

Louvain School of Management

IMPACTS OF FOOTBRIDGES BUILT BY BRIDGING THE GAP AFRICA ON LOCAL COMMUNITIES

Measuring economic and social effects of two new
bridges in West Pokot County (Kenya)

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Table of contents

List of figures.....	v
List of tables.....	v
Chapter 1. Introduction.....	6
1.1. The mobility challenge posed by rivers in Kenya.....	6
1.2. Personal motivation.....	7
1.3. Bridging the Gap Africa motivation.....	8
1.4. Research question and objectives.....	8
Chapter 2. Presentation of Bridging the Gap Africa	11
2.1. History and mission.....	11
2.2. Types of footbridges.....	11
2.2.1. Suspended footbridges.....	12
2.2.2. Suspension footbridges.....	13
2.3. Operations.....	13
Chapter 3. Literature review	15
3.1. Economic impacts of footbridges.....	15
3.2. Social impacts of footbridges.....	16
3.3. Environmental impacts of footbridges	18
3.4. Footbridges traffic and geographical coverage.....	19
3.5. Literature review summary	20
Chapter 4. Methodology	22
4.1. History of the project.....	22
4.2. Theoretical framework of the research.....	23
4.3. Data collection	23
4.3.1. Bridge traffic.....	24
4.3.2. Household survey	24
4.3.2.1. Sampling methodology.....	24
4.3.2.2. Sample achieved	25

4.3.2.3. Interview methodology.....	28
4.4. Data analysis	28
Chapter 5. Research outcomes	30
5.1. Rural Pokot lifestyle	30
5.1.1. Professional occupation.....	30
5.1.2. Education	32
5.1.3. Living standards.....	33
5.2. Footbridges traffic outcomes	34
5.2.1. Tamkal Bridge traffic	34
5.2.2. Sisit Bridge traffic	36
5.2.3. Footbridges utilization patterns.....	38
5.2.4. Price by utilization ratio	39
5.3. Household survey outcomes	41
5.3.1. Flash floods challenges.....	41
5.3.2. Footbridges positive impacts	43
5.3.2.1. Improve access to education.....	43
5.3.2.2. Increase access to healthcare	45
5.3.2.3. Enhance economic activities.....	46
5.3.2.4. Increase safety.....	49
5.3.2.5. Improve social cohesion.....	50
Chapter 6. Discussion.....	52
6.1. Footbridges traffic.....	52
6.2. Economic and social impacts.....	53
6.3. Footbridges as key to achieve SDGs.....	54
6.3.1. SDG 1: No Poverty	54
6.3.2. SDG 3: Good Health and Well-being.....	55
6.3.3. SDG 4: Quality Education.....	56
6.4. Results reliability.....	57
Chapter 7. Conclusion, limits, and future research	58

7.1. Conclusion	58
7.2. Limitations and suggestions for further research	59
Bibliography.....	61
Appendices.....	67

List of figures

Fig 1 – Suspended footbridge	12
Fig 2 – Suspension footbridge	13
Fig 3 – Sample size formula (Qualtrics, 2023)	25
Fig 4 – Number of men and women by age category surveyed in Tamkal	26
Fig 5 – Number of men and women by age category surveyed in Sisit.....	27
Fig 6 – Employment status of our participants	30
Fig 7 – Education level of our participants.....	32
Fig 8 – Living Standard Measure of our participants.....	33
Fig 9 – Tamkal Bridge daily crossings.....	35
Fig 10 – Tamkal frequency of crossings.....	36
Fig 11 – Sisit Bridge daily crossings.....	36
Fig 12 – Sisit frequency of crossings	38
Fig 13 – Frequency of footbridges utilization.....	39
Fig 14 – Properties losses in Tamkal.....	41
Fig 15 – Properties losses in Sisit.....	42
Fig 16 – Communication means	51
Fig 17 – Tamkal (left) and Sisit (right) footbridges	60

List of tables

Table 1 – Price by utilization ratios.....	40
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Chapter 1. Introduction

1.1. The mobility challenge posed by rivers in Kenya

Kenya is a well-known touristic destination of Eastern Africa due to its rich culture, wonderful landscapes, and amazing wildlife. It is also one of the wealthiest African countries (Statista, 2023). Unfortunately, this wealth does not benefit its residents, most of whom live in poor conditions. In 2015, 36.1% of the population lived below the national poverty line (The World Bank Group, 2022a), affecting mainly rural communities (Statista, 2023 ; United Nations, 2020, p.103). In addition, the significant inflation that has been making the headlines over the past few months is of course not helping, and several protests have occurred during my stay in Kenya. In order to improve their living standards, Kenyans that live in rural areas need proper transport infrastructures to access jobs and important services like education and healthcare. In this view, one of the challenges that the local population is facing is the barriers posed by rivers.

Kenya's climate alternates between rainy and dry seasons and the most intense period of rains occurs between March and May. During this time, rivers become so powerful that they create a natural barrier that cannot be passable without proper infrastructure. Furthermore, the presence of wild animals like hippopotamuses and crocodiles can also block the habitants in some regions. At first, this was a bit of a surprise for me as it does not rain continuously for months in Kenya. Hence, rivers fill up and empty out regularly. Nonetheless, after heavy rains, the water level can stay high for several hours, sometimes days, in a row. This isolation is impacting every aspect of the lives of the nearby communities because it prevents people from accessing jobs or markets to sell their goods, children from going to school daily, and it creates an even bigger issue for sick or injured people who need immediate treatment.

In addition, this visible barrier accounts for only half of the problem. As rains can get pretty intense in Kenya, it is not rare to see a river rises in just a couple of minutes. I witnessed this myself in Naivasha (Nakuru County) while visiting the Hell's Gate national park. The rain started to pour and the small stream of water that was flowing at the bottom of the gorge turned into a powerful torrent within just 30 minutes. As a result, rivers fill up very quickly in places, and then flow downstream in areas where there has been no recent rainfall. This makes this phenomenon unpredictable, and it has caused the deaths of several Kenyans who have been washed away while they were washing clothes in the riverbed for instance.

In rural villages, most people do not have a motorized vehicle and cannot afford to pay a driver daily. Hence, they cannot travel far and are thus forced to cross rivers to access necessary services. Last mile transport infrastructure is therefore a significant challenge in Kenya as more than 70% of its population live in rural areas according to The World Bank Group (2023).

The most obvious solution to the problem posed by rivers is to build a bridge over it. However, many rivers overflow their banks during the rainy season, and the wooden footbridges built by the locals are washed away with the first heavy rains when the river is clogged with trees and debris (see Tamkal Bridge before intervention in Appendix 1). These bridges therefore require complex engineering standards to ensure environmental resilience and withstand the test of time. Unfortunately, few companies are dedicated to building such bridges in rural areas, where populations are often neglected by public investment.

To give you a better idea of the scope of the issue, 847 natural disasters have been reported in Eastern Africa (EA) since 2000, out of which 46.9% are from a hydrological cause, either floods or landslides. In Kenya, 51 flood disasters and 5 landslides have been reported over the same period, meaning an average of 2 disasters per year. These 56 incidents caused the death of 1,881 people, destroyed 6,120 houses, and affected almost 4 million Kenyans in total. The damages are estimated to be more than US\$590,000 (UCLouvain, 2023).

In view of climate change, the situation is unlikely to improve in the future. Ongoma, Chen, and Gao (2018) estimated that during the second half of the 21st century, East Africa (EA) is likely to warm by several degrees. “The central parts of Kenya and the Lake Victoria Basin will witness the highest increases in seasonal rainfall. (...) Thus, EA is likely to experience an increase in extreme rainfall events” (Ongoma, Chen, & Gao, 2018). This will not only affect people’s safety but also their incomes. “Projected reductions in net crop revenue in East Africa could be as much as 12% by 2100 (Davis, 2020, p.2).

There will therefore be a growing demand for footbridges in the coming decades, while the current demand is largely exceeding the capacity of the small number of actors present in Africa. Footbridge builders will not only need more workers but also more funds to be able to meet the needs of the numerous rural communities.

1.2. Personal motivation

As part of my Business Engineering master’s degree at Louvain School of Management, I had the opportunity to do a six-months internship with Bridging the Gap Africa ((hereafter referred to as BtGA), a non-profit organization that builds footbridges in rural areas of Eastern

Africa. One of the tasks I have been assigned during my internship was to assist Ms. Ndonga in research that aims at measuring the impact that BtGA footbridges have on the communities that benefit from it.

To successfully carry out this research, I first had to look at the existing literature, and in doing so, I realized just how little has been written about the impact of this type of bridge. Whereas footbridges consume scarce resources and play varied roles, there has been limited study on the significant impact between their provision and utilization in rural settings.

That is why I took the opportunity of writing my thesis on this topic to contribute to the existing literature and raise awareness of footbridge's benefits, having witnessed over the past six months the tremendous impact that these bridges have on the nearby communities. I hope to support previous research to attest that footbridges are necessary to foster development in many countries across the world.

1.3. Bridging the Gap Africa motivation

For BtGA, the research pursues two main objectives. First, it provides the organization with detailed insights on its impact which can be used to assess their work and improve the information transmitted to donors. Indeed, no study has been conducted by BtGA since 2019. Second, it contributes to demonstrate that BtGA footbridges are a safe solution to the mobility challenge posed by rivers and a worthwhile investment given their economic and social impact relative to their cost. By educating about the critical importance of their footbridges, BtGA hopes to develop new partnerships with private and governmental institutions and raise more funds.

1.4. Research question and objectives

To meet the goals outlined in subchapters 1.2. and 1.3., we formulated the following research question: what are the economic and social impacts of the footbridges built by Bridging the Gap Africa on the local communities? To answer this question, we decided to conduct research at two bridges sites located in West Pokot County that have been built in 2020. Data is collected from counting manually the bridges traffic and by asking questions to locals by means of a questionnaire that encompasses various topics like education, healthcare, and economic activity.

Our findings are first relevant for BtGA of course, but also to all stakeholders of the rural footbridges industry, especially policy makers that could direct investment towards disadvantaged populations. There is indeed a crucial lack of investment and attention given to isolated communities in low- and middle- income countries. “One billion people still live more than 2km away from an all-weather road, where lack of access is inextricably linked to poverty.” (The World Bank Group, 2022b, para.1)

Expanding sustainable transport options, especially in low-income or vulnerable communities, is a powerful way for countries to foster human development and social inclusion. For example, in rural Morocco, the enrolment of girls in primary school increased from 17% to 54% when their access to roads improved. In Lima, an additional 100,000 jobs will be available to people living in the poorest districts thanks to the introduction of a new metro line. (The World Bank Group, 2022b, para.6)

It might also be of interest to individuals and organizations that seek to support social business through donations, as this research provides a comprehensive overview of the impact of the investments made by Bridging the Gap Africa.

Based on BtGA experience and similar research, we are expecting these footbridge’s impacts to be highlighted in our empirical observations:

- Removal of the risk of drowning among the community.
- Development of economic activities: increased revenues, reduction of food insecurity, continuous access to markets.
- Improvement of access to education: school-going children who must cross the river to reach their school do not have to deal with absenteeism anymore.
- Increase access to healthcare: all residents can access proper care at any time.
- Improvement of social cohesion: better communication among the community, more interaction with other communities, more frequent meetings with relatives.

Overall, this research is set out to explore the significant economic and social impacts of the provision and utilization of footbridges built by Bridging the Gap Africa in rural isolated communities in Kenya. Our findings support that in rural settings, the lack of proper transport infrastructures affects every facet of people’s life. Hence footbridges are real life-changing solutions for these communities.

In this thesis, I first present Bridging the Gap Africa, the organization that funded the research, in Chapter 2. Then I summarize the previous studies that have been conducted on footbridge’s impacts in Chapter 3. In Chapter 4, I detail the research methodology. After what,

I summarize the outcomes of this research in Chapter 5. I then discuss these findings in Chapter 6 and make recommendations in regard to the United Nations Sustainable Development Goals (SDGs). Lastly, I conclude the research in Chapter 7 and make suggestions for future research.

Chapter 2. Presentation of Bridging the Gap Africa

2.1. History and mission

Bridging the Gap Africa is a non-profit organization that builds footbridges in remote rural areas of Eastern Africa. Their mission, as stated on their website, is:

Bridging the Gap Africa believes that rural African communities should not suffer from the dangers posed by impassable rivers. Footbridges prevent drowning and ensure safe, uninterrupted access to education, health care and economic opportunity. Bridging the Gap Africa is committed to building bridges that save lives. (Bridging the Gap Africa, n.d.)

Almost all their footbridges are built in Kenya, more specifically in West Pokot and Narok counties (see map of Kenya in Appendix 2), but a few have been built in other parts of Kenya and other countries like Tanzania for example. The company was born in 2003 but its founder and current President, Harmon Parker, was already building footbridges in Kenya since 1996. Over the past years, they have been building around 4 bridges per year.

BtGA is still a small organization that currently employs 7 people. 4 of them work in Kitale where the company operations are based. That is where they prepare the hardware for the footbridges as well as other materials in the company workshop. However, the management is based in Nairobi to facilitate business relationships. They also employ 4 casual workers for every bridge construction as well as a cook because the team camps on site during the time of the construction.

2.2. Types of footbridges

Bridging the Gap Africa builds both suspended and suspension bridges that are designed based on Helvetas standards, a recognized organization for footbridge construction. Thus, they cannot exceed 120 meters span. However, most of BtGA bridges range between 30 and 40 meters. The first few footbridges that BtGA built lasted around 20 years. However, they regularly improve their design, so the recent footbridges are expected to last 25 years. This is based on the assumption that the steel components will lose section size (about 1mm) due to rusting. BtGA therefore builds bridges that vehicles cannot use, but for readability, both “bridge” and “footbridge” refer to pedestrian bridges in this thesis.

2.2.1. Suspended footbridges

The term “suspended bridge” does not really make a consortium in the literature. Bridging the Gap Africa builds suspension footbridges that can be either concave or convex. But in engineering, both are simply called suspension bridges. However, the technique and difficulty of the construction is quite different for each of these two bridges. Hence, BtGA differentiates them by calling the convex type “suspended footbridge” and the concave one “suspension footbridge”.

Suspended footbridges are the simplest of the two designs. It takes only 3 to 4 weeks for BtGA team to complete their construction. For instance, BtGA most recent suspended bridge, Kesoien, costed \$26,484.97 US for a 45-meter span and was built in just 3 weeks. This amount includes all types of expenses related to the construction (from hardware to food while camping) but it does not include the wage for designing the bridge and planning the construction with the local communities and partners. It is also free of maintenance costs. They are therefore not a perfect representation of the real cost of these infrastructures.

If we consider the costs from every department, hence including all company expenses, it takes about \$1,600 US to build one meter of footbridge (this cost does not differentiate suspended and suspension bridges though). This cost per meter was computed by taking all the company expenses of the year 2022 and then dividing the total by the number of meters of both suspended and suspension footbridges that have been built over the same period.



Fig 1 – Suspended footbridge

2.2.2. Suspension footbridges

Suspension footbridges are technically more difficult to build and therefore require more time and money. It takes about 6 weeks to build a suspension bridge and the most recent one that the company has built (Nkoilale) costs \$32,465.03 US for a 40-meter span. This is about \$6,000 US more than the most recent suspended footbridge but with a 5-meter shorter span. The differentiation is thus important as the type of footbridge impacts the cost of each project, hence its return on investment.



Fig 2 – Suspension footbridge

2.3. Operations

To fund its bridges, BtGA relies on donations and partnerships which is one of the core values of Bridging the Gap Africa. To build a bridge, the organization expects that the benefiting community provide assistance and ability to participate in the construction of the bridge. These communities help to gather materials like sand and gravel and provide labor during the time of construction to dig foundations and pour the concrete for example. In

exchange, workers receive a wage, and each community takes ownership of the footbridge once completed. BtGA will still take care of the maintenance though. BtGA also strives to develop partnerships with other organizations, like Great Plains Conservation (a safari company who has provided fundings for several bridges), and local authorities.

The company source hardware in local shops in Kitale, except for the steel cables that have been donated by Mammoet. Standards in bigger infrastructure projects are obviously more constraining, therefore the steel cables need to be changed after a certain period. However, they remain way above the quality standards required for the footbridges that BtGA builds so it is a good way to reuse materials.

Together with Bridge to Prosperity (hereafter referred to as B2P)¹, Helvetas and Engineers in Action, Bridging the Gap Africa is trying to solve the issue of impassable rivers in different countries of the African continent. These are the only non-profit organizations operating in this industry that I have knowledge of.

¹ Bridges to Prosperity is a major player of the footbridges sector in developing countries. B2P has constructed more than 350 footbridges in 20 countries (Mortenson Centre in Global Engineering & Resilience, 2022, para.2).

Chapter 3. Literature review

Limited research has been conducted to measure the impact of rural infrastructure, particularly for footbridges. This is mainly due to the low number of actors present in this industry. The first public impact study on rural footbridges has been conducted by Brooks and Donovan, who partnered with Bridges to Prosperity to conduct research in Nicaragua in 15 villages from 2014 to 2016. B2P, Brook and Donovan then partnered a second time with 5 other researchers to conduct similar research in Rwanda from 2019 to 2020 at 12 footbridge sites and 12 comparison sites. BtGA also conducted research at one of its sites in 2019. However, this research was on a smaller scale, with 10 participants interviewed for each topic. This is another reason why BtGA was interested in conducting a more comprehensive study.

3.1. Economic impacts of footbridges

First, among the villages surveyed in Nicaragua, Brooks and Donovan (2020, p.2) found that the “average wage income is 30 percent higher in villages with a bridge than in those without”. They also noticed that floods decrease labor market earnings by 18 percent in the absence of a bridge, and that “the propensity to earn no labour market income increases by 7 percent” (Brooks and Donovan, 2020, p.14). Both these negative effects are eliminated by the presence of a bridge as it removes the uncertainty to access labor market. Furthermore, their participants were not able to compensate these losses by increasing their incomes once the river was again passable (Brooks and Donovan, 2020, p.15).

