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The potential role of mobile phone technology in rural motorcycle and three-wheeler taxi services in Africa

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ABSTRACT

Over the last two decades, motorcycle and motorised three-wheeler taxis have become important means of transport in many sub-Saharan African countries, including in rural areas. However, the emerging role of mobile phone technology in improving mobility in rural areas is currently under-explored in the literature. This paper presents the findings of a small-scale research study that was undertaken into the use of mobile phone technology in the context of motorcycle and three-wheeler taxi use, and its potential to improve rural access. Informed by a literature review, the research focuses on four countries: Kenya, Rwanda, Tanzania and Uganda. Semi-structured interviews and focus group discussions were conducted with riders of motorcycle and motorised three-wheeler taxis and the developers of mobile phone-enabled transport technologies. Mobile technology linked to the utilisation of motorcycle and three-wheeler taxis is increasing, but 'ride-hailing' applications (apps) are likely to be limited to urban areas for the foreseeable future due to various disincentives to their use in rural areas. The study identifies several promising innovations that combine the use of motorcycles and three-wheelers with mobile technology to increase rural people's access to essential services and opportunities. These have the potential to be scaled up or expanded to other countries.

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Introduction

Since trade restrictions with industrial countries were lifted in the 1990s, motorcycles and motorised three-wheeler taxis have become an important means of transport in many sub-Saharan African countries. These vehicles comprise an estimated one-third of all transport in the region (WHO, 2018). In Kenya and Tanzania, there is approximately one motorcycle or three-wheeler for every 60 people. In Kenya, the number of new registrations of motorcycles increased by 75% between 2015 and 2016 (ibid, 2018).

Many rural villages in sub-Saharan Africa lack access to all-season roads, making the use of traditional four-wheel vehicles unfeasible. In contrast, motorcycles and three-

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wheelers are able to negotiate poor quality roads, tracks and paths that are inaccessible by other vehicle types (Porter, 2014). These vehicles play an important role in helping rural people access vital services such as healthcare, education and markets. The fact that these taxi riders provide a door-to-door service is highly convenient for users, including individuals with restricted mobility. Gamberini (2014) studied the impact of motorcycle taxi services in rural Uganda and found that usage provided access to the wider economy and enabled social relations. Unlike some other countries in the region, motorcycle taxis were rarely used for educational or healthcare needs in rural Uganda, suggesting that their potential is presently untapped.

Motorised three-wheelers and trailers are able to carry loads of up to one tonne on rural roads when geared down to an appropriate speed, while the operating costs of these vehicles are approximately half of those compared to conventional vehicles (Dennis and Pullen, 2017). Profitable transport services developed using motorcycles and three-wheelers have the potential to aid development in rural areas. Overall, these vehicles are having a transformative effect on rural areas and the lives of rural people (Porter, 2014; Dennis and Pullen, 2017).

Olvera (2006) studied the benefits of mobile phones in relation to long-distance trading. Mobile phones enabled efficient information exchange, increased profits, expedited new business relationships and provided payment channels. Although the benefits of mobile phones in relation to transport mobility are increasingly evident, there is a lack of research and evidence on this issue. In many parts of rural Africa, non-smart mobile phones play an important role in enabling mobility. Mobile phones help connect demand for travel to the supply of motorcycle and three-wheeler taxis. Mobile phones have increased the use of transport services by allowing riders to store customers' contact details for future business, while providing customers with a rider to call when needed (Porter et al. 2013). Mobile phones enable those living in rural areas in sub-Saharan Africa to access numbers stored on their phones to call a motorcycle taxi and be taken to a major road to pick up an intercity bus within a matter of minutes (Porter, 2015).

The relationship between mobile phones and transport goes beyond linking demand to supply and is likely to become more entwined as new technologies are developed. The use of smartphone applications ('apps') is already starting to influence the use of motorcycle and three-wheeler taxis in sub-Saharan Africa, for example by enabling 'ride-hailing' with safety functions and competitive pricing for customers. To date, these apps have largely targeted urban populations as key service users, although there may be potential to expand their use in rural areas. This has the potential to increase transport accessibility for people living in these areas. While smartphone ownership in rural areas is currently low compared to urban areas, it is expected to grow substantially by 2025 (GMSA, 2018).

