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SOLUTIONSplus

Data Collection of ICE three-wheelers in Dar es Salaam

Intermediate Report

Imprint

About:
This report has been prepared for the project SOLUTIONSplus. The project has received funding from the European Union's Horizon 2020 research and innovation programme under the grant agreement no. 875041

Title:
SOLUTIONSplus
Integrating Urban Electric Mobility Solutions in the Context of the Paris Agreement, the Sustainable Development Goals and the New Urban Agenda

Authors
Several SOLUTIONSPlus partners conducted the data collection methods and drafted the corresponding parts in this report: Urban Electric Mobility Initiative (UEMI), Deutsches Zentrum für Luft- und Raumfahrt (DLR) - German Aerospace Center

Survey with drivers of ICE bajajs
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GPS tracking survey
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The boarding and alighting survey, frequency occupancy survey, survey with passengers of ICE bajajs, conducted by ITDP Africa, will be added to the final version of the report.

July 2022

Project Partners

UEMI www.uemi.net

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RUPPRECHT CONSULT Forschung & Beratung GmbH

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SolutionsPlus Dar es Salaam

Data Collection of ICE three-wheelers Intermediate Report

The SOLUTIONSPlus demonstration action in Dar Es Salaam aims to integrate electric three wheelers (hereafter “e-bajajs”) as feeder services to the Dar es Salaam’s Bus Rapid Transit (BRT) system.

To prepare the implementation of those vehicles, the SOLUTIONSPlus team has worked on a **feasibility assessment** including four components:

- surveys assessing characteristics of current international combustion engine (ICE) bajajs,
- a user and training needs assessment,
- a regulatory framework assessment, and
- an international and local market analysis of electric three-wheelers.

The first component of this feasibility assessment was a **data collection process using multiple methods** to assess characteristics of current ICE bajajs. It integrated the following five sub-components:

- A survey with drivers of ICE bajajs,
- A GPS tracking campaign with ICE bajajs,
- A boarding and alighting survey,
- A frequency occupancy survey,
- A survey with passengers of ICE drivers.

This Intermediate Data Collection Report compiles results from the first two methods.

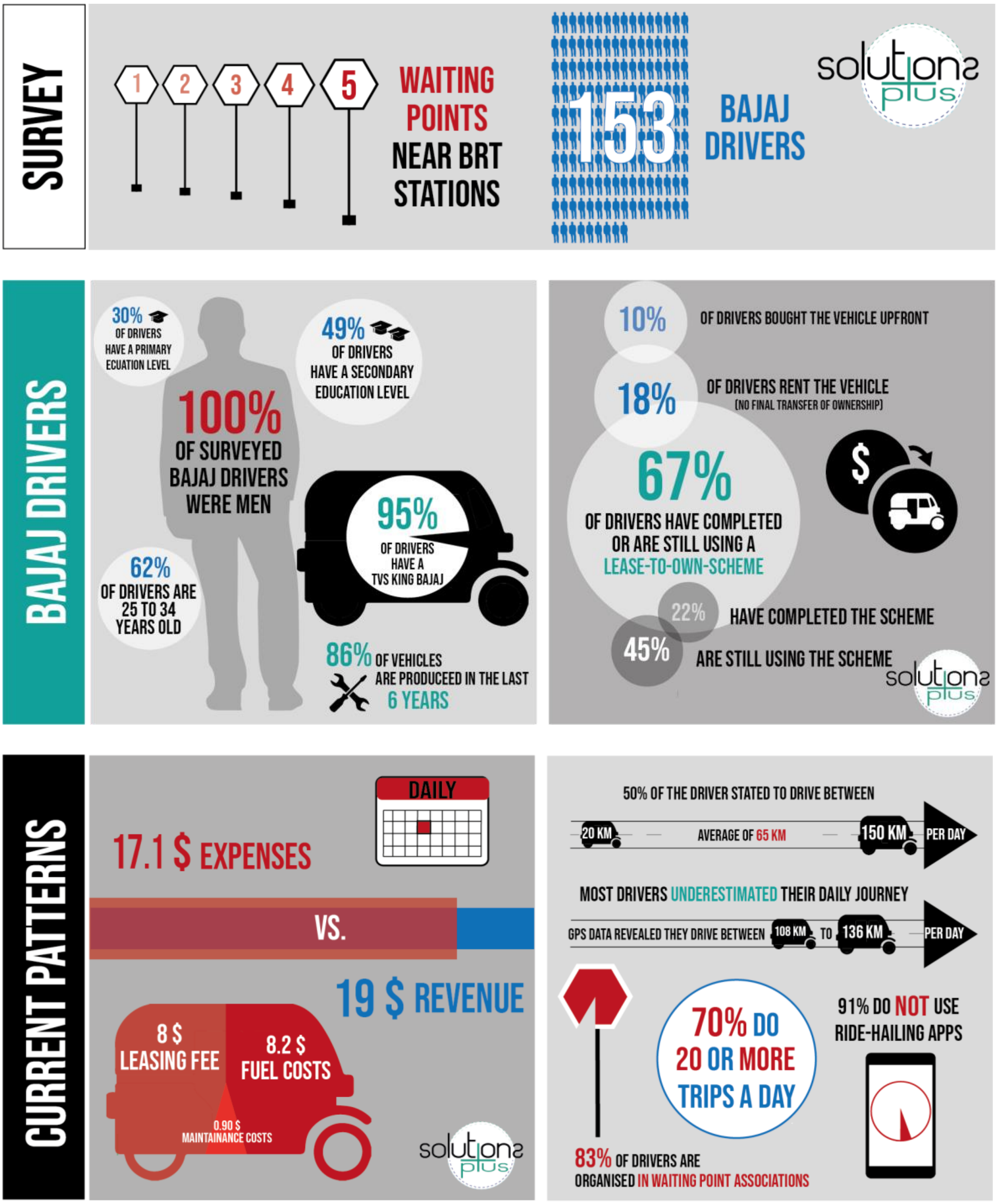
(Senyagwa, 2022)

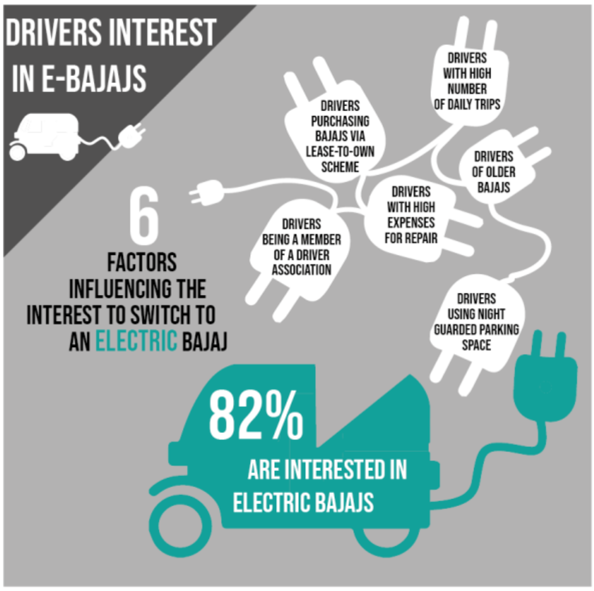
Report structure

Survey with drivers of ICE bajajs

The survey aimed to better understand their characteristics of ICE bajajs and their drivers, assess the impact for the transition to electric bajajs (charging pattern options, possible business models), and ensure that the preferences of drivers will be considered for the introduction of e-bajajs

1. Overview of the survey and main findings




DRIVERS INTEREST IN E-BAJAJS
6 FACTORS INFLUENCING THE INTEREST TO SWITCH TO AN ELECTRIC BAJAJ
DRIVERS PURCHASING BAJAJS VIA LEASE-TO-OWN SCHEME
DRIVERS WITH HIGH NUMBER OF DAILY TRIPS
DRIVERS OF OLDER BAJAJS
DRIVERS WITH HIGH EXPENSES FOR REPAIR
DRIVERS BEING A MEMBER OF A DRIVER ASSOCIATION
DRIVERS USING NIGHT GUARDED PARKING SPACE
82%
ARE INTERESTED IN ELECTRIC BAJAJS


DRIVERS INCENTIVES TO SWITCH TO AN E-BAJAJ
AN E-BAJAJ SHOULD BE ECONOMICALLY INTERESTING FOR ME
AN E-BAJAJ NEEDS TO BE ROBUST
SPARE PARTS SHOULD BE ROBUST
AN E-BAJAJ IS GOOD AS FUEL COSTS ARE HIGH
THE E-BAJAJ SHOULD ALLOW ME TO DO ENOUGH TRIPS
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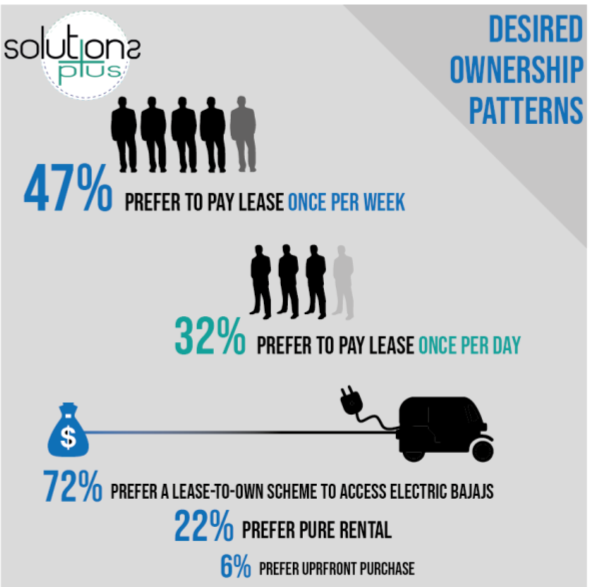
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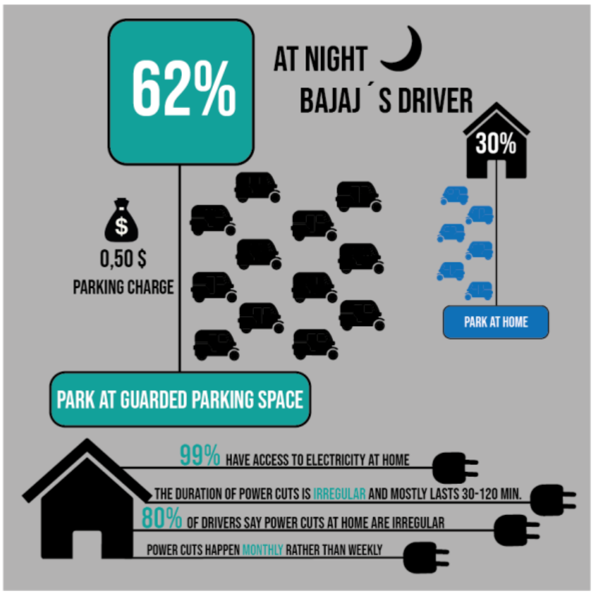
DESIRED OWNERSHIP PATTERNS
47% PREFER TO PAY LEASE ONCE PER WEEK
32% PREFER TO PAY LEASE ONCE PER DAY
$
72% PREFER A LEASE-TO-OWN SCHEME TO ACCESS ELECTRIC BAJAJS
22% PREFER PURE RENTAL
6% PREFER UPRFRONT PURCHASE


62%
AT NIGHT BAJAJ´S DRIVER
30%
$
0,50 $
PARKING CHARGE
PARK AT HOME
PARK AT GUARDED PARKING SPACE
99% HAVE ACCESS TO ELECTRICITY AT HOME
THE DURATION OF POWER CUTS IS IRREGULAR AND MOSTLY LASTS 30-120 MIN.
80% OF DRIVERS SAY POWER CUTS AT HOME ARE IRREGULAR
POWER CUTS HAPPEN MONTHLY RATHER THAN WEEKLY

2. Detailed results of the survey – Methodology

Dual purpose:

1) identify characteristics of ICE three-wheelers (hereafter named “bajajs”, as commonly done in Dar es Salaam), refining or confirming data previously collected by DLR (Goletz et al., 2021)
2) understand interest and preferences of drivers for the electric bajajs, for instance for the upcoming business models, and assess characteristics having an importance for vehicle charging and the type of vehicle (e.g. place of overnight parking, reliability of electricity)

Process:

1) Visual identification of bajaj waiting points with the following combined characteristics: located near BRT stations, and having a high number of bajajs waiting.
2) Identification of the following five waiting points:
    1. Mbezi mwisho, northern side (to Goba)
    2. Mbezi mwisho, southern side (to Kifuru)
    3. Intersection University Rd/Sam Nujoma (to Changanyikeni)
    4. Kimara mwisho, northern side (to Matosa)
    5. Kimara Korogwe (to Maji Chumvi)
3) Identification of waiting point associations, contact taken with the chairman, presentation of the SOLUTIONSPlus project and agreement on the survey
4) Collaborative design of the questionnaire survey
5) Translation to Kiswahili
6) Transcription of the questionnaire in the app “Magic Device”
7) Training of surveyors and test of the questionnaire
8) Administration of the questionnaire at the five waiting points.

Period: February 2022

Questions: closed questions (yes/no, multichoice), except for questions asking about numbers (e.g. amount spent on fuel) or with a too high number of possible answers, such as the place of residence.

Language: Kiswahili

Monetary value: drivers were asked about values in Tanzanian shilling (TSh). Results are presented in this report in Tanzanian shilling and in approximative value in US dollars (USD), as per the conversion rate of the 6th of May 2022.

Support: Magic Device

Results: a total of 153 drivers were interviewed, exceeding the initial target of 100 drivers (20 drivers minimum per waiting point). This represents an unprecedented number in terms of data collection with bajaj drivers in Dar es Salaam. After cleaning the data, the sample size is 152.

3. Detailed results of the survey – Descriptive statistics

1. Gender

	Drivers	Percentage
Male	151	99%
Female	0	0%
No answer	1	1%
	152	100%

All surveyed bajaj drivers were men.