In addition, they discovered that the labor market income is also higher during dry season once a bridge has been constructed. This is explained by an increase in wages and employment. The bridges have led men to switch to jobs outside their village and increased the employment rate of women. As a result, wages within their village have converged towards the external market standard (Brooks and Donovan, 2020, pp.16-17). “The income gains, therefore, extend beyond just flooding periods. The bridges both smooth income during flood shocks, but also increases the average income level of households” (Brooks and Donovan, 2020, p.16).

In Rwanda, the researchers also observed that the labor market income increased, by a factor of 25% this time. (Thomas et al., 2021, p.1). “This comes from changes both inside and outside the village, where household earnings increase by 48 and 21% respectively” (Thomas et al., 2021, p.7). It was interesting to learn that the outside market had an 11% higher daily wage at baseline. “Thus, simply allowing households to more easily access higher paying jobs will increase earnings” (Thomas et al., 2021, p.7). Likewise in Nicaragua, the average wage outside

the village did not change but the inside wage once again rose in response to the bridge construction.

In addition, they noticed a shift in the distribution of their harvest. Participants increased the proportion of their maize harvested sold to the market by 55%, “though off an extremely low baseline of 3%” (Thomas et al., 2021, p.8). A drop of the proportion of maize and beans stored was also observed in Nicaragua (Brooks and Donovan, 2020, p.25), which supports footbridges’ role in smoothing consumption and revenues. Hence, locals do not need to store as much food as before since they can always access the market. The bridges therefore allow these communities to stop making decisions based on risk.

The researchers also brought nuance regarding the impact of the distance between the bridge and the households. “Households can be physically close to bridge sites, but access may still require crossing difficult terrain. Alternatively, households physically far away from a site may have access to roads that facilitate bridge access” (Thomas et al., 2021, p.9).

In Kenya, the respondents explained that Peace Bridge has provided “new access to markets and economic opportunities” (Bowser et al., 2019, p.14). Furthermore, before the bridge, the alternative to reach markets located across the river was a dangerous inner tube ferry that costs 700 KES, “twice the amount of a Kenyan daily minimum wage of 350 kshs in rural agricultural areas” (Bowser et al., 2019, p.17).

Lastly, Brooks and Donovan calculated the cost-effectiveness of B2P's bridges using the income data collected. On average, footbridges brought in an additional \$5,496.44 US² per year to the entire village while each bridge costs around \$40,000 US and is designed to last 40 years. They therefore computed an internal rate of return of 13.67% (Brooks and Donovan, 2020, pp.29-30).

3.2. Social impacts of footbridges

This part of footbridges impacts particularly needs further investigation. On the one hand, no social impacts were assessed in the Nicaragua research and no significant impacts on education or health outcomes were identified in Rwanda. Indeed, these two research projects focused more on the economic aspect. And on the other hand, the previous research completed

² Computed by means of the exchange rate between the Nicaraguan Córdoba and the US dollar at the time of the research. The value would be lower nowadays due to the devaluation of the Nicaraguan Córdoba (Xe, July 4, 2023)

by BtGA did talk more about the social impacts of the footbridges but as this study has a small sample, it cannot alone prove the positive impact of footbridges on social aspects of life.

At Peace Bridge, the researchers noted several non-economic impacts. This footbridge improved access to education, healthcare, and religious facilities. For instance, Dr. Libulele explained that the average distance travelled by his patients used to be 10 km and is now reduced to 1.5 km thanks to the bridge (Bowser et al., 2019, p.10) and one of the local primary schools, Mfunje A.D.C, has reported an increase of the pupils coming from the other side of the river since the construction of the bridge (Bowser et al., 2019, p.6).

Moreover, “the bridge has encouraged both communities to share their cultures with each other” (Bowser et al., 2019, p.6) which was a very positive outcome since there was some tensions between the communities living on each side of the river due to political opinions. Footbridges are certainly an instrument of socialization as “all households interviewed for this report stated in unison that Peace Bridge has allowed them to visit their families more often” (Bowser et al., 2019, p.12).

But more importantly, 6 out of the 10 households surveyed had lost a relative in river drowning in the past. This risk has now been removed by the construction of Peace Bridge. “Both communities agree that cases of drowning due to crossing the river have been eliminated as a result of the safe crossings enabled by this bridge” (Bowser et al., 2019, p.13).

Other studies demonstrate that improved access can increase school attendance and health outcomes, but it did not focus on footbridges. A study in rural India found that improving the access to school with all-weather roads that can withstand monsoons resulted in a 22% increase in school enrollment (Mukherjee, 2012, p.17) and another research, also conducted in India, showed that the construction of new roads shifted the education from within the village to outside schools (Kumar, & Antahal, 2021, p.108).

Better transport infrastructure has also generally been found to improve access to healthcare for poor households by reducing the cost and time taken to reach care (Brenneman & Kerf, 2002, p.84).

In the case of health care, there is a clear association between levels of infant and child mortality and distance to health services. In a study from Cebu, the Philippines (Wagstaff, 2000), proximity to a public hospital emerged as significant explanatory variable. The elasticities indicated that a ten per cent increase in distance is associated with a two per cent increase in all three mortality rates. (Booth, Hanmer, & Lovell, 2000, p.39)

Research in South Africa explored the challenges to access healthcare, and it turned out that the rural population had to travel furthest to reach a health center.

Approximately one third of Africans in rural areas (24.1% of reported cases) are more than one hour travelling time from the closest health care facility. (...). 70.3% of Africans (73.8% in rural areas) reported waiting one hour or more to see a health provider. 48.2% waited more than two hours and 17.7% waited four to five hours. (Ross, Matzopoulos, & Phillips, 1997, p.10)

Moreover, 50% of these respondents reported that their appointment lasted no more than 5 minutes. For 73.8% of them, the cost of the service was the major barrier to healthcare, but another 11.5% reported that their biggest issue was the unavailability or high cost of transport. Indeed, more than a third of them (37.4%) had to walk to the health center while 55.5% of rural individuals relied on public transport (Ross, Matzopoulos, & Phillips, 1997, p.10).

3.3. Environmental impacts of footbridges

Footbridges can also have a significant impact on ecology, by mitigating the climate change negative impact and reducing CO₂ emissions. This is detailed by Davis who explains that the communities that benefit from B2P footbridges are very vulnerable to the climate change because they rely mostly on agriculture to earn a living, but in the meantime, they are also those that “contribute least to the cause of that change” (Davis, 2020, p.2).

There is an immediate need to create resiliency in communities experiencing the brunt of the negative consequences of climate change (...) trailbridges have the power to build transformational resiliency for isolated communities impacted by extreme weather events, while also playing a key role in a climate change prevention strategy. (Davis, 2020, p.2)

Footbridges mitigate one of the climate change negative impacts on these communities, namely isolation. As extreme weather events become more frequent with climate change and seasons become less marked, agricultural revenues become less certain because access to markets is not guaranteed and floods and landslides might destroy the crop (this will be outlined in section 5.3.1.). Hence, as seen in Subchapter 3.1., footbridges mitigate that risk by providing continuous access to markets and alternatives jobs (in the case a farmer lost his crops) on the one hand, and by linking relatives with one another on the other hand. Indeed, a study in South Africa showed that social networks are key to adapt to the challenges created by extreme weather events (Davis, 2020, p.6).

Footbridges also contribute to reducing CO₂ emissions. In the absence of safe crossings solution, communities around the world are forced to travel long distances to reach essential services, which takes several hours of their days when covered by foot. Therefore, by reducing the distance to be covered, footbridges “mitigate future emissions that would result from a transition to vehicular mobility” (Davis, 2020, p.4).

Based on the situation of Rwandese communities, Davis estimated that in the long-term, around 2,100 tons of CO₂ are saved annually when a community remains in a pedestrian lifestyle (Davis, 2020, p.4). Footbridges are therefore a sustainable solution for these communities to improve their quality of life “outside of the seemingly inevitable shift from a walking society to one that is reliant on combustible fuels” (Davis, 2020, p.4).

But the positive environmental impact of footbridges extends also to the way they are designed. Both B2P and BtGA build their bridges at crossings points already used by the locals. Therefore, excavations and construction do not disrupt previously undisturbed land. Moreover, neither organization alters the course of the river or resorts to mid-span piers. The riverbed is thus not altered, and aquatic species are not affected by the bridge construction (Davis, 2020, p.5).

As outlined in Chapter 2, BtGA reuses cables that cannot remain on larger infrastructure and source its hardware locally. This is something other organizations like B2P also do. Davis (2020, p.5) explains that “repurposing these materials not only displaces production of new cable and pipe products (which require significant inputs of energy and raw materials) but also diverts the waste products from recycling plants and landfills” (Davis, 2020, p.5). Indeed, even though recycling is one solution to mitigate climate change, it still generates CO₂ emissions to process the materials. Hence, a typical 60 meters span B2P footbridge saves approximately 4.2 tons of CO₂ by avoiding the recycling of steel cables. B2P bridges save even more CO₂ than BtGA because the organization also reuses steel pipes (Davis, 2020, p.5). Their footbridges actually won prizes like the Ashden Sustainable Transport honor and Keeling Curve Prize (Davis, 2020, p.10).

3.4. Footbridges traffic and geographical coverage

In addition to Thomas et al.’s research in Rwanda, another team was counting the traffic on 4 bridges. The results ranged from 23 to 1138 crossings per day, while the daily average was 85 at the least used site and 478 at the most utilized. The also noticed that there is “no apparent correlation between daily or total weekly rainfall and bridge use, potentially indicating that

transportation behaviors, after a bridge is installed, are no longer impacted by rainfall conditions” (Thomas, Gerster, Mugabo, Jean, & Oates, 2020, para.1). In terms of crossing habits, a higher number of users were registered in the late afternoons, on market days and on Sunday (church day).

The situation is similar at Peace Bridge, where Bowser, Bowser, Soita, and Chepsire recorded an average of 483 crossings per day during the 30 days of the study (Bowser et al., 2019, p.4).

Another study investigated the scale of the geographical reach of footbridges. To do so, they selected 6 bridge sites in Rwanda to measure what they call the “population catchment” of footbridges, the total area served (Noriega, Bagwiza, & Bang, 2020, para.6). They found that on average, each bridge is used by individuals coming from 33 different villages “covering 19 square kilometers of mountainous terrain, or roughly five and a half times the size of New York’s Central Park” (Noriega, Bagwiza, & Bang, 2020, para.7). Moreover, almost every bridge helps individuals that live more than 20 kilometers away from it (Noriega, Bagwiza, & Bang, 2020, para.10).

When adjusted to reflect only journeys in service of livelihoods, health, and education (as opposed to social visits, recreation, and worship), the average catchment area for a bridge was 17 villages, or 10 square kilometers. That means to meet basic needs, members of rural communities are traveling incredible distances. (Noriega, Bagwiza, & Bang, 2020, para.8)

The results are coherent with the economic impacts found in Nicaragua and Rwanda as 47% of their respondents interrogated while crossing the bridge explained that they were doing so for livelihood reasons (Noriega, Bagwiza, & Bang, 2020, para.12)

3.5. Literature review summary

As highlighted in this chapter, footbridges like those of BtGA serve hundreds of people daily, some coming from kilometers away. Footbridges can have a tremendous impact on economic activities and the environment. They are also expected to have a significant social impact, but further investigation is needed in this area.

Apart from these studies, B2P has started new research in 2020 that will last 4 years and collect data at 200 sites in Rwanda. Baseline results of this large-scale research have been shared and more than 50% of the households surveyed said that they have to cross the river to

access markets, hospital and banks. In the meantime, 25.8% of the households that cultivate crops need to cross the river to access their farmlands. Furthermore, “of the households that reported crop cultivation, 32.5 % reported taking the crops to outside markets to sell them. Of the 32.5 %, 68.7 % reported crossing rivers to get to the markets where they most commonly sell their produce” (Macharia, 2022, p.9). The bridges also connect about 1/3 of the households to school and primary jobs.

Chapter 4. Methodology

In this chapter, I detail the research process and the method used to collect and analyze the data. The whole project took about 4 months and the final report reviewed by Ms. Ndonga was sent to the management on June 12, 2023.

4.1. History of the project

In order to conduct this research, two bridge sites were selected in West Pokot County (Kenya): Tamkal Bridge and Sisit Bridge. Bridging the Gap Africa had built those two bridges in November 2020 in response to the dramatic floods that Kenya faced in 2019, especially in West Pokot (PR Newswire, 2019). Their selection was motivated by their relatively recent installation and by the construction of Kesoien Bridge in the same region, which simplifies the logistics of the research and reduces the costs. As BtGA team camped on site during the construction, it was easy for me to stay with them to conduct the research. We thus recruited researchers and monitored the work they carried out without increasing our expenses too much. In addition, the large majority of BtGA bridges are built either in West Pokot or Narok Counties, so these two bridges are a good representation of the others. I therefore had the privilege to stay among rural isolated communities in West Pokot for three weeks.

We arrived in West Pokot on January 31st, 2023, and first looked to hire 2 researchers at each site to collect the data for us because of the language barrier. One would be in charge of counting manually the crossings on the bridge, while the other would meet residents in their house to ask them questions about the impact of the bridge on their life.

Ms. Ndonga was the project manager. She initiated the research in West Pokot on February 12, 2023, by briefing the 4 researchers that had been recruited within the local community by Mr. Reese's local contact. Ms. Ndonga also designed all the data collection materials, hence the tally sheets and questionnaire. She did so based on BtGA experience, previous research that have been outlined in Chapter 3, and in accordance with the research objectives. From that moment, I was in charge of taking care of the completion of the research. I oversaw the data collection by meeting the researchers at least once a week. I could therefore ask them any question regarding the responses gathered as the cultural differences made it difficult for me to understand all the elements that play in this part of the world. Once the data was verified and cleaned, I encoded it on my computer to analyze it. During that time, BtGA team was overseeing the process by asking me regular updates and I could always count on their expertise and availability whenever I needed explanation or support.

The language barrier has been a bit of a challenge within our team as one of the researchers did not speak English well enough to efficiently fill in the questionnaires. We did not notice it during the briefing and one-day trial that preceded the beginning of the data collection but could correct this after a few days by swapping the two researchers. There is indeed no need for language skills to count the bridge traffic. There was also sometimes some misunderstanding with the answers that the researchers had written, due to cultural differences and typo mistakes. However, as I was meeting with the researchers at least once a week to check the questionnaires and tally sheets with them, I could always ask for explanation. Therefore, the data collection went well and ended on March 9th for the household survey and on March 17th for the manual counting of bridge traffic.

4.2. Theoretical framework of the research

The object of our research is confirmatory, as we seek to confirm and quantify the impacts of footbridges on neighboring communities of West Pokot County. To do so, we asked respondents to compare their situation before and after the construction of the footbridge. We could have opted for an explicative research method since previous work has already provided insights on the impacts of footbridges. However, we preferred to work on the assumption that these impacts could vary according to the geographical position of footbridges and the local culture. We also chose to use an open-ended questionnaire to ensure that we did not miss any potential impacts of BtGA footbridges.

Our approach follows a deductive process. Our rule, based on BtGA experience and the literature, is that footbridges prevent drownings, improve access to health care and education, and enhance economic opportunities among other positive impacts. A broader way of formulating this hypothesis is that footbridges are a worthwhile investment given their impact on people's lives. The cause is obviously the construction of an all-weather crossing solution that removes the obstacle posed by rivers during the rainy season. We are therefore looking to quantify the effect of the footbridges on various areas of life but are also keen to discover new impacts. The empirical observations gathered in West Pokot will allow us to support or refute our hypothesis.

4.3. Data collection

The research setting took place at two bridge sites and consists of all individuals residing within all communities accessing these footbridges. Tamkal Bridge is a 40-meter suspension

bridge designed for pedestrians, constructed across the Wei-Wei River and Sisit Bridge is a 53-meter suspended bridge also designed for pedestrians and built across the Wei-Wei River.

The data collection has been conducted in two methods:

- Observation method (non-participant): the researcher conducts a hand count from the side-line. They stay at one end of the bridge to observe and record the number of people crossing the bridge to either side of the river on a tally sheet provided by BtGA.
- The interviewer asks a series of questions addressing different aspects of the social and economic impact provided by the bridges since the initial day of use. A paper questionnaire provided by BtGA is used to ask these questions and record the answers.

Hence, at each site, one researcher counts the crossings manually while a second researcher goes from one household to another to ask questions to the local population. We therefore use a mix of quantitative, categorial and qualitative data. In total, we registered the traffic on these two bridges for 30 continuous days and collected 225 questionnaires.

4.3.1. Bridge traffic

We recorded the traffic on the two footbridges for 30 continuous days. This took place in Sisit from February 15th to March 16th, 2023, and from February 15th to March 17th, 2023, in Tamkal because we missed one day on February 22nd due to some misunderstanding with the researchers. The tally started at 7:00am and ended at 6:00pm. It is divided into 3 segments: morning (7:00am - 12:00am), midday (1:00pm - 3:00pm) & evening (4:00pm - 6:00pm). We also asked our researchers to specify if it was a man, a woman or a child that was crossing the footbridge. A template of the tally sheet used to collect the data can be found in Appendix 23 (not on this document).

The choice for 30 days is arbitrary, but it is coherent with previous studies and allows us to gather a full month of observation. We therefore have at least 4 observations for each day of the week.

4.3.2. Household survey

4.3.2.1. Sampling methodology

At each site, the participants were selected from both sides of the river from random encounters and knocking on doors until a minimum of 110 people in each setting was obtained.

