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A case study of travel habits and demand in Matabeleland North, Zimbabwe

Master's thesis in Civil and Environmental Engineering
Supervisor: Kelly Pitera
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NTNU
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ENGINEERS WITHOUT BORDERS

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Abstract

Zimbabwe is a country where hyperinflation, informal economy and political instability make it hard for the inhabitants to step out of poverty. Sabona, a humanitarian aid organization working in the north-western part of the country, aims to contribute to a change of this, both supporting primary needs and creating long-term, sustainable changes. A big contribution to their *equip to empower*-value is the future Sabona Development Center (SDC): a combined marketplace and center for vocational training. The SDC is assumed to be a big improvement of the accessibility in the area when finished. Accessibility is, alongside mobility, a transport component that is shown to be poverty-reducing, as it makes opportunities more available. Adding to the improved accessibility provided by the SDC, an effort in improving mobility is assumed to considerably contribute to a sustainable future for the communities Sabona work with. Hence, this study aims to map solutions that have potential to improve the mobility for the people in the areas where Sabona works.

The study is based on a travel habit survey distributed in the study area, strategically disseminated central to Sabona's work. The survey was corroborated by relevant people with experience from Sabona and Zimbabwe. The results from the survey were used to map and estimate current and future travel patterns, with special attention to the SDC and what changes it has the potential to bring. Due to the COVID-19 pandemic, the planned field trip was not possible to perform, and restrictions made remote interactions with stakeholders challenging. It also made it difficult to consider the cultural context. However, published research, impact reports from similar projects and interviews with Bicycle for Development-organizations have made a solid theoretical foundation for the discussions of possible mobility services for the area.

The results showed that the travel patterns in the study area are based on walking as the primary means of transport, with the average villager walking 4,5 hours per day. Trips to and from water sources and other domestic tasks are the most dominant, while trips to and from health facilities takes the longest time. This indicates a lack of access to health services, and thus a demand for traveling longer distances (> 10 km). For the future travel demand, there is most interest in non-motorized means of transport (NMT), as well as increasing the access to health facilities and other services found in the nearby cities (70 – 265 km from the study area).

Implementing new transport services and facilitating for increased access to NMTs have the potential to improve the mobility in the area, both increasing speed and load capacity when traveling. In addition, using the SDC as a base for shared mobility can create both direct and indirect employment for the population living in the surrounding areas. There is sufficient proof that the impact from increased use of NMTs in similar areas has created value for the people affected, and thus belief that the same counts for Sabona.

Sammendrag

Zimbabwe er et land der hyperinflasjon, uformell økonomi og politisk uro gjør det vanskelig for innbyggerne å bryte ut av fattigdom. Sabona, en humanitær organisasjon med virke i den nordvestlige delen av landet, jobber for å bidra til en endring av dette. Dette gjør de både ved å støtte primære behov og ved å skape langsiktige, bærekraftige endringer. Et stort bidrag til deres verdi om hjelp-til-selvhjelp er det fremtidige Sabona Development Center (SDC): en kombinert markedsplass og senter for yrkesopplæring. Senteret antas å føre til en stor forbedring av tilgjengeligheten i området. Sammen med mobilitet er tilgjengelighet vist å være fattigdomsreduserende, ettersom det gjør tilgjengeliggjør muligheter. I tillegg til den økte tilgjengeligheten som SDC er antatt å gi, er økt mobilitet antatt å kunne bidra betraktelig en bærekraftig fremtid for samfunnene Sabona jobber med. Denne oppgaven sikter derfor på å kartlegge løsninger som kan ha potensiale til å forbedre mobiliteten i områdene der Sabona jobber.

Oppgaven er basert på en reisevaneundersøkelse distribuert i studieområdet, strategisk plassert sentralt i områdene Sabona jobber. Resultatene fra undersøkelsen ble bekreftet av relevante personer med erfaring fra Sabona og Zimbabwe. Videre ble de brukt til å kartlegge og estimere nåværende og fremtidige reisemønstre, med spesielt fokus på SDC-senteret og hvilke endringer det har potensialet til å skape. På grunn av COVID-19-pandemien ble den planlagte ekskursjonen avlyst, og restriksjoner gjorde det utfordrende å gjennomføre fjernkommunikasjon med interessenter i området. Det gjorde det også vanskelig å ta hensyn til kulturell kontekst. Imidlertid har publisert forskning, konsekvensrapporter fra lignende prosjekter og intervjuer med sykkelbaserte bistandsorganisasjoner lagt et solid teoretisk grunnlag for diskusjoner rundt potensielle mobilitetstjenester i området.

Resultatene viste at reisemønstrene i studieområdet er basert på gange som det viktigste reisemiddelet, og den gjennomsnittlige innbyggeren går 4,5 timer per dag. Turer til og fra vannkilder og andre arbeidsoppgaver relatert til hjemmet er de mest dominerende, mens reiser til og fra helsefasiliteter har lengst reisetid. Dette indikerer mangel på tilgang til helsetjenester, og dermed en etterspørsel for å reise lengre distanser (> 10 km). Den største etterspørselen for fremtidig mobilitet er for ikke-motoriserte transportmidler, samt økt tilgang til helsefasiliteter og andre tjenester i de nærliggende byene (70 - 265 km fra studieområdet).

Implementering av nye transporttjenester og fasilitering for økt tilgang til ikke-motoriserte reisemidler har potensiale til å forbedre mobiliteten i området, både ved å øke hastighet og lastkapasitet for turene. I tillegg kan bruken av SDC-senteret som base for delte mobilitetstjenester skape både direkte og indirekte arbeidsplasser for innbyggerne i de nærliggende områdene. Det er tilstrekkelig bevis for at effekten av økt bruk av ikke-motoriserte transportmidler i lignende områder har vært verdiskapende, og dermed tro på at det samme er gjeldende for Sabona.

Preface

The following paper concludes my master's degree in Civil and Environmental Engineering at the Norwegian University of Science and Technology. The thesis is written as a *Meaningful Master's* in collaboration with Engineers Without Borders Norway and Sabona.

I want to express my gratitude to my supervisor Kelly Pitera, Associate University Professor at NTNU, for giving me the opportunity to write a *Meaningful Master's*. Her support, feedback and patience has made my final year as a student a rewarding experience. I also want to thank my mentor Øyvind Høsser for providing me with valuable input on both transport-related topics and considerations to Zimbabwean circumstances. Thank you to Ellen Flaata, Trude Tørset and James Odeck from the Department of Civil and Environmental Engineering at NTNU for the beneficial feedback to the data collection as well.

This master's would not have been possible without Engineers Without Borders Norway, and I want to give a special recognition to Helene Svendsen for helping me make it happen. The same counts for Ynghild Solholm from Sabona, for trusting and believing in me. I also want to thank Engineers Without Borders NTNU for providing me with the inspiration and motivation I needed to seek beyond and choose this thesis.

Without the support from Munyaradzi Nyamande and Sailota Chagadama from Sabona Trust, I would not have been able to write a thesis in Zimbabwe without having ever been there. Thank you to the survey respondents, interview objects and research assistants as well.

Finally, I want to thank my family, friends and classmates for listening patiently, contributing to discussions, and supporting me endlessly. My university experience would not have been the same without you.

Trondheim, June 2021

Frida Nygaard

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1 Introduction

The scope of this chapter is to provide background information and to present reasoning and motivation regarding the choice of thesis. It will also present the collaboration between the organizations involved. The importance of cultural context when carrying out engineer work in a foreign country will be reviewed. The study area and its settings are described with the intention of giving a brief understanding of the local conditions. To summarize, this chapter will present the objective of the thesis with the following research questions, including the limitations given.

1.1 Background and motivation

The intention behind this thesis is to examine how humanitarian engineering can contribute to Sabona's work with resource-constrained communities in Zimbabwe. The study is carried out from a transport engineering perspective and has been developed from initial ideas to the final objective in collaboration with Sabona and Engineers Without Borders Norway as a part of the Meaningful Master's program[1]. The requirements for writing a Meaningful Master's include, among others:

- Have a clear technical/engineering topic, including technical/engineering assessments, tests and/or implementations.
- The task should focus on a positive outcome for the local community, including local transfer of knowledge.
- The task should be based on local needs, which can be confirmed by the collaborating organization.

The motivation for the thesis is found in the author's personal interest in humanitarian engineering and NTNU's vision – «Knowledge for a better world». There is also found inspiration in the UN Sustainable Development Goals (SDGs), and the way all 17 goals can be said to be directly or indirectly dependent on transport in order to be achieved (Technical Working Group on Transport, 2015).

Sustainable Development Goal number 11 – *Sustainable cities and communities* – says that by 2030 we should «provide access to safe, affordable, accessible and sustainable transport systems for all, […], with special attention to the needs of those in vulnerable situations […]» (Technical Working Group on Transport, 2015). This goal stems from the undoubtedly vital role transport plays in socioeconomic development, as it not only facilitates for infrastructure and services, but also eases the movement of people, freight and information (Technical Working Group on Transport, 2015). For many resource-constrained communities, the limited mobility is described as a major barrier to socioeconomic opportunities (Bocarejo S. & Oviedo H., 2012). Designing a transport system that facilitates for the needs of vulnerable groups is thus inevitable in order to achieve the SDGs.

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[1] https://iug.no/mastermedmening/

1.2 Cultural context

The tale of the Norwegian aid project in Turkana, Kenya, is an example of how cultural context can affect the results and effect of humanitarian engineering. The story is translated from Norwegian and summarized from The Norwegian Agency for Development Cooperation (Norad, 2015):

> «When the British colony was repealed in 1963, Turkana, an isolated region in the north-western part of Kenya, was almost without any infrastructure nor social services. The Norwegian government got involved in the late 1960s, first by providing emergency aid during periods of hunger and drought. The engagement later developed into plans to improve the mobility in the area by building a main road. The speed of the development plans escalated when there was made a decision to commercialize the small-scale fisheries in Lake Turkana.
>
> The construction of a freezing plant in connection to the fisheries began in 1975. Norwegian experts on anthropology, fishery, freezing technology and economy had the leading positions in the planning phases. The construction phase was completed without any large, modern machinery, and the project was finished in 1980. However, the freezing machinery has never been used. Why?
>
> First of all, the Turkana people does not eat fish unless they have to. Secondly, the Lake Turkana fish is possible to export without first filleting and freezing it, which made the purpose of the freezing plant worthless. In addition, maintaining the temperature required for a freezing plant in the hot and dry Turkana climate is highly energy consuming, and thus costly. Even though the plant was planned by experts from Norway – a big fishing nation -, the Norwegian experts were not experts on inland fishery in Kenyan conditions».

The story of Turkana highlights the importance of taking cultural context into account when engaging humanitarian engineers in the Global South. The theoretical framework in chapter 2 describes this aspect further. It also provides a context and backbone for this thesis, particularly seen in chapters 4 and 5.

1.3 Zimbabwe

1.3.1 History and economy

Zimbabwe was once one of the richest African countries, where agriculture was the foundation of the economy, and both the industry and service sectors were well established (Hem, 2019). Despite this, Zimbabwe experienced a decline in the quality of life for its inhabitants through decades of political instability, economic sanctions, periods of drought and high emigration rates. The country was declared a low-income country in 1991 (Norad, 2018). Today, the economy is mostly informal. There is also restricted freedom of speech, low fulfillment of the human rights, and high prevalence of corruption (United National Association of Norway, 2019).

A more detailed description of the history and economy of Zimbabwe can be found in Appendix 1. The location of Zimbabwe in Africa is shown in figure 1.1.
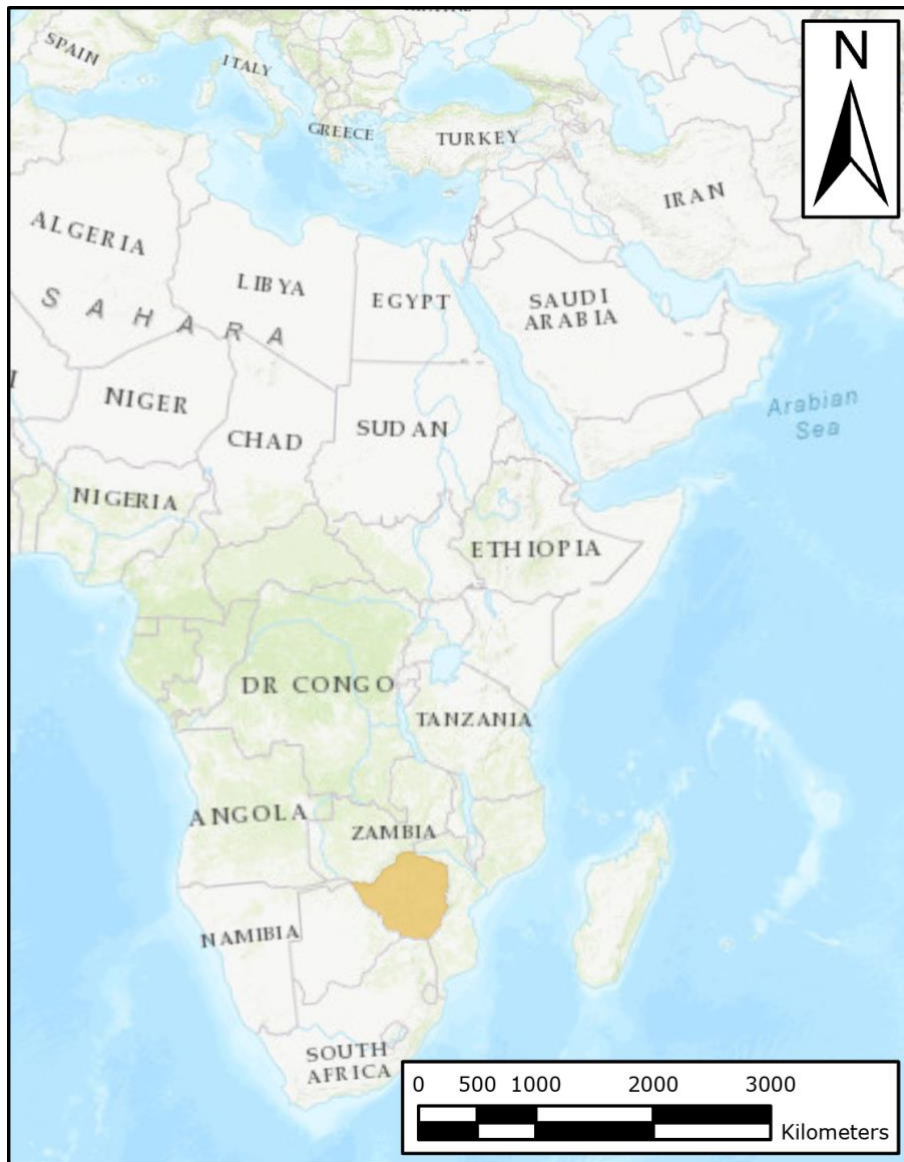
Figure 1.1: Zimbabwe, Africa. Source: Own work/OpenStreetMap

1.3.2 Transport

Zimbabwe is one of the key hubs for road and rail corridors in the Southern African region. As a member of the Southern African Development Community, the country is obliged to assist in the development of a transport network that supports socioeconomic growth in the region (African Development Bank Group, 2019). The Zimbabwean transport system consists of four subsectors; road, aviation, rail and inland water. The road sector is dominant, whilst the aviation sector is mainly utilized for tourism. However, an astounding 87% of tourists arrive to the country by road (African Development Bank Group, 2019). The railway system is freight-based and the transport on waterways is limited (Ndhlovu, 2020).

The Zimbabwean road network consists of 91 665 km, and is divided into four main groups: regional trunk roads, primary roads, secondary roads and tertiary roads (African Development Bank Group, 2019). More than 70% of the regional and primary roads were built in the 1960s and early 1970s. Due to the lack of maintenance throughout the years,

these roads have now exceeded their 20-year design life (Ndhlovu, 2020). The African Development Bank (2019) states that «*increasing investment into rehabilitation and maintenance of transport infrastructure can open up the country to more regional trade and increase Zimbabwe's competitiveness in the region*».

In addition to the roads needing rehabilitation, the petrol prices in Zimbabwe are the most expensive in the world (Giles, 2019). Consequently, the prevalence of motorized vehicles and the development of a reliable public transport system is a challenge.

1.4 Sabona

Sabona is a humanitarian aid organization working on the grassroots level to create a better future for the people of Zimbabwe. It is the only non-governmental, non-profit organization that has been working continuously in Zimbabwe since 1999. They have 7 employees in Norway and Zimbabwe, as well as one board in each country, and many volunteers. As shown in the flow chart in figure 1.2, some of Sabonas key values are:

- Education as the key to a better future,
- Equip to empower,
- Sustainable employment,
- Local ownership,
- Funds directly distributed, and
- Promoting equality.

Figure 1.2: Sabona's five main focus areas. Source: (Sabona, 2019)

Sabona's holistic approach includes five main focus programs; Health, Culture/Innovation, Infrastructure, Education and Farming, as shown in figure 1.2 (Sabona, 2019). The health program includes transportation services for people living with HIV/AIDS, as a way of improving the access to health facilities and medication. The

distribution of equipment, health workers and medication from the city to the rural villages where Sabona operates is also a part of this program. In addition, there is daily distribution of school lunches to the local learners in the area, and Sabona staff members traveling between the villages. All of these services and programs require sufficient access to transportation.

Sabona's focus has mainly been on supporting the primary needs for the most vulnerable. Nevertheless, as one of their key values is *equip to empower*, Sabona aims at facilitating the self-sufficiency and independence of the communities. Transport could further contribute towards this goal, as it has potential to support the daily tasks for the communities in the long run. The fact that several parts of Sabona's daily tasks relies on transport shows that there might be a potential for further development of their projects, both in quality and quantity.

1.4.1 Area of operation: Matabeleland North

Sabona works in Matabeleland North, Zimbabwe, mainly along the 440 km long A8 Highway between the city of Bulawayo and Victoria Falls, as shown in figure 1.3. The projects are mostly linked to medical clinics, small-scale income-generating projects and schools in the Lupane and Hwange districts. There are also some small initiatives in the greater Bulawayo area.
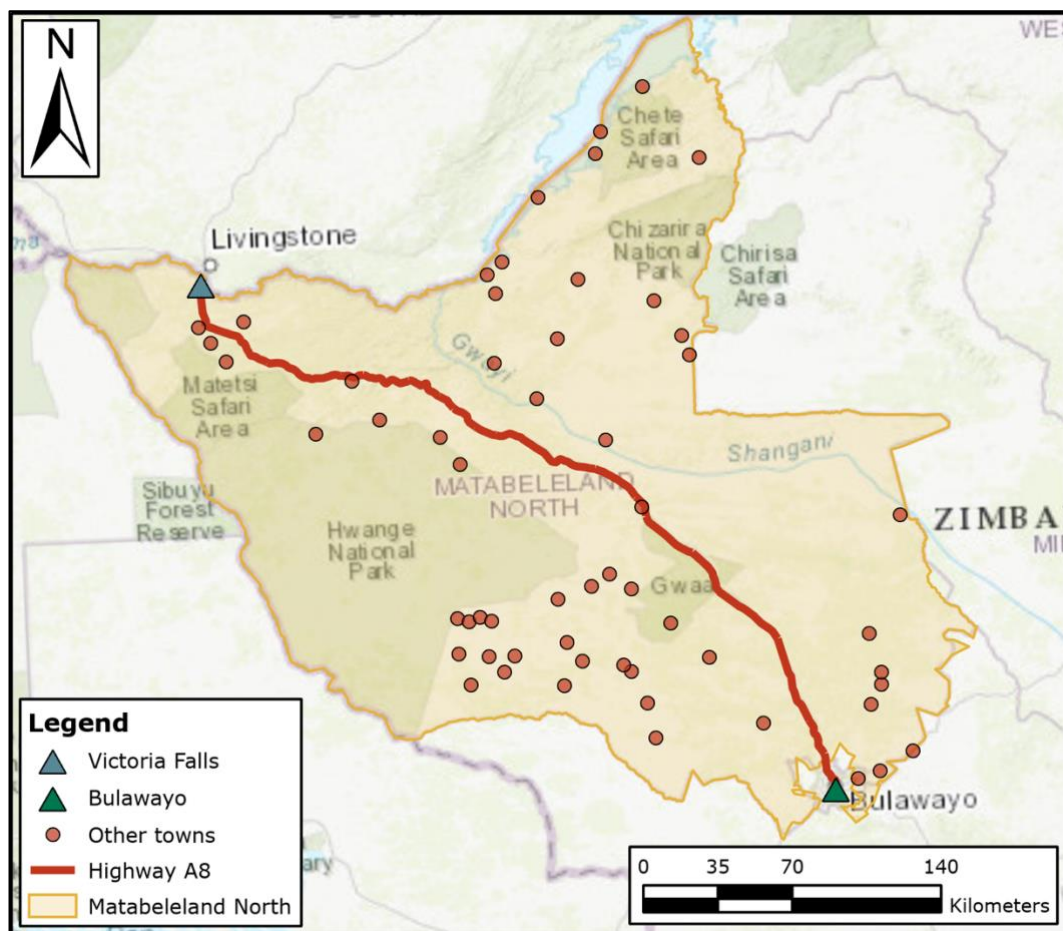
Figure 1.3: Matabeleland North, Zimbabwe. Source: Own work/OpenStreetMap/ArcGIS Online

Matabeleland North consists of 7 districts, where Hwange and Victoria Falls are the largest urban centers, with populations respectively of 19 870 and 33 060 (Zimbabwe National Statistics Agency, 2012). The Zimbabwean Government describes the existing road, rail, air and water transport networks as a uniqueness of the region, with mining, agriculture and tourism as the largest contributors to its socioeconomic foundation (Government of Zimbabwe, u.d.). However, Eppel (2008) describes the region as «generally less hospitable to human habitation than much of Zimbabwe», pointing at water scarcity, low precipitation and less fertile land. Key statistics for Matabeleland North are presented in table 1.1.

Table 1.1: Matabeleland North statistics. Source: (Zimbabwe National Statistics Agency, 2017)

	Zimbabwe	**Matabeleland North**
Population	13 572 560	744 841 (5,5%)
Urban / Rural population distribution	31,6% / 68,4%	5,4% / 94,6%
Literacy rate	94%	91% (Country low)
Unemployment rate	6,6%	0,7%
Share of communal farmer as % of employed population	56%	82%
Households with electricity	48,0%	36,5%
Access to water within 500 m from household	73,6%	47,8%
Main energy source for cooking	Wood (68,0%)	Wood (93,6%)

1.4.2 The Sabona Development Center

Sabona has been allocated 10 000 m^2 of land along the A8 for the brand new Sabona Development Center (SDC), as shown in figure 1.4. The location is strategically placed close to the Hwange National Park, bringing the market closer to the tourist attractions in the area. Their goal is to create:

1) A marketplace where those who offer products and services can meet those with money, and
2) A vocational school to teach practical skills needed in the surrounding communities.

Figure 1.4: Situational drawing of the SDC. Source: (Sabona, 2019)

The center will include 2 classrooms, including a workshop, study room and storage room, 3 store fronts with 5 individual stalls each, 2 vegetable gardens, 3 fowl run with 500 chickens each, a slaughter room and a cold room. In addition, there will be offices for Sabona, accommodation for visitors, storage sheds and security guards.

The SDC idea is based on the potential that lies in the numerous safari lodges in Hwange National Park. In order to buy vegetables, the lodge staff need to drive more than 265 km to Bulawayo (Sabona, 2019). While doing this, they drive past several smaller community gardens that sell the same products. In the SDC business case report, the potential in the center is summarized by asking:

> «What impact could be had from centralizing production and creating a local marketplace where those with goods and services could meet those with money? What if we also could provide vocational schooling to address region-specific needs? What if these two together […] could generate employment opportunities, help infuse cash into the economy and address the overarching brain drain?».

The SDC is assumed to be a major accessibility improvement for the area, as it creates a place for income-generating activities for the local communities. In addition to the market being brought closer to the people, Sabona will also provide funds for a new truck. It is mainly an investment for the construction phase for the center, but will also improve the mobility for Sabona as an organization, as their transport capacity and range will increase. As the literature review in chapter 2 shows, improving both accessibility and mobility are efficient for boosting the economy, which will positively impact the communities Sabona supports.

1.5 Objective and research questions

The objective of this study is to map transport-related solutions that have potential to improve the mobility for the people in the areas Sabona works, and thus create socioeconomic value for the communities. The objective will be fulfilled by answering the following research questions:

1. What are the current mobility patterns in the study area?
2. What are the demands for improved mobility in the study area after the Sabona Development Center is built?
3. How can the implementation of mobility services help Sabona fulfil its values, including but not limited to, employment creation?

In order to address the objective and research questions in a way that fulfills the Meaningful Master's requirements, the thesis will be based on theory of development projects in growing economies. It will also have a particular focus on safeguarding the actual needs of the local communities.

1.6 Limitations

This thesis is written from a civil engineering student's point of view, which affects the perspective on humanitarian aid issues. Regardless, cultural, political, societal and financial aspects are considered, supported by EWB Norway and Sabona.

Getting the necessary understanding of local needs takes time, especially without having seen the conditions first-hand. As this project has a limited time frame and is affected by the COVID-19 pandemic, achieving the desired level of local understanding is considered the most challenging component of the thesis. However, by collaborating with the Sabona staff located in Zimbabwe, it will be possible to work around this challenge. Carrying out the data collection remotely is possible as long as one provides clear instructions, and the transfer of data to the author is easily done.

2 Theoretical framework

The purpose of this chapter is to provide an overview of previous research on similar topics and other literature relevant for this thesis. The first subchapter contains definitions of some frequently used terms, while the following three sums up the literature study done prior to the data collection. The final subchapter ties the theoretical framework together by providing three key principles, which will guide the solutions that are suggested as an answer to research question 3 in chapter 5.

The literature was chosen based the number of citations and the relevance assumed from the abstracts, with *Google Scholar* and *Oria* as the main search engines. The search words used were combinations and variations of *rural areas, mobility, developing countries, economic development, transport services, shared mobility* and *Mobility as a Service.*

2.1 Definitions

Rodrigue (2020) defines **transportation** as a «field of application borrowing concepts and methods from a wide variety of disciplines», where the purpose is to «fulfill a demand for mobility since transportation can only exist if it moves passengers, freight, and information». Transport is, in other words, a complex term consisting of several perspectives, including, but not limited to, accessibility and mobility. In order to find transport services that can create socioeconomic value for the communities where Sabona works, the different aspects of transport as a concept are explained and defined. Other terms frequently used in this thesis are also explained.

Accessibility is defined by Cheng & Chen (2015) as «the ease with which a given destination can be reached from an origin or a set of origins», including the influence of distance, weather and traffic conditions. Existing infrastructure may also have an impact. Accessibility measures how many destinations or services one can reach within a given period of time and given conditions. Central parts of big cities, like Manhattan in New York City, have a high level of accessibility. Litman (2003) says that accessibility is measured based on the generalized costs required to reach opportunities, including time, money, comfort and risk. Since access can be affected by many factors, it may be difficult to measure.

Mobility is defined by Rodrigue (2020) as «the ease of a movement of a passenger or a unit of freight», stating that activities are less constrained by distance when the level of mobility is high. Mobility measures how far (in distance) you can go within a given period of time and given conditions. Areas with low congestion, well-established road networks and high shares of car-ownership have high mobility. Litman (2003) says that mobility is measured «using travel surveys to quantify person-miles, ton-miles and travel speeds, plus traffic data to quantify average automobile and transit vehicle speeds».

Rural areas are defined by Linke, et al. (2008) as areas characterized by notable «distances between villages, homesteads, schools, clinics, markets and churches». In Zimbabwe, rural areas are defined by Zimbabwe National Statistics Agency (2017) as

places that have less than 2 500 inhabitants, a non-compact settlement pattern and where the majority of the employed people are engaged in agricultural occupations. By this definition, Matabeleland North had 99% rural areas in 2017 (the share of the population living in these rural areas were 94,6%), which is the country high.

Value in the business sector is defined by Anderson & Narus (1998) as «the worth in monetary terms of the technical, economic, service and social benefits a customer company receive in exchange for the price it pays for a market offering». In this thesis, **value creation** is understood as the creation of socioeconomic benefits, measurable in both monetary and non-monetary terms.

A **stakeholder** is defined by Cambridge University Press (nd) as «a person such as an employee, customer, or citizen who is involved with an organization, society, etc. and therefore has responsibilities towards it and an interest in its success».

2.2 Mobility needs in the Global South

Early investments in transport-related development in the rural Global South were traditionally set on improving roads and infrastructure (Ali-Nejadfard, 2000). During the 1950s and 60s, The World Bank invested in infrastructural improvements, as there was a belief in roads 'bringing development' to rural areas (Bryceson, et al., 2008). The latent understanding of this belief is that lack of access to vital services and activities contribute to social and economic exclusion, and this is still a main argument for transport-related development today, although the approach on how to solve these issues has changed.

As footpaths, tracks and bridges make up more than 80% of the rural transport, solely improving the main road network failed as it did not succeed in creating economic development (Ali-Nejadfard, 2000). Lissenden, et al. (2015) has done a study of the academic literature in the field of appropriate technology during the last 35 years and discovered how the definition of success has changed over the past decades. The Appropriate Technology movement is described as an alternative to traditional foreign aid, highlighting the importance of local context, local needs and experience-based evidence in development projects (Lissenden, et al., 2015). The study shows a transition from laboratory and research-based results to truly sustainable and scalable value for the developing communities. 20 out of the 43 articles emphasizes the importance of local context or site-specific research in order to understand the actual needs (Lissenden, et al., 2015) (Kodransky & Lewenstein, 2014). This shows that the previously mentioned focus on infrastructural improvements fell outside the scope of issues associated with rural transport and economic development. The investments from the 1950s and 60s is thus difficult to classify as successful.