It is estimated that 16 billion ride-hailing trips were completed globally in 2017 and 24 billion trips in 2018 (ABI Research, 2018). Numerous ride-hailing companies exist, from major global players to local start-ups, which contribute to the proliferation of ride-hailing services and other transportation-related apps. In rural areas, these transport apps have the potential to provide customers with a means to pay for services via smartphones, reducing the need to carry cash, and consequently decreasing the risks of robbery and theft, contributing to positive implications for personal security. This safety factor also applies to the riders themselves; in some parts of Uganda motorcycle and three-

wheeler taxi riders travel in small groups after dark due to the threat of violence and theft.)

Advances in technology can leave certain sub-groups of the population behind. For example, individuals who do not have a mobile phone or smartphone will not be able to benefit from the improved mobility and increased security offered by ride-hailing apps and mobile money, while older people with less access to or experience of mobile technology may be left out of fast-developing transport innovations. Research in Tanzania demonstrated that motorcycle taxis and mobile technology can have major benefits for the mobility of older people in rural areas if support is provided (Porter, 2016). The use of motorcycle taxis and mobile phones helped improve older people's connectivity, especially in cases of limited mobility. Mobile phones are used by some older people as a substitute for travel, for example, when sending riders to collect medication or undertake other errands (Porter et al. 2012; Samuel et al. 2005). They also allowed vulnerable passengers to choose riders who were aware of and responsive to their specific needs.

Combining motorcycle and three-wheeler taxis with mobile phone technology also has the potential to help women overcome some of the challenges that they face when living in rural areas. As passengers, women can face cultural constraints that limit the use of motorcycle taxis, such as the need to sit in close proximity to male riders. However, the benefits that these vehicles offer women, such as reducing the time taken for daily tasks and decreasing the requirement for head loading are substantial. Women have embraced this mode of transport. In rural Sierra Leone and Liberia women make up approximately half of passengers, while in Douala, Cameroon, the majority of passengers are women (Olvera et al. 2012).

Methodology

The aim of this small-scale research study was to improve knowledge and understanding of effective ways to use technology to enable rural people to benefit from the safe use of motorcycle and three-wheeler taxis and thereby increase their access to essential services and development opportunities. The research aimed to highlight gaps in the evidence base and outline future research priorities on this topic. The research was commissioned by the Research for Community Access Partnership (ReCAP), funded by the UK's Department for International Development, and formed part of a larger-scale and broader-ranging four country study on understanding safe motorcycle and three-wheeler use for rural transport access.

The research comprised a literature review on the use of technology and its significance to motorcycle and three-wheeler transport systems. Insights were provided into initiatives that are using or promoting technology to improve rural access or to make transport safer. Gaps in the evidence base were also identified.

Primary research was also undertaken in four countries (Kenya, Rwanda, Tanzania and Uganda) through semi-structured interviews with key informants (motorcycle and three-wheeler taxi riders and the users and developers of mobile transport technologies). A total of 19 respondents were interviewed. In each country, the researcher travelled to peri-urban areas where at least one example of technology used in the context of motorcycle and three-wheeler taxis had been identified by the literature review. In each country, between 15–20 riders participated in focus group discussions in three locations,

including taxi ranks and vehicle repair shops. Most riders surveyed during the research were in their twenties or early thirties. In Kenya and Tanzania, the researcher also joined a rider on a trip and interacted with passengers in a three-wheeler vehicle. One methodological limitation was that it was sometimes difficult to ensure that focus group discussion participants stayed for the entire discussion; in some cases riders would leave the discussion if a client arrived and other riders would join the discussions part way through.

Results

Study country contexts

In Tanzania, motorcycle and three-wheeler taxis are a popular transport option. In some rural areas, poor road conditions make access to remote areas almost impossible by most four-wheeled vehicles. The number of motorcycles has grown very rapidly since the early 2000s. In 2016 there were over 1,280,000 registered motorcycles and three-wheelers (WHO, 2018). Motorcycles and three-wheelers make up 59 percent of the total vehicle fleet in Tanzania, with this figure rising to 90 percent in rural areas where 80 percent of the population lives. As shown in Table 1, a 2018 study found that 79 percent of rural motorcycle and three-wheeler taxi riders in Tanzania own a mobile phone (Adu et al. 2018).

Based on the relatively high levels of ownership of mobile phones there is potential to adopt mobile phone technology to enhance the safety of the rural transport system as well as the safety of both service users and service providers.

