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Who could benefit from a bus rapid transit system in cities from developing countries? A case study from Kampala, Uganda

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ABSTRACT

The present rapid urban growth of cities from developing countries causes negative externalities such as lagging infrastructure development. In combination with rapidly rising motorized vehicle use this leads to severe traffic congestion affecting the mobility of the urban residents. Therefore many urban governments are planning to improve their transport and mobility situations with mass rapid transit systems of which a bus rapid transit (BRT) is a rather easy system to implement at reasonable costs. However, due to high urban inequalities the effects of urban traffic and potential improvements of the urban transport system for the diverse group of urban residents can differ significantly. In our case study Kampala (Uganda) four main groups were identified through cluster analysis of socio-economic and residential data gathered through interviews: extreme poor, poor, middle income and rich. Each group experiences a different mobility with the extreme poor being the most vulnerable group. The planned BRT system aims to decrease the average travel time but risks to exclude the lowest income class since not enough attention is paid to the affordability of the system to all residents. Therefore we argue for a policy that works from bottom up and pays attention to the internal diversity of the population.

1. Introduction

Worldwide the urban population is growing at an average rate of 2% (The World Bank, 2014b) mainly because of natural growth and rural–urban migration. Urban growth is associated with a shift from a rural to an industrial and service society. The 21st century hotspots of urban growth are situated in Africa, Asia and Latin-America. Here, rapid economic growth pushes income levels upwards and improves living standards. Also in Sub Saharan Africa (SSA), World Bank statistics (2014b) show that in many cases the economic growth exceeds urban population growth (Fig. 1). However, income distribution remains highly uneven and many rural-to-urban immigrants in the developing world do not benefit from this evolution and end up in difficult living conditions. This economic exclusion is exacerbated by spatial inequalities that result from uncontrolled urban sprawl. Many new urban neighbourhoods lack access to basic utilities such as electricity, water and an efficient transport network. Trip distances increase and as a result, dependency on car and other motorized types of traffic is on the rise (Zhao, 2010). Lagging infrastructure development and rapidly rising motorized vehicle use induce severe traffic congestion (Gwilliam, 2003).

Hence, urban growth decreases individual mobility. An individual is considered highly mobile when he or she is able to easily and comfortably reach his or her destination(s) in space and time. This is dependent on a city's transportation network and the modes and characteristics of the individual trips. A person's mobility determines his or her livelihood opportunities (Bryceson et al., 2003b; Tacoli and Mabala, 2010); thus, urban transport planning can have a major impact upon urban poverty patterns.

In cooperation with initiatives from development aid institutions, several (urban) governments in SSA are developing plans to improve their transport and mobility situations. A popular solution suggested by policy makers is the implementation of a bus rapid transit (BRT) system on major roads. BRT is a bus service with many characteristics of a rail network. Buses form the high capacity fleet and operate along fixed routes with preserved lanes and

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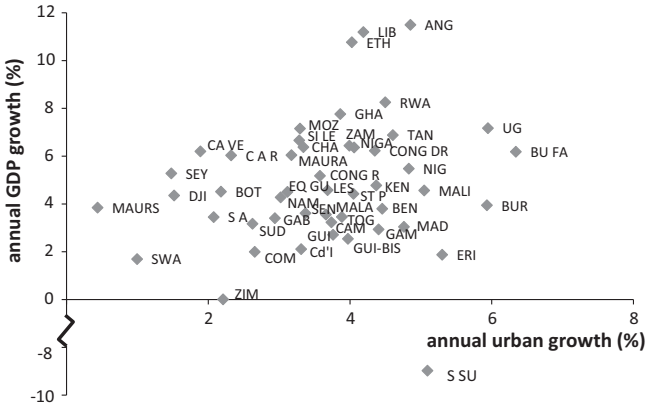

Fig. 1. Average annual growth rates between 2005 and 2012 of GDP and urban growth of Sub-Saharan countries (The World Bank, 2014a,b) (with ANG – Angola, Ben – Benin, BOT – Botswana, BU FA – Burkina Faso, BUR – Burundi, CAM – Cameroon, CA VE – Cabo Verde, C A R – Central African Republic, CHA – Chad, COM – Comoros, CONG DR – Democratic Republic of Congo, CONG R – Republic of Congo, Cd'I – Cote d'Ivoire, DJI – Djibouti, EQ GU – Equatorial Guinea, ERI – Eritrea, ETH – Ethiopia, GAB – Gabon, GAM – Gambia, GHA – Ghana, GUI – Guinea, GUI-BIS – Guinea-Bissau, KEN – Kenya, LES – Lesotho, LIB – Liberia, MAD – Madagascar, MALA – Malawi, MALI – Mali, MAURA – Mauritania, MAURS – Mauritius, MOZ – Mozambique, NAM – Namibia, NIG – Niger, NIGA – Nigeria, RWA – Rwanda, ST P – Sao Tome and Principe, SEN – Senegal, SEY – Seychelles, SI LE – Sierra Leone, SOM – Somalia, S A – South Africa, S SUD – South Sudan, SUD – Sudan, SWA – Swaziland, TAN – Tanzania, TOG – Togo, UG – Uganda, ZAM – Zambia, ZIM – Zimbabwe).

fixed stations, which are embedded within or added to the existing urban infrastructure. BRT case studies proved to be efficient in alleviating traffic pressure at reasonable costs (Levinson et al., 2003). BRT is a frequently cited strategy in North-, Latin America and Europe (Deng and Nelson, 2011) with reported travel time savings of 25–35% (Levinson et al., 2003; ITP, 2010; Prassas, 2013). Although the needs for efficient and affordable mass transit systems like BRT are high in the rapidly growing African cities, the operating examples are limited (Table 1).

