure for active mobility would require large-scale construction and restructuring, which far exceeds the capacities available at the local level. Therefore, clear prioritisation is essential.

Given the magnitude of the issues surrounding pedestrian and cycling promotion and the multitude of factors that influence them, it is difficult to identify suitable starting points. What is needed are effective ways to listen to pedestrians and cyclists, to understand their everyday experiences, and to recognise local needs for action. Waiting for top-down initiatives to deliver solutions is unlikely to be effective, as institutions are often overstretched and risk becoming bottlenecks in implementation.

The key question, therefore, is how local initiatives can be supported and strengthened from the bottom up, allowing progress to develop gradually and sustainably. Prioritising where and how to begin is crucial. The following priorities were identified as promising entry points that can be effectively scaled up — and were also promoted within the CAMA project.

4.2 Creating safe spaces as a starting point for promoting active mobility

One of the main reasons why people in cities such as Kampala or Nairobi refrain from walking or cycling is the lack of safety. Cars and lorries often drive at high speeds, and overtaking on pavements is a common sight. To address this, the project aims to establish so-called “safe spaces” for walking and cycling. Similar initiatives have already been implemented successfully in previous projects, for example on university campuses, and will now be expanded.



The first step involves identifying existing areas where cycling and walking can take place safely. In Nairobi, for instance, the UN campus offers a secure environment that can serve as a model. Such niches for active mobility can later be scaled up – for example, through car-free days, pedestrian zones, or small car-free streets. Even small-scale measures can have a visible impact and create momentum for broader change.

Creating “islands” of safe walking – such as pedestrian zones in Kampala, car-free days in both Kampala and Nairobi, or the pedestrian street in Mekelle – represents an important starting point for promoting walking. These islands can gradually expand, connecting more urban areas and encouraging walking as a viable mode of transport.

Ensuring safety also means introducing comprehensive traffic-calming measures. Experience shows that such interventions can work effectively in Sub-Saharan African cities as well. The traffic-calmed city centre of Nairobi serves as a good example, although it was developed under specific conditions and has rarely been replicated elsewhere. Future efforts should therefore focus on identifying the factors that enable broader implementation.

Once safe areas for walking and cycling are established, the next step is to connect existing cycling infrastructure. In Kampala, for instance, several kilometres of cycle paths already exist, but they remain isolated from the wider transport network. The goal should now be to link these routes with the surrounding infrastructure to create a coherent and usable system for cyclists.

4.3 Promote road safety- especially for crossing pedestrians

Even where fences or barriers are installed, people often continue to cross roads at ground level if it is faster and more convenient. Crossing at grade is usually perceived as easier than using designated junctions or pedestrian bridges. Therefore, making at-grade crossings safer and more comfortable is one of the key entry points for improving road safety and promoting walking. It also helps reduce time losses for pedestrians.

Road safety remains a major challenge, and the most vulnerable road users – especially pedestrians – are the ones most affected. Cycling still plays a minor role due to its low modal share, but pedestrians face significant risks daily. Non-compliance with traffic rules is widespread, particularly towards vulnerable road users. For example, many drivers fail to stop at zebra crossings. While private cars are often passive, boda bodas (motorcycle taxis) and some buses frequently operate without adherence to any traffic rules.

Boda bodas, in particular, pose a serious safety and comfort issue. They encroach upon pedestrian areas, drive on pavements, and often ignore even basic traffic regulations. As a result, they directly compete with pedestrians for space and undermine safety – even in zones meant to be car-free.

Traffic interaction in these environments often relies on non-verbal negotiation, such as eye contact or gestures to determine right of way. In such situations, vulnerable road users are at a disadvantage. This systemic lack of compliance cannot be solved quickly or locally. While stronger enforcement is important, it alone cannot ensure a safe environment for walking and cycling, nor can it sustainably promote active mobility at the community level.

What is needed are concepts for self-enforcing infrastructure – transport environments that promote safety and comfort even when rules are not consistently followed. Such infrastructure should



communicate clearly through design, guiding behaviour intuitively and physically limiting unsafe actions. Examples include improved visibility, reduced speeds, and the structural separation of pedestrian areas. These design principles ensure safety independently of user compliance.

Some promising approaches already exist. In the city centre of Nairobi, for instance, tabletop crossings and traffic-calming elements with gently raised side areas have been implemented to slow vehicles and support safe pedestrian movement. Similar ideas were developed and partially tested within the Living Labs.

Improving pedestrian crossings on major roads remains a high priority. Many accidents occur at these points, where pedestrians also experience long delays when trying to cross. Because such locations are numerous, scalable solutions are required. Experience has shown that grade-separated crossings, such as pedestrian bridges, are often not successful: they tend to have low usage rates despite high construction costs and limited accessibility. Therefore, improving at-grade crossings through design-based, self-enforcing measures represents the most effective and context-appropriate approach for enhancing pedestrian safety.

4.4 Manual und training for cyclists

Education and training of road users should be strengthened – not to shift responsibility onto the more vulnerable groups, but to empower those who wish to walk or cycle but currently lack the confidence to do so. Alongside infrastructural improvements, training for cyclists is essential. Cycling remains a risky activity in cities such as Kampala or Nairobi, where road conditions and traffic behaviour pose significant safety challenges.

A key objective is therefore the development of cycling schools, where everyone – regardless of age, gender, or background – has the opportunity to learn how to ride a bicycle. Beyond learning the basic skill, the emphasis is placed on safe cycling in urban environments, particularly within the complex and often unpredictable traffic of large cities.

Together with local partners, guidelines for responsible cycling behaviour were developed, taking into account the real conditions of urban traffic, including frequent rule violations by motorised vehicles. The result is a set of practical recommendations for cyclists to take active responsibility for their own safety, without relying solely on the compliance of other road users.

This approach underlines that the promotion of cycling is not limited to infrastructure alone. It also depends on education, training, and public awareness to foster a culture of mutual respect and safe coexistence among all road users.

4.5 Consider the needs of different target groups

The COVID-19 pandemic has led to a noticeable increase in street vending, as many small business owners could no longer afford high rental costs and moved their activities into public space. This development needs to be addressed constructively. Future strategies should aim to rethink the use of existing public space rather than simply displacing vendors. It is important not to exclude or criminalise street vendors but to develop solutions in collaboration with them, ensuring that both economic livelihoods and pedestrian accessibility are maintained.

Address social structures in urban life

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Social structures play an essential role in everyday life in African cities. To promote walking, efforts must focus on making the daily journeys of those who already walk safer and more comfortable, in order to prevent them from switching to motorised transport as soon as they can afford to. Another goal should be to challenge social perceptions of cycling, presenting it as a viable and respectable mode of transport for all social groups. Several community-based projects have already illustrated that cycling can be integrated into diverse social contexts when properly supported.

