



### RESEARCH QUESTIONS

- What factors enable or inhibit adoption of bicycles, especially among low-income and other disadvantaged or underserved populations?
- To what extent do existing bicycle solutions perform as expected and meet the needs of the users?

## Access to Affordable Bicycles in Africa

This study, funded by USAID, seeks to understand the background, current state, and opportunities for bicycles to benefit underserved communities, particularly in Sub-Saharan Africa.

It was conducted in three phases over a period of two years, between 2020-2022. An initial Scoping Phase included a literature review and key informant interviews. Phase I consisted of interviews with bicycle users, non-users and other stakeholders in Ghana and Malawi. Phase II constituted data collection through sensors and surveys and in-depth interviews with bicycle-owning households in Ghana and Malawi.

The MIT D-Lab research team collaborated with University of Malawi and World Bicycle Relief in Malawi and Village Bicycle Project and University of Cape Coast in Ghana to implement the study in the two countries.



Research assistants from the University of Malawi installing a sensor on a bicycle. Photo: MIT D-Lab/Megha Hegde

### Key findings

- » Intra-household dynamics, especially gender dynamics, have an effect on who gets to own and use the bicycle, which is, in most cases, male heads of households.
- » Over the course of a day, a single bicycle is often used by different members of the family for different purposes.
- » Sensor data revealed that frequency, duration, and distance of bicycle trips varied widely across the sample groups, with longer and more frequent trips exhibited by rural and older riders with load-carrying bicycles.
- » The transportation needs of a household often cannot be met by one bicycle, leaving other members of the family, especially women, no option but to walk long distances.
- » Prohibitive cost, frequent component failure, and a desire to own a motorized vehicle were often cited as top barriers to bicycle use.
- » Load carrying was reported to be the most desired bicycle feature.
- » A majority of non-users were women who did not know how to ride a bicycle.
- » The study did not reveal gender-specific bicycle design preferences.

## Background

Low-income households in low-income countries face gaps in transportation services available to them, especially if they live in rural areas. Public transportation does not always exist and other forms of motorized transport are often not affordable, forcing people to walk long distances to access schools, markets, healthcare, and other basic services. Bicycles have the potential to fill that gap as a more affordable means of transportation. Studies have shown that bicycle use can result in health, economic, and social benefits such as improved gender dynamics. In light of the benefits associated with bicycles, there are a number of organizations working to improve access to bicycles for low-income households in developing countries. While these organizations have had some success, challenges related to bicycle access and adoption persist, resulting in the continued need for research and development in this area.

## Study design, methodology and phase-wise findings

The study design included a mix of qualitative and quantitative research methods such as literature review, semi-structured interviews, surveys, observation, and bicycle mounted sensors.

### Scoping Phase

Through a literature review and key informant interviews during the Scoping Phase, which took place between June 2020 and February 2021, the team sought to understand the bicycle landscape and explore challenges and opportunities to leveraging bicycles for transportation in Africa. Over 100 documents were reviewed, including academic and grey literature, news, blogs and other popular media, and the team completed 30 key informant interviews with researchers, local and international NGO staff, manufacturers, mechanics, donors, and local bicycle shop owners.

Positive outcomes identified in the literature and interviews included improved gender norms, access to education, productivity and income, and efficiency and time savings. Challenges were related to cost, repair and maintenance of bicycles, infrastructure and government buy-in, social and gender norms, bicycle design, and organizational capacity to promote bicycles. Findings from the Scoping Phase informed the two research questions, as well as the selection of two research sites for Phase I and Phase II (Ghana and Malawi).

### Phase I

In Phase I, which took place between March and June 2021, the team sought to identify key stakeholders, and understand bicycle availability, use cases, bicycle ecosystem, and initial barriers and enablers to bicycle use in each country. Data were collected through observation and interviews with stakeholders in the local bicycle supply chain, such as bicycle users, non-users, producers, and

mechanics. In total, 182 interviews were completed: 95 in Ghana and 87 in Malawi. In each country, three geographical areas were chosen, and within each one, three sites—one urban, one peri-urban, and one rural—were selected.

The findings highlight the importance of load-carrying on bicycles, often for livelihood-related purposes, and shared ownership and usage of bicycles within a household. Affordability, attitudes and perceptions of bicycles, including desire to own a motorized vehicle, and design and quality issues, including frequent component failure, were the primary barriers for adoption. Use of bicycles for productive use, ease of travel, and affordability (in comparison to motorized vehicles) were the primary enablers of bicycle use. These findings helped establish a baseline understanding of the current state of bicycle access, use, and adoption in Ghana and Malawi and informed the specific areas of focus for in-depth data collection in Phase II.

### Phase II

Phase II, which took place between February and September 2022, sought to understand the intra-household dynamics related to bicycle use, gather data related to bicycle usage and challenges over a longer time period, and identify challenges and opportunities related to bicycle design. This phase employed mixed methods of data collection through sensors, surveys, observation, and in-depth interviews. Twenty-four bicycle-owning households were selected in Ghana and Malawi and engaged in the study over a five-week period.