2. Use of GPS trackers provided by SolutionsPlus

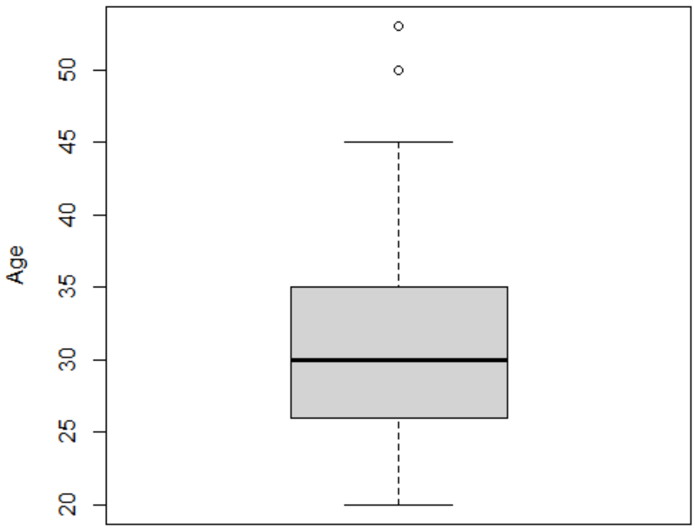
	Drivers	Percentage
yes	105	69%
no	43	28%
no answer	4	3%
	152	100%

The question aimed to identify drivers using a GPS tracker provided in the context of SolutionsPlus, to compare their survey answers with the data collected with the GPS tracking campaign. Given that a total of 20 GPS devices were distributed, a totality of 105 drivers answering "yes" is not realistic. Answers to this question may thus not be answered.

3. Drivers' age

The large majority of drivers (62%) were found to be between 25 and 34 years old. The median age is 30 years, with half of the drivers being between 26 and 35 years old. The median is slightly lower than the age found by Goletz et al. (2021), with an average age of drivers of 34.6 years.

Age	Drivers	Percentage
<20	0	0%
20-24	16	11%
25-29	58	38%
30-34	37	24%
35-39	23	15%
40-44	12	8%
45-49	2	1%
>50	1	1%
no answer	3	2%
	152	100%

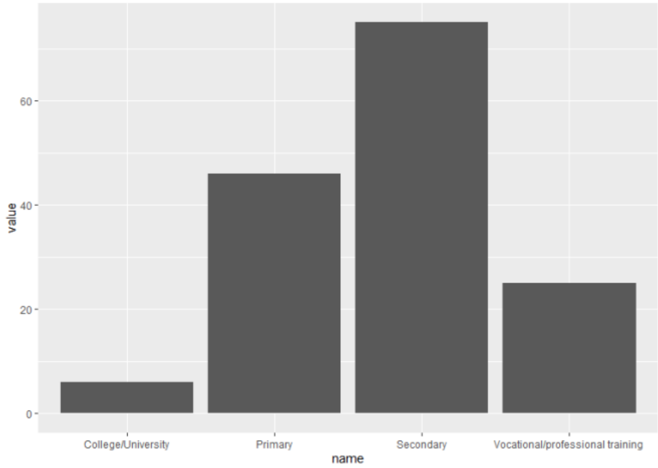


Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
20	26	30	30.66	35	53

4. Level of education

Most of the drivers (49%) have a level of secondary education, followed by 30% having reached primary education, 16% vocational or professional training, and a small minority with a college or university degree. This economic activity may attract individuals with secondary education in the context of high unemployment. For further research it would be desirable to compare these results with the average level of education in Tanzania and in Dar es Salaam.

	Drivers	Percentage
Primary	46	30%
Secondary	74	49%
Vocational/professional training	25	16%
College/university	6	4%
no answer	1	1%
	152	100%



5. Brand of the vehicle

An impressive portion of 95% of drivers have the bajaj model TVS King. Three-wheelers are still named according to the brand "Bajaj", although TVS and other brands are now more widely found in Dar es Salaam. The SolutionsPlus team discussed whether this very impressive number could be inflated or unrealistic, possibly based on misinterpretation. The surveyors confirmed that the absolute majority of vehicles at some waiting points, e.g. Mbezi Mwisho with a total of circa 200 three-wheelers observed, were TVS King vehicles, with only 5 vehicles being from the Bajaj brands. Similar patterns have been identified at the Kimara Korogwe waiting point. Drivers and association chairmen indicated that a lot of people have bought TVS vehicles in recent years for the availability and low prices of spare parts.

	Drivers	Percentage
TVS King	145	95%
Lifan	2	1%
Toyo	1	1%
Piaggio	1	1%
Zongshen	1	1%
Nyingine (other)	1	1%
no answer	1	1%
	152	100%

6. Age of bajaj

Drivers were asked in which year the bajaj they were driving was produced ("x year ago"). Nearly all vehicles (86%) had been produced in the last 6 years. Within this 6 years period, most of them (42% of all vehicles) were aged less than 3 years. This is coherent with data found by Goletz et al. (2021), identifying 94% of vehicles having being produced in the 5 years prior to data collection.

	Drivers	Percentage
Up to 1	3	2%
2	31	20%
3	30	20%
4	23	15%
5	29	19%
6	18	12%
7	5	3%
8	7	5%
9	0	0%
10	1	1%
11	1	1%
12 and more	2	1%
no answer	2	1%
	152	100%

7. Ownership

Different ownership models can be identified in Dar es Salaam and other mobility context in East Africa:

- a driver simply renting the vehicle,
- a driver renting the vehicle, with a planned transfer of ownership after a certain number of payments. This model is interchangeably named "hire-purchase" or "lease-to-own". The driver may still be renting the vehicle, or having completed the agreed number of payments, thus owning the vehicle.
- a driver owning the vehicle after having purchased it upfront.

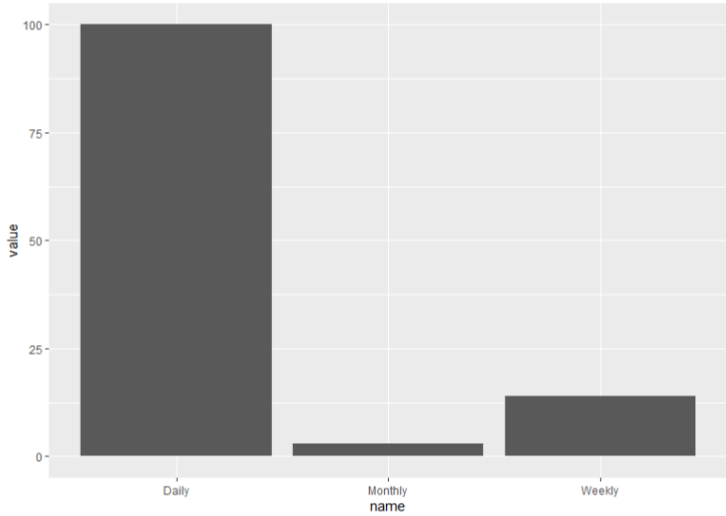
The survey showed that most drivers (45%) were still hire-purchasing the vehicle, while 22% of them had already completed a hire-purchase agreement, thus now being the owner of the vehicle. This means that 67% of drivers have used, or are still using, such a hire-purchase agreement. Less dominant models include pure vehicle rental without transfer of ownership (18%) and ownership with upfront purchase (10%).

Driver being the owner via upfront purchase	15	10%
Driver being the owner, via a completed hire-purchase agreement	34	22%
Driver still hire-purchasing the vehicle	69	45%
Driver purely renting the vehicle (no transfer of ownership)	28	18%
Other	4	3%
No answer	2	1%
	152	100%

Nb. The section "focus group and interview with drivers" provides more insights from drivers on ownership patterns with individuals, deposits, and alternative pattern via banks.

8. Leasing fees

Drivers were asked about the frequency and the level of fees paid to hire-purchase or rent the vehicle. Most drivers pay on a daily basis (100 drivers). Paying per week (14 drivers) and per month (3 drivers) is much less frequent. 35 drivers did not indicate the frequency of payments.
The analysis of fee levels was done for the majority paying on a daily basis only, in the absence of sufficient data for weekly and monthly payment. A mean value of 20,805 Tanzanian shillings (Tsh) was found, with minimum of 15,000 and maximum of 30,000. This value of Tsh 20,805/day - circa USD 8.1 - is coherent with the average 18,265 TZS /day - circa USD 8 - per day found by Goletz et al. (2021) during an earlier data collection in 2018/2019.



Daily= 100; Weekly= 14; Monthly = 3; NA= 35

Daily Rent	Tsh
Min.	15,000
Max.	30,000
Mean	20,805

9. Upfront purchase

Data on financial values of vehicle upfront purchase was not deemed usable as insufficient in number (only 10% of drivers) and with largely deviating numbers, possibly linked to the different conditions of purchase of the vehicle (new, second-hand, numbers of year of operation, etc.) where information was not available.

10. Preference of drivers for the electric three-wheeler business models

The survey did not only aim to better understand the current financial, organisational and socio-economic characteristics of ICE bajajs, but also to pave the way for the upcoming introduction of electric bajajs. To do so, it was very important to ask drivers about the models they would prefer to access e-bajajs, in order to ensure ownership and acceptability of the project.

A large majority of drivers (72%) prefer the hire-purchase agreement model for electric bajajs. This is in line with current practices (67% of drivers having used or still using such a scheme).
When asked about the frequency they prefer for the payment of vehicle leasing fees for the e-bajas and additional charging fees if not charged at home, most drivers preferred to pay once per week (47%) or once per day (31%). This seems different than the current pattern based on daily payment. As two different

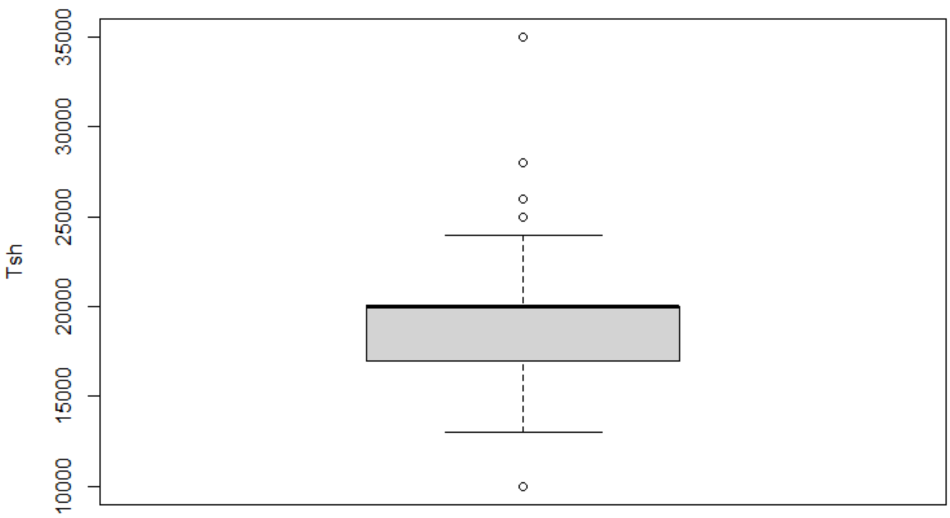
If you were to change for an electric bajaj, what kind of system would you prefer?		
Hire to own	110	72%
Upfront purchase	9	6%
Pure rental	33	22%
No answer	0	0%
	152	100%

opinions are expressed, refining the discussion with the drivers on preferred frequency is recommended.

If you owned an electric bajaj via a leasing system, how would you like to pay for it?		
Every day	47	31%
Twice per week	4	3%
Once per week	72	47%
Twice per month	7	5%
Once per month	13	9%
No answer	9	6%
	152	100%

11. Average daily spending on gasoline

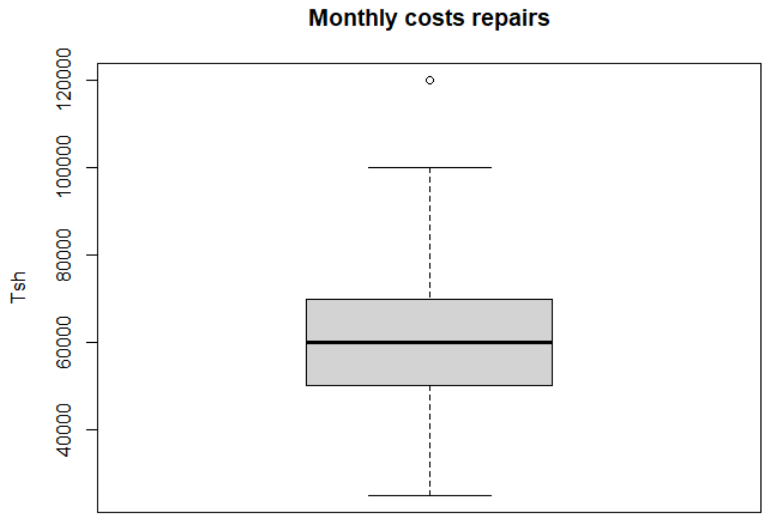
A median value of 20,000 Tsh (USD 8.6) spent on average on fuel was found, with half of the drivers paying between 17,000 and 20,000 Tsh (USD 7.3-8.6). This is more than the average 11,822 Tsh per working day (circa USD 5) found by Goletz et al. (2021).



Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10000	17000	20000	19086	25000	35000

12. Monthly spending on maintenance and repairs

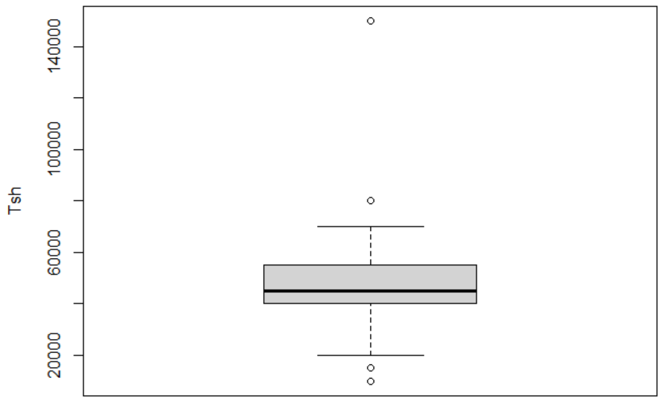
Drivers were asked how much they pay for maintenance, including operational fluids (oil, hydraulics), wear and tear (tires, brakes etc..) and replacement of parts, on average per month. A median value of 60,000 Tsh (approximatively USD 26) was found, with half of the drivers paying between 50,000 and 70,000 Tsh (USD 21-30). This is slightly more than the average Tsh 54,889 TZS per month (approximatively USD 24) found by Goletz et al. (2021) during a previous data collection in 2018.



Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
25000	50000	60000	57987	70000	1200000

13. Daily farebox revenue

Drivers were asked how much fares they receive from passengers per day. A median value of 45,000 Tsh (circa USD 19) was found, with half of the drivers receiving between 40,000 and 55,000 Tsh (USD 17-24). This is in line with Goletz et al. (2021) having found a median 45,000 Tsh/working day and 24,990 gross income.



Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
10000	40000	45000	44605	55000	150000

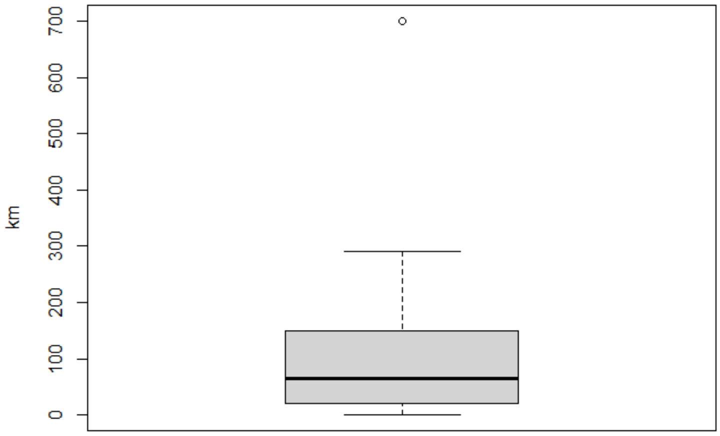
14. Number of daily trips

Drivers were asked how many passenger trips they do every day on average. The large majority of drivers (70%) do 20 trips and more every day. Only 3% of drivers do less than 10 trips per day. Goletz et al. (2021) had found that 61% of drivers were doing more than 16 passenger trips per day in 2018 (details: 17% doing 6-10 passenger trips, 18% doing 11-15, 29% doing 16-20, 17% doing 21-25, 7% doing 26-30, 8% doing more than 30). The small difference could be explained by the selection of other locations in the previous study, and by the time difference between both studies.

	Drivers	Percentage
Up to 4	0	0%
5-9	4	3%
10-14	24	16%
15-19	18	12%
20 and more	106	70%
	152	100%

15. Daily mileage (km)

Drivers were asked how many kilometers they drive every day, including their trip to work. A median value of 65 kilometers was indicated, with important deviation as half of the drivers stated to drive between 20 and 150 kms every day. The previous study conducted by Goletz et al. (2021) had found that 50% of the drivers travel less than 75 km per working day and 75% of all vehicles travel less than 109 km.



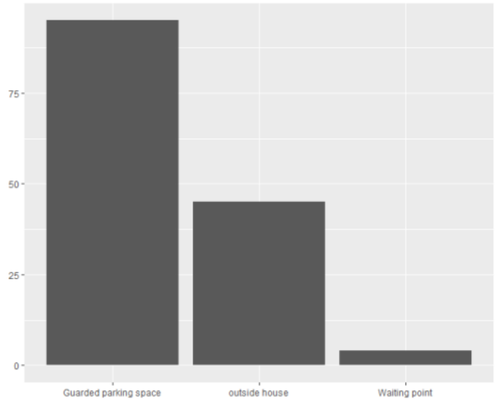
Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	NA's
1	20	65	91.31	150	700	10

16. Night parking of bajaj

Drivers were asked where they park the vehicle at night, since this information is crucial for the question of possible overnight charging of electric bajajs in the SOLUTIONSPlus project. This will inform the possibility and conditions of overnight charging, for instance at the driver's place (need for detachable battery or charging via a cable) or at a protected night parking space (need to involve the guarding entity).

Overnight, most drivers (62%) park their bajaj in a guarded parking space. This is coherent with the figure of 66% found by Goletz et al. (2021), parking on protected private parking areas. A further 30% of drivers park it outside of their home, for instance in the backyard or in front of the house. Only a small minority (3%) parked the bajaj at the place of daytime parking. Lastly, 5% of drivers indicated other locations, for instance four drivers parking at night in front of a mosque.

	Drivers	Percentage
In a guarded parking space	94	62%
Just outside your home (e.g. backyard, in front)	45	30%
At the waiting point where you operate during the day	4	3%
Another location	7	5%
No answer	2	1%
	152	100%



In addition, drivers were asked how many they pay to park at night in a protected space. Most of them paid per night, with a mean found of 1,2229 Tsh, i.e. circa USD 50 Cents.

Fee for guarded parking (*n=106)*	
Min.	1,000
Max.	10,000
Mean	1,229
NA's	46

17. Availability of electricity at home

Nearly all drivers (99%) stated to have access to electricity at home.

	Drivers	Percentage
Yes	150	99%
No	1	1%
No answer	1	1%
	152	100%

18. Blackout frequency and duration

Reliability of electricity is critical to ensure the success of the e-mobility project, choose a charging option and avoid any negative impacts for drivers. Drivers were therefore asked how often they faced power cuts at home, on average over the last year. The large majority of drivers (80%) stated that these are irregular, thus without a specific frequency identified. When identifying a frequency, blackouts were identified as not happening too frequently: monthly (11%) rather than weekly (7%) or every day or night (1%) or several times per day or night (1%). Yet, it is important to note that drivers were asked about home, not about the place where they park the bajaj at night, even if it is likely that these places are not far apart. Further work on access to electricity at these parking places will be required, if this option is selected.

	Drivers	Percentage
Several times per day/night	1	1%
Every day/night	2	1%
Weekly	10	7%
Monthly	16	11%
Irregular	121	80%
No answer	2	1%
	152	100%

In addition, drivers were asked about the typical duration of blackouts. Here again, the majority of drivers (57%) identify irregularity in the duration of blackouts. When quantified, most would last between 30 to 120 min (identified by 27% of drivers), while a minority of drivers identify them as lasting less 30 minutes (6% of drivers) and more than 120 min i.e. 2 hours (7% of drivers).

	Drivers	Percentage
Less than 30 mins	9	6%
30 – 60 mins	20	13%
1 – 2 hours	21	14%
More than 2 hours	10	7%
Irregular	86	57%
No answer	6	4%
	152	100%

19. Part of waiting point association

Drivers were asked whether they are organized at their daily waiting point, for instance in an association. Most of them (83%) are organized in such an association, versus 14% not. The data collected on average fees for the association membership could not be used as lacking specification on the time period for the fee.

	Drivers	Percentage
Yes	125	82%
No	22	14%
No answer	5	3%
	152	100%

20. Part of another organisation

Organisations mentioned:

- Umbani
- Umoja wa madereva bajaji kilungule B/Driver's association of Kilungule B
- Umoja wa chama Cha Waendesha bajaji Mavurunza/ Mavurunza Bajaj driver association
- Goba center bajaji drivers/
- UMWB
- Kumbani
- Umoja wa Bajaji Changanyikeni-Ubungo/ Drivers' association of Changanyikeni-Ubungo
- Bambem (drivers' association)

21. Use of mobility apps

Drivers were asked whether they use a smartphone application, such as Uber or Bolt. The large majority of them (91%) do not use such an app. Among 9 drivers using an app, 6 used Bold, 1 Uber and 1 Wiki.

	Drivers	Percentage
Yes	9	6%
No	138	91%
No answer	5	3%
	152	100%

Among the few of them using an app, no clear tendency could be identified in terms of the number of hours logged in the app, or in terms of average number of trips done using the app.

Hours	Drivers	Percentage
3	1	13%
4	1	13%
6	1	13%
8	2	25%
10	1	13%
12	2	25%
	8	100%

Trips	Drivers	Percentage
4	1	13%
6-9	1	13%
10	2	25%
15	1	13%
20	1	13%
25	2	25%
	8	100%

22. Interest in e-bajaj

When asked whether they would be interested in switching to an electric bajaj, 82% of drivers stated to be interested, versus 5% not interested, and 12% indicating that it will depend. Limited information was provided about electric three-wheelers to avoid creating bias in the answers; additional information about e-bajajs and the SOLUTIONSPlus project was shared after the answers.

	Drivers	Percentage
Yes	125	82%
No	8	5%
It depends	18	12%
No answer	1	1%
	152	100%

Drivers replying “it depends” mentioned the following parameters.:

Linked with benefits:

- It depends on the benefits I get.
- It depends on the conditions (said twice).
- It will depend on the associated benefits.
- It will depend with the electric bajaj’s benefits.

Linked with electricity and fuel costs

- I found if good because fuel costs are high.
- It depends on the running cost of the vehicle.
- It depends on the running cost e.g electricity costs.
- It depends on how much electricity it consumes

Linked with the vehicle's quality

- It depends on the quality of the vehicle.
- It depends on the quality and durability of the vehicle.
- It depends on the make of bajaj that will be involved, it will be better if they get TVS bajaj.

Linked with the range capacity

- I don't know how far the vehicle can travel.
- The kind of vehicle should guarantee the vehicle's trips.

Linked with more information about e-bajajs and about the project

- I can decide whether to agree or not when I will know about the procedure.
- It depends if I am going to like it or not.

We then had a closer look at the 82 % that are interested. Specifically, we use logistic regression to understand whether there are underlying individual or bajaj-related characteristics that increase the likelihood of the stated intention to switch to an electric bajaj. Following a univariate analysis, we identified 6 variables that are statistically significant (at 95 % significance level). Below we describe these variables and how they contribute to the stated intention to switch to an electric bajaj:

i. Those that purchased a bajaj via a 'hire to owner' scheme are more likely to be interested in electric bajajs.
ii. The more drivers pay for repairs, the more likely they are interested in switching to an electric bajaj.
iii. Similarly, the more daily trips they complete per day, the more likely they are interested in switching to an electric bajaj.
iv. Owners of older vehicles are more likely to be interested compared to those that recently purchased a bajaj.
v. The availability of a guarded parking space has a strong positive impact on the intention to switch to an electric bajaj, while those that park outside their house are likely not interested.
vi. Finally, being a member of a driver association has a positive impact on the intention to switch to an electric bajaj.

4. Focus group and interview with drivers

To refine the findings, small focus groups were organised with the drivers and chairman of the waiting point's association, at the two locations considered best for deployment of the SOLUTIONSPlus project.

Kimara Korogwe

Small focus group with two drivers and the association's chairman

The discussion was held in Kiswahili (no recording); notes on paper were subsequently translated in English.

Parking:

- Day parking: the chairperson and the drivers confirmed that they park at Korogwe waiting point, spending most of the time there. Several phases are identified:
  - early morning hours to 8 am: lot of shuttling:
  - 8 am to 3 pm: break. During this non-peak hour time, a driver could wait for an average of 2 hrs before they get customers/ he can make a trip.
  - 3 pm to 8 pm: resumption of shuttling
  - 8 pm to midnight: park and wait for customers at Kimara Korogwe waiting point
  - past midnight: everyone goes back to their own place.

  The area where three-wheeler drivers park to wait for customers at Kimara Korogwe is owned by TANROADS.

- Night parking: at night most drivers park in a public space (CCM office i.e. main party's office, usually providing a space as an income generating activity for the party's office). They also park at *kwa Mzaire* or *Mkua* which is 3.5 km from the Korogwe waiting point, where they pay a fee. Only few park at home.

Charging

- Preference of charging points: The drivers suggested that having a charging point at Kimara Korogwe is the best option for them but DART will have to consult TANROADS.

- The drivers advised to consider the following aspects:
  - Space. Drivers asked how much space charging would take. Drivers were wondering if having charging infrastructure will still allow diverse vehicles, including non-electric ones, to park at the same place.
    "We hope it won't take too much space, if there too little three-wheelers using it."
    Charging equipment should be coherent with the number of e-bajajs, not half of the space used for 10 e-bajajs, and the others ICE bajaj drivers can't use the space anymore.

  - Flexibility. Drivers mentioned the need for flexibility of charging, for instance for long trips.

Interest in e-bajajs

The drivers stressed the following key characteristics that e-bajajs should have:

- Ease of charging
- Robustness of the engine and vehicles
  Most drivers pay off the contracts at 1 year and 10 months; they would like to see the vehicle still in good condition and working for another 2 to 3 years, which would make sense for them. Otherwise, if they finish the contract time and the vehicle is done, that would not "work for" them. They want to be able to make a profit out of it.

- Ease of getting spare parts, in terms of price and availability. Bajaj failed massively due to the unavailability of spare parts and their high costs; it would need 2 to 3 days to get the needed spare parts. This is the reason why TVS got the market.
- Seating capacity: they wanted to have 5 passengers per vehicle. UEMI indicated that it is not allowed by LATRA. Drivers insisted, saying that they see 3-wheelers operating with 5 passenger seating capacity.

Ownership and business models

- Most drivers at the moment get contracts from individuals, not from companies.
- Mkombozi bank has a longer payback of 4 years for the bajaj loans; however, drivers have to deposit 2 million Tsh at the beginning of the contract. Most drivers prefer getting into contracts with individual bajaj owners because they don't have the 2 million to deposit at the beginning of the contract.
- Contracts with individuals are considered to work very well because most drivers own the vehicles at the end of the contract period. This arrangement gives the driver an incentive to take good care of the vehicle.