Ensure the availability of bicycles

In recent years, the demand for bicycles in Kampala has risen significantly, especially during the COVID-19 pandemic, when many people turned to walking and cycling. However, this highlighted a major challenge: the limited availability of affordable and suitable bicycles. New bicycles are expensive and scarce, and the supply of second-hand bicycles remains limited. Moreover, the hilly topography of Kampala makes conventional bicycles less practical for many users. Future measures should aim to improve access to bicycles, considering different user needs—such as men’s and women’s frames, as well as electric bicycles that can better handle steep terrain.

Address gender roles

Gender norms continue to shape who cycles and who does not. In many regions, cycling remains predominantly male, while women often face cultural or practical barriers. Traditional clothing, such as skirts, can make cycling difficult, and in some areas—like rural Kenya—very few women cycle at all. Even those who learned to cycle in their home regions often stop once they move to urban areas due to safety concerns.

To overcome these barriers, campaigns promoting women’s cycling, the creation of safe learning environments, and the provision of women-friendly bicycles (e.g., step-through frames) are crucial. Pilot projects on university campuses have already demonstrated how such targeted measures can encourage women to take up cycling.

Involve children and youth

A strong focus should also be placed on the younger generation. Learning to cycle at an early age promotes independence and enables children to travel longer distances, for example to school. However, safe cycling behaviour must be taught early on. Establishing cycling schools for children can help them learn to handle bicycles properly and understand traffic rules from a young age.

In parallel, surveys can be conducted to better understand children’s mobility patterns. These findings can then be tested and translated into small-scale interventions within Living Labs or Cycling Labs, allowing the effectiveness of measures to be evaluated in real urban contexts.

Integrate street vendors into urban mobility planning

Street vending is an integral part of urban life in many African cities. Vendors often use pedestrian spaces to reach customers, shaping the character of sidewalks and streetscapes. While this can restrict walking or cycling, street vending also represents an essential form of local economic activity. Therefore, future urban mobility planning should aim to balance pedestrian accessibility with the needs of informal traders, integrating them into the planning process rather than treating them as an obstacle.



4.6 Other required measures to promote active mobility

In addition to the themes addressed within CAMA, several emerging approaches have been identified that play an important role in advancing walking and cycling, even though they could not be explored in depth within the project. These approaches highlight broader social, infrastructural, and strategic questions that will be essential for the continued promotion of active mobility in African cities:

- **Strengthening compliance and road culture:**
How can societies foster greater respect for traffic rules and ensure safer behaviour among all road users, particularly in relation to cyclists and pedestrians?
- **Inclusive and accessible infrastructure:**
How can infrastructure be designed to meet the needs of people with mobility impairments, ensuring that walking and cycling are accessible to everyone?
- **Shaping new narratives of mobility:**
What narratives can help redefine walking and cycling as modern, dignified, and desirable forms of transport — moving beyond the traditional idea of upward mobility that links progress with owning motorised vehicles?
- **Developing coherent strategies:**
How can the various building blocks of active mobility promotion be integrated into a cohesive yet manageable strategy — one that provides guidance without overwhelming local actors faced with the scale and complexity of the challenge?

These questions point to important directions for future research and policy development. Addressing them will help ensure that active mobility becomes a sustainable, inclusive, and aspirational component of urban transport systems across Sub-Saharan Africa.



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5. Methodology Learning Alliances and Living labs

In the chapter the question is addressed, under which conditions the transfer of the learning alliance and living lab methodology has worked in the context of promoting active mobility in cities and sub-Saharan Africa.

5.1 Process of the learning alliances

First the different typical phases of the learning alliance process are explored. The learning alliances with living labs follow an essentially consistent sequence of situation analysis, development of hypotheses, development of possible solutions, experimental implementation and subsequent analysis. These general steps are used as a basis for comparing the various learning alliances in the CAMA project with each other.

5.1.1 Initiate and start

In the exploratory and preliminary phase, it is clarified whether the intended topic is suitable for the learning alliance and to identify and involve the relevant stakeholders. At the start an orientation is carried out in which a common understanding of the problem and thus the research and practical objectives of the real-world laboratory is developed with all stakeholders involved. In this way, socially relevant questions are developed together with the practitioners and the scientific questions of the real-world laboratory are derived from this. The start phase includes: identify lack of knowledge and potential learning, identify necessary outcome, conclude relevant process, identify necessary activities, identify relevant actors and check individual added value.

The start phase can be supported by quality assurance criteria such as stakeholder analysis, participation plan and monitoring of participation. These are activities that lie within the direct sphere of influence of the organisers of the learning alliance. In the context of learning alliances (Butterworth et al. 2011; Eckart et al. 2018), it has proven useful to use a set of questions to better understand the stakeholders, which have already been widely used under the title "stakeholder analysis". The stakeholder analysis includes reflective questions about the stakeholders and their motivation and interests. This knowledge about the stakeholders helps to recognise possible conflicts and resistance to the living lab at an early stage, but also to identify key actors and drivers. By identifying the strategic goals of the stakeholders, their scope and relationship to other stakeholders, possible alliances can be identified and thus offer the opportunity to positively influence the living lab process. In the first step of a stakeholder analysis, the stakeholders relevant to participation in the living lab are identified. In real-world laboratories, participation focuses on the relationship between researchers and practitioners. The stakeholder analysis provides a good overview of who has participated in the learning alliances. This includes both high-level involvement and actors who require empowerment. In some cases, however, core stakeholders such as KENHA or KCCA were also missing and were not ready to share their decision-making power with the learning alliance. In a further step, the motivation and interests of each stakeholder are determined. Motivation refers to the stakeholders motives for actively and constructively participating in the living lab. Interests are the aspirations of the stakeholders that they want to achieve as results in the learning alliance. The corresponding knowledge helps to assess the influences of the stakeholders on the object of research (such as obstacles or opportunities) and the transformation process in learning alliances.



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To begin work in learning alliances, coordination meetings are first held with the practical stakeholders. It can take six to twelve months to establish active and constructive participation with the practitioners. A major challenge in the start-up phase is to win over the involved stakeholders for participation in the project and to retain them in the long term. Due to Covid and the civil war in Ethiopia, the process initially started online. This only worked to a limited extent. Only when on-site meetings were possible was it possible to start the process in the cities started. There needs to be an occasion for people to visit to meet and for the stakeholders to come together. Bringing the members of the learning alliance together worked well. A broad circle of stakeholders from different fields were convened. The university partners have a very high convening power. In addition, the project was a good opportunity for local stakeholders working in this field to meet and discuss the topics of promoting active mobility addressing the local needs. Stakeholders could be brought together and constructively discuss the promotion of active mobility. A space for exchange and learning was created.

5.1.2 Analyzing and orientation

In all learning alliances, the process of first selecting specific study sites, understanding the data for analysis there, prioritising topics and developing solutions for possible real-world experiments has worked. The mixture of traditional workshops, visits to stakeholders in their offices, site visits to the locations, joint bike rides, etc. proved successful. This allowed the general discussion to be broken down into specific local challenges.

The new survey and analysis methods, such as the online mapping tool or video analysis, were well accepted. This makes it possible to plan in an informed manner even in data-rich situations. The local requirements are recognised, priorities for action are jointly derived from the local requirements and concrete ideas for scientifically supported real-world laboratories are developed. From the range of possible solutions, those that are locally appropriate and for which acceptance can be created are selected.