There is clear evidence that problems with accessibility causes problems with opportunity to education, health and employment (Starkey, et al., 2002) (Ali-Nejadfard, 2000) (Bocarejo S. & Oviedo H., 2012). In addition, the participation in social, political and community activities decreases when the level of accessibility is low (Starkey, et al., 2002) (Ali-Nejadfard, 2000) (Bocarejo S. & Oviedo H., 2012)). Rural mobility improvements should aim at freeing time for social and economic opportunities, which can be done by improving the accessibility or the mobility. The decision is a matter of time, effort and cost in the measures. Improving the mobility can be done by introducing new transport services or options, while an accessibility improvement is a matter of

bringing services closer. However, there seems to be an agreement that improving the transport opportunities in order to reduce the social exclusion is an effective way of using transport as a catalyst for economic development in rural areas.

2.3 Rural mobility in the Global South

The mobility of rural areas in the Global South is often bound up in domestic tasks, mostly by foot on off-roads paths (Bryceson, et al., 2008) (Ali-Nejadfard, 2000). Most rural travel takes place within the villages, occasionally with animals, carts or bicycles as an aid for carrying heavier loads (Ali-Nejadfard, 2000). The occasional out-of-village travels have enormous economic and social importance (Starkey, et al., 2002), as they provide access to a wider range of goods and services. Traveling consumes time and can be a physical burden when long hours are spent walking and carrying. The burden is to a large degree carried by women, who according to Ali-Nejadfard (2000) stand for 77% of the water and firewood collection in rural areas in the Global South.

To improve mobility in rural areas, Starkey, et al. (2002) advocates for an integrated approach of combined travel means, connected transport systems (road, water, air, rail), and coordinated operators (both public and private). Not taking all factors into account when developing a transport system is unlikely to result in the desired socioeconomic benefits. Starkey, et al. (2002) lists a series of issues that should be paid special attention to:

- Needs of a wide range of stakeholders should be taken into account
- A critical mass of users, operators, and suppliers is needed to sustain services
- Population densities and income levels affect transport demand and supply
- Patterns of adoption and use reflect local conditions
- Complementary and competitive services are important for meeting different needs
- Some interventions can reduce costs

Ensuring the needs of a wide range of stakeholders is advocated for by most literature. An example is the transport planning report for the city of Ranchi, India, which concludes that «transport planning should focus on the movement of people, not vehicles» (Mishra, et al., 2015). The 11th Sustainable Development Goal is in agreement with this, and places vulnerable groups in a unique position. Women, elderly, children and people with disabilities in rural areas live with different conditions, needs and preferences, and are generally underrepresented when it comes to transport planning (Starkey, et al., 2002). Involving the stakeholders, still providing special attention to the vulnerable groups, is an important success factor for rural development. The involvement should start in the early planning phase and cover all steps, including the monitoring and evaluation of the final product.

Women, often being the main responsible for domestic tasks, holds an important role when developing rural transport. Most transport services are owned and operated by men, even in the countries where women are the main transporters (Starkey, et al., 2002). In addition, the means of transport are not gender neutral, concerning both biological differences, traditional gender roles and gender-based power relations. For example, to maneuver a wheelbarrow, one has to use both hands, which limits the use

for women who carries children while transporting (Starkey, et al., 2002). Ali-Nejadfard (2000) suggests involvement from the very beginning as an approach to reduce the burden of women as transporters. In addition, the transport planners should be aware of the clear distinction of male and female transport needs and patterns.

Developing rural transport comes with cost constrains, especially in low-income areas (Starkey, et al., 2002). Communities where the share of individual income available for transport services is low results a low demand, which further limits the opportunity for cheap alternatives to appear (Starkey, et al., 2002). There is a need of a critical mass of users, operators and suppliers, because services are unlikely to develop without a critical mass, and the critical mass is unlikely to develop without supporting services. There should be sufficient supporting infrastructure for manufacture, supply and repair, including routine maintenance and good husbandry for the animals used in transport (Starkey, et al., 2002).

Starkey, et al. (2002) list three areas where measures can be made in order to promote rural mobility: financial, regulatory and complementary. The financial barriers are closely related to the availability of credit, and hire-purchase schemes and subsidized loans are suggested as potential solutions. Some areas may have excessive control over the motorcycles and non-motorized means of transport, which is considered a regulatory barrier. Education and media promotion can improve the understanding and acceptance of these travel means. Finally, complementary steps include pilot studies and good communications technology. Starkey, et al. (2002) emphasizes that quantity often is more important than quality when implementing new transport services in rural areas.

2.4 Mobility services in rural areas

The following chapter will present options for mobility services that are considered to have potential for the study area. Table 2.1 provides an overview of means of transport that are common in rural areas, with their indicative characteristics and important requirements.

Table 2.1: Means of transport with indicative characteristics and important requirements. Source: (Starkey, et al., 2002)

Transport means	Indicative characteristics					Important requirements		
	Cost price ($ relative)	Load (kg)	Speed (km/h)	Range (km)	Cost/tonne/km ($ relative)	Animals and vet services	Mechanics	Good roads or tracks
Carrying / Head load	0	20	5	10	1,5	none	low	low
Sledge	10	100	4	3	0,8	high	low	low
Wheelbarrow	30	100	4	1	0,4	none	low	low
Handcart	60	150	4	5	0,35	none	low	medium
Pack donkey	60	80	7	20	0,7	high	low	low
Bicycle	100	60	10	20	0,6	none	medium	medium
Cycle rickshaw	170	150	8	15	0,45	none	medium	high
Donkey cart	300	400	6	15	0,6	high	medium	medium
Horse cart	500	1000	7	15	0,6	high	medium	medium
Ox cart	500	1000	5	10	0,2	high	medium	medium
Motorcycle	900	100	50	50	1,3	none	high	medium
Power tiller trailer	5000	1000	10	15	0,7	none	high	medium
Pickup	12000	1200	80	200	0,7	none	high	high
Light truck	60000	12000	80	200	0,5	none	high	high

As the petrol prices in Zimbabwe and the income level in the study area limits the ownership of motorized transport, non-motorized means of transport are considered the most relevant. The following subchapters will thus elaborate the bicycle as a rural means of transport, in addition to a presentation of shared mobility services and the Mobility as a Service-concept for rural areas. The different types of carts and transport animals are not further explained as the literature seems to be limited. Cycle rickshaws are most widespread in Asian countries, even though there are pilot projects in some African countries. However, they are not considered practical for the conditions in Matabeleland North, hence not further explained in this chapter.

2.4.1 Bicycles

The bicycle has been praised as an international tool for social and economic development (Ardizzi, et al., 2021). It is described as an innovative and effective response to socioeconomic barriers (Ardizzi, et al., 2021), especially for both urban and rural areas of Sub-Saharan Africa, where there is a lack of well-established public transport systems (Baker, 2020). Bicycles reduce the travel time, which makes both health facilities, educational institutions and employment opportunities more accessible. Hence, improving access positively impact the rural population's health and the learners'

attendance at school, as well as encouraging financial empowerment and participation in the formal economy (Ardizzi, et al., 2021).

The meaning ascribed to the bicycle can vary depending on both time and context (Ardizzi, et al., 2021). There are different views on the utility and the general status of a bicycle, but the general perception in the rural population seems to be that a bicycle provides access to resources and that they are a sign of prestige (Ardizzi, et al., 2021). Variations may be based on land-use and natural environments, where they often are viewed as common and useful if they can move through dirt roads with more ease than cars (Ardizzi, et al., 2021) (Baker, 2020). The word empowerment with regards to bicycles is also understood in a variety of ways, but the common nominator is that empowerment is facilitated by the freedom to be mobile (Ardizzi, et al., 2021). Research shows that bicycles are providing this.

The cultural and political aspects on the bicycle should also be paid close attention to, as these may vary largely (Ardizzi, et al., 2021). The political concerns are difficult to change, especially the common belief among regulators that bicycles are for the poor (Ardizzi, et al., 2021), even though this goes against the general perception within the rural communities. These types of misconceptions give regulators no political reason to incorporate bicycles into policy planning, but rather regulate them by deterring playful and risky behavior (Ardizzi, et al., 2021). The literature looking into cultural aspects are often guided by post/colonial theory, where the critique is based on the lack of focus on historical or social inequalities when implementing market solutions (Ardizzi, et al., 2021). One example is from Namibia, where bicycles were known to be bought by white farmers as transport for black farm laborers (Baker, 2020). This has impacted the cultural perception of bicycles for both elder and younger generations, where older Namibians prefer using their old roadsters to demonstrate their familiar and utilitarian identities, and the young use mountain bikes to mark an active distance to the past and demonstrate a fashion and modern/western way of thinking (Baker, 2020). This implies that it is not only the access to bicycles that impacts the mobility of rural areas, but also the environments in which people move (Ardizzi, et al., 2021).

One way of promoting the socioeconomic benefits provided by bicycles is through Bicycles for Development-organizations (BDF organizations). These organizations range from community-based focused on development at the grassroots level, to international organizations operating with big strategies. Their common goal is to fill a societal gap by enhancing the mobility of developing communities, regions and countries, which according to 19 semi-structured interviews performed by Ardizzi, et al. (2021), seems to have succeeded. However, there may be a lack of critical analysis within these organizations, as they are dependent on impact and financial return (Ardizzi, et al., 2021)(Baker, 2020).

2.4.2 Shared mobility and Mobility as a Service

Hannon, et al. (2016) points out shared mobility as one of the three key mobility trends assumed to grow significantly the following years. Shared mobility services aim to reduce the transportation costs for the users by maximizing the use of vehicles, in addition to expand each individual's transport options. This is done by sharing the vehicles between multiple users, and includes bike-share, car-share, ride-share and transportation network companies (Kodransky & Lewenstein, 2014). The services can be both flexible and fixed.

Daily trips like work/school trips need reliable access in a fixed route, while special purpose trips can be more flexible. In order to maintain the interest of the stakeholders and the diversity of their needs, shared mobility services should aim to meet different needs by providing several types of services (Kodransky & Lewenstein, 2014). This will contribute to a future transportation system that not only satisfies the growing mobility needs, but also the diversity of its users.

As a further development of the shared mobility principles, the concept of Mobility as a Service (MaaS) offers user-oriented and combined shared mobility services, where customers' transport needs are addressed by integrated planning and payment (Eckhardt, et al., 2018) (Eckhardt, et al., 2020). The components of MaaS; shared mobility, ticketing and multi-modal traveler information, are all assembled in one interface, making it a user-friendly platform. MaaS aims to improve accessibility and efficiency, especially in cities where the public transport network is dense.

Rural MaaS providers must think differently from urban MaaS, as the accessibility in rural areas is different to urban areas. This implies that, in order to obtain the desired level of efficiency, the integration of diverse services and users has to be additionally combined in comparison to urban MaaS. The integration should connect last-mile goods deliveries to the traditional mobility of people, and even incorporate public welfare transportation services (Eckhardt, et al., 2020). The research on rural MaaS seems to be concentrated to a few case studies in Finland. These show that there are sustainable benefits to rural MaaS, both economically, socially and environmentally (Eckhardt, et al., 2018) (Eckhardt, et al., 2020). The studies conclude that, if implemented right, MaaS in rural areas can have «major positive impacts at all levels: individual/user, business/organizational and societal» (Eckhardt, et al., 2020).

The research done on MaaS in rural areas in the Global South seems to be limited. However, given the increased ownership of smartphones also in these areas, there might be a sufficient demand in the close future.

2.5 Key principles

In order to provide a coherent theoretical framework, three key principles have been developed. These are meant to act as guidelines for the suggested mobility services in research question 3, as discussed in chapter 5.

Local ownership and anchoring:

Sabona means «I see you» in the local language Ndebele, which reflects their key value of local ownership. This value is also emphasized as a success criterion for development projects in the literature (Starkey, et al., 2002) (Lissenden, et al., 2015). Hence, the suggestions provided in this thesis should be anchored in actual and real needs, and there should exists a positive interest before the initiation of any project. In order to ensure this, there should be involvement in all stages with a diverse composition of stakeholders represented. There should also be a special focus on vulnerable groups.

Holistic, integrated approach:

The suggestions should be based on an integrated approach, as advocated for by Starkey, et al. (2022). This includes both travel means, transport systems and operators. A holistic approach, meaning that all factors are taken into account, is also of importance in order to give the desired socioeconomic benefit.

Sustainable:

The suggestions should be based on all three dimensions of sustainability; economic growth, social inclusion and environmental protection. Economic growth is important for the communities to be financially independent of humanitarian aid, and is also the basis of Sabona's key value of *equip to empower*. Social inclusion provides the communities with democracy, equity and diversity, which is shown to increase when the accessibility and mobility is improved. Promoting equality is also a key value for Sabona. Lastly, environmental protection ensures that local, regional and global consequences from emissions are minimized, which should be a key principle for all transport planning on a global scale.

3 Method

The chosen method included three approaches of both quantitative and qualitative character. The aim was to use the studies of current mobility patterns and future mobility needs to reveal what potential transport services have in bringing socioeconomic value to the study area. As theory emphasizes the importance of stakeholder involvement and identifying local needs, a quantitative survey distributed in the study area was chosen as the main source of data. The survey results were afterwards corroborated with Sabona to check their reliability. In addition, semi-structured interviews with relevant people from organizations working within the same area of interest were held in order to find inspiration, reveal challenges and collect impact data from already established projects. A summary of the research questions and the related approaches and intentions is given in the table.

Table 3.1: Summary of the research questions with their related approaches and intentions.

Research question 1: What are the current mobility patterns in the study area?	1) Survey for villagers, to map current travel patterns.
	2) Conversations with people associated with Sabona, to better understand the area and situation, as well as to confirm and add to the information collected in the survey.
Research question 2: What are the demands for improved mobility in the study area after the Sabona Development Center is built?	1) Survey for villagers, to discover the villagers' demand and potential for future travel patterns.
	2) Conversations with people associated with Sabona, to discover Sabona's demand and potential for future travel patterns, as well as to confirm and add to the information collected in the survey.
Research question 3: How can the implementation of mobility services help Sabona fulfill its values, including but not limited to, employment creation?	1) Interviews with similar organizations, to find inspiration for the mobility services
	2) The results from research question 1 and 2, to adapt to local circumstances and demands.

The study area was defined by an air-distance buffer of 10 km from the SDC. This area contains approximately 4300 buildings. The average household in Matabeleland North includes 3 buildings: a kitchen, a sleeping room and a storage room. As each household

includes several generations of families, an estimate of 2000 to 2500 households was set as the applicable population. The study area includes four primary schools, one secondary school and one high school, the Mabale health clinic, both Mabale and Lupote Business Centres and eleven water sources. All of these are parts of Sabona's projects in the area.

3.1 Research question 1 and 2

3.1.1 Village survey

In order to answer the two research questions on travel habits and future mobility, a paper survey to be handed out to the villagers was designed. The basis for the design of the questionnaire was the Norwegian Travel Habit Survey from 2013/2014, where relevant questions were customized to Zimbabwean circumstances. Additional questions considered applicable to answer the research questions were added, as well as questions that came up after performing a pilot study. The questionnaire was sent to Sabona for feedback two times, to make sure that the questions were a good fit for the circumstances. Examples of local customizations include the division of relevant income levels and the means of transport available in the area.

The front page had information about the project and asked the respondent to answer as if the COVID-19 pandemic was not affecting their daily life, and as if there was dry season. They were also asked to write down questions or comments if they had any. There were mainly multiple-choice questions or questions where the respondents were asked to state only one value. This was done to make sure that the answers were easy to type into a spreadsheet for analyses and to avoid difficulties understanding the respondents' handwritings. To avoid that the respondents marked all alternatives, particularly on the questions related to future demand, a limit of maximum options marked was stated for each question.

The questionnaire was divided into 5 sections:

1. Household
2. Work and education
3. Transport options
4. Current travel patterns
5. Future travel patterns

The first section asked four questions about the household as a whole, with the intention to collect background information of socioeconomic importance. The rest of the questionnaire was to be answered by the respondent as an individual. Section 2 asked seven questions about work and education, where the word *work* was defined to include both work in the households' fields, Sabona's vegetable gardens, poultry projects and sewing clubs, and other income-generating activities. The intention was to collect socioeconomic information about the respondent, as well as key facts about their work trips. The third section asked three questions about their transport options, and the fourth asked three questions about their current travel patterns.

The last section was the largest, asking eight questions about future travel demand. These questions were initially supposed to be a part of group interviews with different stakeholder groups in the area, but was cancelled due to COVID-19 restrictions in

Zimbabwe. The questions covered potential changes in travel patterns because of the Sabona Development Center and what travel options the respondents would use if they had the opportunity. It also included two questions directly related to bicycles, as the organizations recruited for the interviews were mainly focused on this particular means of transport. The questionnaire in its entirety is found in Appendix 2.

The questionnaire was distributed between March 18th and March 27th from the local schools in the study area. To make sure that both men and women responded, the distribution team informed the learners that girls were to ask their mother to respond and boys to ask their father. If the child had only one parent, this particular parent would respond regardless of their gender. Teachers and Sabona staff living in the area were also asked to respond. A total of 100 people answered the survey.

It was debated whether the questionnaire should be translated to Ndebele (the local language) or not. Learners at Zimbabwean schools are taught English from grade 3, which results in a seemingly high national level of English. Adding the high literacy level in Matabeleland North[2], translation was considered irrelevant.

The questionnaires were printed on paper and handed out with a pen, before they were scanned to a digital cloud service for the author to receive with ease. Further, the scanned questionnaires were typed into a spreadsheet before the data was analyzed using Microsoft Excel for diagrams and tables, and ArcGIS Pro for map data. In Excel, IF-sentences were used to isolate certain groups from the sample and analyze potential differences from other groups. Excel was considered sufficient compared to SPSS due to the low number of respondents. ArcGIS Pro was used to analyze travel patterns, mainly by mapping the location of services, but also using Network Analyst tools for more complex analyses. Results were compared to statistics from the Zimbabwe Statistics Agency and conversations with people associated with Sabona to measure the representativeness of the data set.

3.1.2 Conversations with Sabona
After the survey results were analyzed, key people in Sabona with a deep understanding of both Zimbabwean and Norwegian conditions were contacted. The aim was to confirm, evaluate and add to the results by asking questions that occurred during the analyses. They were also asked for subjective opinions on future demand and potential challenges related to transport in the area, both with respect to the communities and for Sabona as an organization. The questions were answered per email due to unforeseen circumstances, and are attached in Appendix 3.

3.2 Research question 3

3.2.1 Interviews with similar organizations
In order to answer the research question about possible mobility services, the first approach was to interview organizations that had relevant experience within the same field of interest. 6 organizations and social enterprises were invited to participate. Of these, 4 answered, whereas 2 accepted the invitation for a digital interview and 2 wanted

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[2] 91%, as presented in table 1.1.

to answer in a written format. One of the respondents never sent their written responses back. An overview of the participants is given in the table, and short descriptions of all participants and organizations are listed below:

Table 3.2: Interview participants with key organization facts.

Participant	Project type	Country of organization	Country of operation
Founder and Managing Director, BEN Namibia	Provider of resources and training in bike shops	Namibia / Remotely managed from Brazil	Namibia
Institutional Markets Lead, World Bicycle Relief	Not-for-profit bicycle supply chain and large-scale bicycle mobility programs	USA, UK, Australia, Germany, Switzerland and Canada	13 countries across South America, Africa and Asia
Head of Impact Measurements, Velafrica	Bicycle supply chain and social entrepreneurship	Switzerland	7 African countries

Founder and Managing Director, BEN Namibia:

- Background in other mobility organizations working in Sub-Saharan Africa. Now living and working in Brazil, while remotely managing the Namibian organization.
- Providing resources and training in business and mechanics for local partners in order for them to open their own bike shops. The shops are made of shipping containers, filled with 300-400 secondhand mountain bikes, tools and spare parts.
- Local partners are responsible for the operation of the bike shops.

Institutional Markets Lead, World Bicycle Relief:

- Background in aid-work and economic growth. Living in the United States.
- Mission-driven, global not-for-profit bicycle supply chain that is involved in every step from design through final distribution. Provides large-scale bicycle mobility programs.
- Works to implement wholly-owned for-profit subsidiary social enterprises that sell their self-produced *Buffalo Bicycle* to individuals, non-profits, private sectors and bi-/multi-lateral institutions.

Head of Impact Measurements, Velafrica:

- Background in political science. Has worked in the organization since the end of their studies. Living in Switzerland.
- Two-way-project, combining job integration in Switzerland with provision of bicycles, spare parts and training for local partners in African countries.

An application for permission was sent to the Norwegian Centre for Research Data (NSD) as the digital interviews were planned to be audio recorded. The application was approved after one week. The interviewees were provided with information about the project and the interview topics beforehand, but were not able to see any questions. The

digital interviews were held using a videoconference software and summarized in text immediately afterwards. The written interview questions were sent per e-mail and answered in a document.

The interviews were semi-structured, which allowed for the respondent to answer freely and the conversation to flow. This was considered valuable as the main intention was to find inspiration and listen to experiences, not to compare the details of the interview results to each other. The interview guide is attached in Appendix 4. It had 4 sections, where the first was an introduction of the organization, the second had more detailed questions about the initiative, the third focused on stakeholder involvement and the last had a few concluding questions. The interview summaries are attached in Appendices 5 to 7.

3.2.2 Using the results from research questions 1 and 2

The survey results and conversations with Sabona, used to answer research questions 1 and 2, were used as the basis for the suggested mobility services in research question 3. This was done to customize the suggestion to local circumstances and actual needs, as described in the principle on local ownership and anchoring.

3.3 Uncertainties

Not being physically present in the study area during the data collection was early identified as the main challenge for the planned data collection. It led to reduced ability to verify whether the results were valid or not, especially for the travel times and stated location of services, households and workplaces. This was managed by close cooperation with Sabona, from the early planning phase of the survey design to the final analyses of the results.

The survey design included several steps, from the author sending the questionnaire to Sabona, Sabona printing and distributing them, the respondents answering, Sabona collecting and scanning the responses, and the author with three NTNU research assistants finally registering the answers in a spreadsheet. In other words, uncertainties were able to occur in many steps of the process. A standard measure for limiting these kinds of uncertainties is to perform a digital survey, but due to the seemingly low share of digital tools and internet access in the area[3], it was rather accepted as a weakness of the study.

A pilot study was developed and performed in order to get experience on collecting data from a survey, as well as processing and analyzing travel habit data. The pilot gave valuable understanding of common missteps and questions that are easily misunderstood. As the survey was the only data collection performed in the study area, errors related to misunderstandings would give a big impact on the final results. In addition, the pilot gave an indication of how keeping the questionnaire short gave consequences to the level of explanation in questions.

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[3] 82,2% of Matabeleland North households were without internet access in the 2014 ICT household survey, (Zimbabwe National Statistics Agency, 2014)

The pilot gave the respondents the opportunity to give comments. The pilot respondents' comments included suggestions for additional alternatives, uncertainties related to specific questions and remarks on how it is difficult to estimate travel times in minutes. The analysis of the data gave input on which questions should be rephrased, which were unnecessary, and which were missing. This was taken into account when the final questionnaire was designed. A more detailed description of the pilot study, including the design process and full list of questions, is found in Appendix 8.

The main uncertainty for the interviews was related to the subjectivity of the responses. The interview guidelines were carefully designed not to be leading nor vague. However, as the interviews were semi-structured and dependent on time and the chemistry between the interviewer and the interviewee, the validity of this approach should be considered low. The interviews were audio recorded before summarized in text and sent to the respondents for their comments and approval. This made it possible for the respondents to clarify their answers or clear up misunderstandings if there were any.

4 Current and future mobility: Results and discussion

The following chapter will present and discuss the results from the survey in order to answer the two research questions on current and future mobility in the study area. The discussion is based on the theoretical framework presented in chapter 2 and conversations with Sabona, as well as the perspectives on cultural context discussed in chapter 1.

4.1 About the sample

A total of 100 respondents answered the questionnaire, whereas 4 responses were deleted because of empty or missing pages. Out of the new total of 96 respondents, 48% were men and 52% were women. The most common age group was 41 to 50 years old. The most common main occupation, chosen from a list defined by the Zimbabwe National Statistics Agency, was farming or fishing for the household. 48% stated secondary education to be their highest finished level of education, and 61% had an average monthly household income of less than 50 USD. A summary of the respondents' demographics is presented in table 4.1, and their validity and reliability, including the N values, will be discussed in chapter 4.4.

Table 4.1: Summary of the respondents' demographics.

	Total	Percentage		Total	Percentage
Gender (N = 96)			**Main occupation (N = 262)**		
Women	50	52%	Income-generating work	55	21%
Men	46	48%	Household or family responsibility	54	21%
I do not wish to state this	0	0%	Farming or fishing for the household	65	25%
Age group (N = 118)			Retired or pensioner	12	5%
0 – 4	7	6%	School	31	12%
5 – 10	6	5%	Studying (University or similar)	3	1%
11 – 15	8	7%	Unemployed	34	13%
16 – 20	10	8%	Family support (Foreign aid)	6	2%
21 – 30	10	8%	Other	2	1%
31 – 40	15	13%	**Household's average monthly income (N = 96)**		
41 – 50	25	21%	Less than 10 USD	20	21%
51 – 60	20	17%	11 – 50 USD	39	41%
61 +	17	14%	51 – 200 USD	12	13%
Highest finished education (N = 95)			201 – 400 USD	9	9%
Primary education (Grades 1 to 7)	29	31%	401 – 600 USD	3	3%
Secondary education (Form 1 to 4)	46	48%	601 – 800 USD	0	0%
High School (Form 5 to 6)	8	8%	801 – 1000 USD	0	0%
Tertiary education (University or similar)	8	8%	More than 1001 USD	0	0%
None	4	4%	I do not wish to state this	13	14%

4.2 Current mobility patterns

Research question 1: **What are the current mobility patterns in the study area?**

4.2.1 Transport options and travel habits

The survey results show that walking is the primary means of transport in the study area, as shown in figure 4.1. On average, 270 minutes, or 4,5 hours per day, is used for walking. This is considered a realistic value given the characteristics of the area, considering respondents' average income level and the vegetation and accessibility as described by Sabona. It is also consistent with the literature (Starkey, et al., 2002).
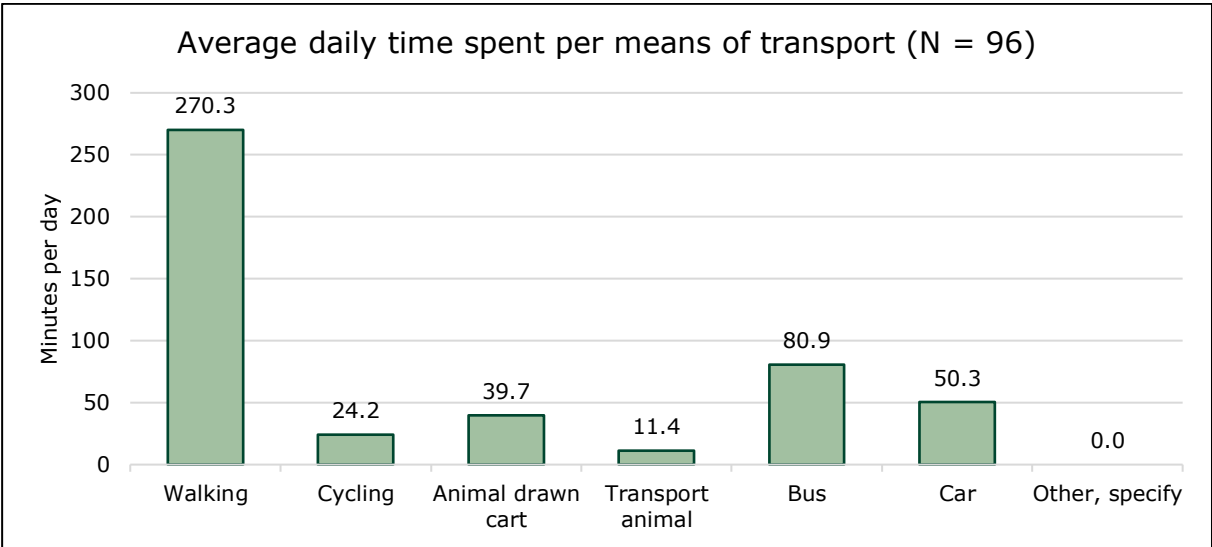
Figure 4.1: Average daily time spent per means of transport.

When asked about the general travel patterns in the area, Sabona describes the trips less than 10 km as mainly based on walking. It can from this be assumed that the daily travels using the four non-motorized means of transport in figure 4.1 (walking, cycling, animal-drawn cart and transport animal) are short-distance trips within the villages. The travels with bus and car are described as occasional trips to health facilities or public offices in the cities of Hwange (approx. 70 km), Victoria Falls (approx. 170 km) and Bulawayo (approx. 265 km).