In Kenya, the Motorcycle Assemblers Association of Kenya (MAAK) estimates that more than 700,000 commercial motorcycles were on the road as of March 2018. Most of these vehicles are imported from either China (50 percent) or India (48 percent). The motorcycle and three-wheeler taxi business is valued at more than US$2.1 billion, higher than the revenues for large mobile operators such as Safaricom. The surge in the number of motorcycle users is driven by traffic congestion in urban areas (i.e. smaller vehicles can move around more easily in dense traffic), and poor road conditions in rural areas. In Nairobi, city authorities have introduced laws to ban motorcycle taxis from entering and travelling in the central business district. However, only 20 percent of commercial motorcycles operate in rural areas where 74 percent of the population resides. An increasing number of young Kenyans see the motorcycle and three-wheeler taxi business as lucrative, leading them to leave their farms and sell key assets such as livestock in order to purchase a motorcycle. In Kenya, 85 percent of rural motorcycle and three-wheeler taxi riders own a mobile phone (Adu et al. 2018).

Table 1. Percentage of motorcycle taxi riders that own a mobile phone (2018).

		Riders		
		Kenya %	Tanzania % Riders	Uganda %
Do you own a mobile phone that is in working order?	Yes	85%	79%	81%
	No	15%	21%	19%
	Total	100%	100%	100%

In Uganda, it is estimated that more than 500,000 motorcycle and three-wheeler taxis are in operation. Half of these vehicles are not registered. Traffic police data show at least 7,000 deaths occurring from motorcycle taxi-related accidents between 2014 and 2016. In 2015, of 25,000 motorcycle and three-wheeler taxi-related accidents, 350 passengers, 730 riders and 1,300 pedestrians were killed (Balikuddembe et al. 2017). Poor decision-making by riders appears to be a leading contributor to road traffic accidents involving motorcycle taxis. In Uganda a reported 81 percent of rural motorcycle and three-wheeler taxi riders own a mobile phone (Adu et al. 2018).

In Rwanda, the total number of motorcycles is about 100,000, mostly produced or assembled in-country by the Rwanda Motorcycle Company and Verma, an Indian-based company. Motorcycle and three-wheeler taxis contribute significantly to the economy and are strictly regulated. Discussions with the Rwandan Federation of Taxi Motor Drivers (FERWACOTAMO), an umbrella organisation for 250 motorcycle taxi cooperatives, indicated that the business was lucrative, well-regulated, and only conducted through a registered cooperative. Operating a motorcycle taxi generates up to US$35 per day per rider on average, much higher than in neighbouring countries. In Rwanda, the motorcycle and three-wheeler taxi business is estimated to generate US $1billion annually. Information on mobile phone ownership amongst riders was not collected in Rwanda as it was not part of the broader 2018 study.

Mobile technologies used in the motorcycle and three-wheeler taxi sector

A variety of technologies that are being used in the context of the motorcycle and three-wheeler taxi sector were identified during the study. The technologies include 'ride-hailing' apps; mobile money and Unstructured Supplementary Service Data (USSD)-based applications[1]; hotlines and reporting centres; and personal mobile contact lists. This section examines where the technology is being used, key target groups for the technology, opportunities to promote social inclusion, potential application of the technology in rural areas and the technology's potential to enhance personal safety.

Ride-hailing apps

In the four study countries, ride-hailing apps are used primarily in cities and urban areas, with little penetration into peri-urban and rural areas. The predominantly urban focus is due to a combination of factors: the existence of a critical mass of customers who can afford to use the services; existence of riders who can afford or are willing to purchase smartphones; and the availability of adequate signal coverage for the apps themselves. There is enormous potential for these services to be expanded into rural areas, but successful expansion depends on the commercial interests of the companies concerned; rural people's ability to afford smartphones; and the level of investment in the infrastructure that is required for efficient operation of smartphones.