5.1.3 Developing and improving Ideas for living labs

Living labs as experiments can be used to check whether measures for the promotion of active mobility are fully effective and whether unintended or even undesirable effects occur in addition to the desired effect. Ideally, transferable, generalisable findings can also be gained from living labs. In addition, living labs are demonstration projects for the public and enable a wide range of stakeholders to understand and experience solutions in order to promote transformation processes. In addition, temporary measures can also be used to illustrate conditions that would not have been introduced on a permanent basis straight away due to possible concerns on the part of the administration or citizens. Gathering local experience in this way can help to overcome resistance to new solutions and contribute to the faster dissemination of innovative measures.

The development of the living labs right through to the pre-planning phase has worked well in all learning alliances. Solutions for the promotion of active mobility have been developed everywhere that offer a small step of innovation. The proposals for living labs identified by the learning alliance are discussed in earnest between the organizers of the learning alliance and the organisations responsible for implementation. Specific locations, implementation conditions, responsibilities, authorisations, etc. of the living labs are discussed. There are many imponderables at this threshold from the idea to temporary realisation of a living lab that are outside the area of responsibility of the researchers. As consequences these uncertainties can often lead to cancellations or changes to plans of the living labs.



5.1.4 Implementation

In the implementation phase of the learning alliance, the promotion of active mobility is addressed through a variety of measures. Most learning alliances involved the implementation, and evaluation of living labs. The implementation of a living lab, from the participatory development of a hypothesis to the analysis of the realized experiment, can take up to a year.

In living labs solution for the promotion of active mobility are implemented at least temporarily in a real setting and can be experienced by the actors in the real world. The duration of the living labs should be long enough to change habits and thus allow an unbiased evaluation of the measure. A period of three months proved to be practicable for this purpose. The living labs were implemented very differently at each location.

- Mekelle: In Mekelle challenges for crossing, insufficient pedestrian space and lack of cycling infrastructure were identified. As living lab an concept for a temporary pedestrian zone was developed and implemented. The jointly developed idea of the living lab was implemented together with stakeholders, a detailed before and after evaluation was carried out and there was an opportunity to learn for all members of the learning alliance.
- Nairobi: The learning alliance Nairobi discussed different opportunities for living labs. The idea to improve pedestrian crossing at University Way in Nairobi could not be implemented. On the opposite a fence was constructed during the project phase to prevent pedestrians to cross on street level. This intervention provided the opportunity to be an unintended living lab. The opportunity arose to evaluate the effect of the fence and to see to what extent this influences the crossing of pedestrians. In addition a living lab to develop manual for safe cycling in Nairobi was successfully implemented with several stakeholders. Hence living labs doesn't always have to be structural interventions.
- Kampala: The learning alliance in Kampala developed the concept of selfenforcing infrastruktur in order to improve crossing pedestrians. The implementation of the living labs was a story of delays and location changes. First a living lab in Sir Apollo Road was planned. This idea was rejected due to concerns of the administration and refered to other possible locations. The advantage of these several changes of locations of the living lab is an understanding how the idea of selfenforcing infrastruktur can work at different locations. It has already been checked and proven that the considerations for the original site can be transferred to other locations. The opportunity was also taken to implement the idea of the living lab as part of Carfree Day in Kampala. Finally the concept of the living lab was implemented on a location near university.

5.1.5 Evaluation and analysis

This phase of the learning alliance is focused on a scientific evaluation as a before-and-after comparison of the living lab. The living lab serve as an empirical research method to evaluate the impact of measures in a before-and-after comparison.

The living labs are accompanied by a process and impact analysis. A process analysis examines the supporting and inhibiting factors (e.g. acceptance of the stakeholders, political framework conditions, conflicting objectives) that occur in the planning, participation and implementation process of the living lab. The impact analysis analyses the traffic, social, ecological and other effects of the living lab. The aim is to obtain scientifically sound statements on the impact of the living lab experiments on the promotion of active mobility that are accepted by all stakeholders. Even if the living labs were



implemented in very different ways and in some cases did not work out as originally intended, learning processes were achieved in all learning alliances.

- Mekelle: In the learning alliance in Mekelle classic learning process from planning an idea, implemented of the living lab, scientific before and after evaluation and meetings for joint learning with the stakeholders could be realized.
- Nairobi: It was possible to learn from the clearly documented undesired intervention of the fence on University Way. The learning is, that this conventional solution does not work in the long term. Although this was already known before, it is documented here in detail and real time. Hence the evaluation methods had to adapted to learn from this “undesired living lab”. Nairobi also learnt from the Cycling Manual which was developed and tested together with the stakeholders.
- Kampala: By moving the location for the living lab several times to different locations, the transferability of the developed solutions to different locations and thus the broad transferability was well tested. In Kampala, the evaluation methods had to be adapted to enable the learning processes.

5.1.6 Learning and transfer

In the final phase the focus of the learning alliance is on transferring the findings from the living labs and any other activities into a permanent and possibly transferable state. The research results are fed back to all those stakeholders and practitioners involved. Evidence-based advice is given on which measures for the promotion of active mobility should be permanently implemented on the ground beyond the living labs. The stakeholders should be able to understand the reasons why certain results from the living labs were or were not taken up.

By feeding the findings from the process and impact analysis back to the practitioners, living labs can initiate or accelerate scientific and social learning processes. For example, the transformation of everyday transport activities requires a change in the behaviour of those involved in practice. Reflecting the findings from research back to those involved in practice can promote the necessary individual, organisational and social learning.

The results from the learning alliances will be consolidated. This should be based on the results of the evaluation of the living labs. Based on the learning outcomes of the temporary implementation, the solution will be made permanent. In addition, this solution will be applied to other locations with comparable problems. The learning alliances and the associated learning process have contributed to the expansion of possible solutions for the promotion of active mobility. Solutions are thus created that fit the local framework conditions.

There are stabilisation and follow-up activities after the completion of the living labs. The aim is to continue working on these issues with the stakeholders. Another research proposal has already been submitted with Stakeholders in Nairobi, but unfortunately this was not successful. Follow-up applications are also being submitted in Mekelle and Kampala, as well as the joint VREF consortium application to promote pedestrian traffic. The new application will also explicitly draw on the learning alliances that have already been established. The established structure allows rapid demand led research to be continued. It is also good if each research project does not set up its own structures but utilises existing structures. This saves the entire set-up effort and allows them to be up and running quickly.



The development of new teaching materials and course content in the field of active mobility is another key achievement. The findings from the project were directly incorporated into existing courses, which were expanded to include content on climate-conscious mobility planning, living labs and participatory infrastructure development. In this way, university teaching in Germany and the partner countries was not only updated, but also internationally networked and deepened in an application-orientated manner.