In general, the means of transport that most respondents have access to are animal-drawn carts. The least accessible are cars. This is valid for both household ownership and what the respondents are able to borrow. The access to means of transport is illustrated in figure 4.2, and the geographical distribution of the access within the study area is illustrated in figures 4.3 a-d.
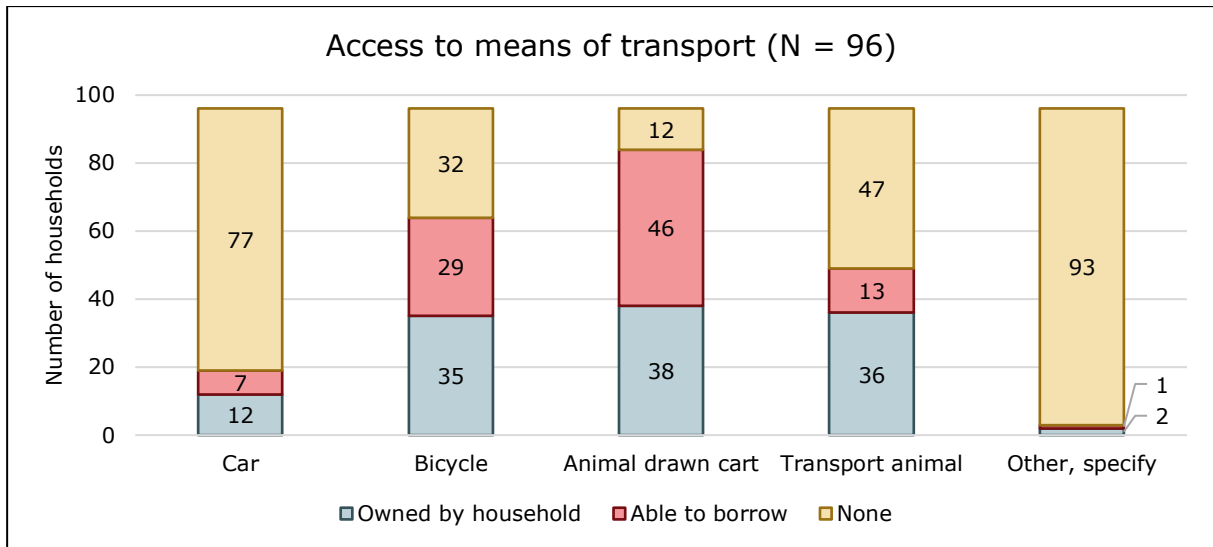
Figure 4.2: Access to means of transport.
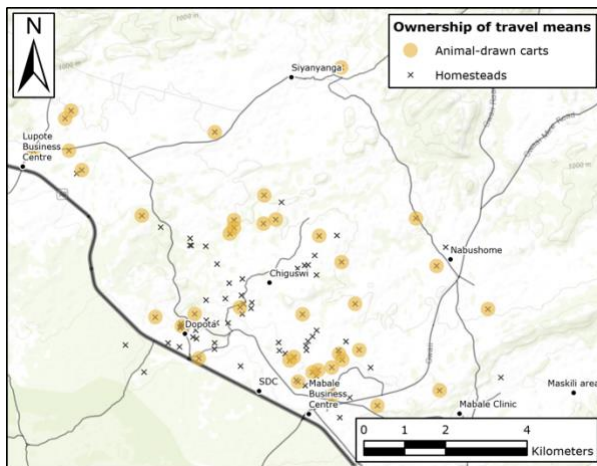
Figure 4.3a: Animal-drawn carts
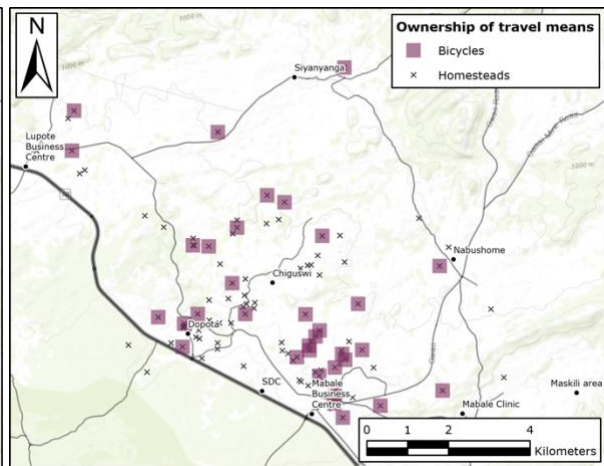
Figure 4.3b: Bicycles
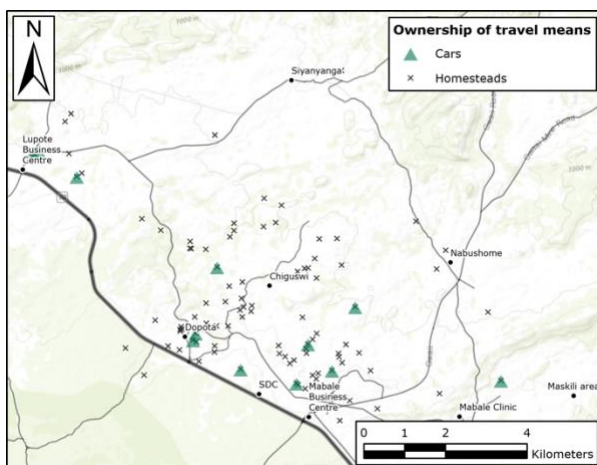
Figure 4.3c: Cars
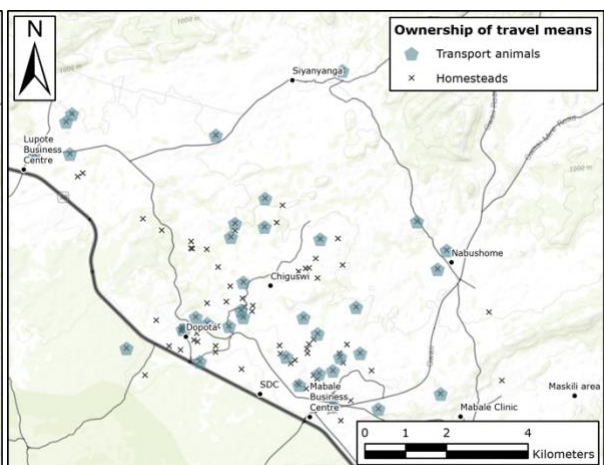
Figure 4.3d: Transport animals

Figure 4.3a-d: Location of travel means.

Studying the maps in figures 4.3a-d, there is a tendency for the respondents who own at least one means of transport to cluster geographically. There is a high concentration around Dopota and Mabale Business Centre, both close to the A8 Highway. The access to means of transport, especially cars, further away from the highway is lower. This can however be subject to coincident due to distribution of the respondents' homesteads. Among the 96 respondents, 69 own at least one means of transport in their household, while 27 does not own any.

On a general basis, most respondents spend the majority of their travel time walking, even though the access to different means of transport is present. The three means of transport most accessible, both in terms of ownership and the ability to borrow, are bicycles, animal-drawn carts and transport animals - all non-motorized means of transport (NMTs). However, the same three means of transport seem to not be widely used, as shown in figure 4.1. Starkey, et al. (2002) describes NMTs as «often inadequate or too expensive», and states that the use of travel means differs based on infrastructure, purpose, distance, gender and age. In conversations with Sabona, the NMTs are described as impractical for domestic tasks given the vegetation and sandy paths encountered along the infrastructure. The wet season, from November to March, makes the bushes grow to limit the visibility along the paths, and when there is rain, the sandy paths get muddy. This may explain why these are not widespread in use even though they are present in the area.

Isolating the bicycles, there are 35 respondents saying they have one or more in their household, but only 7 of them say they cycle to work. The average usage of bicycles is the second lowest of all means of transport based on travel time per day, as shown in figure 4.1. The low usage may be explained by differences regarding gender, age, social status or cultural aspects, or because the bicycles are non-functional and in need of repair services. Conversations with Sabona confirms that some bicycles are non-functional because of bad quality brands, and thus not in use. Bicycles are also described as unpractical for short-distance trips within the villages, because the vegetation along the paths have thorns that easily puncture the tires. There is however some use, mostly by elder and young men, and some girls and women.

A surprising result is that 12 respondents have stated that their household owns a car. Due to the low income level, high petrol prices and seemingly low utility in the area, cars were not expected to be present. However, Sabona confirms that 12 cars is not a surprising result, as teachers, village leaders and politicians often own their own car. There are also some non-functional cars, and some cars available from relatives in neighboring countries in the area. A picture from the Mabale Business Center is showed in figure 4.4, illustrating the presence of cars in the area.

Figure 4.4: Picture of Mabale Business Center with cars. Source: Øyvind Høsser (2019)

Key travel habit statistics for the sample as a whole are found in table 4.2. The standard deviation is approximately the same as the average value for all of the metrics, which means that there is a big spread between the lowest and highest values. For the number of trips per week, the range is between 4 and 128, which indicates that the travel patterns are highly individual. There might also be misunderstandings of the questions, as the respondents were asked for the total number of trips per *week* first, and then for the travel time per means of transport per *day*. Plotting the answers in a scatter plot, as shown in figure 4.5, indicates the responses skew toward the lower end of the range.

Table 4.2: Key travel habit statistics for the sample.

	N	Average	Standard deviation
Number of trips per week	95	26,7	21,4
Travel time per trip [min]	96	86,8	111,6
Travel time (walking) per day [min]	96	270,3	247,9
Travel time (all other means of transport) per day [min]	96	204,3	295,7
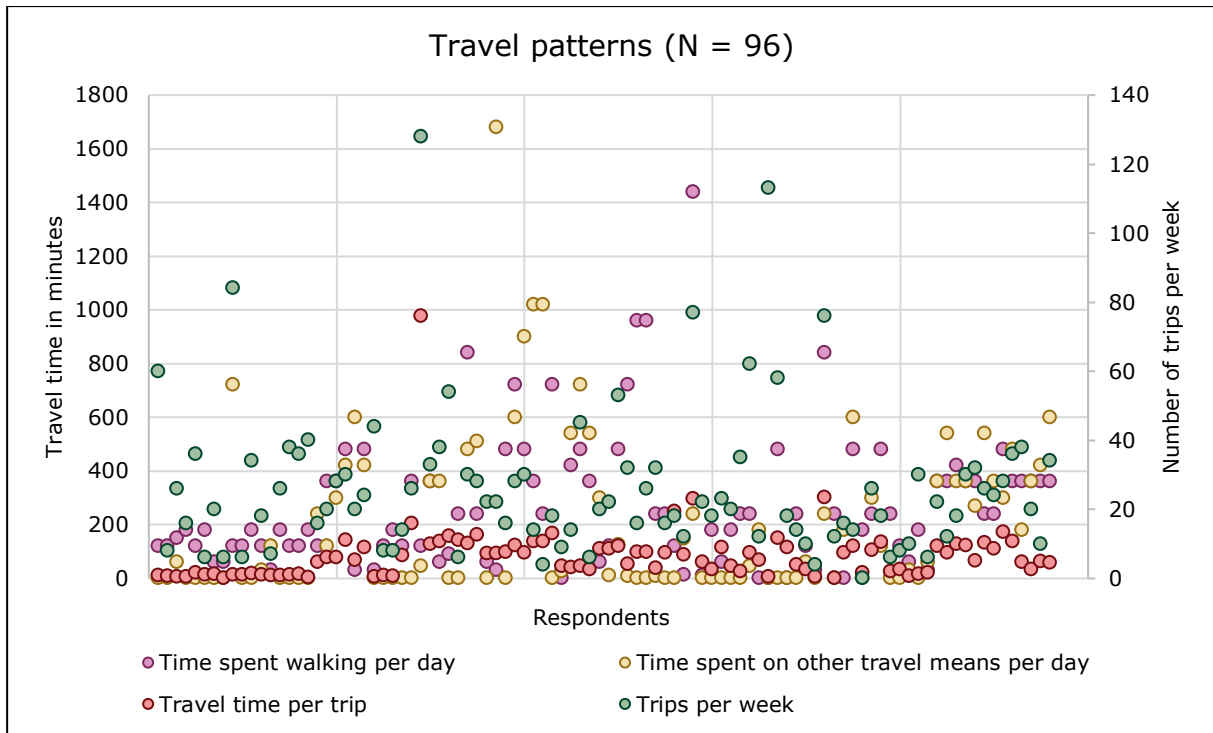
Figure 4.5: Scatter plot of travel patterns.

The average number of trips per week, average travel time per trip and calculated hours per week per travel purpose are illustrated in figure 4.6. The highest number of trips per week is bound up in domestic tasks, here defined as the trips to/from water sources and trips for firewood collection. This is an expected results with regards to the literature (Starkey, et al., 2002) (Bryceson, et al., 2008) (Ali-Nejadfard, 2000). The trips to/from water sources have the highest total travel time per *week*, despite the short travel time per *trip*. The trips to/from health facilities, on the other hand, have few trips per week but the longest travel time per trip. This indicates low access to hospitals and doctors in the area, confirmed by Sabona and digital maps. Such a pattern is also similar for trips to church. The answers specified in *other* include burials, visiting relatives, and village meetings.
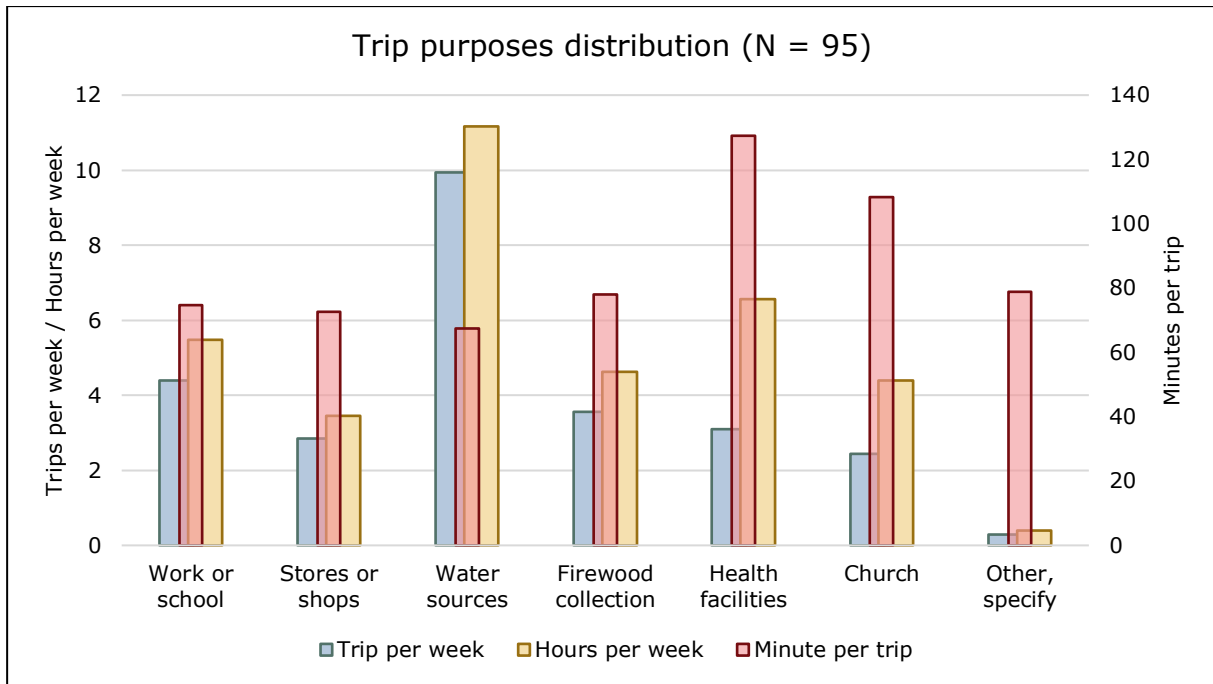
Figure 4.6: Distribution of trip purposes.

4.2.2 Vulnerable stakeholder groups

The role women have as the main transporters in rural mobility is highlighted in the literature (Starkey, et al., 2002) (Ali-Nejadfard, 2000), which makes taking their habits and needs into account when planning for a transport system a crucial success factor.

As seen in figure 4.7, the female respondents average at 305 minutes, or 5,1 hours of walking per day. This is slightly more than the 2,1 to 4,3 hours average for women in rural areas as stated by Starkey, et al. (2002). Compared to men, women walk on average 31% more, while the men cycle and travel by bus more. As previously discussed, traveling by bus is associated with long-distance trips, while walking and traveling by NMTs is associated with domestic tasks. It is, from these results, reasonable to assume that the men in the study area are mainly responsible for long-distance trips like going to the nearby cities, while the women are the main transporters for domestic tasks. This is supported by Starkey, et al. (2002), who states that women make up 77% of all trips related to these tasks.
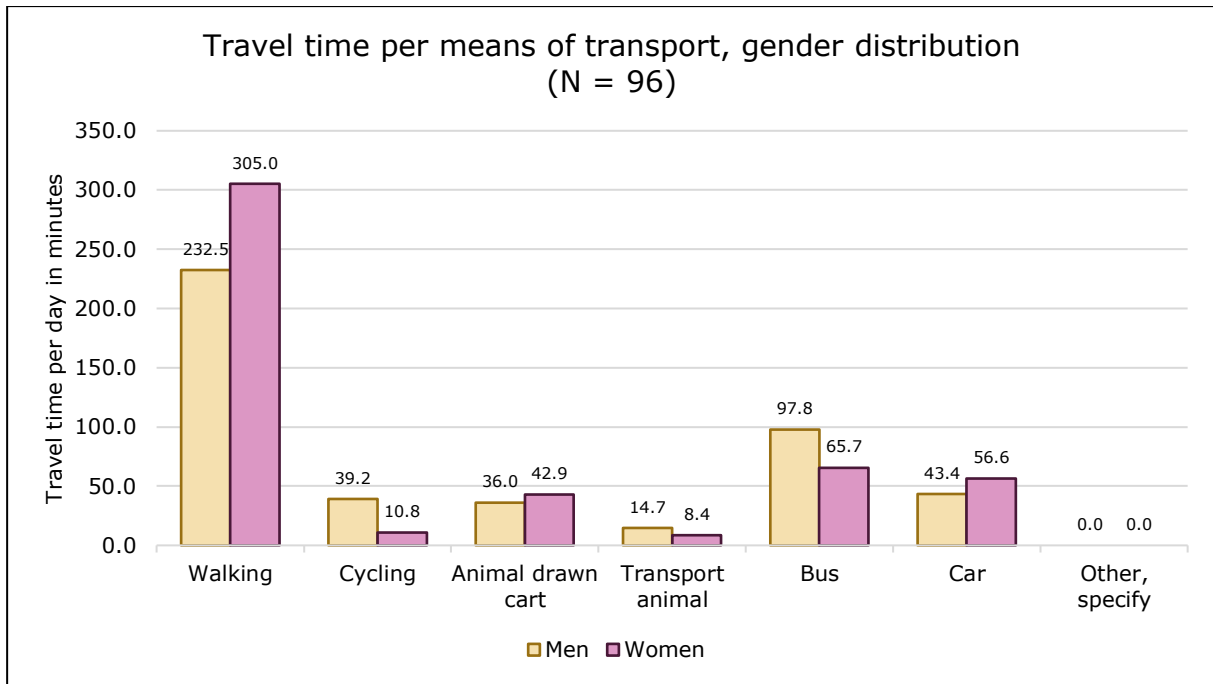
Figure 4.7: Travel time per means of transport, gender distribution

As people with disabilities are described as a vulnerable group (Starkey, et al., 2002), their demands should also be particularly considered. Out of the 96 survey respondents, 23,5% answered that they have at least one disability. The travel patterns seem to be similar to the people without any disabilities, as shown in figure 4.8. The exception is for bus rides, where the respondents with at least disability on average travel more than the double number of minutes per day by bus. Looking at the trip purposes, as illustrated in figure 4.9, there seems to be a slightly higher average number of trips to health facilities among the people with at least one disability. This may explain the difference in travel time by bus, even though the number of respondents with disabilities is too low to conclude with certainty.
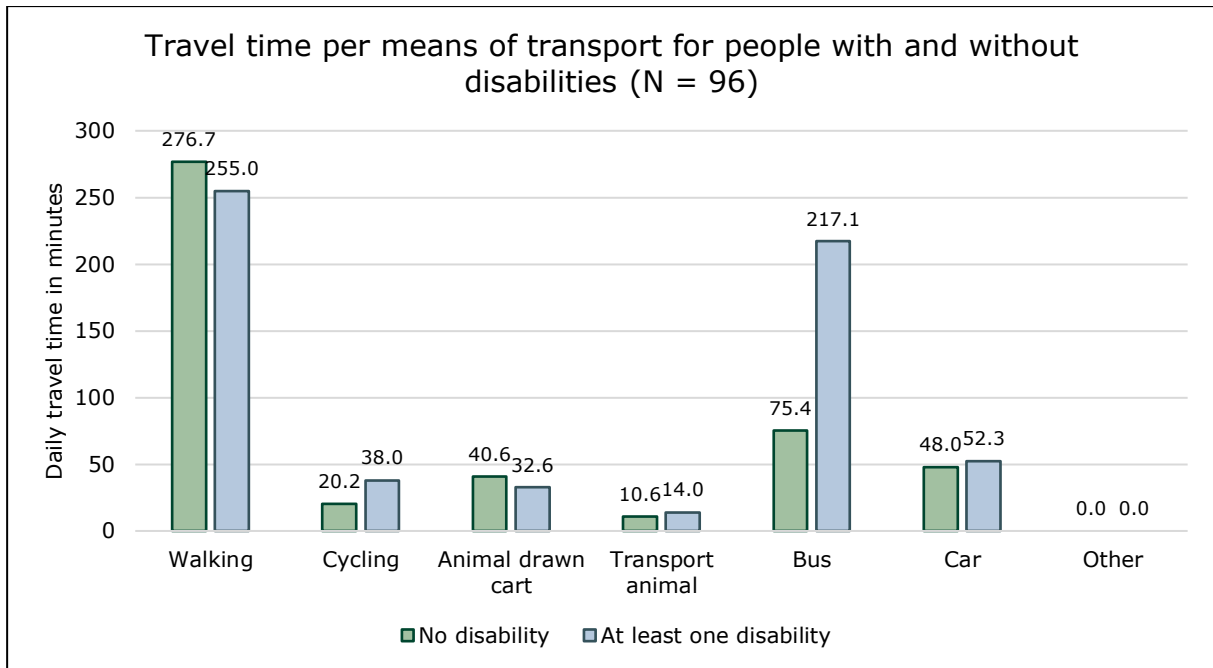
Figure 4.8: Travel time per means of transport, people with and without disabilities.
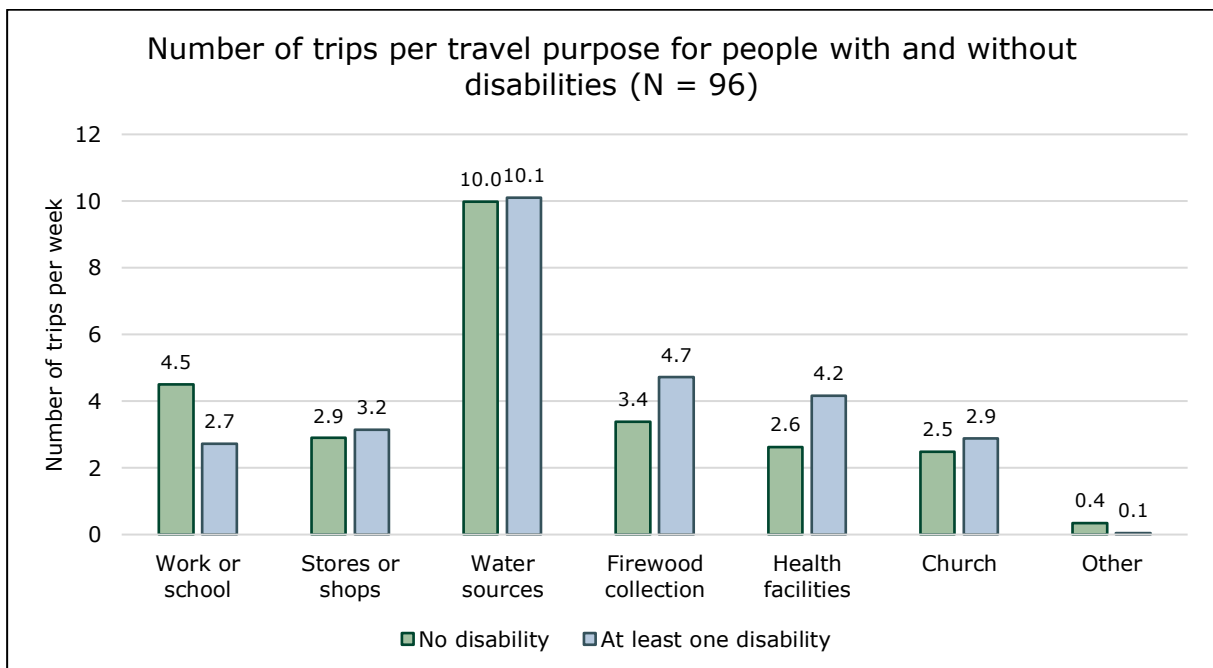
Figure 4.9: Travel purposes, people with or without disabilities.

4.2.3 Level of mobility

Measuring mobility according to Litman (2003) is done by quantifying person-miles, ton-miles and travel speeds. For this study, travel speed was used to consider the level of mobility in the study area. The questionnaire asked for travel patterns using *time* as the measuring unit, as the study population was assumed to have a relatively distant relation to distance units. However, by measuring the distances between known points in the

map, an estimated travel speed was possible to calculate; 16 respondents marked their workplace in the map, which gave an average of 1,4 km air distance from their homestead to their stated workplace. Using the respondents' stated time to get to work, this indicates an average walking speed of 2,2 km/h. In table 2.1, the walking speed is 5 km/h, which is more than double the calculated value. However, as the value of time can be assumed to be different in rural Zimbabwe than for the urban pedestrian in a Western country, and as rural walking often involves carrying 10-20 kg loads (Starkey, et al., 2002), 2,2 km/h is not an unrealistic estimate.

The average time per trip in the study population was 76 minutes, which with an average speed of 2,2 km/h gives a walking range of 2,8 km. This range, shown in blue, is illustrated with a 2,8 km buffer from each of the respondents' households in figure 4.10. The buffer is made using a network analysis tool called *Service Area* in the GIS software ArcGIS Pro, which creates a distance buffer from each given point based on the road network. Assuming that one by using a bicycle can keep a speed of 10 km/h, as given in table 2.1, the distance reached for 76 minutes traveling is 13 km. This range is illustrated with a 13 km *Service Area*-buffer from each household, shown in yellow in figure 4.10. The map illustrates how the mobility for those using a bicycle is greatly improved by the increased travel speed.
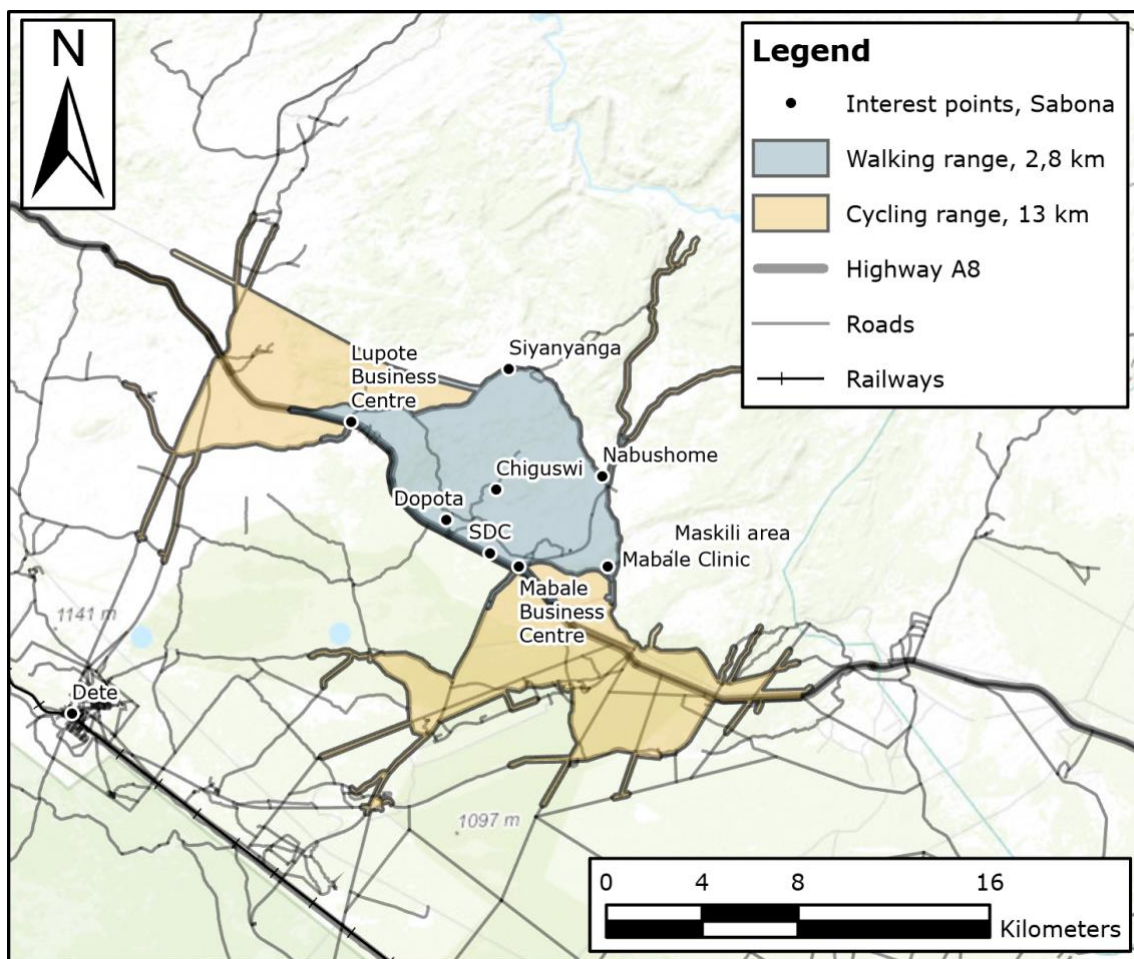
Figure 4.10: Walking and cycling range for 76 minutes travel time.

