# FINAL STUDY REPORT

## A Regional Analytical Analysis of Trends in Trade and Transport in East Africa

**Revision 3**

TRADE MARK EAST AFRICA

*Growing Prosperity Through Trade*

AESDC

Africa Economic & Social Development Consultants

**In Partnership with**

COWI

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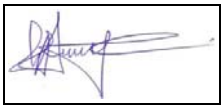
| Editorial Document Review | Mr Alberto Leny | Editor |  | 14/02/2022 |
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# DEFINITIONS & ABBREVIATIONS

| | |
|---|---|
| 3 PL | Third-Party Logistics |
| AADT | Annual Average Daily Traffic |
| ADT | Average Daily Traffic |
| CAPI | Computer-Assisted Personal Interviews |
| CCTTFA | Central Corridor Transit Transport Facilitation Agency |
| CIF | Cost, Insurance, and Freight |
| CONSORT | Consolidated Standards of Reporting Trials |
| DTC | Digital Traffic Census |
| DRC | Democratic Republic of Congo |
| DTOD | Digital Traffic Origin and Destination |
| EAC | East African Community |
| FOB | Free on board |
| GHG | Greenhouse Gases |
| ICD | Inland Container Depot |
| KPA | Kenya Ports Authority |
| NCTTCA | Northern Corridor Transit and Transport Coordination Authority |
| NRES | National Research Ethics Service |
| OEC | Observatory of Economic Complexity |
| OGA | Other Government Agencies |
| RA | Revenue Authorities |
| RAATTE | Regional Analytical Analysis of Trends in Trade and Transport in East Africa |
| TMEA | TradeMark East Africa |
| TEU | Twenty-foot Equivalent Unit |

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# EXECUTIVE SUMMARY

**Introduction**

This report documents the results of the Regional Analytical Analysis of Trends in Trade and Transport in East Africa (RAATTE) study, TradeMark East Africa's (TMEA's) first East Africa-wide survey of traffic and trade trends across the region. The RAATTE study establishes a data collection process, an analysis of trade volumes, an emissions inventory, an assessment of transport costs, and the baseline dataset for use in TMEA's trade facilitation intervention impact assessment efforts.

Implemented by Kenya-based Africa Economic and Social Development Consultants (AESDC), with the support COWI A/S (COWI), this RAATTE study has collected data to report against the following parameters:

- Traffic volumes across the East African trade network and on each of the two major trade corridors (Northern Corridor and Central Corridor).
- The predominant origins and destinations of freight across the network.
- Total cost of transport by country at the commodity level.
- Inventory of the emissions production from goods movement across the region.

**Summary of Key Cost and Time Findings of the Study**

The total cost of trade across East Africa, inclusive of direct transport costs, port costs, illicit costs, compliance costs and delay costs, but excluding shipping line costs is estimated to be:

| Country | Average total cost of trade (USD) |
|---|---|
| Burundi | 4,277[1] |
| Kenya | 2,364 |
| Rwanda | 5,419[2] |
| Tanzania | 5,260 |
| Uganda | 3,320 |
| **Northern Corridor** | **3,065** |
| **Central Corridor** | **4,883** |

[1]Central Corridor
[2]Central Corridor

Naturally, the costs vary substantially by route, given differences in distances and times travelled. The top 20 most frequently used routes are estimated to have the following costs:

| No | Origin | Destination | Road distance (km) | Trade Cost | | Median reported trip times (days) |
|---|---|---|---|---|---|---|
| | | | | Average cost per trip (USD) | Average cost per km (USD/km) | |
| 1 | Mombasa | Kampala | 1,169.0 | 2,779.9 | 2.4 | 3.0 |
| 2 | Dar es Salaam | Kigali | 1,495.0 | 4,907.6 | 3.3 | 4.2 |
| 3 | Dar es Salaam | Mwanza | 1,152.0 | 4,547.7 | 3.9 | 2.1 |
| 4 | Mombasa | Nairobi | 485.0 | 2,916.0 | 6.0 | 0.9 |
| 5 | Mtwara | Dar es Salaam | 556.0 | 4,876.8 | 8.8 | 1.3 |
| 6 | Mombasa | Juba | 1,620.0 | 2,916.0 | 1.8 | 3.3 |
| 7 | Kampala | Juba | 635.0 | 2,916.0 | 4.6 | 2.3 |
| 8 | Kampala | Mombasa | 1,138.0 | 2,916.0 | 2.6 | 2.4 |
| 9 | Nairobi | Kampala | 657.0 | 2,916.0 | 4.4 | 2.0 |
| 10 | Kampala | Arua | 475.0 | 2,916.0 | 6.1 | 0.4 |
| 11 | Dar es Salaam | Bujumbura | 1,494.0 | 4,876.8 | 3.3 | 3.5 |
| 12 | Bagamoyo | Dar es Salaam | 63.0 | 2,916.0 | 46.3 | 0.2 |
| 13 | Arusha | Dar es Salaam | 624.0 | 4,876.8 | 7.8 | 1.3 |
| 14 | Dar es Salaam | Arusha | 624.0 | 4,876.8 | 7.8 | 1.2 |
| 15 | Tanga | Dar es Salaam | 332.0 | 4,547.7 | 13.7 | 1.0 |
| 16 | Mombasa | Jinja | 1,070.0 | 2,896.6 | 2.7 | 2.7 |
| 17 | Dar es Salaam | Kigoma | 1,479.0 | 4,876.8 | 3.3 | 2.6 |
| 18 | Mbeya | Dar es Salaam | 815.0 | 4,876.8 | 6.0 | 1.3 |
| 19 | Dar es Salaam | Mbeya | 815.0 | 4,876.8 | 6.0 | 1.4 |
| 20 | Mombasa | Kigali | 1,477.0 | 2,916.0 | 2.0 | 4.2 |

**Methodology for the Study**

The study team employed a mixed methodology approach in collecting data required for this study and the tools employed included the following:

- Freight Origin and Destination (OD) Survey.
- Traffic Census.
- Freight Transport Cost Survey.

All study tools were tested using a pilot process. The pilot utilized an "iterative process" which enabled the team to improve the tool's design diligently and quickly mobilize for the Full Study.

**Sample Size**

The baseline OD survey managed to reach the target sample size with where the response rate is the proportion of the anticipated sample successfully collected. The results of the OD Survey collection are as follows:

| Country | Target Sample (n) | Sample size (n) | Number of stations covered[3] | Sample/Target |
|---|---|---|---|---|
| Burundi | 372 | 281 | 1 | 76% |
| Kenya | 3,348 | 5,109 | 9 | 153% |
| Rwanda | 744 | 600 | 2 | 81% |
| Tanzania | 3,348 | 4,736 | 9 | 142% |
| Uganda | 2,976 | 4,459 | 8 | 150% |
| **Total** | **10,788** | **15,185** | **29** | **141%** |

**Traffic Census**

A purpose-built web-based Digital Traffic Census (DTC) application was used to collect vehicular traffic on both sides of the road at the selected traffic survey sites. These were supplemented by manual paper census taking to ensure continuity in case of internet access failures. The survey sites were located at high-volume sites in each East African Community (EAC) country. They were selected to subject the methods, tools and research instruments to their maximum stress limits.

The Traffic Census involved counting 100% of the vehicles passing the census traffic count sites, including all types of freight vehicles. The Traffic Census was conducted for twelve (12) hours over seven days for a continuous seven (7) days period, and also included full 24-hour counts for two of the days of each counting period. The national police services were incorporated into each country team and their primary role was to facilitate the traffic census and provide security to the study team. A total regional average daily traffic (ADT) of 343,963 vehicles were counted, of which Kenyan traffic accounted for just under 50%. Overall, freight accounted for about 28% of total traffic on the road during the census period.

**Freight Origin/Destination Survey**

The purpose of the OD Survey was to establish the physical and operational characteristics of traffic flows in terms of, among others, the following particulars: vehicle, owner, driver, headquarters of operation, cargo, journey, fuel consumption, and unofficial payments. The surveys were conducted during the entirety of each census period. The OD Survey was conducted at the same sites as the Traffic Census Survey.

The results obtained from the OD Survey support the estimation of both traffic flows and transport costs for this study.

[3]Station count numbers and locations as agreed with TMEA.

The top freight routes by traffic volumes are reflected in the following table:

| Rank[4] | Regional | Burundi | Kenya | Rwanda | Tanzania | Uganda |
|---|---|---|---|---|---|---|
| 1 | Mombasa-Kampala | Dar es Salaam-Bujumbura | Mombasa-Kampala | Dar es Salaam-Kigali | Dar es Salaam-Mwanza | Mombasa-Kampala |
| 2 | Dar es Salaam-Kigali | Bujumbura-Dar es Salaam | Mombasa-Athi River | Dar es Salaam-Gisenyi | Mtwara-Dar es Salaam | Kampala-Juba |
| 3 | Dar es Salaam-Mwanza | Kampala-Bujumbura | Nairobi-Kampala | Mombasa-Kigali | Bagamoyo-Dar es Salaam | Kampala-Arua |
| 4 | Mombasa-Nairobi | Gitega-Bujumbura | Nairobi-Mombasa | Nairobi-Kigali | Arusha-Dar es Salaam | Kampala-Gulu |
| 5 | Mtwara-Dar es Salaam | Arua City-Bujumbura | Mombasa-Kisumu | Dar es Salaam-Cyangugu | Dar es Salaam-Kigali | Mombasa-Juba |

**Transport Cost Survey of Freight Transport Operators**

The Freight Transport Cost Analysis Survey focused on collecting information from freight transport fleet operators on the principal drivers of cost in terms of transport prices and transport costs from various freight transport and logistic companies. Following the experience of the Pilot Study, the Cost Analysis Survey was simplified, in order to attract a more robust response. This was only partially successful as we collected 83 responses, which was significantly higher than the pilot volume, but well below our target of 250. Information collected from the survey was collated as follows:

List of Freight Transport Operators, Commodities Selected for Discussion, Type of Trucks used to Transport Selected Commodities, Principal Commodity Origin and Destinations, Commodity Packaging, Transport Charges of Transporting the Goods from Origin to Destination, Typical Informal Charges and Transport Cost Build-Up Model.

Our analysis indicates the following in-East African Community (EAC) average total costs per twenty-foot equivalent unit (TEU) trip. The regional average cost by trade corridor in terms of the Northern Corridor and Central Corridor is as follows:

| Item | Northern Corridor | Central Corridor |
|---|---|---|
| Average direct transport cost per trip (USD)[5] | 1,981.9 | 2,980.5 |

The average cost for each EAC member country was as follows:

| Item | Kenya | Tanzania | Uganda | Rwanda | Burundi |
|---|---|---|---|---|---|
| Average direct transport cost Per trip (USD) | 1,282 | 3,375 | 2,243 | 4,383 | 2,391 |

[4]In order of frequency of use
[5]Excludes illicit costs

**Freight Transport GHG Emissions Assessment**

The assessment of the greenhouse gas (GHG) emissions resulting from road freight activities in the five selected countries has been carried out as the calculation of $CO_2$ emissions generated by truck movements along the main national corridors identified in the truck traffic census. The level of these emissions depends on a series of factors such as the number of vehicles circulating on a given route, the type of vehicles used, their average fuel consumption, as well as the average distance travelled on a daily basis. The assessment makes efficient use of the two datasets available: The truck traffic census, which captured the average daily truck traffic along national roads, irrespectively of their initial origin or end destination; and the survey data collected from truck drivers, which enables the refinement of some of the assumptions used for the $CO_2$ calculation. Several corrections were added by the team, to double-check some of the assumptions used in the methodology described in Section 3.3. Our assessment indicates the following annual $CO_2$ emissions caused by truck traffic in the five selected countries (in million tonnes per annum), based on the data available:

| Annual CO2 emissions from truck traffic on main corridors, in million tonnes per annum | | | | | |
|---|---|---|---|---|---|
| **Regional** | **Burundi** | **Kenya** | **Rwanda** | **Tanzania** | **Uganda** |
| 14.56 | 0.01 | 6.94 | 0.74 | 5.47 | 1.40 |

**Conclusion**

TMEA can consider this first RAATTE study to have largely met its objectives. Though, not without problems, the study successfully captured volume, movement, commodity, and cost data, to an extent never previously accomplished by TMEA. The data are largely consistent with expectations, usable, and useful. The data collected should help support the preparation of a regional trade observatory and also improve TMEA's capacity to forecast changes in prices and trade volumes to support its overall mission. And to that end, the study has largely met its goals.

Overall, the study identified the key trade routes being used for freight movements in East Africa, established that Rwanda has largely shifted to use of the Central Corridor for imports, and catalogued a variety of costs that are not well-studied in East Africa. The study also resulted in an emissions inventory for the region which can be built on and used to identify intervention opportunities in the future.

Other key observations arising from the study include:

1. The methodologies established under the RAATTE study did successfully collect most of the hoped-for data and could be repeated for future data collection exercises.

2. A full 25% of truck traffic is using the Mombasa-Kampala corridor and terminating in Nairobi (5.9%) or Kampala (19.1%).

3. Despite the concentration of traffic on the Mombasa-Kampala route, the majority of destinations use the Central Corridor. This includes Kigali which has largely shifted to using the Central Corridor over the past decade. It also includes Burundi which does receive goods via the Northern Corridor, but mostly those originating in Kampala.

4. Trade cost data collected includes comprehensive direct transport cost estimates by operators. These show that other than fuel tankers, container trucks were the most expensive to operate. However, they are also the most efficient by shipment tonnage, in terms of fuel consumption and emissions.

5. Reporting of illicit costs varied substantially across countries surveyed, ranging from just over USD 7 in Kenya up to USD 500 for trips to Rwanda using the Northern Corridor. The study team views these results with some scepticism and suggest these are best used as a baseline for future benchmarking.

6. Costs to trade varied substantially across the two corridors, with the average trip on the Central Corridor costing USD 4,883 while the average trip on the Northern Corridor cost 3,065, a 37% difference, accounted for, in part by the lower average distances travelled. However, the per km cost on the Central Corridor tended to be lower for trips to Bujumbura and Kigali resulting in a near balance of total cost across the two options.

7. While TMEA directed the study team to exclude focus group-based assessment of trade barriers from the full study, some data were collected via the OD Survey. These suggest that road condition improvements and resolution of delaying police checks and other policing issues are the most pressing trade barriers according to operators and may therefore be considered for future assessment of potential impacts, if resolved.

# 1. INTRODUCTION

## 1.1 Context

The Northern Corridor Transit and Transport Coordination Authority (NCTTCA), the Central Corridor Transit Transport Facilitation Agency (CCTTFA), the Dar es Salaam Corridor Secretariat and TradeMark East Africa (TMEA) entered into a partnership to collect extensive information on transport performance in East Africa to identify the bottlenecks and monitor the progress of reforms.

To make reliable predictions on the performance of the corridors, TMEA and its partners require a large amount of reliable data, which includes among many others:

- Data on trade such as origins and destinations of freight.
- Freight prices.
- Freight volumes.
- Data on transport (time and cost).

Further, this data should be collected using a repeatable and reproducible methodology.

TMEA and its partners therefore engaged a consortium of international consultants (the study team) to undertake a regional analysis of prices and performance in both trade and transport in East Africa called Regional Analytical Analysis of Trade and Transport in East Africa (RAATTE).

## 1.2 Study Objectives

The purpose of the consultancy was to undertake the following:

i. To collect traffic volume data at key transport nodes along major trade corridors in East Africa member states.

ii. To carry out freight origin-destination survey to generate and analyse traffic flows of commodities along the major trade corridors by different modes of travel in Eastern Africa.

iii. To collect data on the composition and cost structure of trade in East Africa.

iv. To support the ongoing preparation of a regional trade observatory in East Africa, informing public policy decisions and leading to better development outcomes.

v. To enable TMEA to better forecast changes in the prices and volumes of traded goods, as well as to forecast (and measure) the effect of its interventions.

## 1.3 The Need for a Study

The study team's terms of reference (ToR) note states thus:

"TMEA, in partnership with the East Africa Community (EAC) Secretariat, the Northern Corridor Transit and Transportation Coordination Authority (NCTTCA), the Central Corridor Transit and Transportation Facilitation Agency (CCTTFA) and the Dar es Salaam Corridor Secretariat, now intend to engage a consultant to undertake a regional analysis of prices and performance in both trade and transport. The data will enable better calibration of the estimates from the TMEA IMPACT model and lay the groundwork for future data collection and monitoring.

"The purpose of this study is to generate and analyse traffic flows of commodities and associated costs of movement along the major trade corridors by different modes of travel in East Africa. The data will quantify the breakdown of prices of major traded goods among the sub-regions of Eastern Africa and enable a better understanding of the factors of those prices, including . . . transport . . ."

## 1.4 The Study Team's Approach to the Full-Scale Regional Study

The TMEA Results Division played a key role in providing the study team with guidance throughout the development of the study approach, the study's tools and instruments, and the study's implementation procedures. This collaborative approach established procedures that were framed into a 'Full Regional Study Plan' which is described in **Annex I**. The study team adopted the following approach in developing the study plan that guided its implementation:

- The development of instruments and tools including interview guides.
- Constructing training materials for researchers.
- The application of tablets in conducting computer-aided field data collection.
- Resolution of problems with recording feedback and survey response rates as seen in the Pilot Study.
- The administration of questionnaires to study subjects using online, in person and teleconferencing tools.
- Application of multiple methods of data collection to resolve internet access and other collection issues.

The 'Full Regional Study Plan' offered a series of protocols concerning the planning and execution of the work. It also guided how the study team has interpreted the information gathered from the study.

## 1.5 Report Organisation

The remainder of this report presents the methodology employed in **Chapter 2**, followed by reporting on results.

The emissions analysis of East African traffic is presented in **Chapter 3**, including both method and results. The overall cost analysis is described in **Chapter 4**. The summary, regional results are presented in **Chapter 5**. Here, we present the traffic by top origins and destinations, the cost factor analysis, the cost build-up by commodity, and the analysis of greenhouse gas (GHG) production. Finally, we look at the barriers to trade that were identified in the survey process and where TMEA might focus in future efforts.

The subsequent chapters, **6** through **10**, replicate this reporting approach for each of the five countries included in the study – Kenya, Uganda, Tanzania, Rwanda, and Burundi. At the instruction of TMEA, DRC Congo and South Sudan were excluded from the study due to COVID-19 related challenges. This is followed by summary conclusions in **Chapter 11**.

The annexes include:

- The study plan.
- The commodity classifications used.
- The vehicle type classifications used.
- The cargo flow composition.
- The study tools used.
- Fuel efficiency estimates.

## 1.6 Limitations

TMEA can consider this first RAATTE study to have successfully met its objectives. Though, not without problems, the study successfully captured volume, movement, commodity, and cost data, to an extent never previously accomplished by TMEA. The data are largely consistent, usable, and useful. And to that end, the study has met its goals. The study has catalogued traffic, route preference, costs, and certain non-tariff barriers (NTBs) across East Africa in a comprehensive way that will support TMEA' s objectives of:

- Developing a regional trade and traffic observatory, and
- Developing improved capacity to forecast trade, traffic, and prices.

However, as the first in a planned series of data collection exercises, there are lessons to be learned from this study:

1. The collection of cost data is challenging and likely to continue to be so. Shippers are extremely reluctant to engage with collection efforts. This may be

due to competition concerns, financial and regulatory concerns, a lack of time, or for other reasons. This study attempted multiple collection approaches. Of these, the costliest – in person collection – proved most successful. Future studies should anticipate and plan for this challenge.

2. Field collection of traffic data is complicated by access to electricity and internet connectivity. Planning for connectivity failures is crucial, and the experience of this study is that carrying paper alternatives is wise.

3. Estimation of regional variance in cost is complicated by the inclusion of local trips. At the national level, a good portion of this study's OD data is short trips with a substantially different cost profile than the longer-haul regional trips. This variance tends to become hidden when looking at average costs. Future work may want to consider looking at local and regional trips separately.

4. There is variation across the region on how free respondents feel to provide information. The OD and cost survey datasets are based on respondent disclosure. While we attempt to verify certain information – vehicle km, commodity load, etc. – through the review of paper documentation, much of the data set relies on honest and free disclosure. However, the willingness to disclose certain information, such as illicit payments, varied widely by country and as such, the data indicate substantial variation between countries – possibly more than can be explained by actual differences in payment levels. Interpretation of the results should keep this fact in mind. Several strategies to improve the response were attempted, the most successful of which was the more expensive face-to-face collection approach. The only approach considered, but not attempted, was the offer of incentive payments for completion. TMEA should consider this limitation when planning for future collection efforts and plan for additional time and budget to better manage the process.

# 2. STUDY METHODOLOGY

## 2.1 General

### 2.1.1 The Full Regional Study Plan

The study team developed a 'Full Regional Study Plan' as a means of ensuring that the data collection and interpretation of regional data would be successful. It contains the study's detailed methods including:

- The scope and objectives.
- Implementation details.
- Study logistics.
- Data collection and analysis methods.
- Study sample size targets.

The United Kingdom's Consolidated Standards of Reporting Trials Group and The National Research Ethics Service state that when estimating the sample size for a study, the simplest method to apply is the sample size rule of thumb. This study has employed the "Browne General Flat Rule"[6] that recommends the use of at least 25 subjects or greater to estimate the study target population.

**Table 2-1: Survey description, targetrespondents and sample size**

| SURVEY DESCRIPTION | TARGET RESPONDENTS | SAMPLE SIZE |
|---|---|---|
| 1. Digital Traffic Census (DTC) application. | Freight transport vehicles | 100% sample of all trucks crossing the counting station |
| 2. Origin and Destination Traffic Survey | Truck drivers | 3 trucks levy ½ hour at each counting point. |
| 3. Freight Transport Cost Analysis Survey | Transport fleet operators | 83 firms |

[6]Browne General Flat Rule is an alternative and theoretically approved statistical application used for a pilot study for sample size determination, which thus helps to form a basis of the minimal sample size required per station for the main baseline sample size calculation. For this case a sample of at least 25 per station was used during the pilot study. See https://ncss-wpengine.netdna-ssl.com/wp content/themes/ncss/pdf/Procedures/PASS/Pilot_Study_Sample_Size_Rules_of_Thumb.pdf for further details.

### 2.1.2 COVID-19 Precautions

Preserving the safety of the study team and the study respondents was paramount for this study. Face-to-face interviews carried the risk of exposing the participants to infection by the COVID-19 virus. Face-to-face interviews (such as the Origin-Destination Survey) were therefore conducted according to protocols that provided preventive measures that included temperature screening of all survey participants, along with the permanent wearing of masks and shields, personal hygiene, physical distancing, and training. The COVID protocols were shared with each national authorizing authority for review and modification, where necessary.

### 2.1.3 Commodity Clusters

Commodity cluster grouping was established during the pilot period. The principal purpose during the pilot was to collect granular details for freight transport costs for the top traded commodities i.e. imports and exports in East Africa. Data on the volume of exports and imports was extracted from the Observatory of Economic Complexity (OEC), which is an online data distribution platform focused on the geography and dynamics of economic activities. Commodities were aggregated into commodity clusters according to their HS2 ID classification. The **Commodity Cluster Lists are included in Appendix II** and are applied for this Full Regional Study Report.

### 2.1.4 Vehicle Classification and Configuration

The following classification was applied as guided by the project's terms of reference.

**Table 2-2: Vehicle classification**

| Container Trailers | Commercial Buses: | Personal vehicles: |
|---|---|---|
| • Bulk trailers<br>• Fuel tankers<br>• Light trucks<br>• Medium trucks<br>• Break bulk<br>• Empty trucks | • Coach<br>• Coaster<br>• Minibus | • Sedans, station wagons and minivans<br>• Pickups<br>• Tuk Tuks |

The detailed vehicle classification and configuration is provided in **Appendix III Vehicle Classification and Configuration.**

### 2.1.5 Iterative Process for Finalizing Survey Tools and Instruments

The study team employed an "iterative process" for developing and testing the survey data collection tools and instruments. This approach allowed the study team to improve the tool's design diligently and quickly during the piloting of this study.

Prototype tools and instruments were developed and administered to the target populations and the prototypes were tweaked or completely overhauled in real-time as responses were received from respondents. The study team engaged respondents on any challenges with the tools and this was repeated until the team was satisfied that the respondents, research teams and client concerns with the tools were addressed.

This was only made possible as all tools were embedded on cloud-based platforms that allowed the team to deploy tools, obtain real-time feedback and make required changes. This involved a continual cycle of planning, analysis, implementation, testing, and evaluation. Each cycle improved the tools and survey process.

The pilot study pretested three (3) research instruments and data collection tools (shown in the table below) used for the Full Regional Study, which werethen revised and implemented regionally for this study:

**Table 2-3: RAATTE study research instruments/data collection tools**

| RESEARCH INSTRUMENT/DATA COLLECTION TOOL | TARGET RESPONDENTS |
|---|---|
| 1. Traffic Census Data Collection tool | Freight transport vehicles |
| 2. Origin and Destination (OD) Survey tool | Truck drivers |
| 3. Freight Transport Cost Analysis tool | Transport fleet operators |

### 2.1.6 Traffic Census

A freight traffic count involves the physical counting of vehicular and freight traffic conducted along a particular road, path, or intersection. The purpose of including a traffic census in the study is (a) to contextualize the data collected in the OD Survey to determine an estimate for total origins, destinations and related information for the entirety of traffic in the study area, and (b) to provide a basis for the estimation of total emissions.

For this Traffic Census, the study team used both a purpose-built web-based Digital Traffic Census (DTC) application and manual paper forms to record traffic volumes at the various station locations in Burundi, Kenya, Rwanda, Tanzania and Uganda.[7]

Manual classified traffic counts were conducted over seven (7) consecutive days during October and November 2021. Five (5) days were of 12-hour duration counts and two (2) days were 24-hour duration counts. The 12-hour counts were carried out between 6 am and 6 pm. The 24-hour counts were carried out between 6 am and 6 am. The traffic enumerators used the issued traffic count data forms (see Annex V) to record traffic information regarding vehicle category, the direction of travel and the period in which the vehicles passed a particular census station.

The teams recorded data in both directions of travel. The Traffic Census was used to identify trade routes with significant volumes of vehicular traffic and provided a breakdown of the types and volumes of freight vehicles using a particular route.

The Traffic Census provided a source of data that was used to calculate the Annual Average Daily Traffic (AADT[8]), which is the common indicator used to represent traffic volume on a particular road section. This information is both useful in its own right, as an inventory of traffic, but also as the mechanism for interpreting the sample of traffic that was taken as part of the OD Survey. This data was also used to estimate the volume of traffic on the different trade routes in terms of twenty-foot equivalent unit (TEU) and to estimate the emissions produced by that traffic.

Regardless of their prior participation in the traffic surveys, each participating enumerator underwent training before the start of the traffic count exercise. This training was complemented with on-site instruction and supervision before and during the Traffic Census. The following are the highlights of the Traffic Census:

i. The traffic counts were carried out at the following pre-identified traffic sites across the five East African Community (EAC) member states[9].

[7]Choice of method was dependent on circumstance specific to each location – availability of power and internet access were the primary determinants.
[8]Traffic volume is measured in average annual daily traffic (AADT), equivalent to total annual volume of traffic divided by 365, the number of days in a year.
[9]Note that the original scope, which called for counts at air and seaports, was amended to exclude these by agreement with TMEA.

**Table 2-4: Traffic survey station**

| Country | Station number | Node | Survey location | Traffic route |
|---|---|---|---|---|
| Kenya | 1 | Nairobi | Shell Zambezi petrol station | Nairobi-Nakuru highway (A2 road) |
| | 2 | | 5km past Kitengela town along Athi River-Namanga Road | Nairobi-Namanga Highway (A2 road) |
| | 3 | | Total Sabaki petrol station | Mombasa-Nairobi highway (A8 road) |
| | 4 | | Thika (500m North of Blue Post Hotel) | Nairobi-Nyeri highway (A2 road) |
| | 5 | Mombasa | Danca, Mtwapa petrol station | Mombasa-Malindi road (A7 road) |
| | 6 | | Luqman filling station, Mariakani | Mombasa-Nairobi road (A8 road) |
| | 7 | | Towards Kwale-Ukunda area | Mombasa-Lungalu (A7 road) |
| | 8 | Kisumu | Ahero junction | Kisumu-Busia road (A12 road) |
| | 9 | | Kobil Webuye | Eldoret-Malaba road (A8 road) |
| Uganda | 10 | Kampala | Busitema weighbridge or Magamaga weighbridge | Kampala-Jinja-Malaba road |
| | | | | Kampala-Jinja-Malaba road |
| | 11 | | Lukaya weighbridge | Kampala-Masaka road |
| | 12 | | Mubende weighbridge | Kampala-Mubende road |
| | 13 | | Luzira (Port Bell) | Port Bell road |
| | 14 | | Wakiso | Kampala-Hoima road |
| | 15 | | Luwero weighbridge | Kampala-Luwero road |
| | 16 | Gulu | Corner Kamdini | Luwero-Nakasongola-Gulu road |
| | | | | Luwero-Nakasongola-Gulu road. |
| | 17 | | Atiak | Gulu-Atiak-Nimule road |

| Country | Station number | Node | Survey location | Traffic route |
|---|---|---|---|---|
| Tanzania | 18 | Dar es Salaam | Mwandege centre | Mtwara Corridor |
| | 19 | | Mapping centre | Bagamoyo road |
| | 20 | | Kibaha centre old weighbridge | Tranzam highway |
| | 21 | Nzega | East of Nzega roundabout | Nzega-Central corridor |
| | 22 | Mwanza | East of Usagara junction | Usagara junction |
| | 23 | Mbeya | North of Chunya bus station | Chunya road-Tanzam |
| | 24 | | 200m north of Tazara station | Tunduma Road-Tanzam |
| | 25 | | 200m east of Uyole junction | Uyole Centre-Tanzam |
| | 26 | Kigoma | Salmo oil fuel station, south of Manyovu roundabout | Kigoma-Nyakanazi road |
| Rwanda | 27 | Kigali | Kabuye transit point | Kigali-Gatuna route (RN3) |
| | 28 | | Kinyoni. Gameca station | Kigali-Kanyaru route (RN1) |
| Burundi | 29 | Bujumbura | Ntahangwe City oil station | Bugarama-Bujumbura route |

ii. The Traffic Census involved counting 100% of the vehicles passing the census traffic count sites.

iii. The national police services in each respective country were incorporated into the team and their primary role was to facilitate the traffic census and provide security to the study team.

iv. Staff deployment: The table below shows how enumerators, supervisors and police were deployed during this census.

**Table 2-5: Traffic census staff deployment**

| SHIFT DESCRIPTION | SHIFT TIMES | SUPERVISORS | ENUMERATORS | POLICE | TOTAL |
|---|---|---|---|---|---|
| Day shift | 6:00 am - 6:00 pm | 2 | 6 | 4 | 12 |
| Night shift | 6:00 pm -6.00 am | 2 | 6 | 4 | 12 |
| **TOTAL** | | **4** | **12** | **8** | **24** |

## 2.2 Origin-Destination (OD) Survey

### 2.2.1 Justification for OD Survey

Part of this consultancy's purpose is to generate and analyse traffic flows of commodities along the major trade corridors by different modes of travel in Eastern Africa. The data should enable TMEA to better forecast changes in the volumes of traded goods. The ToR states that this is an initial data collection effort to develop a baseline of information, which will be followed later by two additional surveys to track and measure the changes observed.

The OD study was designed to sample from the full freight traffic collected under the Traffic Census to develop a picture of where freight flows were coming from and going to, not just where they were observed and to collect data from the drivers used to estimate costs and emissions, including vehicle mileage,

Data for trade flows were obtained from the OD Survey conducted at the stations shown in Table 2-4 in Burundi, Kenya, Rwanda, Tanzania and Uganda. The surveys were carried out during October and November 2021.