Clarification of results of boarding and lighting survey

The drivers and chairman were asked why so many people going to Maji Chumvi in the morning. The chairman thought that it was the reverse, namely more people coming in from the inside going towards BRT in the morning, the reverse in the afternoon. They mentioned that Maji Chumvi is a residential area with no factories or vibrant economic activities to attract large numbers of people going there in the morning.

The only plausible explanation they could think about was that the large trips of three-wheelers recorded in the morning hours from BRT to Maji Chumvi could be due to three-wheelers shuttling from BRT to the interior to pick customers.

University Road

Interview of the waiting point chairperson

The discussion was held in Kiswahili (no recording); notes on paper were subsequently translated in English.

Parking

- Day parking
  - Drivers spend most of the time at the university waiting point.
  - Drivers are usually very busy between 6 am -10 am and then again at 4pm to 10 pm.
  - On good days, the typical waiting time on off peak hours (between 10 and to 4 pm) is 10-15 minutes. On not so good days, the waiting time in off peak hours is 30 minutes. Most of the time the drivers wait for 10-15 minutes.
- Night parking
  - Most drivers park in one location every night; it is very rare to find drivers changing location, but it can happen.
  - Drivers at CCM office, supermarkets and at home because the area is safer
  - He believes that half of the drivers park at home – circa 40 drivers - and half in other spaces – circa 40 drivers again -, for a total of about 80 drivers operating at the waiting point.

BRT connection

- The chairman confirmed that most users of the three-wheelers connect to the BRT either by walking or, when in a hurry, by a motorcycle with a fee of 1,000Tsh.

Charging

- The chairman suggests the charging points to be at the waiting point, but he is not clear who owns the area. He is going to find out and come back to us.
- He is not sure if charging is possible at CCM but suggests the flexibility of being able to charge from home.

Ownership and business model

- The chairman believes that half of the drivers are on contract and half of them own the bajaj.
- Pay off times for contracts depends on the terms but vary between 1.5 to 2 yrs. If the driver shares maintenance cost with the owner, the contract becomes longer; when the driver pays for all maintenance costs, the contract is shorter.
- Contracts vary from one driver to the other, depends on negotiations.
- In most contracts you pay every day except for Sunday. The mode of payment could be daily or weekly depending on what you agree with the owner.

What they aspire to see in e-three wheelers

- Long lasting charge
- Robust engine and vehicle

Note: The chairman suggests involving a few other drivers in finding out what they desire in e-3wheelers.

GPS tracking of ICE three-wheelers

This document summarizes the results of the GPS survey conducted with drivers of ICE bajajs between March 19 and April 23, 2022. The purpose of the analysis is to better understand daily distances, movement, and parking patterns in order to assess the needed characteristics of e-bajajs (battery size, charging infrastructure at day and night, charging times).

1. Background and methodology

Purpose and definitions

The GPS tracking survey aims to provide insight into daily distances, movement, and parking patterns to better assess compatibility and needs for transitioning to electric bajajs. Collecting and analyzing GPS data from bajajs makes it possible to gain these insights, capture and evaluate local needs, and identify appropriate solutions. Amongst others, this could include investigating suitable charging solutions (e.g., overnight charging or on-demand charging). In addition, an overview of frequently used parking areas can help assess, for instance, suitable locations for the development of overnight charging parking areas.
In the context of this report, the term "unit" refers to a bajaj that was equipped with GPS trackers as part of the data collection. Each of these units is associated with a waiting point. A waiting point is a location where units can wait to pick up passengers. In addition, these waiting points may be associated with the drivers' union to which a unit belongs.

Data

This analysis includes two primary data sources. The first source is the GPS tracking data collected as part of the SOL+ project between mid-March and mid-April 2022 in Dar es Salaam. The data was collected using "Develogix Technologies" GPS trackers and processed by the "Wialon" platform. The period from 03/19/2022 to 04/23/2022 is observed in this analysis. While the descriptive statistical analysis uses the summary statistics of the platform provider, the spatial analysis uses the raw dataset in ".wln" format. The raw data, which contains GPS messages transmitted by 20 units during the data collection period, were analyzed with the R programming language. Furthermore, additional information regarding each unit's waiting point, including location, name, and description of the waiting point and potential destinations, supplements the GPS data.

The waiting points included in the GPS tracking campaign comprise Mbezi Mwisho (WP1), Kimara Mwisho (WP2), Kimara Korogwe (WP3), and the intersection of University Road/Sam Nujoma (WP4). Each unit is part of a particular waiting point association and therefore based at a specific waiting point located at strategic locations. Figure 2 shows the described waiting points.

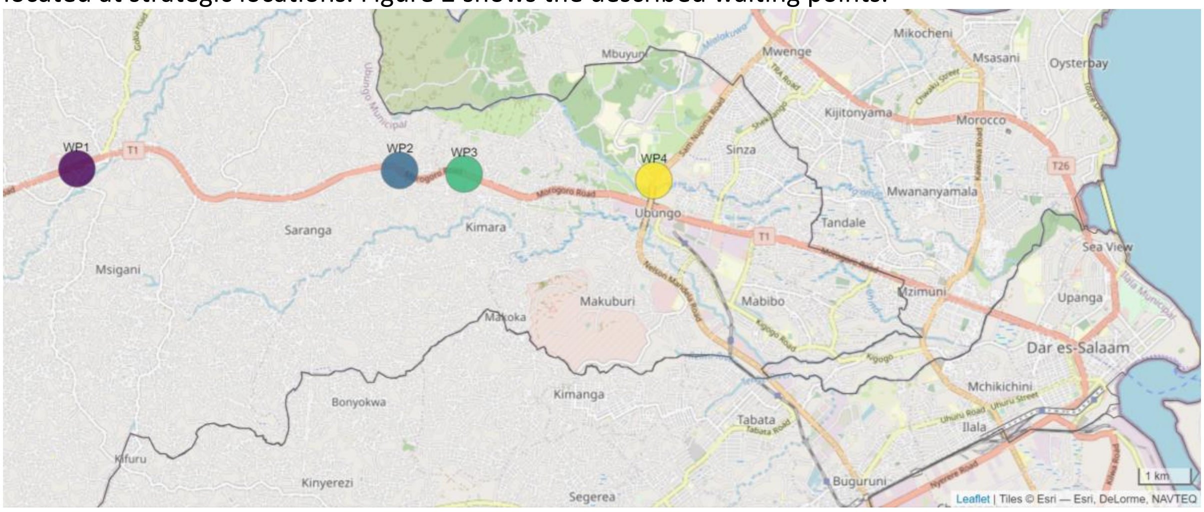


Figure 1 Waiting points included in the GPS survey

Procedure

Data cleaning and preparation

The following paragraphs briefly outline the raw dataset's data preparation and cleaning process.

Raw datasets:

- .wln data export from Wialon
- Information on waiting point locations and potential destinations per driver

Processing of "normal" data:

1. Classification of GPS data regarding the different waiting points
2. Cleaning process
   - Removal of alarm messages and irrelevant columns
   - Removal of invalid data, i.e., Observations with missing or zero values for latitude andlongitude
   - Removal of observations with identical Timestamp, Name/UID, longitude, and latitude (Duplicates)
3. Transformation of the cleaned data frame to a spatial data frame

Processing of "spatial" data frame:

1. Grouping data by unit and date
2. Calculation of new variables (for each observation)
   - Time difference from GPS point to the next GPS point
   - Distance from GPS point to the next GPS point
   - Speed [m/s and km/h]
   - Distance from GPS point to the assigned waiting point
3. Cleaning process:
   - Removal of spatial outliers (See Figure 2: Points in the orange box)

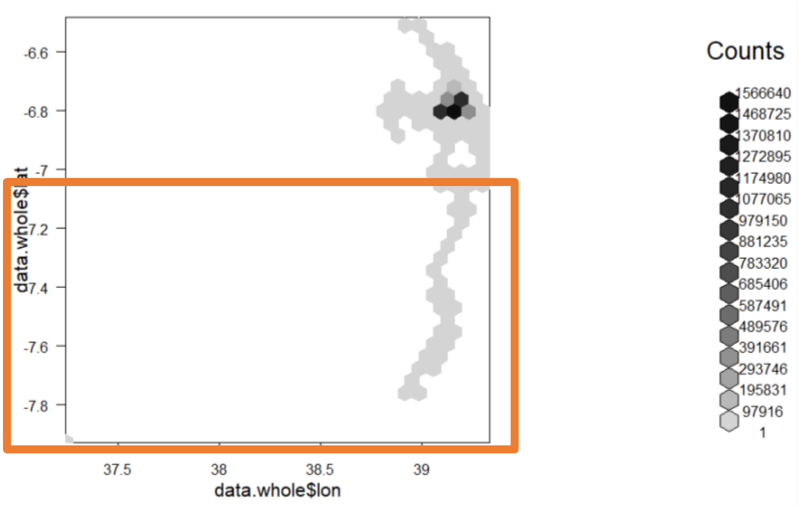


Figure 2 Removed observations outside of Dar es Salaam

Exploratory spatial analysis

The following paragraphs briefly outline the steps followed for analyzing the nighttime parking patterns. The analysis examines locations where units are parked during the night, including drivers parking at home and at various protected or unprotected locations. For this purpose, time windows during which a significant percentage of vehicles stand still between midnight and 3 am were identified. This is followed bya visual representation of the locations and the spatial clustering of the

GPS points based on the geometrical attributes. According to Knox's (1989) definition, cited by Aldstadt (2010), a spatial cluster is "a geographically bounded group of occurrences of sufficient size and concentration to be unlikely to have occurred by chance." There are several methods to identify such spatial clusters, in our case we used a method from the field of spatial data mining. Considering the geometric properties of the data points, we aim to find the exact position and shape information of the clusters (Liu et al. 2012). Other attributes were ignored. Therefore, the spatial clusters presented in this report refer only to the geometric properties, i.e., the geometric coordinates where the vehicles were located during the identified time windows.
The main objective was to determine the spatial distribution of nighttime parking and whether patterns are apparent. Hierarchical clustering was used to identify all data points within 500 m next to each other. The analysis was first performed for the units of each waiting point individually, followed by a collective analysis and clustering of all units. The following steps were performed:

1. Identification of nighttime windows with the smallest amount of unparked units
   1.1 First, a visual exploration was carried out, considering the longitude and latitude patterns during the observation period.
   1.2 For validation the percentage of vehicles with a speed of less than 10 m/s or 0 m/s was calculated.
   1.3 Based on these results, time windows were selected for each waiting point. The following table shows the selected time windows and the proportion of observations with a velocity of less than 10 m/s or 0 m/s.

Table 1 Time windows of nighttime parking analysis per waiting point

	WP1	WP2	WP3	WP4
Time period	1 to 2 am	midnight to 1 am	midnight to 1 am	midnight to 3 am
Speed = 0	97%	92%	96%	97%
Speed < 10 m/s	99%	99%	99%	98%

2. Exploration of the observations for the units of each waiting point. The observations of each waiting point were analyzed individually.
3. Spatial Clustering: GSP points that are closer than 500 m to each other are grouped together.
4. Analysis of units grouped by waiting point.
5. Synthesis of the analysis and spatial clustering to identify patterns for the whole dataset.

2. Descriptive statistics

General overview

After cleaning the data, the data analysis includes approximately 4.85 million observations. The number of observations per bajaj varies significantly. While the transmitted data for most GPS trackers amounts to more than 200,000 observations, data from four bajajs show fewer than 50,000 observations for the entire period. The following figure provides an overview of the number of collected observations for each unit during the data collection period.

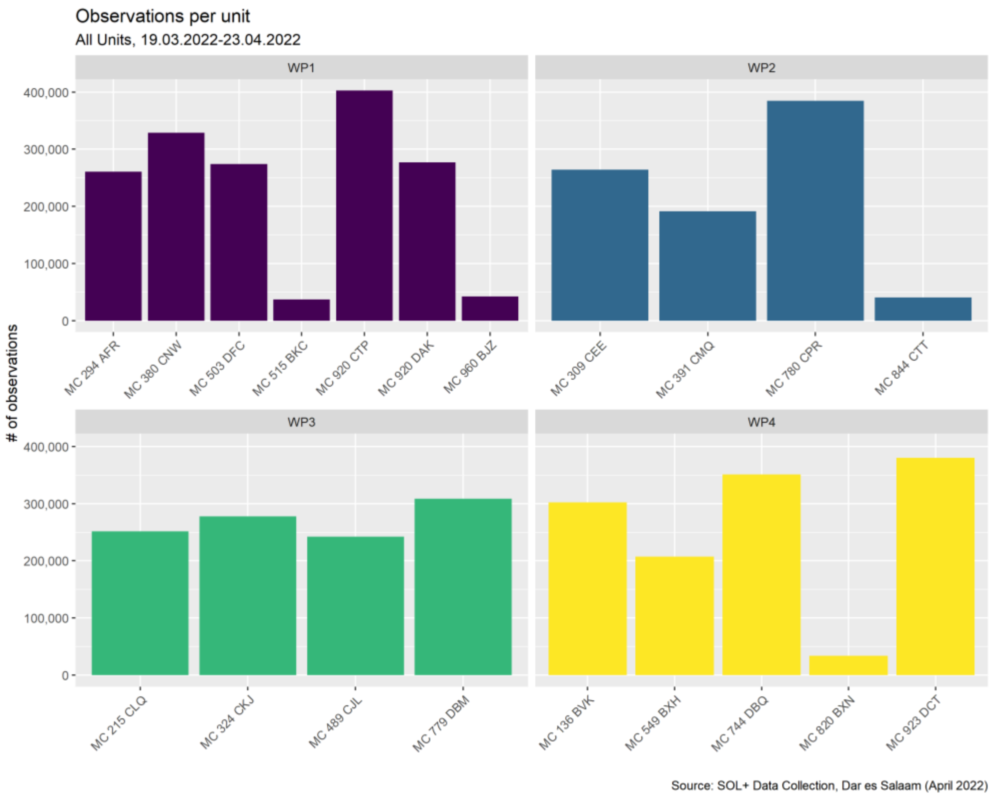


Figure 3 Number of observations per unit

To assess the consistency of the data collection, we look at the distribution of observations collected per hour and per day. Ideally, we would have the same number of observations for each unit every day (e.g., transmitting a GPS track every 10 seconds around the clock). This is not the case on all days and times, which suggests inconsistencies in the collected data. We identified a couple of reasons that contribute to the inconsistencies. During the preparation of the tracking campaign, we noticed that some devices have irregular tracking intervals. Although this was communicated to the data provider, this bias could not be solved entirely. We also monitored the tracking activities during the entire period and noticed that some devices indeed appeared offline. However, the data provider explained that the tracking devices were being charged once the bajaj engine was running. Once the engine was turned off (especially overnight), there was, therefore, the possibility that the devices disconnected. While this would not impact the analysis and results, we also must mention that we have been informed that other devices have been offline due to technical/connection issues.