Often, urban transport planning focuses on quantitative demands while socio-economic diversity of the demanding group is not studied (Jaramillo et al., 2012). Hagerstrand's space–time geography (Hagerstrand, 1970; Shaw, 2012) forms a very useful framework in which to study the mobility patterns of contrasting agent types on one hand and to detect spatial bottlenecks on the other. When the travel activity of agents is presented in space, they can be linked to individual's and/or household's attributes and can therefore be used to study and model travel activities (Kwan, 2000). Mapping the travels and calculating the characteristics (distance, time) based on individual transportation habits and/or preferences allows to evaluate present and to simulate future trends. In this way, urban mobility studies can become decision support tools for urban planners.

At present, however, most African cities lack detailed and up-to-date information on the livelihood and mobility of city residents. This has in turn rendered governments powerless and thus incapable of preparing African cities for future travel demands. Therefore in this paper a livelihood typology is carried out and linked to a mobility analysis. In our case study Kampala (Uganda), as in many cities in developing countries, minibuses play an important role in urban transit. The growing number of these vehicles and their outdated equipment heavily contribute to major environmental and traffic problems with long travel times as a consequence (Mattrisch and Weiss, 2008). Planning suggests to introduce a BRT in order to alleviate traffic pressure and to reduce the travel times of commuters. An evaluation of this proposal is needed by simulating the potential impact on the present mobility situation for different socio-economic groups.

Table 1
List of African bus rapid transit systems (population numbers of latest national census: Statistics South Africa, 2013; NBS Tanzania, 2012; UBOS, 2010a).

Country	City	Inhabitants (millions)	Operational status	Key source
Nigeria	Lagos	17.5	Operational since 2008	Olufemi (2008)
South Africa	Cape Town	3.4	First phases since 2010	Cape Town Government (2014)
	Durban	2.8	Planning	GoDurban (2014)
	Johannesburg	7.9	First phases since 2009	South Africa Government Online (2014)
	Port Elizabeth (Nelson Mandela Bay)	0.9	Planning	Nelson Mandela Bay Municipality (2014)
	Pretoria (Tschwane)	1.8	Constructing	South Africa Government Online (2014)
	Rustenburg	0.3	Planned for 2016	Rustenburg Local Municipality (2014)
Tanzania	Dar es Salaam	4.4	Constructing	Nkurunziza et al. (2012)
Uganda	Kampala	1.8	Planning	ITP (2010)

2. Case study area: Kampala, Uganda

The transport situation of Kampala is a typical Sub Saharan African case study (Kumar and Barrett, 2008). The prime city has spread out organically along a radial road network that leads all local as well as regional traffic through the very dense city centre (Vermeiren et al., 2012). The CBD (central business district) and near surroundings form the main employment centre with multi-story trade and office buildings and even house a large part of the country's industry. In 2009 a northern ring road became operational that slightly reduced the heavy urban traffic in the city centre but is already affected with congestion itself. Due to the rapid urban sprawl, the ring road of 2009 is at present already captured within the residential area of the city. As a result it takes 1–2 h on average to reach Kampala's CBD from the surrounding suburbs by means of motorized transport.

Kampala is currently estimated to house at present around 1.8 million residents (UBOS, 2010a) but because of its role as prime city and major economic hub of the country, the average day-time population is on average estimated at double the official resident number (Emuron et al., 2010). Kampala has sprawled out far beyond its administrative boundaries in the past decades affecting surrounding municipalities. Local governments are now discussing whether or not to establish a Greater Kampala Metropolitan Region (Fig. 2) that encompasses the whole functional urban region. Future growth scenarios predict a continued exponential urbanization which will severely exacerbate traffic congestion.

People use four main modes of traffic: on foot, by *taxi*, *boda-boda* and private cars (Fig. 3). The majority of commuters goes to work by walking, yet footpaths are not always provided and if present, are rarely in good physical condition or even dangerous due to potholes and uncovered manholes. Moreover, large parts of sidewalks in urban areas are occupied by street vendors. On the roadway, private vehicles, *taxis* and *boda-bodas*, dominate. The so-called taxis – or matatus – are mini vans that are privately run but serve as 'informal' public transport. They offer legal seats to 14 fee-paying passengers and are free to choose their routes