### 2.2.2 OD Sample Size, Margins of Error and Confidence Limits

The survey assumed the following:

**Table 2-6: OD sample size, margins of error and confidence limits.**

| Survey Sample Quality Requirement | Specification | Description |
|---|---|---|
| Survey confidence level | 95% | A confidence level indicates the level of reliability regarding a measure. The most common confidence levels are 90%, 95%, and 99%. A 95% confidence level means if the same survey were to be repeated 100 times under the same conditions, 95 times out of 100 the measure would lie somewhere within the margin of error. A higher confidence level requires a larger sample size. |
| Population | 11,650. | This is based on the ADT conducted during the census. The sample size does not change much for populations larger than 20,000. |
| Response distribution | 50% | For each question, what does the survey expect the results will be? If the sample is skewed highly one way or the other, the population probably is, too. Since this is unknown, the survey assumed a response distribution of 50%, which gives the largest sample size. |

| Survey Sample Quality Requirement | Specification | Description |
|---|---|---|
| The survey's acceptable margin of error | 5.0 % | The margin of error is the degree of error in results received from random sampling surveys. A higher margin of error in statistics indicates less likelihood of relying on the results of a survey or poll, i.e. the confidence in the results will be lower to represent a population. A lower margin of error indicates higher confidence levels in the produced results. The universal formula for the margin of error for a sample is |

The required sample size n and margin of error E are given by the formula below:

$x = Z(c/100)2r(100-r)$

$n = N\,x/((N-1)E2 + x)$

$E = Sqrt[(N - n)x/n(N-1)]$

Where N is the population size, r is the fraction of responses that you are interested in, and Z(c/100) is the critical value for the confidence level c. This calculation was based on the normal distribution. Using this formula, the ADT sample size required for the OD Survey was 372 trucks per survey station in each country. The table below shows the OD sample size by country taking into consideration the number of survey stations covered.

The baseline survey managed to reach the target sample size with a summary as follows:

**Table 2-7: OD sample sizes by country**

| Country | Required sample size (n) | The sample covered in the survey | Number of stations covered | Achieved response rate[10] |
|---|---|---|---|---|
| Burundi | 372 | 281 | 1 | 76% |
| Kenya | 3,348 | 5,109 | 9 | 153% |
| Rwanda | 744 | 600 | 2 | 81% |
| Tanzania | 3,348 | 4,736 | 9 | 142% |
| Uganda | 2,976 | 4,459 | 8 | 150% |
| **Total** | **10,788** | **15,185** | **29** | **141%** |

### 2.2.3 Sample Origin-Destination Volume

A total of 15,185 truck drivers were interviewed during the OD Survey. The table below shows total truck OD responses by country.

[10]A response rate above 100% implies that the target population was larger than the required sample size.

**Table 2-8: Truck OD responses by country**

| Country | Responses | Percentage |
|---|---|---|
| Kenya | 5,109 | 34% |
| Tanzania | 4,736 | 31% |
| Uganda | 4,459 | 29% |
| Rwanda | 600 | 4% |
| Burundi | 281 | 2% |
| **Total** | **15,185** | **100.00%** |

### 2.2.4 Interview Procedure for the OD Survey

The interviews included directing vehicles into a designated area and asking a series of interview questions. Each interview was initiated when an interview team member contacted the police who then contacted the driver and requested their participation in the survey.

The Origin and Destination (OD) Survey was carried out by way of a purpose-built web-based Digital Traffic Origin and Destination (DTOD) survey application. Data was collected continuously and recorded in both directions of travel. The questionnaire was designed to ensure that origin and destination questions were simple, clear, and non-ambiguous.

The OD interviews were carried out for seven consecutive days at each survey station for 12 hours (6 am to 6 pm)[11].

The study team collected a wide array of freight transport and vehicle characteristics that would enable TMEA and its partners to respond to the need to effectively plan for the development of an efficient and cost-effective regional freight logistics system. Examples include information on but not limited to the following:

- Freight vehicle/trailer configuration.
- Cargo distribution.
- Origin and destination.
- Trip purpose.
- Journey duration.
- Trip frequency.
- Fuel consumption.
- Journey official and unofficial payments.

[11]During the Pilot Study, the study team faced some challenges collecting the OD data at night from trucks. The police authorities in the different countries advised that the study team should only consider carrying out surveys from 6am-6pm, which, with agreement from TMEA, was implemented during the full study.

## 2.3 Freight Cost Survey

### 2.3.1 Introduction

The Freight Transport Cost Survey was conducted using the simplified freight cost survey tool. The study team was forced to limit the number of respondents to this survey for the following reasons:

i. Despite numerous efforts, it proved difficult to obtain detailed contact lists from the transport freight forwarders and warehousing associations in East Africa. This made it difficult to conduct a randomised sample of respondents for this survey.

ii. Many transport fleet operators were unwilling to participate in a survey where they were expected to provide what they consider proprietary information, for example, cost of labour, cost of maintenance, mark-up margin, etc.

iii. Language barrier limitation: Some transport operators required the survey tool to be translated to Kiswahili and French. After translation, the study team spent a lot of time interpreting and explaining the questionnaire to the transport operators.

Therefore, based on the above and many other challenges experienced, the study team agreed with TMEA that this full study will work with a sample of willing participants.

### 2.3.2 Survey Procedure

The survey procedure began by mapping out the potential respondents from the transport associations in the five East Africa member states. Upon mapping of the respondents, the simplified freight transport cost survey tool was then sent to them through email.

The email was followed up with telephone calls to the freight transport fleet operators who were guided on how to properly complete the spreadsheet. The respondents were then given up to one week to complete the survey and return it to the study team. The team then followed up with respondents to encourage completion, either by phone, or, in some cases, via in-person visits.

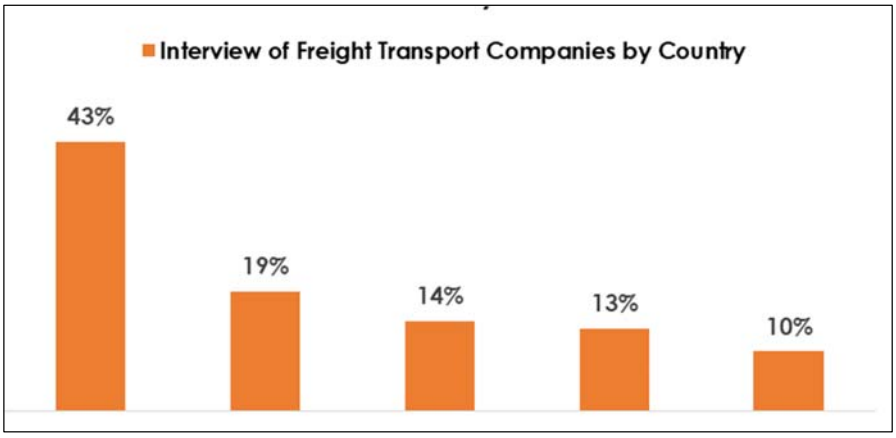
### 2.3.3 Freight Cost Survey Tool

The Freight Cost Survey was conducted using an on-line, Kobo-based survey instrument, which is presented in **Appendix VII**. The survey asked respondents at the identified transport companies to catalogue costs and trip volumes. The tool also collected information on fuel consumption and illicit costs. This study uses the data collected to estimate trip densities by route, transport costs, illicit costs, and fuel consumption, both as a cost item and as a component of GHG emissions.

### 2.3.4 Distribution of Freight Transport Companies Interviewed by Country

A total of 83 freight company interviews were conducted during the regional freight cost survey. Responses were received from Kenya (43%, 36), Uganda (19%, 16), Tanzania (14%, 12), Rwanda (13%, 11) and Burundi (10%, 8) as shown in the figure below.

**Figure 2-1: Interview results from freight transport companies by country**



### 2.3.5 Freight Cost Trade Routes

The table below shows the main trade routes derived from the Freight Cost Survey by country and region.

**Table 2-9: Freight cost survey main trade routes**

| Country | Trade route | | No of responses | Percentage |
|---|---|---|---|---|
| | Main Origin Point | Main Destination Point | | |
| Burundi | **Tanzania** | **Burundi** | **7** | **88%** |
| | Uganda | Burundi | 1 | 13% |
| Kenya | **Kenya** | **Uganda** | **27** | **77%** |
| | Kenya | Kenya | 6 | 17% |
| | Kenya | South Sudan | 3 | 9% |
| Rwanda | **Kenya** | **Rwanda** | **5** | **45%** |
| | Tanzania | Rwanda | 5 | 45% |
| | Kenya | Burundi | 1 | 9% |
| Tanzania | **Tanzania** | **Tanzania** | **4** | **33%** |
| | Tanzania | Zambia | 3 | 25% |
| | Tanzania | DRC Congo | 2 | 17% |
| | Kenya | Zambia | 1 | 8% |
| | Tanzania | Rwanda | 1 | 8% |
| | Tanzania | Uganda | 1 | 8% |
| Uganda | **Kenya** | **Uganda** | **10** | **67%** |
| | Uganda | South Sudan | 2 | 13% |
| | Uganda | Uganda | 2 | 13% |
| | Tanzania | Uganda | 1 | 7% |
| Region | **Kenya** | **Uganda** | **37** | **45%** |
| | Tanzania | Burundi | 7 | 8% |
| | Kenya | Kenya | 6 | 7% |
| | Tanzania | Rwanda | 6 | 7% |
| | Kenya | Rwanda | 5 | 6% |
| | Tanzania | Tanzania | 4 | 5% |
| | Kenya | South Sudan | 3 | 4% |
| | Tanzania | Zambia | 3 | 4% |
| | Tanzania | DRC Congo | 2 | 2% |
| | Tanzania | Uganda | 2 | 2% |
| | Uganda | South Sudan | 2 | 2% |
| | Uganda | Uganda | 2 | 2% |
| | Kenya | Burundi | 1 | 1% |
| | Uganda | Burundi | 1 | 1% |
| | Uganda | Kenya | 1 | 1% |
| | Kenya | Zambia | 1 | 1% |

*Source:* Consultant 2021

From the table above, the main trade routes by country and region were as follows:

- Burundi: Tanzania-Burundi.
- Kenya: Kenya-Uganda.
- Tanzania: Tanzania-Tanzania.
- Rwanda: Kenya-Rwanda and Tanzania-Rwanda
- Uganda: Kenya-Uganda
- Region: Kenya-Uganda, Tanzania-Burundi and Tanzania-Rwanda

### 2.3.6 Cargo Type Transported by Trucks

The figures below show the most frequent cargo transported by the trucks owned by the transport companies. The section below details the summary by country and region of the most frequent cargo transported by transport companies.

- Burundi: Foodstuff
- Kenya: Chemical products
- Rwanda: Mineral products
- Tanzania: All other commodities
- Uganda: All other commodities
- Regional: All other commodities

**Figure 2-2: Most frequent cargo transported in Burundi**

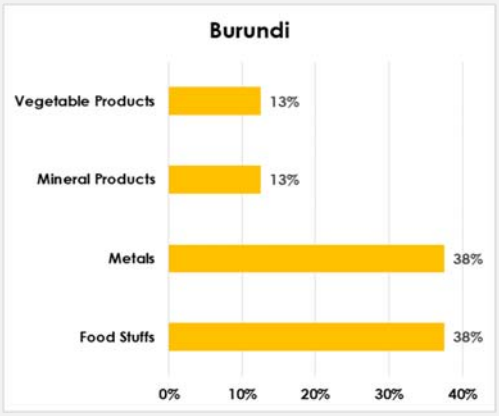



**Figure 2-3: Most frequent cargo transported in Kenya**

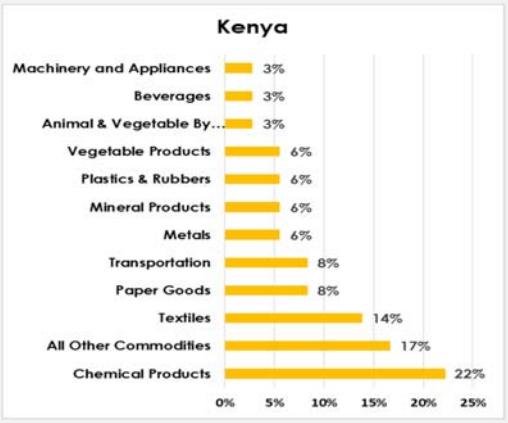



**Figure 2-4: Most frequent cargo transported in Rwanda**

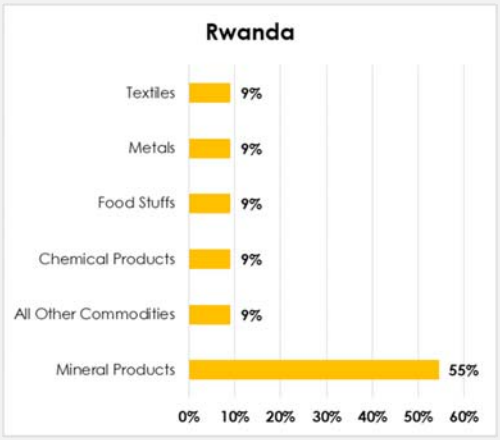



**Figure 2-5: Most frequent cargo transported in Tanzania**

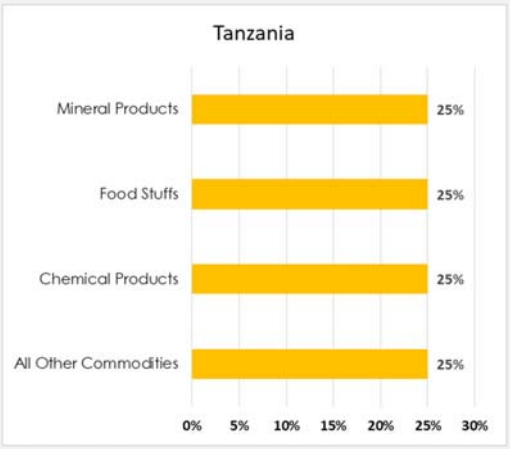



**Figure 2-6: Most frequent cargo transported in Uganda**

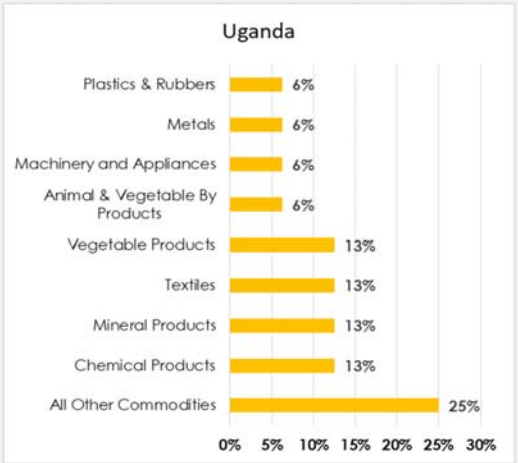
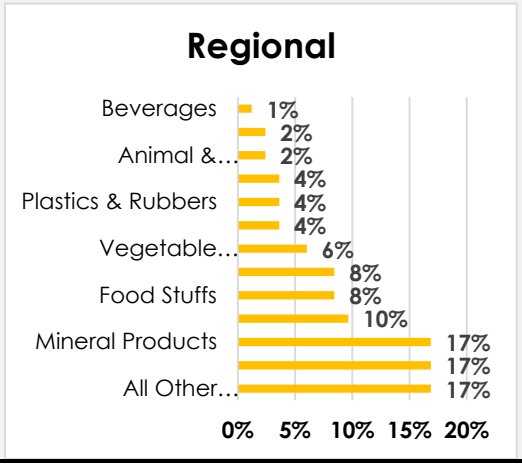



**Figure 2-7: Most frequent cargo transported in the region**



### 2.3.7 Truck Types Owned by Transport Companies

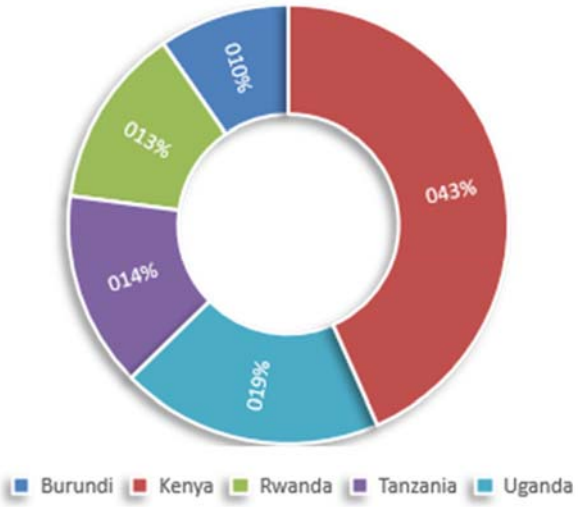
The study established the main truck types owned by the transport companies interviewed. The results showed that the majority of the trucks owned by the transport companies in the region were as follows:

- Container trailer (75%)
- Break bulk (16%)
- Dry bulk trailer (8%)
- Liquid bulk trailer (1%)

### 2.3.8 Regional Distribution of Trucks

In terms of the regional distribution of trucks, the study results showed that Kenya has the highest volume of trucks (43%), followed by Uganda (19%), Tanzania (14%), Rwanda (13%), with Burundi having the lowest volume at (9%).

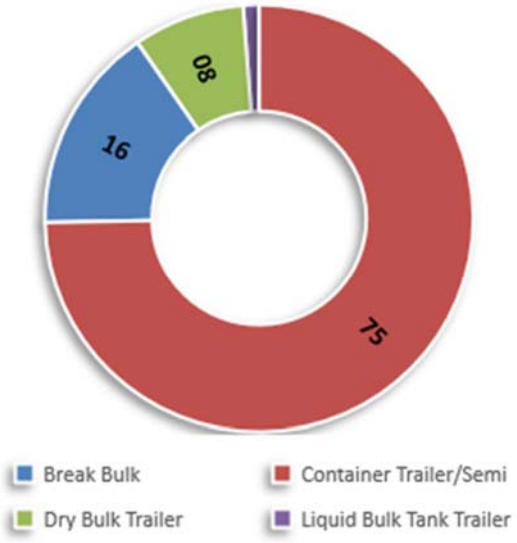
**Figure 2-8: Regional distribution of trucks**




### 2.3.9 Regional Fleet Composition

In terms of the truck types operated in the region, the study results showed that the container trailer (74%) is the dominant mode of freight traffic across East Africa.

**Figure 2-9: Regional fleet composition**

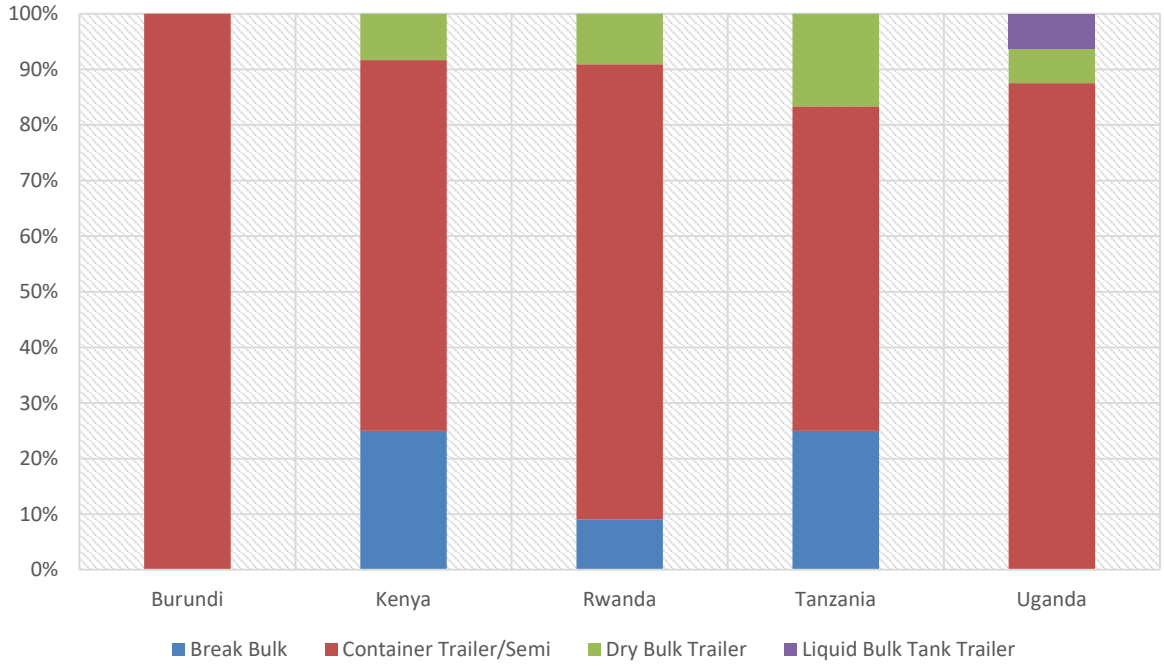



### 2.3.10 National Fleet Composition

In terms of the truck type owned by transport operating companies in each country, the study results showed that Burundi's fleet is composed of only container trailers[12]. Kenya, Rwanda and Tanzania's fleet composition were similar, with container trailers as the majority followed by the break bulk type. A small percentage use the dry bulk trailers. Uganda's fleet is composed of container trailers as the majority, with a small percentage of the fleet being the dry bulk and liquid bulk trailers.

[12]This is true of the data set collected for this study, but is unlikely to be perfectly accurate for the entire Burundian fleet.

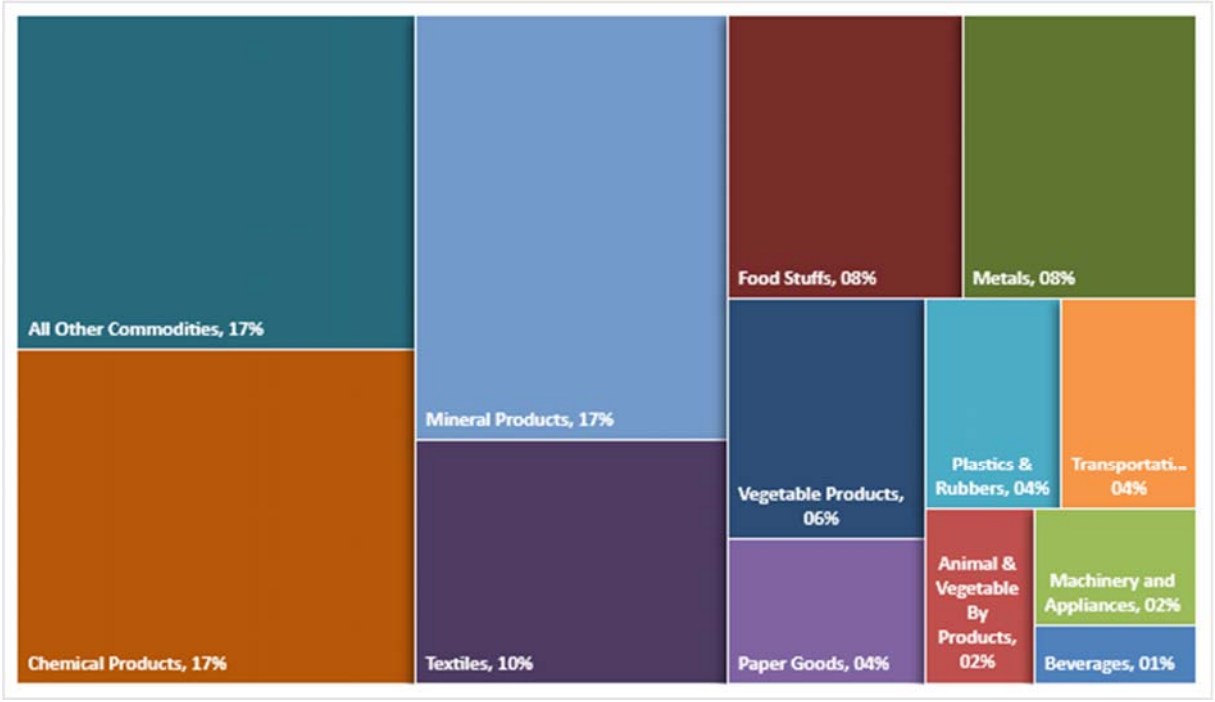
**Figure 2-10: National truck profile**




### 2.3.11 The Dominant Payloads

With regards to good being carried in trucks in the region, chemical products (16.9%), mineral products transport (16.9%) and textiles (9.6%) account for over 50% of the trucks utilised.

**Figure 2-11: Truck utilization**

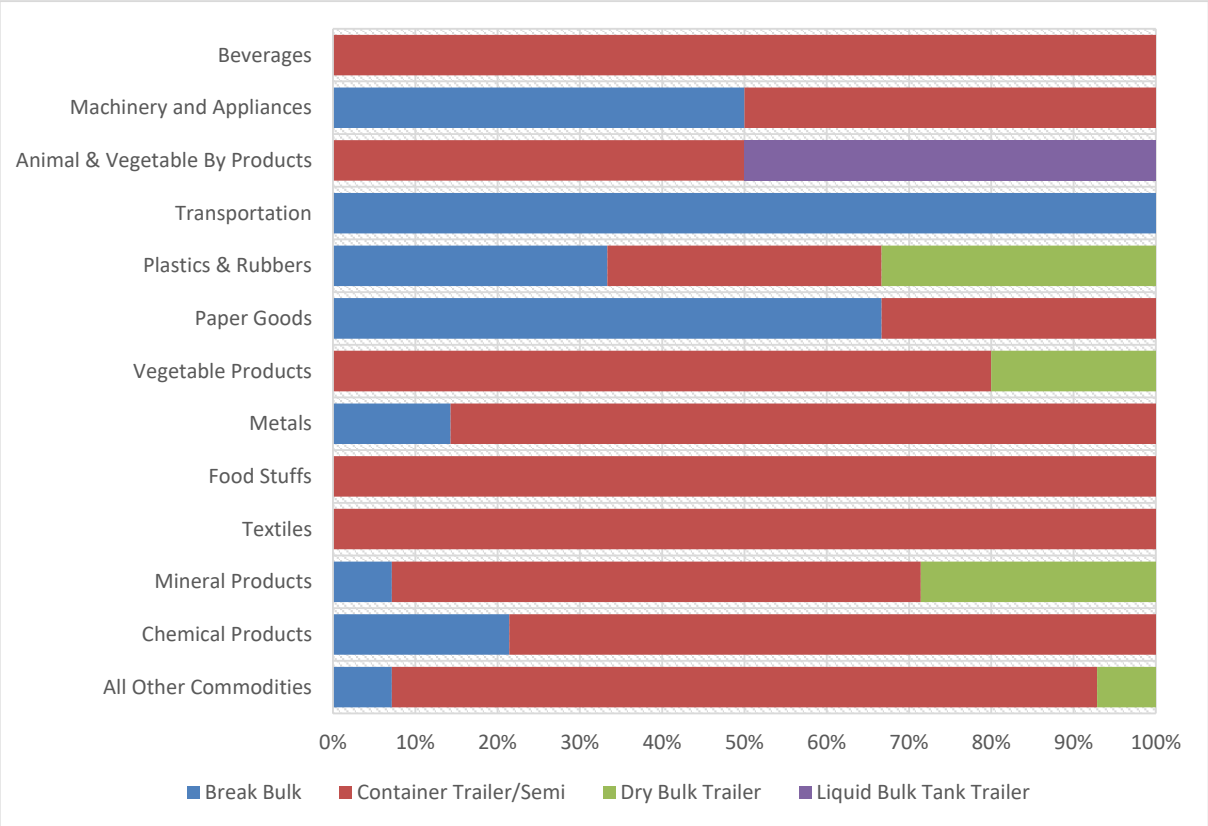


### 2.3.12 Truck Utilization

A significant proportion of commodities are carried by containers/semi-trailers (74.7%), with the least use form of transport being liquid bulk at 1.2%


Figure 2-12 indicates the distribution of observed truck types by commodity carried.

**Figure 2-12: Commodities carried by trucks**



# 3. EMISSIONS ANALYSIS

## 3.1 Introduction

In this section, the focus is on assessing the environmental effects of truck traffic in East Africa, and more specifically the $CO_2$ emissions from road freight transport.

Road freight transport is a direct contributor to climate change due to its reliance on fossil fuels. In addition, the road freight transport sector is responsible for the emission of local atmospheric pollutants such as $SO_X$, $NO_X$[13], and particulates which hurt public health.

This assessment of environmental impacts from freight transportation includes only $CO_2$ which is emitted by diesel-driven engines on the main trade routes in the region, which is the normal type of fuel used for freight transportation in trucks and vans.

The level of $CO_2$ emissions directly correspond to the fuel consumption of freight vehicles, but many factors determine the specific level thereof - the size of engines, the age of the vehicles, the level of maintenance of the trucks and the roads, road congestion, style of driving, cargo load, etc. This data was collected through the Traffic Census, the OD Survey and the Freight Cost Survey.

## 3.2 Aim of Emissions Analysis

This analysis aims to assess and map the $CO_2$ emissions from road freight transportation by country and, also by trade corridor. The figures derived from such an analysis explain both the total level of emissions but also indicate differences between individual countries and where the introduction of mitigating measures is particularly relevant. Moreover, figures for vehicle energy consumption in specific countries can be used for a broader international benchmark.

## 3.3 GHG Emissions Estimation Methodology

For the study, the emissions analysis focuses on greenhouse gases (GHG), measured as $CO_2$ output from the consumption of fuel. Other pollutants such as NOX, SOX and particulate matter were discussed with TMEA, but ultimately, were left out of the study, mostly because an orderly calculation of these must be based on measurements using emissions control equipment which were not available during pandemic conditions.

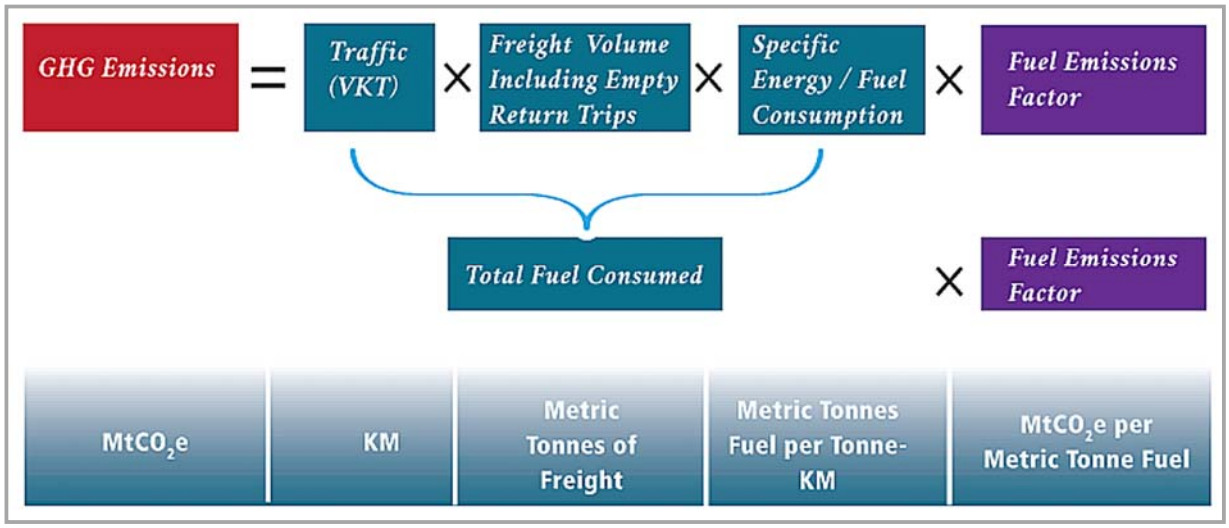
[13] Sulphur oxides ($SO_X$) and Nitrogen oxides ($NO_X$), the latter also being an indirect contributor to greenhouse effect.

Various methodologies for calculating the emission of $CO_2$ from trucks were reviewed by the study team. The selected approach assumes that all emissions are fully related to the energy consumption of diesel in a 1:1 relationship and that all freight vehicles use diesel (not gasoline). Therefore, what is of the essence is to be able to determine the average fuel consumption for the total trucks circulating in the five countries considered for this study. To achieve this, we used three main sources of data:

1. The traffic census data (**Section 2.1.6**), which detail the total number and the type of trucks circulating on different routes within the five countries (see hereafter in the document **Table 5-2** and **Table 5-3**), and
2. The survey data collected from truck drivers, which enable us to calculate average fuel consumption by truck type. This is based on the consumption of the journey reported by the driver (in litres), divided by the total length of the journey (in km). This was also validated using data collected under the Freight Cost Survey.
3. Different academic or technical documents which provided an estimate of truck fuel efficiency (measured in l/km, or km/l for diesel vehicles) in a few comparable countries (Kenya, India).

Such an approach is in line with the one described in 'Report on the Tool for the Estimation of Greenhouse Gas Inventory for Northern and Central Corridors', Trademark, March 2021. The applied calculation model for the assessment of GHG emissions is depicted below:

**Figure 3-1: GHG emissions estimation approach**




*Source*: TMEA, 2021, adapted by the study team

The selected approach has been adapted and follows the methodological steps presented hereunder:

1. Classification of vehicle types to distinguish energy consumption and emissions. This was then programmed into the data collection application.