Although the range accuracy is increased when basing the buffer zones on the road network, the functionality of the *Service Area*-tool is limited for this study area. Sabona describes the walking patterns in the area as mostly based on informal paths, which are not included in the base map data downloaded from Open Street Map. Thus, the range zones in figure 4.10 are not considering the actual walking paths. In addition, as the buffer zones are only taking the respondents' households into account and the distance is based on the average speed, the actual range is larger than shown. To illustrate the range in air distance, a straight-line buffer (a regular vector analysis in ArcGIS Pro, compared to the network analysis used in 4.10) is showed in figure 4.11. Nevertheless, both maps show the significant difference of distances that can be reached when increasing the speed.
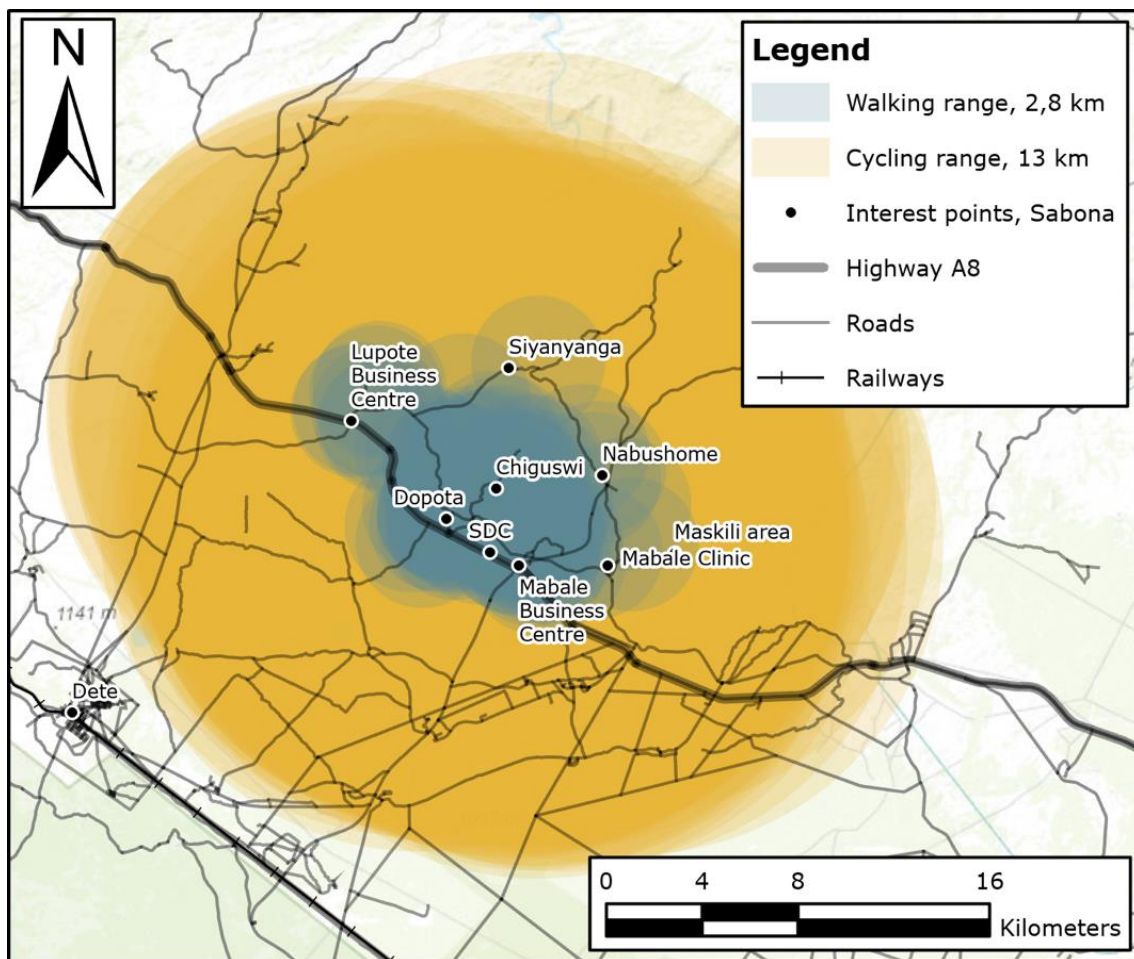
Figure 4.11: Air-distance walking and cycling range for 76 minutes travel time.

In conclusion, given the current availability and use of travel means, the mobility in the study area can be said to be low, which was an expected result for the rural, resource-constrained conditions. However, low mobility itself is not a sign of constrained resources. The same mobility level in an urban area with high accessibility can be said to result in a different socioeconomic status. For the study area, it is the combination of low accessibility (health services and public offices in particular) and low mobility that creates the need for improvement, especially considering the low income level and lack of

resources in the area. Improving the level of mobility is thus seen as an achievable measure for socioeconomic development.

4.2.4 What are the current mobility patterns in the study area?

To respond to the first research question, the current mobility patterns in the area are characterized by people mostly walking. This counts for all groups studied, as there is no notable difference between neither gender nor people with disabilities. However, both men and people with disabilities seems to be taking the bus more, and women walk on average more than men.

The trips are mostly bound up in domestic tasks; to/from water sources and for firewood collection. However, the trips with the longest travel time are to/from health facilities. This indicates low accessibility for health services, which is supported by the high number of bus travels for people with disabilities. There is relatively high access to bicycles, animal-drawn carts and transport animals (NMTs), while the number of motorized vehicles in the area is low. Nevertheless, the use of both NMTs and other means of transport is low.

In conclusion, both accessibility and mobility in the area can be described as low, as the range with which the study area population moves is small and does not include the desired services.

4.3 Future travel demands

Research question 2: **What are the demands for improved mobility in the study area after the Sabona Development Center is built?**

4.3.1 Improved mobility

To study the demand for future improved mobility, five questions on travel means and traveling longer distances were asked. Two of the questions were directly related to bicycles, as a response to the good reputation given in the literature (Ardizzi, et al., 2021) (Baker, 2020).

When asked about what travel means the respondents would buy if they had the money, the animal-drawn cart had the highest demand, marked by 37 of 96 respondents. In comparison, the share of respondents who wants to save for a car or motorbike is 21 of 96. This indicates that the demand for motorized vehicles is low, potentially because of their seemingly low utility given the current in-village travel habits based on domestic tasks. The income level may also affect the results, as operating costs, mainly the previously mentioned petrol prices, are high. The results also indicate a clear demand for increased access to means of transport in general, as only 6 respondents answered that they are satisfied with what they have today. The distribution of demand is illustrated in figure 4.12.
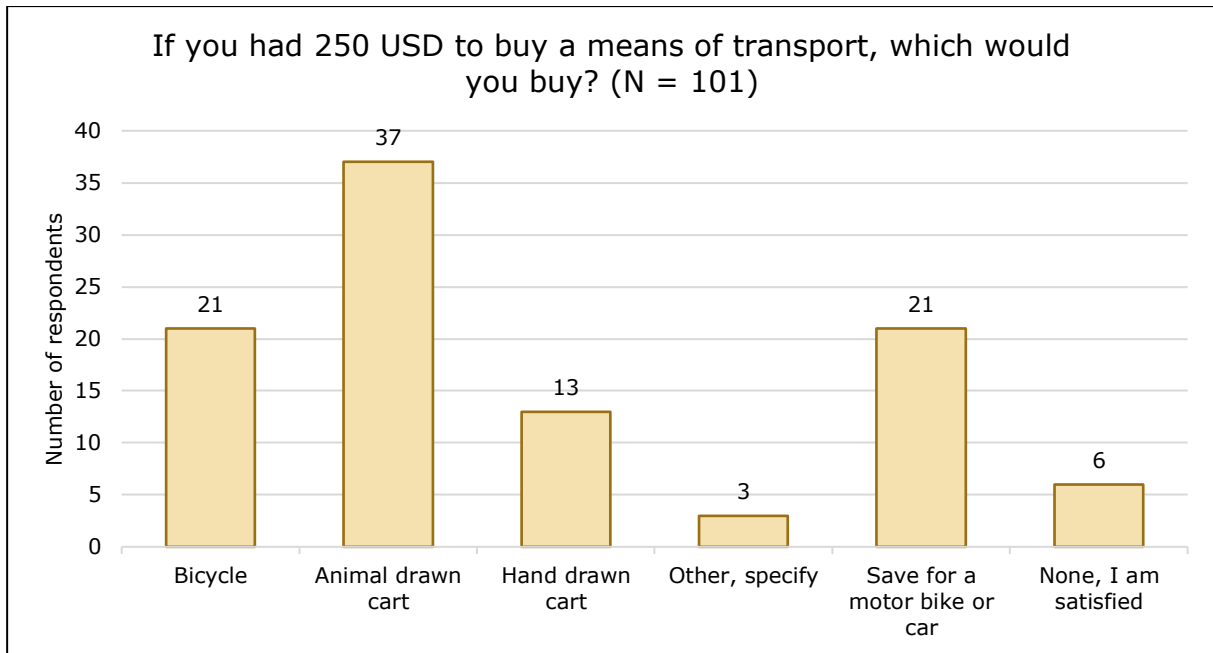
Figure 4.12: Demand for travel means.

When asked for what purposes they would use a bicycle if they had one, most respondents answered that they would use it to access health facilities, go to work or school, or travel longer distances, as shown in figure 4.13. Only 12 respondents state that they would use the bike for domestic tasks, which confirms Sabona's statement on low utility of bikes for water collection. Nevertheless, the results show a clear indication of the population seeing the bicycle as a mobility tool, confirmed by the few respondents stating that they don't want to own a bicycle.
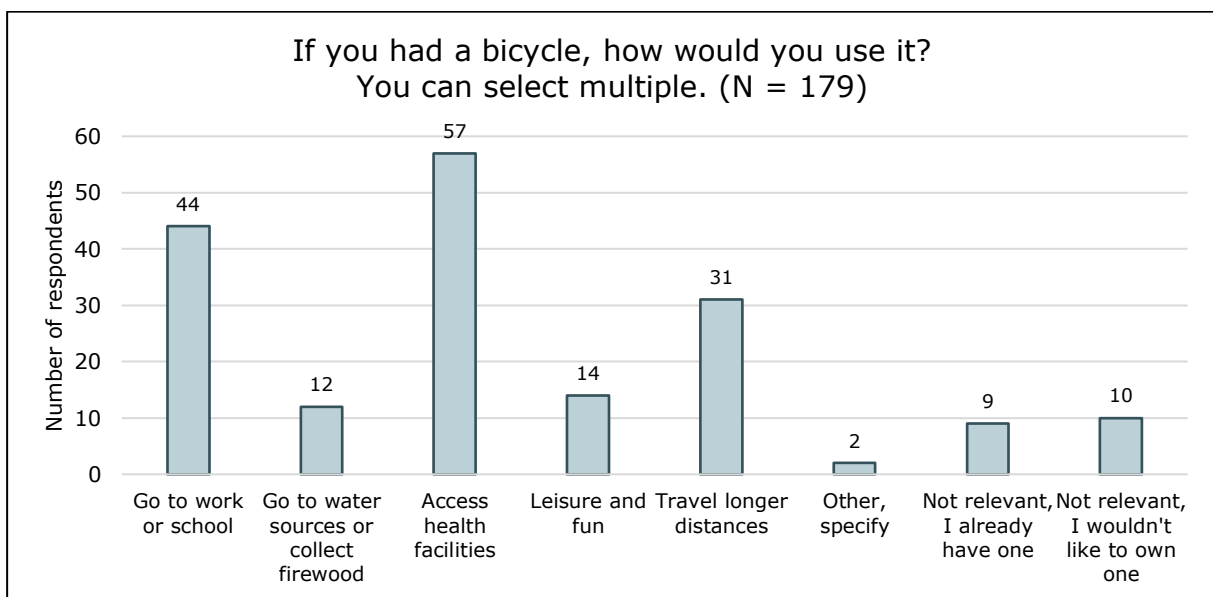
Figure 4.13: Demand for use of bicycles.

As seen in figure 4.14, 60 of 96 respondents answered that they would trade their current means of transport for a bicycle because it is faster and 35 because they would be able to travel longer distances. Distinguishing between traveling faster and traveling longer is a matter of increased efficiency or improved mobility, as traveling faster doesn't necessarily mean reaching destinations further away, but instead using less time for travel. More respondents preferring faster travels may thus indicate a demand for the bicycle to reduce the travel time of their current trips. This argument is strengthened when also considering the 28 respondents who want to be able to carry more on their trips, indicating a demand for utilizing the bicycle in work-related trips as seen in figure 4.13. Being able to travel faster and carry more frees time available for other activities, while longer travels increase the access to services and products. Nevertheless, the utility of the bicycle as a way of improving the mobility seems to be acknowledged.
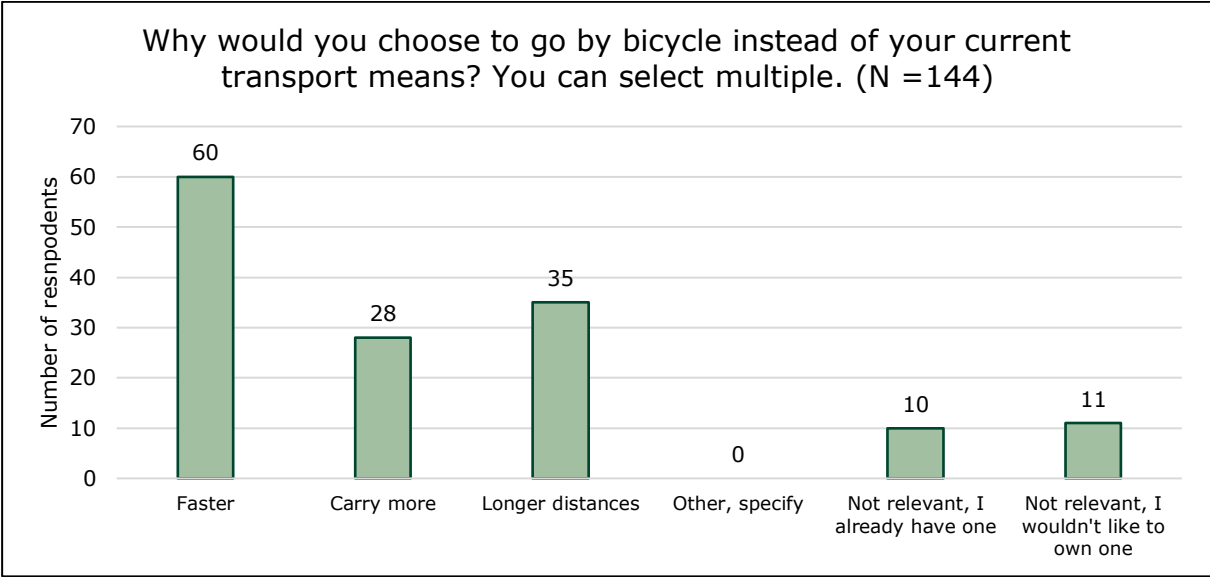
Figure 4.14: Utility of bicycles.

The respondents were asked two questions about longer travels. Money was the dominant barrier, indicated by 90% of the respondents. Among the specified answers on «other», medical reasons, family responsibility and lack of accommodation were mentioned. No respondent answered that they don't want to travel longer distances, which indicates a high demand for improved mobility in the area, even though the barriers are making it challenging.

When asked about purposes for longer travels, the question allowed for maximum three options selected. Most respondents would access health facilities, go a nearby city (Hwange, Bulawayo or Victoria Falls) or visit friends and family, as shown in figure 4.15. This result corresponds to the description of rural mobility given by Starkey, et al. (2002), where the out-of-village travels are of economic and social importance. The low response on the options to look for job opportunities other places in Zimbabwe, in South-Africa or another country indicates that people would want to stay in their villages and are not looking to relocate in the future.
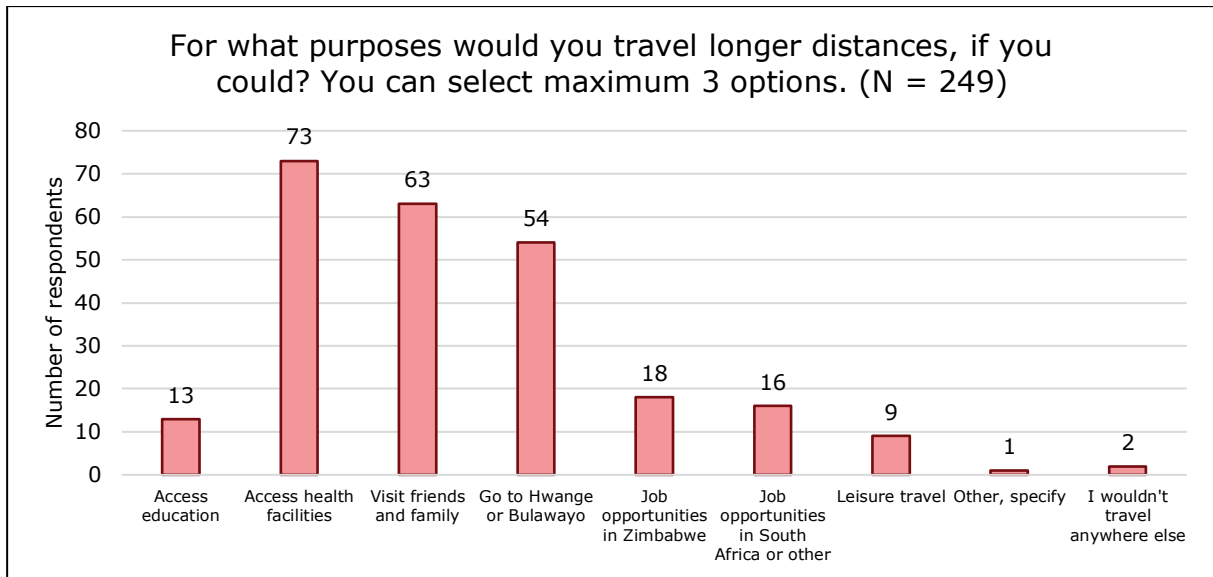
Figure 4.15: Purposes to travel longer distances.

4.3.2 Vulnerable stakeholder groups

Looking at the demand for travel means for women and men separately, the interest in saving for a motorized vehicle is approximately the same, as shown in figure 4.16. However, the demand for bicycles has a notably higher demand among men than women, and the opposite for animal-drawn carts. This might be explained by the difference in their daily tasks. As discussed earlier, it is reasonable to assume that men travel more long-distance, while women are main transporters for domestic tasks. The utility of a bicycle can be said to be higher for long-distance trips, hence the higher demand among men. The opposite counts for women and animal-drawn carts, as they increase the load capacity (Starkey, et al., 2002).
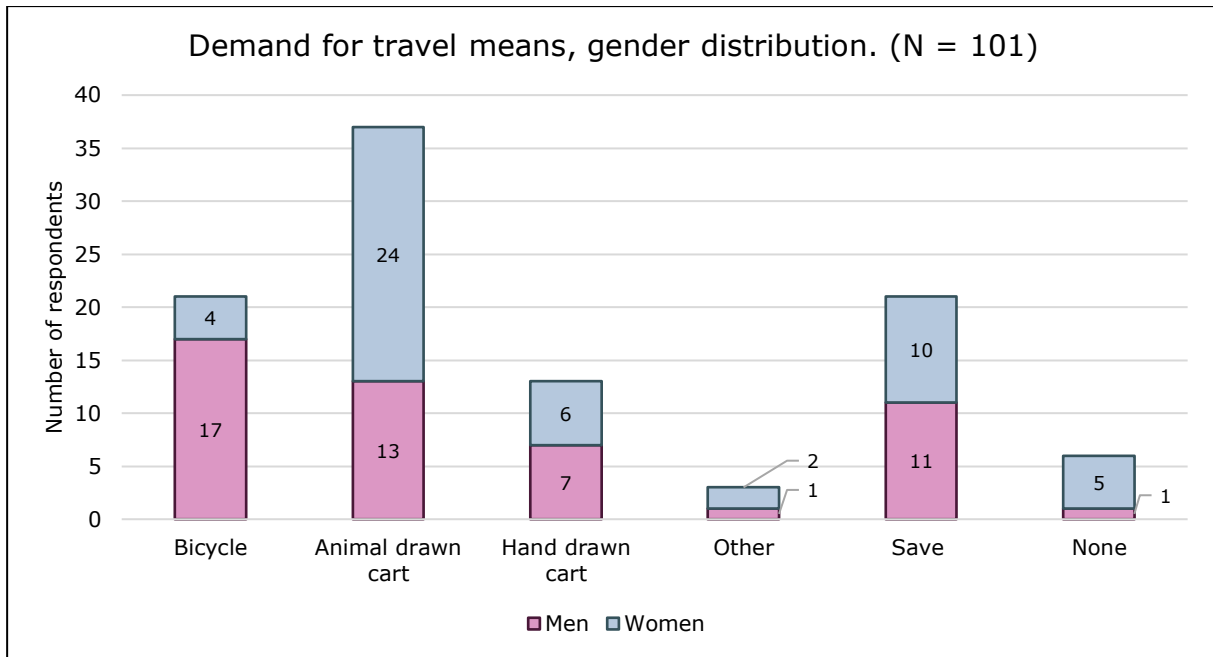
Figure 4.16: Demand for travel means, gender distribution.

For the respondents with disabilities, the distribution of demand for travel means is not as fluctuating as for the population in total, as shown in figure 4.17. The highest demand for this stakeholder group are the NMTs, but in contrary to both women and the population as a whole, the demand for animal-drawn carts is not as notably high. As the sample size for people with disabilities is low, it is difficult to say whether this is a result that is valid for the whole population they represent or not.
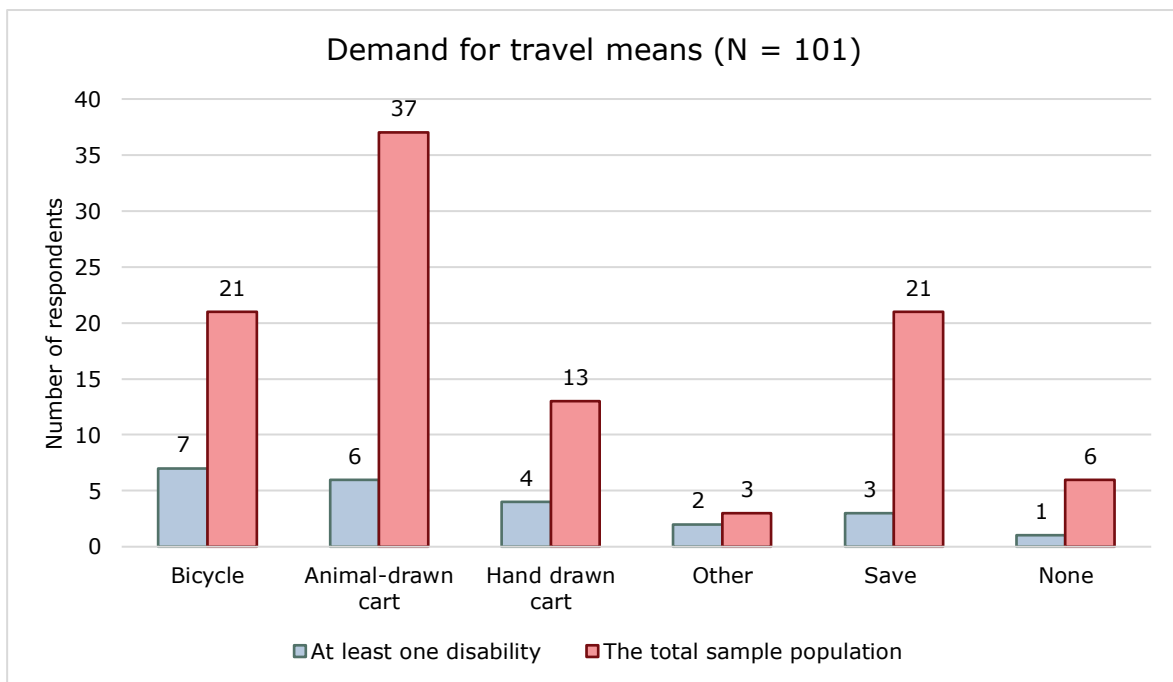
Figure 4.17: Demand for travel means, people with disabilities and total population.

4.3.3 The Sabona Development Center

The answers to the questions on future travel demand show that the respondents are aware of the SDC and the possibilities it will bring to the area. Most respondents view the SDC as a place for income-generating activities, like the poultry project, vegetable gardens and selling stands. In addition, 24 of 96 respondents want to join the vocational school, and 39 want to go there to be social. The answers are illustrated in figure 4.18. Taking into account that the question allowed for multiple answers, the general impression of the SDC within the population is that it is a place generating socioeconomic value for the community.
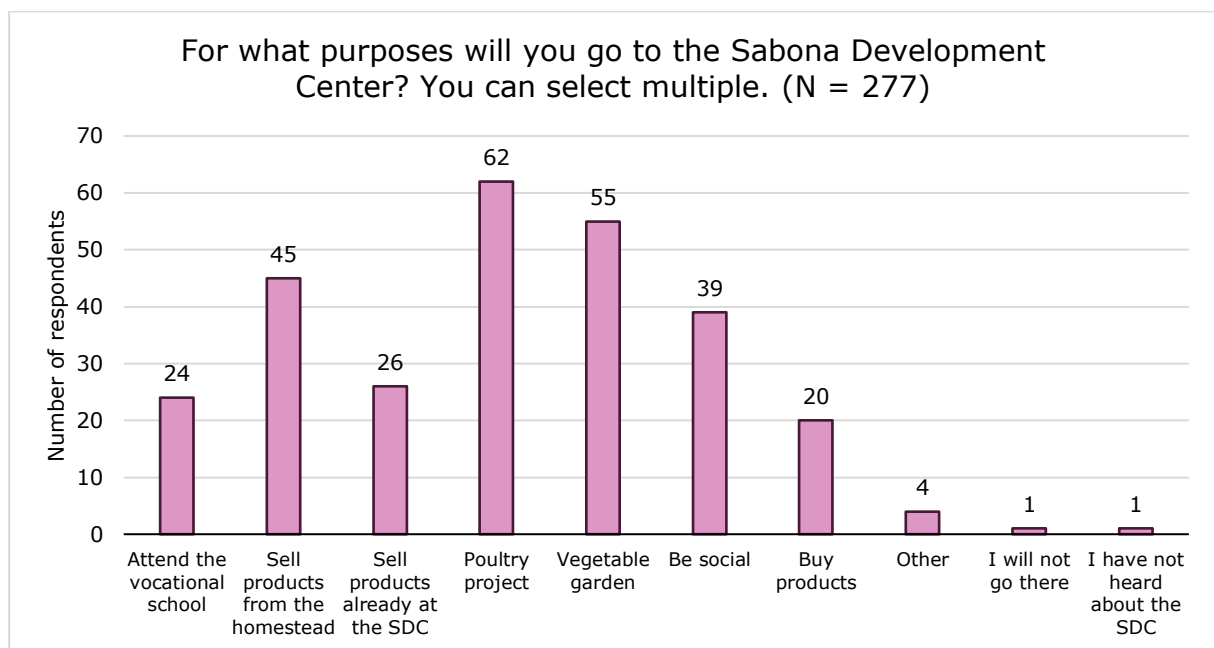
Figure 4.18: Purposes to go to the SDC.

As the SDC is expected to improve the accessibility in the area, it is believed that a changed transport demand will be generated. The change of trips within the villages is expected to be mainly new trips generated by the employment opportunities the SDC will bring, based on the responses showed in figure 4.18. It should also be noticed from figure 4.10 how the SDC is located approximately in the middle of the households' walking range, confirming its strategic location in the area. However, the lack of health facilities will still be present after the center is built, which will continue the demand for long-distance trips and thus the need for improved mobility.

When asked about their preferred means of transport getting to the SDC, 63 of the 96 respondents answered walking. The stated travel time for these trips averaged at 65 minutes, which is slightly less than the current average travel time per trip of 87 minutes. As shown in figure 4.18, 45 respondents answered that they will sell products from their homesteads, and 20 want to buy products at the SDC. This means that there will be transportation of goods between the SDC and the homesteads. Nevertheless, only 14 respondents would prefer going to the SDC by the use of NMTs, and 16 by car.

Whether this is because most respondents want to walk, because of safety issues, the availability of means of transport or any other explanation remains uncertain.

4.3.4 What are the demands for improved mobility in the study area after the Sabona Development Center is built?

To respond to the second research question, the future demand for improved mobility can be classified in two; the continued demand for long-distance travels, and the demand for new trips associated with the SDC.

The SDC is assumed to improve the access to employment options in the area. However, there is still demand for improved access to health facilities, public offices and services in the nearby cities and for visiting friends and family. The main barrier for traveling longer distances is money, and the bicycle is seen as a way of being able to travel further. However, the highest demand is for animal-drawn carts, associated with use for domestic tasks.

For the trips associated with the SDC, the use seems to be based on income-generating activities (joining the poultry project or vegetable gardens, or selling products). These are assumed involve carrying loads between the homesteads and the center. The respondents seem to be aware of the utility a NMT can bring, and there is a stronger demand for investing in NMTs than saving for motorized vehicles. However, most respondents say they will walk when going to the SDC. This counts for both the sample as a whole, for women and for people with disabilities.

4.4 Reliability and validity of the data set

The first two research questions were addressed using data from the surveys. The quality of the survey data set can be analyzed by looking at the reliability and validity of the data. Reliability has to do with trustworthiness, evaluating the sources or whether different observations and measurements of the same phenomenon would give the same results. The validity has to do with the data set and collection; whether the data measures what is relevant to answer the research questions or not.

The survey respondents were selected randomly by handing out the questionnaire to school learners for them to ask their parents to answer. The female learners were asked to give it to the mother in the household, and the male learners asked the father. This gave a distribution of 52,1% women and 47,9% men, which, compared to the 51,6% / 48,4% distribution in the 2017 Matabeleland North Census, is very valid in terms of gender distribution. For the respondents with disabilities, the share is 23,5% in the survey while 3,9% in the 2017 Matabeleland North Census. This can be explained by the respondents' own definition of what a disability is, or simply that the study or study area has a high share of people with disabilities.

The 10 km buffer includes 2000-2500 households, which with a 95% level of confidence and 10% margin of error gives a sample size of 94 households. This was achieved by the 96 respondents answering the questionnaire. It is however important to distinguish between the sample and the population as a whole, as the standard deviations in table 4.2 indicate a highly individual variation among the respondents.

To be able to pick up on possible errors or misunderstandings, the questionnaire provided information about the possibility to comment on the questions in the survey. No comments were written, but there is still reason to believe that not all questions were clear. Examples of this include:

- The two questions where the respondents were asked to state how many household members per category AND mark the relevant category for themselves. The question on the respondents' main occupation got N=262 marks, while there were only 96 respondents. This may be because the respondents considered several occupations as their main, or because there were misunderstandings of the question. The same counts for several questions throughout, which explains the differences in the N value in both tables and figures. This can be said to reduce the reliability of the results.
- For the questions asking the respondents to state their travel times in minutes or hours, several respondents did not write which unit they used. This may have led to inaccuracies in the calculated averages discussed in chapter 4.1.