The ride – hailing apps market contains a mixture of locally established and foreign companies, with large-scale players such as Uber and Taxify competing with local start-ups. All the hailing apps examined during the research use a mobile application that allows potential customers to request a taxi or private driver using their smartphone. Apps are developed using blockchain technology to coordinate taxi riders and deliver

transportation services. Many of these companies now include motorcycle taxi or three-wheeler services, who use the same smart phone application as other taxi drivers. To sign up to a service, riders must own a smartphone, with some companies providing these. Some riders are required to undergo rider training, which includes a road safety component. All the hailing apps require GPS so that riders can charge customers accurately. Some apps are exploring fixed charges, while others have gone further to offer free rides as part of their marketing campaigns. The services are geo-fenced (i.e. the app software triggers a response if the mobile device leaves a pre-defined service area). The main users of hailing apps are reported to be middle class males and females in their mid-twenties to mid-thirties, although survey data on users was not collected as part of this research.

Little Cabs is a Kenyan ride-hailing app backed by telecoms operator Safaricom. Little Cabs allows customers to pay for their or another person's ride through Safaricom's mobile money service (M-Pesa), buy discounted airtime during the trip and access free Wi-Fi. It also lets women exclusively request female riders from 6pm to 6am for safety reasons. Safaricom provides the technology platform on which the app operates, with customers needing to have a smartphone to use the service. Fees are charged based on distance travelled and customers get notification of the fees on their mobile phones. A cash payment option also exists. By using the app, customers can also rate the driver. There is a hotline which can be used in case of accidents or to register complaints about the service. Little Cab allows non-smartphone users to hail a cab through a USSD system, thereby increasing access to the technology.

In Kenya, the Maramoja app runs like most ride-hailing apps. It uses social media platforms such as Facebook and artificial intelligence to assign the driver a trust score. Maramoja uses its trust-based taxi app franchise to grow its market based on trusted relationships created on social media. Customers are offered fixed prices and flexible payment options. Maramoja has a feature that lets passengers report accidents, attacks or other emergencies. Riders accept mobile money, credit, cash, and corporate invoicing.

In Tanzania, the Tigo Twende ride-hailing app was launched in 2017. The app links riders to passengers, both of whom need to have the application on their smartphones in order to use the service. The Tigo Twende app contains the contact details of motorcycle and three-wheeler taxi riders who are vetted by their respective riders' associations. The app uses live GPS maps to link riders to passengers, with payments made using mobile money. All 1,500 three-wheeler taxi (Bajaj) and motorcycle taxi (boda boda) riders who use the app are male. Tigo Twende currently provides mobile phones to recruited riders. Both riders and users download the app for free. Tigo Twende do not train riders themselves, but require that riders are trained by their unions, and that their vehicles obtain the adequate registration paperwork as required by law. Most users of the Tigo Twende app are males and females in the age range 25-30, who are young professionals with some college education. One issue that concerns riders who use the apps is the security of their mobile phone; once it is lost or broken, the driver is not able to participate on the network and revenue is lost for Tigo Twende. Phones can cost up to 80 percent of a months' taxi earnings, making them very expensive to replace. Tigo Twende believe that their application can be adapted for use in rural areas, mainly because it uses low-bandwidth internet and because it can be adapted to use USSD. Currently, the main barriers to using this technology in rural areas are poor connectivity, low availability of GPS, and the absence of a critical mass of users in a given geographical area.

Taxify is a ride-sharing platform and ride-hailing app that is operational in Kenya (Nairobi, Mombasa) Tanzania (Dar es Salaam, Mwanza) and Uganda (Kampala). The company headquarters are in Tallinn, Estonia. Taxify includes a motorcycle and three-wheeler taxi service in Kenya, and the service uses the same application as regular taxis. Safety precautions include requiring that each driver carries two helmets and two jackets. All passengers are required to wear a helmet and jacket with reflectors when on a motorcycle. Riders are screened by a third-party safety partner who is also given responsibility to respond to any accidents. Riders who wish to sign onto the service have to provide their own mobile phone and undergo driver training. The app requires GPS to charge customers accurately, although an option for fixed charges is being developed. Like most ride-hailing apps, the service is geo-fenced, requires a smartphone for both the driver and the user and does not have an option for USSD. In both Tanzania and Kenya, the Taxify team reported the main users to be middle class males and females in their mid-twenties to mid-thirties.