2. Analysis of the traffic census data as input data for the emissions calculation. The results of the census list the mix of vehicles classes (**Table 5-2Table 5-3**) to describe the actual composition/number and types on different national routes (OD pairs, **Table 5-3**).

3. Identification of the listed energy consumption for the different vehicle types based on accessible data from manufacturers, other studies and truck drivers interviewed during the survey.

4. Definition of four categories of vehicles in the survey data as an input to calculate average fuel efficiency (litre per km) per vehicle type. Four aggregated categories of vehicles were selected: empty vehicles, light goods vehicles (LGV), medium goods vehicles (MGV), and heavy goods vehicles (HGV). While empty vehicles, LGVs and MGVs were directly identified in the survey, the HGV category was defined to aggregate the various container, bulk and fuel tanker trucks.

5. Calculation of average fuel efficiency (l/km) per vehicle category from the survey data (**Table 3-1**). Fuel efficiency was calculated as the fuel consumption reported by the drivers in the survey data for their journey (in litres) divided by the road distance between their loading and unloading points. The road distance values had to be retrieved by the consultant and only those of the main origin-destination couples in the survey were estimated (37 origin-destination couples).

6. Correction of the average fuel efficiency calculated at the previous step, which was too high in comparison with values estimated in other technical studies. The average fuel consumption of an HGV before the correction was 2.14 l/km, which is much higher than the fuel efficiency defined in other studies (around 0.37l/km in Mombasa Port Study[14] and 0.34 l/km in a similar study carried out in India[15]). Therefore, the average fuel efficiency values for each vehicle category were corrected by not considering values above 1.5l l/km reported by trucks drivers (see final values considered after correction in **Table 3-2**). The choice of this threshold (1.5 l/km) has been made after analysing several technical studies.

[14] The Port of Mombasa – Emissions Inventory Baseline Survey 2017

[15] Evolution of on-road vehicle exhaust emissions in Delhi, Atmospheric Environment journal, p.83, Rahul Goel and Sarath K. Guttikunda, 2015. https://urbanemissions.info/wp-content/uploads/docs/2015-01-AE-Delhi-Vehicle-Emissions-1990-2030.pdf

7. Calculation of road distances along the national corridors presented in the traffic census data (**Table 5-3**) using Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software. Only the main road network was used to calculate these distances (trunk, motorway, and primary roads). Only the road distance between the cities indicated in the origin-destination couples (**Table 5-3**) was taken into account. Therefore, time spent (and thus fuel consumed) while waiting at border posts was not considered, since only national road corridors were identified.

8. Correction of the truck traffic census average daily traffic (ADT) data (presented in **Table 5-2**) to account for empty vehicles. The share of empty vehicles (in %) on each origin-destination mentioned in the traffic census was calculated using survey data, and then applied to the total truck traffic. The number of vehicles for the other categories were therefore recalculated.

9. Calculation of the actual fuel consumption for each national corridor (as reported in **Table 3-2Table 3-2**) was then calculated.

10. Assessment of the $CO_2$ emissions emitted by the total traffic along national corridors, using a fixed conversion factor between consumption of diesel and $CO_2$ emissions (2.66kg $CO_2$ per litre diesel). The emissions were then summed by country and converted to million tonnes per annum (MTPA).

11. An additional correction has been made in the total truck traffic census data used on the selected origin-destination routes used as input for this analysis. The Nairobi-Mombasa route was mentioned twice in the truck traffic census (**Table 5-2** and **Table 5-3**. One of the two routes captures substantially more traffic than the other (14,711 trucks vs 4,885 trucks). It is believed that one of the two routes are counted as a duplicate and should be removed. After controlling the location of truck traffic count stations, it appears that the count stations (**Table 5-3**) associated with the route with the higher figures are geographically very close to Nairobi, thus potentially capturing traffic not only linked to the Nairobi-Mombasa route. It has thus been decided to remove the route Nairobi-Mombasa reporting the higher number of trucks in the $CO_2$ emission calculation.

Step six, above, describes the need to correct the initial emissions estimates. The initial results of the calculation of fuel efficiency values from survey data are presented in **Table 3-1**. These values show an estimated fuel efficiency ranging from 0.79 to 2.14 l/km according to the vehicle category. This corresponds to an estimated $CO_2$ emission between 2.10 and 5.71 kg per km as it is presumed that all vehicles use diesel as fuel. These are values, which are much higher (up to nearly a factor 6) than values reported in other studies. As an example, a study was carried out in collaboration with the Port of Mombasa. The corrected fuel efficiency values, and thus $CO_2$ emissions by km, are presented in **Table 3-2**.

These values correspond to the average fuel efficiency per vehicle category calculated from the survey data for which road distance was retrieved, after dropping the observations higher than 1.5 l/km (for more information, please refer to the original distribution of fuel efficiency values for HGV vehicles calculated from the survey data, before correction in Appendix VII). The average fuel efficiency values in **Table 3-2** are still higher than those reported in the Mombasa Port or Delhi studies mentioned earlier. These higher fuel consumption values could be explained by a combination of reasons such as the poor condition of roads in certain countries selected for the analysis, especially outside the main urban areas, the likely old age of the trucks used, the method of driving, or a bias from the survey respondents in reporting higher values of fuel consumption for their entire journey.

**Table 3-1: Summary of fuel efficiency data and $CO_2$ emissions before correction – survey data analysis results**

| Truck type | Number of vehicles in the survey dataset considered for calculating fuel efficiency | Average fuel efficiency (litre/km) | Average $CO_2$ emissions (g/km) |
|---|---|---|---|
| Empty trucks | 152 | 1.13 | 3,007 |
| LGVs | 472 | 0.79 | 2,104 |
| MGVs | 600 | 1.06 | 2,824 |
| HGVs | 3,855 | 2.14 | 5,711 |

**Table 3-2: Summary of corrected fuel efficiency and $CO_2$ emissions**

| Truck type | Average fuel efficiency (litre/km) | Average $CO_2$ emissions (g/km) |
|---|---|---|
| Empty trucks | 0.76 | 2,031 |
| LGVs | 0.49 | 1,308 |
| MGVs | 0.57 | 1,512 |
| HGVs | 0.84 | 2,232 |

The above values show that fuel efficiency and $CO_2$ are positively correlated to the weight of the trucks, HGVs emitting more $CO_2$ per km than LGVs. However, as a rule of thumb, one can say, that the most efficient trips (measured in $CO_2$ per tonne-km and not only in $CO_2$ per km) are being carried out by the largest truck possible for the trip in question, as long as the utilization of the trucks is high. This is based on the fact that large/larger trucks have a lower per tonne fuel consumption than smaller trucks.

And again, this is due to the fact, that engine size and specific consumption does not grow on a linear scale but decline when comparing size and consumption. Therefore, when transporting large volumes of goods over long distances the use of large trucks is essentially beneficial. Nonetheless, medium-sized and light trucks are needed for shorter distances and freight volumes within city areas where freight transportation using large trucks is inappropriate (last-mile delivery).

### 3.4 Emissions Analysis by Country Top OD Pairs

The $CO_2$ emissions calculated for the national road corridors identified in the traffic census data are presented in **Table 3-3** here below. The table was constructed based on the average daily truck traffic (ADT) circulating on the national corridors in the Traffic Census[16], the corrected average fuel efficiency (l/km) by vehicle type, the road distance of the national corridors identified, and the fixed assumption of conversion of the litres of diesel into $CO_2$ emission. These assumptions are detailed here above in this document. Three main factors influencing the results shown in the table below are the number of trucks circulating on the national road corridors identified, the distribution of trucks by vehicle category, and the average distance covered by those trucks within a country (a larger country will thus show higher average distances, which will in return have an impact on the $CO_2$ emission levels). It must be kept in mind that the average fuel efficiency values at the basis of the $CO_2$ emissions calculation are higher than in other studies.

The results at the regional level indicate that Kenya is the country showing the highest volume of $CO_2$ emissions from truck traffic on national corridors (6.94 $CO_2$ MTPA). This sounds logical as Kenya is the country with the highest number of truck vehicles registered in the traffic census data (30,871 trucks a day, vs. 27,419 trucks a day on Tanzanian road corridors, the second-highest of the five countries included in this study). It can be noticed that Uganda truck traffic emits twice as much $CO_2$ per annum as Rwanda, even though the daily number of trucks identified on the national corridors of these two countries is not so different (13,541 trucks a day on Uganda corridors, 11,903 trucks a day in Rwanda). The difference in $CO_2$ emissions in the two countries can be explained by the lower distance covered by trucks in Rwanda (100 km on average) compared to Uganda (155 km on average). It is to be noted that truck emissions calculated at the Burundi level are low but based on the low figures present in the traffic census data for the unique national road corridor identified in the country.

[16]The ADT truck traffic census captures all freight vehicles circulating in both directions on the national trade routes identified, and not only the vehicles strictly circulating between the two cities mentioned in the trade routes (OD).

**Table 3-3: CO2 emissions (in million tonnes per annum) calculated along identified national road corridors and vehicle type (traffic census data), using survey data assumption (fuel efficiency and empty vehicles correction) and traffic census data (daily traffic by vehicle type). The total corresponds to the sum of $CO_2$ emissions on road corridors per country per annum.**

| | | | CO2 emissions (million tonnes per annum, MTPA) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country** | **Trade Route** | **Truck traffic ADT** | **Empty trucks** | **Light truck/LGV** | **Medium/Heavy truck** | **Container trailer** | **Fuel tanker** | **Break bulk trailer** | **Bulk trailer** | **Total** | **CO2 emissions (MTPA) from truck traffic at the country level** |
| Kenya | Mombasa-Nairobi | 4,885 | 0.10 | 0.10 | 0.23 | 0.60 | 0.21 | 0.18 | 0.30 | 1.72 | 6.94 |
| | Mombasa-Lamu | 2,504 | 0.00 | 0.10 | 0.26 | 0.03 | 0.01 | 0.00 | 0.00 | 0.42 | |
| | Mombasa-Lunga Lunga | 811 | 0.00 | 0.15 | 0.09 | 0.01 | 0.01 | 0.03 | 0.01 | 0.31 | |
| | Nairobi-Namanga | 2,249 | 0.00 | 0.10 | 0.04 | 0.03 | 0.01 | 0.03 | 0.01 | 0.21 | |
| | Nairobi-Nyeri-Ethiopia | 6,432 | 0.00 | 0.77 | 1.41 | 0.28 | 0.23 | 0.09 | 0.06 | 2.83 | |
| | Nairobi-Nakuru | 5,570 | 0.13 | 0.11 | 0.07 | 0.12 | 0.03 | 0.04 | 0.07 | 0.58 | |
| | Nakuru-Kisumu/Busia | 2,669 | 0.07 | 0.09 | 0.02 | 0.07 | 0.05 | 0.02 | 0.01 | 0.33 | |
| | Eldoret-Malaba | 5,751 | 0.00 | 0.05 | 0.06 | 0.16 | 0.10 | 0.07 | 0.10 | 0.54 | |
| Uganda | Kampala-Jinja-Malaba | 4,177 | 0.00 | 0.17 | 0.06 | 0.17 | 0.08 | 0.11 | 0.01 | 0.59 | 1.40 |
| | Kampala-Masaka | 1,998 | 0.00 | 0.08 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 | 0.15 | |
| | Kampala-Mubende | 1,783 | 0.00 | 0.09 | 0.01 | 0.02 | 0.01 | 0.11 | 0.01 | 0.26 | |
| | Port Bell Road | 950 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | |
| | Kampala-Hoima | 1,434 | 0.01 | 0.08 | 0.05 | 0.01 | 0.01 | 0.00 | 0.00 | 0.15 | |
| | Kampala-Luwero | 1,921 | 0.00 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.07 | |
| | Luwero-Nakasongola-Gulu | 628 | 0.00 | 0.02 | 0.01 | 0.05 | 0.02 | 0.01 | 0.00 | 0.12 | |

| | | | CO2 emissions (million tonnes per annum, MTPA) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country** | **Trade Route** | **Truck traffic ADT** | **Empty trucks** | **Light truck/LGV** | **Medium/Heavy truck** | **Container trailer** | **Fuel tanker** | **Break bulk trailer** | **Bulk trailer** | **Total** | **CO2 emissions (MTPA) from truck traffic at the country level** |
| | Gulu-Atiak-Nimule | 650 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 | 0.05 | |
| Tanzania | Dar es Salam-Mtwara | 2,197 | 0.00 | 0.21 | 0.17 | 0.09 | 0.02 | 0.19 | 0.09 | 0.77 | 5.47 |
| | Dar es Salam-Bagamoyo-Tanga | 1,631 | 0.00 | 0.09 | 0.10 | 0.08 | 0.02 | 0.04 | 0.00 | 0.34 | |
| | Dar es Salam-Morogoro | 6,621 | 0.02 | 0.12 | 0.08 | 0.24 | 0.21 | 0.22 | 0.02 | 0.91 | |
| | Morogoro-Rusumo | 1,572 | 0.00 | 0.07 | 0.10 | 0.36 | 0.26 | 0.48 | 0.04 | 1.31 | |
| | Mwanza-Shinyanga-Nzega | 992 | 0.00 | 0.03 | 0.03 | 0.04 | 0.02 | 0.04 | 0.01 | 0.16 | |
| | Morogoro-Mbeya | 953 | 0.00 | 0.15 | 0.10 | 0.04 | 0.02 | 0.01 | 0.00 | 0.33 | |
| | Mbeya-Tunduma | 10,415 | 0.00 | 0.08 | 0.13 | 0.13 | 0.14 | 0.14 | 0.14 | 0.76 | |
| | Mbeya-Songwe | 2,543 | 0.00 | 0.20 | 0.13 | 0.13 | 0.10 | 0.07 | 0.13 | 0.76 | |
| | Kigoma-Nyakanazi | 491 | 0.00 | 0.08 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.13 | |
| Rwanda | Kigali-Kayonza | 7,588 | 0.00 | 0.06 | 0.06 | 0.18 | 0.05 | 0.03 | 0.02 | 0.40 | 0.74 |
| | Kigali-Kanyaru | 4,315 | 0.00 | 0.05 | 0.12 | 0.09 | 0.04 | 0.04 | 0.01 | 0.34 | |
| Burundi | Bugarama-Bujumbura | 437 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Total truck traffic along corridors | | 81,970 | 0.32 | 2.91 | 3.22 | 2.92 | 1.66 | 1.79 | 0.96 | 13.79 | 13.79 |

## 3.5 Emissions Analysis by Regional Top OD Pairs

An analysis to estimate the level of $CO_2$ emissions released by truck traffic on the most important regional trade corridors has been carried out using survey data (transnational origin-destination couples) and the assumptions used above at country level (fuel efficiency, types of vehicles, daily traffic, etc.). Contrary to the analysis performed at the country level, the $CO_2$ emissions have this time been estimated for the vehicles strictly circulating between the origin and the destination of the **top 20 regional corridors** identified in the survey data. The direction of the traffic is this time indicated by its origin and destination. The emissions were calculated for the top regional OD pairs following the below methodological steps:

- Using survey data (15,260 observations), the top 20 regional origin-destination pairs were identified and ranked based on the number of drivers interviewed who reported these journeys.
- For each regional OD pair selected, the traffic count stations which registered the highest number of truck drivers reporting the journey were identified. The proportion of drivers interviewed reporting the journey at the station over the total number of drivers interviewed at the station was then calculated (**Table 3-4**).
- The estimated average daily truck (ADT) traffic on each regional OD pair was calculated by multiplying the % of respondents reporting the regional journey at a given count station by the ADT truck traffic reported at the corresponding station (**Table 3-4**).
- The daily truck traffic of each regional OD pair was then distributed by vehicle type based on the distribution already observed in the section at every traffic count station (done in the previous sub-section).

Truck traffic $CO_2$ emissions for the top 20 regional OD pairs were then calculated by multiplying the assumed number of trucks circulating on each regional corridor with the road distance on the corridor and the $CO_2$ emission by vehicle type assumption ($CO_2$ grams per km) calculated previously for the analysis at country level. The results were then expressed in million tonnes per annum (MTPA) - **Table 3.5**. Based on the results calculated, it appears that the Dar es Salaam-Kigali trade corridor sees the highest number of $CO_2$ emissions, due to the high number of trucks strictly doing this journey and the important distance between the two cities.

**Table 3-4: Estimation of the top 20 regional OD pairs annual daily traffic**

| Top regional corridors OD | Distance (km) | Number of drivers reporting the journey | Total number of drivers interviewed at the station | % of drivers reporting the journey | Assumed truck traffic - ADT |
|---|---|---|---|---|---|
| Mombasa-Kampala | 926 | 276 | 939 | 29.4% | 1228 |
| Dar es Salaam-Kigali | 1148 | 165 | 393 | 42.0% | 3186 |
| Mombasa-Nairobi | 440 | 139 | 895 | 15.5% | 759 |
| Dar es Salaam-Mwanza | 844 | 159 | 663 | 24.0% | 238 |
| Mombasa-Juba | 1337 | 46 | 498 | 9.2% | 60 |
| Kampala-Juba | 514 | 76 | 653 | 11.6% | 224 |
| Kampala-Mombasa | 926 | 51 | 939 | 5.4% | 227 |
| Nairobi-Kampala | 505 | 47 | 719 | 6.5% | 364 |
| Kampala-Arua | 617 | 101 | 653 | 15.5% | 297 |
| Kampala-Gulu | 272 | 71 | 653 | 10.9% | 209 |
| Dar es Salaam-Bujumbura | 1155 | 107 | 289 | 37.0% | 162 |
| Bagamoyo-Dar es Salaam | 52 | 109 | 915 | 11.9% | 194 |
| Arusha-Dar es Salaam | 471 | 105 | 915 | 11.5% | 187 |
| Dar es Salaam-Arusha | 470 | 94 | 915 | 10.3% | 168 |
| Tanga-Dar es Salaam | 190 | 94 | 915 | 10.3% | 168 |
| Mombasa-Jinja | 875 | 44 | 939 | 4.7% | 196 |
| Dar es Salaam-Kigoma | 1078 | 82 | 271 | 30.3% | 149 |
| Mbeya-Dar es Salaam | 676 | 45 | 454 | 9.9% | 252 |
| Mombasa-Kigali | 1092 | 25 | 375 | 6.7% | 133 |
| Dar es Salaam-Mbeya | 676 | 28 | 454 | 6.2% | 157 |
| Nairobi-Mombasa | 440 | 39 | 895 | 4.4% | 213 |

**Table 3-5: CO2 emissions (in million tonnes per annum) calculated along top 20 regional road corridors, using survey data assumption (fuel efficiency and empty vehicles correction) and traffic census data (average daily truck traffic). The total corresponds to the sum of $CO_2$ emissions for each regional OD pair per annum.**

| Top regional corridors OD | Distance (km) | Assumed truck traffic - ADT | Empty trucks | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | CO2 emissions (MTPA) from truck traffic at OD level |
|---|---|---|---|---|---|---|---|---|---|---|
| Mombasa-Kampala | 926 | 1228 | 0.00 | 0.22 | 0.07 | 0.21 | 0.10 | 0.13 | 0.01 | **0.74** |
| Dar es Salaam-Kigali | 1148 | 3186 | 0.00 | 0.37 | 0.40 | 1.12 | 0.32 | 0.21 | 0.10 | **2.53** |
| Mombasa-Nairobi | 440 | 759 | 0.01 | 0.01 | 0.03 | 0.08 | 0.03 | 0.03 | 0.04 | **0.24** |
| Dar es Salaam-Mwanza | 844 | 238 | 0.00 | 0.03 | 0.02 | 0.03 | 0.01 | 0.03 | 0.01 | **0.13** |
| Mombasa-Juba | 1337 | 60 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 | **0.05** |
| Kampala-Juba | 514 | 224 | 0.00 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | **0.07** |
| Kampala-Mombasa | 926 | 227 | 0.00 | 0.04 | 0.01 | 0.04 | 0.02 | 0.02 | 0.00 | **0.14** |
| Nairobi-Kampala | 505 | 364 | 0.03 | 0.02 | 0.02 | 0.03 | 0.01 | 0.01 | 0.02 | **0.12** |
| Kampala-Arua | 617 | 297 | 0.00 | 0.05 | 0.01 | 0.02 | 0.02 | 0.01 | 0.00 | **0.11** |
| Kampala-Gulu | 272 | 209 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | **0.03** |
| Dar es Salaam-Bujumbura | 1155 | 162 | 0.00 | 0.05 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | **0.11** |
| Bagamoyo-Dar es Salaam | 52 | 194 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | **0.01** |
| Arusha-Dar es Salaam | 471 | 187 | 0.00 | 0.01 | 0.02 | 0.01 | 0.00 | 0.01 | 0.00 | **0.05** |
| Dar es Salaam-Arusha | 470 | 168 | 0.00 | 0.01 | 0.02 | 0.01 | 0.00 | 0.01 | 0.00 | **0.05** |
| Tanga-Dar es Salaam | 190 | 168 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | **0.02** |
| Mombasa-Jinja | 875 | 196 | 0.00 | 0.03 | 0.01 | 0.03 | 0.02 | 0.02 | 0.00 | **0.11** |
| Dar es Salaam-Kigoma | 1078 | 149 | 0.00 | 0.05 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | **0.09** |
| Mbeya-Dar es Salaam | 676 | 252 | 0.00 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | **0.11** |
| Mombasa-Kigali | 1092 | 133 | 0.00 | 0.04 | 0.01 | 0.02 | 0.01 | 0.01 | 0.00 | **0.08** |
| Dar es Salaam-Mbeya | 676 | 157 | 0.00 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | **0.07** |
| Nairobi-Mombasa | 440 | 213 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | **0.07** |

## 3.6 Proposed strategies to combat GHG emissions

A series of actions can contribute to reducing the level of GHG emissions from road freight transport. The most efficient way to obtain such a result would be to reduce the actual number of trips carried out. This can be done either by shifting (a part of) the road traffic towards other modes (rail, sea, inland water) or via better organisation improving the performance of truck operations and the utilization of these (in both directions) together with fitting truck size to the specific transport assignment. Fuel consumption may also be achieved by exchanging old vehicles with newer models with more advanced engine technologies. Alternative green fuels are also an option, but probably only theoretically in the short-term, as available technologies are quite expensive and have limited availability.

### 3.6.1 Encouraging Measures Which May Have Short-term Direct Impacts

#### a) Training drivers to more sustainable methods of driving or "eco-driving"

Driving the truck or the van in the most energy-efficient manner is essential to reduce energy consumption and emissions. Eco-driving is being taught to drivers by specialists taking into consideration the type and age of the vehicle, the circumstances under which it is being used and the driving pattern. Even skilled drivers will be able to learn new ways of operating the trucks more economically. Operating a truck this way might reduce consumption by 10% or more[17].

#### b) Improving the organisation of road operators freight activities

It is a well-established fact that transporting a higher tonnage in a single truck results in a lower fuel consumption per tonne carried. As an example, modular haulage vehicles with a total weight of 60 tonnes consume approx. 15-20% less fuel per tonne transported compared to a 40 tonnes truck[18]. Using large trucks to carry large volumes of goods over long distances should therefore be favoured.

[17]Source: www.iru.org/iru-academy/programmes/eco-driving

[18]"Evaluating af Modulvogntog" VD.DK 2021, " Study of implementation of dimensions for HDV", EU Commission, October 2021 (unpublished) and numerous other studies such as "Duotrailer Report 2020". April 2020 University of Zaragoza (2020), Chalmers Technical University et others.

Medium and light trucks would still be needed for shorter distances and cargo volumes in city areas where access for big trucks is difficult (last-mile delivery).

**c) Better maintenance for lower fuel consumption**

Better maintenance of the driveline, suspension, brakes and tyres is also of major importance concerning the reduction of energy consumption. A low tyre pressure alone can increase energy consumption by perhaps 10% or more[19]. Preventive maintenance can therefore lower overall operational expenditures. In addition to this, maintenance costs as a whole can be decreased through enhanced preventive maintenance operations.

### 3.6.2 Investing in More Efficient and Cleaner Vehicles as Well as in Road Maintenance to Reduce $CO_2$Emissions in the Long-term

**a) Encouraging the renewal of operators' fleet by alternative fuel vehicles and more recent and efficient fossil fuel vehicles**

On a long-term basis, newer and cleaner vehicles will be introduced progressively in East Africa. Electrical trucks have the advantage of emitting no local atmospheric pollutants and no direct $CO_2$ when operating, even if they may induce indirect $CO_2$ emissions in the country (increased electricity production) and at a larger scale (manufacturing of the vehicles and batteries, a lifetime of the batteries, etc.). Other alternative fuel vehicles powered by hydrogen or biogas also open the possibilities to reduce the carbon footprint of the road freight sector.

Renewing truck fleets with alternative fuel vehicles will however represent an important investment not only for freight operators but also for public expenditures to install new recharging/refilling infrastructures.

[19]Source:www.skorstensgaard.dk.ing.dk/artikel/svenske-lastbiler-far-kvaelstof-i-daekkene-104566 http://edukr.ru/da/car-insurance/skolko-atmosfer-v-fure-davlenie-v-shinah-gruzovikov-normy-davleniya-dlya/

Moving up the ladder concerning the age by introducing newer vehicles will also help in reducing energy consumption and emissions ($CO_2$ and other local pollutants). The addition of AdBlue Diesel Exhaust Fluid would be an additional help to reduce $NO_x$ emissions released by diesel vehicles, which act as an indirect GHG[20]. Only recently manufactured vehicles integrate this feature.

**b) Improving the condition of roads in the region to improve road operators fuel efficiency**

Poor road quality affects motorised vehicles fuel consumption and therefore their GHG emissions. This dynamic is also called pavement vehicle interaction (PVI)[21]. According to the MIT CSHub, the roughness of a road (how bumpy or smooth it is), its texture (abrasiveness of the road surface) and deflection (the bending of pavement under the weight of a vehicle) are three factors that contribute significantly to PVI. Therefore, predictive road maintenance activities, as well as a major refurbishment of existing road sections in poor condition, should be prioritised to reduce trucks fuel consumption and GHG emissions.

**c) Encouraging a modal shift**

Reducing truck traffic is probably the most efficient way to decrease GHG emissions caused by road freight activities. Rail and inland water transport are good competitors to road freight activities on long distance and heavy load journeys. In the case of rail freight, major investments in different East Africa may be needed to increase rail commercial speed and enable continuous transnational rail services in the region. These modes also benefit from measures aiming at reducing truck traffic (circulation of HGVs limited during certain hours for example night driving bans in Austria, or lane restrictions on the highway, introduction of road tolls, etc.).

[20]AdBlue is an exhaust fluid, not a fuel additive. It is stored in a separate reservoir and is topped up via a usually blue filler cap. The name AdBlue is a trade name registered by the German car manufacturers association but is the most recognized form of Diesel Exhaust Fluid.

[21]Please refer to MIT Concrete Sustainable Hub for more info and detailed studies on the interaction between road quality and fuel consumption, http://cshub.mit.edu/pavements/pvi

# 4. COST ANALYSIS BUILD-UP

## 4.1 Approach to Cost Analysis

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. The table below shows this framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

**Table 4-1: Approach to the calculation of trade cost**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Costs** | Port costs (USD) | **+** | Cost of Trade Time (USD) + Direct transport costs (USD)[22] | **+** | Direct compliance cost (USD) | **+** | The indirect cost of delay (USD) | **+** | Illicit costs (USD) | **=** | **Trade costs (USD)** |
| **Data source** | Data from World Bank Doing Business Report for 2020 | + | Data obtained from the Freight Transport Cost Analysis Survey | + | Data obtained from published RA and OGA sources | + | Data from OD Survey + Freight Transport Cost Survey | + | Data from the Freight Transport Cost Survey | = | **The total cost of a trade** |

The study team applied the cost build-up approach tested during the pilot process to estimate the trade costs across East Africa. The approach designed was accurate and it nursed the following:

I. Collection of cost category data across the full framework of costs (see table above).

II. Collection of cost data specific to vehicle types.

III. Collection of cost data specific to commodity types.

IV. Collection of any route- or corridor-specific cost variations.

[22]The direct transport cost used in the calculation of cost of trade is less illicit cost.

## 4.2 Port Costs

Port costs were computed by relying on published information from the World Bank Doing Business 2020 reports for Kenya and Tanzania. Doing Business reports record the time and costs associated with the logistical process of exporting and importing goods. The costs recorded measure the time and cost associated with three sets of procedures (documentary compliance, border compliance and domestic transport) with the overall process of exporting and importing a shipment of goods. The table below provides a detailed description of the measurement of three sets of procedures.

**Table 4-2: Measurement of trading across borders processes**

| Documentary compliance | Border compliance | Domestic transport |
|---|---|---|
| 1. Obtaining, preparing and submitting documents during transport, clearance, inspections and port or border handling in the origin economy | Customs clearance and inspections | Loading or unloading of the shipment at the warehouse or port/border |
| 2. Obtaining, preparing and submitting documents required by destination economy and any transit economies | Inspections by other agencies (if applied to more than 20% of shipments) | Transport between the warehouse and port/border |
| 3. Covers all documents required by law and in practice, including electronic submissions of information | Handling and inspections that take place at the economy's port or border | Traffic delays and road police checks while shipment is en route |

*Source:* World Bank Doing Business Report 2020

### 4.2.1 Key Assumptions of Trading across Borders in the Doing Business Report

To make the data comparable across economies, the Doing Business Report makes the following assumptions about traded goods and transaction costs:

- Insurance cost and informal payments for which no receipt is issued are excluded from the costs recorded. Costs are reported in US dollars.
- The mode of transport is the one most widely used for the chosen export or import product and the trading partner, as is the seaport or land border crossing.
- All electronic information submissions requested by any government agency in connection with the shipment are considered to be documents obtained, prepared and submitted during the export or import process.

- A port or border is a place (seaport or land border crossing) where merchandise can enter or leave an economy.
- Relevant government agencies include customs, port authorities, road police, border guards, standardization agencies, ministries or departments of agriculture or industry, national security agencies and any other government authorities.

### 4.2.2 Estimation of Port Costs

Port charges were identified as all charges levied to the consignor/consignee by the port and shipping line. These charges are levied on a free on board (FoB) basis for exports and a cost insurance and freight (CIF) basis for imports. The port charges considered for this study were derived from the World Bank 2020 Doing Business Report for Kenya and Tanzania.

**Table 4-3: Mombasa and Dar es Salaam port charges**

| Indicator | Kenya (Mombasa Port) | Tanzania (Dar es Salam Port) |
|---|---|---|
| Port export cost (USD) | **143** | **1,175** |
| Port import cost (USD) | **833** | **1,359** |

*Source:* World Bank 2020 Doing Business Report for Kenya and Tanzania

The following assumptions were made on the above port charges:

- Cargo is containerized.
- Container size = 20 ft.
- Cargo does not go through any of the Inland Container Depot (ICD) in Kenya and Tanzania.
- Cargo is not on the restricted goods list and does not require special permits.
- Cargo is a homogenous full import container load (FCL).