5.2 The results in the different learning alliances (LA)

To better understand the interaction between the different phases of the Learning Alliances and their role in shaping Living Lab interventions, the activities and outcomes in the three partner cities are presented below. While all Learning Alliances followed a common co-creation logic, their concrete development and results were strongly influenced by local institutional, political and spatial conditions.

5.2.1 Learning Alliance Nairobi

Background and focus

The Learning Alliance in Nairobi evolved from the everyday experiences of cyclists and pedestrians navigating the city's complex traffic environment. Early observations and personal experiences of cycling in Nairobi were systematically discussed with local cyclists, trainers and advocacy groups. These discussions highlighted recurring real-life challenges and formed the basis for two complementary strands of work: (1) pedestrian safety at major urban crossings and (2) cyclist empowerment through training and knowledge exchange.

University Way: pedestrian crossings and an unplanned real-world experiment

One central focus of the Learning Alliance was University Way, an eight-lane urban highway adjacent to the University of Nairobi. Despite the presence of a pedestrian footbridge, large numbers of pedestrians continue to cross at street level, particularly opposite the university's main gate. Together with stakeholders, the project team analysed pedestrian behaviour, infrastructure conditions and safety risks in detail.

Jointly developed ideas aimed at improving safety at ground-level crossings through design-based solutions. However, despite repeated attempts to engage the Kenya National Highways Authority (KeNHA), no agreement on implementation could be reached. Instead, KeNHA later installed a fence along the median to prevent pedestrian crossings.

This intervention, although contrary to the project's approach, created an unplanned real-world laboratory. Observations showed that pedestrians continued to cross, often walking along the fence to its end or creating informal openings within months. This case provided valuable evidence that restrictive, top-down measures do not eliminate pedestrian demand and may even introduce new safety risks. The Nairobi case thus offers a rare longitudinal documentation of how conventional traffic management interventions interact with everyday mobility needs.

Development of the Cycling Safety Manual

In parallel, the Learning Alliance supported the development of a Cycling Safety Training Manual for Nairobi. Local cycling trainers, activists and experienced cyclists collaborated to document practical



knowledge that had previously been informal and inaccessible to less experienced riders. The manual was deliberately designed in a comic-style format to enhance accessibility and engagement.

The aim was not to shift responsibility for safety onto cyclists, but to empower users while continuing to advocate for safer infrastructure. The manual has been tested in practice, and a master's thesis provides the framework for its evaluation. This process represents a form of knowledge democratization and empowerment within Nairobi's cycling community.

Reflections

The Nairobi Learning Alliance demonstrates how meaningful learning can emerge even when planned infrastructure interventions cannot be implemented. The combination of evidence-based analysis, reflection on unplanned interventions and user-oriented knowledge products illustrates the value of flexible, context-sensitive Learning Alliances.

5.2.2 Learning Alliance Kampala

Establishment and stakeholder engagement

A Learning Alliance was successfully established in Kampala as a central component of the project's co-creation strategy. It brought together representatives from Makerere University, Kampala Capital City Authority (KCCA), the Ministry of Works and Transport, UNRA, civil society organisations, advocacy groups, consultants and students.

Key activities included stakeholder workshops, site visits, thematic discussions and experiential learning formats such as bicycle tours, which helped participants better understand walking and cycling conditions from a user perspective.

Evidence-based problem identification

Empirical evidence from surveys, crowd mapping and video-based traffic conflict analysis strongly shaped the Learning Alliance discussions. In particular, analysis at Sir Apollo Kaggwa Road highlighted severe pedestrian safety problems:

- No vehicles yielded at the zebra crossing;
- Most pedestrians waited for gaps despite formal crossing facilities;
- Many pedestrians accelerated or ran while crossing;
- Interactions with boda bodas significantly increased risk.

These findings reinforced the consensus that pedestrian safety cannot rely on rule compliance alone and that self-enforcing infrastructure is essential.

Living Lab development and implementation challenges

Multiple Living Lab locations were explored. Sir Apollo Kaggwa Road was analysed in detail, and initial design concepts were co-developed, but implementation was rejected due to parallel planning processes. A second proposal at the UMI Junction on Jinja Road faced similar challenges.

Although these repeated rejections required significant additional effort, they strengthened the Learning Alliance's capacity to adapt and test the transferability of design concepts across different contexts. An artistic pilot intervention was implemented during Kampala Car Free Day, though its impact evaluation remained limited.



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Ultimately, sustained engagement led to approval of a Living Lab at Makerere Hill Road near Makerere College School, a high-risk pedestrian crossing used daily by students. While time constraints limited full impact evaluation, reaching implementation after prolonged negotiation represents a major achievement of the Kampala Learning Alliance.

Reflections

The Kampala case highlights the importance of institutional alignment, persistence and flexibility. Although implementation proved challenging, the Learning Alliance process generated robust, transferable knowledge and strengthened evidence-based advocacy for pedestrian safety.

5.2.3 Learning Alliance Mekelle

Context and process

In Mekelle, the Learning Alliance operated under particularly challenging conditions. Due to the civil war and its aftermath, external visits were not possible for an extended period, requiring the local partners to work largely independently. Despite these constraints, a strong and inclusive Learning Alliance was successfully established, involving administration, civil society, schools and other local stakeholders.

Living Lab implementation and outcomes

The Learning Alliance identified key gaps for active mobility, including unsafe crossings, insufficient pedestrian space and lack of cycling infrastructure. A clear and pragmatic concept for a temporary pedestrian zone was developed and implemented as a Living Lab.

The intervention included:

- Zebra crossings for safer pedestrian movement;
- Expanded pedestrian areas with dedicated space for street vendors;
- Bicycle lanes;
- Planters and design elements to improve the walking and cycling environment.

The Living Lab had a strong symbolic dimension, representing a return to normality after conflict. Favourable conditions—such as trusted relationships with the local administration and a well-timed implementation window—supported success.

Evaluation and impacts

Evaluation results indicate:

- Increased pedestrian volumes;
- More cyclists using the area;
- Reduced congestion;
- Improved local economic activity;
- Greater presence of children and women in public space.

The Living Lab attracted significant public attention and social media engagement, shifting public discourse toward urban quality and everyday mobility. As a result, the concept of the pedestrian zone was consolidated and further discussed locally.



Reflections

The Mekelle Learning Alliance demonstrates the transformative potential of Living Labs even in post-conflict contexts. Strong local ownership, inclusive participation and context-sensitive timing proved decisive for success.

5.3 Added value and benefits of learning alliances

The potential added value generated through real-world laboratories can be described in general terms. Such laboratories offer opportunities to integrate research and practice, foster innovation, and build socially robust knowledge. The key dimensions of added value include:

- Local customisation of solutions: Tailoring interventions to specific local contexts and needs.
- Facilitation of implementation processes: Supporting the practical application and acceptance of new solutions.
- Use of previously untapped knowledge resources: Mobilising practical and experiential knowledge to develop socially robust insights.
- Bridging research and practice: Promoting the uptake of innovative solutions by strengthening ownership among local stakeholders.
- Adaptation to stakeholder needs: Aligning innovations with what people truly require, rather than with assumptions made solely from a technical or engineering perspective.
- Generation of diverse forms of knowledge: Contributing to the development of systems knowledge, orientation knowledge, transformative knowledge, and experience-based knowledge.