Uber began operations in East Africa in 2015. At the time of the study the company was operating in four cities (Nairobi and Mombasa in Kenya; Dar es Salaam, Tanzania; and Kampala, Uganda). Like the other ride-hailing apps, the Uber service can be accessed from the company websites and mobile apps. In East Africa, Uber has recruited at least 5,000 drivers of four-wheeled vehicles, and launched UberBoda, the motorcycle version of its services in Nairobi, Dar es Salaam and Kampala. In Kenya, Tanzania and Uganda driver requirements include a valid driving licence and public service vehicle licence. Riders are screened and require a certificate of good conduct. Vehicles are also required to have adequate paperwork. Uber provides riders and passengers with an emergency hotline. Uber uses a number of marketing innovations. This includes ensuring that service materials such as posters and pamphlets are available in public places that potential customers are known to frequent. Uber's app now locks out its riders for six hours if they have been logged in and working for 12 straight hours. This is done to reduce the risk of driving when fatigued.

MondoRide operates in Kenya (Nairobi and Kisumu), Tanzania (Dar es Salaam) and Uganda (Kampala). It offers regular taxi services alongside motorcycle and three-wheeler taxi services. The firm differentiates itself through ride options tailored to suit each region's specific transport requirements. According to the app's developers, the focus for growth lies in the understanding of what each target city needs, and then developing an option that is tailor-made. In some contexts, incentives are provided for businesses that regularly use the service. The company operates a 24-hour call centre, and trains recruited riders on safety procedures. MondoRide's business focus allows companies to hail rides for employees and clients and to track their spending on both an individual and departmental level. Long-distance journeys to other cities are catered for, based on a predetermined price. The app allows customers to choose from a range of hailing options, which can be selected based on their financial means.

In Rwanda, Yego Moto uses an app that is similar to that used by Uber and Taxify. There are 680 registered riders. Like other providers, Yego Moto uses GPS devices installed on motorcycles to deliver information about the journey covered by a passenger. Installation of the system on a motorcycle is free, and helmets are also provided at no cost. Riders are trained on customer behaviour, management and other related skills. One challenge with the app relates to the use of GPS in Rwanda, which is a hilly

country. Although distances are calculated correctly, it is difficult to include a terrain factor in pricing.

Another notable player in Rwanda is start-up SafeMotos which was conceived as an Uber for African motorcycle taxis. SafeMotos uses GPS data to measure real time driver safety. The company offers its app to riders and passengers to pinpoint pickup spots, metre fares and facilitate payments. Although less than three percent of their 5,000 riders are currently female, SafeMotos plans to offer an all-female motorcycle-taxi service in future. SafeMotos is highly localised, targeting trips where it can provide sufficient customer value to be profitable at a per trip level. More than 50 percent of rides are paid for using mobile money.

In Uganda, SafeBoda is using modern technology to provide safer rides to motorcycle taxi passengers, while increasing profitability and improving rider regulation. The ride-hailing app links customers with a community of trained professional riders. The Shell Foundation has supported SafeBoda to increase its driver fleet and develop strategic partnerships with the Global Road Safety Partnership and the Kampala police. A report by the Shell Foundation into the impact of the service on female passengers indicated that women think that SafeBoda is safer than most motorcycle-taxis and is reliable during night rides (7-10pm). Women felt that Safeboda services are sensitive to the needs of women users, riders are linked to a trusted institution, riders can be identified and tracked using the app and their identity numbers, and riders are not intimidating or rude to women passengers. Other feedback was that the credit option which allows users to pay later removes the need to negotiate fares with male riders (Nesbitt-Ahmed and Fraser, 2017). SafeBoda continues to attract investment with the recent announcement (at the time of writing) of a strategic partnership with Allianz.

Personal mobile phone contact lists

Where ride-hailing apps are not in use, motorcycle and three-wheeler taxi riders tend to rely on contact lists they create on their mobile phones. In all four study countries, riders belonged to cooperatives or unions and used mobile phones extensively for communication, business and sharing intelligence. In Gitarama, Rwanda, motorcycle riders interviewed as part of the study were members of the Rwanda Federation of Taxi Motor Drivers (FERWACOTAMO). Most riders pick up clients from the town centre and take them to their rural homes. Each driver maintains their own list of clients and is responsible for developing their own customer base. A similar situation was found in Kenya. In Kenya and Tanzania, a common meeting point for motorcycle taxis and three-wheelers are repair centres. In Tanzania, local rider associations often meet at repair centres. Meetings are coordinated using mobile phones.