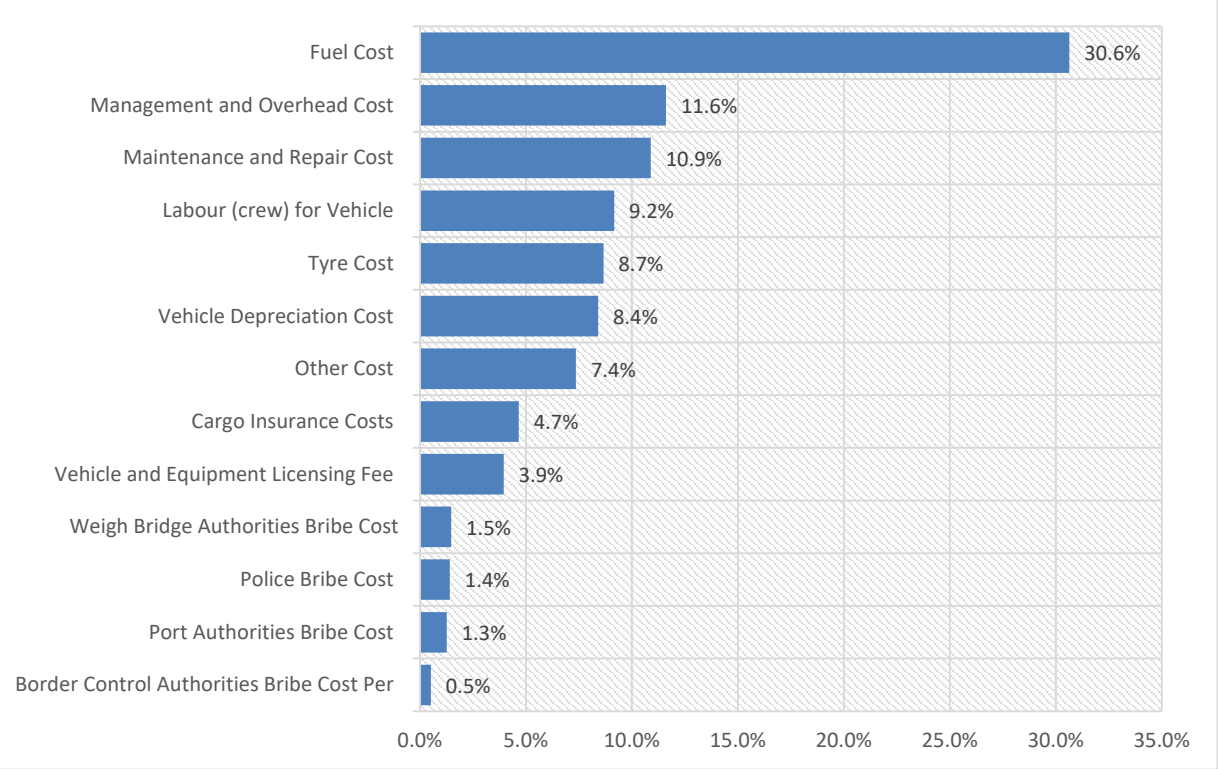
### 4.2.3 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey described in **Section 2.3** of this report. This section will present the overall breakdown of the regional transport costs, the average cost per trip and average cost per trip/km by route for the top trade routes identified in the region as shown in **Table 2-9**.

### 4.2.4 Breakdown of Regional Direct Transport Costs

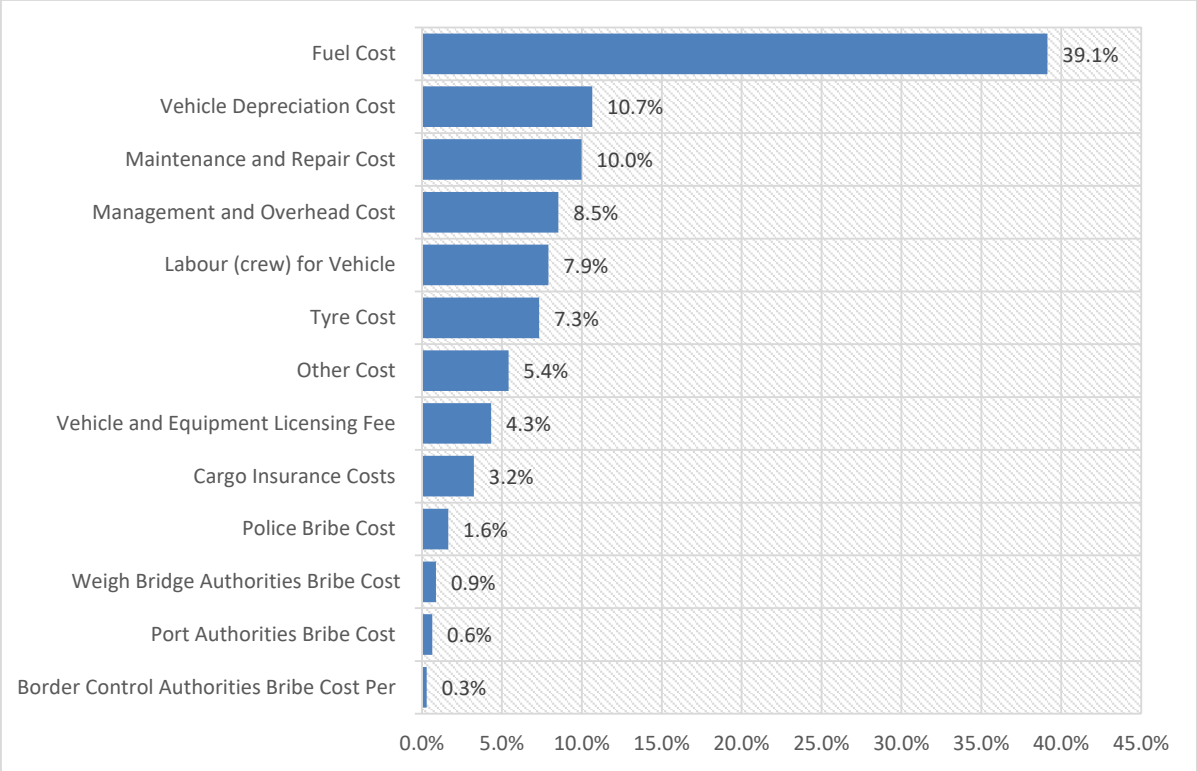
The figure below shows the breakdown of regional direct transport costs per truck plying the Northern Corridor and the Central Corridor. The results were derived from the freight cost survey by analysing trucks plying the Northern Corridor whose origin was Mombasa Port and trucks plying the Central Corridor whose origin was Dar es Salaam Port.

**Figure 4-1: Breakdown of direct transport costs - Northern Corridor**




*Source:* Consultant 2021

**Figure 4-2: Breakdown of direct transport costs - Central Corridor**




*Source*: Consultant 2021

**Figure 4-1** above shows the breakdown of regional direct transport costs along the Northern Corridor. The results showed that fuel cost was the most significant as it comprised 30.6% of the direct transport cost. The least-cost was border control and other government authorities' payments (0.5%).

**Figure 4-2** above shows the breakdown of regional direct transport costs along the Central Corridor. The results showed that fuel cost was the most significant as it comprised 39.1% of the direct transport cost. The least-cost was border control and other government authorities' payments (0.3%).

### 4.2.5 Regional Average Transport Cost by Trade Route

To derive the regional cost per kilometre, the study team apportioned the direct transport costs across the top three regional routes detailed in **Table 2-9** which included Kenya-Uganda, Tanzania-Burundi and Tanzania-Rwanda.

**Table 4-4** below illustrates the regional transport cost per trip derived from the analysis for trucks plying the Northern Corridor and the Central Corridor.

**Table 4-4: Regional transport cost per trip - Northern Corridor**

| Transport cost item | Northern Corridor | Central Corridor |
|---|---|---|
| | Average cost per trip (USD) | Average cost per trip (USD) |
| Vehicle depreciation cost | 166.6 | 317.5 |
| Fuel cost | 607.2 | 1,166.4 |
| Labour (crew) for vehicle | 181.7 | 235.9 |
| Maintenance and repair cost | 215.8 | 297.7 |
| Tyrecost | 171.7 | 218.4 |
| Management and overhead cost | 230.1 | 254.5 |
| Vehicle and equipment licensing fee | 78.3 | 128.9 |
| Cargo insurance costs | 92.4 | 96.8 |
| Other cost | 145.9 | 161.5 |
| Port authorities bribe cost | 25.1 | 19.0 |
| Weighbridgeauthorities bribe cost | 29.1 | 26.2 |
| Border control authorities bribe cost | 10.2 | 8.7 |
| Police bribe cost | 27.9 | 49.0 |
| **Total freight cost per trip** | **1,889.5** | **2,877.5** |
| **Total bribe/illicit cost trip** | **92.4** | **103.0** |
| **Total transport cost per trip** | **1,981.9** | **2,980.5** |

*Source:* Consultant 2021

To derive the cost per kilometre, the study team divided the average cost per trip with the distances for the different trade routes. The table below illustrates the costs per trip in USD/km for the main regional trade routes as shown in **Table 2-9**. It is important to note that this analysis includes only regional trips that cross at least one border.

**Table 4-5: Regional transport cost per trip in USD/km by trade route**

| Transport cost item | Cost per trip (USD/km) | | |
|---|---|---|---|
| | Kenya-Uganda[23] | Tanzania-Burundi[24] | Tanzania-Rwanda[25] |
| | Average cost/km | Average cost/km | Average cost/km |
| Vehicle depreciation cost | 0.14 | 0.19 | 0.21 |
| Fuel cost | 0.52 | 0.71 | 0.78 |
| Labour (crew) for vehicle | 0.16 | 0.14 | 0.16 |
| Maintenance and repair cost | 0.18 | 0.18 | 0.20 |
| Tyre Cost | 0.15 | 0.13 | 0.15 |
| Management and overhead cost | 0.20 | 0.16 | 0.17 |
| Vehicle and equipment licensing fee | 0.07 | 0.08 | 0.09 |
| Cargo insurance cost | 0.08 | 0.06 | 0.06 |
| Other cost | 0.12 | 0.10 | 0.11 |
| Port authorities bribe cost | 0.02 | 0.01 | 0.01 |
| Weighbridge authorities bribe cost | 0.02 | 0.02 | 0.02 |
| Border control authorities bribe cost | 0.01 | 0.01 | 0.01 |
| Police bribe cost | 0.02 | 0.03 | 0.03 |
| **Total freight cost per trip** | **1.62** | **1.75** | **1.92** |
| **Total bribe/illicit cost per trip** | **0.08** | **0.06** | **0.07** |
| **Total transport cost per trip** | **1.70** | **1.82** | **1.99** |

*Source:* Consultant 2021

As depicted in the table above, the baseline regional annual average transport costs per truck were as follows along the top three regional routes:

- Mombasa-Kampala route (1,169km) - USD 1.70 per km
- Dar es Salaam-Bujumbura route (1,640Km) - USD 1.82 per km
- Dar es Salaam-Kigali (1,495km) - USD 1.99 per km

[23]Mombasa-Kampala route
[24]Dar es Salaam – Bujumbura route
[25]Dar es Salaam – Kigali route

**Note:** The survey process and extent of data collected will allow for analysis of direct transport cost by cargo type, truck type and most common origin and destination pairs. This will be presented in subsequent chapters 6-10. This analysis will aim to establish the variation of transport cost by vehicle type and commodity type along a particular route.

## 4.3 Direct Trade Compliance Cost

Direct trade compliance costs can be defined as all charges levied by the government in compliance with existing government regulations excluding customs duties.

### 4.3.1 Trade Compliance Documents

The World Bank 2020 Doing Business Report for Kenya and Tanzania lists the various trade documents which are required for exports and imports. The figures below provide a breakdown list of the key trade documents required in the two countries when undertaking trade transactions for exports and imports of goods.

**Table 4-6: Trade compliance documents - Kenya**

| Exports | Imports |
|---|---|
| Inland bill of lading | Bill of lading |
| Release order | Cargo release order |
| Certificate of origin (COMESA) | Pre-import verification of conformity (PVoC) |
| Commercial invoice | Commercial invoice |
| Exit note | Import declaration form (IDF Form C-61) |
| Certificate of import | Packing list |
| Export declaration | Proof of payments of Customs duties |
| Packing list | Terminal handling receipts |
| Phytosanitary certificate | Declaration of Customs value (Form C- 52) |
| | SOLAS certificate[26] |

*Source:* World Bank 2020 Doing Business Report for Kenya

[26] International Convention for the Safety of Life at Sea

**Table 4-7: Trade compliance documents - Kenya**

| Exports | Imports |
|---|---|
| Bill of lading | Bill of lading |
| Certificate of origin | Certificate of origin |
| Commercial invoice | Commercial invoice |
| Customs export declaration | Packing list |
| Release order | Certificate of conformity |
| Export permit | Import declaration (C41 Form) |
| Fumigation certificate | Delivery order |
| Phytosanitary certificate | Authority letter |
| Letter of authorization | Taxpayer identification number certificate |
| Packing list | SOLAS certificate |
| SOLAS certificate | |
| Radiation certificate | |

*Source:* World Bank 2020 Doing Business Report for Tanzania

### 4.3.2 Trade Compliance Charges

Trade compliance charges for this study were derived from the 2020 World Bank Doing Business Report for Kenya and Tanzania as shown in the table below.

**Table 4-8: Trade compliance documents - Kenya (Northern Corridor) and Tanzania (Central Corridor)**

| Category | Cost Indicator | Kenya (Mombasa Port) | Tanzania (Dar es Salaam Port) |
|---|---|---|---|
| Export | Document compliance (USD) | 191 | 275 |
| Import | Document compliance (USD) | 115 | 375 |

*Source:* World Bank 2020 Doing Business Report for Kenya and Tanzania

The following assumptions were considered in the analysis:

- Cargo is containerized.
- Container size = 20 ft.
- Cargo does not go through any of the inland container depots (ICD) in Kenya and Tanzania.
- Cargo is not on the restricted goods list and does not require special permits.
- Cargo is a homogenous full container load.

Results by the route are presented in **Chapters 5 – 10.**

## 4.4 Transport Times and Cost of Trade Time

The 'Cost of Trade Time' includes both direct (operating and maintenance) and indirect (capital reserve, excess stock, storage, etc.) costs. For the study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tyres, maintenance, insurance) based on annual total expenditures (including for delayed trips), these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the 'Direct Cost of Trade Time' is presented in **Equation 1**, based on the average delay with the sample (see **Table 4-10**):The calculation of the cost of trade is based on the following, defined variables.

**Table 4-9: Variables for calculating cost of trade time**

| Code | Cost of time data |
|---|---|
| DCTT | The direct cost of trade time per trip |
| TD | Trip delay (days) |
| RMT | Route mode time (days) |
| DTC | Direct transport cost[27] |
| ACF | The average cost of fuel |
| ACT | The average cost of tyres per trip |
| ACM | The average cost of maintenance per trip |
| ACI | The average cost of insurance per trip |
| ATT | Actual trip time |
| LCL | Survey trip time lower control limit (1σ) |
| MSTT | Minimum survey trip time (days) |
| MSTT | Maximum survey trip time (days) |
| N | Number of values in the sample |
| R | Survey trip time range (R) |
| S | Sample standard deviation of survey trip time |
| UCL | Survey trip time upper control limit (1σ) |
| X | Average survey trip time (days) |

[27]Excludes illicit costs

**Table 4-10: Truck Trip Times: Regional Average**

| Trip Category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 4.27 | 4.06 | 3.85 | 6.34 | 2.21 | 755 |
| **On-time trips** | 2.6 | 2.93 | 2.94 | 4.21 | 0.99 | 546 |

*Source:* Consultant 2021

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here the cost is calculated for the average trip across the entire sample.

In addition to calculating the trip time for the entire sample, the team also assessed the time by major route, to develop a snapshot of journey times for the most common trips. These are reported in **Table 4-11**. **Equation 1**, below, presents the data and calculations used to estimate the regional average trip time cost.

**Table 4-11: Transport Times, Top 20 Origin and Destination Pairs**

| No | Origin | Destination | Number of trips | Corridor | Road distance (Km) | Trip time statistics (days) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | Median | Mode |
| 1 | Mombasa | Kampala | 734 | NC | 1,169.0 | 3.1 | 3.0 | 3.0 |
| 2 | Dar es Salaam (Dar) | Kigali | 332 | CC | 1,495.0 | 4.3 | 4.2 | 4.2 |
| 3 | Dar | Mwanza | 244 | CC | 1,152.0 | 2.1 | 2.1 | 2.1 |
| 4 | Mombasa | Nairobi | 228 | NC | 485.0 | 1.0 | 0.9 | 0.9 |
| 5 | Mtwara | Dar es Salaam | 159 | CC | 556.0 | 1.6 | 1.3 | 1.2 |
| 6 | Mombasa | Juba | 153 | NC | 1,620.0 | 3.0 | 3.3 | 0.6 |
| 7 | Kampala | Juba | 149 | NC | 635.0 | 2.3 | 2.3 | 2.5 |
| 8 | Kampala | Mombasa | 147 | NC | 1,138.0 | 2.4 | 2.4 | 0.7 |
| 9 | Nairobi | Kampala | 146 | NC | 657.0 | 2.2 | 2.0 | 0.6 |
| 10 | Kampala | Arua | 137 | NC | 475.0 | 0.4 | 0.4 | 0.4 |
| 11 | Dar | Bujumbura | 136 | CC | 1,494.0 | 4.1 | 3.5 | 3.5 |
| 12 | Bagamoyo | Dar es Salaam | 118 | NC | 63.0 | 0.3 | 0.2 | 0.1 |
| 13 | Arusha | Dar es Salaam | 110 | CC | 624.0 | 1.2 | 1.3 | 1.4 |
| 14 | Dar | Arusha | 99 | CC | 624.0 | 1.2 | 1.2 | 1.3 |
| 15 | Tanga | Dar es Salaam | 97 | CC | 332.0 | 0.9 | 1.0 | 1.0 |
| 16 | Mombasa | Jinja | 93 | NC | 1,070.0 | 2.6 | 2.7 | 0.7 |
| 17 | Dar | Kigoma | 87 | CC | 1,479.0 | 2.7 | 2.6 | 3.0 |
| 18 | Mbeya | Dar es Salaam | 81 | CC | 815.0 | 1.3 | 1.3 | 0.7 |
| 19 | Dar | Mbeya | 80 | CC | 815.0 | 1.5 | 1.4 | 0.8 |
| 20 | Mombasa | Kigali | 80 | NC | 1,477.0 | 3.9 | 4.2 | 0.7 |

**Equation 1: Calculation of Cost of Trade Time**

| Cost of Time Data | Formula/Source | Code | Unit | Value | |
|---|---|---|---|---|---|
| | | | | Northern Corridor | Central Corridor |
| The direct cost of trade time per trip | $DCTT = \frac{(ATT-RMT)}{RMT} \times (DTC - ACF - ACT - ACM - ACI)$ | DCTT | USD | 92.8 | 127.0 |
| Trip delay (days)[28] | $TD = (ATT - RMT)$ | TD | Days | 0.12 | 0.12 |
| Route mode time (days) | *Source:* Freight Transport Cost Analysis Survey | RMT | Days | 2.94 | 2.94 |
| Direct transport cost | *Source:* Freight Transport Cost Analysis Survey | DTC | USD | 1,889.5 | 2,877.5[29] |
| The average cost of fuel | *Source:* Freight Transport Cost Analysis Survey | ACF | USD | 607.2 | 1,166.4 |
| The average cost of tires per trip | *Source:* Freight Transport Cost Analysis Survey | ACT | USD | 171.7 | 218.4 |
| The average cost of maintenance per trip | *Source:* Freight Transport Cost Analysis Survey | ACM | USD | 215.8 | 297.7 |
| The average cost of insurance per trip | *Source:* Freight Transport Cost Analysis Survey | ACI | USD | 92.4 | 96.8 |
| Actual trip time | *Source:* Freight Transport Cost Analysis Survey | ATT | Days | 2.6 | **2.6 days** |

*Source:* Consultant 2021

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. The value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries[30]. **Equation 2** presents the approach used to estimate the indirect costs of delay for the study sample for trucks plying the Northern Corridor and the Central Corridor.

[28] The trip delay takes into consideration the trip times that go beyond the route mean trip, generating positive values from the differences between reported average trip time and route mean trip time. These values are used then to calculate the indirect delay cost per trip as shown on equation 2.

[29] This is less illicit costs.

[30] See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

**Equation 2: Approach to calculation of indirect cost of delay**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x shipment value[31] (USD) | = | Indirect delay cost per Trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 4.27 | - | 3.85 | | 0.42 | | 100 | | 42 |

Source: Consultant 2021

## 4.5 Cost of Illicit Payments

The estimate of illicit payment costs is sourced from the OD Survey and the Freight Transport Cost Analysis Survey and include illicit payments made to the port, weighbridges, police, and other government agencies (OGA). Respondents were asked to self-report payments made, by trip stage and value. Information collected from drivers via the OD Survey were assessed against data collected from transport firms. The equation below demonstrates the approach taken to estimate total illicit costs per trip along the Northern Corridor and the Central Corridor.

[31] Shipment value assumption is USD 20,000 and the indirect cost estimate is 0.5% per day.

**Equation 3: Approach to the calculation of the cost of illegal payments in USD)**[32]

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| Northern Corridor | 25.1 | + | 29.1 | + | 10.2 | + | 27.9 | = | 92.3 |
| Central Corridor | 19 | + | 26.2 | + | 8.7 | + | 49 | = | 102.9 |

Source: Freight Transport Cost Analysis Survey[33]

## 4.6 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade along the Northern Corridor and the Central Corridor are calculated as follows:

**Equation 4: Overview of calculation approach for total cost of trade - Northern Corridor**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[34] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 833 | + | 1,982[35] | + | 115 | + | 42 | + | 92.3 | = | 3,065 |

Source: Consultant 2021

[32] Note that this example is for the intra-regional trips in the sample and is therefore indicating greater values than any of the following country-specific analyses, which include local, and therefore less-costly trips.
[33] Data obtained from Table 4-4
[34] The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[35] This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time

**Equation 5: Overview of calculation approach for total cost of trade - Central Corridor**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[36] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,359 | + | 3,004[37] | + | 375 | + | 42 | + | 102.9 | = | 4,883 |

*Source:* Consultant 2021

## 4.7 Trade Costs by Commodity Analysis Methodology

The commodity transport cost analysis approach applied is to first identify baskets of commodities and then the components of the cost that vary and those that are constant across commodity basket types.

The terms of reference required the study team to measure the cost build-up for each vehicle type. This approach was used to allocate differing costs to a basket of commodities as they move from origin to destination. Carrying out this measurement required a separate determination for each basket of commodities.

At the inception stage of the project, the study team proposed to cluster commodities into baskets according to the "harmonized system" (HS) codes main sections, which group commodities into twenty-one (21) commodities namely:

- Vegetable products
- Mineral products
- Foodstuffs
- Textiles
- Chemical products
- Metals
- Machines
- Animal and vegetable by-products
- Animal products
- Plastics and rubbers
- Paper goods
- Transportation
- Precious metals
- Miscellaneous
- Footwear and headwear
- Animal hides
- Stone and glass
- Instruments
- Wood products
- Arts and antiques
- Weapons

[36]The direct transport cost used in the calculation of cost of trade is less illicit cost.
[37]This figure is a summation of direct transport cost (less illicit cost) and cost of trade time

These were used in the Freight Origin Destination and the Freight Transport Cost surveys. The analysis of costs by commodity is provided in **Chapters 5-10**, for intra-regional trips and national trips in each country section.

# 5. REGIONAL RESULTS SUMMARY

This chapter presents the results of the RAATTE regional survey analysis. Subsequent chapters look at the results specific to each country in the sample. The results sections all review the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis and the emissions analysis. We then summarize the findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 5.1 Regional Traffic Census Results

The table in the section below illustrates the detailed average daily traffic (ADT) results from the Traffic Census Survey based on the survey stations shown in **Table 2-1**.

The study team used the results presented in the table to derive a summary of the truck traffic observed at the different stations across East Africa. The results from the truck traffic analysis are shown in the table below.

**Table 5-1: Detailed regional traffic census results - average daily traffic (ADT)**

| Country | Station number | Node | Survey Location | Tuk Tuk | Personal vehicles/Small vehicles | Pick-Up | Commercial bus-Minibus | Commercial bus - Coaster | Commercial bus -Coach | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Other | Total passenger vehicles | Total Goods Vehicle | Total Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kenya | 1 | Nairobi | Shell Zambezi petrol station | 76 | 9,017 | 1,008 | 4,320 | 303 | 462 | 1,882 | 1,072 | 1,195 | 274 | 433 | 714 | 11 | 15,186 | 5,570 | 11 |
| | 2 | | 5km past Kitengela town along Athi River-Namanga Road | 1,344 | 5,375 | 891 | 1,229 | 43 | 58 | 1,247 | 432 | 225 | 42 | 214 | 89 | 11 | 8,939 | 2,249 | 11 |
| | 3 | | Total Sabaki petrol station | 375 | 14,812 | 2,410 | 4,374 | 3,819 | 590 | 5,317 | 3,547 | 3,203 | 821 | 1,302 | 521 | 49 | 26,380 | 14,711 | 49 |
| | 4 | | Thika (500m North of Blue Post Hotel) | 626 | 14,476 | 3,492 | 7,920 | 167 | 142 | 2,094 | 3,303 | 439 | 365 | 138 | 92 | 1,387 | 26,824 | 6,432 | 1,387 |
| | 5 | Mombasa | Danca, Mtwapa petrol station | 4,307 | 6,377 | 768 | 2,787 | 57 | 123 | 709 | 1,570 | 139 | 59 | 7 | 19 | 5 | 14,421 | 2,504 | 5 |
| | 6 | | Luqman filling station, Mariakani | 131 | 2,321 | 374 | 1,706 | 233 | 370 | 478 | 928 | 1,618 | 568 | 489 | 804 | 58 | 5,135 | 4,885 | 58 |
| | 7 | | Towards Kwale-Ukunda area | 8,115 | 2,593 | 412 | 1,083 | 217 | 254 | 443 | 248 | 25 | 10 | 59 | 26 | 30 | 12,674 | 811 | 30 |
| | 8 | Kisumu | Ahero junction | 513 | 5,477 | 946 | 2,242 | 57 | 218 | 1,272 | 235 | 596 | 391 | 123 | 53 | 38 | 9,452 | 2,669 | 38 |
| | 9 | | Kobil Webuye | 11 | 2,586 | 418 | 1,302 | 267 | 345 | 806 | 821 | 1,545 | 949 | 654 | 976 | 193 | 4,930 | 5,751 | 193 |
| Uganda | 10 | Kampala | Magamaga weighbridge | 2 | 3,202 | 789 | 3,319 | 106 | 113 | 1,660 | 467 | 947 | 463 | 601 | 38 | 0 | 7,531 | 4,177 | 0 |
| | 11 | | Lukaya weighbridge | 5 | 3,254 | 542 | 1,580 | 139 | 220 | 1,257 | 138 | 313 | 90 | 141 | 59 | 0 | 5,741 | 1,998 | 0 |
| | 12 | | Mubende weighbridge | 28 | 1,694 | 318 | 752 | 19 | 71 | 850 | 117 | 109 | 60 | 608 | 40 | 184 | 2,882 | 1,783 | 184 |
| | 13 | | Luzira (Port Bell) | 68 | 6,469 | 1,015 | 1,408 | 47 | 19 | 535 | 216 | 162 | 27 | 6 | 3 | 0 | 9,026 | 950 | 0 |
| | 14 | | Wakiso | 0 | 1,770 | 271 | 1,186 | 23 | 21 | 876 | 455 | 46 | 36 | 10 | 11 | 0 | 3,271 | 1,434 | 0 |
| | 15 | | Luwero weighbridge | 15 | 1,600 | 503 | 963 | 33 | 197 | 1,071 | 242 | 277 | 193 | 114 | 24 | 3 | 3,312 | 1,921 | 3 |
| | 16 | Gulu | Corner Kamdini | 3 | 522 | 139 | 83 | 26 | 63 | 165 | 80 | 230 | 81 | 62 | 10 | 5 | 836 | 628 | 5 |
| | 17 | | Atiak | 10 | 525 | 119 | 63 | 3 | 26 | 215 | 104 | 182 | 115 | 28 | 4 | 19 | 747 | 650 | 19 |
| Tanzania | 18 | Dar es Salam | Mwandege Centre | 462 | 3,235 | 439 | 485 | 2,290 | 89 | 790 | 548 | 207 | 38 | 414 | 201 | 4 | 7,001 | 2,197 | 4 |
| | 19 | | Mapping centre | 176 | 2,951 | 520 | 45 | 824 | 196 | 542 | 564 | 299 | 65 | 156 | 5 | 0 | 4,712 | 1,631 | 0 |
| | 20 | | Kibaha Centre- old weighbridge | 277 | 5,539 | 503 | 440 | 1,979 | 787 | 1,391 | 728 | 1,547 | 1,388 | 1,424 | 143 | 1 | 9,526 | 6,621 | 1 |
| | 21 | Nzega | East of Nzega roundabout | 573 | 1,015 | 88 | 257 | 102 | 205 | 137 | 170 | 405 | 288 | 533 | 39 | 1 | 2,238 | 1,572 | 1 |
| | 22 | Mwanza | East of Usagara junction | 485 | 1,918 | 377 | 1,117 | 441 | 408 | 283 | 189 | 199 | 90 | 198 | 35 | 1 | 4,746 | 992 | 1 |
| | 23 | Mbeya | North of Chunya bus station | 4,027 | 1,443 | 800 | 506 | 453 | 237 | 510 | 296 | 86 | 36 | 21 | 5 | 1 | 7,467 | 953 | 1 |
| | 24 | | 200m north of Tazara station | 3,254 | 2,663 | 4,622 | 1,477 | 2,499 | 1,953 | 1,690 | 2,326 | 1,497 | 1,677 | 1,609 | 1,615 | 2 | 16,468 | 10,415 | 2 |
| | 25 | | 200m east of Uyole junction | 2,432 | 2,347 | 1,632 | 605 | 2,209 | 232 | 885 | 515 | 342 | 266 | 183 | 353 | 0 | 9,457 | 2,543 | 0 |
| | 26 | Kigoma | Salmo oil fuel station, South of Manyovu roundabout | 1,780 | 1,730 | 229 | 1,234 | 104 | 62 | 347 | 56 | 35 | 26 | 21 | 6 | 1 | 5,140 | 491 | 1 |
| Rwanda | 27 | Kigali | Rugende | 26 | 4,024 | 2,340 | 947 | 2,501 | 295 | 1,628 | 1,500 | 2,846 | 826 | 538 | 251 | 1 | 10,133 | 7,588 | 1 |
| | 28 | | Mjerwa | 240 | 3,438 | 1,949 | 553 | 549 | 559 | 869 | 1,702 | 866 | 429 | 381 | 68 | 46 | 7,288 | 4,315 | 46 |
| Burundi | 29 | Bujumbura | Ntahangwe City oil | 4,488 | 4,650 | 689 | 548 | 268 | 130 | 243 | 67 | 64 | 31 | 17 | 15 | 0 | 10,773 | 437 | 0 |

**Table 5-2: Traffic level (ADT) by trade route**

| Country | Station number | Node | Survey location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Kenya | 1 | Nairobi | Shell Zambezi petrol station | 1,882 | 1,072 | 1,195 | 274 | 433 | 714 | 5,570 |
| | 2 | | 5km past Kitengela town along Athi River-Namanga Road | 1,247 | 432 | 225 | 42 | 214 | 89 | 2,249 |
| | 3 | | Total Sabaki petrol station | 5,317 | 3,547 | 3,203 | 821 | 1,302 | 521 | 14,711 |
| | 4 | | Thika (500m North of Blue Post Hotel) | 2,094 | 3,303 | 439 | 365 | 138 | 92 | 6,432 |
| | 5 | Mombasa | Danca, Mtwapa petrol station | 709 | 1,570 | 139 | 59 | 7 | 19 | 2,504 |
| | 6 | | Luqman filling station, Mariakani | 478 | 928 | 1,618 | 568 | 489 | 804 | 4,885 |
| | 7 | | Towards Kwale-Ukunda area | 443 | 248 | 25 | 10 | 59 | 26 | 811 |
| | 8 | Kisumu | Ahero junction | 1,272 | 235 | 596 | 391 | 123 | 53 | 2,669 |
| | 9 | | Kobil Webuye | 806 | 821 | 1,545 | 949 | 654 | 976 | 5,751 |
| **Total** | | | | **14,248** | **12,156** | **8,985** | **3,479** | **3,419** | **3,294** | **45,581** |
| **Percentage** | | | | **31%** | **27%** | **20%** | **8%** | **8%** | **7%** | **100%** |
| **Country** | **Station number** | **Node** | **Survey Location** | **Light truck/LGV** | **Medium/Heavy truck** | **Container trailer** | **Fuel tanker** | **Break bulk trailer** | **Bulk trailer** | **Total truck traffic** |
| Uganda | 10 | Kampala | Magamaga weighbridge | 1,660 | 467 | 947 | 463 | 601 | 38 | 4,177 |
| | 11 | | Lukaya weighbridge | 1,257 | 138 | 313 | 90 | 141 | 59 | 1,998 |
| | 12 | | Mubende weighbridge | 850 | 117 | 109 | 60 | 608 | 40 | 1,783 |
| | 13 | | Luzira (Port Bell) | 535 | 216 | 162 | 27 | 6 | 3 | 950 |
| | 14 | | Wakiso | 876 | 455 | 46 | 36 | 10 | 11 | 1,434 |
| | 15 | | Luwero weighbridge | 1,071 | 242 | 277 | 193 | 114 | 24 | 1,921 |
| | 16 | Gulu | Corner Kamdini | 165 | 80 | 230 | 81 | 62 | 10 | 628 |
| | 17 | | Atiak | 215 | 104 | 182 | 115 | 28 | 4 | 650 |
| **Total** | | | | **6,629** | **1,819** | **2,266** | **1,065** | **1,572** | **190** | **13,540** |
| **Percentage** | | | | **49%** | **13%** | **17%** | **8%** | **12%** | **1%** | **100%** |
| Tanzania | 18 | Dar es Salaam | Mwandege centre | 790 | 548 | 207 | 38 | 414 | 201 | 2,197 |
| | 19 | | Mapping centre | 542 | 564 | 299 | 65 | 156 | 5 | 1,631 |
| | 20 | | Kibaha centre - old weighbridge | 1,391 | 728 | 1,547 | 1,388 | 1,424 | 143 | 6,621 |
| | 21 | Nzega | East of Nzega roundabout | 137 | 170 | 405 | 288 | 533 | 39 | 1,572 |
| | 22 | Mwanza | East of Usagara junction | 283 | 189 | 199 | 90 | 198 | 35 | 992 |
| | 23 | Mbeya | North of Chunya bus station | 510 | 296 | 86 | 36 | 21 | 5 | 953 |
| | 24 | | 200m North of Tazara station | 1,690 | 2,326 | 1,497 | 1,677 | 1,609 | 1,615 | 10,415 |
| | 25 | | 200m East of Uyole junction | 885 | 515 | 342 | 266 | 183 | 353 | 2,543 |
| | 26 | Kigoma | Salmo oil fuel station, south of Manyovu roundabout | 347 | 56 | 35 | 26 | 21 | 6 | 491 |
| **Total** | | | | **6,574** | **5,393** | **4,617** | **3,874** | **4,558** | **2,401** | **27,416** |
| **Percentage** | | | | **24%** | **20%** | **17%** | **14%** | **17%** | **9%** | **100%** |
| Rwanda | 27 | Kigali | Rugende | 1,628 | 1,500 | 2,846 | 826 | 538 | 251 | 7,588 |
| | 28 | | Mjerwa | 869 | 1,702 | 866 | 429 | 381 | 68 | 4,315 |
| **Total** | | | | **2,497** | **3,202** | **3,711** | **1,255** | **919** | **318** | **11,903** |
| **Percentage** | | | | **21%** | **27%** | **31%** | **11%** | **8%** | **3%** | **100%** |
| Burundi | 29 | Bujumbura | Station Ntahangwe City oil | 243 | 67 | 64 | 31 | 17 | 15 | 437 |
| **Total** | | | | **243** | **67** | **64** | **31** | **17** | **15** | **437** |
| **Percentage** | | | | **56%** | **15%** | **15%** | **7%** | **4%** | **3%** | **100%** |
| **Grand total** | | | | **30,191** | **22,638** | **19,643** | **9,703** | **10,484** | **6,219** | **98,878** |
| **Percentage** | | | | **31%** | **23%** | **20%** | **10%** | **11%** | **6%** | |

## 5.2 Traffic Level by Trade Route

The study team analysed traffic levels by key trade routes based on the traffic nodes identified for this study. The main purpose of this assessment was to show the traffic density levels along the different trade routes and respective corridors in East Africa. The table below shows the traffic level by trade route in their respective countries.