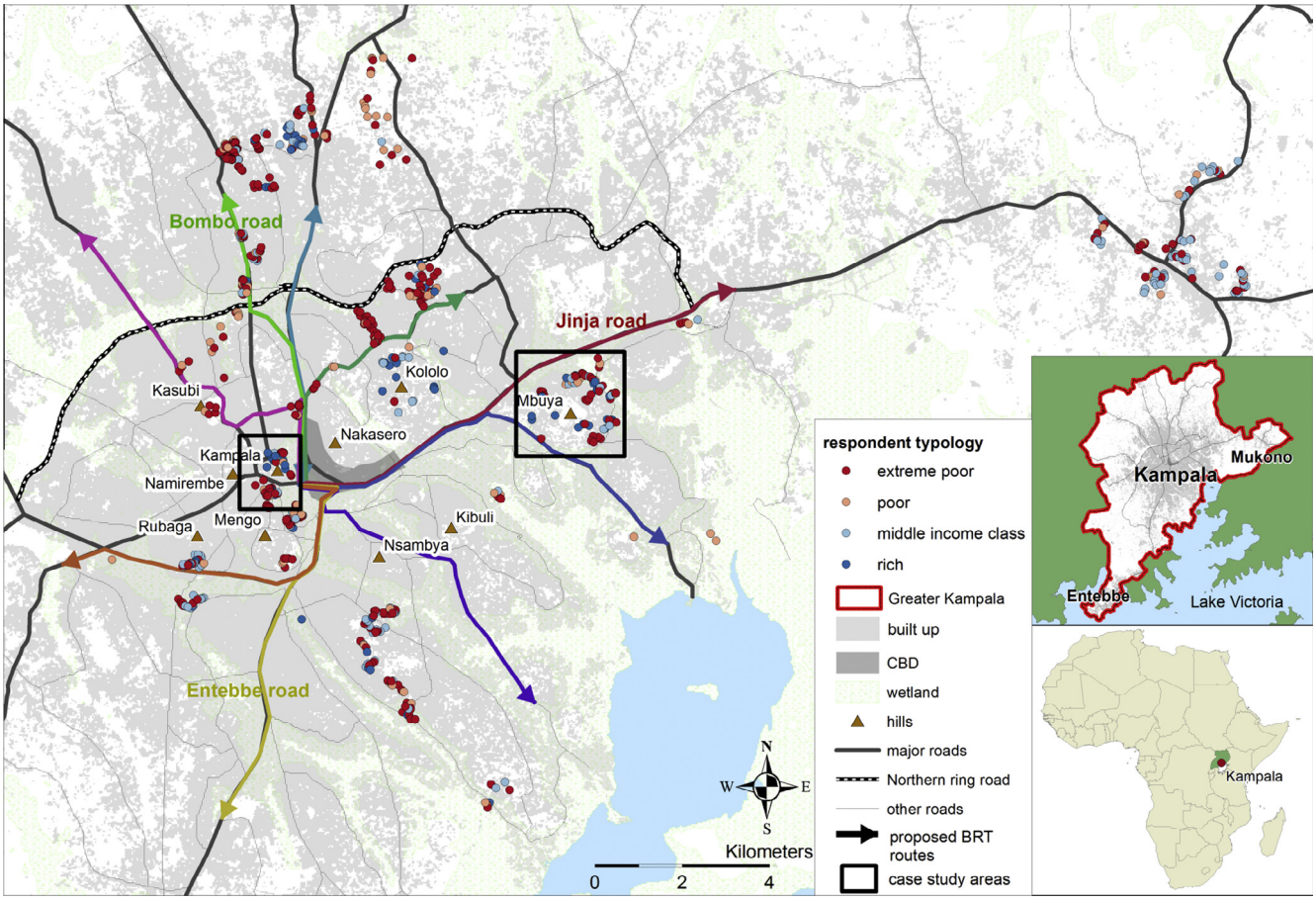

Fig. 2. Overview of case study area: respondent types and location, proposed BRT routes (own data; ITP, 2010).

but serve more or less fixed routes directed by demand. According to official numbers taxis only represent ca. 20% of all vehicles on urban roads, however they are responsible for the transit of approximately 80% of Kampala's road passengers (KCCA, 2013). *Boda-bodas* are motorbike-taxis that became a popular mode of transport due to the poor state of roads and traffic congestion (Kumar, 2011). They offer their customers (officially restricted to one) a relatively fast and flexible ride. Their popularity is tempered by the large number of accidents involving boda-bodas but nevertheless are frequently used – especially by commuters seeking to avoid heavy traffic. Bicycles are few in Kampala. Heavy traffic, infrastructure conditions and topography make it hard to ride a bike in the city. Buses in Uganda are the main mode of transport for long distance travel, but do not yet serve intra-urban movements. The Kampala City Council Authority (KCCA, 2013) in cooperation with the World Bank are presently developing an introduction plan for a bus rapid transit (BRT) system in the Greater Kampala Metropolitan Area to reduce road congestion. According to a pre-feasibility study (ITP, 2010) the matatu taxis often carry excess passengers. This causes discomfort to the passengers and increases travel times because the taxis frequently and irregularly stop to drop off or pick up passengers along the route. Moreover the report mentions passenger dissatisfaction with peak-hour extortion. Therefore, the city wants to engage with the taxi-operators for the implementation of a BRT system in order to upgrade Kampala to a "secure, economically vibrant, well managed, sustainable and environmentally pleasant city" – as cited in the Council's vision of the city (ITP, 2010, p.I). The BRT project proposes to deploy 25-seater-minibusses that follow fixed routes with fixed stops. The routes are proposed to follow the major traffic flows in separate lanes and are therefore radiate from the city centre but in contrast to existing transport modes are intended to use the infrastructure more efficiently and thereby significantly reduce traffic congestion and air pollution.

3. Materials and methods

Throughout a four year period (2010–2013) almost 800 residents were interviewed in various, and contrasting neighbourhoods of the Greater Kampala Metropolitan Area (Fig. 2). The aim of the interviews was to identify the main social groups of the Kampala residents. Therefore, in consultation with local research partners from the Makerere University and Kampala Capital City Authority, a range of neighbourhoods with contrasting social statuses were selected, including upper class neighbourhoods, middle class neighbourhood, neighbourhoods with mixed social classes and slum areas. Respondents were selected by a random door-to-door sampling approach during neighbourhood walks covering the main residential sites of an area. This method of sampling is used as an explorative rather than as a representative respondent selection procedure.

The residential location of respondents was registered during the interviews by means of a Garmin 60–62 handheld GPS with planimetric accuracy of 10 m and plotted on a map. During the interviews – which were carried out within the framework of different field work missions – the socio-economic status of the respondents and their households was established. The interviews were processed to numerical and ordinal categorical variables. The resulting data table was used as input for a cluster analysis to

Fig. 3. Main transport modes in Kampala: from up left to down right foot, *taxi*, *boda-boda*, car (own photos).

identify homogeneous groups within the dataset (Table 2). Variables such as housing and household size relate to the whole household while education level refers only to the education level of the head of the household. The income per person is the average daily income calculated by dividing the household income by the number of household members. All monetary values refer to the reported values during the research of 2010–2013. Job security indicates the stability of income; whether an income is assured daily and is related to all active household members, if that data was available. By means of a Ward clustering method (Ward, 1963; Aldenderfer and Blashfield, 1984), groups were identified with a maximal variability between the groups and a minimal variation between group members. This is a hierarchical agglomerative clustering method whereby observations are merged step by step to clusters based on the similarity of the added observation to the average of the clusters. For each merging step indicators describe the homogeneity within the clusters and the variation amongst clusters. The merging or clustering is ideally stopped at the point where these indicators suggest a large loss of intra-cluster homogeneity and inter-cluster variance. This allows to determine the optimal number of clusters.

To describe the characteristics of the resulting clusters, scores are assigned to each variable in the form of *T*-values. A *T*-value is calculated according to the following formula:

$$T = (X_k - X)/s(x) \quad (1)$$

With X_k = average of a variable x within group k, X = average of variable x and $s(x)$ = standard deviation of the variable x. A positive *T*-value for a certain variable indicates that the group scores more than average on that variable. The *T*-values of resulting groups on all variables allowed to describe the socio-economic characteristics of an average group member and to conclude about popular livelihood strategies.