This is because we decided to use a simple random sampling method. “Because it uses randomization, any research performed on this sample should have high internal and external validity and be at a lower risk for research biases” (Thomas, 2023). Therefore, with a sample of 220 respondents, we can achieve a 92% confidence level with an error margin of 6%. This is the formula we used to compute our targeted sample size:

$$\text{Necessary Sample Size} = \frac{(\text{Z-score})^2 \times \text{StdDev} \times (1 - \text{StdDev})}{(\text{margin of error})^2}$$

Fig 3 – Sample size formula (Qualtrics, 2023)

First, we computed the Z-score corresponding to a 92% confidence level, which is 1.75 (Qualtrics, 2022). Then we selected an error margin of 6%. Standards in research field are to use a 95% confidence interval and a 5% margin of error, but this would have required us to survey 385 households which was out of our research budget. Therefore, we slightly lowered the standards. Lastly, we set a standard deviation of 0.5 because we did not conduct a preliminary survey that would have allowed us to define it. 0.5 is thus a recommended value that will “help make sure your sample size is large enough” (Qualtrics, 2023).

Our formula thus become:

$$\frac{(1.75^2) * (0.5) * (1 - 0.5)}{(0.06^2)} = 212.67$$

We then decided to round the sample to 220 to have a little margin for precaution. It was thus expected that obtaining a minimum of 110 people from each village would result in a good cross-section of subjects in terms of gender, age, and residential setting. The guidelines of our researchers were to survey only one member per household, not younger than 8 years old and possibly as many men than women. We also asked them to survey people that live within a radius of 5 km away from the bridge to first survey the communities that did ask BtGA for the construction of Tamkal and Sisit bridges.

4.3.2.2. Sample achieved

We collected data for 22 consecutive days from February 15th to March 9th, 2023. In Tamkal, 41 questionnaires were completed by Samson Rotich and 71 by Robinson Toroitich for a total of 110 households surveyed. In the meantime, 68 questionnaires were completed by Abraham Maitelle and 47 by Noah Pogisho in Sisit, for a total of 115 households surveyed.

The majority of Tamkal respondents are men (69.1%), and the average age of the sample is 44 years old, ranging from 19 to 102 years old. As the respondents were chosen randomly, the representation of the different age categories and genders is unequal.

If you look at Fig 4, the first thing that stands out is that women are underrepresented, as they account for only 30.9% of our participants. We do not consider this as a sampling bias though because this is due to cultural practices. In West Pokot, men are considered the head of the household. They feel therefore obliged to be the one interviewed.

No children (8-15 yrs.) were interviewed. It was indeed difficult to interrogate them because they were mostly in school during the day while our researchers were working.

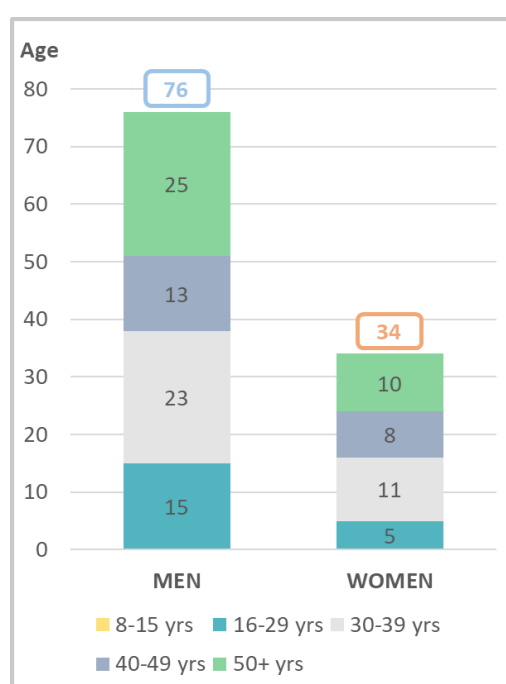


Fig 4 – Number of men and women by age category surveyed in Tamkal

Otherwise, the repartition of the other age categories is more satisfying for both genders, but still unequal. There is indeed a bigger proportion of the “30-39 yrs.” and “50+ yrs.” categories compared to the “16-29 yrs.” and “40-49 yrs.” ones (see Appendix 3).

The sampling in Sisit is not very different from Tamkal. We gathered 5 more questionnaires for a total of 115 households surveyed. Most respondents are once again men, and the average age is 40 years old, ranging from 11 to 73 years old.

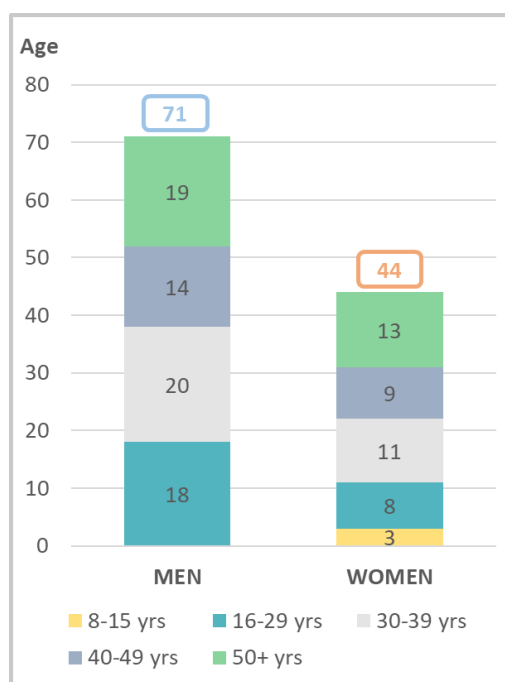


Fig 5 – Number of men and women by age category surveyed in Sisit

Here also, women are underrepresented (38.3%) for the same reasons as in Tamkal. The researchers also faced difficulties interviewing children but still managed to interview 3 of them.

Similarly, the age groups “30-39 yrs.” and “50+ yrs.” are more represented but the difference is less pronounced than in Tamkal. As displayed in Appendix 3, these categories range between 25% and 30% while the categories “16-29 yrs.” and “40-49 yrs.” range from 18% to 25%.

Nevertheless, the wide range of age among the participants for both bridges is very positive, as it allowed us to gather a wide variety of points of view.

According to a census made by the county in 2019 (City Population, 2019), there are currently more than 600,000 people living in West Pokot with an almost equal number of men and women. 94.9% of them are rural and more than half of the population is aged under 15. It is a population that lives in difficult conditions. In 2016, 57.3% of them were living below the poverty line and in 2006, it was estimated that 60.4% of the population had fever or malaria. Furthermore, the infant mortality rate was 8.1% in 2009 (Knoema, n.d.).

Thus, compared to the demographic data of West Pokot County, our sample is not an exact representation of the population, especially regarding the under 15 years old category. However, this is not considered as a sample bias for our research for two reasons. First, children were considered to be less able to provide relevant answers to the whole questionnaire since some questions are more directed at their parents, like the economic impact of the bridge for

instance. Second, the questions of the questionnaire relate to the whole household instead of the participant himself. Thus, the profile of the respondent has less impact on the relevancy of our sample. By interrogating the father of a family, we also gathered information on his wife and all his children.

The average size of the households of our participants is 7 in Tamkal and 6 in Sisit. It ranges between 1 and 17, which is quite wide. However, 57.4% of our sample falls between 5 and 8 people per house in Tamkal and 59.1% falls between 4 and 7 people per house in Sisit. As expected, the average household size increases with the age of participants in both bridge areas, suggesting that most of the household members are children. Given the number of people in each household surveyed, we have actually gathered data on 782 residents in Tamkal and 722 in Sisit, as shown on Appendix 4.

4.3.2.3. Interview methodology

The questionnaire first asks for demographic information to help us better understand who is answering our questionnaire and who is the population that benefits from BtGA bridges. Then it focuses on the river and flash floods past impact to understand the challenges that the local population is dealing with. Finally, we ask specific questions to enquire how the footbridges have impacted their life. These questions cover topics such as education, healthcare, and economic impacts. There is also one extra question to gather any additional information that participants would wish to tell us.

We specified to our researchers to fill in the questionnaires themselves due to the language barrier. Some participants spoke English well enough, but others needed them to translate the questions in their local language. In this case, our researchers translated their answers in English when writing it on the questionnaire. A template of the questionnaire used to collect the data can be found in Appendix 24 (not on this document).

4.4. Data analysis

The data collected from the bridges traffic has been analyzed using univariate, bivariate and cross tabulation statistical computations.

For the questionnaires, very few outliers were removed during the data cleansing process as almost no answers were proven to be an error. Moreover, when a doubt on the reliability of a questionnaire was questioned, I simply discarded it. This is why we have a difference of 5 questionnaires between Tamkal and Sisit.

To analyze the questions with quantitative data, I also applied univariate, bivariate, and cross tabulation statistical computations and for the qualitative answers, I applied text analysis methods. I first grouped the answers in thematic to then draw statistic from it and used the responses to explain the phenomenon and challenges observed. Some information was just mentioned by one or two respondents, so I either mention it briefly in this thesis if relevant and otherwise leave it aside.

Chapter 5. Research outcomes

In this chapter, I first provide insights on the lifestyle of the participants surveyed in Subchapter 5.1. because it is necessary to first understand who the beneficiaries of BtGA footbridges are, and what are their living conditions, to then assess the extent of the impact of BtGA footbridges better. Then in Subchapter 5.2., I present the results of the bridge traffic analysis, first for Tamkal and then for Sisit, and describe bridge utilization habits. After what, I compute the price by utilization ratio for these two bridges. I then summarize the past challenges that people have been facing in terms of properties losses and present the economic and social impacts of Tamkal and Sisit footbridges in Subchapter 5.3.

5.1. Rural Pokot lifestyle

5.1.1. Professional occupation

As seen on Fig 6, most of the people surveyed among the working population (16 yrs. to retirement) are self-employed. Among the participants that have a job in Tamkal, 50.0% are farmers and 15.0% are teachers. It is even 78.0% of farmers in Sisit, but 3.0% of teachers. These are the 2 most common professions.

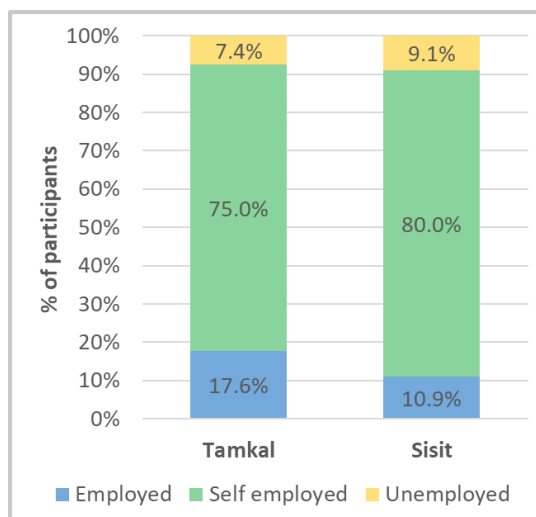


Fig 6 – Employment status of our participants

Our researchers managed to survey a wide variety of job as they also interviewed a Member of the County Assembly, a police officer, a doctor, a barber, and many others (see Appendix 5). Besides, two participants in each site are retired and the 3 girls surveyed in Sisit that are under 15 years old are still going to school.

Even though not all respondents are farmers, 91.8% of them have at least one family member (often themselves) that is involved in trades in Tamkal local market. In Sisit, it is 98.5% on the right bank. Unfortunately, there has been a misunderstanding with one of the researchers, so we do not have accurate data on this specific point for the left side of Wei-Wei River in Sisit.

In Sisit, the difficulty of finding work affects mostly the younger generation as the unemployment rate among the “16-29 yrs.” rises to 30.8%. Indeed, 8 of the 10 unemployed respondents are aged 18 to 29 (none is still a student). In Tamkal, the “16-29 yrs.” are also the most impacted (20.0%), with 4 out of 8 unemployed participants being aged 19 to 29. In addition, the unemployment rate of the 40-49 years old is also significant (9.5%) as you can observe in Appendix 6.

The employment rate is also more affecting women than men. As you can see on Appendix 7, the proportion of unemployed respondents is 6.5% higher for women compared to men in Tamkal and 4.9% in Sisit, exceeding 10.0% in both areas. However, this is not very surprising given that the culture in this region is more paternalist.

Besides, there is a slight increase in the men’s proportion among farmers. It increases from 69.4% to 74.0% in Tamkal and 61.7% to 66.7% in Sisit. And since the proportion of working men and women is rather similar to their proportion among the whole sample of both bridges, we also observe a 7.2% increase of women proportion among the non-farmer professions in Sisit to reach 45.5%. However, it increases by only 1.4% in Tamkal (see Appendix 8).

In addition, as displayed in Appendices 9 and 10, the employment status varies with the education level. In both Tamkal and Sisit, the education level of farmers is lower than the average with respectively 80.0% and 85.9% of them who stopped after primary school. Most of the unemployed respondents finished secondary school in Sisit (60.0%), while the others stopped after primary school. In Tamkal, the education level of unemployed respondents is more diverse, but 87.5% of them have stopped after secondary school. Our researchers have also surveyed a large number (20) of people that went to a college or a university for this region. 95.2% of them have other professions than farmer, among which are 13 of the 15 teachers interrogated. Finally, more than 2/3 of the participants that have followed a tertiary degree or higher in Sisit have other professions than farming. The 3 teachers surveyed went all to a college or university. Still, more than 1/3 of the non-farmers have stopped their education in primary school.

5.1.2. Education

Regarding education, you can see in Fig 7 below the education level of our respondents. A large proportion (56.8%) stopped after primary school in Tamkal. This is even greater in Sisit (74.8%), and this can be explained by the larger proportion of farmers there, as they have a lower average level of education than the other respondents. In fact, less than a fifth of our participants have persuaded degrees after secondary school.

In addition, the youngest respondent to have a college or university level degree is 23 years old in Tamkal (3/20 that graduated college or university are 16-29 yrs.) but in Sisit, the youngest is 34 years old. This shows that it is not something as easy to pursue as in western societies.

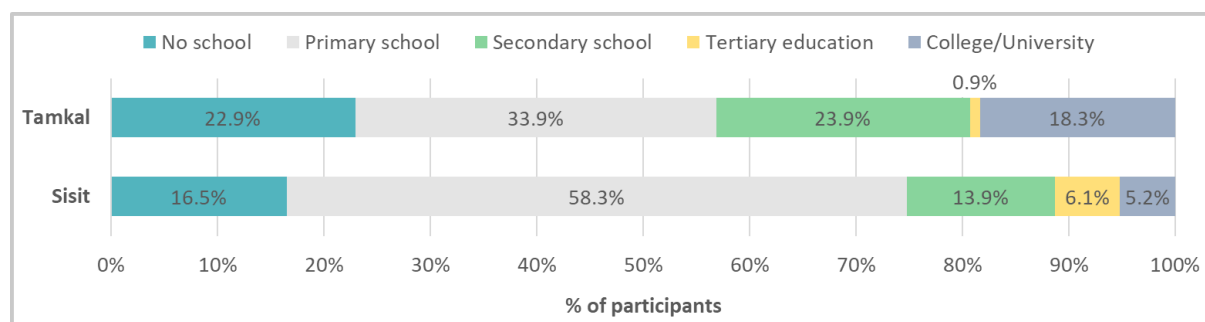


Fig 7 – Education level of our participants

Besides, there are no significant differences of education level between each side of the river in Sisit. At first, I thought this was contradicting the hypothesis that footbridges improve access to education but then I noticed that there are a primary and a secondary school on both sides of the river in Sisit.

Regarding the link between gender and education, the situation is a bit different. In Tamkal, men seem to be more educated, as 80.0% of the people that went to college or university are men. Furthermore, 52.6% of men have graduated in secondary school or above, while it is only 20.6% for women. However, in Sisit, there was more women that went to tertiary level and above (13.6% of women and 9.9% of men) but also more than did not go to school at all (22.7% of women and 12.7% of men). Lastly, both 1/4 of men and women have reached the secondary level or above.

I also observed in both Tamkal and Sisit that the average size of the household decreases as the education level increases (see Appendix 11).

5.1.3. Living standards

To assess the living standards of our participants, we decided to use the SAARF Living Standards Measure (LSM). It has been designed in South Africa and is a segmentation tool that ranks people's living standards on a scale from 1 to 10 based on their ownership of a defined panel of goods.

Both in Tamkal and Sisit, the average living standard is around 3 (2.8 and 3.1 respectively), ranging from 2 to 5, but the mode is 2. More than half (50.9%) of respondents fall into this category in Tamkal and 44.3% in Sisit (see Appendix 12).

From 1 to 4, Ntloedibe and Ngqinani (2020, p.2) explain that it is the people that have the least access to wealth. 96.0% of our participants are therefore at the lowest level of LSM. They live in a small traditional hut or shack and have minimal ownership of durables except cell phones and radios. They do not have flush toilets or a fridge for instance. Besides, only homeless people have an LSM of 1. Having camped in the region for 3 weeks, I was able to take the measure, to some extent, of the challenges that these people face, and indeed realize how little means they have at their disposal. The 9 respondents that rank 5 either employ people in their farm or own rare possessions in this region like a motor vehicle or a TV.