**Table 5-3: Traffic level average daily traffic (ADT) by trade route**

| Country | Trade route | Total ADT | Truck traffic ADT |
|---|---|---|---|
| Kenya | Mombasa-Nairobi | 10,078 | 4,885 |
| | Mombasa-Lamu | 16,929 | 2,504 |
| | Mombasa-Lunga Lunga | 13,516 | 811 |
| | Nairobi-Namanga | 11,200 | 2,249 |
| | Nairobi-Nyeri-Ethiopia | 34,643 | 6,432 |
| | Nairobi-Mombasa | 41,140 | 14,711 |
| | Nairobi-Nakuru | 20,767 | 5,570 |
| | Nakuru-Kisumu/Busia | 12,158 | 2,669 |
| | Eldoret-Malaba | 10,873 | 5,751 |
| Uganda | Kampala-Jinja-Malaba | 11,708 | 4,177 |
| | Kampala-Masaka | 7,739 | 1,998 |
| | Kampala-Mubende | 4,849 | 1,783 |
| | Port Bell road | 9,976 | 950 |
| | Kampala-Hoima | 4,705 | 1,434 |
| | Kampala-Luwero | 5,236 | 1,921 |
| | Luwero-Nakasongola-Gulu | 1,469 | 628 |
| | Gulu-Atiak-Nimule | 1,415 | 650 |
| Tanzania | Dar es Salam-Mtwara | 9,202 | 2,197 |
| | Dar es Salam-Bagamoyo-Tanga | 6,343 | 1,631 |
| | Dar es Salam-Morogoro | 16,149 | 6,621 |
| | Morogoro-Rusumo | 3,811 | 1,572 |
| | Mwanza-Shinyanga-Nzega | 5,740 | 992 |
| | Morogoro-Mbeya | 8,421 | 953 |
| | Mbeya-Tunduma | 26,885 | 10,415 |
| | Mbeya-Songwe | 12,000 | 2,543 |
| | Kigoma-Nyakanazi | 5,632 | 491 |
| Rwanda | Kigali-Kayonza | 17,722 | 7,588 |
| | Kigali-Kanyaru | 11,649 | 4,315 |
| Burundi | Bugarama-Bujumbura | 11,209 | 437 |

## 5.3 Assessment of Primary Origins and Destinations and Prevailing Trade Routes – Regional Results

### 5.3.1 OD Interviews by Truck Type

The table below shows the result of OD Surveys by truck type for the region[38]. A total of 15,185 drivers were interviewed at the survey stations across East Africa. The survey results showed that the composition of container trailers (40ft) (20%) was the highest followed by light trucks (16%), medium trucks (15%), bulk trailers (14%), container trailers 20ft (12%), break bulk (9%) and fuel tankers (8%). The composition of empty trucks (4%) was the least along the surveyed roads.

**Table 5-4: Composition of OD trucks Interviewed across the region**

| Vehicle type | Frequency | Percentage |
|---|---|---|
| Break bulk | 1,428 | 9% |
| Bulk trailer | 2,163 | 14% |
| Container trailer (20ft) | 1,870 | 12% |
| Container trailer (40ft) | 3,063 | 20% |
| Empty truck | 631 | 4% |
| Fuel tanker | 1,276 | 8% |
| Light truck | 2,455 | 16% |
| Medium truck | 2,299 | 15% |
| **Total** | **15,185** | **100%** |

### 5.3.2 Truck Country of Registration

Study results showed that most of the trucks interviewed were registered in Kenya (39%) followed by Tanzania (33%), Uganda (22%), Rwanda (3%), Burundi (2%), South Sudan (1%) and the Democratic Republic of Congo (DRC) (0.2%). A paltry (less than 1%) of the trucks were registered in other countries including Malawi, South Africa and Zambia.

**Table 5-5: Truck country of registration**

| Truck country of registration | Frequency | Percentage |
|---|---|---|
| Kenya | 5,917 | 39% |
| Tanzania | 4,939 | 33% |
| Uganda | 3,279 | 22% |
| Rwanda | 485 | 3% |
| Burundi | 297 | 2% |
| South Sudan | 147 | 1% |
| Others | 93 | 1% |
| Democratic Republic of Congo (DRC) | 28 | 0.2% |

[38] EAC Member States: Kenya, Rwanda, Burundi, Uganda and Tanzania.

### 5.3.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages. The study results showed that the mean age of the drivers was 40 years. The median age was 39 years, the mode age was 35 years and the maximum age was 67 years.

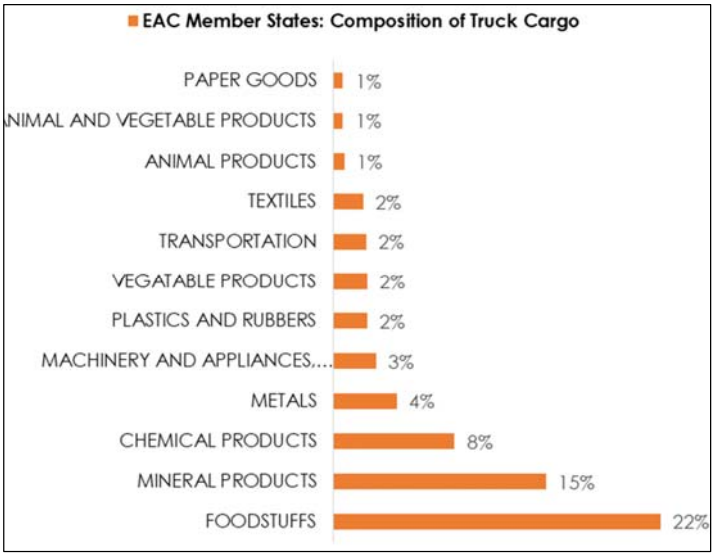
**Table 5-6: Summary statistics of drivers' ages in the East African Community (EAC)**

| Statistics | Value |
|---|---|
| Mean | 40 |
| Median | 39 |
| Mode | 35 |
| Standard deviation | 9.1 |
| Range | 74 |
| Minimum | 19 |
| Maximum | 67 |
| Count | 15,185 |

### 5.3.4 Truck Cargo Distribution

As shown in the figure below, the top five (5) most common identified cargo surveyed at the OD stations in the region were foodstuff (22%), mineral products (15%), chemical products (8%), metals (4%) and machinery and appliances (3%).

**Figure 5-1:Composition of truck cargo[39]**




[39] Cargo composition was disaggregated based on common types of goods that may be part of transportation in the region, in some cases further breakdown of cargo types are required e.g., animal products only, food stuff only etc. For clarification, food stuff category includes goods of mixed types of food groups e.g., beans, fruits, coffee, etc. Vegetable products are category of goods that only constitute fresh vegetables, cold storage vegetables and processed /canned vegetables only. Animal products include transport goods that only include produce from farm livestock products such as

### 5.3.5 Truck Cargo Most Common Origins (Loading) and Destination (Discharge) Points

The survey results across the region recorded 9,214 distinct origins, with the top 10 accounting for 61% of the overall trip origins. The top ten identified origins included Mombasa (17%), Dar es Salaam (16%), Kampala (10%), Nairobi (6%), Mbeya (3%), Athi River (2%), Kajiado (2%), Kisumu (1%), Mwanza (1%) and Jinja (1%).

The survey results recorded 7,310 distinct destinations with the top 10 accounting for 48% of the overall trip destinations. The top ten identified destinations included Kampala (12%), Dar es Salaam (9%), Mombasa (6%), Nairobi (5%), Kigali (4%), Juba (3%), Mwanza (3%), Mbeya (2%), Gulu (2%) and Jinja (2%).

The figures below illustrate the concentration of the trucks' most common origin and destination points.

meat. Animal and vegetables products constitute goods transportation that combines both animal and vegetables. Figure excludes goods in "all other goods category".

**Figure 5-2: Regional map of the top 20 truck trip origins (point of loading)**

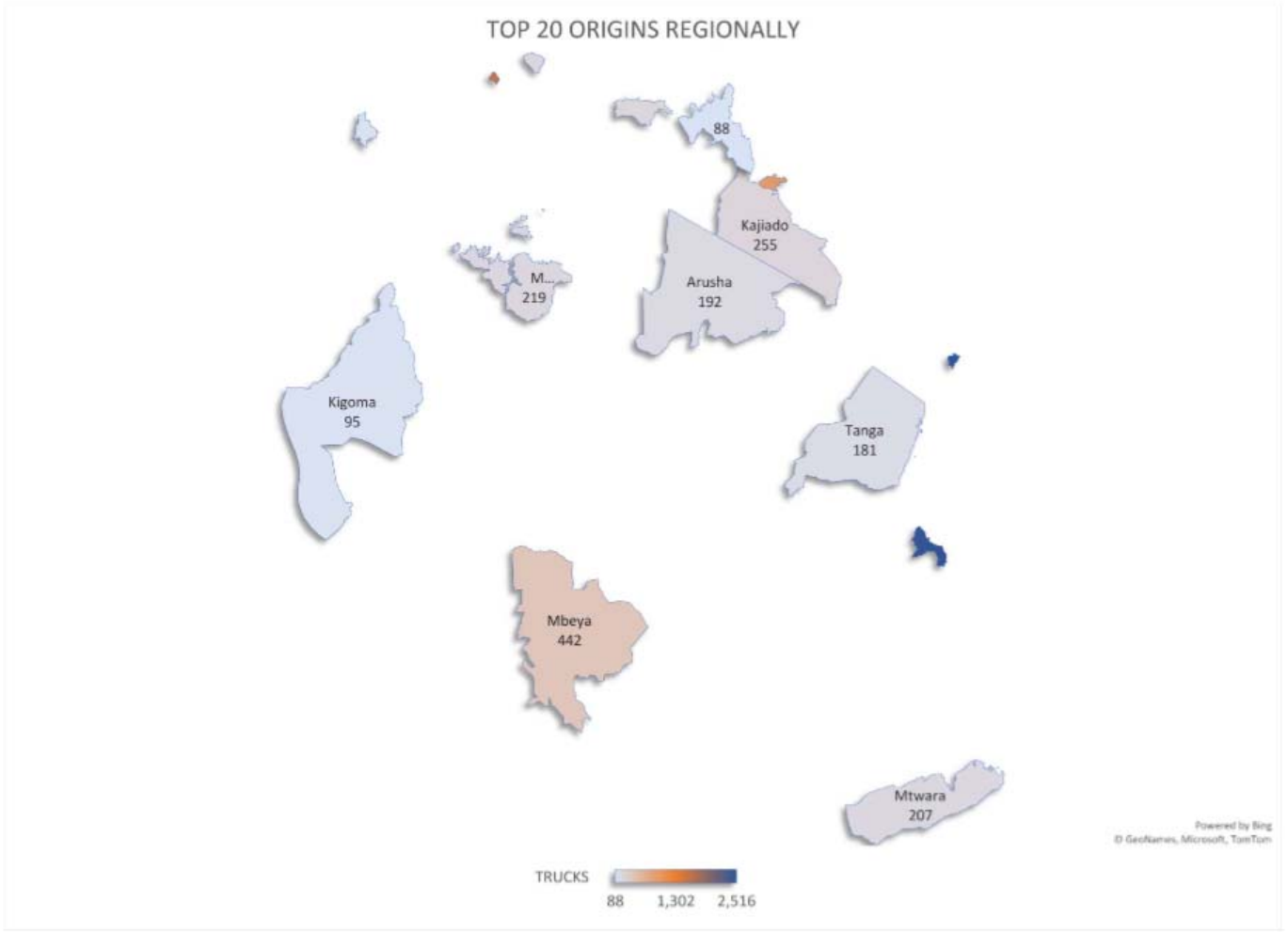


**Figure5-3: Regional map of the top 20 truck trip destinations (point of discharge)**

### 5.3.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most important trade routes in the region were identified by analysing the origin and destination pairs which were derived from the freight origin and destination analysis. The origin and destination towns were referenced to traffic nodes using the East African Community (EAC) country administrative boundaries. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across the region as shown in the table below.

**Table 5-7: Top 20 most common origin (loading) and destination (discharge) pairs for the region**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km)[40] | Category of commodities[41] transported by trucks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vegetable products | Mineral products | Foodstuffs | Textiles | Chemical products | Metals | Machinery and electricalappliances, | Animal andvegetable prroducts | Animal Products | Plastics and Rubbers | Paper Goods | Transportation |
| 1 | Mombasa | Kampala | 734 | 19.1% | NC | 1,169.0 | 3 | 60 | 57 | 21 | 48 | **61** | 28 | 7 | 3 | 26 | 6 | 10 |
| 2 | Dar es Salaam | Kigali | 332 | 8.6% | CC | 1,495.0 | 18 | **66** | 50 | 13 | 57 | 25 | 8 | 2 | | 8 | 2 | 5 |
| 3 | Dar es Salaam | Mwanza | 244 | 6.3% | CC | 1,152.0 | 1 | 28 | 22 | 1 | **30** | 5 | 6 | | | 5 | 1 | |
| 4 | Mombasa | Nairobi | 228 | 5.9% | NC | 485.0 | 2 | 26 | **69** | 5 | 16 | 25 | 7 | 2 | 1 | 2 | 5 | 2 |
| 5 | Mtwara | Dar es Salaam | 159 | 4.1% | CC | 556.0 | 1 | 6 | **94** | 23 | 1 | | | | | | | |
| 6 | Mombasa | Juba | 153 | 4.0% | NC | 1,620.0 | 3 | 2 | **39** | 5 | 3 | 7 | 3 | | 1 | 4 | 2 | 2 |
| 7 | Kampala | Juba | 149 | 3.9% | NC | 635.0 | 3 | 11 | **72** | 2 | 3 | 13 | 5 | | | 5 | | 3 |
| 8 | Kampala | Mombasa | 147 | 3.8% | NC | 1,138.0 | 3 | 3 | **68** | 1 | | | 3 | 1 | | 4 | | |
| 9 | Nairobi | Kampala | 146 | 3.8% | NC | 657.0 | 1 | 5 | **64** | 1 | 6 | 2 | 1 | | | 4 | | 3 |
| 10 | Kampala | Arua_city | 137 | 3.6% | NC | 475.0 | 1 | 23 | **39** | 5 | | 6 | 3 | | 1 | 4 | | |
| 11 | Dar es Salaam | Bujumbura | 136 | 3.5% | CC | 1,494.0 | | 1 | **14** | 4 | 7 | 11 | 2 | | | 1 | | 4 |
| 12 | Bagamoyo | Dar es Salaam | 118 | 3.1% | NC | 63.0 | **53** | 7 | 2 | 7 | 7 | 4 | | 1 | | 2 | | 2 |
| 13 | Arusha | Dar es Salaam | 110 | 2.9% | CC | 624.0 | 3 | 4 | **28** | 6 | 14 | 5 | 11 | 1 | 2 | 6 | | |
| 14 | Dar es Salaam | Arusha | 99 | 2.6% | CC | 624.0 | 26 | 2 | **27** | 8 | 7 | | | | | 3 | | 1 |
| 15 | Tanga | Dar es Salaam | 97 | 2.5% | CC | 332.0 | 3 | 10 | 5 | 1 | 46 | 5 | 3 | | | 2 | | 3 |
| 16 | Mombasa | Jinja | 93 | 2.4% | NC | 1,070.0 | 1 | 10 | 12 | 2 | 14 | 6 | 4 | | 2 | 3 | 1 | 2 |
| 17 | Dar es Salaam | Kigoma | 87 | 2.3% | CC | 1,479.0 | | 2 | **25** | 3 | 25 | 3 | 5 | | | 1 | | 3 |
| 18 | Mbeya | Dar es Salaam | 81 | 2.1% | CC | 815.0 | 3 | | **65** | | 1 | | | 1 | | | 1 | |
| 19 | Dar es Salaam | Mbeya | 80 | 2.1% | CC | 815.0 | | 3 | **28** | 5 | 15 | 3 | 1 | 1 | | | | 3 |
| 20 | Mombasa | Kigali | 80 | 2.1% | NC | 1,477.0 | 4 | 14 | **15** | 2 | **15** | 1 | 4 | | | 1 | | 1 |

NB: CC – Central Corridor & NC – Northern Corridor

[40] Road distances have been derived from Transport Observatory Reports and TANROADS Roads Distance Chart

[41] Most trucks interviewed during the survey were identified to transport all other commodities. For purposes of this analysis, this commodity category together with other categories were dropped.

The results from the table above show that most of the trips paired (51.3%) at the regional level were international. Some of the top five international trips observed included:

- Mombasa-Kampala (19.1%)
- Dar es Salaam-Kigali (8.6%)

The other trips observed in the top five OD national pairs included:

- Dar es Salaam-Mwanza (6.3%)
- Mombasa-Nairobi (5.9%)
- Mtwara-Dar es Salaam (4.1%)

It was established that Rwanda and Burundi rely primarily on the Central Corridor whereas Uganda relies on the Northern Corridor for international trade.[42]

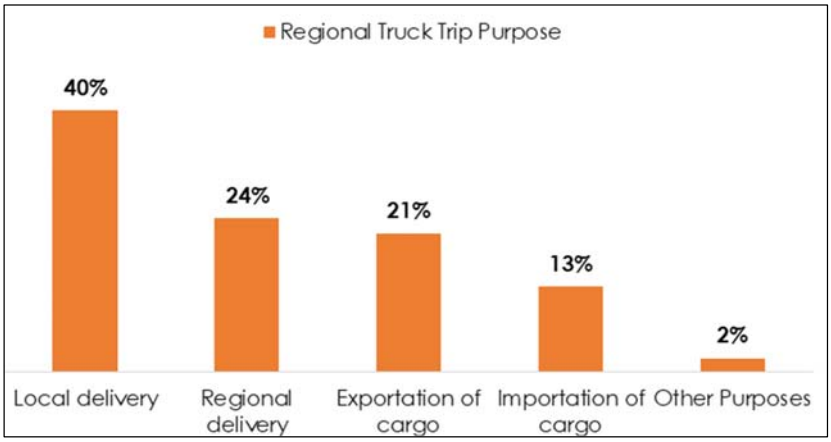
### 5.3.7 Truck Trip Purpose

The study classified trip purposes of trucks interviewed in the region at the different survey stations. The results in the figure below showed that most truck trips were involved in local delivery (40%) followed by regional delivery (24%), the exportation of cargo (21%) and importation of cargo (13%). The study results also showed that some of the trips were undertaken for other purposes (2%) such as return journeys and collection of cargo.

These results show that most of the trucks are used in their respective countries to carry out local and regional deliveries.

[42] The trade costs incurred for each of the most common OD pairs, by taking consideration the major category of commodity transported by trucks on each route, is provided below (see Section 5.4.8).

**Figure 5-4:Regional Truck Trip Purpose**




## 5.4 Freight Transport Cost Analysis - Regional

### 5.4.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey and analysis procedure described in Section 2.3of this report. This section presents the overall breakdown of the regional transport costs by vehicle type along the Northern Corridor and the Central Corridor.

#### 5.4.1.1 Breakdown of Regional Direct Transport Costs

The figure below shows the breakdown of regional direct transport costs by truck plying the Northern Corridor and Central Corridor. The results were derived from the freight cost survey by analysing trucks plying the Northern corridor whose origin was Mombasa Port and trucks plying the Central corridor whose origin was Dar es Salaam Port.

### Table 5-8: Direct transport costs for regional analysis (USD) - Northern Corridor

| Transport cost item | Break bulk | | Container trailer/Semi | | Dry Bulk Trailer | | Liquid Bulk Tank Trailer | |
|---|---|---|---|---|---|---|---|---|
| | Average Cost | Percentage | Average Cost | Percentage | Average Cost | Percentage | Average Cost | Percentage |
| Vehicle depreciation cost per trip | 99.8 | 6.6% | 191.5 | 8.8% | 65.3 | 5.7% | 215.0 | 9.3% |
| Fuel cost per trip | 497.1 | 33.0% | 645.5 | 29.8% | 524.7 | 45.5% | 537.5 | 23.4% |
| Labour (crew) for vehicle per trip | 126.6 | 8.4% | 200.4 | 9.2% | 87.5 | 7.6% | 322.5 | 14.0% |
| Maintenance and repair cost per trip | 144.7 | 9.6% | 240.6 | 11.1% | 111.9 | 9.7% | 322.5 | 14.0% |
| Tyre cost per trip | 109.3 | 7.3% | 195.1 | 9.0% | 104.3 | 9.0% | 129.0 | 5.6% |
| Management and overhead cost per trip | 230.4 | 15.3% | 236.2 | 10.9% | 137.1 | 11.9% | 279.5 | 12.2% |
| Vehicle and equipment licensing fee per trip | 47.8 | 3.2% | 91.0 | 4.2% | 13.2 | 1.1% | 107.5 | 4.7% |
| Cargo insurance cost per trip | 70.7 | 4.7% | 104.2 | 4.8% | 20.7 | 1.8% | 86.0 | 3.7% |
| Other cost per trip | 129.0 | 8.6% | 154.9 | 7.1% | 89.3 | 7.7% | 150.5 | 6.5% |
| Port authorities bribe cost per trip | 12.4 | 0.8% | 30.8 | 1.4% | 0.0 | 0.0% | 15.0 | 0.7% |
| Weighbridge authorities bribe cost per trip | 15.2 | 1.0% | 34.0 | 1.6% | 0.0 | 0.0% | 75.0 | 3.3% |
| Border control authorities bribe cost per trip | 5.4 | 0.4% | 11.8 | 0.5% | 0.0 | 0.0% | 30.0 | 1.3% |
| Police bribe cost per trip | 17.0 | 1.1% | 33.1 | 1.5% | 0.0 | 0.0% | 30.0 | 1.3% |
| **Total freight cost per trip** | **1,455.5** | | **2,059.5** | | **1,153.9** | | **2,150.0** | |
| **Total bribe cost per trip** | **50.0** | | **109.7** | | **0.0** | | **150.0** | |
| **Total transport cost per trip** | **1,505.5** | | **2,169.2** | | **1,153.9** | | **2,300.0** | |

**Table 5-9: Direct transport costs for regional analysis (USD) - Central Corridor**

| Transport cost item | Break blk | | Container trailer/semi | | Dry bulk trailer | |
|---|---|---|---|---|---|---|
| | Average cost | Percentage | Average cost | Percentage | Average cost | Percentage |
| Vehicle depreciation cost per trip | 456.0 | 12.0% | 306.1 | 10.3% | 345.0 | 13.0% |
| Fuel cost per trip | 1,596.0 | 42.0% | 1,198.1 | 40.3% | 682.5 | 25.7% |
| Labour (crew) for vehicle per trip | 190.0 | 5.0% | 251.4 | 8.5% | 127.5 | 4.8% |
| Maintenance and Repair Cost per trip | 76.0 | 2.0% | 311.4 | 10.5% | 292.5 | 11.0% |
| Tyre cost per trip | 38.0 | 1.0% | 220.3 | 7.4% | 292.5 | 11.0% |
| Management and overhead cost per trip | 760.0 | 20.0% | 230.0 | 7.7% | 210.0 | 7.9% |
| Vehicle and equipment licensing fee per trip | 38.0 | 1.0% | 129.1 | 4.3% | 172.5 | 6.5% |
| Cargo insurance cost per trip | 38.0 | 1.0% | 81.7 | 2.7% | 255.0 | 9.6% |
| Other cost per trip | 608.0 | 16.0% | 133.9 | 4.5% | 172.5 | 6.5% |
| Port authorities bribe cost per trip | 0.0 | 0.0% | 18.9 | 0.6% | 30.0 | 1.1% |
| Weighbridge authorities bribe cost per trip | 0.0 | 0.0% | 28.5 | 1.0% | 20.0 | 0.8% |
| Border control authorities bribe cost per trip | 0.0 | 0.0% | 6.7 | 0.2% | 30.0 | 1.1% |
| Police bribe cost per trip | 0.0 | 0.0% | 55.0 | 1.9% | 22.5 | 0.8% |
| **Total freight cost per trip** | **3,800.0** | | **2,861.8** | | **2,550.0** | |
| **Total bribe cost per trip** | **0.0** | | **109.1** | | **102.5** | |
| **Total transport cost per trip** | **3,800.0** | | **2,970.8** | | **2,652.5** | |

### 5.4.2 Port Costs

The port costs for the Regional analysis are reported in **Equation 4** and **Equation 5** in **Chapter 4**.

### 5.4.3 Direct Trade Compliance Cost

The direct trade compliance costs for the Regional analysis are reported in **Table 4-5** in **Chapter 4**.

### 5.4.4 Cost of Trade Time

The costs of trade time for the regional analysis are reported in **Equation 4** and **Equation 5** in **Chapter 4**.

### 5.4.5 Indirect cost of delay (USD)

The indirect costs of delay for the regional analysis are reported in **Equation 4** and **Equation 5** in **Chapter 4**.

### 5.4.6 Cost of Illicit Payments

The cost of illicit payments for Regional analysis reported in **Equation 4** and **Equation 5** in **Chapter 4**.

### 5.4.7 Trade Costs by Commodity Results and Trade Corridor Regional Average

In the dataset, the primary variance across commodity types was the mix of vehicle types used, the average illicit payment, and some, minor variance in terms of delay cost. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were then summed up to create a picture of average cost by commodity basket for the sample dataset.

**Equation6: Calculation of cost of trade by commodity, regional average, USD - Northern Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs[43] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| VALUE BY COMMODITY | | | | | | | | | | | |
| Cement and clinker connections | 833 | + | 1,722.37 | + | 115 | + | 42 | + | 92 | = | 2,804.67 |
| Cereals, sorghum, etc. | 833 | + | 1,833.73 | + | 115 | + | 42 | + | 92 | = | 2,916.03 |
| Clay, minerals, etc. | 833 | + | 1,722.37 | + | 115 | + | 42 | + | 92 | = | 2,804.67 |
| Edible fruits: | 833 | + | 1,833.73 | + | 115 | + | 42 | + | 92 | = | 2,916.03 |
| Manufactured goods | 833 | + | 1,839.29 | + | 115 | + | 42 | + | 92 | = | 2,921.59 |
| Coffee and tea | 833 | + | 1,839.29 | + | 115 | + | 42 | + | 92 | = | 2,921.59 |
| Construction materials | 833 | + | 1,722.37 | + | 115 | + | 42 | + | 92 | = | 2,804.67 |
| Petroleum, oils etc. | 833 | + | 1,814.26 | + | 115 | + | 42 | + | 92 | = | 2,896.56 |
| Iron steel and aluminium - raw | 833 | + | 1,697.62 | + | 115 | + | 42 | + | 92 | = | 2,779.92 |
| Edible vegetables, roots and tubers | 833 | + | 1,833.73 | + | 115 | + | 42 | + | 92 | = | 2,916.03 |

[43]The direct transport cost used in the calculation of cost of trade is less illicit cost.

**Equation 7: Calculation of cost of trade by commodity, regional average (USD) - Central Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[44] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| | | | | | VALUE BY COMMODITY | | | | | | |
| Cement and clinker connections | 1,359 | + | 2,733.58 | + | 375 | + | 42 | + | 103 | = | 4,612.48 |
| Cereals, sorghum, etc. | 1,359 | + | 2,997.93 | + | 375 | + | 42 | + | 103 | = | 4,876.83 |
| Clay, minerals, etc. | 1,359 | + | 2,733.58 | + | 375 | + | 42 | + | 103 | = | 4,612.48 |
| Edible fruits: | 1,359 | + | 2,997.93 | + | 375 | + | 42 | + | 103 | = | 4,876.83 |
| Manufactured goods | 1,359 | + | 2,916.63 | + | 375 | + | 42 | + | 103 | = | 4,795.53 |
| Coffee and tea | 1,359 | + | 2,916.63 | + | 375 | + | 42 | + | 103 | = | 4,795.53 |
| Construction materials | 1,359 | + | 2,733.58 | + | 375 | + | 42 | + | 103 | = | 4,612.48 |
| Petroleum, oils etc. | 1,359 | + | 2,668.80 | + | 375 | + | 42 | + | 103 | = | 4,547.70 |
| Iron steel and aluminium - raw | 1,359 | + | 3,028.68 | + | 375 | + | 42 | + | 103 | = | 4,907.58 |
| Edible vegetables, roots and tubers | 1,359 | + | 2,997.93 | + | 375 | + | 42 | + | 103 | = | 4,876.83 |

### 5.4.8 Trade Cost for Top 20 Most Common OD Pairs by Most Common Commodity Transported

The table below shows the trade cost incurred for each of the top 20 common OD pairs by taking into consideration the major category of commodities transported by trucks along each route.