Subsequently, the specific added value achieved through the real-world laboratories in the CAMA project will be analysed in detail.

5.3.1 Knowledge generation

Real-world laboratories contribute significantly to knowledge generation by fostering close collaboration between practitioners and scientists. Through the active participation of stakeholders, extensive and context-specific knowledge of real-world challenges can be obtained.

This process includes both the creation of new knowledge, based on the identification of novel data and insights, and the integration of existing knowledge from different sources. Participatory approaches enable the development of insights that go beyond the scope of conventional empirical research.

Living labs provide particularly favourable conditions for collecting everyday and local knowledge from practitioners. They bring together all relevant stakeholders involved in the desired transformation process and ensure continuous exchange between practice and research.

In these collaborative settings, knowledge emerges that could not be generated through traditional research methods alone. For example:

- In Mekelle, a valuable before-and-after analysis became possible, which would not have been achievable without the real-world laboratory approach.
- In Nairobi, previously untapped knowledge resources from experienced cyclists were captured and systematically documented.



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- In Kampala, the frequent shifts between application sites allowed valuable insights into local implementation processes to be gained.

Overall, these experiences highlight how real-world laboratories enable the co-production of knowledge that is deeply embedded in practical realities while advancing scientific understanding.

5.3.2 Co-design of research and practice

The co-design of research and practice lies at the core of the living lab approach. Research is conducted in close alignment with the needs of social and professional practice, ensuring that scientific inquiry directly supports real-world decision-making and transformation processes.

The primary goal of living labs is to enable scientists and practitioners to work together in shaping both the research and transformation agenda. Through this collaboration, they jointly identify:

- the solutions to be developed,
- the knowledge gaps to be addressed, and
- the transformations to be initiated.

This co-design process also helps to determine which information and research questions are most relevant for practitioners—for example, when they need evidence to decide whether to support or reject a proposed transformation.

In the context of the CAMA real-world laboratories, this collaborative approach proved particularly effective in identifying the specific framework conditions for promoting active mobility in sub-Saharan Africa. The discussions within the learning alliances were strengthened by a multi-method approach, including diverse surveys and participatory activities. This made it possible to prioritise among the many similar challenges related to active mobility.

Furthermore, concrete and context-sensitive solutions were explored, such as self-enforcing infrastructure designed to protect pedestrians and cyclists even under conditions of low rule compliance.

The adaptation of solutions to local contexts became evident through the variations in results and processes across the different real-world laboratories. In Kampala, for example, the frequent changes of location served as practical exercises in adapting interventions to local conditions.

5.3.3 Empowerment of innovators

A key objective of living labs is the empowerment of innovators. By providing innovators with access to research capacities and fostering opportunities for exchange and coordination, living labs help strengthen the processes of innovation and transformation.

The nurturing of innovators is grounded in diffusion theory, which explains the factors influencing the adoption or rejection of innovations. By actively involving innovators in living labs, they are supported in both the development and dissemination of their ideas. This participation gives them access to scientific expertise and methodological support, as well as organisational assistance for conducting their own research activities.

Moreover, their involvement facilitates communication and collaboration with other relevant practitioners, creating a networked environment that encourages shared learning and coordinated action.



In the CAMA real-world laboratories, the principle of empowerment was particularly embraced by civil society actors. This was evident across all sites, where numerous participants—often referred to as “real alumni”—actively engaged in the learning alliances. The opportunity to participate, exchange ideas, and contribute suggestions for dialogue with local authorities was widely appreciated.

A prominent example of this empowerment is the creation of the Nairobi Cycling Manual, which illustrates how previously marginalised actors were given a platform to share their experiences and expertise. Their specific, practice-based knowledge was documented and made available for broader discussion, representing a tangible outcome of inclusive innovation and co-production.

5.3.4 Promoting learning processes

Living labs play a crucial role in promoting learning processes by providing a framework for exchange, evaluation, and reflection. Through the systematic feedback of research-based knowledge to practitioners, living labs can initiate or accelerate both scientific and social learning.

The emphasis on learning processes stems from the understanding that transformation often requires changes in people’s lifestyles and actions. These new ways of thinking, living, and acting must be learned. In this sense, living labs function as “places of learning”, offering space for experimentation, reflection, and shared understanding.

The promotion of learning within and through living labs allows for both direct learning—through hands-on participation—and indirect learning, by observing and reflecting on processes and outcomes.

In the CAMA real-world laboratories, several forms of learning could be observed:

- In Mekelle, a learning process unfolded from the initial development of a local innovation, through experimentation and performance evaluation, to its practical realisation.
- In Nairobi, actors used the opportunity to record and document their previously tacit knowledge, allowing them to reflect on and systematise what had previously been intuitive or experience-based.
- In Kampala, the repeated and unplanned re-design of solutions across multiple sites provided valuable lessons about the concept of safe crossings and the principles of self-enforcing infrastructure.

Overall, these experiences demonstrate how living labs foster continuous learning, supporting both individual and collective transformation toward more sustainable practices.

5.4 Supporting and inhibiting factors for successful living labs

The reasons why some real-world laboratories progressed further through the different stages than others were examined in detail. This analysis was conducted through several reflection rounds and semi-structured group discussions involving participating researchers and key stakeholders.

In addition, the documented results from the individual real-world laboratories were analysed to identify patterns and influencing factors. An effort was made to differentiate between local factors, which are specific to each context, and general factors, which may be transferable across settings.

While each case is unique and cannot simply be replicated, it is still possible to identify several key general factors that influenced the success and progression of the real-world laboratories:



5.4.1 Good management Participation process

The learning alliances must be well managed with the already known quality criteria:

- Identifying, involving all key players. Handling if certain core players are missing. Stakeholder analysis in particular.
- Establish a constructive atmosphere for dialogue between research and practice. In particular, good moderation.
- Ongoing monitoring helps to recognise potential problems at an early stage and develop appropriate solutions
- Scientifically sound methods are used for before and after evaluation in order to clearly record the impact of the real-world laboratories.
- There is feedback on the learning outcomes and a shared space for learning is created.

The learning alliances must be carefully managed according to well-established quality criteria to ensure effective collaboration between research and practice. Key aspects include:

- Identifying and involving all key stakeholders: Conducting thorough stakeholder analyses to ensure that all relevant actors are represented and managing situations where certain core players may be absent.
- Creating a constructive atmosphere for dialogue: Fostering open and respectful communication between researchers and practitioners, supported by skilled facilitation and moderation.
- Implementing continuous monitoring: Maintaining ongoing observation and evaluation processes to identify potential challenges early and to develop suitable solutions in time.
- Applying scientifically sound evaluation methods: Using robust before-and-after assessment techniques to accurately document the impact and outcomes of the real-world laboratories.
- Providing feedback and creating shared learning spaces: Ensuring that learning outcomes are communicated back to participants and that spaces for mutual reflection and knowledge exchange are established.