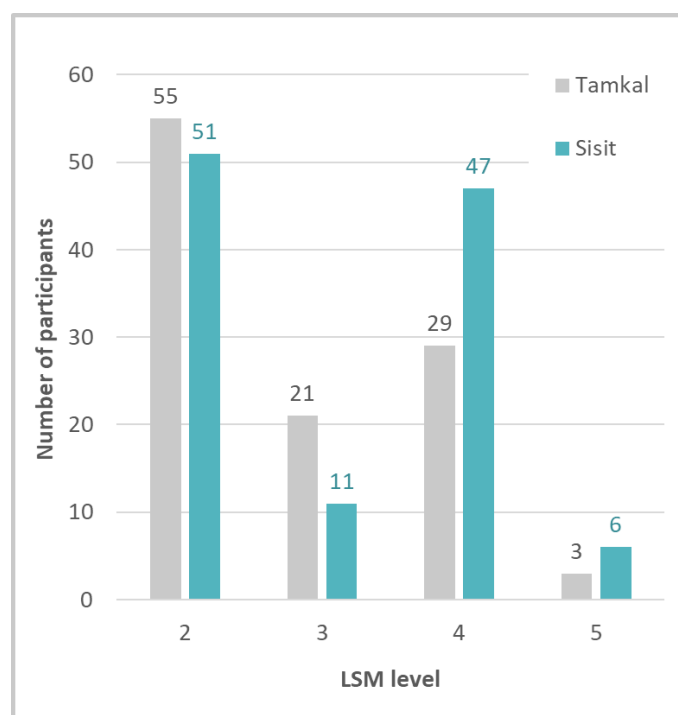


Fig 8 – Living Standard Measure of our participants

In Sisit, the average LSM of older respondents (40+) is higher than the younger ones as shown on Appendix 13. This needs to be taken carefully as it was not observed in Tamkal.

However, there is a clear difference of average living standard between the right (2.4) and left bank (4.0) of Wei-Wei River in Sisit (see Appendix 14). This supports that the access to necessary places like a market, school or health care has a positive impact on people's living standards as this is something that residents living on the left side already had before the construction of the bridge. As Sisit Bridge was built close to 4 years ago, it appears that more time is required to close the living standard gap between each side of the river.

Furthermore, there is a significant positive correlation of 0.34 between the living standards and the education level in Tamkal. This means that the living standard of the household increases moderately with the education level of the respondent. However, there is no significant correlation between these two variables in Sisit, so we need to be careful with these results once again. You can see the outcomes of the statistical tests on Appendix 15.

Lastly, the living standards of our participants in Sisit remain almost the same no matter what their professional occupation, going from 2.9 to 3.1 (2.9 is the average of the unemployed group). In Tamkal, the range is slightly bigger (2.6 to 3.2) and surprisingly, the highest average is among the unemployed people. The lowest, 2.6 is among farmers. But this is not a significant difference as all participants are still around an LSM of 3 which is very low (see Appendix 16). The difference between an LSM of 2 and 3 is mostly a question of how many radios and cell phones they own.

5.2. Footbridges traffic outcomes

5.2.1. Tamkal Bridge traffic

As you can see on Fig 9 below, the daily crossings in Tamkal can vary greatly from one day to another. The observations range from 290 to 1678 and average 890 crossings per day.

A total of 26,693 crossings were registered during the 30 days of tallying. These crossings are distributed as so: 6,120 men with a mean of 204 daily, 7,067 women with a mean of 236 daily and 13,506 children with a mean of 450 daily. There is therefore a greater number of children crossing the bridge as they represent 50.6% of the crossings recorded. This can be explained mostly by the location of the bridge because it ends just next to a primary and a secondary school (see a map of Tamkal area in Appendix 17).

There is also a greater variation of children, with a more than doubled standard deviation compared to men and women. This is explained by a drop on Saturdays when they are going neither to school nor church.

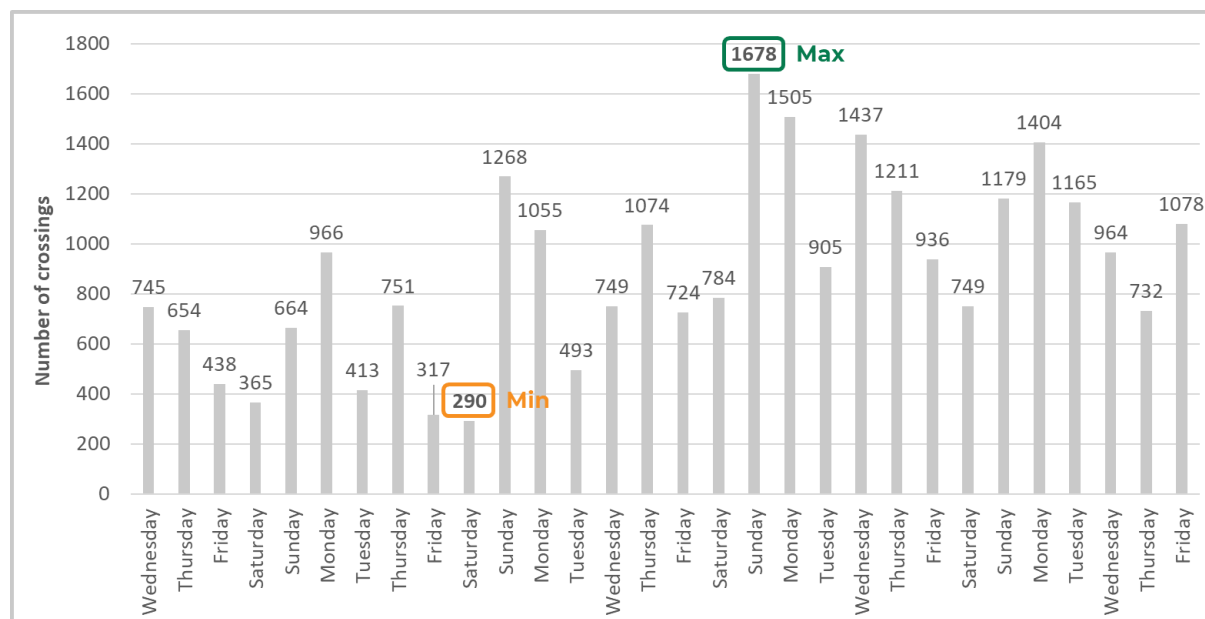


Fig 9 – Tamkal Bridge daily crossings

These figures are satisfying but they underestimate the real number of users. Indeed, the study has been conducted during the dry season, when a shortcut can be taken about 190 meters downstream given the low level of the river at that time. We therefore believe that this path might have been taken more often by adults as it provides a more direct access between the center of Tamkal town and the houses of the residents that live on the other side of the river. This is something I could observe myself, being on site during the research.

Regarding the differences between the different days of the week, Monday was recorded as the busiest day with 1232 crossings on average. This is not a surprising outcome because it is the market day in Tamkal. These higher number of crossings are therefore explained by an increase in crossings of both men and women, +140.7% and +123.1% respectively, compared to the mean of the rest of the week. This far offsets the slight decrease in children's crossings (-20.6%).

Then, Sunday was recorded as the second highest mean of the week, with 1197 crossings. It is explained by an increase in crossings of children (+106.6%), which far offsets the decrease in both men and women crossings (-15.5% & -13.8% respectively). The reason for it is mostly that people go to church. 91.8% of the population in West Pokot is indeed Christian (City Population, 2019).

I also looked for differences between the different periods of the day. On average, there were about 125 less crossings recorded during the middle of the day compared to the morning and evening. This is mostly due to children being at school, but it also decreases for men and women because most people are settled at their working places for the day.

Finally, I looked at the frequency of crossings and, as you can see on Fig 10, we registered at least 600 crossings in a day more than 80% of the time. Moreover, more than 1 day on 3 recorded at least 1000 crossings.

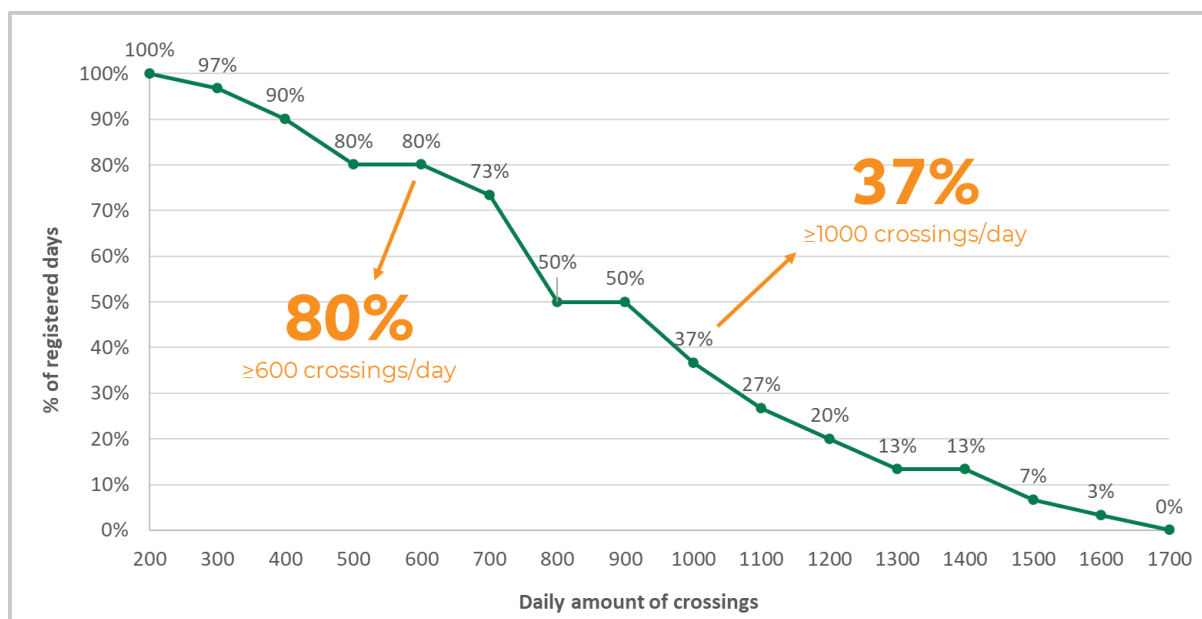


Fig 10 – Tamkal frequency of crossings

5.2.2. Sisit Bridge traffic

The situation in Sisit is quite different. As you can see on Fig 11 below, the daily crossings in Sisit can also vary a lot like in Tamkal. However, the range and maximum are much lower. The observations range from 107 to 312 and average 175 crossings per day.

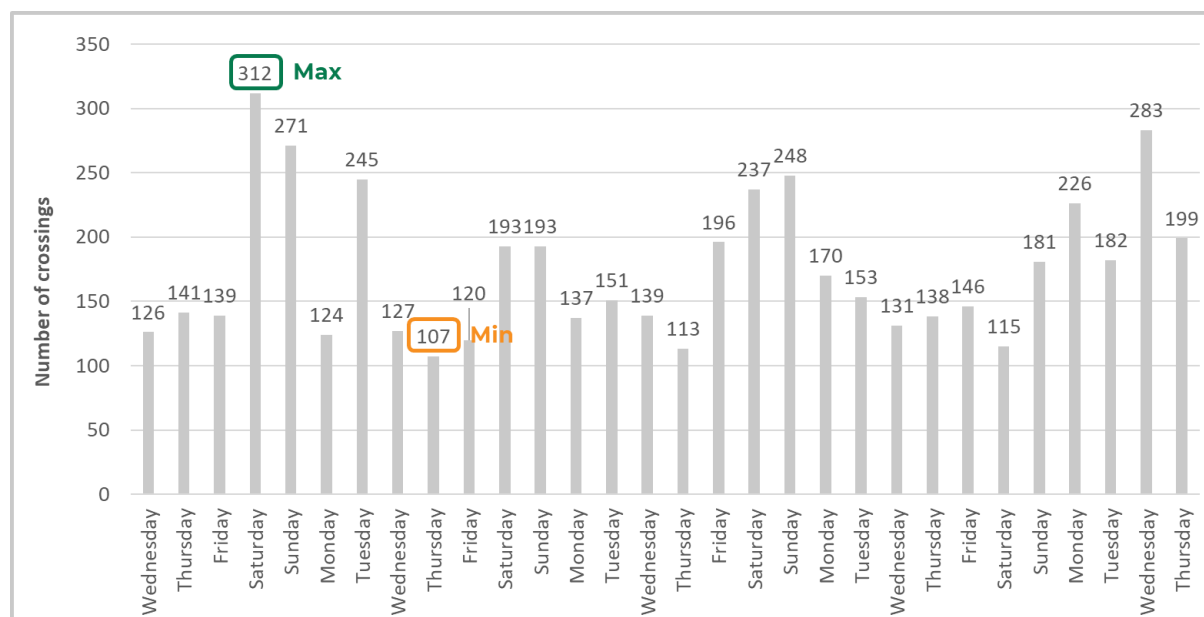


Fig 11 – Sisit Bridge daily crossings

A total of 5,243 crossings were registered during the 30 days of tallying. These crossings are distributed as so: 2,229 men with a mean of 74 daily, 1,082 women with a mean of 36 daily and 1,932 children with a mean of 64 daily. There is therefore a greater number of men crossing the bridge as they represent 42.5% of the crossings recorded. They are followed by children (36.8%) and women (20.6%). Here again, the variation in children crossings is much higher, though I could not find a relevant explanation for it at Sisit.

Sunday registered the highest mean (223) of the week, closely followed by Saturday (214). However, Saturday has a double standard deviation (71.4) compared to Sunday (37.4). I assume that this lower variation of crossings on Sunday is due to the habit of going to church for most people while activities on Saturday might be less repetitive. This increased traffic during the weekend is mostly explained by an increase of children crossings, but the averages for men and women are also higher compared to the rest of the week.

Tuesday, the market day in Sigor, comes in 3rd with 183 crossings on average. Similarly to Tamkal, we registered an increase of men and women on these days, while the number of children using the bridge was lower (-41.3%).

Besides, there are no significative differences in terms of crossings depending on the time of day unlike in Tamkal.

As you can see, Sisit Bridge utilization is significantly lower than what we recorded in Tamkal, and this can be explained by several factors:

- First, on the left bank of the river, people do not need to cross the river to reach Sigor, the nearest town. Therefore, they have uninterrupted access to a bigger market, healthcare, schools, etc. (see a map of Sisit area in Appendix 18).
- Second, some people come back very late from Sigor due to the drought, and thus cross the bridge around 8-9pm. Some even work at night.
- Third, the study has been conducted during the dry season so people could cross at different places. The households in Sisit area are more spread than in Tamkal. Therefore, the bridge is not as central, and people cross at many other points when the river is low. Abraham, one of the researchers, estimates that there will be 4 times more people crossing during the rainy season.

The accuracy of the 2nd and 3rd factors could not be verified, as these insights were provided by the researchers after completion of the research. However, the responses collected from the household survey support the 1st factor.

Indeed, there is a clear difference in the bridge utilization between residents living on the left bank of the river (Sigor side) and those living on the right bank. 64.7% of respondents living on the right bank use the bridge daily while this figure drops to 31.9% for those living on the left bank. Overall, 51.3% of Sisit inhabitants cross the bridge daily while it rises to 79.1% in Tamkal. Several other indicators confirm this analysis, but we will discuss them in Subchapter 5.3.

Lastly, I also looked at the frequency of crossings for Sisit Bridge and, as you can see on Fig 12, we registered at least 150 crossings per day more than half of the time. Moreover, we recorded at least 250 crossings 10% of the time.

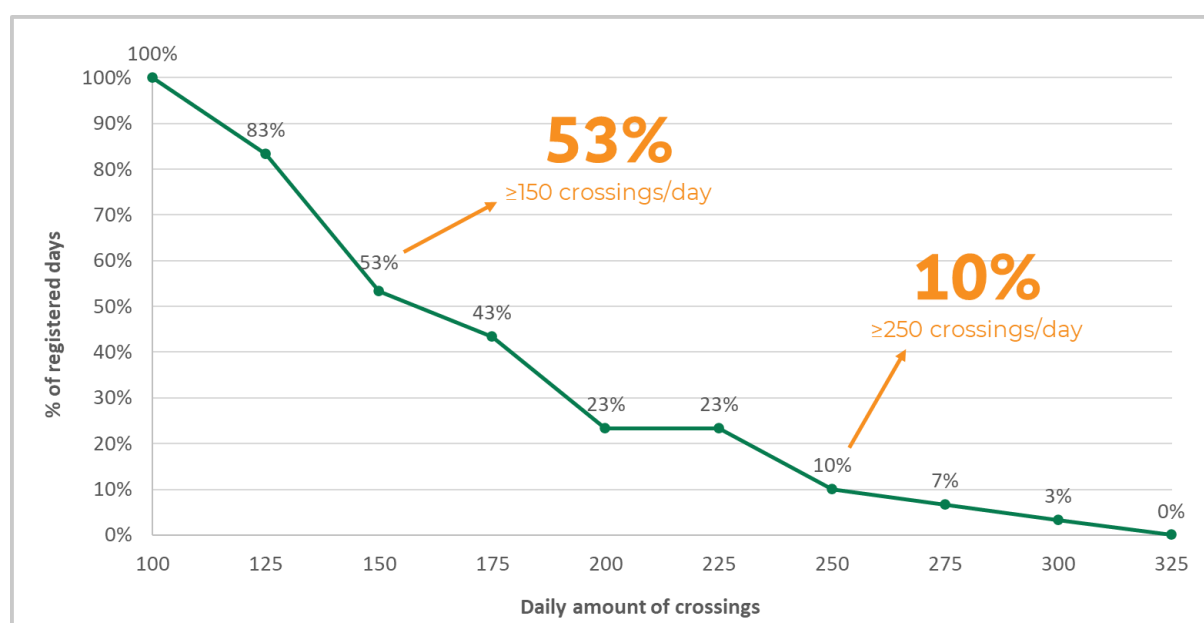


Fig 12 – Sisit frequency of crossings

5.2.3. Footbridges utilization patterns

In Tamkal, more than 3/4 of the population use our bridge daily, and only 2 participants said that they don't. In Sisit, about 1/2 of the residents use the bridge daily and it increases to 64.7% on the right bank of the river (31.9% on the left). In addition, all participants that only use the bridge once or twice a month live on the left side (Sigor side).

Among the school-going children, 92.2% need to cross the bridge to reach their school in Tamkal and 19.6% in Sisit. However, it increases to 28.8% on the right side of the river. Students' bridge use is correlated to the utilization of the respondents. There is indeed a larger proportion of children that cross the bridge to reach school among the group of parents that use the bridge daily.