[44]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

**Table 5-10: Trade cost by common OD pair by commodity type transported**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average cost per trip (USD) | Average cost per km (USD/km) |
| 1 | Mombasa | Kampala | 734 | 19.1% | NC | 1,169.0 | Metals | 2,779.9 | 2.4 |
| 2 | Dar es Salaam | Kigali | 332 | 8.6% | CC | 1,495.0 | Mineral products | 4,907.6 | 3.3 |
| 3 | Dar es Salaam | Mwanza | 244 | 6.3% | CC | 1,152.0 | Chemical products | 4,547.7 | 3.9 |
| 4 | Mombasa | Nairobi | 228 | 5.9% | NC | 485.0 | Foodstuff | 2,916.0 | 6.0 |
| 5 | Mtwara | Dar es Salaam | 159 | 4.1% | CC | 556.0 | Foodstuff | 4,876.8 | 8.8 |
| 6 | Mombasa | Juba | 153 | 4.0% | NC | 1,620.0 | Foodstuff | 2,916.0 | 1.8 |
| 7 | Kampala | Juba | 149 | 3.9% | NC | 635.0 | Foodstuff | 2,916.0 | 4.6 |
| 8 | Kampala | Mombasa | 147 | 3.8% | NC | 1,138.0 | Foodstuff | 2,916.0 | 2.6 |
| 9 | Nairobi | Kampala | 146 | 3.8% | NC | 657.0 | Foodstuff | 2,916.0 | 4.4 |
| 10 | Kampala | Arua_city | 137 | 3.6% | NC | 475.0 | Foodstuff | 2,916.0 | 6.1 |
| 11 | Dar es Salaam | Bujumbura | 136 | 3.5% | CC | 1,494.0 | Foodstuff | 4,876.8 | 3.3 |
| 12 | Bagamoyo | Dar es Salaam | 118 | 3.1% | NC | 63.0 | Vegetable products | 2,916.0 | 46.3 |
| 13 | Arusha | Dar es Salaam | 110 | 2.9% | CC | 624.0 | Foodstuff | 4,876.8 | 7.8 |
| 14 | Dar es Salaam | Arusha | 99 | 2.6% | CC | 624.0 | Foodstuff | 4,876.8 | 7.8 |
| 15 | Tanga | Dar es Salaam | 97 | 2.5% | CC | 332.0 | Chemical products | 4,547.7 | 13.7 |
| 16 | Mombasa | Jinja | 93 | 2.4% | NC | 1,070.0 | Chemical products | 2,896.6 | 2.7 |
| 17 | Dar es Salaam | Kigoma | 87 | 2.3% | CC | 1,479.0 | Foodstuff | 4,876.8 | 3.3 |
| 18 | Mbeya | Dar es Salaam | 81 | 2.1% | CC | 815.0 | Foodstuff | 4,876.8 | 6.0 |
| 19 | Dar es Salaam | Mbeya | 80 | 2.1% | CC | 815.0 | Foodstuff | 4,876.8 | 6.0 |
| 20 | Mombasa | Kigali | 80 | 2.1% | NC | 1,477.0 | Foodstuff | 2,916.0 | 2.0 |

## 5.5 Summary of Findings and Key Barriers to Trade

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the Pilot Study, were excluded, at TMEA's direction, for the full study.

However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of 'not a challenge' to 'a severe challenge':

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weighbridge issues.
- Weather conditions.
- Radar speed check issues.

At the regional level, the issue most often identified as a 'moderate' or 'severe' challenge was road conditions. The second most frequently identified issue was police checks.

By contrast, vehicle condition, weather, port and border post issues were most frequently identified as either 'not a challenge', or 'a slight challenge'.

## 5.6 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles across East Africa. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were USD 100 per trip along the Central Corridor and USD 92 per trip along the Northern Corridor. Of these, illicit costs at weighbridges and to non-police government authorities were the most significant. This suggests that along with non-monetary NTBs, efforts to reduce illicit payments might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study, did identify police checks and road conditions as the most pressing items of concern for transporters. Again, this may a fruitful area for TMEA attention, including working to better understand the issue and its impacts, in the future.

# 6. KENYA RESULTS SUMMARY

This chapter presents the results of the RAATTE Kenya Survey Analysis. Certain details on methods and sampling can be found in **Chapter 2**. This chapter focuses on the data and analysis specific to Kenya. Results for other surveyed countries can be found in the other chapters of this report. A summary of the overall regional results can be found in **Chapter 5**. This section reviews the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis, and the emissions analysis. We then summarize findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 6.1 Regional Traffic Census Results

The Kenya Traffic Census was carried for a period of seven days from 2nd October to 8th October, 2021 at nine counting stations across the country. The table below provides the truck traffic census analysis by station.

**Table 6-1: Detailed Kenya traffic census results - average daily traffic (ADT)**

| Country | Station number | Node | Survey location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Kenya | 1 | Nairobi | Shell Zambezi petrol station | 1,882 | 1,072 | 1,195 | 274 | 433 | 714 | 5,570 |
| | 2 | | 5km past Kitengela town along Athi River-Namanga Road | 1,247 | 432 | 225 | 42 | 214 | 89 | 2,249 |
| | 3 | | Total Sabaki petrol station | 5,317 | 3,547 | 3,203 | 821 | 1,302 | 521 | 14,711 |
| | 4 | | Thika (500m North of Blue Post Hotel) | 2,094 | 3,303 | 439 | 365 | 138 | 92 | 6,432 |
| | 5 | Mombasa | Danca, Mtwapa petrol station | 709 | 1,570 | 139 | 59 | 7 | 19 | 2,504 |
| | 6 | | Luqman filling station, Mariakani | 478 | 928 | 1,618 | 568 | 489 | 804 | 4,885 |
| | 7 | | Towards Kwale-Ukunda area | 443 | 248 | 25 | 10 | 59 | 26 | 811 |
| | 8 | Kisumu | Ahero junction | 1,272 | 235 | 596 | 391 | 123 | 53 | 2,669 |
| | 9 | | Kobil Webuye | 806 | 821 | 1,545 | 949 | 654 | 976 | 5,751 |
| **Total** | | | | **14,248** | **12,156** | **8,985** | **3,479** | **3,419** | **3,294** | **45,581** |
| **Percentage** | | | | **31%** | **27%** | **20%** | **8%** | **8%** | **7%** | **100%** |

## 6.2 Assessment of Primary Origins and Destinations and Prevailing Trade Routes – Kenya Results

### 6.2.1 OD Interviews by Truck Type

The table below provides the result of the OD Survey by truck type for Kenya. The survey results indicate that of the truck types in the sample, medium trucks (22%) were the most represented, followed by container trailers (40ft), bulk trailers (18%), light trucks (14%), container trailers (20ft)(8%), empty trucks (7%), break bulk (6%) and fuel tankers (5%).

**Table 6-2: Composition of Kenya OD Truck Interviews**

| Country | Vehicle type | Frequency | Percentage |
|---|---|---|---|
| Kenya | Fuel tanker | 257 | 5% |
| | Break bulk | 305 | 6% |
| | Empty truck | 354 | 7% |
| | Container trailer (20ft) | 401 | 8% |
| | Light truck | 737 | 14% |
| | Bulk trailer | 900 | 18% |
| | Container trailer (40ft) | 1,029 | 20% |
| | Medium truck | 1,126 | 22% |
| **Total** | | **5,109** | **100%** |

### 6.2.2 Truck Country of Registration

The study results indicate that most of the trucks surveyed in Kenya were registered in Kenya (93.5%) followed by Tanzania (3.0%), Uganda (2.2%), Rwanda (0.6%), South Sudan (0.3%), other countries (0.2%), Burundi (0.2%) and the Democratic Republic of Congo (DRC) (0.1%).

**Table 6-3: Composition of Kenya OD truck interviews**

| Country | Truck country of registration | Frequency | Percentage |
|---|---|---|---|
| Kenya | Kenya | 4,776 | 93.5% |
| | Tanzania | 153 | 3.0% |
| | Uganda | 111 | 2.2% |
| | Rwanda | 29 | 0.6% |
| | South Sudan | 17 | 0.3% |
| | Other (specify) | 9 | 0.2% |
| | Burundi | 8 | 0.2% |
| | Democratic Republic of Congo (DRC) | 6 | 0.1% |
| **Total** | | **5,109** | |

### 6.2.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages in Kenya. The study results showed that the mean age of the drivers was 41.3 years, the median age was 40 years, the mode age was 40 years and the maximum age was 75 years.

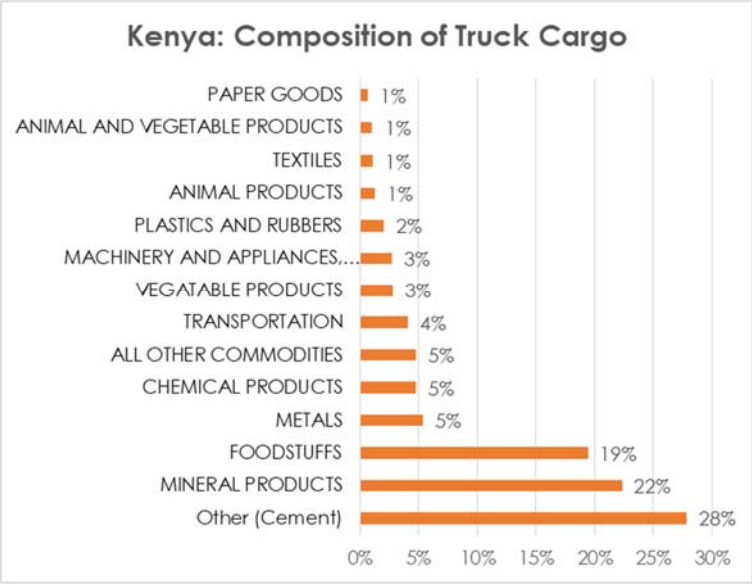
**Table 6-4: Summary statistics of drivers' age in Kenya**

| Statistics | Value |
|---|---|
| Mean | 41.3 |
| Median | 40 |
| Mode | 40 |
| Standard deviation | 9.1 |
| Range | 75 |
| Minimum | 0 |
| Maximum | 75 |
| Count | 5109 |

### 6.2.4 Truck Cargo Distribution

As shown in the figure below, the top five most common cargo surveyed at the OD stations in Kenya were other products (cement) (28%), mineral products (22%), foodstuffs (19%), metals (5%) and chemical products (5%)[45].

**Figure 6-1:Composition of truck cargo**




[45] Chemical products include fuel.

### 6.2.5 Top 10 Most Common Origin (Loading) and Destination (Discharge) Points

The survey results for Kenya include 4,278 distinct origins with the top 10 accounting for 84% of the overall trip origins. As shown in **Figure 6-2** below, the top ten origins included Mombasa (35%), Nairobi (14%), Athi River (7%), Kajiado (5%), Kisumu (3%), Thika (3%), Kampala (2%), Malindi (2%) and Kitengela (1%).

There were also 3,791 distinct destinations recorded, with the top 10 accounting for 74% of the overall trip destinations. As shown in **Figure 6-3** below, the top ten destinations included Mombasa (15%), Nairobi (14%), Kampala (12%), Kisumu (5%), Athi River (4%), Murang'a (4%), Kajiado (3%), Nakuru (3%) and Meru (2%).

Combined, these results indicate that the vast majority of traffic flowed between major origins and destinations, with relatively limited side traffic.

The maps below demonstrate a concentration of traffic at major urban centres.

**Figure 6-2: Kenya map of the top 20 truck trip origins (point of loading)**

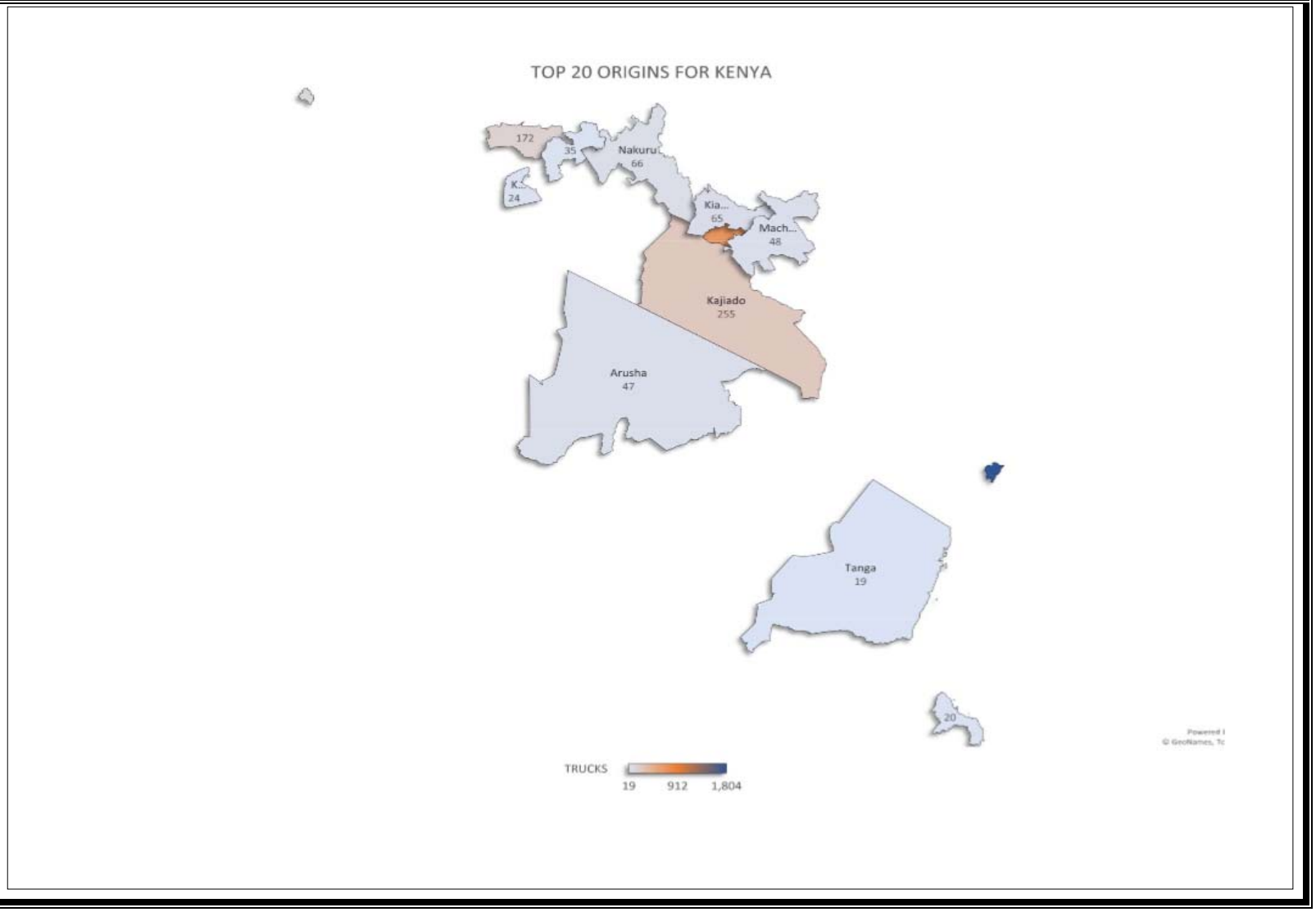
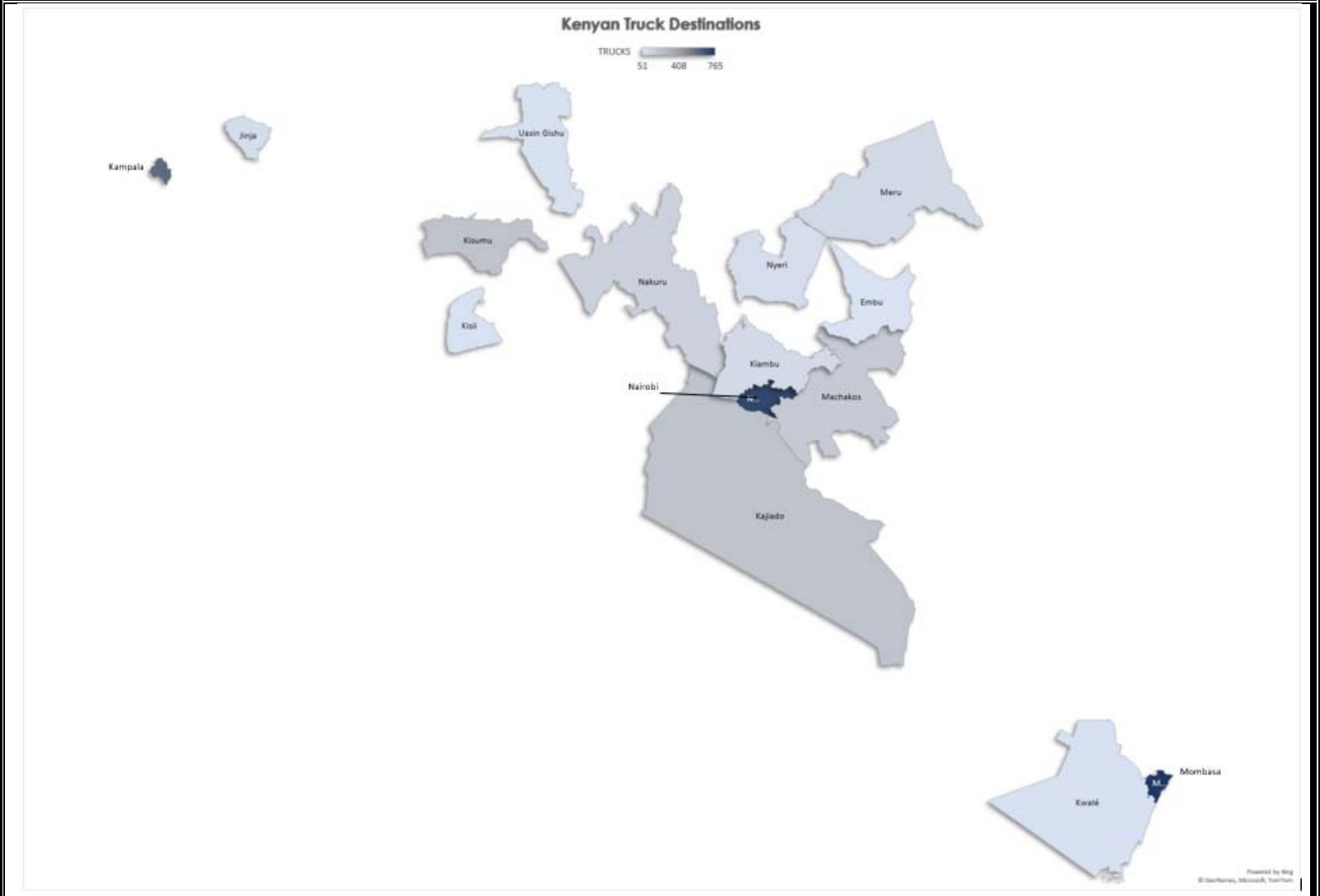


**Figure 6-3: Kenya map of the top 20 truck trip destinations (point of discharge)**



### 6.2.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most predominant trade routes in the Kenya were identified by analysing origin and destination pairs which were derived from the freight origin and destination analysis. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across Kenya are shown in the table below.

**Table 6-5:Top 20most common origin (loading) and destination (discharge) pairs for Kenya**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (Km) | Category of Commodities Transported by Trucks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vegetable products | Mineral products | Foodstuff | Textiles | Chemical products | Metals | Machinery and electrical appliances | Animal and vegetable products | Animal Products | Plastics And Rubbers | Paper Goods | Transportation |
| 1 | Mombasa | Kampala | 427 | 25.3% | NC | 1,169.0 | 2 | 55 | 25 | 11 | **37** | 41 | 11 | 5 | 1 | 9 | 3 | 7 |
| 2 | Mombasa | Nairobi | 228 | 13.5% | NC | 485.0 | 2 | 26 | **69** | 5 | 16 | 25 | 7 | 2 | 1 | 2 | 5 | 2 |
| 3 | Kampala | Mombasa | 94 | 5.6% | NC | 1,138.0 | 3 | 3 | **46** | | | | 3 | 1 | | 2 | | |
| 4 | Nairobi | Kampala | 84 | 5.0% | NC | 657.0 | | 3 | | **42** | 1 | 5 | | | | 3 | | 2 |
| 5 | Nairobi | Mombasa | 79 | 4.7% | NC | 485.0 | 1 | 7 | **11** | 1 | 4 | 5 | 3 | | 1 | 3 | | 1 |
| 6 | Athi_River | Nairobi | 72 | 4.3% | NC | 28.0 | | **30** | 3 | | | 8 | 2 | | | 4 | | |
| 7 | Mombasa | Athi_River | 71 | 4.2% | NC | 457.0 | | **53** | 1 | | 9 | | 3 | | | | | 1 |
| 8 | Kajiado | Nairobi | 57 | 3.4% | NC | 107.0 | 1 | **14** | 5 | | 2 | | | 1 | 1 | 1 | | 9 |
| 9 | Mombasa | Kisumu | 55 | 3.3% | NC | 829.0 | 1 | 8 | **18** | | 3 | 6 | 1 | 1 | | | 1 | 1 |
| 10 | Malindi | Mombasa | 52 | 3.1% | NC | 116.0 | | **37** | 1 | | 1 | 1 | 1 | | | 1 | | 3 |
| 11 | Mombasa | Juba | 51 | 3.0% | NC | 1,620.0 | | 1 | **15** | | 2 | 1 | | | 1 | 1 | | 1 |
| 12 | Thika | Muranga | 51 | 3.0% | NC | 47.0 | | **22** | 4 | | 1 | 3 | | 3 | 4 | | | |
| 13 | Kajiado | Mombasa | 50 | 3.0% | NC | 489.0 | | **23** | 4 | 1 | 1 | 1 | 1 | | | | | 13 |
| 14 | Nairobi | Kisumu | 50 | 3.0% | NC | 351.0 | 1 | | **28** | | 3 | 2 | 1 | | | 2 | 3 | 6 |
| 15 | Nairobi | Muranga | 50 | 3.0% | NC | 85.0 | 1 | **8** | 5 | | 3 | 5 | 4 | 2 | 1 | 3 | | 2 |
| 16 | Mombasa | Jinja | 49 | 2.9% | NC | 1,070.0 | | 10 | 7 | 1 | **14** | 3 | 4 | | 1 | 1 | 1 | |
| 17 | Mombasa | Malindi | 48 | 2.8% | NC | 116.0 | | 6 | **14** | | 3 | 2 | 4 | | | 1 | | 1 |
| 18 | Mombasa | Nakuru | 42 | 2.5% | NC | 648.5 | 1 | 5 | **14** | | 2 | 4 | 3 | | | | 1 | |
| 19 | Nairobi | Kajiado | 40 | 2.4% | NC | 107.0 | 2 | 2 | **5** | | | 3 | 3 | 1 | | 3 | 1 | 3 |
| 20 | Nairobi | Meru | 39 | 2.3% | NC | 225.4 | | 5 | **11** | | 2 | 1 | 2 | | | 1 | 2 | 1 |

From the table above, the top five Origin-Destination pairs included three international trips:

- Mombasa-Kampala (25.3%)
- Kampala-Mombasa (5.6%)
- Nairobi-Kampala (5.0%)

The other trip observed in the top five OD pairs were national in nature and included:

- Mombasa-Nairobi (13.5%)
- Nairobi-Mombasa (4.7%)

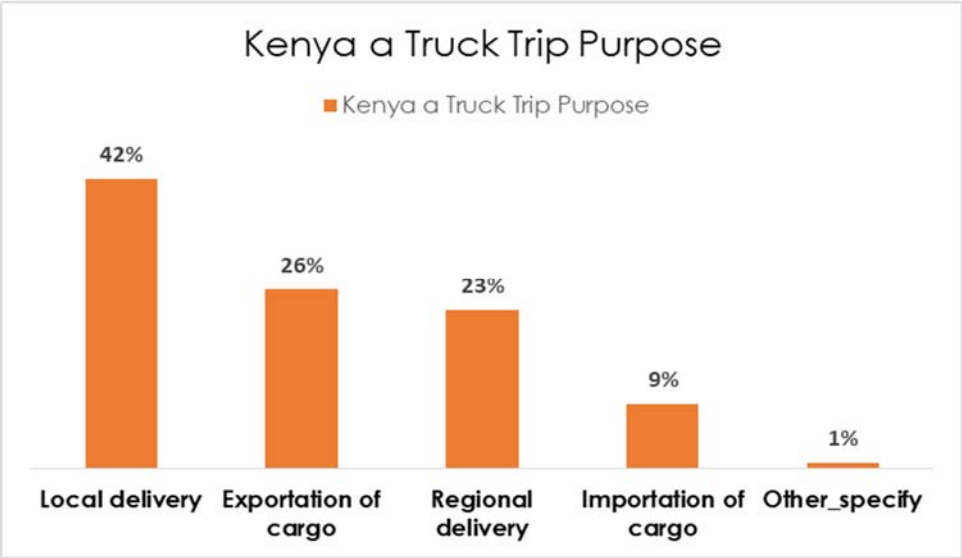
It was established that Uganda relies primarily on the Northern Corridor for international trade through Kenya. [46]

### 6.2.7 Truck Trip Purpose

The study classified trip purposes of trucks interviewed in Kenya at the nine survey stations. The results as shown in the figure below indicate that most trip purposes were local delivery (42%) followed by exportation of cargo (26%), regional delivery (23%), importation of cargo (9%) and other purposes (1%). With local delivery dominating truck traffic, policies and practices aimed at reducing intra-regional delay will likely impact only a fraction of traffic.

[46] The trade costs incurred for each of the most common OD pairs by taking into consideration the top 5 major categories of commodity transported by trucks on each route are provided in the next subsection (Refer to Section 6.3.9).

**Figure 6-4: Kenya Truck Trip Purpose**




## 6.3 Freight Transport Cost Analysis - Kenya Results

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. **Table 4-1** shows this framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

### 6.3.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey results presented in **Section 2.4** of this report. This section will present the overall breakdown of the Kenya transport costs by vehicle type along the Northern and Central Corridors.

#### 6.3.1.1 Breakdown of Kenya Direct Transport Costs

The figure below shows the breakdown of Kenya direct transport costs by trucks plying the Northern Corridor. The results were derived from the freight cost survey by analysing trucks identified as utilising the Northern Corridor and whose origin was Mombasa Port.

**Table 6-6:Direct Transport Costs for Kenya Analysis (USD) - Northern Corridor**

| Transport Cost Item | Break Bulk | | Container Trailer/Semi | | Dry Bulk Trailer | | Overall Results for Kenya | |
|---|---|---|---|---|---|---|---|---|
| | Average Cost | Percentage | Average Cost | Percentage | Average Cost | Percentage | Average Cost | Percentage |
| Vehicle depreciation cost per trip | 66.50 | 5.6% | 85.10 | 6.3% | 65.30 | 5.7% | 77.50 | 6.0% |
| Fuel cost per trip | 441.20 | 37.3% | 464.10 | 34.3% | 524.70 | 45.5% | 463.30 | 36.2% |
| Labour (crew) for vehicle per trip | 96.20 | 8.1% | 104.00 | 7.7% | 87.50 | 7.6% | 100.00 | 7.8% |
| Maintenance and repair cost per trip | 116.40 | 9.8% | 182.40 | 13.5% | 111.90 | 9.7% | 155.50 | 12.1% |
| Tyre cost per trip | 99.30 | 8.4% | 106.90 | 7.9% | 104.30 | 9.0% | 104.30 | 8.1% |
| Management and overhead cost per trip | 211.50 | 17.9% | 221.60 | 16.4% | 137.10 | 11.9% | 210.20 | 16.4% |
| Vehicle and equipment licensing fee per trip | 8.70 | 0.7% | 21.80 | 1.6% | 13.20 | 1.1% | 17.00 | 1.3% |
| Cargo insurance costs per trip | 20.80 | 1.8% | 32.70 | 2.4% | 20.70 | 1.8% | 27.90 | 2.2% |
| Other cost per trip | 112.30 | 9.5% | 125.80 | 9.3% | 89.30 | 7.7% | 118.10 | 9.2% |
| Port authorities bribe cost per trip | 0.00 | 0.0% | 0.70 | 0.1% | 0.00 | 0.0% | 0.40 | 0.0% |
| Weighbridge authorities bribe cost trip | 0.00 | 0.0% | 0.70 | 0.1% | 0.00 | 0.0% | 0.40 | 0.0% |
| Border control authorities bribe cost per trip | 3.30 | 0.3% | 0.70 | 0.1% | 0.00 | 0.0% | 1.40 | 0.1% |
| Police bribe cost per trip | 7.80 | 0.7% | 5.10 | 0.4% | 0.00 | 0.0% | 5.40 | 0.4% |
| **Total freight cost per trip** | **1,172.70** | | **1,344.40** | | **1,153.90** | | **1,273.90** | |
| **Total bribe cost trip** | **11.10** | | **7.20** | | **0.00** | | **7.70** | |
| **Total transport cost per trip** | **1,183.90** | | **1,351.70** | | **1,153.90** | | **1,281.50** | |

### 6.3.2 Port Costs

The port costs for the Kenya analysis are derived from **Equation 4** in **Chapter 4**.

### 6.3.3 Direct Trade Compliance Cost

The direct trade compliance costs for the Kenya analysis are derived from **Equation 4** in **Chapter 4**.

### 6.3.4 Cost of Trade Time

The "Cost of Trade Time" for Kenya analysis was derived using the same approach discussed in **Section 4.4**. For the Kenya study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tyres, maintenance, insurance) based on annual total expenditures (including for delayed trips), these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the 'Kenya Direct Cost of Trade Time' is presented in **Equation 8**, based on the average delay with the sample (see **Table 6-7**):

**Table 6-7: Truck Trip Times - Kenya Average**

| Trip Category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 3.86 | 3.83 | 3.17 | 5.82 | 1.89 | 141 |
| **On-time trips** | 2.6 | 2.97 | 2.97 | 4.22 | 0.99 | 308 |

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here the cost is calculated for the average trip in the Kenya sample.

**Equation 8: Calculation of Cost of Trade Time for Kenya**

| Cost of time data | Formula/Source | Code | Unit | Kenya (Northern Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 65.10 |
| Trip delay (days) | | TD | Days | 0.12 |
| Route mode time (days) | *Source:* Freight Transport Cost Analysis Survey | RMT | Days | 2.97 |
| Direct transport cost | *Source:* Freight Transport Cost Analysis Survey | DTC | USD | 1,273.90[47] |
| Average cost of fuel | *Source:* Freight Transport Cost Analysis Survey | ACF | USD | 463.30 |
| Average cost of tires per trip | *Source:* Freight Transport Cost Analysis Survey | ACT | USD | 104.30 |
| Average cost of maintenance per trip | *Source:* Freight Transport Cost Analysis Survey | ACM | USD | 155.50 |
| Average cost of insurance per trip | *Source:* Freight Transport Cost Analysis Survey | ACI | USD | 27.90 |
| Actual trip time | *Source:* Freight Transport Cost Analysis Survey | ATT | Days | 2.6 |

### 6.3.5 Indirect Cost of Delay (USD)

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. The value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries[48] **Equation 9** presents the approach used to estimate the indirect costs of delay for the study sample for trucks plying the Northern Corridor and the Central Corridor.

**Equation 9: Approach to Calculation of Indirect Cost of Delay for Kenya**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x Shipment value (USD) | = | Indirect delay cost per trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 3.86 | | 3.17 | | 0.69 | | 100 | | 69 |

[47]This is less illicit costs.

[48]See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

### 6.3.6 Cost of Illicit Payments

The 'Cost of Illicit Payments' for Kenya analysis was derived using the same approach discussed in **Section 4.5**. The equation below demonstrates estimates the total illicit costs per average trip along the Northern Corridor in Kenya.

**Equation 10: Approach to the calculation of the cost of Illegal Payments in USD**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Kenya) Northern Corridor | 0.40 | + | 0.40 | + | 5.40 | + | 1.40 | = | 7.70 |

The above costs were derived from the overall costs presented In **Table 6-6**.

### 6.3.7 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade per average trip along the Northern Corridor in Kenya was calculated as follows:

**Equation 11: Overview of Calculation Approach for Total Cost of Trade for Kenya (Northern Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[49] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 833 | + | 1,339 | + | 115 | + | 69 | + | 7.7 | = | 2,364 |

[49]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

### 6.3.8 Trade Costs by Commodity Results, Kenya

In addition to an average cost per trip, the study also estimated an average cost per trip by commodity type. In the data set, the primary variance across commodity types is the mix of vehicle types used. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were summed up to create a picture of average cost by commodity basket for the sample data set.