It can be observed that the units MC 515 BKC (WP1), MC 960 BJZ (WP1), MC 820 BXN (WP2), and MC 844 CTT (WP3) contain fewer observations than the majority of units. This could mean that the data is incomplete. To avoid incomplete data from skweeing the analysis days with a daily distance of less than 10 km traveled are excluded from the analysis. In addtion, for comparison purposes, Chapter 2 discusses both the descriptive statistics for all units (n=20), and those for units with more than 50,000 observations, excluding units with missing data (n=16), separately.

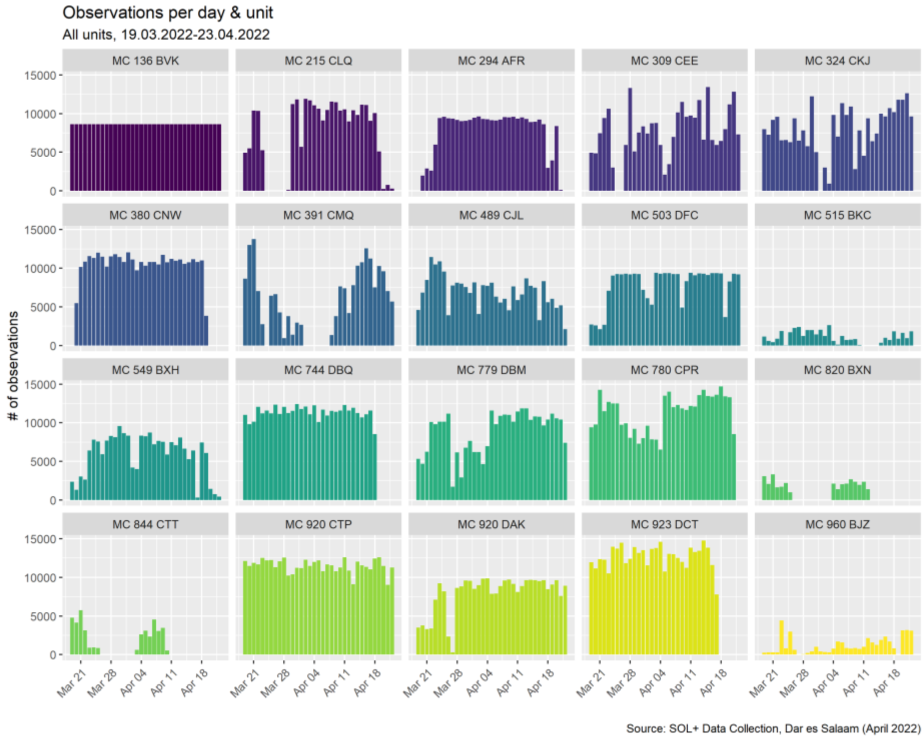


Figure 4 Number of observations per day for each unit

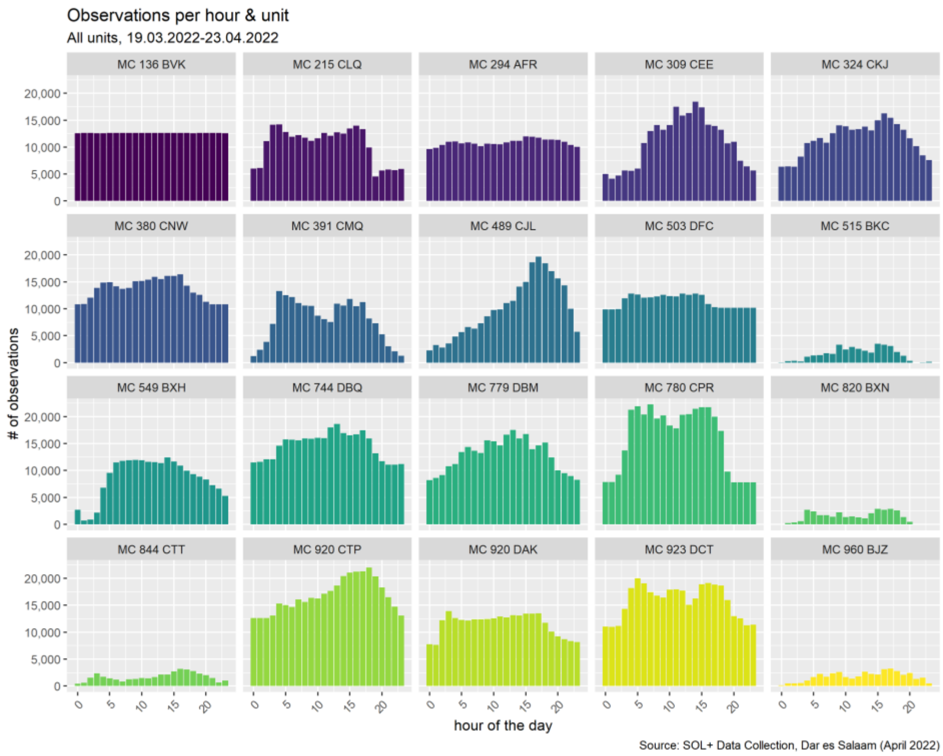


Figure 5 Number of observations per hour for each unit

Mileage patterns

We analyze the milage patterns per unit during the data collection period to obtain information about daily distances. In the following, we first present the analysis results obtained by considering the entire dataset. However, as previously described, there is the possibility of invalidity for four surveyed units.

For this reason, the data are then considered separately, and an insight into the results of the data from the units with and without the potentially invalid observations is provided.

Milage pattern of all bajajs (n=20)

According to the GPS tracking results, the average daily mileage of bajaj is about 120 km. This distance is higher than expected, especially when compared to findings in the literature (Goletz et al. 2021) and from the driver survey. Possible explanations are the different locations within the city that have been analyzed as well as the imperfect relationship between perceived (by the drivers) and actual (measured) distance. In addition, note that for validation purposes we also calculated milage patterns based on the raw dataset (see following sub-section). The breakdown of average daily mileages by weekdays, Saturdays, and Sundays suggests some differences in usage patterns regarding the different days of the week. While the average value remains relatively robust for all categories (between about 111 km and 125 km), notable differences are observed when taking a closer look at the reasonable extremes of the data – i.e., the 1.5 interquartile range (IQR) values that are denoted by the whiskers in our boxplots.

Simply put, this statistic indicates the highest values that fall within 1.5 times below and above the middle 50 % of data. For the daily calculation, we obtain an upper 1.5 IQR value of about 154, which increases to about 166 for weekdays, 182 for Saturdays, and 212 for Sundays, respectively. In other words, while the daily mileage of all tracked vehicles are relatively close to each other on a daily and weekday basis (note, also, the size of the boxes and that there are just a couple of outliers), for the Saturdays and Sundays calculation, we observe many vehicles that tend to drive more considerable distances. This could indicate less idling time (e.g., due to less traffic or less waiting time for passengers), private hires for out-of-town trips, or other personal trips of drivers without passengers. However, some of the variations can certainly also be attributed to the shorter period and the small(er) number of observations in the respective sub-samples. Consider that we draw on 620 observations (=mileages per day per unit) from 36 days for the daily calculation, while there are only 86 observations on five days for the Sunday calculation.

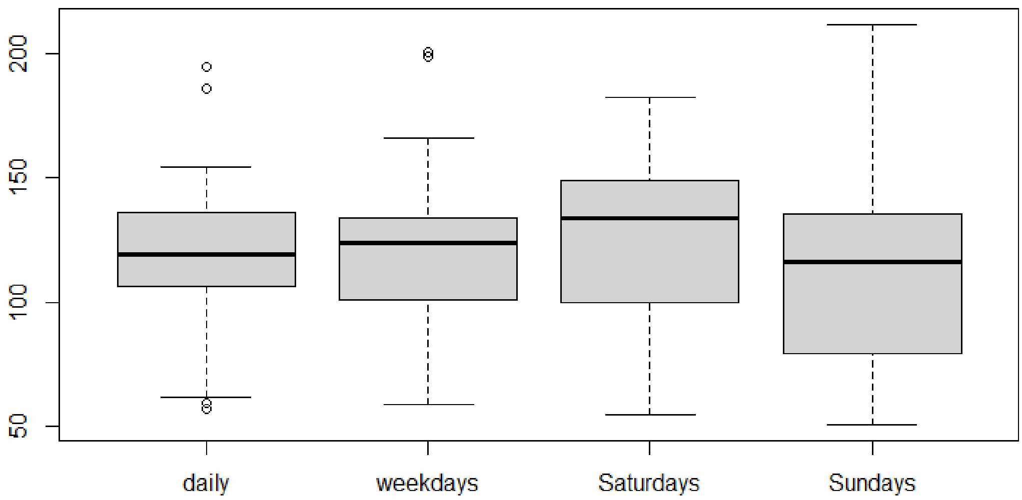


Figure 6 Boxplot of average mileage in km (n=20)

Table 2 Descriptive statistics average mileage in km (n=20)

	Distance in km					
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**
Daily	57.38	107.91	119.41	120.11	135.85	194.83
Weekday	58.92	101.92	123.97	121.53	133.56	200.35
Saturdays	54.83	105.00	133.97	125.15	147.31	182.40

Sundays	51.00	82.66	116.38	111.53	133.00	211.50

Milage pattern of bajajs with more than 50,000 observations (n=16)

Compared to the previous analysis, we can see here that the mean daily distance, excluding the incomplete data, increases from 120 to 129 km. In addition, the mean daily distance is likewise relatively robust, ranging from 124 to 130. Although the comparison of the two datasets generally does not reveal significant discrepancies, it should be noted that we cannot rule out the occurrence of systematic errors in GPS monitoring due to factors beyond our control (e.g., tracker calibration).

Figure 7 Boxplot of average mileage in km (n=16)

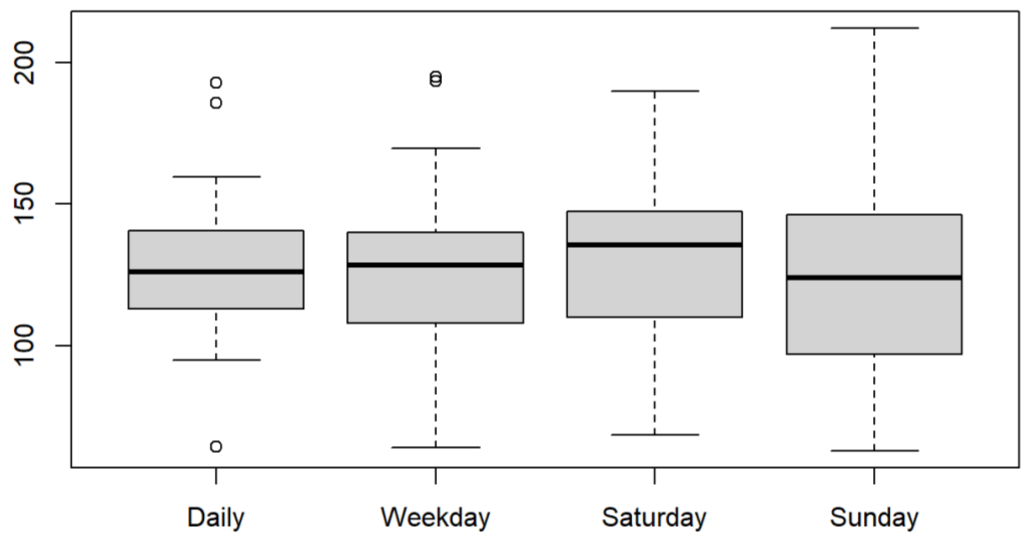


Table 3 Descriptive statistics average mileage in km (n=16)

	Distance in km					
	Min.	**1st Qu.**	**Median**	**Mean**	**3rd Qu.**	**Max.**
Daily	64.3	114.6	126.0	129.3	138.2	192.8
Weekday	63.86	108.77	128.36	130.38	137.14	194.73
Saturdays	68.51	111.34	135.53	129.08	146.01	189.88
Sundays	62.9	102.1	123.8	124.4	143.8	212.0

3. Exploratory spatial analysis of night parking locations

The following analysis results present the nighttime parking behavior of all bajajs participating in the GPS survey. The analysis first focuses on exploring time windows in which the movement patterns of bajaj show little to no movement during the night. After the time windows are identified, the analysis includes identifying high frequency-parking areas. One goal of this analysis is to investigate potential interrelationships between nighttime parking locations and determine if there are locations at which different units park collectively. Identifying night parking patterns can provide insights into the parking behavior of bajaj drivers in Dar Es Salaam and support the development of charging strategies or the location planning of potential shared nighttime charging stations. The analysis results include the night parking locations of all bajajs; these can include public and private parking facilities and parking locations in front of homes.

The following figure shows the distribution of night parking locations during the data collection. The color scale corresponds to the waiting point each bajaj is assigned to. For example, points in purple represent vehicles belonging to waiting point 1, while points in yellow belong to waiting point 4.