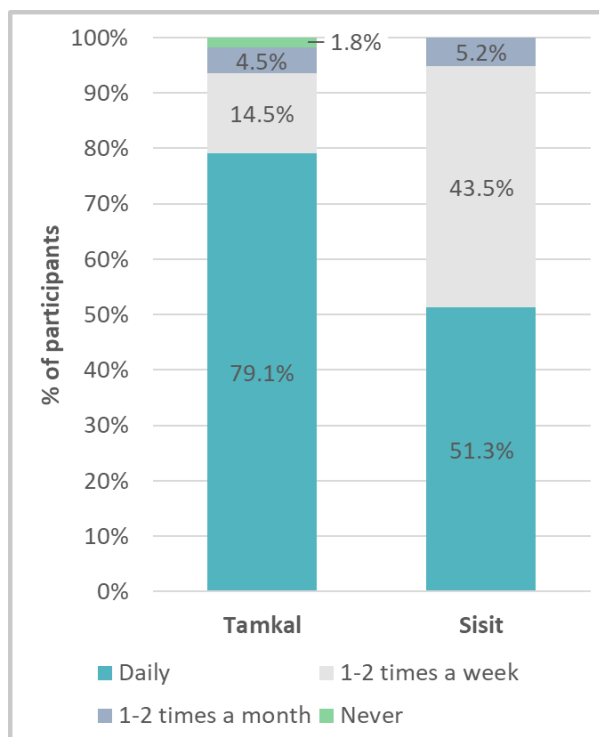


Fig 13 – Frequency of footbridges utilization

At both sites, unemployed members record the most frequent utilization of the bridge (see Appendix 19). This might be because they are looking for small daily jobs. Tamkal farmers are using the bridge less frequently, as 70.0% use it daily and 8.0% monthly. Teachers particularly use it though, as 86.7% of them cross daily. In Sisit, it is rather the opposite. Farmers are using the bridge more than the others as their daily users' average is 14.9% higher. And among the 3 teachers surveyed, only 1 crosses the bridge to reach his school.

Overall, 93.6% of respondents in Tamkal and 94.8% in Sisit use our bridge at least once a week, which is very satisfying.

5.2.4. Price by utilization ratio

In the previous sections 5.2.1. and 5.2.2., I focused on the number of crossings. So, in this section, I will focus on the number of users to better assess the impact of these bridges. I therefore intend to compare the price of the bridge to the number of people it helps.

To estimate the number of users, I decided to take the highest number of crossings recorded in a day because on that day, the probability of having the largest number of distinct users is highest. I did not use the average daily crossings because not everyone uses the bridge daily, as outlined in Section 5.2.3. I then divided this figure by 2 assuming that each user crosses the bridge twice during that day to reach their destination and return home. This introduces an error

margin due to people who may have made fewer or more than 2 trips between tally times. Nevertheless, it is the most accurate assumption to generalize the crossings patterns of these kind of bridges. Since we recorded a maximum of 1,678 crossings in Tamkal and 312 in Sisit, I estimate to have 839 users in Tamkal and 156 in Sisit.

I then compute the cost of these two bridges. In Tamkal, the overall construction cost is 2,322,215 KES and in Sisit 1,480,275 KES. Sisit cost is actually lower than average because most of the bridge components were already available in BtGA's workshop inventory. However, Sisit Bridge is a 53-meter suspended footbridge while Tamkal is a 40-meter suspension footbridge. Therefore, the actual cost of Sisit should not exceed that of Tamkal, despite being 13m longer.

Since the Kenyan Shilling is not a popular currency and most of BtGA donors are from the United States, I find it more appealing to compute the price by utilization ratio in American Dollars. Both bridges were completed on Novembre 8th, 2020 and on that date, 1 KES was equal to \$0.00917876 US (Xe, May 15, 2023). To simplify the computations, I rounded it to the 4th decimal (0.0092). I therefore compute a cost of \$21,364.38 US for Tamkal and \$13,618.53 US for Sisit. The choice to take the date of completion of the bridge is arbitrary because the various expenses are paid throughout the process. But I selected it because it is the last day that payments are made for the project. Besides, the exchange rate did not vary enough during the 3 months that preceded the completion day to impact the ratio by more than a dollar (see Appendices 20 & 21).

However, as outlined in Chapter 2, these costs are incomplete. Thus, by taking BtGA most recent estimation that includes all costs, \$1,600 US per meter of bridge, Tamkal (40m span) would cost \$64,000 US and Sisit (53m span) \$84,800 US.

Table 1 below summarizes the information and the associated price by utilization ratios.

Bridge:	TAMKAL	SISIT
Estimated number of users	839	156
Construction cost in KES	2,322,215 KES	1,480,275 KES
Construction cost in USD	\$21,364.38 US	\$13,618.53 US
Overall cost in USD	\$64,000 US	\$84,800 US
Price/utilization ratio (construction cost)	\$25.46 US	\$87.30 US
Price/utilization ratio (overall cost)	\$76.28 US	\$543.59 US
Yearly price/utilization ratio (construction cost)	\$1.02 US	\$3.49 US
Yearly price/utilization ratio (overall cost)	\$3.05 US	\$21.74 US

Table 1 – Price by utilization ratios

By dividing the cost of the bridges by their number of users, I obtain a ratio of \$25.46 US for Tamkal and \$87.30 US for Sisit. Assuming 25 years of lifespan for these bridges, it means that anybody that gave \$25.46 for Tamkal Bridge at the time of its construction was providing to one person a safe and continuous access to markets, jobs, schools, healthcare centers and relatives for the next 25 years. This means that it only requires a \$1.02 donation to help 1 person for 1 year. For Sisit, it would be \$87.30 for 25 years, and \$3.49 per year.

These ratios are based on incomplete costs and are a bit outdated now due to various time effects like inflation for instance. Thus, if we consider BtGA highest estimate of the costs of these bridges, which are based on 2022 figures, the ratios increase to a \$3.05 yearly donation for Tamkal and a \$21.74 yearly donation for Sisit, which still seems to be a small amount to give regarding the benefits for the local population. Another way of looking at these figures is to say that Bridging the Gap Africa needs less than 10,000 people to make a one-time donation of \$10 US to fund their next bridge.

Either way, these results complement the cost-effectiveness of footbridges calculated by Brooks and Donovan in Nicaragua to demonstrate that these rural infrastructures are a worthwhile investment, both economically (revenue generated by the footbridges calculated in Nicaragua) and socially (number of beneficiaries compared to the cost of the footbridges in West Pokot).

Lastly, as mentioned previously, the research was conducted during the dry season and the tally did not cover the entire day. The ratios therefore underestimate the actual number of users, which is expected to soar in the event of flash floods.

5.3. Household survey outcomes

5.3.1. Flash floods challenges

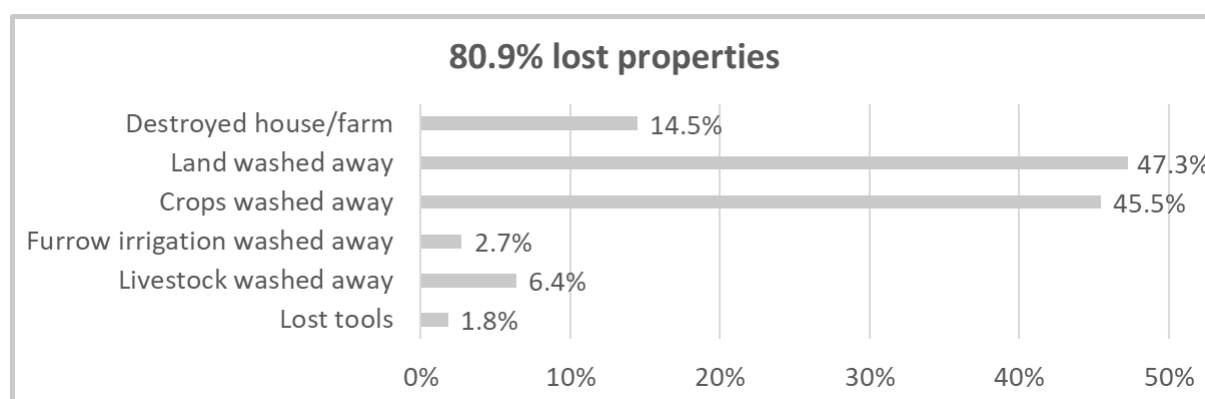


Fig 14 – Properties losses in Tamkal

In Tamkal, 80.9% of respondents lost properties in the past due to flash floods. Fig 14 details the different types of properties destroyed and the proportion of respondents that it has affected. The percentages do not add up to 80.9% since several people endured losses in more than one category.

It is frightening to see more than 1 participants in 10 suffered some damage to their houses and that almost half of them owned crops that have been washed away. These losses are substantial for the local population as it is their main source of revenue.

The answers to this question were a little bit less detailed as the top crops washed away were “trees” (66.0%). Then are mangoes (18.0%), maize (16.0%) and bananas (14.0%) suggesting these are also the most cultivated seeds. The loss of furrow irrigation also affects crop production as some respondents explained that it has slowed down the growth of their plants.

Furthermore, 5 respondents have been forced to move due to their destroyed house, like Kama who explained that they are still living with friends. In addition, 3 respondents specified that they depended on their possessions to earn a living.

Overall, 9.1% explained living in poverty due to their losses.

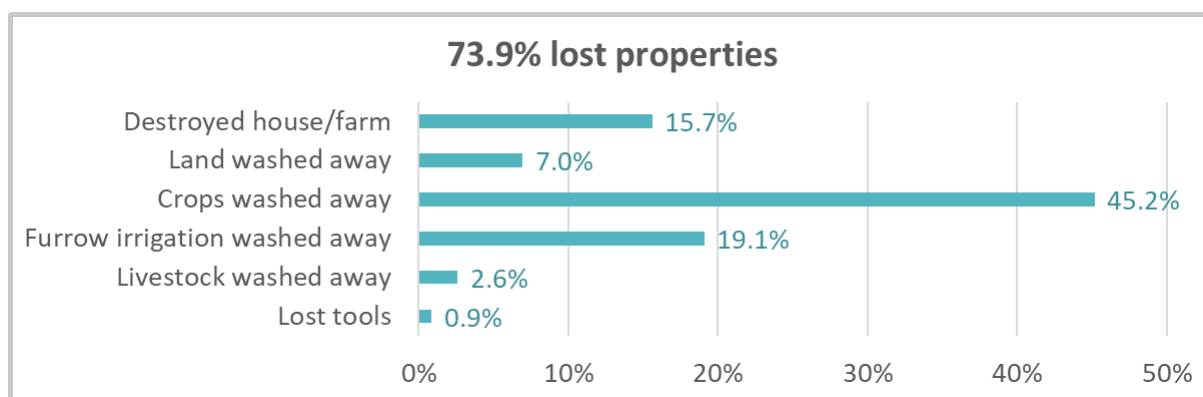


Fig 15 – Properties losses in Sisit

In Sisit, the situation is rather similar to Tamkal. 73.9% of respondents lost properties. Fig 15 details the proportion of respondents affected in each category. Likewise in Tamkal, the percentages do not add up to 73.9% since several people endured losses in more than 1 category.

Here again, around 15% of respondent's house have been damaged by the floods and almost 50% lost crops. The top 3 destroyed crops are mangoes (59.6%), bananas (50.0%) & sugarcane (17.3%), suggesting these are the most cultivated seeds in Sisit. The loss of furrow irrigation has been much more reported than in Tamkal and it also affects the crop production as

sometimes, it has led the crops to wilt. However, many less respondents reported that their land has been washed away than in Tamkal.

Some participants gave us more details on their situation as 17.6% told us that they depended on their possessions to earn a living. Hence, 5.9% had to borrow to sustain their family.

The right bank of Wei-Wei River has been more impacted with 3 times more respondents mentioning the loss of their crops for instance. This is due to the landscape as the river is bordered by a steep hill on its left bank.

Overall, 38.8% consider their life to be hard due to their losses.

5.3.2. Footbridges positive impacts

Alongside the property's losses, many residents have also been impacted in their lifestyle, but footbridges can be of a much bigger help in this case.

5.3.2.1. Improve access to education

In Tamkal, the bridge has resolved the challenge of school accessibility that were facing 92.2% of the 103 respondents that have school going children. 9.7% of them even specified that these absences were frequent. This raised concerns about the school performance of their children for 10.7% of parents surveyed. 5 respondents even explained that their children dropped out of school due to repeated absences. This is the case for Brian (23 years old), who told us: "the river was full of floods, so my children were never going to school." The remaining 7.8% do not need to cross the bridge to go to school, but also reported some school absenteeism due to floods.

Sadly, the problem of absenteeism also impacts the children that are able to go to school. Jonathan explained to us that it was tough for his children not to see their friends regularly, not to mention the anxiety that came with it.

Among the 92 households surveyed in Sisit that have school going children, almost a third (31.5%) said that BtGA bridge has allowed their children to attend school every day. One of our youngest respondents, Linet (11 years old), said "during the rainy season I had the tendency of becoming absent during school-going days." For 55.2% of these households, the river prevented their children from accessing school resulting in absenteeism, while for the other 44.8%, the bridge has increased their revenue and they could therefore eventually pay the

school fees for their children. Joseph (30 years old) explained that “the increased income I make will enable me to pay my children school fees, thus improving the literacy rate in my family.”

Some days, the river was still passable but not everywhere. Therefore, some students had to travel long distance to attend school, which extended the length of the day. As highlighted by Afoakwah and Koomson (2021), this hinders learning consequently. Distance to school is also listed among the top 10 barriers to education around the world (Global Citizen, 2014).

In addition, this repeated absenteeism resulted obviously in lower performances which has been a concern for 1/3 of the households that dealt with school absenteeism.

The more critical issue of school accessibility in Tamkal can once again be explained by Sisit proximity to Sigor. There are indeed more schools in Sisit area compared to Tamkal, increasing the possibilities to educate your children. Likewise, it was not surprising to see that most of school-related issues reported in Sisit came from the right side of Wei-Wei River (90.6%). Even though there are schools on both sides of the river, most families want to send their children to those located on Sigor side because they have a better reputation.

Among the other challenges mentioned, a few respondents explained that their children were sleeping at other people’s houses to foresee eventual floods. 9 respondents also said that their children were taking the risk to cross the river, with the little ones being carried on the back of their parents or siblings. This was mentioned by Kennedy (26 years old): “we used to go with them during the rainy season and we would carry them to cross the river if possible.” Unfortunately, this resulted in losses of school materials or shoes for some of them, like Paul (38 years old): “they faced numerous challenges including failing to attend class due to heavy rainfalls. Some lost their learning materials like books and bags.”

As mentioned previously, BtGA team was building Kesoien Bridge not far from Tamkal above a tributary of Wei-Wei River during the time of the study. This gave Ms. Ndonga and I the opportunity to interview a local teacher and ask him more details about education challenges in rural West Pokot.

60 of his students need to cross the tributary to reach the school and he is therefore also facing absenteeism issues. Parts of his students are leaving during the middle of the day by fear of the rain. Even during the dry season, time of interview, they have only 200 students coming among the 300 registered (1/3 absenteeism). As a result, only 40% of students in his learning institution pursue their education to the last year, the other 60% have dropped of school on the road.

The school fees are 5,000 KES per year (around \$35 US), plus additional expenses such as school supplies. This might not seem a lot for westerners, but the answers gathered are supporting that it is a consequent expense for some families. As outlined by Davis (2020, p4), “the majority of the residents living in the world’s most isolated communities are surviving on less than \$2 USD a day.”

Finally, he explained that children particularly need to sleep in other people’s houses during the examination periods as external examiners are coming. Most of them are comprehensive and will stay overnight if it’s flooded. Still, if you could not attend the examination due to floods, you will have to restart the year.

5.3.2.2. Increase access to healthcare

In Tamkal, 30.0% of respondents have at least once been unable to reach a health care facility during the rainy season. Some therefore used natural medicine and others postponed their care. Todosia (30 years old) could not accept either solution, so he told us: “one time, my child got sick, so I asked a doctor to throw medicine across the river. It was dangerous but we managed to get the dose which helped my child.”

Then, about 1/5 (20.9%) managed to reach the healthcare. Among them, 69.6% took the risk to cross the river which is very challenging as 1/3 needed assistance. The other 30.4% had to travel long distances to reach the facility, which is not a more desirable option when you are sick or injured, especially in a case of emergency. The remaining 49.1% explained that healthcare was difficult to access, as none found it easy before the construction of the bridge, without specifying whether they travelled long distance, crossed the river, or stayed home.

The difficulty to access healthcare in Tamkal sometimes ended tragically. 7.3% of respondent have known someone who died either by lack of care or by crossing the river to reach the healthcare center. Kama (56 years old) was kind enough to share her story with us: “I lost one of my daughters while we were crossing the river to seek for healthcare.” Furthermore, 10.9% of respondents emphasized that it was particularly problematic to give birth for pregnant women, like Evans (25 years old): “one time, during the rainy season, my wife was pregnant and got sick. We carried her using our arms to cross the river, but God helped us to reach to the healthcare facility.”

Since the bridge has been constructed though, the situation has changed for the best. 19.3% find it now easy to access healthcare, and 56.9% are rather neutral on the difficulty to access it. However, 23.8% still find it difficult to access healthcare, but 57.7% of them recognize that the

bridge has made it easier for them. Overall, it means that our bridge has guaranteed at least 89.8% of Tamkal residents uninterrupted access to healthcare throughout the year.

In Sisit, the situation is once again a bit different due to the proximity to Sigor. Moreover, there were already healthcare facilities on both sides of the river before the construction of BtGA bridge. But the one on the right bank is just a dispensary. Therefore, 22.6% of respondents did not face any challenges to access healthcare in the past. This is the case for 38.3% of people living on the left bank but 11.8% on the right.