**Equation 12:: Calculation of Cost of Trade by Commodity, Kenya Average (USD): Northern Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[50] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| VALUE BY COMMODITY | | | | | | | | | | | |
| Cement and clinker connections | 833 | + | 1,158.46 | + | 115 | + | 69 | + | 8 | = | 2,183.13 |
| Cereals, sorghum, etc. | 833 | + | 1,242.59 | + | 115 | + | 69 | + | 8 | = | 2,267.25 |
| Clay, minerals, etc. | 833 | + | 1,158.46 | + | 115 | + | 69 | + | 8 | = | 2,183.13 |
| Edible fruits: | 833 | + | 1,242.59 | + | 115 | + | 69 | + | 8 | = | 2,267.25 |
| Manufactured goods | 833 | + | 1,316.33 | + | 115 | + | 69 | + | 8 | = | 2,341.00 |
| Coffee and tea | 833 | + | 1,316.33 | + | 115 | + | 69 | + | 8 | = | 2,341.00 |
| Construction materials | 833 | + | 1,158.46 | + | 115 | + | 69 | + | 8 | = | 2,183.13 |
| Petroleum, oils etc. | 833 | + | 990.11 | + | 115 | + | 69 | + | 8 | = | 2,014.78 |

[50]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Iron steel and aluminium - raw | 833 | + | 1,293.60 | + | 115 | + | 69 | + | 8 | = 2,318.27 |
| Edible vegetables, roots and tubers | 833 | + | 1,242.59 | + | 115 | + | 69 | + | 8 | = 2,267.25 |

### 6.3.9 Trade Cost for Top 5 Most Common OD Pairs by Most Common Commodity Transported

Finally, the study also calculated a cost per trip for each of the top five major origin-destination pairs in the Kenya sample. These costs are calculated based on the most frequently observed commodity type for each routing. The costs are also estimated per kilometre based on the distances by routing indicated in the Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software.

The estimated costs range from USD 1.90 to USD 4.70 per km. the most frequently observed commodities range from the more expensive to transport foodstuff to the lower cost mineral products.

The table below shows the trade cost incurred for each of the top five common OD pairs by taking into consideration the major category of commodities transported by trucks along each route in Kenya.

**Table 6-8: Trade cost by common top 5 OD pair by commodity type transported**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average transport cost per trip (USD) | Average transport cost per km (USD/km) |
| 1 | Mombasa | Kampala | 427 | 25.3% | NC | 1,169 | Mineral products | 2,183.10 | 1.90 |
| 2 | Mombasa | Nairobi | 228 | 13.5% | NC | 485 | Foodstuff | 2,267.30 | 4.70 |
| 3 | Kampala | Mombasa | 94 | 5.6% | NC | 1,138 | Foodstuff | 2,267.30 | 2.00 |
| 4 | Nairobi | Kampala | 84 | 5.0% | NC | 657 | Textiles | 2,341.00 | 3.60 |
| 5 | Nairobi | Mombasa | 79 | 4.7% | NC | 485 | Foodstuff | 2,267.30 | 4.70 |

## 6.4 Summary of Findings and Key Barriers to Trade in Kenya

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the study pilot, were excluded, at TMEA's direction, for the full study. However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of 'not a challenge' to 'a severe challenge':

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weighbridge issues.
- Weather conditions.
- Radar speed check issues.

At the Kenya national level, the issue most often identified as a 'moderate' or 'severe' challenge was security, which concerned over 14% of drivers. The second most frequently identified issue was that of police checks.

By contrast, port, radar, and border post issues were most frequently identified as either 'not a challenge', or 'a slight challenge'.

## 6.5 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles in Kenya. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were a relatively low USD 7.70 per trip for the Kenya sample, suggesting non-monetary barriers (NTBs) might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study, did identify police checks as the most pressing item of concern for transporters. Again, this may a fruitful area for TMEA attention, including working to better understand the issue and its impacts, in the future.

# 7. UGANDA RESULTS SUMMARY

This chapter presents the results of the RAATTE Uganda Survey Analysis. Certain details on methods and sampling can be found in **Chapter 2**.This chapter focuses on the data and analysis specific to Uganda. Results for other surveyed countries can be found in the other chapters of this report. A summary of the overall regional results can be found in **Chapter 5**. This section reviews the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis and the emissions analysis. We then summarize findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 7.1 Uganda Traffic Census Results

The Uganda traffic census was carried out for a period of seven days from 9th October 2021 to 15th October, 2021 at eight counting stations across the country. The table below provides the truck traffic census analysis by station.

**Table 7-1: Detailed Ugandatraffic census results - average daily traffic (ADT)**

| Country | Station number | Node | Survey location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Uganda | 10 | Kampala | Magamaga weighbridge | 1,660 | 467 | 947 | 463 | 601 | 38 | 4,177 |
| | 11 | | Lukaya weighbridge | 1,257 | 138 | 313 | 90 | 141 | 59 | 1,998 |
| | 12 | | Mubende weighbridge | 850 | 117 | 109 | 60 | 608 | 40 | 1,783 |
| | 13 | | Luzira (Port Bell) | 535 | 216 | 162 | 27 | 6 | 3 | 950 |
| | 14 | | Wakiso | 876 | 455 | 46 | 36 | 10 | 11 | 1,434 |
| | 15 | | Luwero weighbridge | 1,071 | 242 | 277 | 193 | 114 | 24 | 1,921 |
| | 16 | Gulu | Corner Kamdini | 165 | 80 | 230 | 81 | 62 | 10 | 628 |
| | 17 | | Atiak | 215 | 104 | 182 | 115 | 28 | 4 | 650 |
| **Total** | | | | **6,629** | **1,819** | **2,266** | **1,065** | **1,572** | **190** | **13,540** |
| **Percentage** | | | | **49%** | **13%** | **17%** | **8%** | **12%** | **1%** | **100%** |

## 7.2 Assessment of primary origins and destinations and prevailing trade routes – Uganda results

### 7.2.1 OD Interviews by Truck Type

The table below shows the result of the OD Survey by truck type for Uganda. A total of 4,459 drivers were interviewed across Uganda. The survey results show that light trucks are the most prevalent freight transport vehicle (23%), followed by container trailer - 40ft(16%), container trailer - 20ft (16%), medium truck (15%), break bulk (12%), bulk trailer (9%), fuel tanker (8%) and empty truck (1%).

**Table 7-2:Composition of Uganda OD truck interviews**

| Country | Vehicle type | Frequency | Percentage |
|---|---|---|---|
| Uganda | Empty truck | 39 | 1% |
| | Fuel tanker | 335 | 8% |
| | Bulk trailer | 406 | 9% |
| | Break bulk | 529 | 12% |
| | Medium truck | 670 | 15% |
| | Container trailer (20ft) | 718 | 16% |
| | Container trailer (40ft) | 728 | 16% |
| | Light truck | 1,034 | 23% |
| **Total** | | **4,459** | **100%** |

### 7.2.2 Truck Country of Registration

The study results indicate that most of the trucks in the sample were registered in Uganda (70.2%) followed by Kenya (24.2%), South Sudan (2.8%), Rwanda (1.0%), Tanzania (0.8%), Democratic Republic of Congo (DRC) 0.4%, other countries (0.4%) and Burundi (0.2%).

**Table 7-3: Composition of Uganda OD truck interviews**

| Country | Truck country of registration | Frequency | Percentage |
|---|---|---|---|
| Uganda | Uganda | 3,132 | 70.2% |
| | Kenya | 1,078 | 24.2% |
| | South Sudan | 127 | 2.8% |
| | Rwanda | 45 | 1.0% |
| | Tanzania | 35 | 0.8% |
| | Democratic Republic of Congo (DRC) | 17 | 0.4% |
| | Other (specify) | 17 | 0.4% |
| | Burundi | 8 | 0.2% |
| **Total** | | **4,459** | **100.0%** |

### 7.2.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages. The study results showed that the mean age of the drivers was 40 years. The median age was 39 years, the mode age was 35 years, and the maximum age was 75 years.

**Table 7-4: Summary statistics of drivers' ages in Uganda**

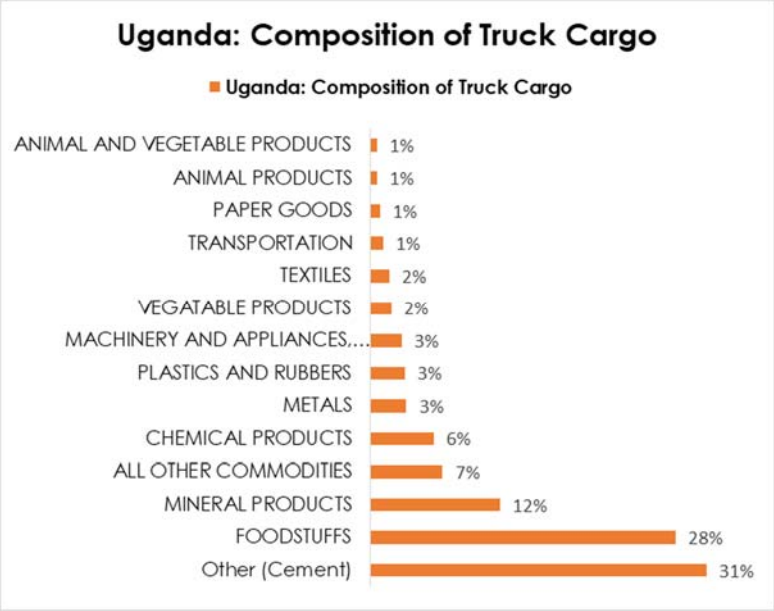
| Statistics | Value |
|---|---|
| Mean | 40.0 |
| Median | 39.0 |
| Mode | 35.0 |
| Standard deviation | 9.2 |
| Range | 56.0 |
| Minimum | 19.0 |
| Maximum | 75.0 |
| Count | 4,459.0 |

### 7.2.4 Truck Cargo Distribution

As shown in the figure below, the top five (5) most common cargo types in the Uganda sample were other products (cement) (31%) followed by foodstuffs (28%), mineral products (12%), all other commodities (7%) and chemical products (6%)[51].

[51] Fuel is included in chemical products.

**Figure 7-1: Composition of truck cargo - Uganda**




### 7.2.5 Top 10 Most Common Origin (Loading) and Destination (Discharge) Points

The survey results for Uganda include 4,060 distinct origins with the top ten (10) accounting for 91%of the overall trip origins. As shown in **Figure 7-2** below, the top 10 origins included Kampala (31%), Mombasa (15%), Nairobi (5%), Jinja_ (4%), Mbarara (2%), Eldoret (2%), Gulu (2%), Hoima (2%) and Arua (1%).

There were also 4,020 distinct destinations, with the top 10 accounting for 90% of the overall trip destinations. As shown in **Figure 7-3** below, the top ten (10) destinations included Kampala_ (28%), Juba (10%), Gulu (6%), Arua_ (4%), Jinja (4%), Hoima (3%), Mbarara_ (2%), Mombasa (2%) and Masaka (2%).

Combined, these results indicate that about two-thirds of traffic flowed between major origins and destinations, with relatively limited side traffic.

**Figure 7-2: Uganda map of the top 20 truck trip origins (point of loading)**

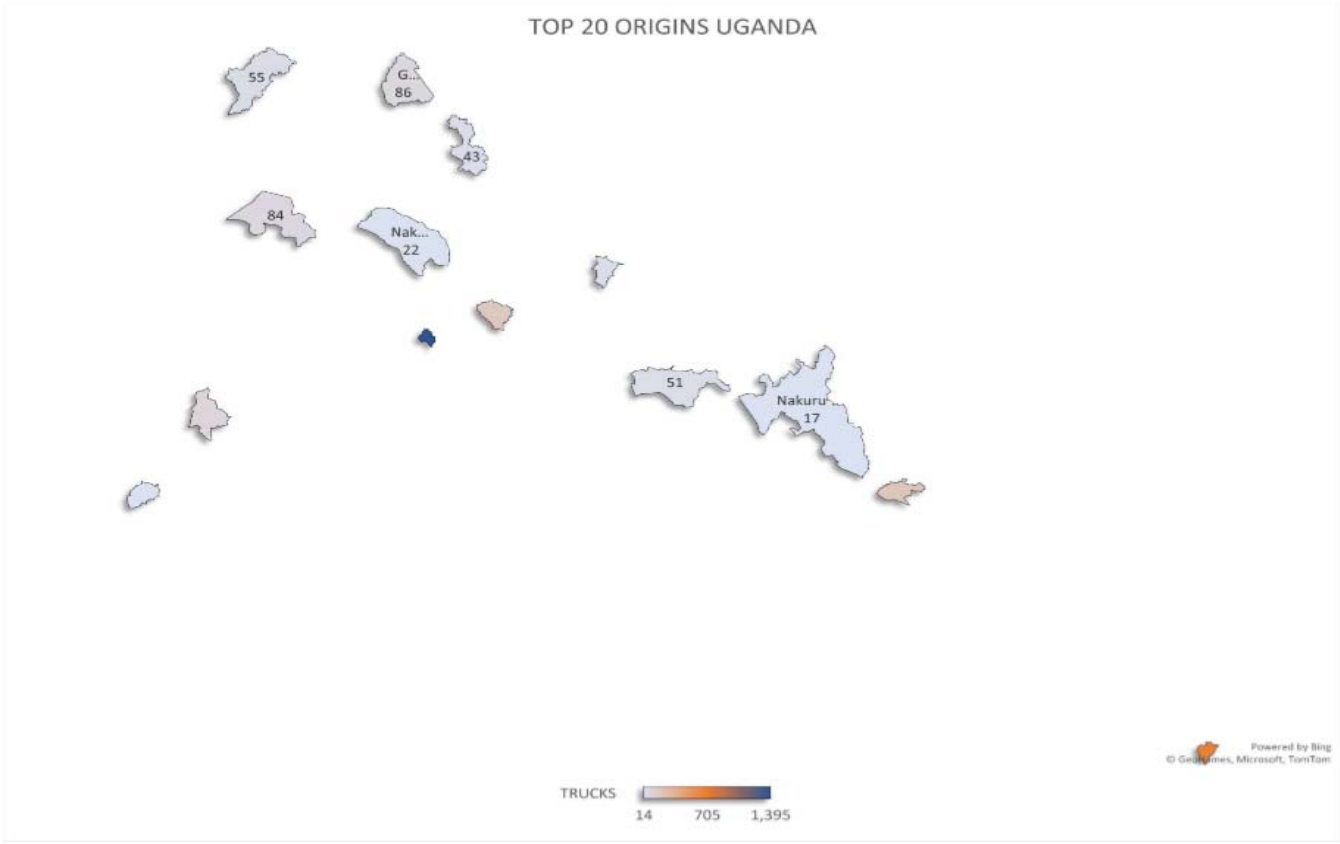
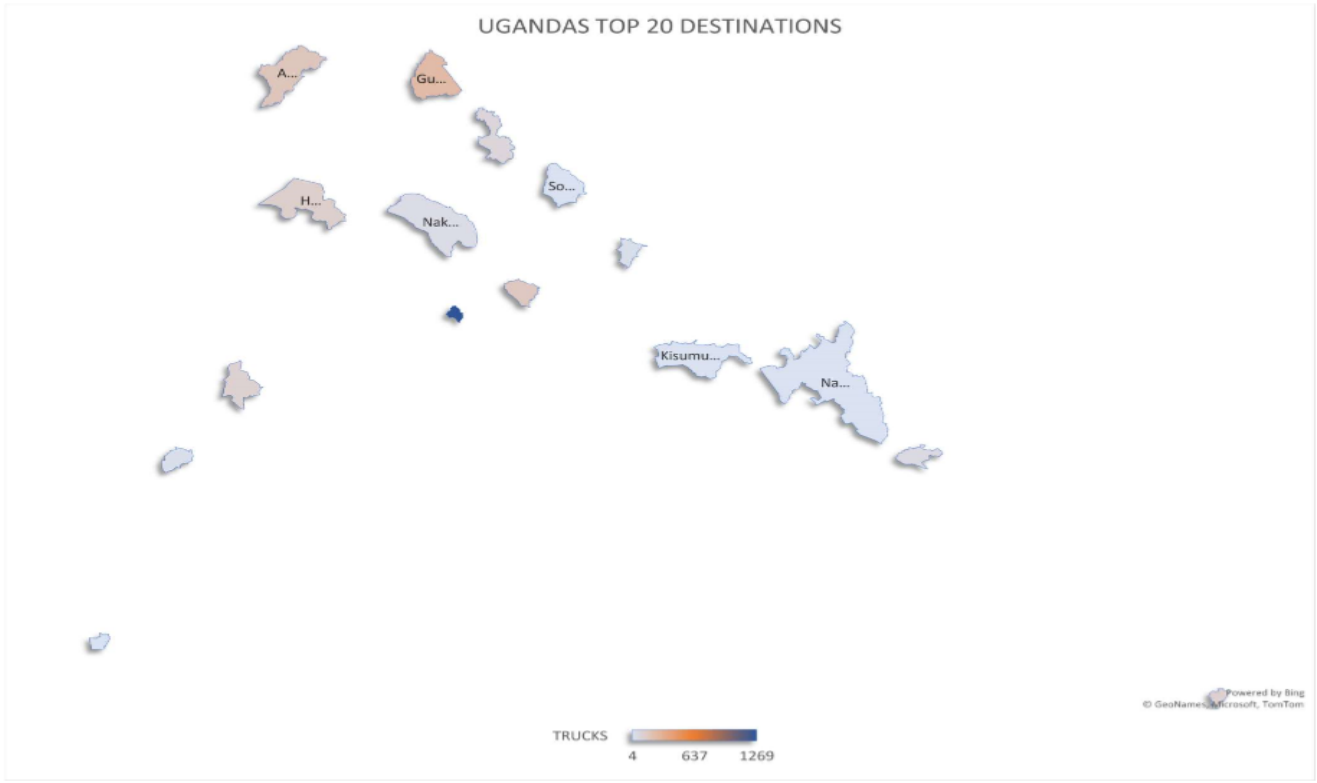


**Figure 7-3: Uganda map of the top 20 truck trip destinations (point of discharge)**



### 7.2.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most important trade routes in the Uganda were identified by analysing the origin and destination pairs which was derived from the freight origin and destination analysis. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across Uganda as shown in the table below. The table below highlights the most common commodity carried for each OD pair for trips identified in the Uganda sample.

**Table 7-5:Top 20most common origin (loading) and destination (discharge) pairs for Uganda**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Category of commodities transported by trucks number | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vegetable products | Mineral products | Foodstuff | Textiles | Chemical products | Metals | Machinery and electrical appliances | Animal and vegetable products | Animal products | Plastics and rubbers | Paper goods | Transportation |
| 1 | Mombasa | Kampala | 307 | 19.7% | NC | 1,169.0 | 3 | 60 | 57 | 21 | 48 | **61** | 28 | 7 | 3 | 26 | 6 | 10 |
| 2 | Kampala | Juba | 147 | 9.4% | NC | 635.0 | 3 | 11 | **72** | 2 | 3 | 13 | 5 | | | 5 | | 3 |
| 3 | Kampala | Arua | 136 | 8.7% | NC | 475.0 | 1 | 23 | **39** | 5 | 6 | 3 | | | 1 | 4 | | |
| 4 | Kampala | Gulu | 135 | 8.7% | NC | 334.0 | 17 | **27** | 3 | 4 | 7 | 1 | | | | 3 | | 5 |
| 5 | Mombasa | Juba | 102 | 6.6% | NC | 1,620.0 | 3 | 2 | **39** | 5 | 3 | 7 | 3 | | 1 | 4 | 2 | 2 |
| 6 | Kampala | Mbarara | 75 | 4.8% | NC | 269.4 | 1 | 3 | **38** | 1 | 11 | 5 | 1 | | 1 | 5 | 1 | 1 |
| 7 | Nairobi | Kampala | 62 | 4.0% | NC | 657.0 | 1 | 5 | **64** | 1 | 6 | 2 | 1 | | | 4 | | 3 |
| 8 | Kampala | Hoima | 60 | 3.9% | NC | 200.0 | 3 | 13 | **17** | | 5 | 2 | 6 | | 1 | 2 | | 3 |
| 9 | Kampala | Lira | 60 | 3.9% | NC | 337.0 | | 6 | **8** | | 9 | 4 | 2 | | | 6 | | 2 |
| 10 | Hoima_city | Kampala | 57 | 3.7% | NC | 200.0 | 5 | 11 | **27** | | 1 | | 1 | | | 1 | | |
| 11 | Kampala | Mombasa | 53 | 3.4% | NC | 1,169.0 | 3 | 3 | **68** | 1 | | | | 3 | 1 | 4 | | |
| 12 | Kampala | Masaka | 51 | 3.3% | NC | 131.0 | 1 | 3 | **22** | 1 | 11 | 3 | | | | 2 | | |
| 13 | Mbarara | Kampala | 50 | 3.2% | NC | 269.4 | 1 | 1 | **29** | | 1 | 1 | 1 | 2 | 3 | 1 | | |
| 14 | Mombasa | Jinja | 44 | 2.8% | NC | 1,070.0 | 1 | 10 | **12** | 2 | 14 | 6 | 4 | | 2 | 3 | 1 | 2 |
| 15 | Arua | Kampala | 41 | 2.6% | NC | 475.0 | | 2 | **28** | | | | 1 | | | | | 2 |
| 16 | Mombasa | Kigali | 40 | 2.6% | NC | 1,477.0 | 4 | 14 | **15** | 2 | 15 | 1 | 4 | | | 1 | | 1 |
| 17 | Nairobi | Kigali | 40 | 2.6% | NC | 1,167.0 | | **10** | 8 | | 8 | 6 | 3 | | | 4 | 4 | 1 |
| 18 | Eldoret | Juba | 38 | 2.4% | NC | 816.5 | | 9 | | | **18** | | | | | | | |
| 19 | Kampala | Fort_Portal | 29 | 1.9% | NC | 294.6 | | 5 | **9** | | 5 | | | | | 2 | 1 | |
| 20 | Kampala | Nakasongola | 29 | 1.9% | NC | 115.0 | | **13** | 1 | | 1 | 3 | 1 | | | 2 | | 1 |

From the table above, of the top five trips observed in Uganda three were intra-regional:

- Mombasa-Kampala (19.57%)
- Kampala-Juba (9.4%)
- Mombasa-Juba (6.6%)

The other two trips observed in the top five OD pairs were national in nature:

- Kampala-Aura (8.7%)
- Kampala-Gulu (8.7%)

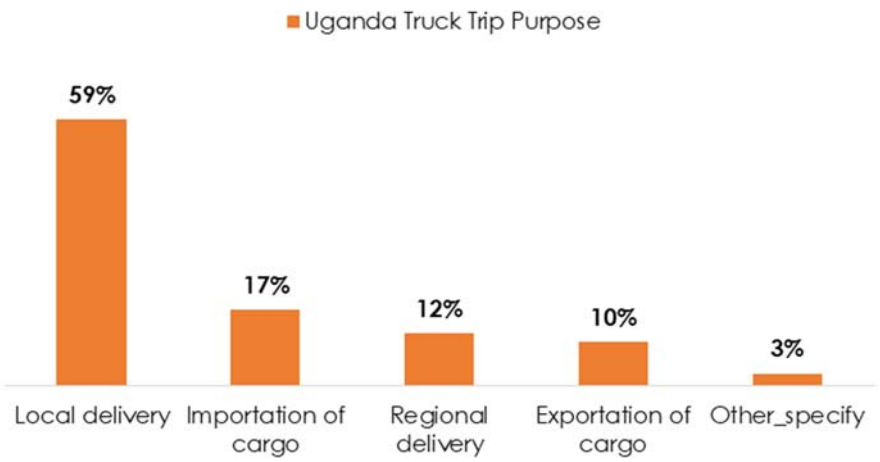
It was established that Uganda relies primarily on the Northern Corridor for international trade through the Mombasa Port in Kenya.[52]

### 7.2.7 Truck Trip Purpose

The study classified the trip purposes of trucks interviewed in Uganda. The results, in the figure below, indicate that most trips were local delivery (59%) followed by importation of cargo (17%), regional delivery (12%), exportation of cargo (10%) and other purposes (3%). With local delivery dominating truck traffic, policies and practices aimed at reducing intra-regional delay will likely impact only a fraction of overall traffic.

[52]The trade costs incurred for each of the most common OD pairs by taking into consideration the top 5 major categories of commodity transported by trucks on each route are described in the next section. (Refer to Section 7.3.9).

**Figure 7-4: Uganda Truck Trip Purpose**




## 7.3 Freight Transport Cost Analysis: Uganda Results

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. Refer to **Table 4-1** for the framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

### 7.3.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey results presented in **Section 2.4** of this report. This section will present the overall breakdown of the Uganda transport costs by vehicle type along the Northern Corridor.

#### 7.3.1.1 Breakdown of Uganda Direct Transport Costs

The figure below shows the breakdown of Uganda direct transport costs by trucks plying the Northern Corridor. The results were derived from the freight cost survey by analysing trucks identified as utilising the Northern Corridor and whose origin was Mombasa Port.

**Table 7-6: Direct Transport Costs for Uganda Analysis (USD) - Northern Corridor**

| Transport cost item | Liquid bulk tank trailer | | Container trailer/Semi | | Overall results for Uganda | |
|---|---|---|---|---|---|---|
| | Average cost | Percentage | Average cost | Percentage | Average cost | Percentage |
| Vehicle depreciation cost per trip | 215.00 | 9.3% | 245.80 | 11.0% | 243.40 | 10.9% |
| Fuel cost per trip | 537.50 | 23.4% | 675.80 | 30.2% | 665.10 | 29.7% |
| Labour (crew) for vehicle per trip | 322.50 | 14.0% | 277.60 | 12.4% | 281.00 | 12.5% |
| Maintenance and repair cost per trip | 322.50 | 14.0% | 212.30 | 9.5% | 220.80 | 9.8% |
| Tyre cost per trip | 129.00 | 5.6% | 160.60 | 7.2% | 158.20 | 7.1% |
| Management and overhead cost per trip | 279.50 | 12.2% | 228.30 | 10.2% | 232.20 | 10.4% |
| Vehicle and equipment licensing fee per trip | 107.50 | 4.7% | 93.30 | 4.2% | 94.30 | 4.2% |
| Cargo insurance costs per trip | 86.00 | 3.7% | 91.60 | 4.1% | 91.20 | 4.1% |
| Other cost per trip | 150.50 | 6.5% | 164.90 | 7.4% | 163.80 | 7.3% |
| Port authorities bribe cost per trip | 15.00 | 0.7% | 16.90 | 0.8% | 16.70 | 0.7% |
| Weighbridge authorities bribe cost per trip | 75.00 | 3.3% | 25.40 | 1.1% | 29.20 | 1.3% |
| Border control authorities bribe cost per trip | 30.00 | 1.3% | 15.80 | 0.7% | 16.90 | 0.8% |
| Police bribe cost per trip | 30.00 | 1.3% | 29.80 | 1.3% | 29.90 | 1.3% |
| **Total freight cost per trip** | **2,150.00** | | **2,150.00** | | **2,150.00** | |
| **Total bribe cost per trip** | **150.00** | | **87.90** | | **92.70** | |
| **Total transport cost per trip** | **2,300.00** | | **2,237.90** | | **2,242.70** | |

### 7.3.2 Port Costs

The port costs for Mombasa Port in the Uganda analysis were derived from **Equation 4** in **Chapter 4**.

### 7.3.3 Direct Trade Compliance Cost

The direct trade compliance costs for the Uganda analysis were derived from **Equation 4** in **Chapter 4**.

### 7.3.4 Cost of Trade Time

The 'Cost of Trade Time' for the Uganda analysis was derived using the same approach discussed in Section 4.4. For the Uganda study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tyres maintenance, insurance) based on annual total expenditures (including for delayed trips, these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the direct cost of trade time' is presented in **Equation 13**, based on the average delay with the sample (see **Table 7-7**):

**Table 7-7: Truck trip times, Uganda average**

| Trip Category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 4.25 | 4.1 | 4.42 | 6.31 | 2.19 | 161 |
| **On time trips** | 2.64 | 2.97 | 2.97 | 4.26 | 1.01 | 192 |

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here cost is calculated for the average trip in the Uganda sample.

**Equation 13: Calculation of cost of trade time for Uganda**

| Cost of time data | Formula/Source | Code | Unit | Uganda (Northern Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 112.8 |
| Trip delay (days) | | TD | Days | 0.11 |
| Route mode time (days) | Source: Freight Transport Cost Analysis Survey | RMT | Days | 2.97 |
| Direct transport cost | Source: Freight Transport Cost Analysis Survey | DTC | USD | 2,150.0[53] |
| Average cost of fuel | Source: Freight Transport Cost Analysis Survey | ACF | USD | 665.1 |
| Average cost of tires per trip | Source: Freight Transport Cost Analysis Survey | ACT | USD | 158.2 |
| Average cost of maintenance per trip | Source: Freight Transport Cost Analysis Survey | ACM | USD | 220.8 |
| Average cost of insurance per trip | Source: Freight Transport Cost Analysis Survey | ACI | USD | 91.2 |
| Actual trip time | Source: Freight Transport Cost Analysis Survey | ATT | Days | 2.64 |

[53]This is less illicit costs.

### 7.3.5 Indirect cost of delay (USD)

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. The value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries. **Equation 14**[54] presents the approach used to estimate the indirect costs of delay for the study sample for trucks plying the Northern Corridor in Uganda

**Equation 14: Approach to calculation of indirect cost of delay for Uganda**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x Shipment value (USD) | = | Indirect delay cost per trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 4.25 | - | 4.42 | | 0.17 | | 100 | | 17 |

### 7.3.6 Cost of Illicit Payments

The 'Cost of Illicit Payments' for the Uganda analysis was derived using the same approach discussed in **Section 4.5**. The equation below demonstrates the approach taken to estimate total illicit costs per trip along the Northern Corridor for Uganda transporters.

**Equation 15: Approach to the calculation of the cost of illegal payments in USD for Uganda**

| Corridor | Illicit payments at the port per trip (USD) | | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| (Uganda) Northern Corridor | 16.70 | | + | 29.20 | + | 29.90 | + | 16.90 | = | 92.70 |

The above costs were derived from the overall costs presented In **Table 7-6**.

[54]See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

### 7.3.7 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade per average trip along the Northern Corridor in Uganda was calculated as follows:

**Equation 16: Overview of calculation approach for total cost of trade for Uganda (Northern Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[55] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 833 | + | 2,263[56] | + | 115 | + | 17 | + | 92.7 | = | 3,320 |

### 7.3.8 Trade Costs by Commodity Results, Uganda

In addition to an average cost per trip, the study also estimated an average cost per trip by commodity type. In the data set, the primary variance across commodity types is the mix of vehicle types used. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were summed up to create a picture of average cost by commodity basket for the sample data set.

[55]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[56]This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time

**Equation 17: Calculation of cost of trade by commodity, Uganda average (USD) - Northern Corridor**

| Cost category | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[57] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| | | | | | VALUE BY COMMODITY | | | | | | |
| Cement and clinker connections | 833 | + | 1,477.92 | + | 115 | + | 17 | + | 93 | = | 2,535.92 |
| Cereals, sorghum, etc. | 833 | + | 1,293.00 | + | 115 | + | 140 | + | 93 | = | 2,474.00 |
| Clay, minerals, etc. | 833 | + | 1,477.92 | + | 115 | + | 140 | + | 93 | = | 4,070.92 |
| Edible fruits: | 833 | + | 1,293.00 | + | 115 | + | 140 | + | 93 | = | 3,886.00 |
| Manufactured goods | 833 | + | 1,826.22 | + | 115 | + | 140 | + | 93 | = | 4,419.22 |
| Coffee and tea | 833 | + | 1,826.22 | + | 115 | + | 140 | + | 93 | = | 4,419.22 |
| Construction materials | 833 | + | 1,477.92 | + | 115 | + | 140 | + | 93 | = | 4,070.92 |
| Petroleum, oils etc. | 833 | + | 1,586.23 | + | 115 | + | 140 | + | 93 | = | 4,179.23 |
| Iron steel and aluminium - raw | 833 | + | 1,108.78 | + | 115 | + | 140 | + | 93 | = | 3,701.78 |
| Edible vegetables, roots and tubers | 833 | + | 1,293.00 | + | 115 | + | 140 | + | 93 | = | 3,886.00 |

### 7.3.9 Trade Cost for Top 5 Most Common OD Pairs by Most Common Commodity Transported

Finally, the study also calculated a cost per trip for each of the top five major origin-destination pairs in the Uganda sample. These costs are calculated based on the most frequently observed commodity type for each routing. The costs are also estimated per kilometre based on the distances by routing indicated in the Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software.