A subset of this data was gathered during the period July–August 2011. This research mission targeted two study area zones within Kampala: one located in the centre and one in the suburbs. The central parish (the lowest administrative unit) is situated next to the central business district (CBD) which is at less than 2 km away (Fig. 2). The suburban parish is situated ca. 7 km eastwards of the CBD along the very busy Jinja Road which is one of the major access roads to Kampala. In both zones a hill forms a natural segregation element. Wealthier classes can be found on top of the hill while downhill the residential density increases and the residential neighbourhoods house lower income classes. By interviewing over the entire compass of the hill slope, a diverse socio-economic data set was obtained.

The subset comprises 143 semi-structured interviews on socio-economic status and on daily mobility characteristics such as mode of transport, travel time and cost. The derived information on costs and on living and transportation standards helped to determine the quality of life for the different groups within the dataset. Average daily rental prices are used to represent housing cost and the cost of a return ticket to the working place is taken as measure for transportation cost. All monetary values are expressed in US $ (at the rate of exchange prevailing during the period of collection). The housing and transport comfort of respondent types are ranked very low to high according to increasing quality standards of the most common housing and transport mode respectively. A low housing comfort refers to low-quality dwellings, commonly called tenements. A tenement is a brick construction of 1–2 rooms, often with electricity but without tap water within the dwelling. High housing comfort refers to gated

Table 2
Variables derived from interviews, used in cluster analysis (NA = not applicable).

Variable	Variable type	Class	Variable code	Percentage respondents (total # households = 798)
Household size	Numerical	1–>10	NA	NA
Period living in Kampala	Numerical	0–100% of life time	NA	NA
Job security	Ordinal	No occupation	0	16%
		Casual/trade	1	42%
		Vocation/small scale crop farming	2	13%
		Large scale non crop farming	3	5%
		Salary non qualified	4	4%
		Salary qualified/rentals	5	20%
Education level	Ordinal	No education	0	2%
		Until primary school	1	11%
		Until secondary school	2	60%
		O-level (finished secondary)	3	10%
		Post-secondary (technical, certificates, non university)	4	13%
		University	5	4%
Ownership	Ordinal	Squatter	1	<1%
		Occupant (with permission)	2	22%
		Renter	3	42%
		Owner	4	36%
Type of housing	Ordinal	Semi-permanent structure	1	8%
		Tenement	2	61%
		Apartment	3	7%
		Detached house	4	15%
		Gated detached house	5	9%
Income per person	Ordinal	<3000UGX ≈ <1$	1	50%
		3–7500UGX ≈ 1–3$	2	24%
		7.5–15,000UGX ≈ 3–5$	3	12%
		15–30,000UGX ≈ 5–10$	4	8%
		>30,000UGX ≈ >10$	5	6%

single standing houses. For transport comfort going on foot scores lowest and driving a car highest.

To understand the work-related travel of Kampala residents the space–time framework of Hagerstrand (1970) is used to integrate spatial and temporal dimensions of their work-related activities. For the respondents that were travelling for work purposes (and thus not the ones who worked/stayed at home) the individual's daily work travels were mapped based on the information respondents gave about their travel habits in combination with an observation on the transportation system and daily traffic of Kampala during field work campaigns. Available traffic reports on Kampala (ITP, 2010; Uganda Ministry of Works and Transport, 2008) assessed average travel speed during peak hours for the major access roads, which allowed to calculate travel time for each individual trajectory. This in combination with the reported travel information, derived from interviews, allowed to evaluate the assessed travel speed contained in the traffic report. Moreover, reported travel costs give insight in the transportation costs per mode of transport and per social class. Finally, the pre-feasibility study of the BRT system in Kampala suggests that the average travel speed would increase up to 25 km/h along the BRT transect. The individual travel paths are used to calculate the total travel time in case respondents would make use of the planned BRT to evaluate whether this would benefit commuters and in that case, which group would benefit most.

4. Results and discussion

The results of the cluster analysis presented as *t*-values for each variable per cluster reveal four major groups amongst all respondents of Kampala: extreme poor, poor, middle income and rich (Fig. 4). Fig. 5 show the characteristics of each group according to cluster variables, supplemented by a graph showing the average location (central versus periphery) and average age of the

Fig. 4. Socio-economic profiles of respondent types.

household head. The groups were named according to their income since this variable is most distinctive for each group.

The lowest income group are the extreme poor where a the majority of the households earn on average less than 1$ a day per person. Extreme poor were encountered in the city centre as well as the periphery. The average extreme poor household consists of 3–4 persons. A large share of the group members consist of singles (12%) or single parent families. The average age structure of this group is generally younger than that of the other groups. Three out of four extreme poor households gather their income mainly by small-scale trade, trade of single commodity food items or casual employment. Therefore the score on job security is not high since a daily income is not assured. However, since these are common strategies for all persons within the whole data set, the *T*-value is not explicitly negative either. Almost one out of five dropped out from primary school before finishing and most left school somewhere during secondary school (Fig. 5). The time they spent in Kampala is remarkably lower than other groups (Fig. 4).