Still, most of our respondents had trouble accessing healthcare. 42.6% had to travel long distance to reach a healthcare facility and close to 1/4 of them complains about the high transport costs it incurred like Esther (26 years old): “before, it was very hard and even expensive because of the transport cost through a long distance.” Then 39.1% risked crossing the river, with 28.6% of them using assistance. However, 12.2% of respondents had to stay home at least once as the river was impassable. One respondent, Titus, also mentioned that many of his neighbors died during the rainy season due to the challenge posed by the river.

It is interesting to see the differences in answers between the right and left sides of the river. Almost every respondent that had to walk long distance or was unable to cross the river lives on the right bank, while there was a 21.7% higher proportion of people that risked crossings on the left side compared to the right side.

Just as in Tamkal, the bridge has considerably improved healthcare accessibility in Sisit. Out of the 89 respondents that faced challenges, 100.0% find it easier to seek healthcare thanks to the bridge. 96.6% even find it easy now.

In addition, Ilinca, Di Giorgio, Salari, and Chuma (2019) found that healthcare expenses of Kenyans are positively correlated to their revenues. This is true for our participants. Thanks to the increased revenue generated by the bridge, several families explained spending more money on healthcare and 7.0% explained that they balance their diet more since then, which improved their health. “It has improved my health cover system since I have also invested in NHIF health coverage” (Reuben, 37 years old).

5.3.2.3. Enhance economic activities

BtGA bridge has improved the accessibility to the local market for 100 of the 110 respondents in Tamkal (90.9%). Of course, this positively impacted businesses as people could not sale their products in time of floods, but it also impacted customers that needed to buy their supplies but could not access the market. Petasia (49 years old) explained: “it has made my family to live in happiness because it is now easy to go to the market to buy goods to feed my

family” and Ngadomo (80 years old) emphasized on the safety that the bridge provides: “it is now easy to reach the market every day without worrying about river drowning.”

One particular issue that hindered their sales in the past was the difficulty of getting to the market on time. 1/3 (33.6%) of respondents explained that BtGA bridge has solved this problem for them. Furthermore, 18.2% say that the bridge has saved them a lot of time.

In addition, more than 1/5 (20.9%) explained that their number of customers has increased. As a result, about 1/3 (33.6%) reported an increase in their revenues. This is the case for Diana (23 years old) who sell maize and fruits in the market: “we make twice more profit than before.” 5.5% added that it has increased their living standards.

The bridge brought many other benefits: two residents explained that it has enhanced foreign trade, and another one said that it has built trust between sellers and their clients. Besides, 6.4% of respondents explained that the bridge has improved transport overall, especially for the transportation of goods. The bridge has also allowed 8.2% of respondents to access their workplace continuously, and simplified sourcing.

This access to workplace is particularly critical as highlighted by Brook and Donovan:

First, workers report that the choice to work outside the village without a bridge is too risky because days when flooding causes work to be inaccessible translates directly to lost labor income. As such, they view jobs outside the community as having high returns, but also a great deal of risk. Second, they explain that employers do not want to hire workers that are unable to get to work consistently. Although the majority of workers are employed on a short-term basis, many workers have a set of relationships with employers that they go to as work becomes available. As such, the reputation of the worker matters, and unpredictable flooding damages the workers’ reputations for reliability to get to work when they are expected to be there. (Brook & Donovan, 2020, p18).

In Sisit, among the 115 households surveyed, almost half of them (49.6%) reported that the bridge has improved their market accessibility. Out of these 57 respondents, 36.8% added that their number of customers has increased but another 15.7% respondents also observed an increase in their customers. Not only do more customers come to the market, but they also visit the farms more often. This is what Envin (46 years old) told us: “customers come to my farm through the bridge to buy my mangoes twice a week without fear of water, hence increasing my sales.”

This had a huge impact on people's lives as 58.3% of households reported an increase in their sales and profit. It is then not surprising that 46.1% of households indicated that their living standards have increased thanks to the bridge. "The income I earned from the sale of my mangoes has enabled me to buy good clothes" (Reuben, 37 years old). Continued access to the market also prevented food from going stale, as highlighted by 4 interviewees.

Likewise in Tamkal, some respondents indicated that the bridge has improved sourcing and work accessibility (4.3%). Besides, the issue of arriving on time at the market was also a concern in Sisit, but less often reported.

Most of these improvements (around 90.0%) were reported on the right banks of Wei-Wei River. This could be explained by the bigger isolation that this area suffered before the construction of the bridge. Although, the researcher that surveyed the households on the left side of the river is still a student. Therefore, he might have focused less on work-related issues when asking for more details from his respondents.

In addition, 29.6% of our participants said it has ease transportation overall, out of which 44.1% explained that the shorter travel distance/time has allowed them to save money on transportation costs.

In Sisit, respondents gave more details on how they used their increased revenues. I previously explained that some spent it on school fees or healthcare. Others used it to improve their house (13.0%), especially the roof. They bought iron sheets to prevent the rain from pouring inside their house as it used to.

In addition, 6 respondents told us that they invested in their business, like Esther, who bought cattle to support her family by selling milk or Paulina who opened a kiosk in her farm to diversify her resources. Investing in their job was also a consequence of the bridge in Nicaragua, where farmers spent nearly 60% more on fertilizer and pesticide (Brooks and Donovan, 2020, p3). In Sisit, every sector is impacted by these new economic opportunities. "Since customers have flourished to my tailoring shop, even during the rainy season, I bought a large stock of materials for sewing clothes" (Tecla, 28 years old).

One respondent, Rofinah, added that the bridge created some jobs as she is hiring some men and women to carry her products that she bought across the river.

Still, despite these significant increases in revenues, the average living standard in both Sisit and Tamkal is really low, as seen previously in Subsection 6.1.3. Hence, the improvement brought by our bridges are both a necessity, but it alone cannot close the gap that remains between these isolated communities and the rest of the country.

Overall, Tamkal and Sisit bridges have enhanced economic activities and reduced hardship at work. These results must be taken carefully before generalizing it because it is especially about the economic impact that I mentioned in Subchapter 4.2. that the local culture can impact the extent to which BtGA footbridges benefit the local communities.

The other county where BtGA is doing a lot of business is Narok County. This is the home of the Maasais who have a very different culture than the Pokots. Pokots mainly live from agriculture by farming their crops to feed their family or sell it on the market. Maasais however do not grow any crops for the large majority of them. Instead, they own herds of cattle. Cattle's prices are of course much higher than crops. Therefore, Maasais do not need to make sales at the market every week. In fact, most of them do not sell more than a dozen animals per year. Consequently, the bridges that BtGA build in the Mara do not have an as significant impact on Maasais revenues than it does in West Pokot.

5.3.2.4. Increase safety

Nevertheless, the positive impacts brought by footbridges are touching many more areas of life than just market accessibility. The most important one being to reduce the number of drownings. In Tamkal, 17.3% of respondents knew a family member, friend or relative that drowned over the past years, some of whom are still dealing with grief. In Sisit, it is 21.7% of respondents who knew someone that drowned over the past years, out of which 92.0% live on the right side of the river. BtGA footbridges are thus lifesaving solutions for the neighboring communities.

The security that it brings also has a positive impact on people's mental health. Whether it was to access school, healthcare facilities or markets, the guaranteed accessibility to important places has removed the fear of crossing that 11.6% of participants expressed. It has also reduced the stress induced by the river that 7 residents were dealing with. "The bridge has overcome the fear of having to cross the dangerous river, thus living a happy life" (Samson, 30 years old)

This was particularly striking regarding food security. 9.1% of Tamkal's respondents have lacked food in the past due to their incapacity to reach a market in times of heavy rains. 40.0% of them specified that it was detrimental for their children who had to go to school, like Lokeliman who explained that they once did not eat for 2-3 days. Likewise, 7.0% of respondents in Sisit have lacked food in the past, but the majority explained that it is due to the destruction of their crops, rather than to the market accessibility.

5.3.2.5. Improve social cohesion

Alongside the other benefits, the footbridges have both enhanced socialization and improved communication. This has been mentioned by almost 1/4 (24.5%) of our respondents in Tamkal and even 1/2 (49.6%) in Sisit. The bridges have allowed parents to visit their children in boarding school, friends to meet anytime, and grandparents to see their grandchildren more often. We collected many rejoicing stories, like Chepocnechewto (68 years old), who told us that “the bridge has improved communication since I can now walk around to see my grandchildren on the other side of Sisit” or Solomon (25 years old) who said that “reaching friends and interacting with them has become simple.”

Among the other reasons given, respondents in Tamkal emphasized the gain in knowledge allowed by an enlarged community, as 7.3% said they learned new skills due to new encounters. They appreciate also exchanging points of views and ideas with people that live in other villages. “Interacting with the neighboring village became easy thanks to the bridge” (James, 30 years old).

Participants in Sisit also added that it has allowed them to receive information on time, and this issue was particularly critical for them as some areas of Sisit do not benefit from network. Information must therefore be transmitted orally.

Before the bridge, residents were also facing the issue of coming back home. Indeed, many residents have been separated from their family by the river: 39.1% in Tamkal, and 73.9% in Sisit without a significative difference between each side of the river for this issue.

In Tamkal, 69.8% of the 43 people that have been blocked by the river had to wait 1 or 2 days before coming home. Then, 11.6% stayed on the other side for 3 to 5 days and another 16.3% spent more than a week away from their family. Only 1 respondent spent less than a day separated from his family by the river, but he still had to wait for 8 hours.

In Sisit, 74.1% of these 85 respondents have been separated for at least a full day, with more than half of them who had to wait 2 to 7 days. For the others, 12.9% had to wait between 5 and 12 hours and only 11.8% could come back home after less than 4 hours. This is not an isolated phenomenon as Brooks and Donovan (2020, p7) also found that the rivers in Nicaragua block the locals from a few hours to 9 days.

We then asked them how they communicated with their family during that time and the majority could inform them by phone, preventing any stress for their relatives. Some were able to communicate across the river, by hand signs or shouting when possible. The river can indeed make a lot of noise in times of heavy rain. But of course, it incurred some stress as their relatives

probably hurried to the river when they realized they were not coming back today. However, more than 1/3 of both Tamkal and Sisit participants did not or could not communicate with their family. This could happen for both short (a few hours) and long separation (several days). Indeed, the means of communication is not significantly correlated to the length of separation, suggesting that everyone did with what he had.

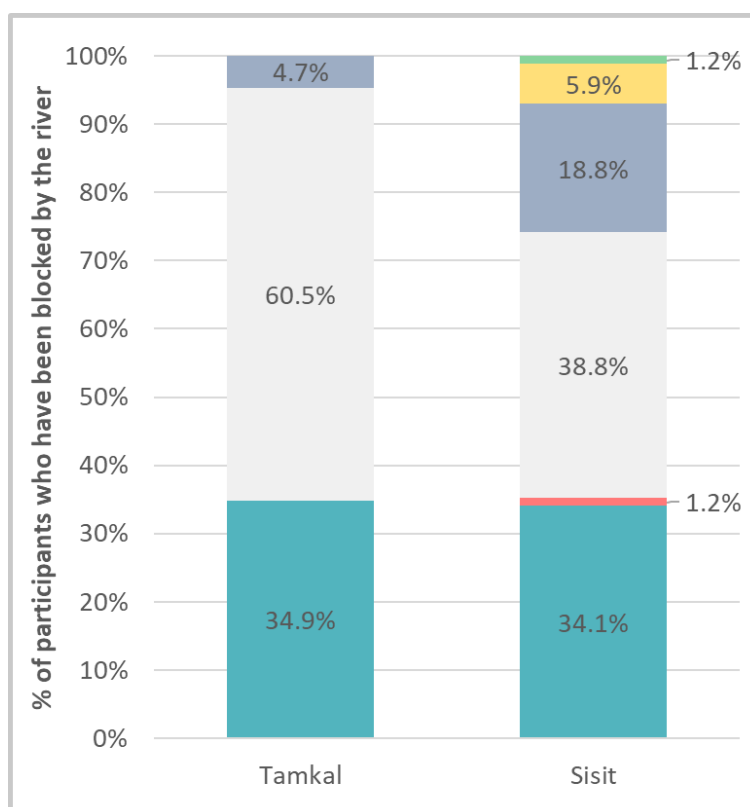


Fig 16 – Communication means

Besides, one individual, Solomon, decided to walk back home by taking a detour but it took him a day, so it is not a good alternative to waiting.

Last but not least, just like any other destination, the bridges have also helped people to access religious places all year long (churches in this region). I did not dedicate a specific section for this topic because I did not gather enough information on it. But since 7 respondents emphasized it, I wanted to add it to this thesis. As displayed in Section 4, Sundays recorded among the highest number of crossings on average showing that the improved accessibility to churches was important to these communities.

Chapter 6. Discussion

To conduct this research, we collected 225 questionnaires, gathering data on more than 1504 individuals. The participants are aged 11 to 102 years old and about 2/3 of them are male. 56.8% of Tamkal respondents and 74.8% in Sisit stopped their education after primary school and less than 1/5 of our participants have persuaded degrees after secondary school. Both in Tamkal and Sisit, the average living standard is around 3. This level encompasses the people that have the least access to wealth, emphasizing the need for development initiatives in this region.

In this chapter, I therefore first summarize the findings of the research and then make connections with the Sustainable Development Goals of the United Nations to give examples on how footbridges can improve the Kenyan society.

6.1. Footbridges traffic

Regarding the utilization of BtGA footbridges, I want to emphasize 4 main takeaways.

First, the average daily crossings reached 890 individuals in Tamkal and 175 in Sisit. These figures are expected to rise in time of flash floods because the research has been conducted during the dry season. In Tamkal, 80% of the days exceeded 600 crossings while in Sisit, 53% of the days reached at least 150 crossings. Among the 225 participants surveyed, more than 90% use BtGA footbridges at least once a week and the majority use them daily. This is especially helping unemployed people to look for daily jobs.

Second, the geographic location of the bridge has a considerable impact on its use. The difference in utilization between Tamkal and Sisit bridges is significant. Elements such as the presence of a town on one side of the river or the location of important infrastructures like schools can affect greatly the number of footbridge users.

Third, the traffic is higher on market days and during the weekend, especially to go to church as 91.8% of West Pokot population is Christian (City Population, 2019). This is coherent with Thomas et al. (2020) findings in Rwanda.

Fourth, you can change a life by giving less than \$5 US per year for a similar bridge like Tamkal and less than \$25 US for a bridge like Sisit. This removes the risk of drowning and helps people to access markets, healthcare, and schools as well as meeting with their relatives.

Besides, our findings also support that the habit of crossing the bridge remains even during the dry season just as outlined in Thomas et al. (2020) research paper. It might also be that footbridges remain a simpler means of crossing the river rather than walking on rocks or in the water. Lastly, children seem to be the category that benefits the most from our bridges.

6.2. Economic and social impacts

Through the answers gathered in Tamkal and Sisit, we can say that the 2 footbridges that have been built in this area in 2020 have had a positive impact on all aspects of the life of the nearby communities.

We found that 17.3% respondents in Tamkal and 21.7% in Sisit knew a relative that drowned over the past years. This risk is now removed. We then learned that 39.1% of participants in Tamkal, and 73.9% in Sisit, have been separated from their home by the river in the past. These separations varied from a couple of hours to more than a week.

In addition, the footbridges improved the accessibility to the local market for 90.9% of respondents in Tamkal and 49.6% in Sisit. This brought more customers to farmers that can now sell their crops every week, but also improved the food security situation of households that could not get food in times of heavy rain. Indeed, 9/10 households are involved in trades in the local market in this region. Moreover, it also benefits other businesses like the tailoring shop of Tecla. As a result, 33.6% of the respondents reported an increase of their income in Tamkal, and 58.3% in Sisit. This increased revenue has been used in many ways, like paying school fees, balancing their diets, increasing their healthcare expenses, or improving their house to prevent the rain from pouring inside for instance.

Furthermore, it is very satisfying to see that Tamkal and Sisit footbridges have improved the school accessibility for 92.2% of households in Tamkal and 31.5% in Sisit. Accessibility will no longer be a reason to drop out of school or be absent in times of flash floods. Similarly, 89.8% of Tamkal residents and 100.0% in Sisit now have safe uninterrupted access to healthcare facilities. In the past, 30.0% of Tamkal respondents and 12.2% of Sisit had at least once been unable to reach a healthcare facility during the rainy season. Consequently, 7.3% of respondent have known someone who died either by lack of care or by crossing the river trying to reach the healthcare center.

The bridges have many more benefits, impacting every aspect of people' lives. 1/4 (24.5%) of our respondents in Tamkal and even 1/2 (49.6%) in Sisit explained that the bridges have enhanced socialization and improved communication. The bridges have allowed parents to visit

their children in boarding school, friends to meet anytime, and grandparents to see their grandchildren more often. It also enhances new encounters between communities and gives peace of mind by removing the stress and fear of crossing that 11.6% of participants expressed.

6.3. Footbridges as key to achieve SDGs

In 2019, research conducted by the Infrastructure Transition Research Consortium (ITRC) and the United Nations Office for Project Services (UNOPS) found that “networked infrastructure³ influences 72 percent of SDG targets” (UNOPS, 2019, para.2). It is then not surprising that I could make direct connections between Tamkal and Sisit footbridges and 11 out of the 17 SDGs (see Appendix 22). Nevertheless, I would like to highlight a few targets of SDGs 1, 3 and 4 in particular.