5.4.2 Successfully integrating stakeholders

The success of real-world laboratories depends strongly on whether all veto players can be involved and whether they are willing to cooperate. This aspect is closely linked to power dynamics, as these actors may be reluctant to share influence or decision-making authority with researchers and practice partners in the dissemination of innovative solutions.

Whether successful collaboration can be achieved depends not only on the approach and initiative of the researchers—for example, by creating suitable framework conditions or using existing networks—but also on the attitude of the veto players, which often cannot be influenced externally.

If contact persons are in transition, overloaded with other tasks, or unwilling to share power, these factors can severely hinder the progress of the real-world laboratories. Such barriers are often difficult to overcome during the course of a project. Experience suggests that it is highly beneficial when personal relationships and mutual trust already exist prior to the start of the living lab. Establishing these connections from scratch within a limited project timeframe has proven to be challenging.

In several cases, key institutional actors such as KENHA or KCCA chose not to participate actively in the Learning Alliance meetings. This may have been a way to avoid situations in which they would have to



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share authority or engage in collective decision-making. Consequently, these actors often had to be contacted separately and maintained the role of external veto players rather than active collaborators.

The reasons for their non-participation remain unclear but may include a lack of interest, perceived absence of added value, unwillingness to share power, low prioritisation of active mobility, or limited human and time resources. Where personal connections and agreements existed, however, it was possible to build stronger commitment—even among challenging stakeholders. In contrast, those who did not participate in the Learning Alliance process tended to show limited ownership of the outcomes, perceiving the Living Lab not as an opportunity but rather as an additional task or obligation.

Despite these challenges, empowering previously marginalised stakeholders has proven to be a major strength of the approach. By engaging such actors, valuable knowledge resources—previously inaccessible to scientific research—can be uncovered. Real-world laboratories thus create significant added value for these participants and often yield highly relevant and innovative results.

Within the CAMA project, substantial capacity building took place, demonstrating that living labs can serve as effective dialogue platforms. They go beyond “talking about change” and instead engage stakeholders in tangible opportunities for co-creation and experimentation.

Finally, the size and complexity of the urban context also appear to influence success. Medium-sized cities tend to provide a more manageable administrative environment compared to large metropolitan areas, where bureaucratic systems are more fragmented and hierarchical. In smaller cities, it is generally easier to identify and reach the right decision-makers, and fewer actors need to be coordinated. However, administrations that are too small may lack the necessary personnel and institutional capacity to support implementation effectively.

5.4.3 Building on the existing relationships and structures

Successful implementation of learning alliances and real-world laboratories often depends on the ability to build on existing relationships and structures for stakeholder engagement. When existing relationships with key stakeholders could be utilised, the establishment of learning alliances was generally much easier.

On the one hand, this is due to existing trust, which provides stability and reduces the perceived risks associated with experimental formats such as real-world laboratories. On the other hand, maintaining established relationships fosters a sense of long-term commitment, as stakeholders are more willing to stay engaged and participate in events that help sustain these connections.

For example, in Mekelle, strong pre-existing relationships facilitated collaboration and participation. In contrast, the project in Kampala entered a phase of transition, with changing contact persons and no established relationships to rely on, which complicated coordination efforts.

Building on existing projects and initiatives also offers many advantages. It reduces the effort required for setup and organisation, prevents stakeholder fatigue, and ensures that activities align more closely with local agendas and priorities. Events such as Car-Free Days, Cycling Days, and Urban October—which are already established in several cities—proved to be ideal frameworks for implementing Living Lab activities in Kampala, Mekelle, and Nairobi.

By linking with such existing structures, Living Labs can be realised with comparatively less organisational effort, while still achieving visible results. This approach allows ideas developed within



the Learning Alliances to be tested and refined in practice, and lessons learned from these initiatives can be directly incorporated into ongoing projects.

5.4.4 Favourable Implementation Windows

Another important success factor is the availability of favourable implementation windows. When the timing and focus of a Living Lab align with the interests and needs of local stakeholders—helping them to achieve their own goals or solve pressing problems—the initiative is more likely to be embraced as an opportunity rather than perceived as an additional burden.

Active involvement of stakeholders throughout the process can help to ensure this alignment. Conversely, if core actors or veto players are not engaged early on and are later presented with results that do not match their agenda, it becomes much harder to find a suitable window for implementation.

5.4.5 Offering added value and overcoming resistance

For real-world laboratories to be successful, their added value must be clear and tangible to all those involved. Participants need to recognise that the initiative offers genuine benefits—otherwise, it risks being perceived as an additional burden rather than an opportunity.

This distinction became evident in the CAMA project: in Mekelle, the real-world laboratory was widely seen as providing added value, whereas in Kampala, it was often regarded as an extra obligation rather than a benefit.

- The added value of real-world laboratories can manifest in several ways:
- the development of locally adapted solutions,
- the removal of barriers to implementation,
- the opening up of previously inaccessible research opportunities, and
- the empowerment of marginalised actors by giving them a stronger voice in shaping outcomes.

It is also important to consider the individual benefits for each stakeholder. For some, the value lies in solving existing practical problems; for others, it is about gaining recognition or having influence in transformation processes. In the African context, the potential for empowering previously marginalised stakeholders is particularly significant. The contrast between privileged and disadvantaged groups is often greater than, for example, in Germany—making such participatory approaches a valuable opportunity to foster greater equity and inclusion.

Another challenge concerns risk-taking and responsibility. Some stakeholders are reluctant to engage in real-world laboratory activities, especially when interventions involve changes in public or street spaces. There is a fear that something might go wrong and that they will be held accountable.

In contrast, researchers and civil society actors are generally more open to experimentation and willing to take calculated risks. These differing attitudes can lead to tension and slow down decision-making processes. It remains unclear whether such differences could be mitigated through risk-sharing agreements or clearer delineation of responsibilities.

In some African contexts, there is also a phenomenon of donor fatigue. Local actors are often confronted with numerous overlapping projects and initiatives, which can lead to overload rather than enthusiasm. When external programmes dominate the local agenda, stakeholders may feel that they have lost control over their own priorities.



To prevent this perception, it is crucial to involve local stakeholders from the outset and ensure that initiatives align with their existing goals and strategies.

Unlike in Germany, participation fatigue was not observed among most civil society stakeholders in the CAMA project. On the contrary, there was a strong interest in engagement and exchange, and many actors welcomed the opportunity to participate in collaborative discussions and activities. This openness presents a valuable opportunity to build participatory structures and strengthen the culture of dialogue through living lab approaches.