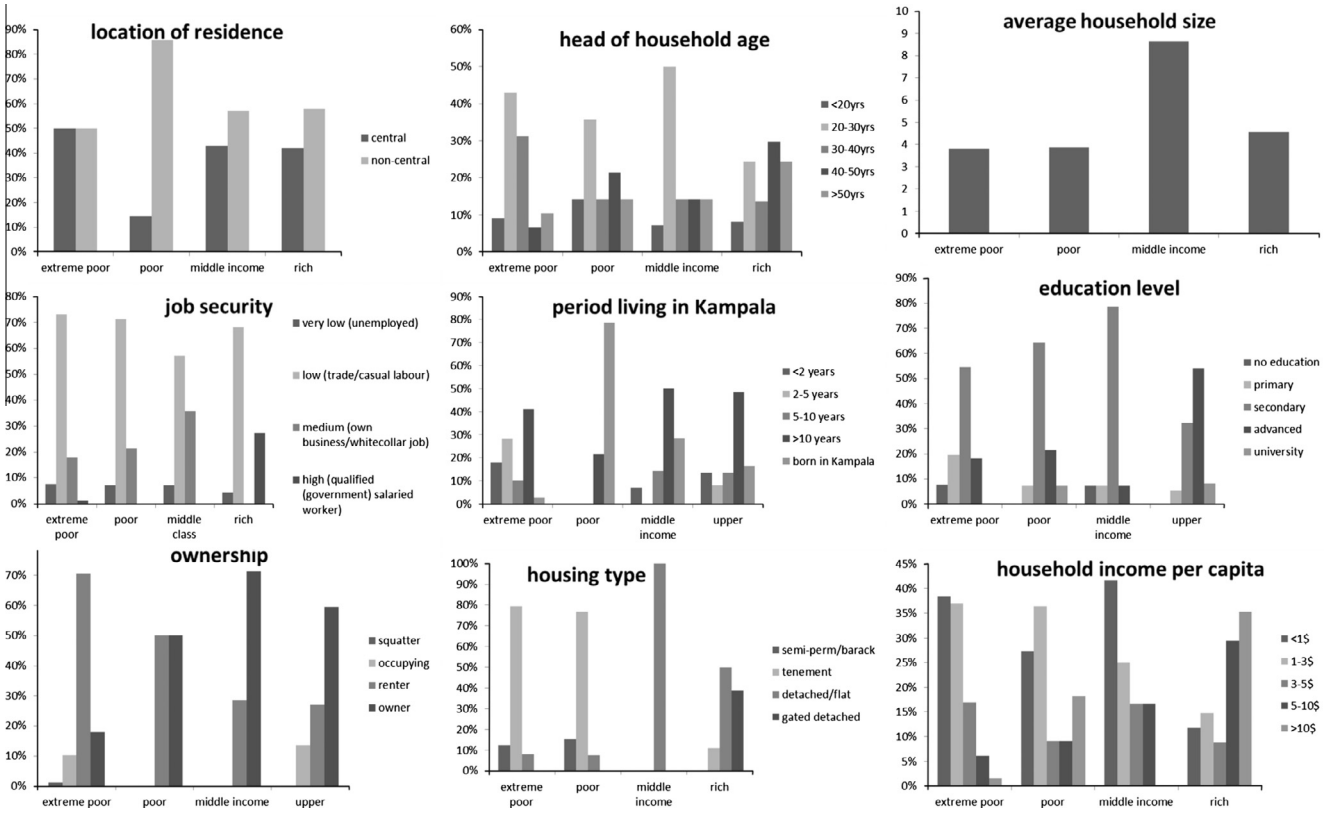

Fig. 5. Overview of variable scores per respondent type.

Few were born and raised in Kampala while in other groups this is at least one third. Most group members are thus migrants who spent on average around one third of their lifetime in the capital. This, in combination with the very low income, results in poor tenure positions with the majority of the group members renting (ca 70%) or occupying (10%) their place of residency. Almost 80% of extreme poor households reside in a tenement. Others are even forced to live in semi-permanent constructions due to limited financial means.

While the research did not aim at sampling representative numbers regarding percentages of income groups among Kampala's population, it can be noted that the data set relatively comprises remarkably more extreme poor households than the latest national household survey (UBOS, 2010b). One out of two households from the collected data set were categorized as extreme poor. In comparison, 7.8% of Kampala households are reported to make up the lowest income class that earn up to ca. 1$ a day. Despite the fact that the collected data set is not capable of claiming representativeness, these results raise the concern of underestimation of poverty in major African cities and thereby overestimation of affordability of (public) transport.

One out of five interviewed households were categorized as a poor household. The average per capita income is only slightly higher, but the income structure of this group is more polarized (Fig. 5). More than 70% of poor households earn less than 3$ per person a day, but their ownership standard promotes them to a higher social class. Many live in tenements and pay rent (44%) but almost fifty percent owns the tenement (this often means they constructed the building themselves, on a plot owned by someone else who is in most cases aware of the construction on his/her plot). This reinforces their purchasing power since rent commonly takes a large share of the income. Besides trade (26%), many households are involved in crop (23%) or livestock (13%) farming for income gathering or provide casual labour (18%). This group therefore also scores low on employment security. Most household heads reached secondary level education and an average household consists of 5 members. This group is deeply rooted in Kampala since they are already living for most of their lifetime in Kampala. Most of the poor households were found to be living in the urban periphery indicating a high commuting need.

The third group is classified as middle income. A modal middle income household earns between 1 and 3$ per person per day, which still is rather low, but since a household counts on average 7 members, the total household income is moderate. Most heads of households reached secondary education level. Nevertheless, the employment security score is low since ca. 65% of the households are involved in trade or casual work. Some call themselves "self-employed" since they have a fixed location from where to sell and were able to trade on a larger scale then previous groups. Others consider themselves self-employed when they deliver services on demand base. These entrepreneurs, despite of their employment status, were able to gather a more than average income. However, for many households the per capita income is still below 1$, partly explained by the fact that the number of households are on average significantly larger as compared to the other groups. A middle income household is typically an extended family. The middle class is also deeply rooted in Kampala; around 30% were born and raised in Kampala and another ca 50% has lived already more than 10 years in the capital. The houses they occupy are of higher standards: apartments or detached houses with electricity and/or tap water inside. Around 70% of the households own their place of residence while the rest are mainly renting.

Finally, the rich make up 10% of our sample. These households are often headed by qualified salary workers. Average income per capita averages 5–10 or even more than 10$ a day. The average household consists of 5 household members with mainly couples

and an important share of extended families. Rich households typically live in (gated) detached houses, which they often own. This group is the highest educated with more than 50% who finished technical institute or university. The time of residency in Kampala varies but the majority lives already over 10 years in Kampala. The age of the head of the rich households is on average higher than for the other groups indicating that incomes might rise when they mature.