6.3.1. SDG 1: No Poverty

SDG 1 aims to end poverty in all its forms everywhere. Poverty is a crucial challenge that touches every aspect of life, and it is certainly one of the most salient in our societies. Unfortunately, inequalities in wealth are still huge. Between 1995 and 2021, the 50% poorest citizens of the world “only captured 2.3% of overall wealth growth” (United Nations, 2023, p.50), while the 1% richest captured 38% of it. In Sub-Saharan Africa, the situation in terms of unemployment and hunger is very concerning. Even if hunger is increasing in a large part of the world since 2015, Sub-Saharan Africa remains the only region where more than 1/5 individual is undernourished (United Nations, 2023, p.30). It is also the only region with Latin America and the Caribbean whose unemployment rate has increased between 2015 and 2022 (United Nations, 2023, p.35). In Kenya, undernourishment was affecting 14.4 million people in 2020, which is more than a quarter of the population (26.9%) (Department of Economic and Social Affairs, August 4, 2023). The county of West Pokot makes no exception regarding these issues as highlighted in Chapter 5.

The unemployment rate among the 15 to 24 years old Kenyans was 12.85% in 2019 while it was only 3.35% for the 25+ years old. The situation is even worse among our respondents as 20.0% of the 16-29 years old in Tamkal and 30.8% in Sisit are unemployed.

³ “Networked infrastructure” encompasses water, waste, energy, digital communications, and transport infrastructure, and “non-networked infrastructure” encompasses buildings and facilities (UNOPS, 2019, para.1).

I believe long-term poverty occurs mainly from isolation, whether it is a geographical isolation or a social isolation. In both cases, the underlying reason is the same: the lack of opportunities. I therefore see BtGA footbridges primarily as a gateway to opportunities for the local communities, who can now decide which school to send their children to, get health care when they need it, choose their jobs or when to sell their crops, etc. It can thus surely contribute to reducing poverty.

Target 1.1 objective is to eradicate extreme poverty by 2030 for all people everywhere and is currently measured as people living on less than \$1.25 a day (Department of Economic and Social Affairs, July 28, 2023). In Kenya, even though the proportion of the population living on less than \$1.25 a day has reduced by 7.3% between 2005 and 2015, it still concerns 29.4% of the population (Department of Economic and Social Affairs, August 4, 2023). This figure even increases to 36.1% at the national poverty line. I thus do not believe that Kenya will reach 0% by 2030. Footbridges can therefore contribute to the achievement of that target as they are providing sustainable revenues growth for the nearby communities and help them to diversify their resources as outlined in Subsection 5.3.2.3 and in other studies supported by B2P. Footbridges also impact other targets of SDG 1 like ensuring that everyone, in particular the poor and the vulnerable, have access to basic services for instance (target 1.4).

6.3.2. SDG 3: Good Health and Well-being

SDG 3 focusses on ensuring healthy lives and promoting well-being for all at all ages. On this point, Kenya has done some good work, but it remains insufficient to reach the 2030 objectives. That is why healthcare is one of the 4 focus points of the “Big 4 Agenda” prioritized by the Kenyan government in 2020 to succeed in reaching the objectives of the SDGs by 2030 (United Nations, 2020, para.13).

For instance, target 3.2 aims at reducing the neonatal and under-5 years mortality rates to respectively 12 and 25 per 1,000 live births by 2030 (Department of Economic and Social Affairs, July 28, 2023) and Kenya already shows promising results in this category. “The neonatal mortality rate reduced from 27.3 deaths per 1,000 live births in 2000 to 18.4 deaths per 1,000 live births in 2021” and over the same period, the under-5 mortality rate dropped from 98.8 to 37.2 per live births (Department of Economic and Social Affairs, August 5, 2023). However, in terms of maternal mortality (target 3.1), Kenya is far to reach the objective of less than 70 deaths per 100,000 live births as this ratio only decreased from 563.8 to 530.0 per 100,000 live births between 2000 and 2020.

By providing continuous safe access to healthcare, footbridges can therefore contribute to reducing the deaths caused by childbirth. Their role could be quite significant because more than 70% of the Kenyan population live in rural areas (The World Bank Group, 2023). It can also contribute to achieve Target 3.6 by reducing the number of road traffic accidents that stagnates around 27 as Kenya has not been able to reduce it in the 21st century (Department of Economic and Social Affairs, August 4, 2023).

Furthermore, almost half of the Kenyan population do not have access to proper healthcare (Indicator 3.8.1: coverage of essential health services), even though the progression made in that area is satisfying. “The universal health coverage (UHC) service coverage index increased from 28.0 in 2000 to 53.0 in 2021” in Kenya (Department of Economic and Social Affairs, August 5, 2023). This means that 47% of Kenyans are still not well connected to essential health services.

6.3.3. SDG 4: Quality Education

SDG 4 aims to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (Department of Economic and Social Affairs, July 28, 2023) and I believe footbridges can especially impact target 4.1: “by 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes” (Department of Economic and Social Affairs, July 28, 2023).

In 2021, 74.1% of children and young Kenyan achieved a minimum proficiency level in mathematics, but only 46.7% in reading (Department of Economic and Social Affairs, August 4, 2023). This highlights the insufficient effort put into improving education in the country. In Kenya, “the proportion of total government spending on essential education services declined from 23.4% in 2000 to 19.0% in 2018” (Department of Economic and Social Affairs, August 5, 2023).

As outlined in Chapter 5, BtGA footbridges ensure safe crossing for many children and Tamkal Bridge is especially used by students that head to either Tamkal Primary School or Tamkal Mixed Secondary School. Before the bridge, 90% of the participants reported some school absenteeism and some mentioned that their children dropped out of school. Footbridges thus provides crucial help to improve school enrolment and education level in the country.

6.4. Results reliability

In view of the methodology used to collect the data and determining the size of the sample, we can generalize our results to the whole population of Sisit and Tamkal areas with an error margin of 6%. This means that if we were to reproduce the research on the whole population of Tamkal and Sisit areas, we would get the same results with an accuracy of 6%. For instance, we would find that between 27.6% and 39.6% of Tamkal population reported an increase of their income attributable to the bridge. In this case, the confidence interval is [27.6% ; 39.6%].

Furthermore, our 92% confidence level means that if we would take a sample of the same population and repeat it multiple times, the true parameter of the population would be within the confidence interval 92% of the times.

Chapter 7. Conclusion, limits, and future research

7.1. Conclusion

In conclusion, I started with this research question: what are the economic and social impacts of the footbridges built by Bridging the Gap Africa on the local communities? To answer it, I first tried to understand the challenges that these communities are facing and searched the related literature. Previous research provided many insights on the economic and ecological impacts of footbridges. However, few research on rural footbridges impact in mid and low-income countries has been focusing on social matters. With the help of BtGA team, I therefore investigated the impacts of two of their footbridges built in West Pokot County.

Counting the traffic of these bridges provided a good idea of their utilization and I then complemented the cost-effectiveness of footbridges computed by Brooks and Donovan in Nicaragua by focusing on the number of users per bridge. It appeared that it only takes \$3.05 US per year to positively affect the life of 1 person living in Tamkal area and \$21.74 US in Sisit.

Then, the results of the household survey demonstrated that the two footbridges built by BtGA in this region are effectively providing neighboring communities with safe, uninterrupted access to critical locations. Both Tamkal and Sisit bridges are helping dozens of people every day, preventing drowning. Almost 1/5 (19.6%) of our respondents knew a relative that drowned in the river and more than half of them (56.9%) have been separated from their home by the river in the past. Footbridges allow farmers to sell their crops weekly, children to access schools and patients to receive proper care. We also found that these rural infrastructures have an impact on many more areas of life, extending well beyond accessibility, like socialization and mental health.

The responses of our participants provided us with new insights to better define the challenges in different aspects of life. For instance, many people still take the risk of crossing the river to reach schools or healthcare in the absence of a bridge (14.5% in Tamkal, 39.1% in Sisit). It also appeared that the cost of transport was a recurring issue in this region. The footbridges therefore not only improve mobility and increase revenue by linking people to markets, farms, and shops, but also allow people to save money. The positive economic impacts reported by our participants support the findings of Brooks and Donovan in Nicaragua and Thomas et al. in Rwanda.

An interesting outcome of this research is that we could quantify the proportion of individuals that needed and now benefit from an improved access to schools and healthcare centers.

Lastly, I outlined in Chapter 6 how these footbridges are tremendously impacting the lives of their beneficiaries and how it could play a key role in helping Kenya to reach its Sustainable Development Goals by 2030. Development plans could identify certain types of sites that would be given priority for the provision of footbridges. These sites could be selected using criteria that target specifically one particular Sustainable Development Goal. BtGA already incorporates various criteria into its project selection, but without focusing on a particular SDG. For example, sites that would link a large number of pupils to a local school are often preferred.

7.2. Limitations and suggestions for further research

All these effects are expected to have a positive impact on people's standards of living. However, it is harder to assess this metric within 3 years following the completion of the bridge because outcomes such as education degrees require more years to be achieved. It would therefore be interesting for BtGA to conduct future research by surveying the community before their intervention and many years later to enquire about the changes in education and health outcomes over a longer period. This would also help to better assess the scope of the impact that footbridges can have on SDGs 3 and 4. Moreover, gathering data on household's distance to important places and the transport cost related to these trips would help to better define the reduction in CO2 emissions and savings in transport costs for families.

This research has enabled Bridging the Gap Africa team to better appreciate their impact on the communities they serve but for budget reasons, we implemented this research at two bridges sites only. It would therefore also be interesting to enquire if similar outcomes are found in a larger scale research that would encompass many more sites in different region of Kenya. This would benefit the current literature to support or refute what has been discovered in this research. Kenya has indeed a rich cultural diversity with over 40 tribes. Habits and customs vary greatly from one to the next and therefore, the extent of the impact of footbridges can also vary among tribes depending on their lifestyle.

Moreover, to have a better idea of crossing pattern and the utilization of BtGA footbridges, it would be interesting to record the river height and rainfall quantity over the tallying period. This would enable us to differentiate the average crossings between days when the river is passable and days when the bridge is the only crossing alternative.

Personally, this research and my whole internship at Bridging the Gap Africa have been an eyes-opening experience on an industry, a culture, and a part of the world that I barely knew. I met wonderful people and got to see many beautiful places. It contributed to my academical education by teaching me how to lead a project to its end and deal with unforeseen events as well as to my personal development. I would like to thank one last time the whole Bridging the Gap organization and the Louvain School of Management for this opportunity. Finally, I could not end my thesis without adding pictures of Tamkal and Sisit footbridges, that have certainly been used by a few people while you were reading it.



Fig 17 – Tamkal (left) and Sisit (right) footbridges

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Appendices

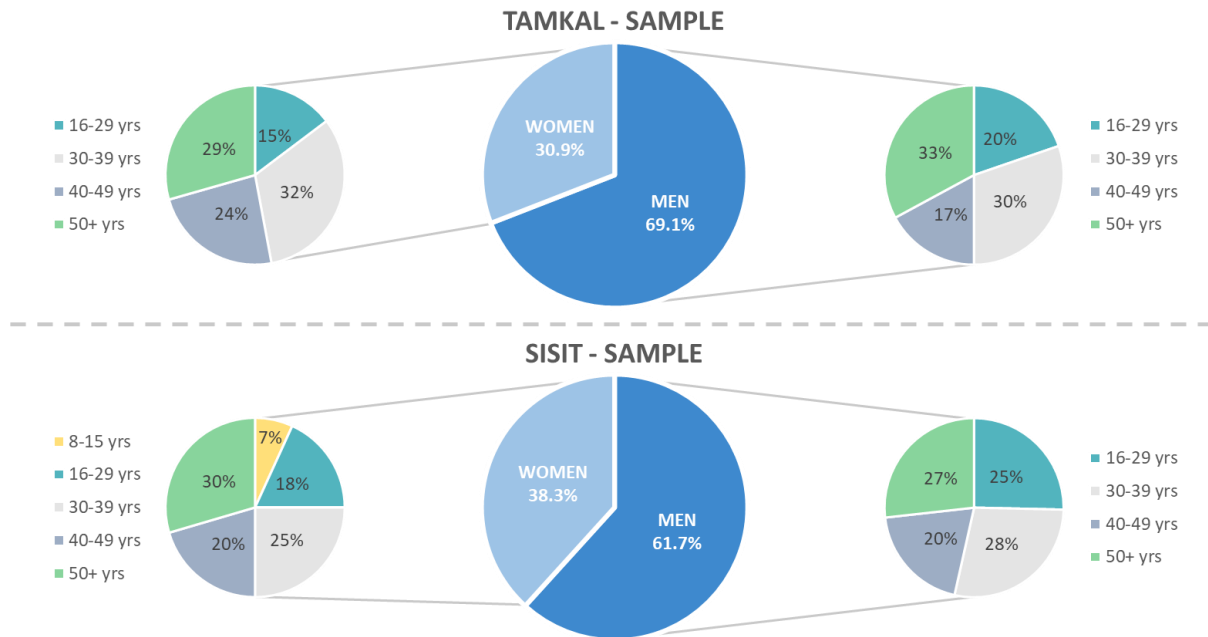
Appendix 1: Tamkal Bridge before BtGA intervention (Bridging the Gap Africa, 2020)



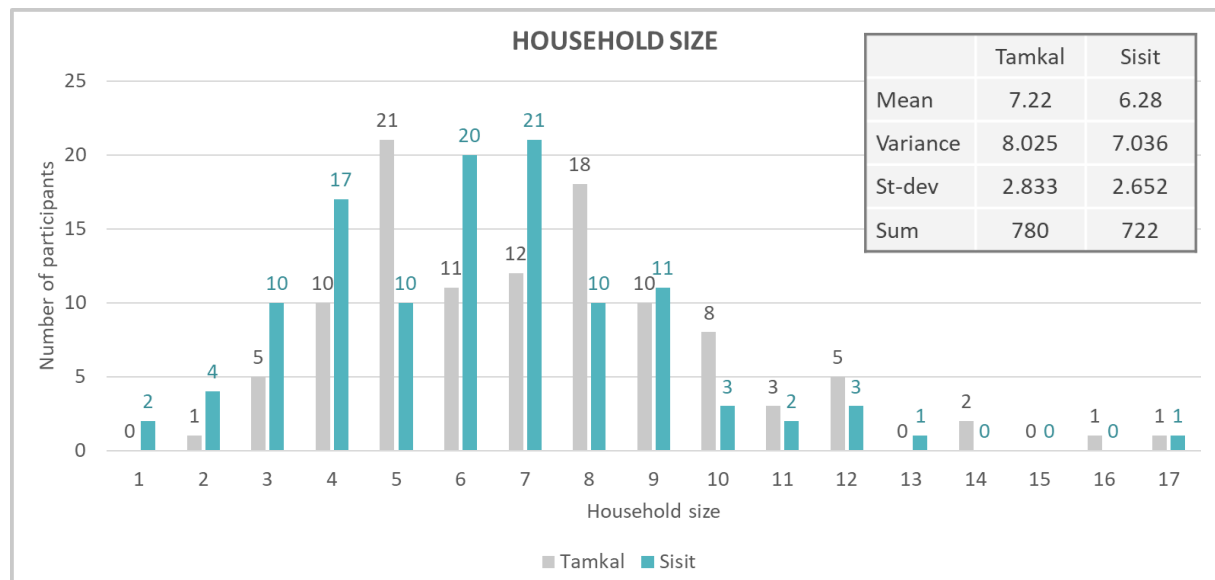
Appendix 2: Map of Kenya (Kenya Investment Authority, 2022)



Appendix 3: Questionnaire samples



Appendix 4: Number of participants per household size

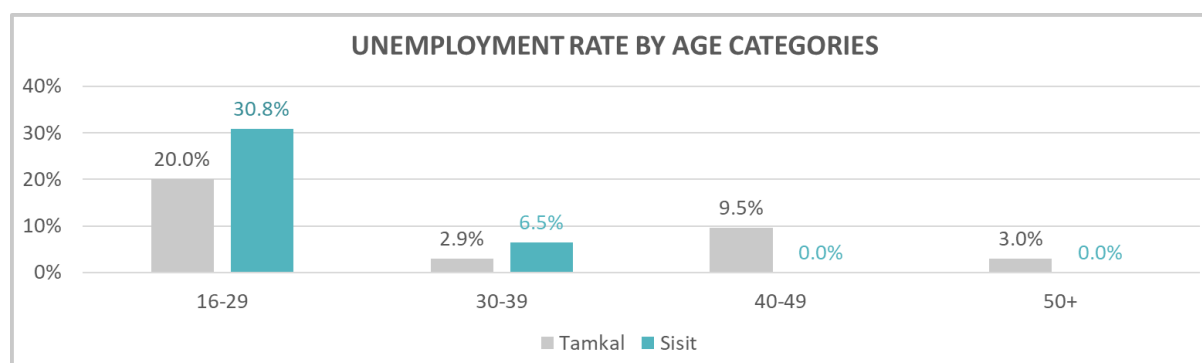


N.B. Two respondents in Tamkal did not provide their household size.