5.5 Reflections on learning alliances and living labs

The following key findings can be summarised from the implementation and analysis of the real-world laboratories:

- **Pursuing a clear transformation goal:**
The overarching goal of transformation must be transparent and clearly communicated to all stakeholders. Openness and accessibility are essential—every relevant stakeholder should have the opportunity to participate meaningfully in the process.
- **Legitimisation:**
The legitimacy of the process must be recognised from the perspective of all relevant stakeholders. It is equally important to clarify the right and responsibility of scientists to pursue transformational objectives, ensuring trust and understanding of their role.
- **Local adaptation and ownership:**
Solutions must be adapted to local conditions, fostering local ownership of the innovations developed. This helps ensure that new solutions are context-appropriate and sustainable beyond the project's duration.
- **Research only possible within living labs:**
Many of the research activities carried out would not have been possible outside the living lab setting. The support and engagement of stakeholders enabled testing and experimentation in real urban environments. Moreover, it is vital to respect different forms of knowledge, recognising the value of practical and experiential expertise alongside scientific knowledge.
- **Learning from unexpected outcomes:**
Even when implementation did not proceed as originally planned, valuable learning processes were achieved in every case. In fact, projects often provided deeper insights through challenges and setbacks than through straightforward successes.
- **Empowerment and capacity building:**
Not only researchers but also a broad range of stakeholders had opportunities to learn, reflect, and build capacities through participation. The continuation and follow-up activities after the formal conclusion of the real-world laboratories should therefore be planned and encouraged to sustain momentum.
- **Understanding barriers to scaling up innovations:**
Important lessons were learned regarding the barriers to scaling innovative solutions, including conflicting interests, reluctance to share recognition, and institutional constraints that limit flexibility and innovation beyond established guidelines.
- **Effectiveness, efficiency, and communicability:**
Transformation processes are most successful when they lead to visible and tangible results. Newly developed solutions should be easy to test, experience, and communicate. The more



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accessible and demonstrable the outcomes, the more effectively transformation and behavioural change can be promoted.



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Note on Report Preparation

Digital tools were used in the preparation of this report to support language editing, structural refinement and improved readability. The content, selection, assessment and interpretation of the presented results remain the sole responsibility of the project partners.



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Annex A – Survey Questionnaire (Case Study Kampala)

COLLABORATION ON ACTIVE MOBILITY IN AFRICA (CAMA) SURVEY OF WALKING AND CYCLING IN KAMPALA, MEKELLE & NAIROBI

Dear respondent,

Makerere University Kampala is conducting a research project on active mobility in Africa in collaboration with other 2 African Universities and 2 Universities from Germany. The research project entitled “Collaborations on Active Mobility Africa-CAMA” aimed to better capture the requirements of the pedestrians and cyclists, promote walking and cycling, build learning alliances, and conduct real live experiments that focus on small, tangible, and innovative solutions on the community level. We are inviting you to participate in this research by completing the following survey. The questionnaire has 4 parts and will take approximately 45 minutes to complete. We truly appreciate your valuable time and effort in helping us with this research project. Under no circumstances are you obliged to answer any of these questions; however, doing so will be very helpful for us to complete our research and improve our understanding of the reality of active mobility (walking and cycling) on the ground. We ensure that all your information and data collected for this research will remain confidential and will be used for academic purposes only.

If you would like to reach us please contact:



City Codes

Start

Time:

Date: _____

1. Kampala
2. Mekelle
3. Nairobi

Part - 1: Users' preference and perception towards walking and cycling.

1. How often do you generally use the listed mode of transport for your commuting?

	Daily	3-4 days a week	1-2 days a week	1-3 days a month	once a month	1-2 times a year	never
Walking							
Cycling							
Public transport (Bus/minibus/ /matatu)							
)Three-wheeler (Bajaj/tuktuk)							
Taxis (Uber, Bolt)							
Two-wheeler (Bodaboda)							
Office transport service							
Own private motorcycle							
Own private car							
Other, specify							

2. What is the primary reason for your preference to any mode of transportation?

Fares are affordable / cheaper	Efficiency/ takes less effort	Convenience/ easily accessible	Safety	Comfort	Reliability/ available	Takes lesser time/ quick	Easy to reach	Other(specify)

3. From your experience how long is your usual average walking per day?

Below 15 minutes	15 -20 minutes	21-30 minutes	31 minutes - one hour	1-2 hours	More than two hours





4. What is your main purpose for using the following modes of transport:

	To work place	To school	For shopping	For activity of care*	For fun	For social events (religious, family gatherings...)	Never used it	Other (specify)_
Walking								
Cycling								
Public transport (Bus, minibus, taxi)								
Three-wheeled (Bajaj/tuktuk)								
Two-wheeled (Bodaboda)								
Office transport service								
(Own) Private motorcycle								
(Own) Private car (driver)								

*Under an activity of care is understood for example picking up/dropping a child/children, visiting elderly people/relatives, bringing some relatives to a doctor etc.

5. Please estimate the walking time to the most popular transport stops in your residential area.

Less than 5 minutes	6-10 minutes	11-20 minutes	21-30 minutes	31-45 minutes	45- 60 minutes	More than an hour	Other(specify): _____

6. Please estimate the walking time to the most popular transport stops from your work place/ school.

Less than 5 minutes	6-10 minutes	11-20 minutes	21-30 minutes	31-45 minutes	45- 60 minutes	More than an hour	Other(specify): _____

7. When you walk for longer which one of the streets/road corridors would you prefer?

7.1 Kampala	Luwum Namirembe Road	Jinja Road	Entebbe Road	Gayaza Road	Other(specify): _____
7.2 Mekelle	Hakfen street	Selam street	Hawelti semaetat street		Other (specify)
7.3 Nairobi	University Way	Muindi Mbingu	Jogoo Road		Other (specify)

Why? / reason for your preference: _____

8. How do you assess the quality of the following modes of transport in terms of the listed factors

Transport mode	Motivating factor	Strongly agree	Agree	Neither agree nor disagree	disagree	Strongly disagree
Walking	Safety					
	Comfort (spacious & well-groomed sidewalks)					
	Convenience/ easily accessible					



	Fares are affordable / cheaper					
	Efficiency/ takes less effort					
	Reliability/ available					
	Other (specify)					
Cycling	Safety					
	Comfort (direct well-paved side-tracks)					
	Convenience/ easily accessible					
	Fares are affordable / cheaper					
	Efficiency/ takes less effort					
	Reliability/ available					
	Other (specify)					
Public transport (Bus/ Minibus/ Taxi)	safety					
	Comfort (courtesy, cleanliness & enough leg space)					
	Convenience/ easily accessible					
	Fares are affordable / cheaper					
	Efficiency/ takes less effort					
	Reliability/ available					
	There is no other option that fits my need					
Three-wheeled (Bajaj/tuktuk) *	safety					
	Comfort (courtesy, cleanliness & enough leg space)					
	Convenience/ easily accessible					
	Fares are affordable / cheaper					
	Efficiency/ takes less effort					
	Reliability/ available					
	Other (specify)					
	Safety					