From the 143 respondents of the mobility subset almost 55% are extreme poor, 10% is poor, 10% middle income and the remaining 25% rich. Fifty-six percent were interviewed in the suburban parish and forty-four in the centrally located case study area. All classes except middle income households are more or less equally represented in the centre as well as in the suburbs. Consequently, the mobility characteristics for middle income households differ. While the majority is working home-based or in the nearby neighbourhood or are – temporarily – unemployed, middle income respondents are the most mobile. This frequent occurrence of working home-based or nearby, is related to the dominance of the informal sector work in Kampala which is often locally based (Bryceson et al., 2003b). The number of commuters increases with the socio-economic status with an exceptional peak of middle income commuters (Fig. 6). Among motorized transport modes, taxis are the most popular for the lowest social class, the poor opt more frequently for boda-boda while middle income and rich usually choose for the car. Nevertheless, walking remains an important mode of transport since at least 10% of the low to middle income groups identify a walk to work. The per capita income of the lowest class is on average 2$ a day of which on average 0.5$ per person is spend on rental of poor to very poor housing and another 0.8$ on low quality transport to work. While poor respondents appeared to inhabit the same situation regarding quality and price of housing, they receive a daily income almost double as high and pay on average only slightly more for transport of a relatively better quality. This means that extreme poor people had to spend daily more than 50% of their income on basic needs such as housing and transport while this is 42% for poor people. Middle income respondents reported to obtain daily 5$ and spend 1.5$ on higher quality motorized transport for daily commuting. Since they almost all were owner of their houses, they still keep 70% of their daily income for other needs than housing and transport. Rich respondents earn and spend significantly more than previous groups, but spending on transport takes a much smaller share of the income which makes them more wealthy (Table 3).

Forty-four individuals from all social classes of the subset provided us with detailed information on their daily travel to work. When the respondent reported to travel to various places for his/her work, no fixed working place could be determined and thus

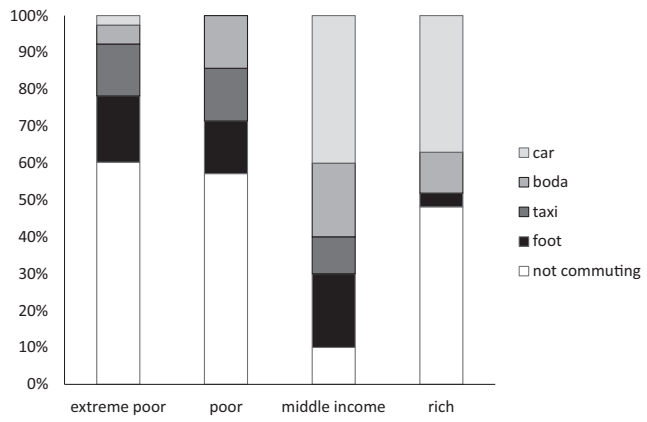

Fig. 6. Mobility and transport mode by respondent type.

Table 3
Quality of life table by respondent type (NA = not applicable).

	Average daily income ($) per person (in 2011)	Average daily rent cost ($) per person (in 2011)	Average daily transport cost ($) (return ticket, in 2011)	Housing comfort	Transport comfort/mode
Extreme poor	2	<0.5	0.8	Low	Very low
Poor	3.5	0.5	1	Low	Low
Middle income	5	NA	1.5	Medium	Medium
Rich	12.5	1	1.3	High	High

no fixed daily travel distance either. These respondents are therefore excluded from the travel path analysis. Fig. 7 maps the travel paths by respondent type, the thicker the line, the higher the percentage of respondents of that group that take the same route. For all groups, Jinja road forms an important access road to the CBD where most of the paths lead. The lines along Jinja road become thicker when the social class increases and the full extent of the Jinja road from periphery to city centre is more travelled by higher than lower social classes. This implies that from all commuters amongst the data subset, the higher income classes are more dependent on the city centre for their income and are more in need for fluid transport along the full extent of this main road.

The average travel distance for all respondents is 3.4 km. Similar to other mobility studies in Kampala (Bryceson et al., 2003a), the extreme poor cover the shortest commuting distances (an average of 2.7 km) and the rich the longest distances (4 km). For all groups the average travel time is slightly above half an hour with the exception of the poor who travel on average 20 min. Travel times are related to the mode of transport (Fig. 8). Walking is the most time-intensive mode of transport, mostly chosen by the extreme poor. For short distances private cars even seem to delay the commuting time. Travelling by taxi becomes more profitable in terms of time and cost over a longer distance. Boda-bodas are used for shorter distances since their higher distance unit price and cars exceeds the price of all other modes. When we apply the travel speeds on Kampala roads that are reported in the BRT pre-feasibility study (ITP, 2010) (based on the Transport Master Plan of Kampala and a parallel mobility study) to calculate travel times for each mapped travel, travel times are systematically underestimated in comparison to travel times that were reported by respondents, even when crossroads were included as stopping places with some minutes delay. Even though the ITP report claims to report on travel speed during peak hour, actual travel times in Kampala indicate an even more severe traffic congestion.

The BRT pre-feasibility studies indicate that the average speed is expected to increase to 25 km/h when using BRT. We implemented this speed for all individual travels and took into account that commuters will have to walk parts of the travel path that do not coincide with the BRT trails. For 58% of the respondents who reported their travel time, switching to the BRT system would decrease their travel time by almost half. In case all commuter respondents would use BRT, the average travel time for all groups would be between 18–30 min, average speed for all groups would be ca. 10 km/h without traffic jams since portion of the commuting paths would still have to be travelled on foot. The group that would benefit most regarding travel time are the extreme poor, since time gains by taking BRT instead of the reported main mode of transport are largest for pedestrians.

However urban poor and extreme poor do not always have a transportation choice but are financially forced to settle with going on foot. Therefore, in order to make use of the travel speed advantage that a BRT system could bring, they have to be able to afford it.