Appendix 5: Tamkal and Sisit respondents' jobs

T A M K A L - O C C U P A T I O N	Employed	Total	19	S I S I T - O C C U P A T I O N	Employed	Total	12
		Farmer	0			Farmer	3
		Teacher	13			Teacher	3
		Shop Keeper	1			School cook	2
		MCA	1			School Matron	1
		Police officer	1			Community Health Worker	1
		Doctor	1			Security agent	1
		Prisoner guard	1			Taxi driver	1
		Tax collector	1			Total	88
	Self-employed	Total	81		Self-employed	Farmer	75
		Farmer	50			Food related	5
		Food related	11			Tailor	2
		Shop keeper	3			Sell firewood	1
		Teacher	2			Barber	1
		Carpenters	2			Mason	1
		Sell firewood	2			Hotel	1
		Tailor	1			School cook	1
		Having wholesaler at the market	1			Selling herbal medicine	1
		Hardware	1				
		Welder	1				
		Electrician	1				
		Selling herbal medicine	1				
		Selling petrol	1				
		Phone accessories	1				
		Safaricom shop	1				
		Taxi driver	1				
		Lab technician	1				

Appendix 6: Unemployment rates by age categories

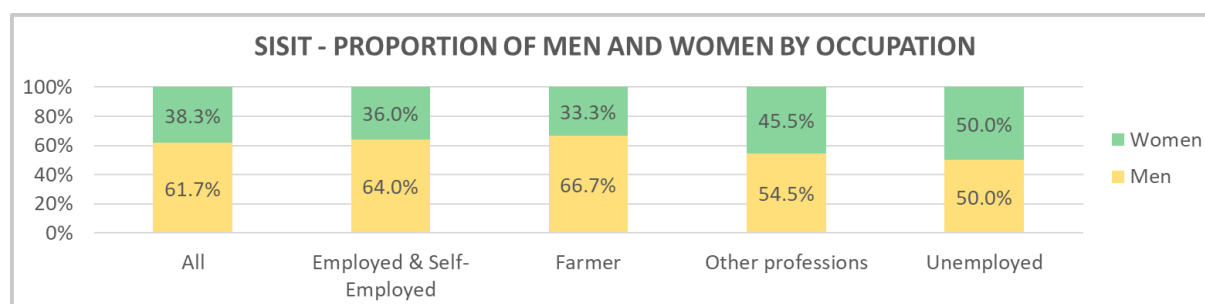
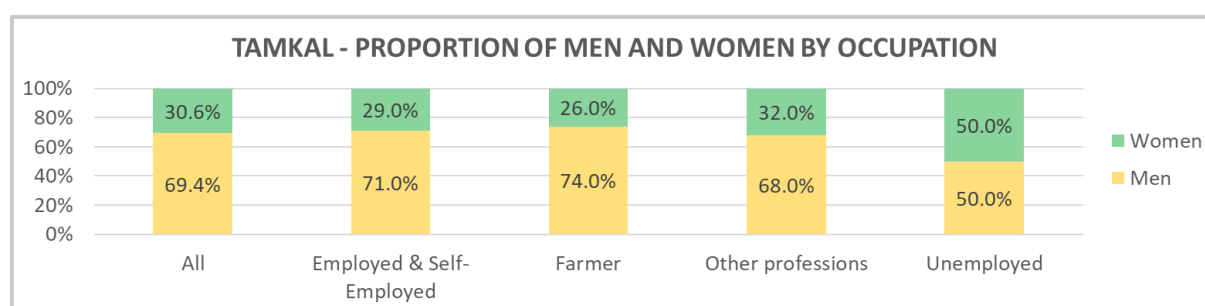


Age	TAMKAL		SISIT	
	Working	Unemployed	Working	Unemployed
16-29	16	4	18	8
30-39	33	1	29	2
40-49	19	2	23	0
50+	32	1	30	0
Total	100	8	100	10

Appendix 7: Unemployment rates by sex

	Unemployment Rate	
	Men	Women
TAMKAL	5.26%	11.76%
SISIT	7.25%	12.20%

Appendix 8: Proportion of men and women by occupation



Appendix 9: Tamkal - occupation by education level

TAMKAL - OCCUPATION BY EDUCATION LEVEL					
	All	Employed & Self-employed	Unemployed	Farmer	Other professions
No school	23	22	1	17	5
Primary school	37	34	3	23	11
Secondary school	26	23	3	10	13
Tertiary education	1	1	0	0	1
College/University	20	19	1	0	19
Total	107	99	8	50	49
<i>NB: total of 107 instead of 110 because 1 participant did not answered this question and 2 are retired</i>					
No school	21.7%	22.2%	12.5%	34.0%	10.2%
Primary school	34.6%	34.3%	37.5%	46.0%	22.4%
Secondary school	24.3%	23.2%	37.5%	20.0%	26.5%
Tertiary education	0.9%	1.0%	0.0%	0.0%	2.0%
College/University	18.7%	19.2%	12.5%	0.0%	38.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

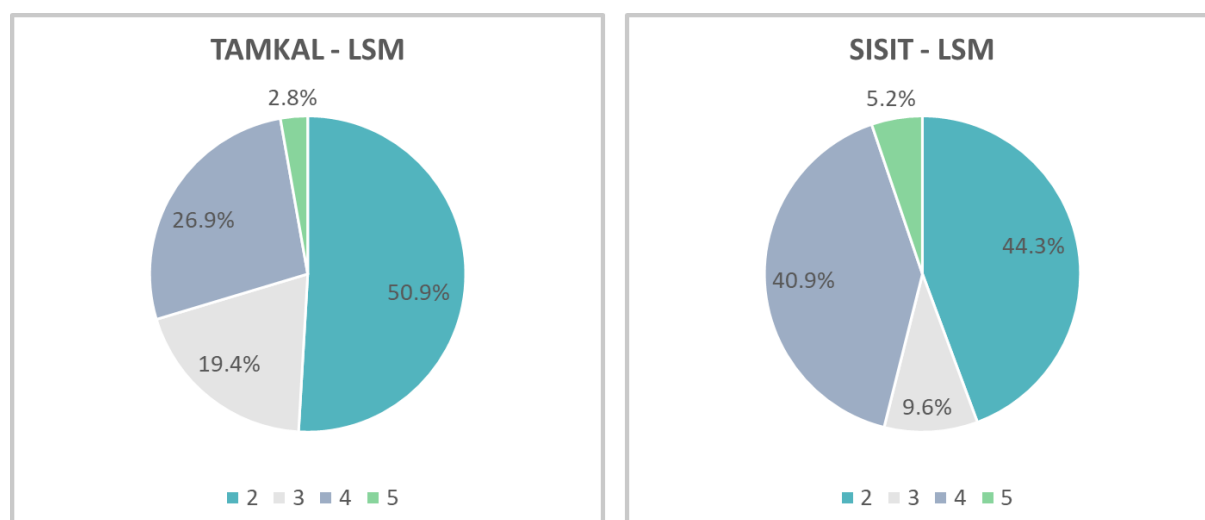
Appendix 10: Sisit - occupation by education level

SISIT - OCCUPATION BY EDUCATION LEVEL					
	All	Employed & Self-employed	Unemployed	Farmer	Other professions
No school	19	19	0	16	3
Primary school	63	59	4	51	8
Secondary school	16	10	6	8	2
Tertiary education	7	7	0	2	5
College/University	5	5	0	1	4
Total	110	100	10	78	22
<i>NB: total of 110 instead of 115 because 2 participant are retired and 3 participants under 15 yrs are still at school</i>					
No school	17.3%	19.0%	0.0%	20.5%	13.6%
Primary school	57.3%	59.0%	40.0%	65.4%	36.4%
Secondary school	14.5%	10.0%	60.0%	10.3%	9.1%
Tertiary education	6.4%	7.0%	0.0%	2.6%	22.7%
College/University	4.5%	5.0%	0.0%	1.3%	18.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix 11: Household size by education

HOUSEHOLD SIZE BY EDUCATION	TAMKAL			SISIT		
	Mean	Standard deviation	Total	Mean	Standard deviation	Total
No school	8.04	2.905	25	6.74	3.176	19
Primary school	7.59	3.132	37	6.58	2.610	67
Secondary school	6.27	2.550	26	5.81	2.214	16
Tertiary education	8.00	0.000	1	4.14	1.641	7
College/University	6.68	1.948	19	5.17	1.344	6

Appendix 12: Proportion of participants by LSM level



Appendix 13: LSM by age

LSM BY AGE		All	16-29 yrs	30-39 yrs	40-49 yrs	50+ yrs
TAMKAL	Mean	2.81	3.15	2.70	3.05	2.60
	Standard deviation	0.924	0.963	0.904	1.023	0.763
SISIT	Mean	3.07	2.92	2.65	3.39	3.41
	Standard deviation	1.028	0.917	0.969	1.010	0.996

Participants that are aged under 15 years old are not taken into account here since their data is representative of their parents. It cannot be linked to their age then.

Appendix 14: LSM in Sisit in both sides of the river

SISIT - LSM	Left bank	Right bank
Mean	4.02	2.41
Standard deviation	0.483	0.752

Appendix 15: LSM by education level

Kendall's rank correlation test between the education level and living standards in Tamkal:

$z = 4.1558$, $p\text{-value} = 3.241e-05$

Alternative hypothesis: true tau is not equal to 0

Sample estimates:

Tau: 0.3439802

⇒ The p-value is lower than the significance level $\alpha = 0.05$. We can conclude that the two variables are significantly correlated with a correlation coefficient of 0.34.

Kendall's rank correlation test between the education level and living standards in Sisit:

$z = 0.13902$, $p\text{-value} = 0.8894$

Alternative hypothesis: true tau is not equal to 0

Sample estimates:

Tau: 0.0115405

⇒ The p-value is greater than the significance level $\alpha = 0.05$. We cannot conclude that the two variables are significantly correlated.

Appendix 16: LSM by occupation

TAMKAL - LSM BY OCCUPATION					
Categories	Mean	Standard deviation	Min	Max	Total
All	2.81	0.924	2	5	106
Employed & Self-employed	2.78	0.909	2	5	98
Unemployed	3.25	1.090	2	5	8
Farmer	2.58	0.802	2	4	50
Other professions	2.98	0.968	2	5	48

SISIT - LSM BY OCCUPATION					
Categories	Mean	Standard deviation	Min	Max	Total
All	3.07	1.028	2	5	115
Employed & Self-employed	3.09	1.030	2	5	100
Unemployed	2.90	0.831	2	4	10
Farmer	3.10	1.057	2	5	78
Other professions	3.05	0.928	2	4	22

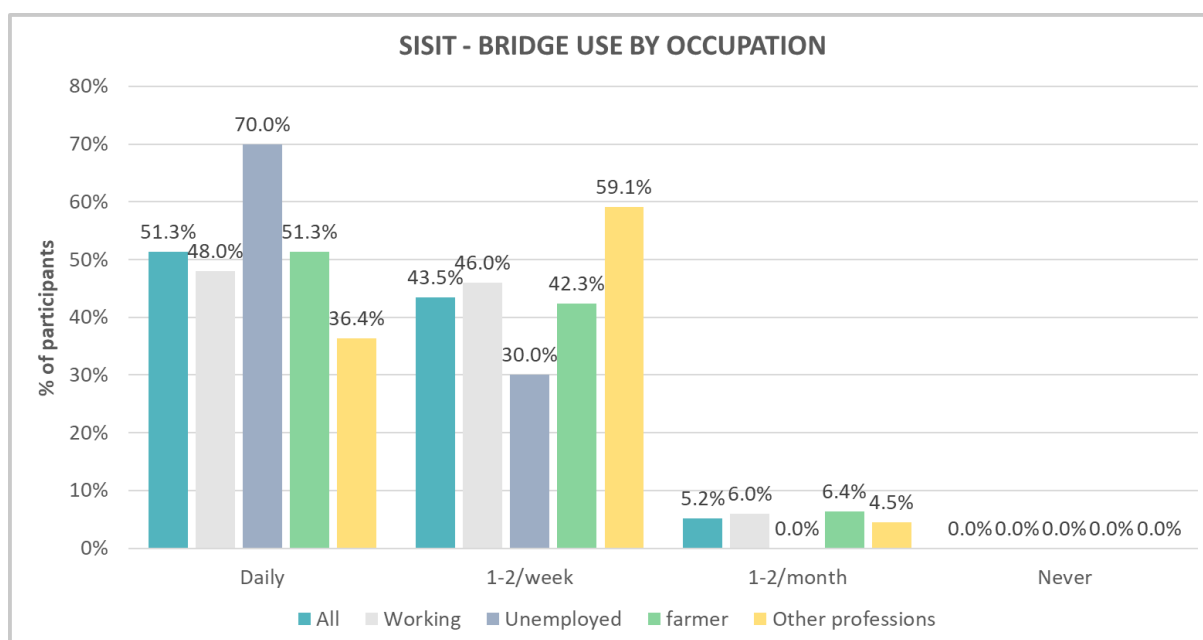
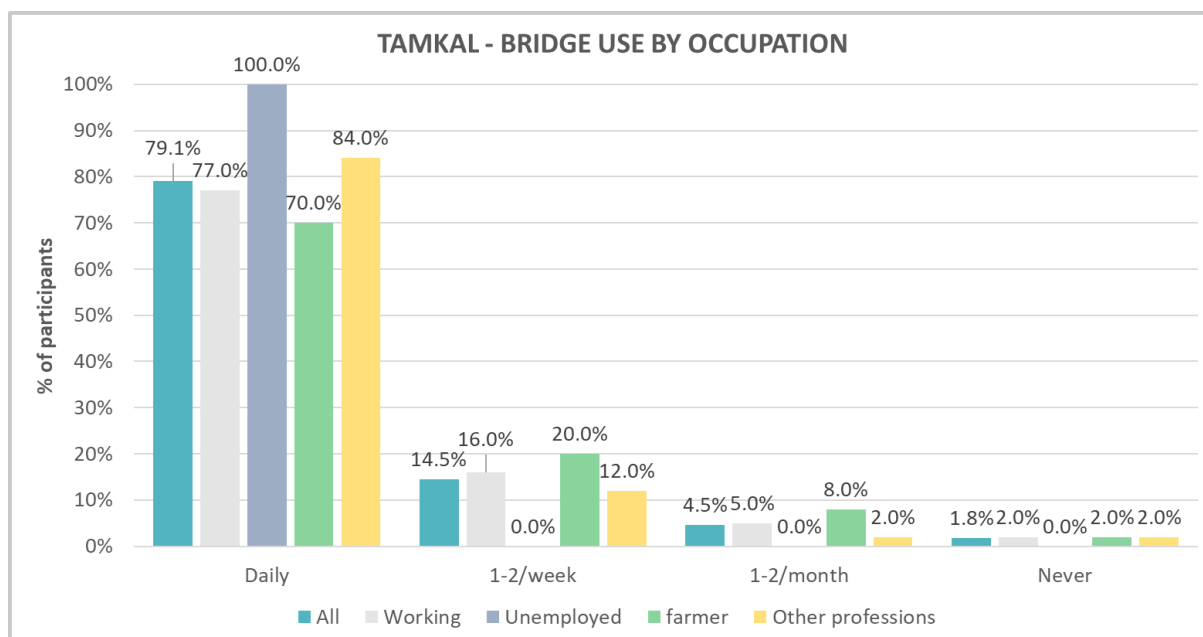
Appendix 17: Map of Tamkal area (Google Maps, 2023b)



Appendix 18: Map of Sisit area (Google Maps, 2023A)



Appendix 19: Bridge utilization by occupation



Appendix 20: Impact of the exchange rate on the Price/Utilization ratio for Tamkal

Construction cost [KES]	Exchange rate	Date	Reason	Construction cost [USD]	Price / Utilization ratio
2,322,215 KES	0.00930805	20-07-2020	First to exceed 0.0093	\$21,615.29	\$25.76
2,322,215 KES	0.00925868	08-08-2020	3 months before completion	\$21,500.65	\$25.63
2,322,215 KES	0.00925948	10-08-2020	Highest within 3 months	\$21,502.50	\$25.63
2,322,215 KES	0.0092	/	Chosen	\$21,364.38	\$25.46
2,322,215 KES	0.00917876	08-11-2020	Completion date	\$21,315.05	\$25.41

Highest withing 3 months – Completion date = \$25.63-\$25.41 = \$0.22

Appendix 21: Impact of the exchange rate on the Price/Utilization ratio for Sisit

Construction cost [KES]	Exchange rate	Date	Reason	Construction cost [USD]	Price / Utilization ratio
1,480,275 KES	0.00930805	20-07-2020	First to exceed 0.0093	\$13,778.47	\$88.32
1,480,275 KES	0.00925868	08-08-2020	3 months before completion	\$13,705.39	\$87.86
1,480,275 KES	0.00925948	10-08-2020	Highest within 3 months	\$13,706.58	\$87.86
1,480,275 KES	0.0092	/	Chosen	\$13,618.53	\$87.30
1,480,275 KES	0.00917876	08-11-2020	Completion date	\$13,587.09	\$87.10

Highest withing 3 months – Completion date = \$87.86-\$87.10 = \$0.76

*Appendix 22: List of SDGs directly impacted by Tamkal & Sisit footbridges
(Department of Economic and Social Affairs, 2015, p.18)*

SDG 1: No poverty

- **Target 1.1:** By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than \$1.25 a day.
- **Target 1.2:** By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.
- **Target 1.4:** By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance.
- **Target 1.5:** By 2030, build the resilience of the poor and those in vulnerable situations and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.

SDG 2: Zero Hunger

- **Target 2.1:** By 2030, end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round.
- **Target 2.3:** By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

SDG 3: Good Health and Well-being

- **Target 3.1:** By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births.
- **Target 3.2:** By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births.
- **Target 3.3:** By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases.
- **Target 3.4:** By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being.
- **Target 3.6:** By 2020, halve the number of global deaths and injuries from road traffic accidents.

- **Target 3.8:** Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.

SDG 4: Quality Education

- **Target 4.1:** By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes.
- **Target 4.5:** By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations.
- **Target 4.6:** By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy.

SDG 8: Decent Jobs and Economic Growth

- **Target 8.1:** Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries
- **Target 8.2:** Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors.
- **Target 8.5:** By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.
- **Target 8.6:** By 2020, substantially reduce the proportion of youth not in employment, education or training.

SDG 9: Industry, Innovation and Infrastructure

- **Target 9.1:** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

SDG 10: Reduced Inequalities

- **Target 10.2:** By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status.
- **Target 10.7:** Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies.

SDG 11: Sustainable Cities and Communities

- **Target 11.1:** By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums.
- **Target 11.2:** By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special

attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

- **Target 11.5:** By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.
- **Target 11.a:** Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

SDG 12: Responsible Consumption and Production

- **Target 12.3:** By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.
- **Target 12.6:** Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle.

SDG 13: Climate Action

- **Target 13.1:** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- **Target 13.2:** Integrate climate change measures into national policies, strategies and planning.

SDG 15: Life on Land

- **Target 15.1:** By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in line with obligations under international agreements.

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