Two-wheeled (Bodaboda) **	Comfort (safe, comfortable seat & direct route)						
	Convenience/ easily accessible						
	Fares are affordable / cheaper						
	Efficiency/ takes less effort						
	Reliability/ available						
	Other (specify)						
Private car	Safety						
	Comfort						
	Convenience/ easily accessible						
	Efficiency/ takes less effort						
	Reliability/ available						
	Other (specify)						
Office transport service	Safety						
	Comfort (cleanliness & enough leg space)						
	Convenience/ easily accessible						
	Fares are affordable / cheaper						
	Efficiency/ takes less effort						
	Reliability/ available						
Own private motorcycle	Safety						
	Comfort						
	Convenience/ easily accessible						
	Fares are affordable / cheaper						
	Efficiency/ takes less effort						
	Reliability/ available						
Other (specify)							

9. When you plan to cycle for longer distances which of the streets/road corridors would you prefer? (if you use cycling as a mode)



9.1 Kampala	Luwum Namirembe	Jinja Road	Entebbe Road	Gayaza Road	
9.2. Mekelle	Hakfen Street	Selam Street	Hawelti Semaetat street		Other(specify): _____
9.3 Nairobi	University Way	Muindi Mbingu	Jogoo Road		Other (specify)

Why? /reason for your preference: _____

10. Benefits of active mobility (walking and cycling) in general?

Benefits	strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Offers cheap transport option					
Reduces congestion					
Parking costs					
Health benefits					
Environmentally friendly/ reduces air pollution					
Socially inclusive/ accessible for all					
Other (specify)					

11. Please indicate how much you agree or disagree with the following statements.

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I would buy a car if I had a higher income.					
I perceive the transportation situation as stressful in my area.					
I see a need to switch to a more environmental friendly transport because of the climate change.					
I see a need to switch to a more environmental friendly transport because of the air pollution.					
I would walk more in the city if there were more comfortable sidewalks with better quality and amenity.					
I walk because I have no alternative					
I would use more public transportation services if they had a better quality.					
I believe that others buy a car because there is no other alternative available.					



I like going by car as it gives me comfort.					
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Part - 2: Users experience on active mobility (walking and cycling)

12. Did you change your mode of transportation in the last 2 years?

	I use it more often	I use it slightly	I have not changed	I use it less/rare	Never used it
Walking					
Cycling					
Public transport (minibus, matatus, taxi)					
Three-wheeled (Bajaj/tuktuk)*					
Two-wheeled (Bodaboda)**					
Office transport service					
Own private motorcycle					
Private car					
other					

13. What was your main reason for modal change, please tick all that apply?

Change in Social status (Marriage, Childbirth, taking child to school)	Injury (physical disability)	Change location	Change occupation/change a job	Getting a better salary/ Could afford a more expensive option	The pandemic (COVID19)	The ongoing war in Tigray	Transport mode not available anymore	Other, specify:

14. To which mode of transport did you shift after the siege in Tigray and how do you feel about your new transport mode?

	I like it and I would like to continue afterwards as a life style	I like it but I want to go back to my former means of transport	I like it but I don't know what I will decide after wards	I don't like it but I don't have any other option
Walking				
Cycling				
Public transport (Bus, minibus, taxi)				
Three-wheeled (Bajaj)				
Office service				
(Own) Private motorcycle				
(Own) Private car (driver)				

15. In your opinion, what are the main conditions/reasons hindering users from using active mobility (walking and cycling) in the city?

Conditions /reasons	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
It's too dangerous					
It's too hot and I get sweaty					
It's too windy and cold					



It's too windy and dusty					
It's too hilly					
There's nowhere to park my bike					
It's too far					
I'm too old					
I'm not fit enough					
It takes too long /it's inconvenient					
In my community, cycling is mainly for men					
I do not cycle because I do not have a bicycle/ costly to hire					
I do not cycle because I do not know how to ride a bicycle					
Other: (specify)_____					

16. In your observation, while walking which one of the following do you think mostly obstructs pedestrian walkways? (You may select more than one response)

17. What emerging mobility challenges do you observe in Kampala, Mekelle and Nairobi cities?

Business/ shop extensions	Street vendors	Construction materials	Advertisement boards/electric poles	Inappropriately placed trees	Inappropriately placed sidewalk furniture	Parked vehicles /cars	Garbage	Broken infrastructure pieces	flower pots	high human traffic	Other: ___
Mobility challenges				Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree			
Lack of a complete pedestrian walkway											
Limited cycling facilities											
Lack of Bicycle rentals											
Lack of Bicycle sharing option											
Poorly managed on-street parking											
Lack of clear guidelines for mobility planning											
Poor planning for Non-Motorised Transport											
Poor street vendor management											
Concerns of road safety											
Lack of Non-motorised Transport implementing strategy											
Other:_____											

Part- 3: Recommendations





24. I believe the following preconditions would have an impact in enhancing positive impression towards walking:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Change in mind set?					
Improve the infrastructure					
Better connectivity with other modes of transport					
Awareness creation and capacity building on active mobility					
Law enforcement					
Traffic management					
Improve Policy framework/regulation					

25. I believe the following preconditions would have an impact in enhancing positive impression towards cycling:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Change in mind set?					
Improve the infrastructure					
Better connectivity with other modes of transport					
Awareness creation and capacity building on active mobility					
Law enforcement					
Traffic management					
Improve Policy framework/regulation					

26. Please indicate how much you agree or disagree to the following measures to improve the culture of cycling:

Suggested measures	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Change in mind set?					
Improve infrastructure for active mobility users					
Provision of more space for cycling (e.g. separate bike lanes)					





Improve safety of active mobility users					
Awareness creation and capacity building on active mobility					
Law enforcement					
Traffic management					
Policy framework					
Leadership commitment to promote active mobility					

Part-4: Basic information and demography of the respondent

1. Gender

Male		Female	
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2. Age

18-25		26-35		36-45		46-55		56-65		Above 65	
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3. Total number of household members in your house

One		Two		Three		Four		More than 5
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4. Number of children (if any)

One		Two		Three		Four		More than 4
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5. How old are they and what means of transportation do they normally use?

Mode of transportation	Under 6	7-12		13-15		16 -17
Walking						
Cycling						
Public transport (Bus, minibus, matatus, taxi)						
Three-wheeled (Bajaj/tuktuk)						
School transport service						
Office transport service						
(Own) Private motorcycle						
(family) own Private car						

6. Educational level

Not formally educated	Grade 1-8	Grade 9-12	Diploma (TVET)	Degree and above
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7. Occupation

Civil servant	Entrepreneur/ company owner	employee in a company	Small retailing	Unemployed	Student	Pensioner	Other: _____
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8. Monthly income (gross salary)



Low income		Lower middle income		Middle income		Higher middle income		High income
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9. Ability/disability (type)

visual		hearing		physical		mental		Other: _____
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10. Sub-city

10.1 Kampala	Central	Kawempe	Nakawa	Makindye	Rubaga		
10.2 Mekelle	Kedamay Weyane	Hadnet	Adihaki	Hawelti	Semen	Ayde r	Quiha
10.3 Nairobi	Starehe	Makadara					

1. Type of vehicle available at your household?

Vehicle type	Number			
	One	Two	Three	Other
Bicycle				
Service car				
Bajaj				
Private car				
Motor cycle				

Anything else that you may want to share with us?

Thank you for your time.

End time:.....

Date:.....