All responses and the full list of corrections done to the data set is attached in Appendix 9.

5 Implementation of mobility services

This chapter will give a summary of the interviews with the three Bicycle for Development (BFD)-organizations and the documentation provided by the interviewees. These are, together with the theoretical framework and the results and discussions from chapter 4, used to discuss the final research question on how implementation of mobility services can contribute to Sabona's values.

5.1 Bicycles for Development: Interviews and impact reports

The documentation provided was mainly reports of the socioeconomic impact of the work the three organizations do, as well as a few presentations and research theses. Measuring impact was in the interviews described as a time-consuming and costly process, but important for proof of effect and thus funding. The reports are conjointly presented with the interviews in three different themes: employment, health and education, as these are considered important socioeconomic factors. The interviews also covered business models, financial agreements, stakeholder involvement, challenges and success factors. As these are not directly related to the third research question, they are not described further in this chapter, but included in Appendices 5 to 7. They are however referred to in the discussion in chapter 5.2.

The three organizations are:

- **BEN Namibia:** Provider of second-hand bicycles, resources and training for bike shops in Namibia.
- **World Bicycle Relief:** Not-for-profit bicycle supply chain and large-scale bicycle mobility programs in 13 countries across South America, Africa and Asia.
- **Velafrica:** Second-hand bicycle supply chain and social entrepreneurship in 7 African countries.

It should be mentioned that the three organizations operate in different countries and both urban and rural areas. Factors that may affect the measured impact include level of accessibility, population density and local regulations, which means that the impact is not necessarily applicable for the thesis' study area and Sabona.

5.1.1 Employment

Employment is reported as both a direct and indirect impact for all three organizations. The direct employment is the employment that comes from the establishment of bike shops or other initiatives in the country of operation. The indirect employment is the increased productivity or new workplaces that come from increasing the use of bicycles in the surrounding areas.

Looking at the direct employment, all three organizations train and employ local staff as mechanics and within business administration and/or finances for their bicycle shops. BEN Namibia reports that they employ up to five people in total per shop, while the numbers vary for Velafrica and WBR. In 2010, the average increase in income for the

BEN Namibia employees were 710%, and 80% of them said the program positively changed the way the rest of the communities see them (Linke, 2011). The organization expanded from 1 shop in 2006 to 26 in 2010. Velafrica counts 5 hubs and several bicycle shops, while WBR currently have a total of 35 bicycle shops.

When measuring the indirect employment, Velafrica focuses on the increased speed and load capacity the bicycle brings, as pointed out by Starkey, et al. (2002). Compared to walking, Velafrica states that using a bicycle for work-related trips takes 1/3 of the time, and the workers can carry 3 times the load weight (Velafrica, 2016). This contributes to lighten the field work and increase productivity, and thus sell more goods and generate higher income. The bicycle not only provides a shorter way to the fields, but also to the markets. Decreasing the time barrier when traveling to the market may open for a choice of markets, where the worker can bring their supplies to the market where the highest profit can be made. Those who use the bicycle instead of paying for public transport can save their money to invest.

The Velafrica impact reports show a direct correlation between the access to bicycles and the number of crops produced, with an average increase by the factor of 2,5 (Velafrica, 2016). WBR also see effect within agriculture, and states that with their *Buffalo Bicycle*, «dairy farmers made more deliveries, transported more milk each trip, reduced spoilage and increased income, compared to farmers who walked or used inferior bikes and other transportation modes» (World Bicycle Relief, 2016). The numbers show a 25% increase in the dairy farmers' deliveries, with 23% increase in both volumes sold and generated income (World Bicycle Relief, u.d.).

5.1.2 Health

Velafrica emphasize the role the bicycle has in facilitating for access to medical services, both for the sick and injured, and for their families. As rural areas often lack reliable public transport services, the bicycle is considered the fastest and cheapest form of transporting mid- to slightly injured people to health facilities. As a response to this, several BFD organizations, including BEN Namibia and WBR, have developed bicycle ambulances that both ease and increase the speed of this type of transport. In addition, owning a bicycle in the family eases the provision of food for family members having to stay at the hospital for a longer time, as food is rarely included.

For healthcare workers, WBR point at an 88% increase in patient visits when using a bicycle instead of walking (World Bicycle Relief, 2021). However, informal studies carried out by BEN Namibia show that, surprisingly, health volunteers equipped with a bicycle didn't visit more clients. Although the travel time was reduced, the volunteers chose to rather increase the time spent with each client. The studies also found that clients were prouder when visited by a health worker arriving by bicycle than on foot, which improved the status of external volunteers in the communities (BEN Namibia, 2020).

5.1.3 Education

Velafrica states that the bicycle positively influences the educational development, as using a bicycle to get to school makes the students arrive more relaxed, more punctual and with more attention in class. In addition, arriving earlier back home gives more time for chores, homework and leisure activities. The security aspect is also important, as

children walking to school often take shortcuts that may be dangerous. With a bicycle, the main road is used more, where they are watched over by other road users. They also add that the bicycle is seen as an enormous relief for firewood and water collection, and that this has a direct influence on the quality of life for the entire family.

WBR has performed a larger study of schoolgirls in Zambia, providing more statistics and numbers. A program giving girls access to bicycles showed that their school commuting time was reduced by a third, and thus the punctuality was increased by 66%. The girls in the program attended school an extra five days per year, accounting for 28% reduction in absenteeism. The girls were also less likely to miss school due to safety concerns and 22% less likely to be whistled at or teased on their way to school. They scored higher on a mathematics assessment than the girls in the comparison group, but no impacts were found on reading nor English. On average, the research did not find evidence that access to bicycles impacted school dropouts, how many children the girls wanted to have in the future, their life goals or their freedom of movement (World Bicycle Relief, 2020).

Both studies show that cycling to school has a positive impact on the learners' lives, as punctuality and attendance at school increase, and more time is made available for other activities.

5.2 Discussion of research question 3

Research question 3: **How can the implementation of mobility services help Sabona fulfil their values, including but not limited to, employment creation?**

As discussed in chapter 2.2, improving accessibility and mobility provides opportunities to education, health and employment (Ali-Nejadfard, 2000). Accessibility is a matter of bringing goods and services closer, while improving mobility makes the travelers able to reach destinations further away. Mobility is measured in person-miles, ton-miles and travel speeds (Litman, 2003), and improving mobility can be done by increasing these measures. Implementing mobility services is thus a way of increasing opportunities for the communities where Sabona works.

Although the question mentions employment creation specifically, the impact on health and education described in chapter 5.1 should not be ignored. Sabona's values include education, equality and sustainability, with the overall vision of growth for Zimbabwe and its people. To keep these values and vision in mind and ensure the principle of a holistic approach, the discussion aims to reflect on several aspects of socioeconomic value.

The discussion of this research question is structured in two parts: private ownership of means of transport, and shared mobility services. The research question is answered by discussing how these correspond to the demand for in-village and long-distance travels in subchapter 5.2.3.

5.2.1 Private ownership of means of transport

All non-motorized means of transport will increase either load capacity, speed or both, as shown in table 2.1. The impact reports emphasize how reducing travel time can free time available for other income-generating activities. Increased speed can also expand the range of trips, opening opportunities to new markets or other employment. Improved mobility is also shown to increase the production of crops or other goods to sell at the market. These implications are all positively associated with the new trips generated from the SDC, where the demand is based on the transport of goods to and from the center. Promoting increased use of NMTs is thus assumed to have a positive impact on the mobility within the villages.

Furthermore, having access to an NMT provides the opportunity to start a small-scale entrepreneur business. Examples of these include moving libraries or ICT services like the ones provided by the Rural Libraries and Resources Development Programme in Zimbabwe[4]. WBR also have experience with people creating their own small-scale businesses after having bought a bicycle, e.g. a delivery-service for bread to the nearby villages. Starting a business is also a direct employment opportunity, as it requires business administration and employees, depending on the scope and scale of the business.

The use of bicycles as a tool for development is widespread in use, given its relatively low cost, high load capacity and increased speed (Ardizzi, et al., 2021) (Starkey, et al., 2002). The survey results show that bicycles are present in the area, although they seem to be rarely used. Sabona describes the vegetation and paths as the main challenges to bicycle use, as they puncture easily due to thorns. They also describe the quality of the bicycles currently in use as bad. WBR and BEN Namibia advocates for the use of robust bicycles that can handle being driven on rocky, sandy paths. Velafrica also acknowledges that the highest demand is for mountain bikes. Sabona is thus encouraged to facilitate for increased private ownership of robust and good-quality bicycles.

The availability of spare parts and repair services is pointed out as crucial for the success of increased use of bicycles. As a prerequisite for promoting increased use, Sabona is encouraged to facilitate for repair services and easily available spare parts. This will ensure the long-term sustainability of this particular mobility measure. Establishing a bike shop with associated repair services would create employment options within the areas of mechanics, business administration and finances. Taking the facilities for vocational training at the SDC into account, there is potential for training mechanics and thus educate and employ several local villagers.

Cycle rickshaws and other types of tricycles are widespread in use in especially East-Asian countries. According to Starkey, et al. (2002), a cycle rickshaw can carry more than a regular bicycle, although the speed and range to some extent will be reduced. They also have the potential to be income-generating by providing taxi- or delivery services. However, as briefly mentioned in chapter 2, they are not considered practical for the local conditions of the study area, as the vegetation and sandy paths make the unstable cycle rickshaws difficult to maneuver. One of the interviewees also mentioned the low access to spare parts as the main challenge for widespread use of cycle rickshaws in rural areas. For Sabona, if there is need for an expansion the load capacity of a regular bicycle, attachable trailers would be a more achievable option. BEN Namibia

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[4] http://www.rurallibrarieszim.com/index.html

and WBR have experience with attachable ambulance-trailers, which eases the transport of sick and slightly injured.

Hand-drawn carts or trolleys are good tools to increase the load capacity for the short or intermittent journeys, e.g. to/from the SDC when selling or buying products. A handcart with 2-4 wheels is more stable than a one-wheeled wheelbarrow, which will be better for the sandy paths in the area. In addition, Starkey et al. (2002) remarks that carts with two handles can limit the female usage, as women often carry children in one hand and the load in the other. Carts with several wheels that can be operated using one handle only is preferrable for the study area, as the women are the main transporters for domestic tasks. In the same way as for bicycles, there should be access to repair services and spare parts for the increased use of carts to be sustainable in the long term.

Animal power includes both transport animals and animal-drawn carts, and differ in both utility and characteristics depending on the type of animal (Starkey, et al., 2002). Sabona tells that in the area, donkeys are used for transporting products and people who are not able to walk themselves, while oxen are used for agriculture. The animals require additional work and effort in terms of good husbandry and vet services, but provides an affordable and appropriate tool for improved mobility in rural areas (Starkey, et al., 2002). The survey shows that the access to both transport animals and animal-drawn carts is high. In addition, the demand for additional animal-drawn carts makes increased use of animal power a good alternative for the study area.

Table 2.1 shows that motorized vehicles, like motorcycles or pickups, increase both speed and range notably. The load capacity of 100 to 1200 kg is however somewhat obtainable by the use of animal power, given a 1000 kg load capacity from ox-drawn carts. Given the vehicles' need for mechanics and repair services, high Zimbabwean petrol prices and low income level in the study area, promoting increased use of motorized vehicles is not recommended.

5.2.2 Shared mobility services

Although shared mobility is spoken highly of as a way of improving the mobility in low-income areas (Kodransky & Lewenstein, 2014), one of the interviewees recommended to be cautious if implementing rental services in rural areas. The reason behind the warning was the additional monitoring that comes with limited time durations and extra maintenance, as a result of the lack of feeling of ownership. However, Sabona finds themselves positive to rental services, as there are currently some informal agreements that work well. They also see them as potential small businesses that can generate income.

For the long-distance travels, fixed-time ridesharing is already an established service in the Sabona HIV/AIDS support program. Expanding this service to include more users has the potential to notably improve the mobility for the communities. When the SDC-associated truck is funded, carsharing and ridesharing on both flexible and fixed routes is a good option. The survey results showed that almost half of the respondents think they will go to the SDC 2-3 times per week. Rideshare services can thus be designed with this number as the basis for trip frequencies, e.g. setting up fixed times for ridesharing on a set route.

Establishing bike shops will also have the potential to open up rental services. This can be promoted for both local villagers and the tourists in Hwange, with a variety of NMTs and rental durations.

5.2.3 How can the implementation of mobility services help Sabona fulfill their values, including but not limited to, employment creation?

To answer the final research question, the current travel habits and future demand for mobility studied in chapter 4 is separated in two categories: in-village trips and long-distance trips. Improving mobility for both types of trips can be done by promoting private ownership of non-motorized means of transport or by establishing shared mobility services, as shown in figure 5.1.
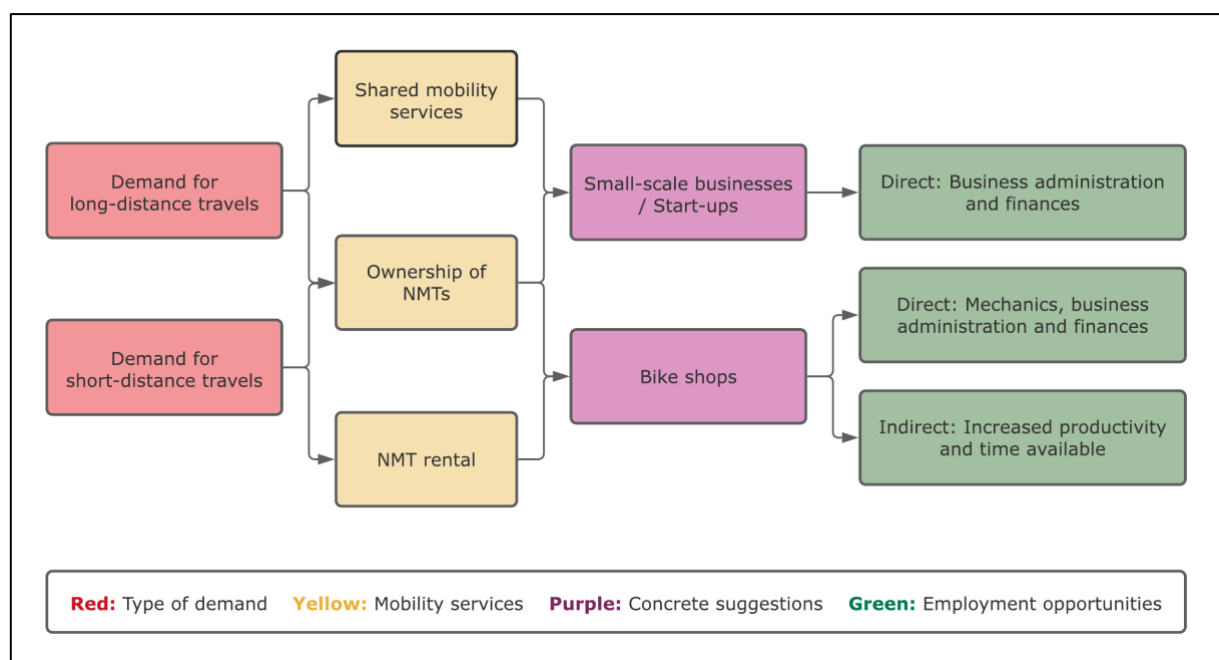
Figure 5.1: Flow chart of mobility services with their associated demand, implementation suggestions and expected impact.

By promoting and facilitating for private ownership of NMTs, like bicycles, carts or animal power, Sabona can contribute to increase both speed and load capacity on in-village trips in the areas where they work. This will have the potential to create indirect employment by improving the mobility for trips associated with domestic tasks in particular.

One way of promoting and facilitating for private ownership of bicycles is by establishing bike shops, where the villagers can rent or buy a bicycle, in addition to get their bicycles repaired. This has been successfully implemented in similar regions, as seen in the interviews discussed in chapter 5.1. Establishing a bike shop will create direct employment within mechanics, business administration and finances, which would be a good addition to the employment focus Sabona currently has. The bike shops can also sell and rent out other types of NMTs, to apply to a more diverse group of customers.

For the long-distance trips, rideshare and other shared mobility services is considered a good option to improve the mobility. This can be done either with Sabona as the employer or by facilitating for the villagers to start their own businesses based on the means of transport available. Creating small-scale businesses providing goods or services that are not mobility is also an option, e.g. delivery-services or selling goods off carts or bicycles.

The principle of local ownership and anchoring advocates for a focus on creating a sense of ownership among the end users. Although this is possible to obtain in several ways, facilitating for increased private ownership of travel means is considered the best measure for improved mobility in the study area. However, aiming for the holistic approach, a combined use of both private ownership and public services is recommended.

6 Discussion of the study method and lessons learned

Developing and writing this thesis during the COVID-19 pandemic led to challenges in several aspects of the project work. The data collection was initially planned to include a three-week field trip to the study area, where getting a deeper understanding of local culture and conditions was in focus. Involving a diverse group of stakeholders was also an important part of the trip. However, due to the pandemic restrictions within and across borders for both Norway and Zimbabwe, only parts of the planned method were possible to complete. This led to the results being less comprehensive than desired, which put limitations on the analysis of the data.

In this chapter I will discuss the differences between the initial study method and what was performed, and discuss how the conclusion of the thesis was affected by this. I will also provide personal reflections about the remote data collection and the process of writing a *Meaningful Masters'*.

6.1 Evaluation of the study method

The initial method included five steps:

1) Observations of travel patterns and traffic volumes
2) Travel habit survey for the villagers
3) Group interviews with different stakeholder groups, focusing on future demand
4) Interviews with the Sabona staff in Zimbabwe and Norway, and
5) Interviews with organizations working within the same area of interest.

Due to the field trip being cancelled, steps 1 and 3 were not possible to perform as planned. Digital interviews were then planned for steps 3 and 4, but as Zimbabwean government restrictions prohibited the gathering of groups, it was decided not to go through with these either. The survey was then chosen as the main source of data. It was expanded with questions about the Sabona Development Center and future travel demands associated with the new center being built, to compensate for the loss of input on future demand from step 3. In addition, the Sabona interviews in step 4 were altered into conversations aiming to evaluate the survey results, as a compensation for the absence of own observations and thus lack of understanding of the local conditions.

The survey being the main source of data made it important to make sure it gave sufficient results. However, despite having made a pilot in Norway and worked thoroughly with Sabona before the final questionnaire was distributed in the study area, there were some limitations. Due to the downscaling of the method, there should have been both broader and deeper questions in order to get more input to the discussion, e.g. on gender-based variations or more specific transport needs. Implementing stated preference-questions would also have been a good way to compare the valuation of different options, and thus customize the suggestions in chapter 5.2 to a greater extent.

Adding questions would however affect the length of the questionnaire, and thus possibly lose the respondents' attention.

The project was in an early phase more focused on bicycles than other travel means, as the results when searching for similar projects dominated on Bicycle for Development-organizations. This may have limited the ability to think outside the box when suggesting transport solutions in chapter 5.2. The bias is especially clear when looking at the questionnaire, as there are two questions directly related to bicycles and none dedicated to the other travel means. Whether it has affected the results or not is unknown.

If the method had been carried out as initially planned, the data collection would have been based on a higher degree of stakeholder involvement. In addition, being able to make observations myself would potentially give a greater understanding basis for the analyses of travel patterns and future demand. The limitations led to the results being more generalized than initially wanted, only scratching the surface of the travel needs and being highly based on assumptions. The project has however built a foundation for further exploration of transport needs and possibilities for improved mobility for the people living in the study area.

6.2 Remote data collection

6.2.1 Understanding local conditions and culture

Not being able to visit the study area was a bigger barrier to the project than first expected, as it limited the understanding of local conditions and culture. However, it was known during the initial project planning stages that the field trip might not be possible, and the project was planned for compensating measures. Keeping close contact with Sabona, both in Norway and Zimbabwe, as well as to the Engineers Without Borders mentor who has previously volunteered for Sabona in Zimbabwe, was identified as the most important. This was also stated clearly in the project thesis: «The challenges will be met by collaborating with the Sabona staff located in Zimbabwe, as they know and understand the situation and the people, and they are located close to the areas that need to be physically reached».

In order to understand more about the local conditions, the following measures were taken as a part of the preparation phase:

- Study pictures from the area (both Sabona's photos and the mentor's taken on their trip there), aerial photos, maps, and the few meters of Google Street view available,
- Read international articles about the history and politics of Zimbabwe,
- Read local Zimbabwean newspapers,
- Read the occasional newsletters Sabona writes for their donors,
- Have conversations with people with relevant experience from both working and volunteering for Sabona. The main source was Sabona's founder, Ynghild Solholm, who has lived in the area for several years, and thus knows both Zimbabwean and Norwegian conditions well,
- Reflect and learn from my own travel experiences in remote areas and the Global South, even though they might be different to what it is like in Zimbabwe, and
- Attend talks, workshops and other events arranged by Engineers Without Borders NTNU, focusing on cultural context and working as a humanitarian engineer.

It came clear during the data analyses that being more familiar with the circumstances would be valuable in order to understand the details of the results. Political, economic and cultural contexts were difficult to implement, and I did not have my own experiences with Zimbabwean transport systems. An example is how the results showed that 35 respondents own at least one bicycle, while only 7 respondents use them to and from work. With a field trip, I would have had a better basis when assuming the reason for the low usage. The evaluating conversations with Sabona were helpful in order to understand, confirm and add to what the results showed. However, having my own experiences would reduce the uncertainties that came with solely relying on what I was told.

Prior to writing this thesis, my view on remote humanitarian engineering was that it was possible to carry out without any major issues. However, experiencing the importance of a thorough understanding the local culture and conditions has made me change my view.

6.2.2 Stakeholder involvement

When planning for remote involvement of the different stakeholders in the study area, a digital workshop was the initial solution. One thing the pandemic has showed is the way digital platforms make communication easy despite long distances, yet this relies on the connectivity of all participants. As the villagers were assumed to have limited access to internet in their homes[5], it was planned to gather the workshop participants at the local schools for a joint session where the facilitators provided the digital platforms and internet access. However, Zimbabwean restrictions prohibited the gathering of larger groups of people when the workshops were scheduled, forcing the third step to be excluded from the method.

The cancellation of the digital workshops was compensated by including some of the planned workshop questions into the questionnaire, e.g. the questions about how and when they would use the Sabona Development Center, and purposes and barriers for long-distance travels. This was however a limited compensation as the workshops were designed to be dynamic and allow for an open discussion between both stakeholders and the workshop facilitators, while the revealed answer-questions in the questionnaire gave no explanation for the way the respondents answered.

Not being able to interact more with the stakeholders made it difficult to ensure that their interests were taken into account, as recommended strongly by especially (Starkey, et al., 2002) and (Mishra, et al., 2015). This led to the study not being able to identify the concrete demand, as the compensating survey questions only scratched the surface of the local needs. In addition, the diversity of stakeholder groups in the area was not taken into account. Mainly basing the suggested transport services on the villager survey excluded stakeholders like local authorities, safari lodges, tourism agents, and Sabona's staff. These were all planned to be a part of the focus groups in step 3, to assure the principle of a holistic approach.

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[5] 82,2% of Matabeleland North households were without internet access in the 2014 ICT household survey, (Zimbabwe National Statistics Agency, 2014)

6.3 Writing a Meaningful Master's

Writing a Meaningful Master's provides additional aspects to the thesis, as humanitarian engineering and development also have political, cultural, economic and historical considerations. What I first imagined to be the scope of my thesis was quite ambitious and needed to be constrained, especially with the limited timeframe a master's thesis has. An example is how I first wanted to do a 4TM transport analysis of the area, but chose not to as it was assumed to need large amounts of data on travel habits, walking paths and AADT on the roads. In addition, the results would potentially be too complex for the objective of my thesis, shifting the focus away from easing the movement of people.

Working in a resource-constrained country meant that tools I had previously taken for granted were not available. The statistical foundation was limited compared to what I was used to, and I was not able to find any travel habit surveys from Zimbabwe. In addition, the Zimbabwe National Statistics Agency web page was unavailable due to server errors several times during the research period. This meant that analyzing the survey results was challenging, as I had limited sources of data to compare them to.

Other constrained tools include a well-developed map with a high level of details, which would be beneficial for analyzing the accessibility in the area. A detailed map would also be beneficial for network analyses in the GIS software ArcGIS Pro, which use network datasets to calculate e.g. what facilities can be reached within a set number of minutes or kilometers. The fact that the people in the study area (and other rural areas in the Global South) don't necessarily move on the official roads in the maps made the use of network analysis tools for my study purpose limited. In conclusion, writing a Meaningful Master's meant that I was had limited resources compared to what transport analyses I previously have been able to perform, which forced me to think differently on how I could answer the research questions.

Collaborating with a development/humanitarian aid organization also comes with its challenges. Generally speaking, these organizations are working at the grassroots level, using limited resources to facilitate for a better future for vulnerable communities. During my data collection period, the Sabona staff in Zimbabwe were coping with the pandemic and how it affected both them as an organization and the communities they work with. Being an external researcher fully dependent on the local staff helping me collect data for my thesis was thus a challenge, as I didn't want to create any additional stress for them.

The requirements for writing a Meaningful Master's say that the thesis should focus on a positive outcome for the local community. Whether the impact of my thesis will be possible to measure as positive or not is difficult to say, as there aren't any physical implementations in the communities yet. Nevertheless, I am confident that the thesis has built a good foundation for further studies of transport services and improved mobility in the area, which have the potential to be positively impacting the communities if implemented. All in all, despite the challenges discussed in this chapter, writing a Meaningful Master's has been a rewarding experience.

7 Conclusion

7.1 Answering the research questions

The objective of this study was to map mobility solutions that have the potential to improve the mobility for the people in the areas where Sabona works. Improved mobility is showed to ease the access to opportunities for resource-constrained areas and thus create socioeconomic value for these communities. The study was carried out by collecting travel habit data and future transport demand from the study area, which was further corroborated by Sabona. There were also held interviews with organizations working with mobility-improvements as a way of creating socioeconomic value. The conclusion was reached by discussing three research questions designed to give an overview of what potential there is for improved mobility in the area:

1. What are the current mobility patterns in the study area?
2. What are the demands for improved mobility in the study area after the Sabona Development Center is built?
3. How can the implementation of mobility services help Sabona fulfil their values, including but not limited to, employment creation?

The results showed walking to be the primary travel means in the area. The trips are mainly bound up in domestic tasks like water and firewood collection, which are currently making up the highest total travel time per week. The analysis showed that increased use of non-motorized means of transport (NMTs) have the potential to reduce the travel time and increase the load capacity for these in-village trips (< 10 km). The highest demand for future transport is on improving the access to health facilities and public services in the nearby cities (> 70 km). As accessibility is a matter of bringing services closer, improving the mobility for the people living in the area is considered the most achievable measure.

Implementing new and promoting increased use of current transport options have the potential to create both direct and indirect employment. To ensure the sustainability of widespread NMT use, there should be sufficient access to spare parts and repair services. This will create direct employment within mechanics, business administration and finances, whether it is sales or rental services. The indirect employment stems from the improved mobility, which provides access to more employment opportunities. In addition, the reduced travel time frees time available for other income-generating activities.

Even though the thesis has been mainly focused on employment creation, there are other benefits that come from improved mobility as well. Impact reports show that improvements of mobility and accessibility also show a positive effect on the health and education in the resource-constrained communities. Although the results were not unexpected, there has been created knowledge-based evidence on travel habits and future travel needs in the area. This is considered valuable for Sabona as an organization, as they do not have specific expertise within transport.

7.2 Further work

To further explore the potential for implementing new and promoting increased use of means of transport, it is recommended to continue the work initiated in this study. The concrete suggestions for implementation of mobility services, as seen in purple in figure 5.1, should be studied further, both by additional literature and by testing the acceptance with the actual stakeholders.

As discussed in chapter 2, improving mobility in rural areas should aim to connect several transport systems, combine the use of travel means and coordinate public and private operators. For the transport systems in the study area, the railway seems to have the highest potential, as the railway between Victoria Falls and Bulawayo stops in both Hwange and Dete. There lies potential in this route, but the neither the current nor future use has been studied further. The same counts for the Hwange Airport and other air systems in the area. The waterways in Zimbabwe are, as presented in chapter 1, not widespread in use. For the operators, there has not been done any research on what public services exist in the area. Researching the potential that lies in this holistic approach is recommended for future studies.

Even though the income level in the study area is low, Sabona informs that the share of households owning a smart phone is increasing. Mobility as a Service is a solution dependent on smart phones, as it is an integrated one-platform service providing different options for the desired travel. As the MaaS concept in rural and/or the Global South still seems to be limited, the service is not explored further as an option for the study area.

The study has been largely affected by the limited data collection, which was downscaled due to the COVID-19 pandemic. To ensure the local anchoring of new or increased use of transport services in the study area, there should be focus on involving a diverse group of stakeholders from the early phases. This includes, but is not limited to, Sabona's staff in the area, village leaders, local authorities, tourism agencies and the end users, particularly vulnerable groups. It is highly recommended to do this as a part of a field trip to the area, to ensure the understanding of local context.

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Appendices

Appendix 1: The history and economy of Zimbabwe

Appendix 2: Questionnaire

Appendix 3: Corroborations from Sabona

Appendix 4: Interview guidelines

Appendix 5: Interview summary, BEN Namibia

Appendix 6: Interview summary, World Bicycle Relief

Appendix 7: Interview summary, Velafrica

Appendix 8: Pilot study

Appendix 9: Survey responses and corrections

Appendix 1: The history and economy of Zimbabwe

Zimbabwe was once one of the richest African countries, where agriculture was the foundation of the economy, and both the industry and service sectors were well-established (Hem, 2019). However, Zimbabwe has experienced a decline in the quality of life for its inhabitants through decades of political instability before the country was declared a low-income country in 1991 (Norad, 2018).