Passengers also create their own contact lists by storing preferred riders' numbers on their mobile phones. This allows passengers to call their preferred riders, which is especially beneficial to vulnerable people who may have specific needs (e.g. being assisted onto a vehicle; travelling slowly and avoiding bumps etc.). Some users utilise the numbers stored on their mobile phones to ask trusted riders to collect items such as medical prescriptions, which reduces their need to travel.

Safety and security concerns of riders

Some users and motorcycle and three-wheeler riders raised concerns regarding the use of mobile technologies in both urban and rural areas. Fear of vehicle theft was reported as a serious concern for many riders, especially in peri-urban Dar es Salaam. Riders indicated that they were sometimes reticent to respond to new clients who called them on a mobile phone. In one location visited in Kinondoni, Tanzania, security was a serious problem. Reports of motorcycle thefts were recorded every 2–3 days. One rider who had lost a son (and motorcycle) to armed robbers felt that technology should be used to track all motorcycles, including those in rural areas where stolen vehicles were often sold. This rider felt that manufacturers should be mandated to install security features on the motorcycles, such as microchips that would make it easier to arrest and convict criminals.

The safety of the phones themselves was a further concern. Riders indicated that they often dropped their phones in situations where their vehicles lacked a proper phone holder. Special protectors for smart phones were deemed expensive and many riders indicated that they were not prepared to invest in these. Riders also felt that smart phones were more susceptible to theft than old-style phones, leaving them feeling at risk. Lost or stolen phones are also expensive to replace relative to a rider's income. As a result, most riders indicated that they preferred older mobile phones with keypads. Regardless of what type of phone is used, driver distraction due to using the phones while driving is a major safety issue for riders and passengers.

Mobile phone technology use in rural development projects

The research also explored how mobile phones are currently being used in a number of rural development initiatives located in the four study countries. The aim was to identify promising innovations with the potential to be scaled up to improve rural people's mobility and access to essential services and opportunities.

In Tanzania, the Marie Stopes organisation provides sexual and reproductive health and family planning services to approximately one third of the population. Thirty-five mobile outreach teams have been created to serve clients living in remote rural areas in every region of the country. This includes 13 three-wheeler or 'Bajaji' mobile outreach teams of nurses who serve migrant clients in peri-urban and urban slum areas. Marie Stopes' outreach programme has a hotline that clients can use to check the areas that are served by the outreach teams. The outreach motorcycle fleet is fitted with GPS trackers which allows each mobile team's movements to be tracked by service co-ordinators. Outreach field teams are trained on how to use a mobile outreach app which is linked to a central database and hospital management information system. All data are recorded onto tablet computers which sync with a central database.

In Mbale, eastern Uganda, 212 motorcycle and three-wheeler taxi riders have been trained to transfer sick children from villages to health facilities as part of a Malaria Consortium project to reduce child deaths in the region. The project is funded by Comic Relief. Village Health Teams are trained to recognise the symptoms of malaria and other childhood illnesses, to ensure the availability of medicines and other health supplies in health facilities and to establish a functional community-facility referral system. Motorcycle taxi riders are trained by the Ugandan police force and Mbale District

Health Team on traffic rules and how to treat and handle patients. The intervention aims to improve referral times between the community and a health facility. Community members can contact riders via mobile phones that are located at intervention health facilities. Community health volunteers also keep records of all active motorcycle taxi riders in their area. Village Health Team leaders in each village provide riders with vouchers according to the distance they have to cover to transport patients to a health facility. The riders are then paid by the health worker at the health facility upon presentation of the voucher.

In a similar project implemented by Transaid in five districts in Uganda between 2012 and 2016, motorcycle taxi riders were trained to transfer pregnant women to a local health facility at a reduced fee. A total of 3,720 women were transported over a seven-month period. Over this timeframe, journey costs for pregnant women were reduced considerably (by as much as 42 percent in one area). A qualitative study implemented by the project identified reduced journey times and an increased willingness on the part of riders to provide credit to pregnant women using the service. The riders anecdotally reported that their business had improved even though they had lowered their fees for pregnant women.

In Tanzania, the Tanzania Rural Health Movement uses short message service (SMS) app-based emergency medical dispatching software designed specifically for communities that cannot afford advanced dispatching technologies. By relaying an SMS from the scene of an emergency to trained responders throughout the community, the software enables the nearest available emergency care providers to quickly locate, treat and transport individuals experiencing a health emergency to local hospitals. The Community First Response Project was launched in Mwanza Region in 2015 in partnership with Fire and Rescue Force-Mwanza. This initiative uses trained community first responders recruited from among motorcycle riders, traffic police and fire-fighters. Victims of an emergency can call for help from community first responders who are given first aid training and medical supplies. In many cases, motorcycle and three-wheeler riders who are members will respond. Although initially focused on Mwanza city, the scheme is now serving communities within a 15-kilometre radius of the city.