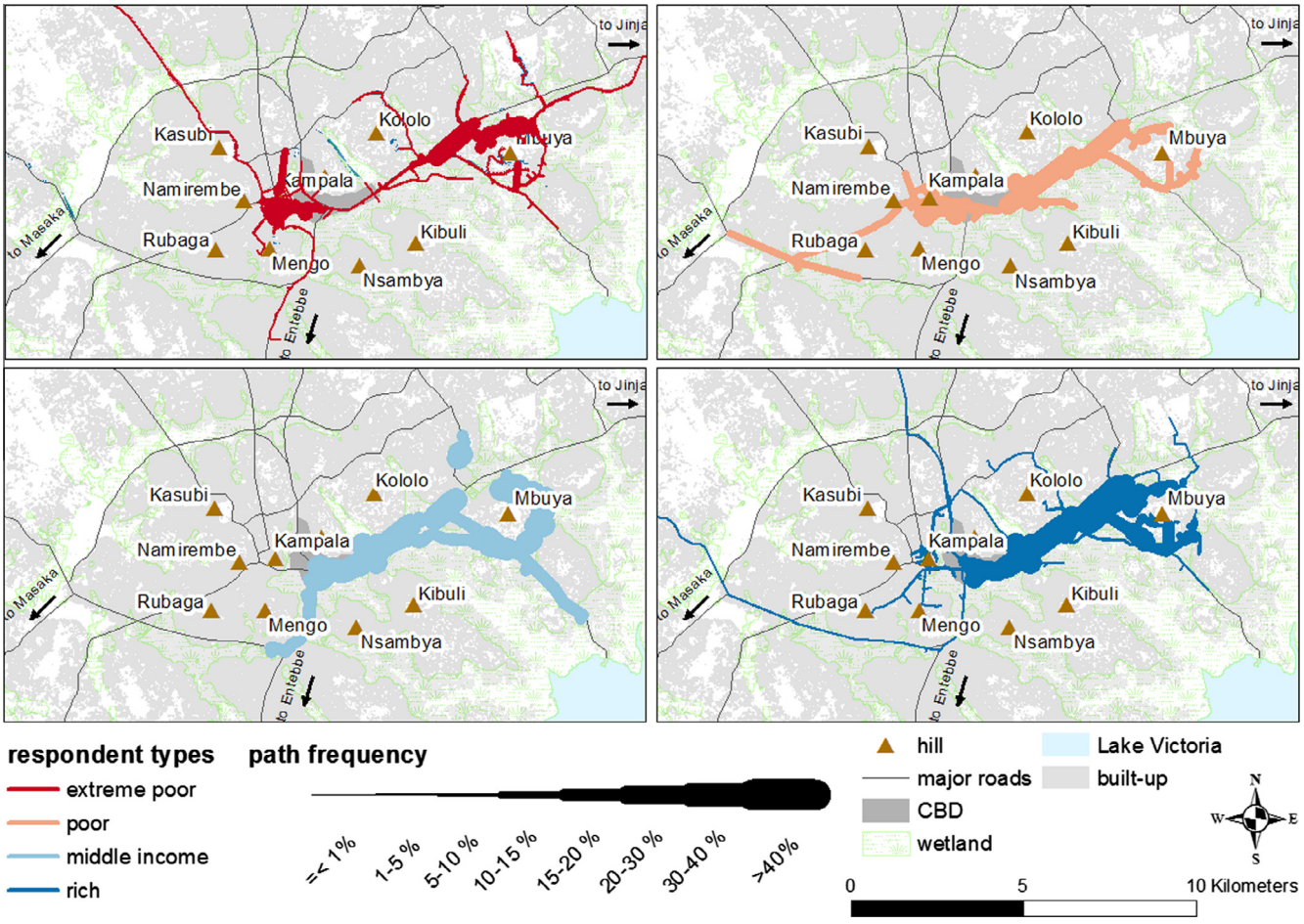

Fig. 7. Frequency of daily travel paths of commuting respondents, by respondent type.

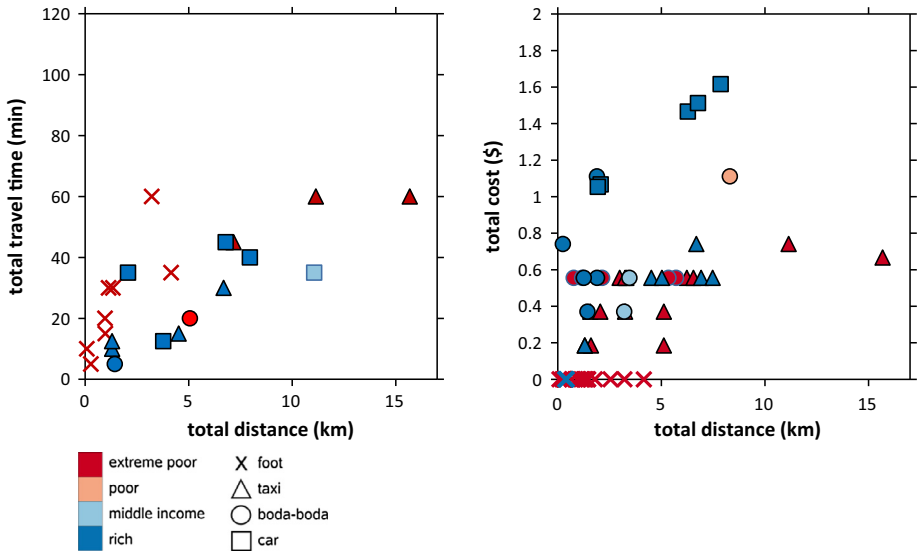

Fig. 8. Total travel time (left) and cost (right) versus total distance travelled by respondent type.

However the pre-feasibility study states that fares should not be higher than present rates and it also states that mark-down would not be sustainable (ITP, 2010). Moreover, a willingness to pay a small surplus for a comfortable, less congested travel is reported. This however, only relates to present public transport users and excludes a major group of extreme poor who are at present often not able to afford forms of public transport like taxis. In case a BRT system will be implemented with prices at least as high as present public transportation travel costs, extreme poor will not be able to make use of the system.