Economic sanctions have followed Zimbabwe since the attempted declaration of independence in 1965 (Norad, 2018). This was further expanded when Mugabe came to power in 1980, as several changes in the constitution were set in order to expand his power (United National Association of Norway, 2019). Reforms to redistribute the lands from the white upper-class to the black lower-class lead to catastrophic consequences on the agriculture (United National Association of Norway, 2019), which further lead to international aid being withdrawn (Norad, 2018). The participation in the Second Congo War (1998 – 2003) was also contributing negatively on the Zimbabwean economy (United National Association of Norway, 2019). The hard hit of drought in the 1990s made the government take loans to import foods, which initially was supported by the World Bank and International Monetary Fund, before they were withdrawn when the country stopped paying installments (United National Association of Norway, 2019).

The Zimbabwean government was accused of increasingly breaking the human rights and moving towards a one-party state as the 20th century came to an end. The elections in the 2000s were at political unrest, and there were claims of the Mugabe government manipulating and cheating the elections (Norad, 2018). The economic situation evolved into a deep crisis, which led highly educated Zimbabweans to emigrate, leaving the country with increased poverty, poorer public health and hunger issues (United National Association of Norway, 2019). The agriculture is nearly destroyed due to the reforms in the 1990s and 2000s, and the country has one of the highest uses of toxic pesticides in the world (United National Association of Norway, 2019).

In 2008 and 2009, the country experienced hyperinflation with a peak of 50 sextillion (5×10^{22}) percent (Hem, 2019), which led the Zimbabwean currency to be suspended and substituted by foreign currency. Today, the economy is mostly informal, where the inhabitants prefer to trade products and services in order to survive. Many Zimbabweans are dependent of receiving food aid. Mugabe was couped in 2017, and Emmerson Mnangagwa was elected president in 2018. The country still has restricted freedom of speech, low fulfillment of the human rights, and high prevalence of corruption (United National Association of Norway, 2019).

Table A.1: Zimbabwe statistics

Republic of Zimbabwe	
Capital	Harare
Official languages	English, Shona, Ndebele, other local languages and dialects (16 in total)
Ethnic groups	Shona (82%), Ndebele (14%), others (4%)
Government	Parliamentary democracy / Unitary dominant-party presidential constitutional republic / Parliament
President	Emmerson Mnangagwa
Independence	November 1965 / April 1980
Population	13 572 560 (Zimbabwe National Statistics Agency, 2017)
Pop. Under 25 years	60% (Zimbabwe National Statistics Agency, 2017)
Currency	In theory: Zimbabwean dollar / In practice: US dollar, South African rand and Botswanan pula
Life expectancy at birth	61,5 (The World Bank, 2019)
Literacy level	94% (Zimbabwe National Statistics Agency, 2017)
Unemployment rate (% of total labor force)	16,86% (The World Bank, 2019)

Depending on the definition and source, the employment rate varies between 5% and 95%. The International Labour Organisation (ILO) defines an unemployed person to be someone that has been without work, available for work and actively seeking it, which gave Zimbabwe a 5,2% unemployment rate in 2016 (Reality Check team, 2017). Forbes Magazine stated the rate to be 95% in 2017 (Worstall, 2017), while Zimbabwe National Statistics Agency estimated 7% the same year (Zimbabwe National Statistics Agency, 2017). Onishi and Moyo (2017) clarifies that 95% of all Zimbabweans were working in the *informal economy*, which according to BBC Reality Check means «unpaid work in family businesses or paid work without the right to take out sick leave or paid holidays» (Reality Check team, 2017).

Appendix 2: Questionnaire on travel habits

You are invited to participate in a research project where the purpose is to find transport solutions that can create socioeconomic value for Sabona and the people living in Mabale, Lupote and the surrounding areas. The project is a master's thesis, based on the Sabona Development Center and the changed travel patterns in the area that are assumed to follow.

The student: Frida Nygaard, student at the Norwegian University of Science and Technology in Trondheim. Writing her master's degree in Civil Engineering, specializing in transport systems and roads.

Sabona and the Sabona Development Center: Sabona is a Norwegian-Zimbabwean humanitarian aid organization that has been working continuously in Matabeleland North, since 1999. They have three focus areas; health, education and employment, and their work is grounded in a *equip to empower*-principle. Sabona has been allocated land for a development center to be built along the strategic A8 Highway, which goes from Victoria Falls through Hwange National Park to the city of Bulawayo. The Sabona Development Center aims to house both a marketplace and a vocational school, forming a job creation initiative.

Ethics and rights: The questionnaire is asking for minimal personal information, as the main goal is to map travel habits. The personal data (income, homestead, workplace and physical limitations) are asked for statistical reasons only, and will be deleted at the end of the project before the end of the year.

The questionnaire is estimated to take **15 to 20 minutes** to perform. Please answer the question **as if the COVID-19 pandemic was not affecting your daily life**, and as if there is **dry season.** Please write down any comments or questions to the specific questions in the survey, if you have any.

Thank you so much for attending.

Household	
Where do you live (village)? Please also mark with a ✕ on the map on the last page.	
State the number of household members in each of the given age groups. Please also mark the box for **your** age.	☐ 0 – 4 years old: _____ ☐ 5 – 10 years old: _____ ☐ 11 – 15 years old: _____ ☐ 16 – 20 years old: _____ ☐ 21 – 30 years old: _____ ☐ 31 – 40 years old: _____ ☐ 41 – 50 years old: _____ ☐ 51 – 60 years old: _____ ☐ 61+ years old: _____
How many of your household members have the following occupations as their **main** occupation? Please also mark the box for **your** main occupation.	☐ Income-generating work: _____ ☐ Engaged in household or family responsibility: _____ ☐ Farming or fishing to produce food for the household: _____ ☐ Retired or pensioner: _____ ☐ In school (primary, secondary or High School): _____ ☐ Studying (University, vocational school or similar): _____ ☐ Unemployed: _____ ☐ Family support from outside the country: _____ ☐ Other, specify: _____, _____
What is your household's average monthly income?	☐ Less than 10 USD ☐ 11 – 50 USD ☐ 51 – 200 USD ☐ 201 – 400 USD ☐ 401 – 600 USD ☐ 601 – 800 USD ☐ 801 – 1000 USD ☐ 1001 USD and above ☐ I do not wish to state this
Work and education	
In the rest of the survey, the word *work* includes both working in the field, vegetable gardens, the poultry project, sewing club or other similar, not exclusive to income-generating work.	
What is your gender?	☐ Male ☐ Female ☐ I do not want to state this.

What is your highest **finished** education?	☐ Primary education (Grades 1 to 7) ☐ Secondary education (Form 1 to 4) ☐ High school (Form 5 to 6) ☐ Tertiary education (University, technical, polytechnic and teacher training colleges, and vocational training) ☐ None

Do you have a permanent workplace? If yes, mark with a △ on the map on the last page.

How many days per week do you travel for work?	
How many times per day do you travel related to work?	
How do you get to work?	☐ I walk ☐ I use my own transport. Specify what kind of transport: _____ ☐ I am being transported by someone else. Specify what kind of transport, and who: _____ ☐ Not relevant / I do not have a workplace
How much time does it take you to get to work? Please state the number of <u>minutes</u>. *If you don't know, you can try to guess or estimate by using a device that shows the time.*	

Transport options	
Do you or your household own any means of transport? Please state how many.	Car: _____ Bicycle: _____ Anima-drawn cart: _____ Transport animal: _____ Other, specify: _____, _____
Do you have the possibility to borrow any of the given means of transport? Please state how many.	Car: _____ Bicycle: _____ Animal-drawn cart: _____ Transport animal: _____ Other, specify: _____, _____
Do you have any disabilities that limits your transport opportunities?	☐ Yes, regarding sight ☐ Yes, regarding hearing ☐ Yes, regarding mobility ☐ Yes, other ☐ No

	Current travel patterns
How many trips do you perform during a <u>week</u>? Please state how many. (One trip is to **or** from the given place. If you go to the water source and back home 7 days per week, your stated number will be 14)	To/From work or school: _____ To/From stores or shops: _____ To/From water sources: _____ To/From firewood collection: _____ To/From health facilities: _____ To/From church: _____ Other, specify: _____, _____
How much time do you spend on these trips? State the number of <u>minutes</u> per trip:	To/From work or school: _____ To/From stores or shops: _____ To/From water sources: _____ To/From firewood collection: _____ To/From health facilities: _____ To/From church: _____ Other, specify: _____, _____
How many minutes/hours do you spend travelling per means of transport each day?	Walking: _____ Cycling: _____ Animal-drawn cart: _____ Transport animal: _____ Bus: _____ Car: _____ Other, specify: _____, _____
	Future travel patterns
For what purposes will you go to the Sabona Development Center? You can select multiple.	☐ To attend the vocational school ☐ To sell products that I will bring from my homestead ☐ To sell products that are already at the SDC ☐ To be a part of the poultry projects ☐ To be a part of the vegetable garden projects ☐ To be social ☐ To buy products from others ☐ Other: _____ ☐ I will not go there ☐ I have not heard about the SDC
How will you get to the Sabona Development Center? Select your **preferred** means of transport by checking off the box, and state how many minutes it will take you.	☐ Walking: _____ ☐ Cycling: _____ ☐ Animal-drawn cart: _____ ☐ Transport animal: _____ ☐ Bus: _____ ☐ Car: _____ ☐ Other, specify: _____, _____ ☐ I will not go there

How often do you think you will go to the SDC?	☐ Every day ☐ 2 – 3 times per week ☐ Every other week ☐ Once per month ☐ Less than once per month
If you had 250 USD to buy a means of transport, which would you buy?	☐ Bicycle ☐ Animal-drawn cart ☐ Hand drawn cart ☐ Other, specify: _____ ☐ I would save for a car or motor bike ☐ None. I am satisfied as it is now.
For what purposes would you travel longer distances, if you could? You can select maximum 3 options.	☐ To access education ☐ To access health facilities ☐ To visit friends or family that live far away ☐ To go to the city of Hwange or Bulawayo to buy products ☐ To search for job opportunities another place in Zimbabwe ☐ To search for job opportunities in South Africa or another country ☐ For leisure travels ☐ Other, specify: _____ ☐ I wouldn't travel anywhere else
What is stopping you from doing the long-distance travels you want? You can select multiple	☐ I don't have the money ☐ I don't have the time ☐ Other, specify: _____ ☐ Not relevant, I am able to travel longer distances ☐ Not relevant, I don't want to travel longer distances.
If you had a bicycle, how would you use it? You can select multiple	☐ To go to work / school ☐ To go to water sources or collect firewood ☐ To access health facilities ☐ For leisure and fun ☐ To travel longer distances, instead of paying to take the bus or go by car ☐ Other, specify: _____ ☐ Not relevant, I already have a bicycle. ☐ Not relevant, I would not like to own a bicycle.
Why would you choose to go by bicycle instead of your current transport means? You can select multiple	☐ It is faster ☐ I can carry more on a bicycle ☐ It makes me able to travel longer distances ☐ Other, specify: _____ ☐ Not relevant, I already have a bicycle. ☐ Not relevant, I would not like to own a bicycle.

Top map labels:

Siyanyanga primary

Lupote primary
Lupote secondary
Lupote business centre

Mapane solar borehole and garden
Mapane deep well
Chiguswi fowl run
Kulisumpula sewing club
Chiguswi garden and borehole
Community borehole
Nabushome

Ynghi's hut
Dopota dam
Dopota primary school
Nechilibi
Dopota office high school borehole
Sonyathi garden and
Dopota community borehole
Solar borehole
Nechilibi/Sonyathi fowl
Simkhululwe
poultry Zamani
run
Mabale primary school
fowl run sewing
Sabona
Masikili area
high school
Meshack's Nechilibi
homestead borehole
Mabale clinic
Cross Mabale / Mabale Business Centre
Cross Mabale

For these areas, see maps below

Bottom-left map labels:

Ynghi's hut
Dopota dam

Dopota community borehole
Dopota primary school
Dopota office
Dopota poultry fowl run
Nechilibi high school borehole

Zamani sewing club
Matshabela Solar borehole

Nechilibi high school

Bottom-right map labels:

Sonyathi garden and borehole
Simkhululwe sewing club
Nechilibi/Sonyathi fowl run
Nechilibi borehole
Meshack's homestead
Nechilibi borehole

Cross Mabale / Mabale Business Centre
Cross Mabale

Appendix 3: Corroborations with Sabona (Norwegian)

Hvordan beveger folk seg generelt i området? Hvor og med hvilke reisemidler? Er det noen forskjeller i kjønn og alder?

De går. Tar Buss/Haik om det er lengre enn en mil. Buss/Haike med bil/lastebil når skal til Hwange, 60km Dete 20km(?) Bulawayo/VicFalls (ca300km). De reiser til disse plassene om de må til lege/immigrasjon/offentlige kontorer.

Hva er dine tanker om å drive utleie-tjenester i området? For eksempel sykkelutleie eller utleie av vogner/traller. Vil det virke på samme måte som i vestlige land? Hvilke utfordringer kan dukke opp?

Dette er en god ide til en startup (small businessfund) I dag er det slik at du kan leie esel og vogn -fra de få som har dette- så det er en veldig god ide. Når gjelder sykler, må det isåfall importeres sykler av en viss standard og tilby rep v punktering. (ref. samtale vi hadde).

Kan du nevne kort betydningen av trucken som skal være tilknyttet SDC? Hvordan er det tenkt at den skal brukes i Sabona Trust sin daglige drift?

Brukes til frakt av materialer osv. under byggingen av SDC. (de første årene) Den vil også markedsføres til å leies ut- (vi har vel snakket om med sjåfør).

Resultatene sier at det er 12 husstander som eier en bil. Kan dette være riktig, eller er det mulig at noen respondenter har svart ukorrekt av kulturelle årsaker, for eksempel for å virke mer suksessfull, eller svart for andre familiemedlemmer som bor andre steder, for eksempel i Sør-Afrika?

Det stemmer nok det- er det 12 ut av 400 husstander? Det er nok iallfall det antall biler i WARD 17. Jeg kjenner flere som har bilen til onkelen sin som er i Sør-Afrika. Kjenner også flere som har bil, som står for 15 året på rad, fordi man ikke kan få reparert den. (disse er sikkert inkludert). Flere lærere/politikere/høvding osv. som har bil, så vil tro at det stemmer godt.

Hvordan har du observert bruken av sykler i området?

> **Hvem bruker dem? Er det noen forskjell i kjønn eller alder?**
> Det er ikke et vanlig syn, men ser det nå og da. Stort sett menn, litt eldre og ungdom? Men også flere kvinner/jenter som har.

> **Hva slags tilstand er syklene i? Er de brukbare eller trenger de reparasjon?**
> Etter norsk standard, svært dårlige. Lappet sammen for det meste.

Hva slags forhold har de lokale til sykler, kulturelt sett? Er det høy eller lav status å eie/bruke? Vanskelig å bruke? Praktisk for transport av vann?

Ikke praktisk for vann, ikke spes. praktisk inni landsbyen pga. tornene, sand osv., men på veiene er det veldig praktisk for å komme seg raskere frem enn å gå. Kinesiske sykler er svært dårlige.

Hvordan fungerer de i regntid?

Fungerer kun på hovedveien.

Mange har svart at de ofte bruker dyr til å trekke vogner i sine daglige reisevaner. Hva brukes disse til? Transport av varer fra Cross Mabale? Til jordbruk på egne åkre? Hva slags dyr brukes?

Esler. Gravferd/syke, materialer osv. Okser til jordbruk.

Når dere jobber med distribusjon av medisiner, lunsjer og andre ting, hvordan transporterer innbyggerne varene hjem? Spesielt når det er snakk om store eller mange varer.

På hodet. De får hele familien og alle barna til å bære. Naboer/Sabona hjelper de svake og eldre om ikke barn/familie i nærheten. Alle hjelper hverandre. Man lar aldri syke eller eldre bære en tung bør, ser du noen så spør du om å hjelpe å følge de hjem, selv om du er på vei til en avtale. (Derfor alt tar sånn tid)

Har du noen drømmer eller tanker rundt transport i området, både generelt for Sabona og relatert til SDC?

Åjaaaa! Det har vært mange drømmer opp igjennom årene- både hva gjelder ambulanse (Det er horribelt å tenke på hvor mange mennesker/området - den ene ambulansen dekker). Egen Lastebil som også kan brukes til utleie lokalt og ikke måtte betale i dyre dommer fra Bulawayo - når vi må leie. Skolebuss, slik at elevene ikke utsettes for fare for ville dyr og mennesker med dårlige intensjoner. Flere small business fund ideer - som ønsker å starte opp transporttjenester, verksteder osv. Ja, har veeeldig mange drømmer.

Ser du noen utfordringer relatert til transport i området, både generelt for Sabona og relatert til SDC?

Ja, det flere knyttet til dette. Det gjelder i all hovedsak økonomisk for Sabona. Eie eller leie. Har ikke økonomi til å kjøpe, dyrt å leie. Blir stor budsjettpost på transport om man ikke får til å få donert en lastebil. Avgjørende for kyllingprosjektet, men også byggeprosjektet. Når man kjøper bil/lastebil er det avgjørende hva slags type for å vite at man får reservedeler.

Appendix 4: Interview guidelines and consent form

Do you want to participate in the research project "Improved Mobility as Value Creation for Sabona"?

This is a request for you to participate in a research project where the purpose is to find transport solutions that can create socioeconomic value for Sabona and the people their work affects. In this letter, we give you information about the goals of the project and what participation will mean for you.

Purpose

The project is a master's thesis entitled «Improved Mobility as Value Creation for Sabona». The thesis has three research questions:

1. What are the current mobility patterns in the areas and communities where Sabona works?
2. What are the demands and possibilities for improved mobility after the Sabona Development Center is built?
3. How can the implementation of shared mobility services help Sabona to fulfill its values, including but not limited to job creation / employment?

The research questions build on the purpose of creating socioeconomic benefits for the people affected by Sabona's work in Matabeleland North, Zimbabwe. The project is limited to a technological perspective, as the author is a student in the master's engineering program *Civil and Environmental Engineering* at NTNU. However, it will take into account cultural, economic, social science and other perspectives, as far as possible.

Who are responsible for the research project?

Responsible for the research project are:

- Frida Nygaard, master's student at NTNU
- Kelly Pitera, supervisor and associate professor at the Department of Civil and Environmental Engineering, NTNU

The project is a collaboration between the student and NTNU, Engineers Without Borders Norway and Sabona.

Why are you asked to participate?

You have been asked to participate in the project because you have experience with similar projects, or research on transport solutions or user involvement in rural areas in the global south.

What does it mean for you to participate?

If you choose to participate in the project, it means that you participate in an interview or answer the questions in an email correspondence. The interview will last about 45

minutes. You will not be asked to provide any personal information, but an audio recording will be made which will later be summarized in text. The interview is semi-structured, which means that it will feel like an open conversation about the topics chosen. The questions contain topics such as humanitarian aid, user involvement, transport services and own experiences with projects in rural areas in the Global South.

After the interview has been completed, the audio recording will be summarized, and then sent to you as a participant so that you can make sure that no misunderstandings have arisen during the transcription. You will then also have the opportunity to remove or change parts of your answer, if this is necessary. After the summary has been reviewed by you as a participant, the audio recording will be deleted.

It is voluntary to participate

It is voluntary to participate in the project. If you choose to participate, you can withdraw your consent at any time without giving any reason. All your personal information will then be deleted. It will not have any negative consequences for you if you do not want to participate or later choose to withdraw.

Your privacy - how we store and use your information

We will only use the information about you for the purposes we have described in this article. We treat the information confidentially and in accordance with the privacy regulations. Only the following persons will have access to the audio recording and the information made during the interview, or the information given in correspondence:

- Frida Nygaard, master's student at NTNU
- Kelly Pitera, supervisor and associate professor at the Department of Civil and Environmental Engineering, NTNU

Your name will be replaced with a code stored in a separate name list separated from the audio files. The name list is deleted together with the audio recordings after transcription has been approved or the consent has been taken back by you as a participant. The name list and audio files will be stored on a server from NTNU, and can only be unlocked by Frida Nygaard.

As a participant, you will not be recognized in the publication that follows from the project, as names and other information about the interviews will not be given in the publication. The summary of the interview will be attached to the publication, if this is approved by you as a participant. The transcript will then also not contain any kind of information beyond the answers you give during the interview.

What happens to your information when we end the research project?

According to the plan, the project will end on June 10, 2021. Audio recordings or other information that can identify you as a person will then be deleted. As long as it is with your consent, the information given during the interview / correspondence will be retained for potential follow-up studies. All information will be completely anonymized.

Your rights

As long as you can be identified in the data material, you have the right to:

- Access the personal information that is registered on you, and
- Receive a copy of the information, have personal information about you corrected, have personal information about you deleted, and
- Send a complaint to the Norwegian Data Protection Authority about the processing of your personal data.

What entitles us to process personal information about you?

We process information about you based on your consent.

On behalf of NTNU, NSD - Norwegian Center for Research Data AS has assessed that the processing of personal data in this project is in accordance with the privacy regulations.

Where can I find out more?

If you have questions about the study, or want to exercise your rights, please contact:

- NTNU by supervisor Kelly Pitera (kelly.pitera@ntnu.no, +47 944 28 548) or student Frida Nygaard (fridany@stud.ntnu.no, +47 948 01 219).
- Our privacy representative: Thomas Helgesen (thomas.helgesen@ntnu.no, +47 930 79 038)

If you have questions related to NSD's assessment of the project, you can contact:

- NSD - Norwegian Center for Research Data AS by email (personverntjenester@nsd.no) or by phone: +47 55 58 21 17.

Best regards

Kelly Pitera   Frida Nygaard

(Supervisor)   (Student)

Declaration of consent

I have received and understood information about the project «Improved Mobility as Value Creation for Sabona», and have had the opportunity to ask questions. I agree to:

- ☐ participate in interviews
- ☐ participate in electronic email correspondence

I agree that my information will be processed until the project is completed.

_____

(Signed by the project participant, date)

Interview guidelines

Intention: Find inspiration for possible transport services that have worked in other initiatives, and listen to good and bad experiences from the implementation of these. *What worked, what didn't work and why?*

The student: Frida Nygaard, NTNU Trondheim. Master's thesis in Civil Engineering, specializing in transport and roads engineering. Last semester of a 5-year master's program, with deadline of the thesis June 10, 2021. Knowledge in traffic engineering, transport analyses, road technology and geometry, project planning and management, leadership and teambuilding, GIS, among others. General interest in humanitarian aid and social responsibility.

Background / Sabona: Sabona is a Norwegian-Zimbabwean humanitarian aid organization that has been working continuously in Matabeleland North, the north-western part of Zimbabwe, since 1999. They have three focus areas; health, education and employment, and their work is grounded in a *equip to empower*-principle. Sabona has been allocated land for a development center to be built along the strategic A8 Highway, which goes from Victoria Falls through Hwange National Park to the city of Bulawayo. The center aims to house both a marketplace and a vocational school, forming a job creation initiative.

The master's project: The project is based on the development center and the changed travel patterns that are assumed to follow. The work is planned to result in several suggestions for how improved mobility can create value in the form of socioeconomic benefits (employment, income, improved quality of life) for Sabona and the people they work with. Key principles are stakeholder involvement, sustainability and a holistic approach.

Recording and rights: The interviews will be audio-recorded, before they are summarized in text, and the recordings deleted shortly after. The interview summaries will be sent to the interviewee for approval or changes. Personal information about the interviewee will be kept confidential, and they can ask to be deleted from the project at any given time.

Themes for the interview: The interviewee's experiences and role in the initiative. Challenges, success factors and the planning phase of the initiative. Stakeholder involvement.

Introduction

Getting to know the interviewee, their experience and the initiative they work with.

- Can you explain the initiative you work on, and how it was developed?
- What is/was your role in the initiative?
- Do you have experience from other similar projects or initiatives? What kind?

The initiative

More in-depth questions related to the specific initiative, from planning to long-term effects.

> **Disclaimer**: The word *initiative* is used for the organization as a whole, while *projects* is used for the different aspects of the organization's work. If you want to define them differently or add any other terms, please describe them clearly here.

- Briefly explain the process of implementing the initiative and its projects:
    - What issues does/did the initiative/projects aim to solve?
    - How does/did the initiative/projects solve these?
    - Did you ever consider other transport means? Which, and why did you not go through with them?

- What challenges have you met in your work with the initiative/projects?
    - How did you overcome them?

> The term **creating value** is understood as socioeconomic benefits, improved quality of life or increased income.

- Have you seen that the initiative/projects have created value for the community? How?
    - Are any of these long-term impacts?

- How was the response on the projects/initiative from the community?
- Have you seen any change in the travel patterns in the area after the initiative was implemented? How?

Stakeholder involvement

More in-depth questions related to stakeholder involvement in the specific project.

> **Definition of stakeholder:** A person such as an employee, customer, or citizen who is involved with an organization, society, etc. and therefore has responsibilities towards it and an interest in its success. End users, local authorities, project staff, people in the area not directly affected, etc.

- Who are the most important stakeholders related to the initiative?
    - How and when were they involved?
    - Did you separate vulnerable groups, like women, differently able, elderly and children, as a separate stakeholder? Why / Why not?

- Were local/national authorities involved?
    - How and when?

- How did the involvement/absence of involvement affect the success of the initiative?

Concluding part

Clarification and follow-up of the answers given.

- How would you sum up the factors making the initiative a success?
- Has the initiative created local employment (both direct and indirect) in any kind of way? How?
- How does the users pay for the services?
- Do you have any specific tips/words of advice for projects that are similar to yours?

Appendix 5: Interview summary, BEN Namibia

Can you explain the initiative you work on, and how it was developed?

Started in 2005, distributed more than 60 000 bikes since then. The BEN Namibia model results in an effective distribution mechanism.

The BEN Namibia model - The Enterprise Box (eBox): Bike shops run out of shipping containers (400 decent quality, second-hand mountain bikes) that are set up in the partner's location, as long as there is an agreement on the land use. Usually partner with community-based organizations that have different focuses; health care, orphan support, disability groups, etc. The partners need to have existing networks, and they do the participant selection and local negotiation. BEN is a service provider, that provide resources, training and ongoing. Anything that is implemented need to have a strong local partner in order for it to work, even though that is not always the case. The bicycles are donated, and BEN pays for the costs related to transport logistics from donation to end location. BEN puts a unit price on the bicycles (based on the transport logistics cost), and the partner pays for that. The partner then sells the bikes to the end users, or sometimes they give them out for free. There are also experiences with microfinancing. For Namibian projects, BENN include 2 weeks of business skills training, in addition to the mechanic training. For international projects, they usually provide training materials for a local organization to conduct this training. They can also provide someone to explain the business model. «It's a relatively cheap and fast turn-around project for providing mass-mobility». The eBox programme started in 2006.

What is/was your role in the initiative?

Managing Director and founder of the BEN Namibia *franchise;* Shares the name and logo with BEN South Africa, but not any projects. There is some cooperation, but not like a big international organization.

Do you have experience from other similar projects or initiatives? What kind?

Currently working on a proposal for electric rickshaws as a Mobility as a Service project, in partnership with Ebikes for Africa.

Briefly explain the process of making the decision on implementing the initiative/projects

While volunteering in another organization, they got a request from a HIV/AIDS support group in Namibia, looking for 700 bikes for their volunteers. Their main issue was the time they spent travelling long distances, and how walking long hours in sunlight was exhausting. They wanted their volunteers to be rested and present in their visits, and spend more time with their patients, and saw bicycles as an opportunity to save the time and improve the quality of the visits. The interviewee went to South Africa and spent a couple of weeks with BEN South Africa, before going to Namibia. Realized that the real problem was building capacity in the distribution of the bicycles. The capacity levels of local organizations were not high enough to ship them a container of bicycles that needed service, maintenance and repairs. The idea of bike shops came from the locals themselves, as they wanted to run a shop with maintenance and spare parts locally.

What challenges have you met in your initiative/projects? How did you overcome them?

- Infeasible taxes, as experienced in Kenya.
- Cost and logistics: It must be possible to reach the location with a container and do it for a reasonable price. Challenges related to shipping, customs declaration and security (when transporting the containers along the road).
- The partners being able to do the maintenance of the bicycles and access to spare parts in rural areas.
- The partners understanding the business model and how to run a small business.
- Unreliable partners and the local ecosystem.
- Rental arrangements, where the people renting the bicycles are irresponsible on taking care of the bicycles and also respecting the time duration of the rental. Rental services need for more monitoring than selling arrangements.
- BEN Namibia was doing everything (distribution, maintenance) centralized at first, but it was not possible due to capacity. They would distribute the bikes up to 700 km, but when a pedal fell off there were no spare parts, even though there were workshops and trained mechanics nearby. The solution was to decentralize and make the partners responsible for maintenance.

Have you seen that the initiative/projects have created value for the community? How? Are any of these long-term?

BEN Namibia doesn't monitor the impact very closely anymore, because of the cost that comes with gathering data. Old data has proved that the model works. "We have enough evidence to prove that our program makes more good than harm".

Have you seen any change in the travel patterns in the area after the initiative was implemented? How?

Travel patterns have not been monitored. Informal surveys with health care workers showed that they were more easily able to get to the clients and spend more time with them.

The questions in the section on stakeholder involvement were not asked, as BEN Namibia's partners are responsible for this interaction.

Has the initiative created local employment (both direct and indirect) in any kind of way? How?

BEN Namibia has seen, and the customers also say, that the bicycles making people able to get to and from work. BEN Namibia imagined that they would see people using the bikes to get to and from the market with goods, but there is no data that supports this as much as the data says that people get to and from job opportunities and kids getting to and from school. BEN Namibia doesn't have data on time saved on water collection either.

How do the users pay for the services?

The local partner pays BEN Namibia for the bicycles, and then distributes them, either by selling them or giving them out for free to the end users. The arrangement of distribution

and decision on payment is done by the partners themselves. There are also some attempts on microfinancing.

Do you have any experience with other transport modes that can fulfill a mobility demand in similar areas?