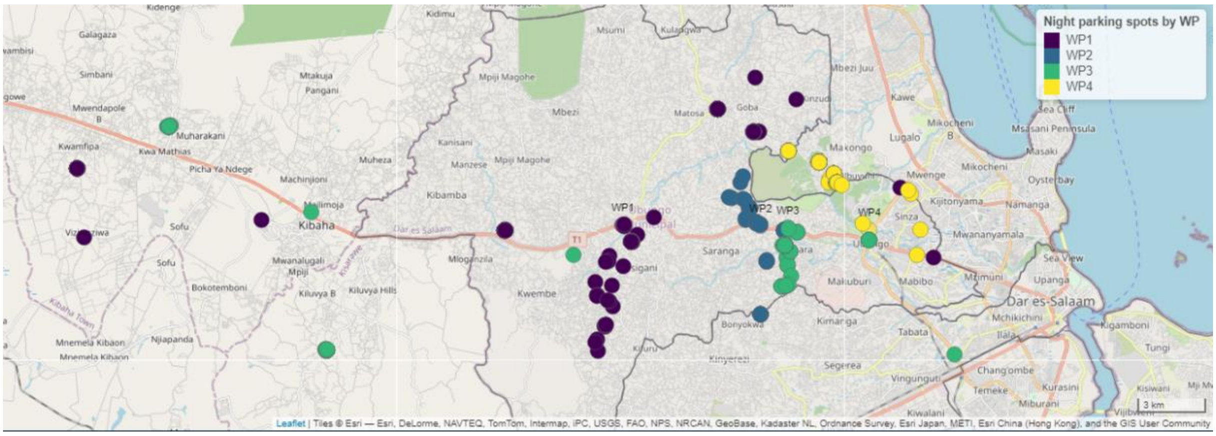


Figure 8 Distribution of night parking locations per waiting point

In the following paragraphs, we explore the observations of the individual waiting points separately. The goal is to determine the location of nighttime parking hotspots. After analyzing the data of each individual waiting point, all observations are analyzed together.

Mbezi Mwisho north & south (WP1)

For the waiting point Mbezi Mwisho the analysis considers a time window between 1 and 2 am. In total, the data of 201 overnight parking locations are available, which are initially divided into 20 spatial clusters. A spatial cluster is a group of points less than 500 m apart. From these 20 clusters, five main clusters are finally identified. Out of the 201 observations, 170 are within these five clusters. Clusters 1 and 2 are located on the potential WP1 corridor, with Cluster 1 being located next to the Mbezi Mwisho waiting point. Cluster 5 is located outside of Dar es Salaam. Thirty-nine of all night parking spots used by the units of WP1 are in Cluster 1, followed by Clusters 3 and 4. It can be observed that the parking clusters are mainly used by a single bajaj, which is parked there regularly. Cluster 3 had a maximum of two bajaj parked on six nights. Cluster 1 was used by two bajajs in four nights of data collection. It is important to note that few intersections and thus shared parking locations were found. The spatial clusters described, therefore rather represent the most frequently used nighttime parking spots of individual units.

The following figure shows the five main parking locations of the units from WP 1. The table shows how often which unit parked in the respective cluster. In addition, it provides information about the ratio of observations in this cluster to the total number of observations.

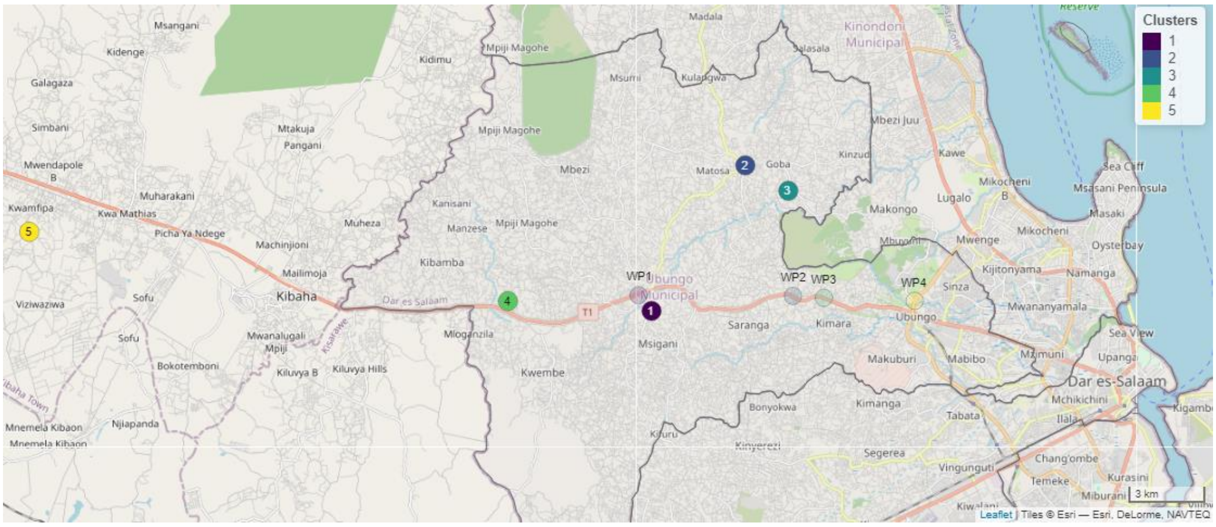


Figure 9 Locations of night parking clusters (WP1)

Table 4 Nights spent at each spatial cluster (Units of WP1)

	Nights spent in each cluster per unit									
Cluster	**MC 294 AFR**	**MC 380 CNW**	**MC 503 DFC**	**MC 515 BKC**	**MC 920 CTP**	**MC 920 DAK**	**MC 960 BJZ**	**Max. # of vehicles per night**	**Total**	**Ratio (in %)**
1	4	0	35	0	0	0	0	**2**	**39**	**19**
2	0	30	0	0	0	0	0	**1**	**30**	**15**
3	0	0	0	7	0	0	27	**2**	**34**	**17**
4	0	0	0	0	35	0	0	**1**	**35**	**17**
5	0	0	0	0	0	32	0	**1**	**32**	**16**
Total # of observations per unit	30	30	35	8	35	33	30			

Kimara Mwisho (WP2)

For WP2, the analysis focuses on the distribution of night parking between midnight and 1 am. The decision for this time window is based on the result that 92% of all observations of WP2 have a speed of zero and 99% a speed of less than ten m/s. In total, 83 observations are available for this waiting point. First, 8 spatial clusters were identified, from which the three main clusters were selected. The main clusters contain 64 of the 82 observations. Cluster 3 is located directly at WP3, and cluster 2 is located on a potential corridor to Matosa. As with WP1, it can be observed that the parking areas are used mainly by one vehicle. While clusters 1 and 3 were used by only one bajaj, cluster 2 was used by a maximum of two bajajs. It is worth noting that while there is no complete data for unit MC 844 CTT (resulting in a total of eight available observations for this bajaj), the unit parked three of the eight nights in cluster 2.

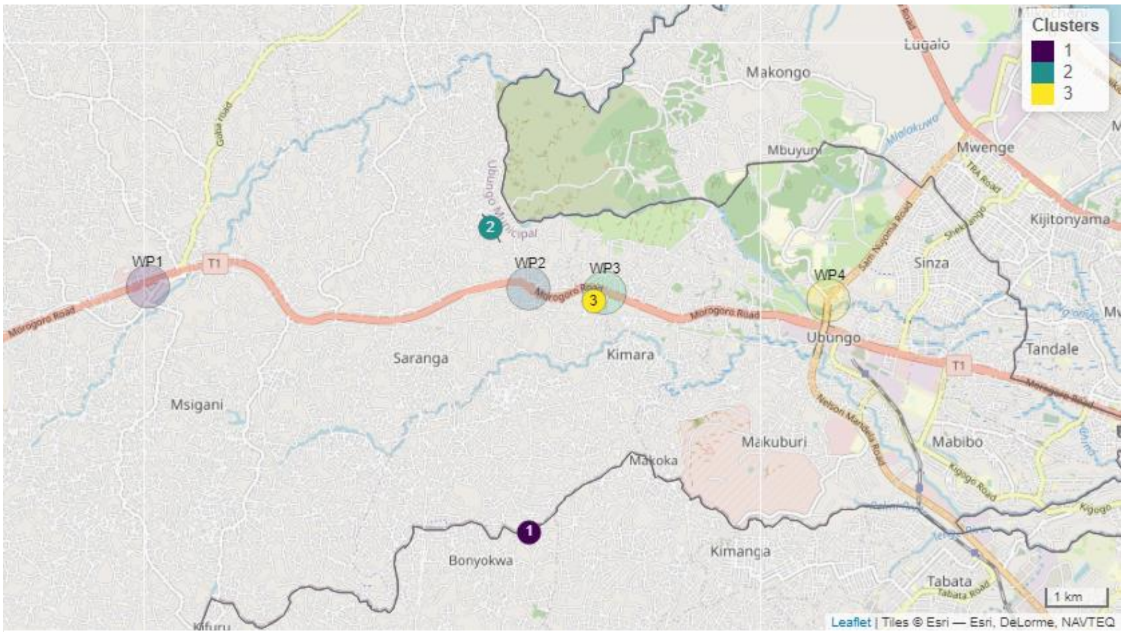


Figure 10 Locations of night parking clusters (WP2)

Table 5 Nights spent at each spatial cluster (Units of WP2)

Nights spent at each cluster per unit							
Cluster	**MC 309 CEE**	**MC 391 CMQ**	**MC 780 CPR**	**MC 844 CTT**	**Max. # of vehicles per night**	**Total**	**Ratio (in %)**
1	17	0	0	0	**1**	**17**	**20**
2	0	10	0	3	**2**	**13**	**16**
3	0	0	34	0	**1**	**34**	**41**
Total # of observations per unit	24	17	34	8			

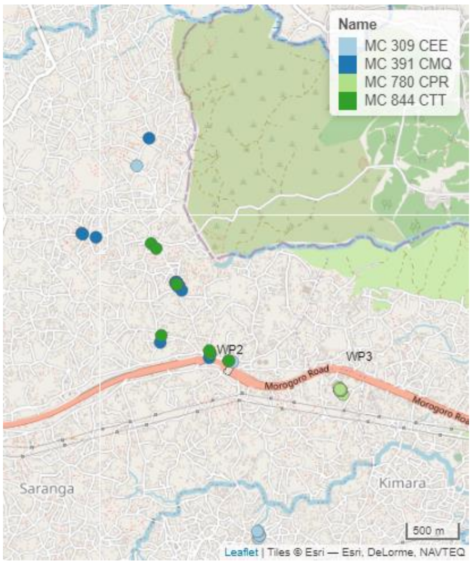


Figure 11 Locations of night parking spots around WP2 & WP3 (only observations of WP2 bajaj)

Kimara Korogwe (WP3)

Among the parking locations of the units belonging to the third waiting point, 13 spatial clusters were initially identified. In total, 104 observations are available for this waiting point, of which 77 lie within the three main clusters. Two of the parking areas - clusters 2 and 3 - are located outside Dar es Salaam and a used by a single bajaj each. Clusters 1, located near WP3, comprises 40 observations and hosts a maximum of two bajaj per night.

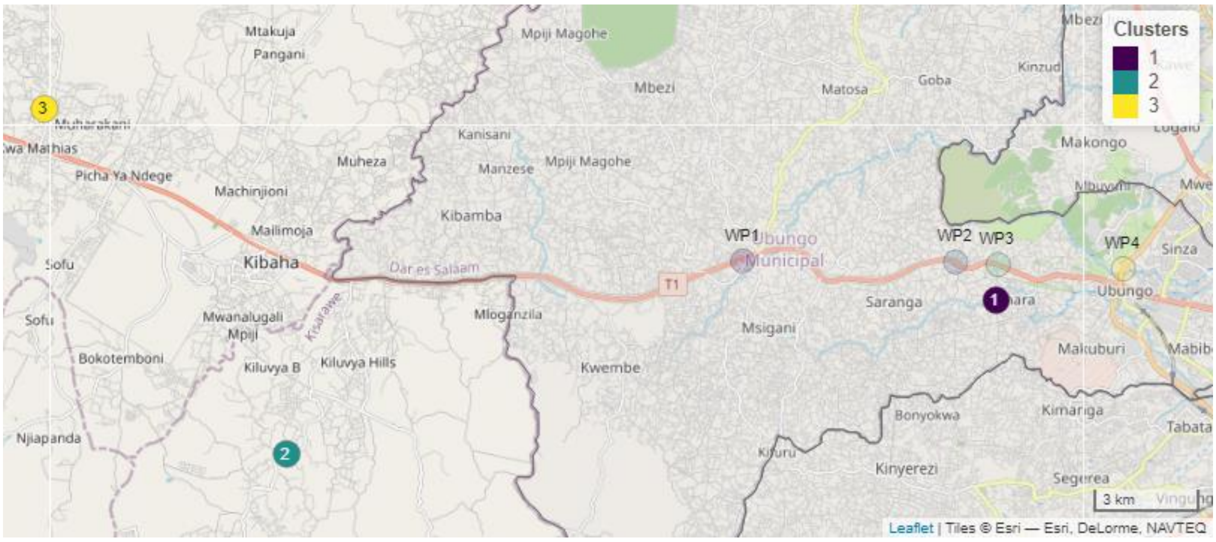


Figure 12 Locations of night parking clusters (WP3)

Table 6 Nights spent at each spatial cluster (Units of WP3)

	Nights spent at each cluster per unit						
Cluster	**MC 215 CLQ**	**MC 324 CKJ**	**MC 489 CJL**	**MC 779 DBM**	**Max. # of vehicles per night**	**Total**	**Ratio (in %)**
1	5	0	0	35	**2**	**40**	**36**
2	17	0	0	0	**1**	**17**	**15**
3	0	0	20	0	**1**	**20**	**18**
Total # of observations per unit	27	19	23	35			

While the bajaj with the ID "MC 780 CPR" does not reside in one of the main nighttime parking areas, the analysis shows that the vehicle parks in various locations throughout the survey period. Figure 13 provides a glimpse of the nighttime parking patterns for this unit. Out of 19 nights, the unit spent five nights near Cluster 1 or WP3 and six nights near WP4.