Discussion

The research reported here has identified a range of initiatives that combine mobile phone technology with motorcycle and three-wheeler transportation to improve people's access to essential services, markets and other development opportunities in Kenya, Rwanda, Tanzania and Uganda. There appears to be considerable scope to expand or scale-up some of these initiatives in order to improve rural access and mobility.

The affordability of motorcycles and three wheelers is increasing in rural areas in the four study countries. The rise in vehicle ownership in urban areas is having a ripple effect on rural areas, where motorcycles and three-wheelers are often purchased second hand. The research found that as competition in urban areas continues to increase, some riders with older vehicles are beginning to favour rural routes. The increase in availability of taxis for hire in rural areas will, in turn, increase rural people's mobility and access to

essential services and development opportunities and hence represents a significant development opportunity.

The proliferation of ride-hailing apps is primarily an urban phenomenon, although there is potential to extend these services into rural areas with the right mix of incentives and with improved rural access to smartphones. The way in which Little Cabs (Kenya) has adapted its rider hailing system for non-smart phone users, and Tigo Twende's (Tanzania) recognition of the feasibility of doing this, offers significant potential for rural areas. However, growing ownership of phones and smart phones in rural areas, also offers considerable opportunities for expansion of new technologies into these areas. The extent of smartphone ownership among the taxi riders' rural client base is also important. Table 2 suggests that mobile phone ownership amongst passengers is relatively high in Kenya, Tanzania and Uganda (Adu et al. 2018). In Kenya and Tanzania the opportunities to establish rural ride-hailing services may be most encouraging, with 53 and 42 percent respectively of motorcycle and three-wheeler taxi passengers in rural areas indicating that they own a smartphone.

Ride-hailing apps provide customers with a number of benefits. They provide greater transparency regarding the pricing of journeys and remove the need for customers to negotiate prices, as well as offering customers greater choice by allowing them to select what type of vehicle they would like. The use of mobile payments can also help with the safety of riders as they are no longer required to carry money around with them. These factors are likely to be especially helpful for more vulnerable customers. The operators of the ride-hailing apps are also helping to improve road safety by requiring riders to meet certain standards, as well as requiring riders and customers to wear protective clothing. Riders are screened, often by a third-party safety partner who is also given responsibility to respond to any accidents.

The main user group for ride-hailing apps in urban areas are young professionals. Some companies are specifically tailoring services to meet women users' needs (e.g. SafeMotos in Rwanda and SafeBoda in Uganda). A more inclusive and responsive service is likely to be good for business, increasing demand for transport services and increasing riders' and owners' income. Research undertaken by HelpAge International in Kenya, Rwanda, Tanzania and Uganda found that motorcycle taxis and mobile phones can support the transport and other related needs of older people, including in rural areas (Porter et al. 2013). This is an age group that has potential to be excluded from technological innovation and other new developments. HelpAge's research identified that 41 percent of older men and 15 percent of older women owned mobile phones in rural

Table 2. Mobile phone and smart phone ownership amongst passengers in Kenya, Tanzania and Uganda.

		Passengers		
		Kenya %	Tanzania %	Uganda %
Do you own a mobile phone that is in working order?	Yes	89%	72%	74%
	No	11%	28%	26%
	Total	100%	100%	100%
If yes, does it have internet access?	Yes	53%	42%	29%
	No	47%	58%	71%
	Total	100%	100%	100%

Tanzania, while most of the remainder were able to access phones through relatives and friends. Motorcycle and three-wheeler taxi services were especially efficient when requested through mobile phones, as older people are able to order services from reliable riders who are cognisant of their needs. Mobile phones provide 'virtual mobility' to older people as they are able to call in support, while physical travel was reserved for 'important reasons'. There is potential to modify motorcycle and three-wheeler taxis to suit the transport needs of sick and vulnerable people, and to promote access to markets for these groups (ibid, 2013).