- Pedicabs and auto-rickshaws (3-wheelers in general). More difficult to maintain because of the lack of spare parts, compared to bicycles.
- Emissions-free vehicles, before motorcycles dominate the market.
- The market is mostly run by the cost of a trip, not necessarily comfort or safety. If you can deliver a transport service that cost less than the motorized taxi, the customer will most likely choose the cheapest option.
- A lot depends on the objective; Do you want to create workplaces, create a new market (i.e. for electric three-wheelers), solve fuel-security issues, or another issue?
- There should be testing of the proof of concept before implementing a new project: Testing the social acceptance etc.

Appendix 6: Interview summary, World Bicycle Relief

Can you explain the initiative you work on, and how it was developed?

We will focus much of our response on World Bicycle Relief's (WBR's) Mobilized Communities activity in Hwange District. As appropriate, we will broaden our focus to make particular points or raise awareness of outcomes that may be interesting to your work.

We first provide a high level overview of WBR and then highlight our Mobilized Communities program:

　　　WBR: World Bicycle Relief (WBR) mobilizes people through the Power of Bicycles. We envision a world where distance is no longer a barrier to education, health services, and economic opportunity. Our robust Buffalo Bicycles are a cost-effective and reliable means of overcoming the challenges posed by long distances and systemic mobility challenges in developing countries. We are a mission-driven, global not-for-profit that manages a highly-refined bicycle supply chain from design through final distribution. WBR employs an ecosystem approach, with the end-user and community at the center of everything we do. This ensures that our activities are evidence-driven and sustainable. We work collaboratively with field partners to design, test, and implement large-scale bicycle mobility programs. To-date we have distributed over 500,000 bicycles since 2006. Key results from our impact includes a 28% reduction in student absenteeism, 23% increase in farmer income and 45% increase in patient visits by healthcare workers.

Funding for our program activities comes from individuals, NGOs, foundations, corporations, and bilateral and multilateral donors. WBR has an innovative structure with a wholly-owned for-profit subsidiary social enterprise that sells our Buffalo Bicycles to individuals, non-profits, private sector entities, and bilateral and multilateral institutions. All proceeds from bicycle and spare parts sales contribute to our program activiites. This structure enables us to scale our impact, diversify our funding, and magnify the impact of donations, as well as reduce per unit costs through economies of scale, place the end-user at the heart of our efforts, and, because we operate within the rigors of the market, works in harmony with local economies.

WBR is a registered not-for profit in the USA (501c3), Canada, UK, Germany, Switzerland and Australia. We have supported programs in 20 developing countries, and have country offices, staff, and assembly facilities in Colombia, Kenya, Malawi, Zambia, and Zimbabwe.

Here are some high level numbers to give you a sense of our scale and footprint.

550,000+
TOTAL BICYCLES DISTRIBUTED
HEALTHCARE:152,588
EDUCATION: 216,792
ECONOMIC DEVELOPMENT:181,302

21 COUNTRIES
ACROSS AFRICA,
ASIA & SOUTH AMERICA

2,500+
FIELD MECHANICS
TRAINED

34 SHOPS
SUPPLY CHAIN SPARE PARTS

Mobilized Communities: Without reliable, affordable, context-appropriate transportation, people ~~individuals~~ living in rural areas of developing regions have to ~~must~~ primarily rely on walking to access basic goods and services, limiting their potential. WBR has developed a holistic program that addresses the cross-sectoral challenges posed by distance and lack of transport access: Mobilized Communities. We go into further details in this program below.

What is/was your role in the initiative?

Primary respondent is Andy Batchelor: I work within WBR's institutional markets team to engage institutional partners (e.g. bilateral organizations like USAID and UKAID; multilateral organizations like UNICEF and FAO; and private sector organizations like foundations and corporations) to support WBR's field activities. In some cases, I will work with our field team to develop new concepts for institutional partners to support. I also work with our field-based team to report on results.

Do you have experience from other similar projects or initiatives? What kind?

Yes. I've worked with WBR for three years in this capacity, including on our newer Mobilized Communities program, as well as our education- and health-specific activities. For 10 years prior to WBR, I worked with Abt Associates (a major USAID-implementer), Chemonics International (another major USAID-implementer), and DevTech Associates (smaller USAID-implementer), including on field level program development and implementation on economic growth-oriented activities.

Briefly explain the process of implementing the initiative and its projects:

WBR addresses the systemic challenges of distance and last mile mobility by manufacturing a bicycle specially designed from the ground up for rough roads and heavy loads for base of the economic pyramid consumers. Rugged, affordable, long-lasting, and locally-assembled, WBR distributes the Buffalo Bicycle to health service providers, students, farmers, and entrepreneurs, while building a sustainable bicycle mobility ecosystem to support end-users. By working with and through partners, training local bicycle mechanics, providing market-based access to spare parts, and nurturing community ownership of programming, WBR supports community-based long-term impact and a vibrant mobility support network.

What issues does/did the initiative/projects aim to solve?

We are focusing this response on Mobilized Communities, our cross-sector project that we implement in Hwange District. We are currently implementing (or in the process of designing) Mobilized Communities in each of our countries of operation: Colombia, Kenya, Malawi, Zambia, and Zimbabwe.

Prior to designing any Mobilized Community activity WBR conducts a Mobility Needs Assessment, a comprehensive review of a district's and community's mobility disposition, needs, and preferences. Our team spends several days visiting the target geography, engaging with community leaders and members, seeking community input, interviewing community based organizations and potential local partners, understanding landscapes and geo-locations of critical community/social infrastructure (e.g. markets, churches, water sources), gathering data, etc. This allows us to have a qualitative and quantitative understanding of a community's mobility needs and preferences. We then work with the communities and local partners (in Hwange, our primary local implementing partner is Greenline Africa Trust) to design a responsive, holistic, community-owned bicycle

mobility activity that addresses community mobility needs in the areas of education, health, livelihoods, and the environment. If requested, we could potentially share some of the output from one of our mobility needs assessments.

In general, Mobilized Communities will address education challenges (e.g. helping children that live 3km or more away to access school), obstacles to accessing health services (e.g. mobilizing community health workers to enable them to visit more patients per month), livelihoods hindrances (e.g. helping farmers get more product to market more quickly, increasing access to extension services and lead farmers), and environmental concerns (e.g. mobilizing park rangers, increasing community access to natural resources like water that would otherwise be challenging to reach and might be addressed through less environmentally friendly means).

For reference, while this data does not reflect a Mobility Needs Assessment in Hwange, we initially selected Hwange as a target site for several reasons. Nearly two-thirds of Hwange's population live in rural areas. All facets of society are affected by distance and lack of mobility options [data sourced from Zimbabwe National Statistics Agency). Nearly 10% of the district's primary school students drop out of the education system. Hwange District's net intake rate for secondary school is just 22%. Health outcomes are similarly depressed. More than 50% of residents fall below the food poverty line, contributing to 8% of the population classifying as underweight. Health outcomes in rural communities are even more acutely impacted by distance. For example, rural-based women have a 62% higher maternal mortality rate than their urban peers. And, livelihoods opportunities remain limited: rural unemployment rates exceed 30%, but are less than 4% in urban areas. Meanwhile, an astonishing 67% percent of Hwange's residents live below the total consumption poverty line.

How does/did the initiative/projects solve these?

WBR provides bicycles to those who are not able to afford them through a community-led selection process within Mobilized Communities, and where appropriate, also establishes social enterprise retail shops in the same geographies for individuals, businesses, and community based organizations that can afford to purchase bicycles and spare parts. Mobilized Communities employs an ecosystem approach, with the end-user and community at the center of everything we do. This ensures that our activities are community-led, evidence-driven, and sustainable. The bicycle ecosystem approach integrates five interrelated features: user-centered bicycles, Bicycle Supervisory Committees (BSCs), community-based mechanics, and a spare parts supply chain.

Our user-centered Buffalo Bicycles are designed to be durable, rugged, easy to maintain, and affordable for base-of-the-economic-pyramid users. We train community-selected Bicycle Supervisory Committees (BSCs) to assist in participant selection, ongoing program management, and monitoring. Comprised of local leaders, BSCs also establish and enforce service-to-own or study-to-own agreements with end-users for ownership of their bicycles.

Finally, WBR also trains community-based mechanics to provide preventative maintenance and repair services at market rates, and links them to our spare parts supply chain.

With particular emphasis on womens' and girls' issues, WBR engages end users and communities in a needs assessment (discussed above) and collaborative design process, enabling us to address local mobility needs and tailor programming to on-the-ground

realities. And by regularly seeking out and integrating user feedback in settings where our bicycles our actually used, we iterate the Buffalo Bicycle and programming based on user needs.

Through this approach, World Bicycle Relief supports healthy local bicycle value chains, expands demand for bicycle mobility, and builds programs and social enterprise operations that are complementary and mutually reinforcing, boosting impact and sustainability

Did you ever consider other transport means? Which, and why did you not go through with them?

No, we have only worked through bicycles. Our origin story lies with one of the founding members of SRAM Corporation, the second largest bicycle component manufacturer in the world (though we are our own independent organization). Our expertise lies in bicycle design and engineering, supply chains, rural bicycle mobility, and analyzing and responding to bicycle market needs.

What challenges have you met in your work with the initiative/projects?

From time to time, theft, using bicycles for something other than their intended purpose (e.g. a student receiving a bicycle but the family using it for farming), and retention was a challenge.

How did you overcome them?

Mobilized Communities—and most every WBR program—includes a great deal of community engagement and empowerment, particularly through the Bicycle Supervisor Committee (BSC). BSCs are charged with supporting program implementation, and part of that is being the community's face for supporting participants and troubleshooting. So, in the rare case a bicycle is being used for something other than its intended purpose, BSC representatives will speak to the participating individual/family to amicably address the issue. If the challenge is still not resolved, the village chief, chieftainess, or similar traditional authority or community leader will assist, which is nearly always successful. Similarly, with theft, a Buffalo Bicycle is a unique design and easily identified. The BSC and community leaders are usually able to address theft on their own. In the rare cases when they aren't, they are able to contact law enforcement. However, theft is traditionally not a challenge because Buffalo Bicycles are so easily identifiable.

Finally, to ensure retention in our programs and incentivize the maintenance of a bicycle, Mobilized Communities incorporates service-to-own and study-to-own agreements. These agreements allow a participant to take ownership of a bicycle after a mutually agreed upon duration. For a student, a certain grade level, for example, must been completed for her/him to take official ownership of the bicycle. For a community health worker or other service provider (e.g. lead farmer), s/he may be required to remain in their position for two years before taking ownership of the bicycle. Again, this incentivizes full participation in the program, using the bicycle for its intended purpose, and keeping the bicycle in good repair. Service-to-own and study-to-own are extremely successful elements of our activities.

Have you seen that the initiative/projects have created value for the community? How?

Absolutely. While Mobilized Community is a new program for us (launching this year), we do know that our sector-specific activities have had tremendous impact. We anticipate this type of impact, and more, through Mobilized Communities. Here is a selection of some of our impact.

Stat	Sector	Value	Indicator	Data Release Year	Country	Citation (copy/paste)
1	Education	28%	Reduction in absenteeism	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
2	Education	66%	Increase in punctuality	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
3	Travel time	5.8	Hours saved per week in school commute time with a Buffalo Bicycle (SAFE TO SAY "NEARLY SIX HOURS")	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
4	Empowerment	Increased locus of control (.16 SD)	Locus of control (the degree to which they felt in control of their lives)	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
5	Empowerment	Increased bargaining power	Increased bargaining power (includes access and control over resources and open communication with parents)	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
6	Safety	33%	Reduction in absenteeism or early departure from school for safety reasons	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.
7	Safety	22%	Reduction in harrassment	2019	Zambia	Innovations for Poverty Action, 2019. Wheels of Change: Impact of Bicycles on Female Education and Empowerment in Zambia. New Haven, CT.

8	Livelihoods	25%	Increase in number of monthly deliveries to dairy cooperative (i.e. frequency)	2015	Zambia	World Bicycle Relief, 2015. Mobility: Buffalo Bicycles Impact on Dairy Farmer's Productivity. Lusaka, Zambia.
9	Livelihoods	23%	Increase in volume of milk delivered per month to dairy cooperative (i.e. volume)	2015	Zambia	World Bicycle Relief, 2015. Mobility: Buffalo Bicycles Impact on Dairy Farmer's Productivity. Lusaka, Zambia.
10	Health	88%	Increase in average patient visits per month with a Buffalo Bicycle	2015	Kenya	PATH, 2015. Bicycles That Make a Difference in Tuberculosis Care (TB-ARC). Nairobi, Kenya.

Are any of these long-term impacts?

Yes. We know anecdotally from our long history of working in a given community that our programs have long lasting, positive impact on the individuals that participate and the communities at-large. We see more educated individuals are healthier, healthier individuals are more productive and prosperous, and more prosperous individuals prioritize education and can afford health services. We anticipate measuring these types of long term impacts from Mobilized Communities, but that data will not be available for some time. We do have some longitudinal data form the independent RCT study on our Zambia education activity. We are continuing follow up with these RCT cohorts, and we presently have two years of data.

Education	19% less likely	After two years, girls with bicycles are 19% less likely to drop out of school than girls without bicycles.
Education	38%	After two years, on average, girls with bicycles have a 38% reduction in days missed than girls without bicycles (over two school terms).
Education	40% less likely	After two years, boys with bicycles are 40% less likely to drop out than boys without bicycles.
Education	50%	After two years, on average, boys with bicycles had a 50% higher attendance rate than boys without bicycles (over two school terms).

How was the response on the projects/initiative from the community?

Highly positive. Each community is always eager for additional bicycles and engagement. BSC members are proud to be part of our programs and provide leadership.

Have you seen any change in the travel patterns in the area after the initiative was implemented? How?

Definitely. Please see the impact data above. Additionally, please note that not all impact is captured via data. For example, we see the vast majority of students participating in our programs carrying a sibling or friend to school on their Buffalo Bicycle's back carrier. We don't collect data on the second student that benefits, but we know they do. Similarly, at appropriate times, participants that receive bicycles are permitted to use

their bicycles for purposes other than those which they received their bicycles (for example, a student's family can use her/his bicycle outside of school hours for livelihoods, health, church, etc.). So, participating families (and their neighbors who borrow the bicycle), rather than just the individual participants, benefit from having an important mobility asset available to them.

Who are the most important stakeholders related to the initiative?

In our mobility needs assessment, design process, and program implementation, community leaders and members are essential stakeholders. A community leader may be a headmaster, school official, agricultural cooperative manager, pastor or lay leader, traditional leader, district level government official, or head nurse. A community member might be an experienced community health work, parent-teacher association member, student, farmer, or peer group member.

How and when were they involved?

Community leaders and members are involved throughout, from provision of design input and community sensitization at the beginning of a program, to activity management and data collection during implementation (e.g. through the BSC), to reviewing learnings and applying them to future iterations of the program at the end.

Did you separate vulnerable groups, like women, differently able, elderly and children, as a separate stakeholder? Why / Why not?

YES!!! Women's empowerment and gender responsiveness are critical elements to WBR's activities. We actively seek to promote women's empowerment throughout our activities. In Mobilized Communities, we aim to ensure 70% of participants receiving bicycles are women.

Were local/national authorities involved?

Yes, we primarily engage with district level authorities, but we also engage with national and provincial level authorities as well.

How and when?

We typically find it advantageous to engage national and provincial level leaders at the beginning of program design to ensure they have an opportunity to consider our approach and target geographies and provide input/feedback, and ensure that our work aligns with their objectives. We continue to provide updates and document progress to them as we implement a program. Sometimes they become vocal advocates (e.g. Zambia's Ministry of Education has been a powerful voice in support of our education activities).

We work most directly and most frequently with district level line ministry representatives (e.g. district agricultural officers, district education officers, district health officers). Depending on the location, they sometimes participate in the program's design, provide feedback, assist with introductions, and facilitate implementation.

How did the involvement/absence of involvement affect the success of the initiative?

Already noted above. In general, if a government authority is not receptive of a program (which has rarely, if ever, happened), we will not seek to implement in that particular geography. Support at all levels is critical to maximizing the impact of our work.

How would you sum up the factors making the initiative a success?

- "All answers are found in the field" (an organization mantra…meaning we are humble and listen to our community partners to seek solutions and design innovations).
- Community ownership and empowerment
- Promote sustainability through a vibrant and holistic bicycle ecosystem

Has the initiative created local employment (both direct and indirect) in any kind of way? How?

Yes. Community based mechanics are remunerated by those they serve (we have trained over 2,500 mechanics). WBR as an organization hires only local staff in our countries of operation (e.g. country directors, program managers, M&E managers, assemblers). With a few small exceptions, all local staff are hired on a long term basis with pay and benefits. We are eager to contribute to the economic development of the countries we serve. We try to lead by example.

How does the users pay for the services?

Participants of Mobilized Communities typically make "micro contributions" to help pay for the mechanic's services and contribute to a pool for spare parts. These might be the equivalent of $1 to $5 at the beginning of the program, and an appropriate sum on an annual basis (the micro contribution is based on what the BSC determines participants can reasonably manage without affecting the participants' economic wellbeing)

Others are able to purchase Buffalo Bicycles and spare parts through our social enterprise locations.

Do you have any specific tips/words of advice for projects that are similar to yours?

We consider the concept of "ownership" to be very important to the success of our activities, whether it's the participant feeling a sense of ownership and pride in their bicycle (which they will eventually own through the service or study-to-own agreement), the family unit who feels a sense of pride and ownership over a valuable asset to their family's well-being, or community ownership through the design input and ongoing support for program implementation. Without this ownership element, some of the intangibles of our programs' would not maximize impact as they currently do.

Appendix 7: Interview summary, Velafrica

Can you explain the initiative you work on, and how it was developed?

The idea is not only to provide bicycles to African countries, but also to be a part of an integration project in Switzerland. Used bicycles of all kinds (even non-functional bikes and e-bikes) are collected in Switzerland, as a kind of bicycle recycling point. The employees in the integration program handle the bikes in their workshop in Switzerland; Functional bikes are given a quick fix, non-functional bikes are deconstructed and used for spare parts, and everything that is not functional is recycled in Switzerland. The functional bikes and spare parts are then shipped in containers to African countries.

The bikes that are sent are always of good quality. Low-quality bikes are kept in Switzerland or used for spare parts. The local partners can pre-select what kind of bicycles they want to order, and Velafrica tries to fulfill the wishes as long as the demand matches the stock. There are 7 types to choose from, including touring bikes for men, touring bikes for women, mountain bikes, kids' bikes, among others. The partners normally prefer mountain or touring bikes. They can also select what kind of recycled spare parts they want.

Normally, all provided bikes can be used on dirt roads without problems. There is no data on whether regular bikes need more maintenance than mountain bikes or not. If the collected bicycles in Switzerland have low-quality tires, the mechanics will try to replace them with tires that are more resilient.

Velafrica also provides training for the mechanical trainers, which are hires by the local partners to train bicycle mechanics. Once a year a trainer from Switzerland visits the local partners for training sessions.

What is/was your role in the initiative?

The interviewee has a PhD in political science, and now works in Velafrica. They are responsible for impact assessment, which includes a monitoring system with indicators, as well as feedback on financial and impact related factors.

Do you have experience from other similar projects or initiatives? What kind?

The interviewee joined Velafrica right after finishing their PhD.

Briefly explain the process of making the decision on implementing the initiative/projects

The initiative started as Bicycles for Africa, a program as a part of the recycling bicycle workshop Drahtesel in 1993. Drahtesel was working with integration in Switzerland, where people that had difficulties getting into the job market (immigration, long-time unemployment, light handicaps, youth that can't find an internship or similar) where engaged in the secondary job market. Velafrica became independent as its own non-profit organization four years ago.

In the early days, the business model consisted of small companies buying 1-2 containers per year. In 2015, the business model was switched up because Velafrica wanted to export more and make a greater impact. The new model included local empowerment of youth in the African countries and the opening of a social bicycle hub; a

center where the containers arrive with the bikes, as well as a vocational school and repair service for the local population. The hubs are social enterprises which Velafrica support and invest in, where the objective is that in 3-5 years the enterprises will be financially independent from Velafrica.

Why did they choose bicycles? Did they consider other transport means?

Drahtesel was based on bicycles in particular because the founders were bicycle-people. The Bicycles for Africa program was based on contacts the founder had in Ghana. In addition, the re-selling market of bicycles in Switzerland was not great at that time, so they considered bicycles a starting point for this combined integration- and aid initiative.

What challenges have you met in your initiative/projects? How did you overcome them?

- To produce enough bikes. Velafrica normally is able to find enough second-hand bikes, but the production of fully functional bicycles to ship is difficult because of the low-capacity labor force in Switzerland. However, when introducing inmates to the integration program, this problem was solved. During the pandemic, there was issues finding enough bikes.
- To provide enough supply to the demand, which can grow to double of the current supply. This is a chronic problem.
- To get the local enterprises recognized by the state in the African countries.
- To find a good solution for the Bike to School maintenance service. "We cannot only provide bikes, we need to provide repair services as well." The challenge is to implement a repair service system that also works in the long term.

Have you seen that the initiative/projects have created value for the community? How? Are any of these long-term?

Velafrica exports 20 – 25 000 bikes per year, which equals one container per week.

Raising money to measure impact is difficult, so Velafrica tries to integrate impact measurement in every program. For the B2S program, there is a lot of agnostic data on improved punctuality and attendance in particular. Saving travel time by using bicycles also gives more time to other things, in addition to improved presence and attention in the classrooms. Velafrica knows that by riding a bicycle, the feeling of safety increases. Especially girls can leave home later, which means less time traveling in the dark, and less bothering from other road users (this includes sexual harassment).

Have you seen any change in the travel pattern in the area after the initiative was implemented? How?

Travel patterns are not studied, but Velafrica knows that other family members often borrow the *Bike 2 School*-bicycles for going to church or other activities. Normally, bikes not only make the end users able to travel faster, but they can also carry more and travel longer. There are plenty of examples of farmers, health care workers and others that can expand their range of action.

The questions in the section on stakeholder involvement were not asked, as Velafrica's partners are responsible for this interaction.

How would you sum up the factors making the initiative a success?

- The integration two activities, one in Switzerland and one in African countries, gives a greater leverage for fundraising.
- The entrepreneurial mindset both in Switzerland and the local bike hubs. If one of the partners disappear, the other will be able to stand financially on its own. It also expands the organization from not just providing bikes or support in a traditional way, but in a market-oriented way.
- The program is dynamic: It's easy to start new projects or programs if there is a demand and a potential.

Has the initiative created local employment (both direct and indirect) in any kind of way? How?

The bicycle hubs have people within administration and finances. They also have mechanical trainers and mechanics, but there is not a requirement that all the bike shops have their own local mechanics - they can travel from shop to shop whenever there is a need.

How does the users pay for the services?

The partners normally cover all shipping costs, and sell the bicycles on the local market. The price for a bike is quite expensive (2-3 months average salary).

Recently, a Bike 2 School program has been established, and there is thought put into a similar program for adults. The program is pre-financed from fundraising in Switzerland, which enables the student's family to only pay a small part of the full price for these bikes. The requirements for receiving a B2S bike is a minimum 90-minute walk to school, as well as a selection process from the local NGO or directly with the schools. The idea is not only to provide the bicycles as a product, but also giving access to repair services and spare parts. The spare parts are funded by fundraising in Switzerland, so that the students only pay for the labor when they need repairs.

Appendix 8: Pilot study

In order to get experience on collecting data from a survey, as well as the processing and analyzing of travel habit data, a pilot study was developed. The study was performed as a part of the preparation phase in February and gave a valuable understanding of the planned method for the questionnaire.

The study was designed to reflect the situation in the Mabale area, translated to Norwegian conditions. As the setting had to be quick and easy to collect data from, a group of students of immediate vicinity was asked to participate. Students are also mostly moving by foot, bicycle or public transport[6], which is to some extent comparable to the assumed travel patterns in the Mabale area.

To demonstrate the SDC, Helgasetr (Elgeseter gate 10) was chosen. Helgasetr is a part of the co-location project of the NTNU campuses in Trondheim[7]. It aims to gather the education facilities for NTNU's health and social sciences programs, as well as sports and catering services from the Student Association (Sit). The building is supposedly ready for use in 2023. Helgasetr will house the following:

- Students and employees at the following study programs: Audiology, child welfare work, occupational therapist, physical therapist, radiography, sociology, nursing
- Sports facilities and gym, as well as social zones connected to these
- Catering services (restaurant, café or kiosk, similar to Sit's current services)
- Social and educational zones, for studying, student organizations and social gatherings.

To demonstrate a mobility improvement, questions about electric micro mobility (electric bicycle, electric scooter/kick-bike or similar[8]) was added. This was similar to the questions about bicycles added to the Mabale survey after the interviews with WBR and BEN Namibia.

The analysis was performed using Microsoft Excel and ArcGIS Pro.

The survey questions were divided into 5 sections, with a total of 23 questions. The respondents were asked to answer as if the covid-19 pandemic was not affecting their lives, from a summer perspective (no snow), and as if they were to live in Trondheim in 2023 as well. They were also asked to write down any comments to specific questions or the general impression of the survey, if they had any. The questions were:

1. **Household**
    a. What is your address (in Trondheim)?
    b. How many people live in your household, including yourself?
    c. State the number of household members in each of the given age groups
        i. [0 – 10], [11 – 15], [16 – 20], [21 – 30], [31 – 40], [41 – 50], [51 – 60], [61 +]
    d. How many of your household members have the following occupations as their **main** occupations?

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[6] https://miljopakken.no/wp-content/uploads/2011/01/Reisevaner-2013-14_ferdig.pdf (24.02.2021)
[7] https://www.ntnu.no/campusutvikling/elgesetergate-10 (24.02.2021)
[8] https://www.mdpi.com/2071-1050/12/1/273 (24.02.2021)

i. [Income-generating work], [Engaged in household or family responsibility], [Going to school or studying], [Military service], [Maternity / Paternity leave], [Pensioner], [Long-term sick leave], [Unemployed], [Other, specify:]

e. What is your household's monthly income?
   i. [Less than 19 000 NOK], [Between 20 000 and 59 999 NOK], [Between 60 000 and 99 999 NOK], [More than 100 000 NOK], [I do not wish to state this], [I don't know]

2. Work and education

a. What is your highest <u>finished</u> education?
   i. [Early education], [Secondary education], [Tertiary education]

b. What do you consider your main occupation?
   i. [Income-generating work], [Engaged in household or family responsibility], [Going to school or studying], [Military service], [Maternity / Paternity leave], [Pensioner], [Long-term sick leave], [Unemployed], [Other, specify:]

c. Do you have a permanent workplace or place to study? If yes, state the address.

d. How many days per week do you travel for work / studies / school?

e. How long time does it take you to get to work / studies / school? (In minutes)

f. What is your main means of transport for your trips to work / studies / school?
   i. [Walking], [Cycling], [Car], [Motor bike], [Public transport], [Electric kick-bike or similar], [Other, specify:]

3. Current transport options

a. Do you or your household own any means of transport? Mark and state how many.
   i. [Car], [Motor bike], [Electric bicycle], [Bicycle], [Electric kick-bike or similar], [Other, specify:]

b. Does your household have the possibility to borrow any of the given means of transport from family or friends? *(This does <u>not</u> include rental services like VOI, Ryde, Bysykkel or similar)*
   i. [Car], [Motor bike], [Electric bicycle], [Bicycle], [Electric kick-bike or similar], [Other, specify:]

c. Do you have any disabilities that limits your transport opportunities?
   i. [Yes, regarding sight], [Yes, regarding hearing], [Yes, regarding mobility], [Yes, other], [No]

4. Current travel patterns

a. What kind of trips do you do during a week? Mark and state how many. *(One trip is to OR from the given place. If you go to and from work 5 days per week, your stated number will be 10)*
   i. [To/From work or school], [To/From stores or shops], [To/From sports facilities], [To/From health facilities], [To/From entertainment], [To/From friends or family], [Other]

b. How much time do you spend on these trips? State the number of <u>minutes</u> per trips.
   i. [To/From work or school], [To/From stores or shops], [To/From sports facilities], [To/From health facilities], [To/From entertainment], [To/From friends or family], [Other]

  c. How many minutes do you spend travelling per means of transport on an average week?
    i. [Walking], [Cycling], [Car], [Motor bike], [Public transport], [Electric kick-bike or similar], [Other, specify:]

5. Helgasetr and future travel patterns
  a. For what purposes will you go to Helgasetr? You can select multiple.
    i. [For study purposes (the given study programs)], [For study purposes (other)], [For the sports facilities], [For the catering / food services], [For social hangouts], [I will not go there], [Other, specify]
  b. How will you get to Helgasetr? Select your preferred means of transport and how many minutes it will take you to get there with your selected means of transport.
    i. [Walking], [Cycling], [Car], [Motor bike], [Public transport], [Electric kick-bike or similar], [Other, specify:]
  c. For what purposes would you travel longer distances, if you could? You can select multiple.
    i. [Visit friends and family that live far away], [Go to stores in the city], [For leisure travels (cabin, vacation, activities and similar)], [Other, specify], [I wouldn't travel anywhere else]
  d. What is stopping you from doing the long-distance travels you want? You can select multiple.
    i. [I don't have the money], [I don't have the time], [Other, specify]
  e. If you had 15 000 NOK to buy a means of transport to ease your daily travel, which would you buy?
    i. [Bicycle], [Electric bicycle], [Electric kick-bike or similar], [Other, specify], [I am satisfied with the way I travel daily as of today], [I would save for a car or motor bike]
  f. If you had an electric bicycle, electric kick-bike or similar, how would you use it? You can select multiple.
    i. [To go to work / school], [To access health facilities], [To go to sports facilities or other leisure activities within my city], [To go to stores], [Other, specify], [I would not use it, because I don't like riding electric bicycles nor kick-bikes], [I would not use it, because I am satisfied with the way I travel daily as of today], [I would not use it, state reason]

Appendix 9: Survey responses and corrections

Question 2: State the number of household members in each of the given age groups. Please also mark the box for *your* age.