Findings from Phase II revealed the effects of intra-household dynamics, especially gender dynamics, on bicycle usage and ownership; frequency, duration, and distance of bicycle trips reported by sensors; more details on barriers and enablers of bicycle use for users and non-users and bicycle design preferences; and current and desired modifications as reported by the users. Key findings from Phase II are discussed in detail in the next section.



A bicycle mechanic repairing a bicycle in Zomba, Malawi. Photo: MIT D-Lab/Megha Hegde

## Program results

This section outlines some of the key conclusions from Phase II, recommendations, and who can address the recommendation. These findings build on the work completed in the Scoping Phase and Phase I.

Findings	Recommendations	Who can act?
Intra-household dynamics matter when it comes to bicycle use. Male heads of household are often the owners of bicycles and their needs (as they relate to bicycle use) are often met before the needs of others in the household. The use of the bicycle is often tied to the user rather than the task. The transportation needs of the household are often not met by one bicycle.	<ul style="list-style-type: none"> <li>-Programs that provide greater access to bicycles for women and children could be beneficial, while also providing access to bicycles for male users.</li> <li>-Consider introducing aspects of the bicycles that are more attractive for female users and less attractive for male users.</li> <li>-Teaching women and children how to ride a bicycle will also be important.</li> </ul>	<ul style="list-style-type: none"> <li>-Implementing partners</li> <li>-Government programs for bicycles</li> </ul>
Most people said that the bicycle is not affordable.	<ul style="list-style-type: none"> <li>-Design a bicycle that is more affordable and durable.</li> <li>-Create financing options that make bicycle purchase more affordable. Could include things like rent to own, payment in installments, and leasing for a short period of time.</li> </ul>	<ul style="list-style-type: none"> <li>-Universities and/or manufacturers who can work on the design of more affordable and durable bicycle</li> <li>-Financial institutions or implementing partners providing access to bicycles</li> </ul>
Broken parts remain the primary challenge in both countries. Damage to components occurs often and repairs and replacements are often not affordable.	<ul style="list-style-type: none"> <li>-Provide access to affordable, durable parts.</li> <li>-Consider sourcing more durable parts from places like India while considering the high import duties for bicycle parts.</li> <li>-Design new parts that are more durable and affordable.</li> <li>-Train small local businesses or users in bicycle repair to bring down the cost.</li> </ul>	<ul style="list-style-type: none"> <li>-Implementing partners</li> <li>-Bicycle mechanics</li> <li>-Universities, civil society or non-government organizations, and/or manufacturers who can work on the design of more affordable and durable parts</li> </ul>
Modifications were not as common as expected, but of the modifications people had made or would like to make, adding a load-carrying option was most popular. However, this modification is often not affordable. In addition, some people said that their bicycles were too light to carry a load.	<ul style="list-style-type: none"> <li>-Add gears or change existing sprockets on bicycles to make it easier to carry a load.</li> <li>-Design load-carrying modification that is affordable, such as a low-cost carrier made from locally-available materials.</li> <li>-Consider developing a heavier bicycle that is better suited for load carrying.</li> </ul>	<ul style="list-style-type: none"> <li>-Manufacturers</li> </ul>
The study did not reveal major design preferences based on gender. Bicycles are used by many different people in the household.	<ul style="list-style-type: none"> <li>-Develop a bicycle that can easily be adjusted to accommodate riders of different sizes.</li> </ul>	<ul style="list-style-type: none"> <li>- Implementing partners</li> <li>-Universities and/or manufacturers who can work on the design of more affordable and durable parts</li> </ul>





## VISITING MALAWI

MIT D-Lab collaborated with the University of Malawi and World Bicycle Relief on this research project. The photo at left was taken in Zomba when Megha Hegde, a D-Lab researcher traveled to Malawi to oversee the beginning of data collection for Phase II. Left to right: Sly Munthali (University of Malawi), Megha Hegde, Chinsisi Kanyerere (World Bicycle Relief, Malawi), Spy Munthali (University of Malawi), Esther Njiwa (University of Malawi), and two local community members. Photo: MIT D-Lab/MeghaHegde

## Next steps and future work

This study has revealed a number of interesting findings related to bicycle use, ownership, design constraints, and barriers to and enablers of bicycle use. In terms of next steps, the D-Lab research team will share the results with key collaborators and discuss the ways in which the research applies to their work.

There are many opportunities for work to be done as outlined in the recommendations section, such as developing bicycle programs that target women and children, design improvements for bicycle parts and load carrying options, and adapting financing mechanisms to make bicycles more affordable, among others. In addition, there could be opportunities to explore these issues from Phase II in more urban or periurban settings. There are opportunities for additional sensor related research, such as using sensors to study things like health benefits and looking at options to measure bicycle use for carbon financing. Finally, there are also opportunities to improve sensor solutions for tracking bicycle usage.

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