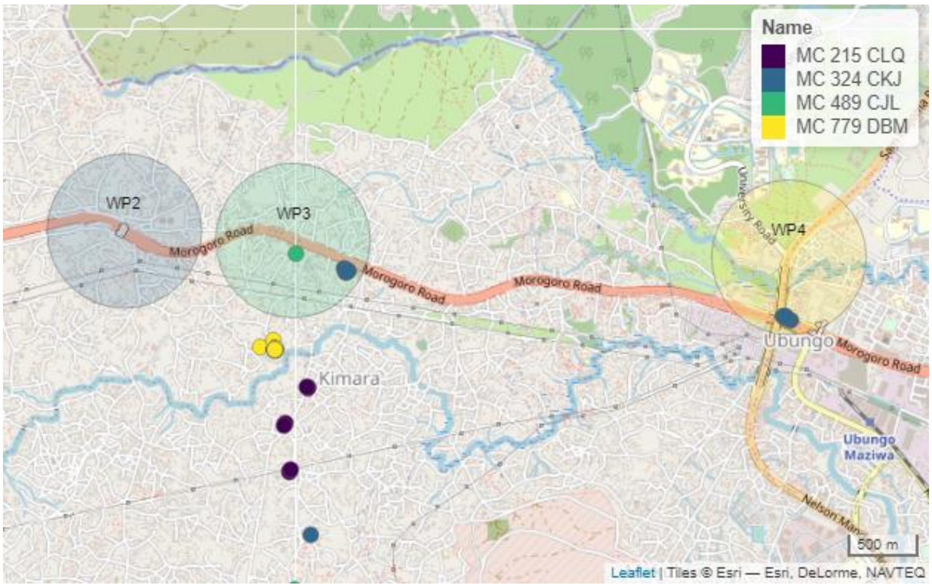


Figure 13 Parking behavior around WP2, WP3 & WP4 (only bajaj's of WP3)

University Rd/Sam Nujoma (WP4)

The analysis of night parking patterns of bajaj's based at WP4 looks at the time window between midnight and 3 am. The reason for choosing this time window is that 97% of the observations have a speed of 0 km/h at this time during the whole survey period. In addition, observations for the unit "MC 820 BXN" are available in this time window, which is not the case for smaller time windows (i.e., from midnight to 1 am). Initially, nine spatial clusters were identified, from which the four main clusters were selected. The main four clusters contain 106 of 113 observations.

As in the analysis of the previous waiting points, it can be observed that four units show a regular parking pattern. For two clusters, there are days when two vehicles simultaneously park within these clusters. It is noticeable that the identified parking locations are at the end of the potential corridor to Changanyikeni.

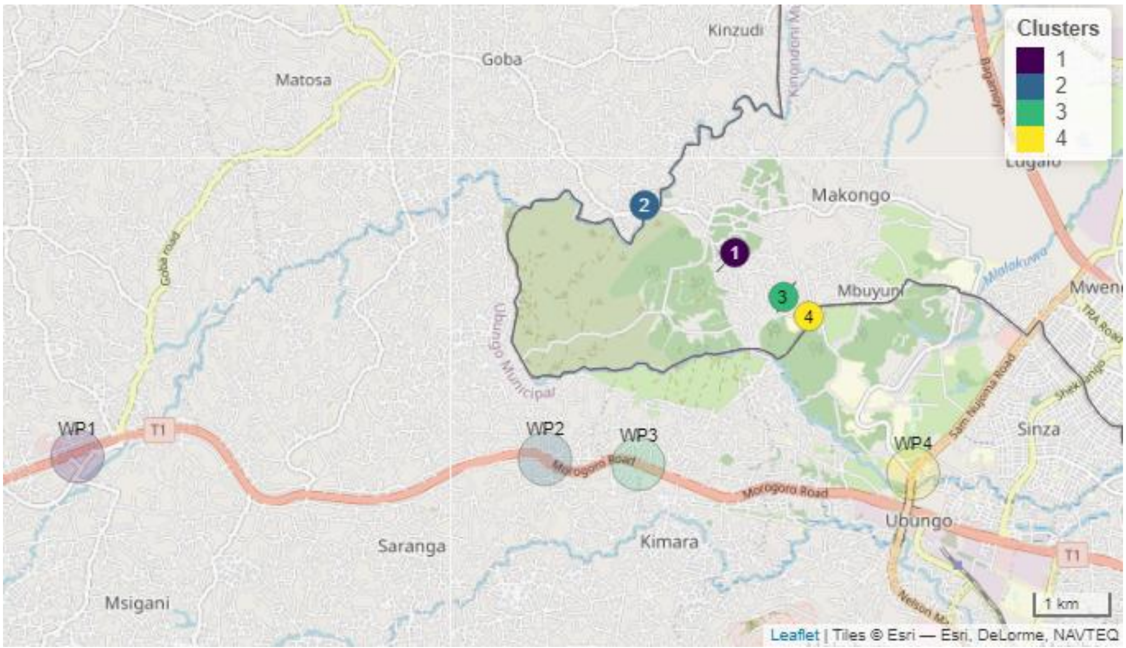


Figure 14 Locations of night parking clusters (WP4)

Table 7 Nights spent at each spatial cluster (Units of WP4)

	Nights spent at each cluster per unit							
Cluster	**MC 136 BVK**	**MC 549 BXH**	**MC 744 DBQ**	**MC 820 BXN**	**MC 923 DCT**	**Max. # of vehicles per night**	**Total**	**Ratio (in %)**
1	35	0	0	1	0	**2**	**36**	**32**
2	0	13	0	0	0	**1**	**13**	**12**
3	0	1	29	0	0	**2**	**30**	**27**
4	0	0	0	0	27	**1**	**27**	**24**
Total # of observations per unit	35	14	31	3	30			

Analysis of all waiting points

The joint analysis of parking locations for all WPs highlights similarities and differences in nighttime parking patterns among the WPs. The following figure summarizes the previous results by showing the earlier described clusters of the individual WPs displayed on one map.

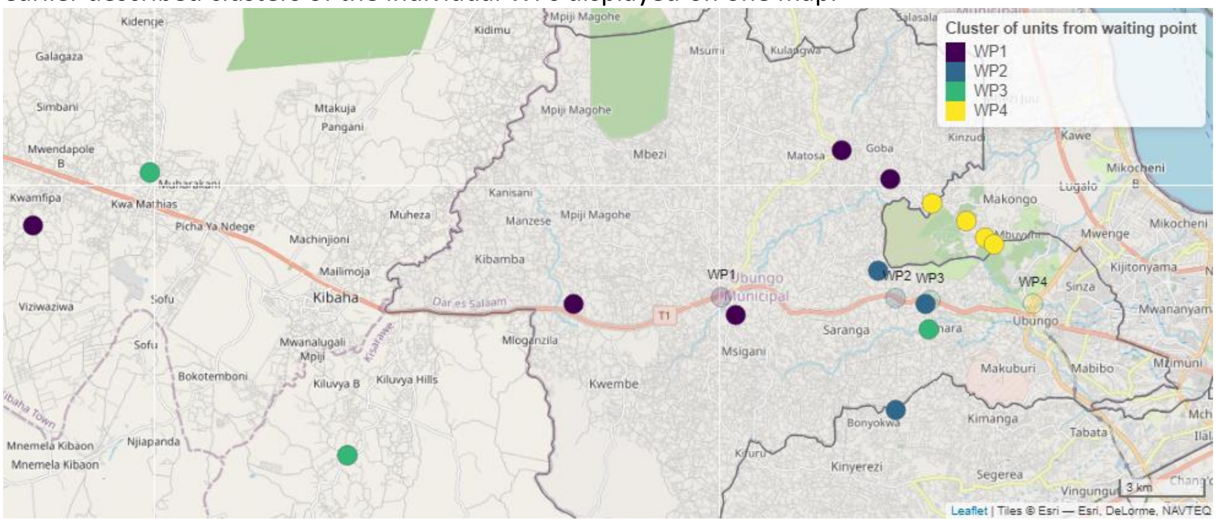


Figure 15 Combined map including clusters of all WP's

Subsequently, the analysis procedure applied to the individual WPs is performed on the entire dataset. First, clusters of points closer than 500 m are identified. Then, the spatial clusters with the most significant number of observations (above ten) are selected, and the number of units parked at each location is examined. A total of 15 main clusters were identified, which correspond to the clusters identified during the analysis of the individual waiting points. While three of the clusters are located outside the Dar es Salaam city boundary, several clusters are located close to the surveyed waiting points. Three are near Kimara Mwisho (WP2) and Kimara Korogwe (WP3), and one is on the south side of Mbezi Mwisho (WP1).

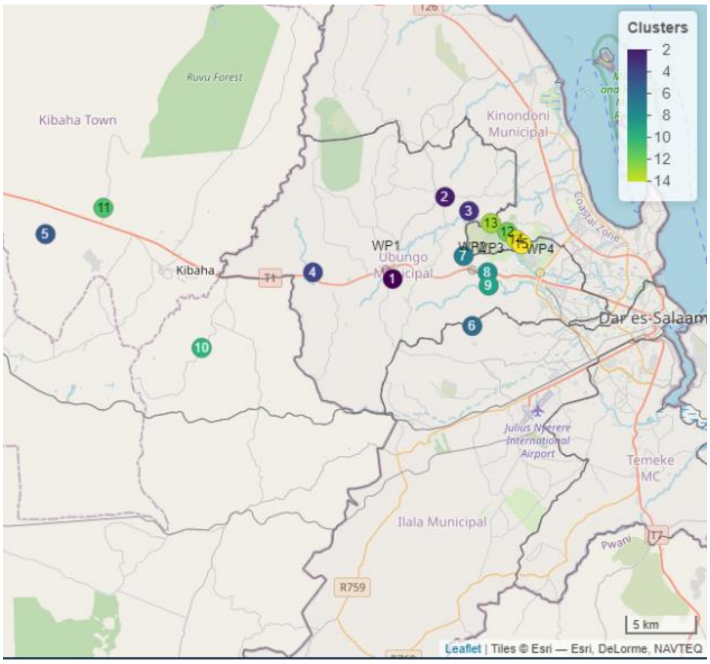


Figure 16 Locations of night parking clusters (entire dataset)

This iteration aims to investigate potential interrelationships between nighttime parking locations and determine if there are locations at which units from different waiting points park collectively. However, this hypothesis could not be verified. As shown in the table below, the distribution of overnight parking by different units from each waiting point is distributed among the clusters, and no overlapping pattern can be identified. A reason for this may be the distance chosen between the points or the small sample size, among other factors. Nevertheless, the results allow us to conclude the tendency of a large proportion of bajajs to park at a regular location. The proximity of some parking clusters to the waiting point is also worth emphasizing. The analysis shows that units based at one waiting point tend to use nearby nighttime parking locations, such as clusters 12, 13, and 14 (Figure 18). In addition, there are cases where units from different waiting points park close to each other, such as in clusters 7, 8, and 9 (Figure 17).

Table 8 Nights spent at each spatial cluster (entire dataset)

Cluster	WP1	WP2	WP3	WP4	Total
1	39	0	0	0	**39**
2	30	0	0	0	**30**
3	34	0	0	0	**34**
4	35	0	0	0	**35**
5	32	0	0	0	**32**
6	0	17	0	0	**17**
7	0	13	0	0	**13**
8	0	34	1	0	**35**
9	0	0	40	0	**40**
10	0	0	17	0	**17**
11	0	0	20	0	**20**
12	0	0	0	36	**36**
13	0	0	0	13	**13**
14	0	0	0	20	**30**
15	0	0	0	27	**27**

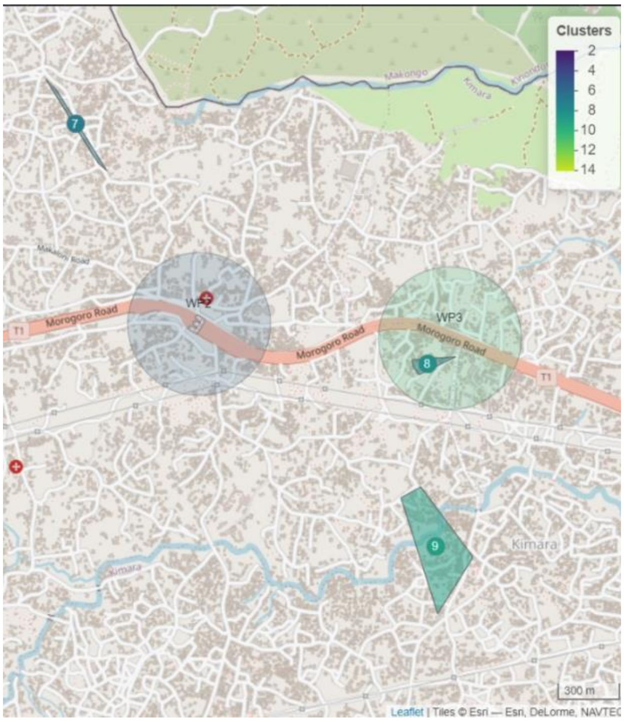


Figure 17 Clusters around WP2 & WP3 (entire dataset)