Question 3: How many of your household members have the following occupations as their *main* occupation? Please also mark the box for *your* main occupation.
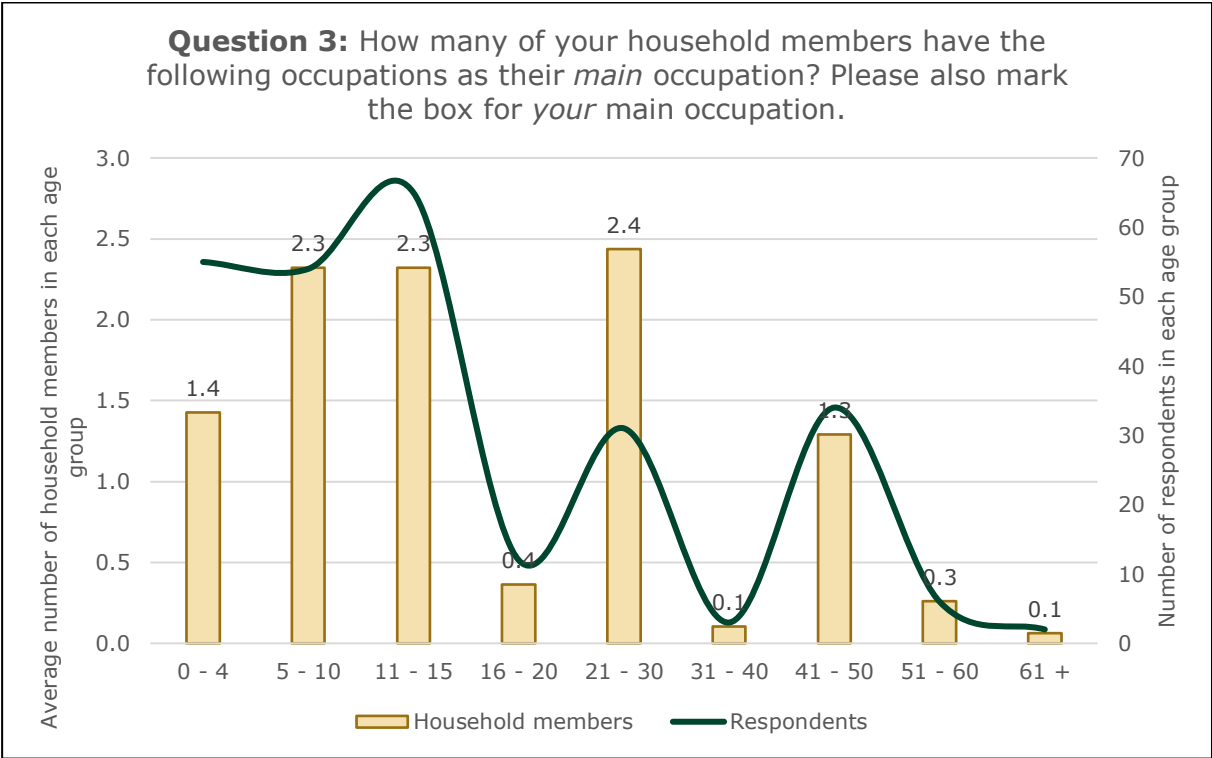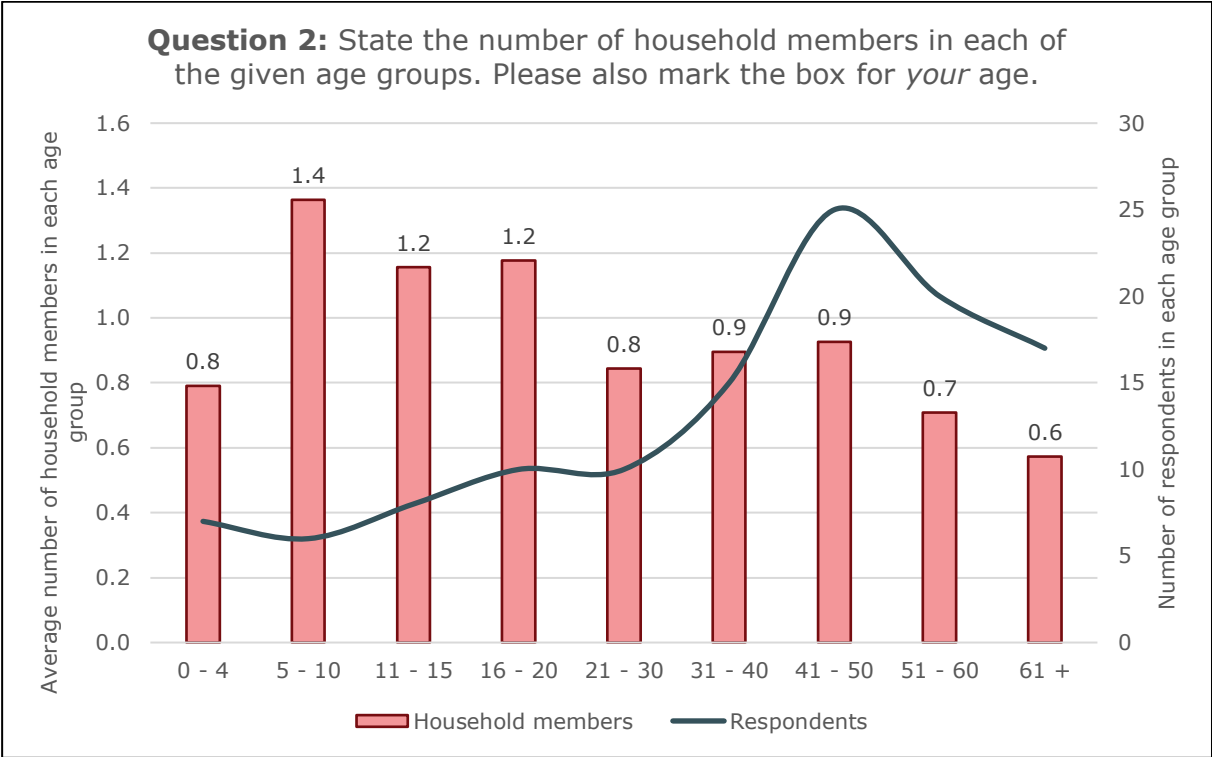
Question 4: What is your household's average monthly income?

Category	Value
Less than 10 USD	20
11 - 50 USD	39
51 - 200 USD	12
201 - 400 USD	9
401 - 600 USD	3
601 - 800 USD	0
801 - 1000 USD	0
1001 USD +	0
I do not wish to state this	13
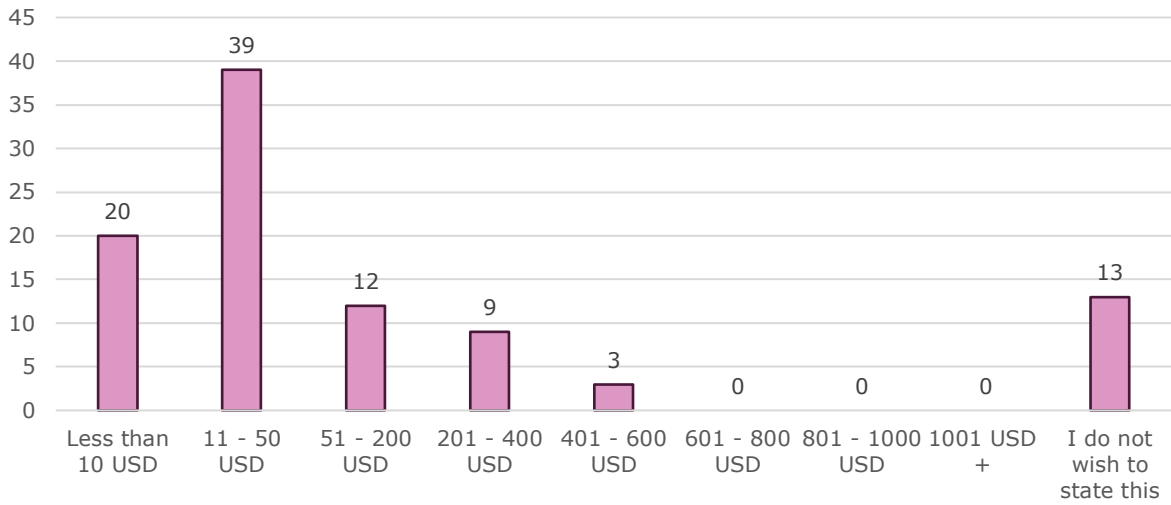
Question 5: What is your gender?
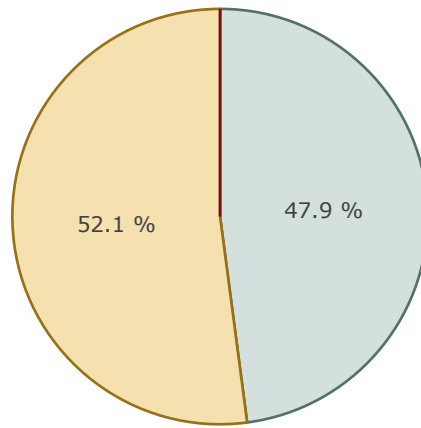
Male 47.9 %
Female 52.1 %
□ Male □ Female ■ I do not wish to state this

Question 6: What is your highest *finished* education?

Category	Value
Primary education	29
Secondary education	46
High school	8
Tertiary education	8
None	4
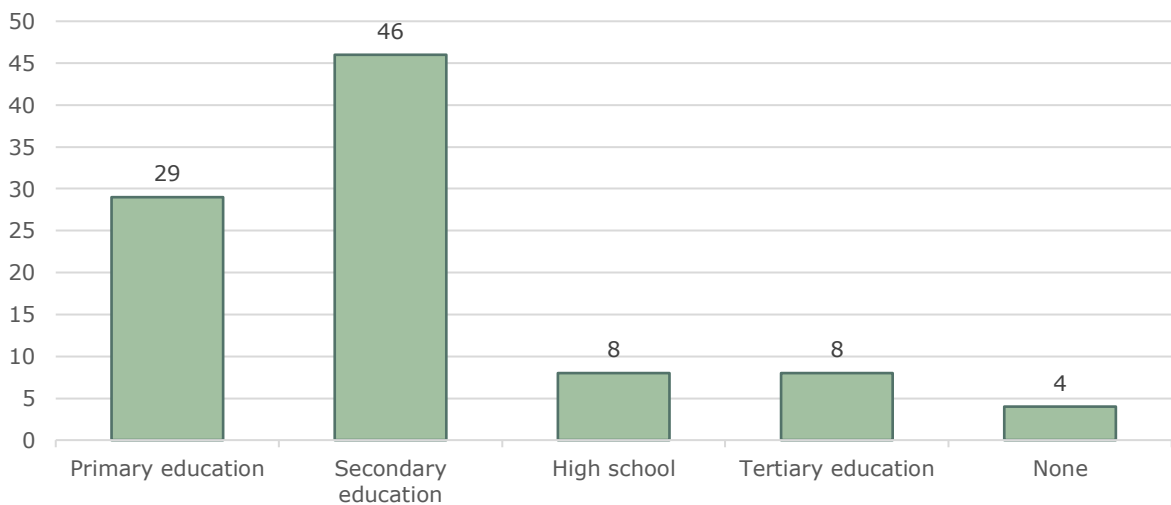
Question 8: How many days per week do you travel for work?

Average: 4,9

Question 9: How many times per day do you travel related to work?

Average: 4,3

Question 10: How do you get to work?

Category	Value
I walk	82
I use my own transport. Specify what kind.	11
Being transported by someone else. Specify what kind and by who.	3
Not relevant / I don't have a workplace	2
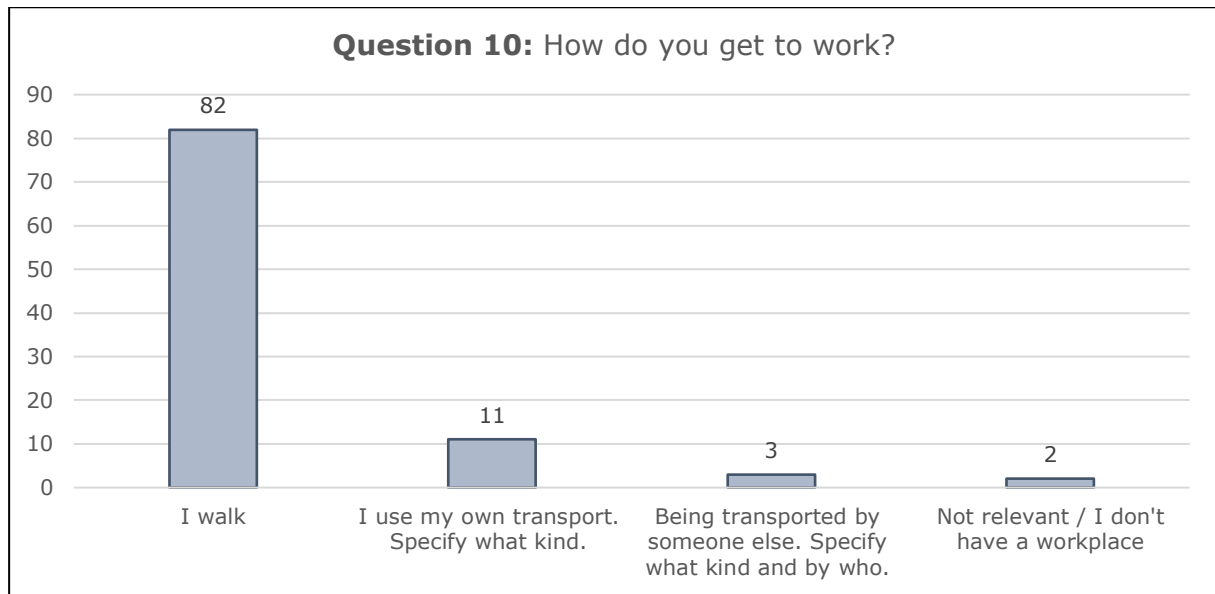
Question 11: How much time does it take you to get to work?

Average: 64,2 minutes

Question 12: Do you or your household own any means of transport? Please state how many.

	Owned by household	Total number owned
Car	12	12
Bicycle	35	41
Animal drawn cart	38	38
Transport animal	36	409
Other, specify	2	0
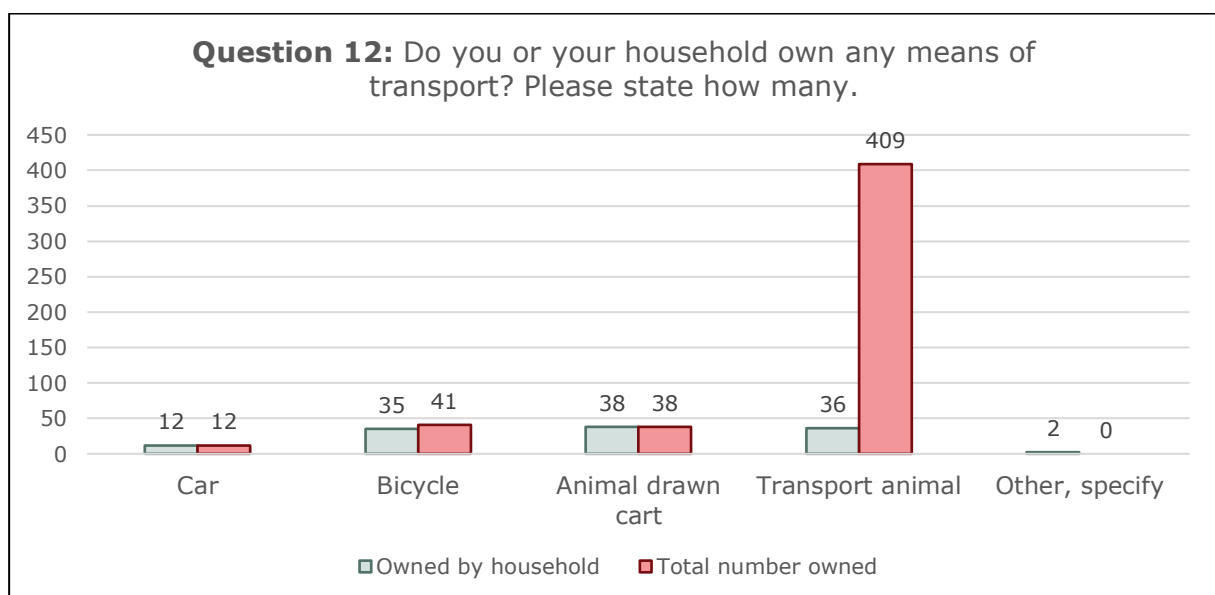
Question 13: Do you have the possibility to borrow any of the given means of transport?

Means of transport	Count
Car	7
Bicycle	29
Animal drawn cart	46
Transport animal	13
Other, specify	1
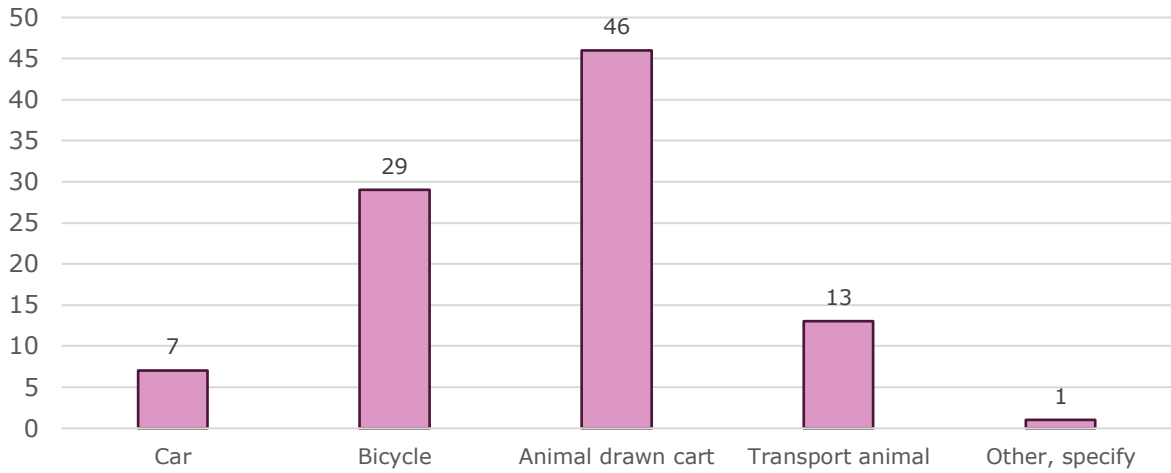
Question 14: Do you have any physical problems that limits your transport opportunities?

Problem	Count
Sight	10
Hearing	1
Mobility	6
Other	6
No	75
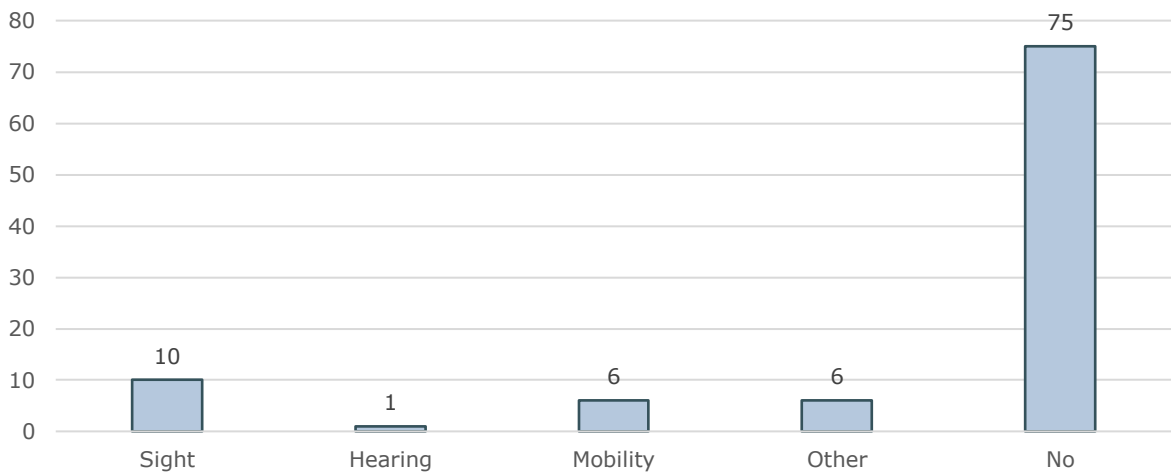
Question 15: How many trips do you perform during a week?

Destination	Trips
Work or school	4.4
Stores or shops	2.9
Water sources	9.9
Firewood collection	3.6
Health facilities	3.1
Church	2.4
Other, specify	0.3

Question 16: How much time do you spend on these trips?

Average minutes per purpose

Work or school	Stores or shops	Water sources	Firewood collection	Health facilities	Church	Other, specify
74.7	72.7	67.4	78.0	127.4	108.3	78.9

Question 17: How many minutes do you spend travelling per means of transport each day?

Walking	Cycling	Animal drawn cart	Transport animal	Bus	Car	Other, specify
270.3	24.2	39.7	11.4	80.9	50.3	0.0

Question 18: For what purposes will you go to the Sabona Development Center? You can select multiple.

Number of respondents

Attend the vocational school	Sell products from the homestead	Sell products already at the SDC	Poultry project	Vegetable garden	Be social	Buy products	Other	I will not go there	I have not heard about the SDC
24	45	26	62	55	39	20	4	1	1

Question 19: How will you get to the Sabona Development Center? Select your preferred means of transport.

Category	Value
Walking	63
Cycling	12
Animal drawn cart	1
Transport animal	1
Bus	0
Car	16
Other	0
I will not go there	3

Average minutes walking: 64,6

Average minutes cycling: 32,3

Average minutes by animal-drawn carts: 40,0

Average minutes by transport animal: 20,0

Average minutes by car: 41,7

Question 20: How often do you think you will go to the SDC?

Category	Value
Every day	3
2 - 3 times per week	46
Every other week	25
Once per month	18
Less than once per month	2

Question 21: If you had 250 USD to buy a means of transport, which would you buy?

Number of respondents

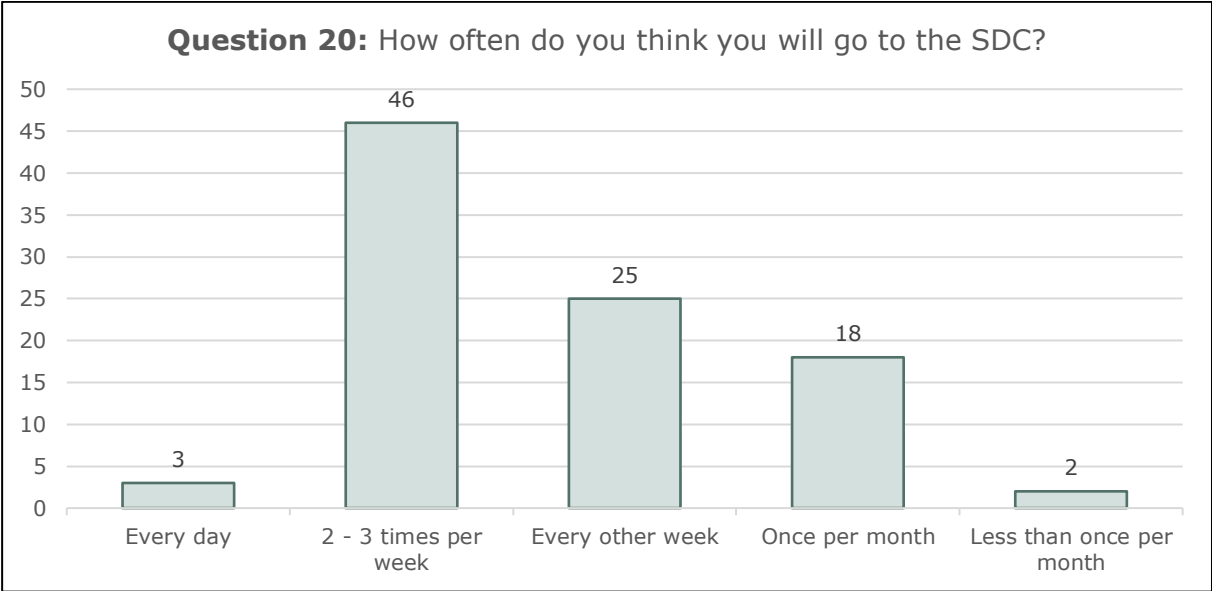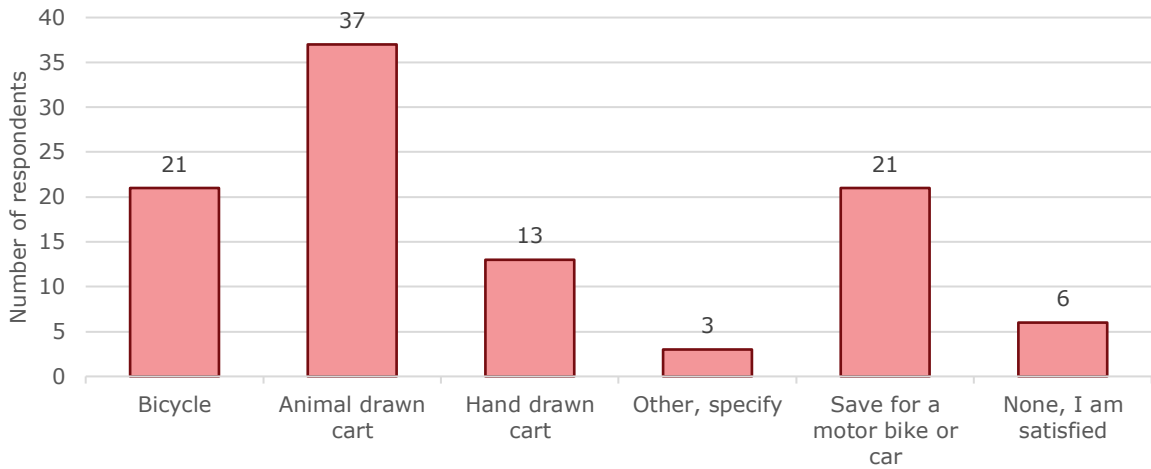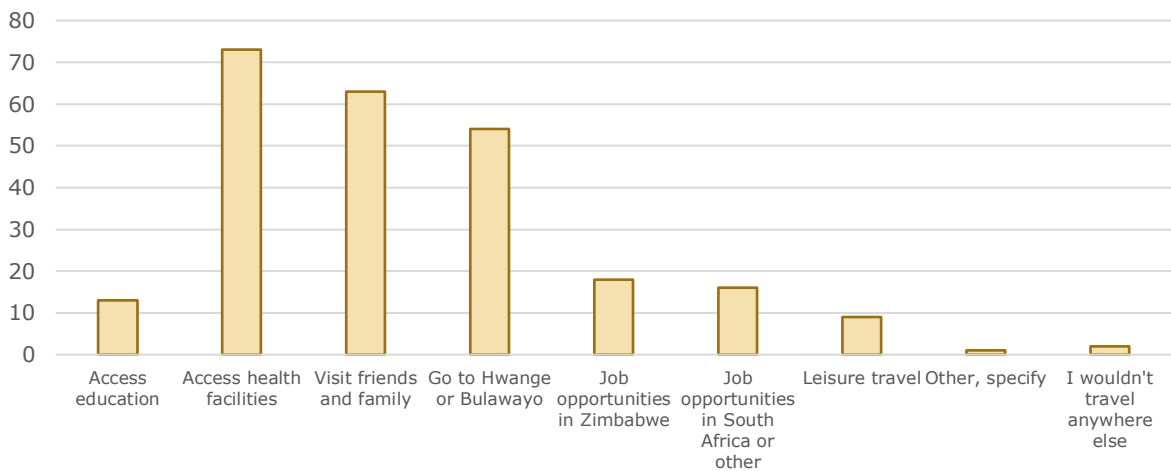| Category	Value
Bicycle	21
Animal drawn cart	37
Hand drawn cart	13
Other, specify	3
Save for a motor bike or car	21
None, I am satisfied	6

Question 22: For what purposes would you travel longer distances, if you could? You can select maximum 3 options.

Category	Value
Access education	13
Access health facilities	73
Visit friends and family	63
Go to Hwange or Bulawayo	54
Job opportunities in Zimbabwe	18
Job opportunities in South Africa or other	16
Leisure travel	9
Other, specify	1
I wouldn't travel anywhere else	2

Question 23: What is stopping you from doing the long-distance travels you want? You can select multiple.

Category	Value
Money	86
Time	8
Other, specify	19
Not relevant, I am able to travel longer if I want	5
Not relevant, I don't want to travel longer distances	0

Question 24: If you had a bicycle, how would you use it? You can select multiple.

Category	Value
Go to work or school	44
Go to water sources or collect firewood	12
Access health facilities	57
Leisure and fun	14
Travel longer distances	31
Other, specify	2
Not relevant, I already have one	9
Not relevant, I wouldn't like to own one	10

Question 25: Why would you choose to go by bicycle instead of your current transport means? You can select multiple.

Category	Value
Faster	60
Carry more	28
Longer distances	35
Other, specify	0
Not relevant, I already have one	10
Not relevant, I wouldn't like to own one	11

Some of the responses were corrected by the author after they were registered in excel. The following list include all corrections:

- Deleted responses because of blank pages: 18, 22, 80, 100.
- For question 2, 3 and 12: When marked extra for the respondents' answer in addition to the household, but the number stated was 0, the number was changed to 1.
- "Less than 60 minutes": Changed to "60" in order to make it easier to perform calculations.
- "Once per month": Changed to 0,25 per week in order to make it easier to perform calculations.
- "NIL" and "N/A": Changed to 0 in order to make it easier to perform calculations.
- Missing time unit (minutes/hours): Assumptions made based on the other answers and measuring distances in ArcGIS.

Frida Nygaard

Improved Mobility as Value Creation for Sabona

NTNU
Norwegian University of
Science and Technology

ENGINEERS
WITHOUT
BORDERS