5. Conclusions

We identified four main groups amongst the 798 respondents interviewed in Kampala: extreme poor, poor, middle income and rich. The lower the social class, the more financially vulnerable. Extreme poor and poor often earn less than 1$ a day while households at the other end of the income ladder earn at least ten times this amount. Most recent immigrants are extreme poor supporting the theory that no direct increase in income can be expected after migration. However, since the age of the head of rich households is on average higher than for other groups, an income increase might be expected as they mature. Casual labour and trade are the most popular employment sectors amongst the lowest income classes, but also for middle class. Trading and casual labour offer little employment and income security for the involved actors. They often start small and some succeed to extend to larger businesses and move to a higher income class. All groups were found in the centre as well as in the periphery, but especially poor were overrepresented in the periphery inducing an important need for commuting amongst this group.

Studying the mobility of a subset of 143 respondents living either in the city centre or in a suburban parish confirms previous Kampala transport studies in the finding that the mode of travel chosen by an individual strongly correlates to his or her income level (KCCA, 2013; Bryceson et al., 2003a). This leads to a severe mobility gap with an alarming lack of accessibility to opportunities for the urban poor.

Not all respondents commute to supply their household with a daily income. This applies especially to the extreme poor of which two third indicate that they work from home, by running a small store or shop and other small scale trading activities or are housewives. The population in their near surroundings creates the market and opens up job opportunities for this group. On the other hand, as we can see on Fig. 7 for the ones who do commute, the city centre forms a major source of employment opportunities, supplemented by the industrial area along the main road heading to Jinja. The CBD is the main area for office, commercial and by extension industrial space. From the results it also appears that the higher the social class of these commuters, the more percentage of commuters travel daily to the CBD. This confirms that access to opportunities plays an important role in livelihood construction and besides residential location, mobility co-determines this access. Moreover, it indicates that at present the higher social classes daily travel the full extent of Jinja road from periphery to centre and are therefore in the highest need of a fluid traffic and transport systems such as BRT.

With plans for a BRT system in Kampala, the Kampala Capital City Authority should be able to meet its first and often stated as the most important (Nkurunziza et al., 2012) goal: the results indicate that for the majority of respondents, using BRT at projected speed can reduce the average travel time by 50%. While average speed along Jinja road is reported at 20 km/h (ITP, 2010) and research results reveal that actual speed is below even this, a BRT proved in other case studies to be able to obtain speeds up to 25 km/h. In addition to this, further improvements of travel speed can be obtained if factors that cause delay in the present traffic situation are considered. Based on participant observation in traffic in Kampala, we suggest investment in improvement of traffic flow at intersections by for example prioritizing the BRT buses or separate them completely from other traffic. This however, implies extra infrastructural costs.

Despite the potential benefits, the BRT system might have a downside as well. The planned BRT risks to overlook the socio-economic heterogeneity regarding accessibility and affordability of the BRT. Since the BRT will only be operational at the major axes many residents would still have to commute to these axes. In our research we assumed this would be on foot, entailing a strong increase in total travel time for the respective group especially since current pedestrian infrastructures in Kampala are very poor. In case commuters have the financial means, they can for example opt for a boda-boda to head towards an access point of the BRT system. In this perspective the lowest income groups are most vulnerable to become physically excluded from the BRT.

Furthermore, the importance of travel cost is underestimated and neglected by transport planning. Since Kampala's BRT travel prices are not planned to be adapted to all income classes, extreme poor will not profit from the increased travel speed since they won't be able to afford this mode of transport. This research revealed and confirmed (Bryceson et al., 2003b; Carruthers et al., 2005) that transport costs take a large share (10–40%) from the available daily income – especially for the lower income groups (40%) – which forces many respondents to travel on foot.

In this respect, BRT could be a leverage for socio-economic development of deprived neighbourhoods if two crucial criteria are met: (1) the BRT is physically accessible from these neighbourhoods, (2) the BRT-fares are made affordable for the lowest social classes. The travel time advantages of a potential BRT could be much larger if it would not be limited to the main access roads but reaches the area with high residential densities of potential socio-economic user groups. This is also argued in a critical review of the popular BRT example in Bogota where it is suggested that the BRT network should focus on physically reaching poor settlements (Gilbert, 2008). An alternative way to realize this connectivity is by providing a supportive transit system more readily accessible to the poor that can connect inaccessible neighbourhoods to the main BRT. By unlocking deprived neighbourhoods the mobility of vulnerable groups and their accessibility to livelihood opportunities could be increased. Secondly, fare prices have to be affordable to all income groups. This research suggests – in accordance with previous research (Ahmed et al., 2008; Fouracre et al., 2003) – that in order for a BRT to be viable and effective, government subsidies that can keep the fares low are needed.

At the macro-level, when transportation planning and physical planning are aligned they have the potential to reenforce each other. In the development of the new Physical Development Plan of the Greater Kampala Metropolitan Area alternative scenarios for a balanced growth are studied that consider various satellite cities models (KCCA, 2012). A BRT could support the development of such decentralised economic hubs as economic activity will be attracted to places that become more accessible thanks to the unlocking through BRT. In this perspective, new settlements can be located closer to the BRT and economic opportunities. This kind of neighbourhood upgrading involves, however, the risk that newly accessibly land increases in value and becomes unaffordable for poor and extreme poor people to reside. A strong physical plan could anticipate to this in order to develop an inclusive planning.

With this research we argue for a policy that works from bottom up and pays attention to the internal income diversity of the population. Planning actions should be based not only on demand studies, but also consider the socio-economic profile of the (potential) users of the urban transportation network. Besides making efforts to increase the overall mobility, special focus needs to be laid on the most vulnerable income groups.

Hagerstrand's space–time framework is a useful tool to further elaborate the mobility research since it can deliver deeper insight in the spatial demand of the BRT network. This research confirms that at present the majority of the travel paths largely coincide with the planned radial network, but this doesn't mean that this is in all cases the optimal route. The options of the transport network are limited and the value of introducing non-radial routes should be considered.

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