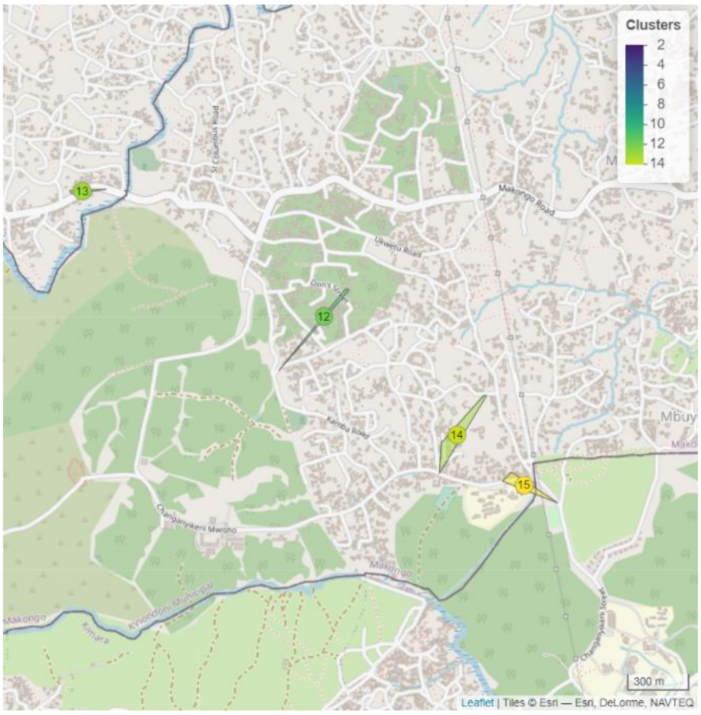
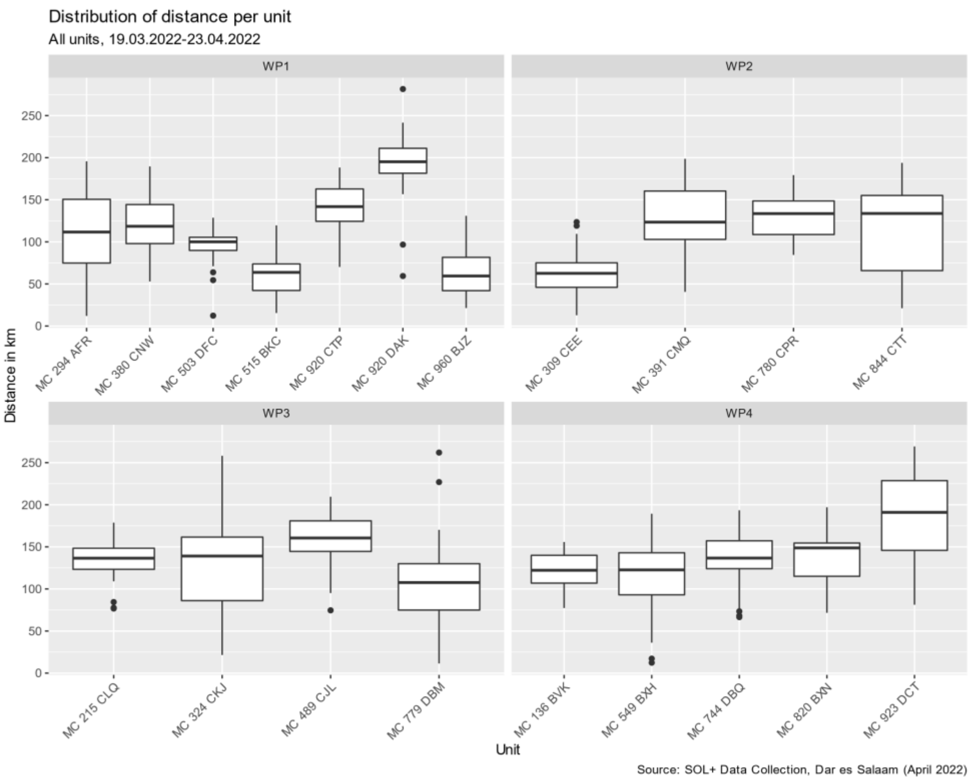


Figure 18 Cluster in the area Changanyikeni (entire dataset)

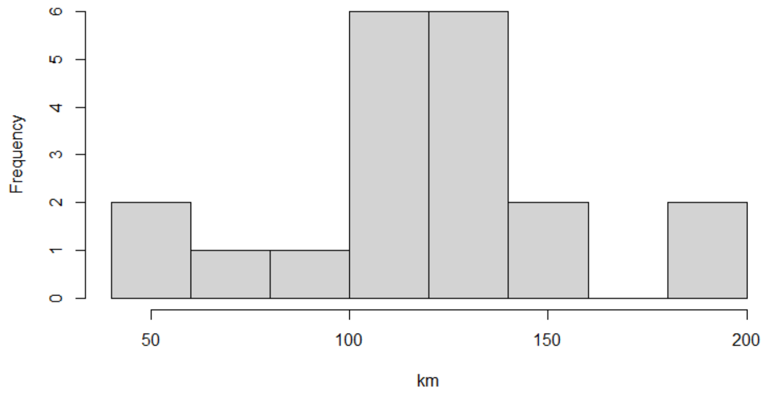
Appendix

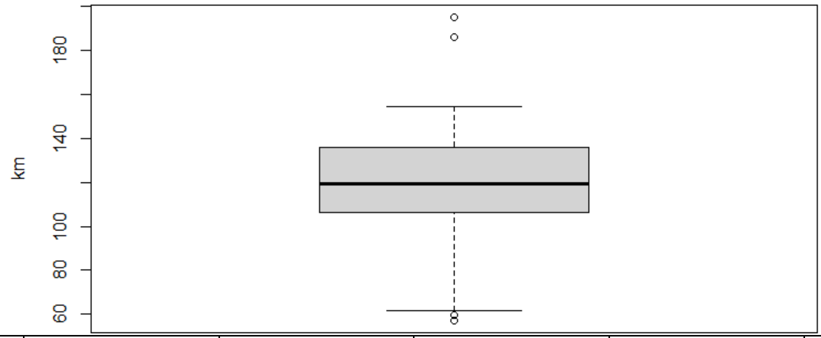
Additional figures milage patterns of bajajs (n=20)

i. Average daily milage during the entire analysis period per unit



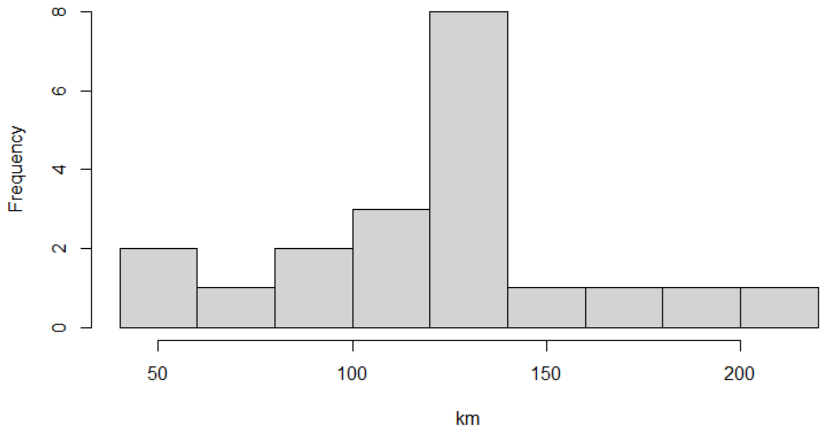
ii. Average daily mileage during entire analysis period (36 days)

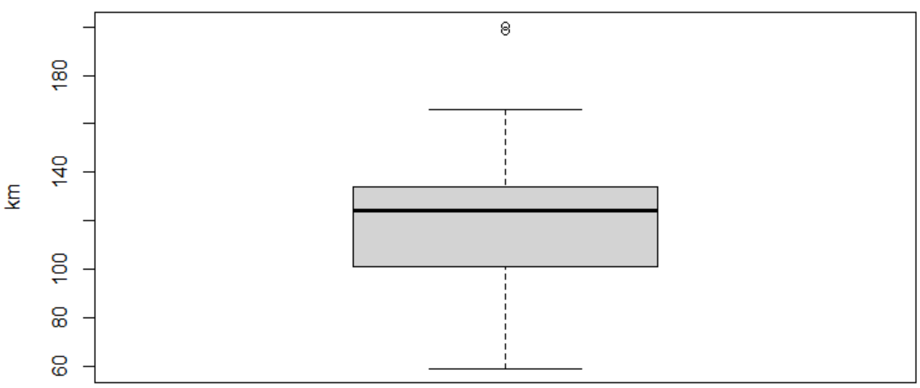




Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
57.38	107.91	119.41	120.11	135.85	194.83

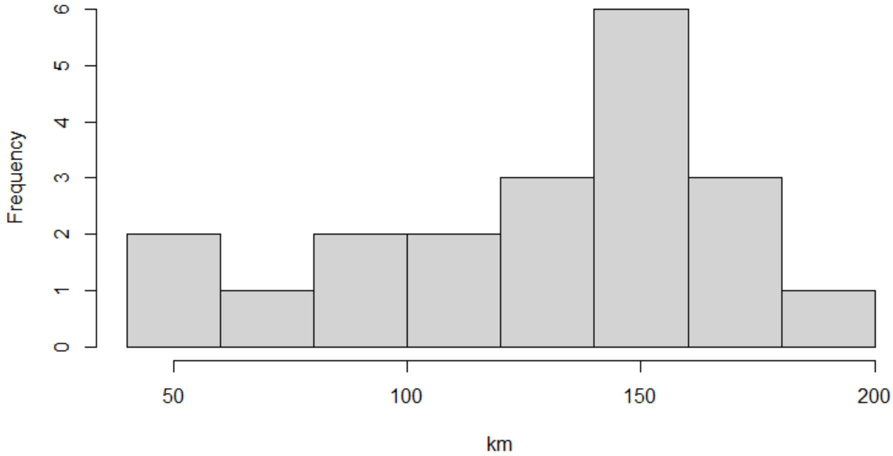
iii. Average daily mileage on weekdays (25 days)

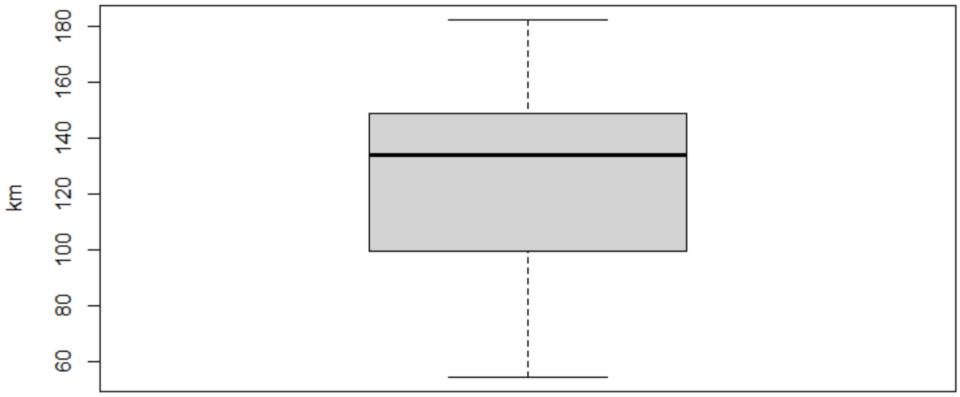




Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
58.92	101.92	123.97	121.53	133.56	200.35

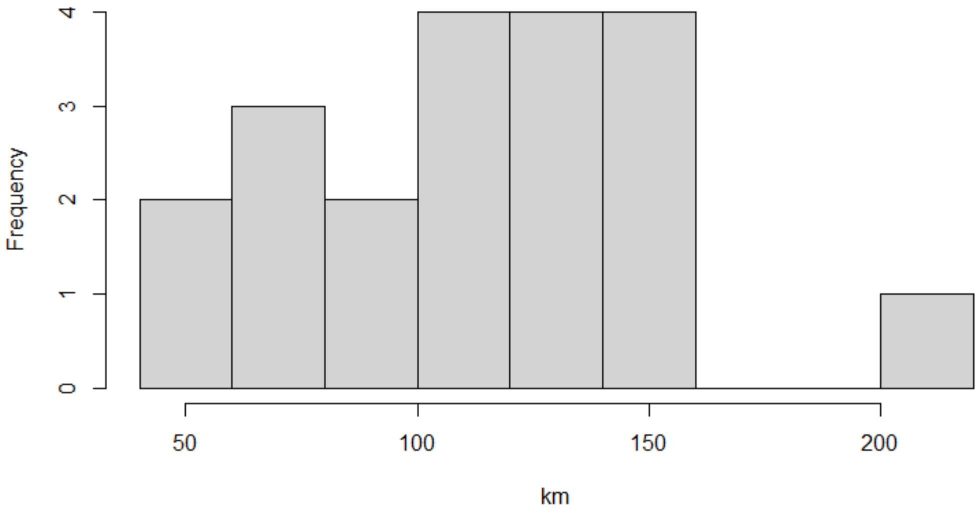
iv. **Average daily mileage on Saturdays (6 days)**

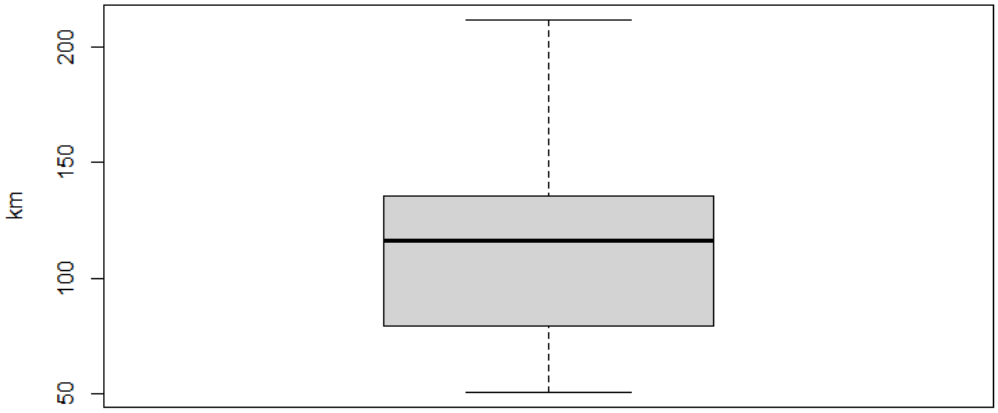




Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
54.83	105.00	133.97	125.15	147.31	182.40

v. **Average daily mileage on Sundays (5 days)**





Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
51.00	82.66	116.38	111.53	133.00	211.50

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