There are a number of challenges to rolling out ride-hailing services to peri-urban and rural areas. Riders subscribing to a ride-hailing app would need to own a smartphone and have reliable access to the internet. Recent related research in Kenya, Tanzania and Uganda found that the majority of rural riders and passengers have access to a mobile phone, although smart phone ownership is still relatively low. Riders also need to ensure that they have a reliable means of recharging their phone. Currently, many of the ride-hailing apps do not have options for non-smartphones (Little Cabs in Kenya is the exception). Riders who operate in peri-urban and rural areas indicated that they prefer older style phones (i.e. non-smart phones) due to their longer battery life and the lack of reliable facilities for recharging their phones. Portable solar-powered chargers or kiosks that offer mobile phone charging services could offer a solution to this challenge.

The research highlights examples of people in rural areas utilising the added advantages of mobile phones and motorcycle and three-wheeler transport options. Use at individual level is largely driven by personal contact lists (of clients or riders), and there is little coordination of service provision. Common meeting points with riders are shopping centres and cycle repair shops. This means that there is the possibility for mobile technology to enhance the safety of rural transport systems. However, in the peri-urban and rural areas visited in Rwanda, Tanzania and Uganda most riders mentioned that only a small fraction of their business was conducted using mobile phones. Most relied on collecting customers from designated ranks and would only respond to phone calls from customers they knew well. In many cases, customers would call for a taxi but use the first option that they found available. This often meant that the driver they had called upon would find that the passenger had already gone.

In the four study countries, organisations such as Tanzania Rural Health Movement, Malaria Consortium and Marie Stopes are utilising the synergies embedded in the combination of mobile phones and motorcycle and three-wheeler taxis, resulting in improved access to health care, including for health emergencies, and other development outcomes. The interventions that were reviewed as part of this research demonstrate potential to be scaled up to achieve greater population coverage in the country of implementation, and also to be adopted by other countries. Further research is required to determine their suitability to be implemented on a larger scale.

Conclusions

This research has found that mobile phones play a key role in the motorcycle and three-wheeler taxi sector, connecting passengers to riders. In urban areas, the use of smartphone ride-hailing applications is increasing. However, in rural areas, internet-based ride-hailing applications are not yet in use. There is considerable potential for these

services to be expanded into rural areas, especially in the context of growing smartphone ownership. However, successful expansion depends on the commercial interests of the companies concerned; rural people's ability to afford smartphones; and the level of investment in the infrastructure that is required for efficient operation of smartphones. In Kenya and Tanzania where smart phone ownership is higher than Uganda, there is more potential for the technology. For all the study countries, there are potentially interesting lessons from Little Cabs' use of USSD technology, which could be extended to rural areas with the right business and other incentives.

In the context of increasing uptake of smartphones and access to the internet in rural areas in the study countries, technology offers the potential to address some of the challenges related to use of motorcycle and three-wheeler taxis in these areas. For example, the use of mobile money is widespread in rural areas, allowing less cash to be carried and so reducing the security risks associated with handling cash. Mobile phone technology is being combined with motorcycle and three-wheeler use in creative ways in various development projects to improve people's access to essential services, including emergency healthcare. Further research into the effectiveness, impact and potential scalability of these promising initiatives is recommended.

By identifying the successes and current challenges with use of mobile phone technology in rural areas of Kenya, Rwanda, Tanzania, and Uganda, this research aimed to identify some of the steps required by government and the private sector (e.g. transport providers, mobile technology developers) to further expand the reach and benefits provided by mobile phone technologies. This includes the benefits of increased access to healthcare, education and jobs.

Key themes for further research include the following four topics: first, assessing the appropriateness and feasibility of extending ride-hailing apps into rural areas using USSD technology; second, exploring the potential role of rider associations in promotion of ride-hailing apps in rural areas; third, examining the role of government in supporting rider associations to set up ride hailing schemes, especially if combined with road safety training and a means by which government can channel road safety and health-related messages to riders who are at risk from both road traffic incidents and lifestyle choices; and, finally, exploring the scope to scale up some of the innovative initiatives that are combining mobile phone technology and motorcycle and three-wheeler taxi riders to increase emergency and routine health care access in hard to reach areas.

Note

1. The Global System for Mobile (GSM) communication technology that is used to send texts between a mobile phone and an application programme in the network. Applications may include prepaid roaming or mobile chatting or banking.

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