The estimated costs range from USD 2.40 to USD 12.20 per km. The most frequently observed commodities range from the more expensive to transport mineral products to the lower cost foodstuffs and metals.

[57]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

The table below shows the trade cost incurred for each of the top five common OD pairs by taking into consideration the major category of commodities transported by trucks along each route in Uganda.

**Table 7-8: Trade cost by common top five OD pair by commodity type transported for Uganda**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average transport cost per trip (USD) | Average transport cost per km (USD/km) |
| 1 | Mombasa | Kampala | 307 | 19.7% | NC | 1,169.0 | Metals | 3,701.8 | 3.2 |
| 2 | Kampala | Juba | 147 | 9.4% | NC | 635.0 | Foodstuffs | 3,886.0 | 6.1 |
| 3 | Kampala | Arua | 136 | 8.7% | NC | 475.0 | Foodstuffs | 3,886.0 | 8.2 |
| 4 | Kampala | Gulu | 135 | 8.7% | NC | 334.0 | Mineral products | 4,070.9 | 12.2 |
| 5 | Mombasa | Juba | 102 | 6.6% | NC | 1,620.0 | Foodstuffs | 3,886.0 | 2.4 |

## 7.4 Summary of Key Barriers to Trade, Uganda

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the Pilot Study, were excluded, at TMEA's direction, for the Full Study.

However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of 'not a challenge' to 'a severe challenge':

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weigh bridge issues.
- Weather conditions.
- Radar speed check issues.

At the Uganda national level, the issue most often identified as a 'moderate' or 'severe' challenge was road conditions, which concerned almost 26% of drivers. The second most frequently identified issue was weighbridge issues, though this only concerned 6.5% of drivers.

By contrast, port, radar, and border post issues were most frequently identified as either 'not a challenge', or a 'slight challenge'.

## 7.5 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles in Uganda. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements were addressed.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were USD 92.70 per trip for the Uganda sample, around 2-3% of the average trip cost. Of these, illicit costs to police were the post significant, representing about a third of total illicit costs. This suggests that along with non-monetary non-tariff barriers (NTBs), efforts to reduce illicit payments might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study did identify road conditions as the most pressing item of concern for transporters. Again, this may be a fruitful area for TMEA's attention, including working to better understand the issue and its impacts, in the future.

# 8. TANZANIA RESULTS SUMMARY

This chapter presents the results of the RAATTE Tanzania Survey Analysis. Certain details on methods and sampling can be found in **Chapter 2**. This chapter focuses on the data and analysis specific to Tanzania Results for other surveyed countries can be found in the other chapters of this report. A summary of the overall regional results can be found in **Chapter 5**. This section reviews the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis, and the emissions analysis. We then summarize findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 8.1 Tanzania Traffic Census Results

The Tanzania traffic census was carried out for two consecutive periods of seven days. The eastern half of the country was surveyed from 31st October2021 to 6th November 2021 and the Western half from 8thNovember 2021 to 14th November, 2021. Overall, counts were collected at nine counting stations across the country. The table below provides the truck traffic census analysis by station.

**Table 8-1: Detailed Tanzania truck traffic census results: average daily traffic (ADT)**

| Country | Station number | Node | Survey Location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Tanzania | 18 | Dar es Salam | Mwandege centre | 790 | 548 | 207 | 38 | 414 | 201 | 2,197 |
| | 19 | | Mapinga centre | 542 | 564 | 299 | 65 | 156 | 5 | 1,631 |
| | 20 | | Kibaha Center - old weighbridge | 1,391 | 728 | 1,547 | 1,388 | 1,424 | 143 | 6,621 |
| | 21 | Nzega | East of Nzega roundabout | 137 | 170 | 405 | 288 | 533 | 39 | 1,572 |
| | 22 | Mwanza | East of Usagara junction | 283 | 189 | 199 | 90 | 198 | 35 | 992 |
| | 23 | Mbeya | North of Chunya bus station | 510 | 296 | 86 | 36 | 21 | 5 | 953 |
| | 24 | | 200m north of Tazara station | 1,690 | 2,326 | 1,497 | 1,677 | 1,609 | 1,615 | 10,415 |
| | 25 | | 200m east of Uyole junction | 885 | 515 | 342 | 266 | 183 | 353 | 2,543 |
| | 26 | Kigoma | Salmo oil fuel station, south of Manyovu Roundabout | 347 | 56 | 35 | 26 | 21 | 6 | 491 |
| **Total** | | | | **6,574** | **5,393** | **4,617** | **3,874** | **4,558** | **2,401** | **27,416** |
| **Percentage** | | | | **24%** | **20%** | **17%** | **14%** | **17%** | **9%** | **100%** |

## 8.2 Assessment of Primary Origins and Destinations and Prevailing Trade Routes – Tanzania Results

### 8.2.1 OD Interviews by Truck Type

The table below shows the result of OD Survey by truck type for Tanzania. A total of 4,736 drivers were interviewed across Tanzania. The survey results showed that the composition of container trailers(40ft) (21%) was the highest followed by bulk trailers (18%), light truck (14%), container trailer (20ft) (13%), fuel tankers (11%), medium truck (10%), break bulk (10%) and empty trucks (4%).

**Table 8-2: Composition of Tanzania OD truck interviews**

| Country | Vehicle type | Frequency | Percentage |
|---|---|---|---|
| Tanzania | Empty truck | 201 | 4% |
| | Break bulk | 450 | 10% |
| | Medium truck | 471 | 10% |
| | Fuel tanker | 498 | 11% |
| | Container trailer (20ft) | 638 | 13% |
| | Light truck | 640 | 14% |
| | Bulk trailer | 842 | 18% |
| | Container trailer (40ft) | 996 | 21% |
| **Total** | | **4,736** | **100%** |

### 8.2.2 Truck Country of Registration

The survey data indicate that most of the intercepted trucks were registered in Tanzania (94.3%) followed by Rwanda (2.4%), other countries (1.4%), Burundi (1.0%), Kenya (0.5%), Uganda (0.3%), Democratic Republic of Congo (DRC) (0.1%) and South Sudan (0.04%).

**Table 8-3: Composition of Tanzania OD truck interviews**

| Country | Truck country of registration | Frequency | Percentage |
|---|---|---|---|
| Tanzania | Tanzania | 4,467 | 94.3% |
| | Rwanda | 114 | 2.4% |
| | Other (specify) | 65 | 1.4% |
| | Burundi | 48 | 1.0% |
| | Kenya | 24 | 0.5% |
| | Uganda | 13 | 0.3% |
| | Democratic Republic of Congo (DRC) | 3 | 0.1% |
| | South Sudan | 2 | 0.04% |
| **Total** | | **4,736** | **100.0%** |

### 8.2.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages. The study results showed that the mean age of the drivers was 38 years. The median age was 37 years, the mode age was 35 years, and the maximum age was 72 years.

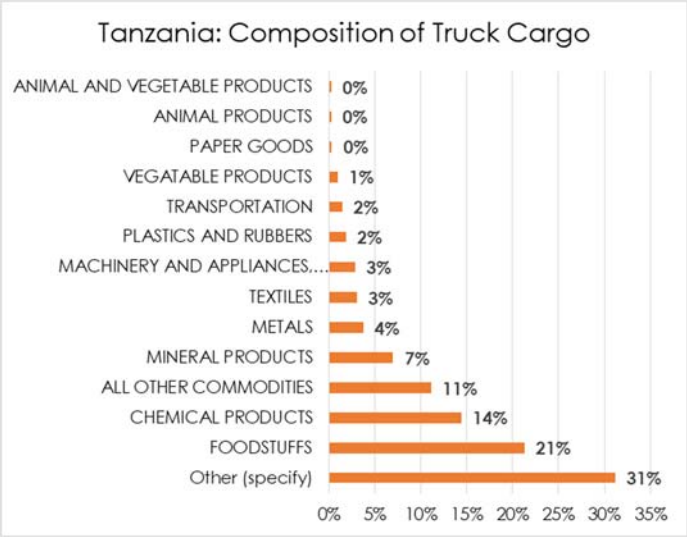
**Table 8-4: Summary statistics of drivers' age in Tanzania**

| Statistics | Value |
|---|---|
| Mean | 38.3 |
| Median | 37 |
| Mode | 35 |
| Standard deviation | 8.6 |
| Range | 53.0 |
| Minimum | 19.0 |
| Maximum | 72.0 |
| Count | 4,736.0 |

### 8.2.4 Truck Cargo Distribution

As shown in the figure below, the top five (5) most common cargo surveyed at the OD stations in Tanzania were other products (31%), foodstuffs (21%), chemical products[58] (14%), all other commodities (11%) and mineral products (7%).

**Figure 8-1: Composition of truck cargo - Tanzania**




[58] Fuel is included in chemical products.

### 8.2.5 Top 10 Most Common Origin (Loading) and Destination (Discharge) Points

The survey result for Tanzania include 4,203 distinct origins, with the top 10 accounting for 89% of the overall trip origins. As shown in **Figure 8-2** below, the top ten origins included Dar es Salaam (41%), Other (17%), Mbeya (9%), Mwanza (4%), Mtwara (4%), Tanga (3%), Bagamoyo (3%), Arusha (3%), Kigoma (2%) and Moshi (1%).

There were also 4,077 distinct destinations with the top 10 accounting for 86% of the overall trip destinations. As shown in the **Figure 8-3**, the top ten destinations included Dar es Salaam (29%), Other (27%), Mwanza (9%), Mbeya (7%), Kigoma (4%), Kigali (3%), Arusha (2%), Dodoma (2%), Bagamoyo (2%) and Tanga (2%).

These results indicate that about two-thirds of traffic flowed between major origins and destinations, but a third of traffic did flow to other, smaller destinations. The maps below indicate that traffic was fairly even spread across the country, except for a strong concentration in Dar es Salaam.

**Figure 8-2: Tanzania map of the top 20 truck trip origins (point of loading)**

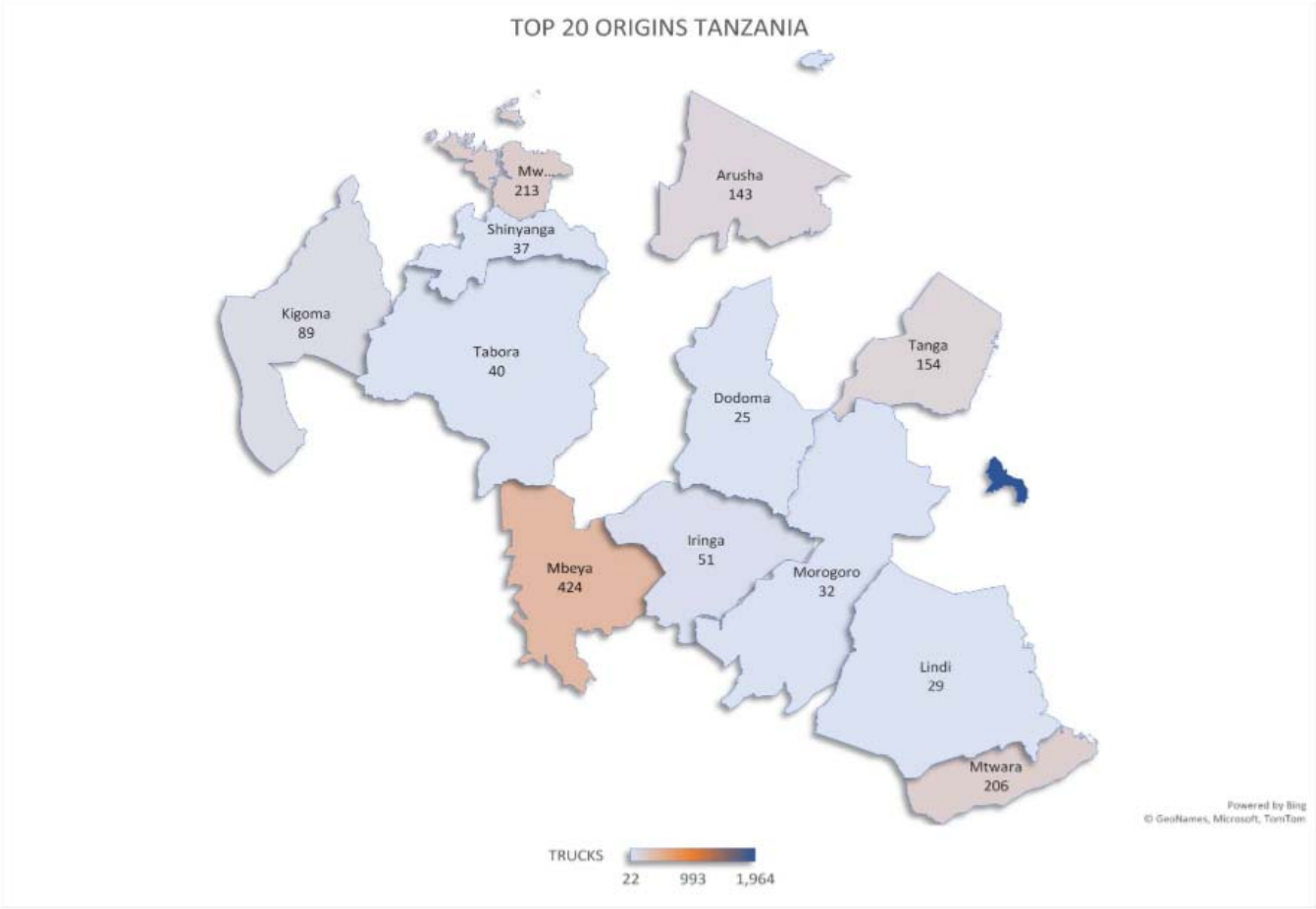
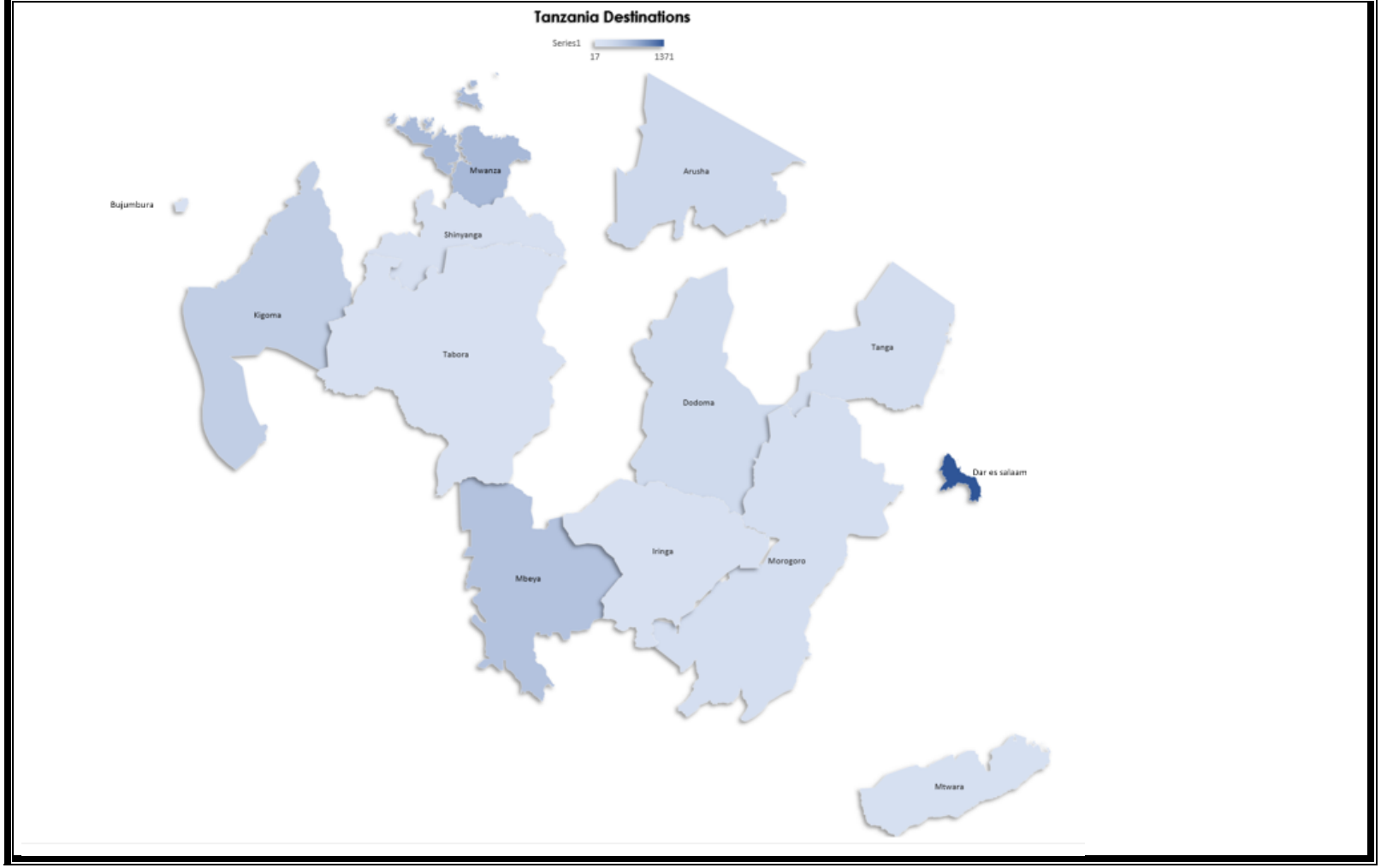


**Figure 8-3: Tanzania map of the top 20 truck trip destinations (point of discharge)**



### 8.2.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most important trade routes in the Tanzania were identified by analysing the origin and destination pairs which was derived from the freight origin and destination analysis. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across Tanzania as shown in the table below. The table highlights the most common commodity carried for each OD pair for trips identified in the Tanzania sample.

**Table 8-5: Top 20 most common origin (loading) and destination (discharge) pairs for Tanzania**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Category of commodities transported by trucks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vegetable products | Mineral products | Foodstuff | Textiles | Chemical products | Metals | Machinery and electrical appliances | Animal and vegetable products | Animal products | Plastics and rubbers | Paper goods | Transportation |
| 1 | Dar es Salaam | Mwanza | 243 | 15.1% | CC | 1,152.0 | 1 | 28 | 22 | 1 | **30** | 5 | 6 | | | 5 | 1 | |
| 2 | Mtwara | Dar es Salaam | 159 | 9.9% | CC | 556.0 | 1 | 6 | **94** | | 23 | 1 | | | | | | |
| 3 | Bagamoyo | Dar es Salaam | 118 | 7.3% | CC | 62.8 | | **53** | 7 | 2 | 7 | 7 | 4 | 1 | | 2 | | 2 |
| 4 | Arusha | Dar es Salaam | 110 | 6.8% | CC | 624.0 | 3 | 4 | **28** | 6 | 14 | 5 | 11 | 1 | 2 | 6 | | |
| 5 | Dar es Salaam | Kigali | 110 | 6.8% | CC | 1,495.0 | 18 | 66 | 50 | 13 | **57** | 25 | 8 | 2 | | 8 | 2 | 5 |
| 6 | Dar es Salaam | Arusha | 99 | 6.1% | CC | 624.0 | | | 26 | 2 | **27** | 8 | 7 | | | 3 | | 1 |
| 7 | Tanga | Dar es Salaam | 97 | 6.0% | CC | 332.0 | 3 | 10 | 5 | 1 | **46** | 5 | 3 | | | 2 | | 3 |
| 8 | Dar es Salaam | Kigoma | 86 | 5.3% | CC | 1,479.0 | | 2 | **25** | 3 | **25** | 3 | 5 | | | 1 | | 3 |
| 9 | Mbeya | Dar es Salaam | 81 | 5.0% | CC | 815.0 | 3 | | **65** | | 1 | | | 1 | | | 1 | |
| 10 | Dar es Salaam | Mbeya | 80 | 5.0% | CC | 815.0 | | 3 | **28** | 5 | 15 | 3 | 1 | 1 | | | | 3 |
| 11 | Mwanza | Dar es Salaam | 56 | 3.5% | CC | 1,152.0 | | | **15** | 2 | 1 | | 2 | | | 2 | | 2 |
| 12 | Dar es Salaam | Bagamoyo | 54 | 3.4% | CC | 63.0 | 1 | 3 | 7 | | **16** | 4 | 6 | | | | | |
| 13 | Dar es Salaam | Dodoma | 51 | 3.2% | CC | 444.3 | | | **14** | | 9 | 2 | 1 | | | 1 | 1 | |
| 14 | Dar es Salaam | Morogoro | 48 | 3.0% | CC | 187.0 | | 2 | **17** | | 8 | 3 | 2 | | | | 1 | 1 |
| 15 | Moshi | Dar es Salaam | 44 | 2.7% | CC | 543.0 | 4 | 6 | **12** | 1 | 4 | 1 | 5 | | 1 | 1 | | |
| 16 | Dar es Salaam | Tanga | 43 | 2.7% | CC | 332.0 | | 2 | **10** | 2 | 8 | 5 | 7 | | | 1 | | |
| 17 | Dar es Salaam | Tunduma | 34 | 2.1% | CC | 918.8 | | | 9 | **12** | 5 | 1 | 1 | | 1 | | | |
| 18 | Kigali | Dar es Salaam | 34 | 2.1% | CC | 1,495.0 | **1** | | | | | | | | | | | |
| 19 | Iringa | Dar es Salaam | 32 | 2.0% | CC | 491.0 | | 1 | **14** | | | | 1 | | | | | |
| 20 | Dar es Salaam | Moshi | 31 | 1.9% | CC | 543.0 | | 1 | 5 | | **12** | 1 | | | | 2 | | |

From the table above, of the top 5 trips observed in the Tanzania sample, one was international:

- Dar es Salaam-Kigali (6.8%)

The other trip observed in the top five OD pairs were national in nature. These included:

- Dar es Salaam-Mwanza (15.1%)
- Mtwara-Dar es Salaam (9.9%)
- Bagamoyo-Dar es Salaam (7.3%)
- Arusha-Dar es Salaam (6.8%)

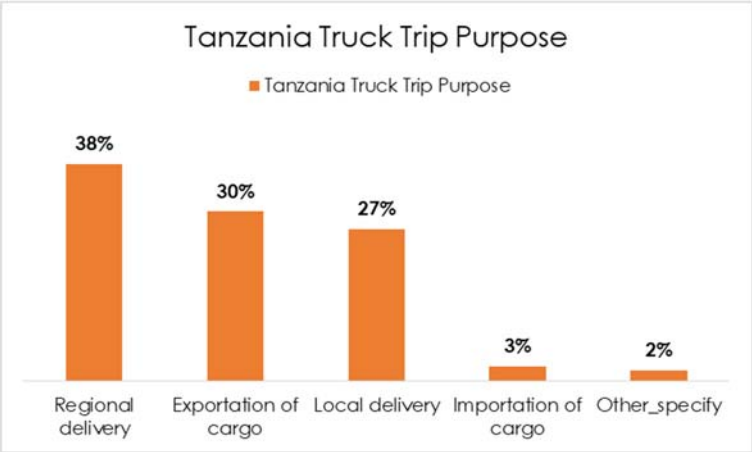
It was established that Tanzania and Rwanda rely primarily on the Central[59] Corridor for international trade through the use Dar es Salaam Port.

### 8.2.7 Truck Trip Purpose

The study classified trip purposes of trucks interviewed in Tanzania at the survey stations. The results in the figure below indicate that most trips were regional delivery (38%) followed by exportation of cargo (30%), local delivery (27%), importation of cargo (3%) and other purposes (2%). The results, with 38% of traffic moving across national boundaries, underscored the importance of Tanzania being a regional transport hub for Burundi, Democratic Republic of Congo (DRC), Rwanda and Zambia.

[59] The trade costs incurred for each of the most common OD pairs by taking into consideration the top five major categories of commodity transported by trucks on each route are presenting in the next section (see Section 8.3.9).

**Figure 8-4: Tanzania truck trip purpose**




## 8.3 Freight Transport Cost Analysis: Tanzania Results

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. Refer to **Figure 4-1**: Framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

### 8.3.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey results presented in **Section 2.4** of this report. This section will present the overall breakdown of the Tanzania transport costs by vehicle type along the Central Corridor.

#### 8.3.1.1 Breakdown of Tanzania Direct Transport Costs

The figure below shows the breakdown of Tanzania direct transport costs by trucks plying the Central Corridor. The results were derived from the freight cost survey by analysing trucks identified as utilising the Central Corridor and whose origin was Dar es Salaam Port.

**Table 8-6: Direct transport costs for Tanzania analysis (USD) - Central Corridor**

| Transport Cost Item | Break bulk | | Container Trailer/Semi | | Overall results for Tanzania | |
|---|---|---|---|---|---|---|
| | Average cost | Percentage | Average cost | Percentage | Average cost | Percentage |
| Vehicle depreciation cost per trip | 456.00 | 12.0% | 285.17 | 8.6% | 309.57 | 9.2% |
| Fuel cost per trip | 1596.00 | 42.0% | 1276.83 | 38.6% | 1322.43 | 39.2% |
| Labour (crew) for vehicle per trip | 190.00 | 5.0% | 389.58 | 11.8% | 361.07 | 10.7% |
| Maintenance and repair cost per trip | 76.00 | 2.0% | 454.17 | 13.7% | 400.14 | 11.9% |
| Tyre cost per trip | 38.00 | 1.0% | 172.50 | 5.2% | 153.29 | 4.5% |
| Management and overhead cost per trip | 760.00 | 20.0% | 280.33 | 8.5% | 348.86 | 10.3% |
| Vehicle and equipment licensing fee per trip | 38.00 | 1.0% | 118.33 | 3.6% | 106.86 | 3.2% |
| Cargo insurance costs per trip | 38.00 | 1.0% | 51.25 | 1.6% | 49.36 | 1.5% |
| Other cost per trip | 608.00 | 16.0% | 196.83 | 6.0% | 255.57 | 7.6% |
| Port authorities bribe cost per trip | 0.00 | 0.0% | 6.78 | 0.2% | 5.81 | 0.2% |
| Weighbridge authorities bribe cost per trip | 0.00 | 0.0% | 23.73 | 0.7% | 20.34 | 0.6% |
| Border control authorities bribe cost per trip | 0.00 | 0.0% | 17.32 | 0.5% | 14.84 | 0.4% |
| Police bribe cost per trip | 0.00 | 0.0% | 30.83 | 0.9% | 26.43 | 0.8% |
| **Total freight cost per trip** | **3,800.00** | | **3,225.00** | | **3,307.10** | |
| **Total bribe cost per trip** | **0.00** | | **78.70** | | **67.40** | |
| **Total transport cost per trip** | **3,800.00** | | **3,303.70** | | **3,374.60** | |

### 8.3.2 Port Costs

The port costs for Dar es Salaam Port in Tanzania analysis were derived from **Equation 5** in **Chapter 4**.

### 8.3.3 Direct Trade Compliance Cost

The direct trade compliance costs for Tanzania analysis were derived from **Equation 5** in **Chapter 4**.

### 8.3.4 Cost of Trade Time

The 'Cost of Trade Time' for Tanzania analysis was derived using the same approach discussed in **Section 4.4**. For the Tanzania study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tires, maintenance, insurance) based on annual total expenditures (including for delayed trips, these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the 'Tanzania Direct Cost of Trade Time' is presented in **Equation 18**, based on the average delay with the sample (see **Table 8-7**):

**Table 8-7: Truck trip times, Tanzania average**

| Trip Category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 3.63 | 3.5 | 3.5 | 5.54 | 1.73 | 146 |
| **On time trips** | 1.38 | 1.38 | 1.38 | 2.54 | 0.2 | 1 |

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here the cost is calculated for the average trip in the Tanzania sample.

**Equation 18: Calculation of cost of trade time for tanzania**

| Cost of time data | Formula/Source | Code | Unit | Tanzania (Central Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 138.19 |
| Trip delay (days) | | TD | Days | 0.10 |
| Route mode time (days) | *Source*: Freight Transport Cost Analysis Survey | RMT | Days | 1.38 |
| Direct transport cost | *Source:* Freight Transport Cost Analysis Survey | DTC | USD | 3,307.14[60] |
| Average cost of fuel | *Source:* Freight Transport Cost Analysis Survey | ACF | USD | 1,322.43 |
| Average cost of tires per trip | *Source:* Freight Transport Cost Analysis Survey | ACT | USD | 153.29 |
| Average cost of maintenance per trip | *Source:* Freight Transport Cost Analysis Survey | ACM | USD | 400.14 |
| Average cost of insurance per trip | *Source:* Freight Transport Cost Analysis Survey | ACI | USD | 49.36 |
| Actual trip time | *Source:* Freight Transport Cost Analysis Survey | ATT | Days | 1.38 |

### 8.3.5 Indirect cost of delay (USD)

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. Data to calculate this cost was not collected during theFull Regional Study, but the value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries **Equation 19**[61] presents the approach used to estimate the indirect costs of delay for the study sample for trucks plying the Central Corridor in Tanzania

**Equation 19: Approach to calculation of indirect cost of delay for Tanzania**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x shipment value (USD) | = | Indirect delay cost per trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 3.63 | - | 3.50 | | 0.13 | | 100 | | 13.00 |

[60]This is less illicit costs.

[61]See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

### 8.3.6 Cost of Illicit Payments

The 'Cost of Illicit Payments' for the Uganda analysis was derived using the same approach discussed in **Section 4.5**. The equation below demonstrates the approach taken to estimate total illicit costs per trip along the Central Corridor for Tanzania transporters.

**Equation 20: Approach to the calculation of the cost of illegal payments in USD for Tanzania**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Tanzania) Central Corridor | 5.80 | + | 20.30 | + | 26.40 | + | 14.80 | = | 67.40 |

The above costs were derived from the overall costs presented In **Table 8-6**.

### 8.3.7 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade per average trip along the Central Corridor in Tanzania was calculated as follows:

**Equation 21: Overview of calculation approach for total cost of trade for Tanzania (Central Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[62] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,359 | + | 3,445[63] | + | 375 | + | 13.00 | + | 67.4 | = | 5,260 |

[62]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[63]This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time

### 8.3.8 Trade Costs by Commodity Results

In addition to an average cost per trip, the study also estimated an average cost per trip by commodity type. In the dataset, the primary variance across commodity types is the mix of vehicle types used. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were summed up to create a picture of average cost by commodity basket for the sample data set.

**Equation 22: Calculation of cost of trade by commodity, Tanzania average (USD): Central Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[64] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| VALUE BY COMMODITY | | | | | | | | | | | |
| Cement and clinker connections | 1,359 | + | 2,362.77 | + | 375 | + | 13.00 | + | 67 | = | 4,177.20 |
| Cereals, sorghum, etc. | 1,359 | + | 3,049.21 | + | 375 | + | 13.00 | + | 67 | = | 4,863.64 |
| Clay, minerals, etc. | 1,359 | + | 2,362.77 | + | 375 | + | 13.00 | + | 67 | = | 4,177.20 |
| Edible fruits: | 1,359 | + | 3,049.21 | + | 375 | + | 13.00 | + | 67 | = | 4,863.64 |
| Manufactured goods | 1,359 | + | 2,631.89 | + | 375 | + | 13.00 | + | 67 | = | 4,446.32 |
| Coffee and tea | 1,359 | + | 2,631.89 | + | 375 | + | 13.00 | + | 67 | = | 4,446.32 |
| Construction materials | 1,359 | + | 2,362.77 | + | 375 | + | 13.00 | + | 67 | = | 4,177.20 |
| Petroleum, oils etc. | 1,359 | + | 1,525.79 | + | 375 | + | 13.00 | + | 67 | = | 3,340.22 |
| Iron steel and aluminium - raw | 1,359 | + | 2,444.04 | + | 375 | + | 13.00 | + | 67 | = | 4,258.46 |

[64]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Edible vegetables, roots and tubers | 1,359 | + | 3,049.21 | + | 375 | + | 13.00 | + | 67 | = | 4,863.64 |

### 8.3.9 Trade Cost for the top five most common OD pairs by most common commodity transported

Finally, the study also calculated a cost per trip for each of the top five major origin-destination pairs in the Tanzania sample. These costs are calculated based on the most frequently observed commodity type for each routing. The costs are also estimated per kilometre based on the distances by routing indicated in the Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software.

The estimated costs range from USD 2.20 to USD 66.50 per km. The most frequently observed commodities range from the more expensive to transport mineral products to the lower chemical products.

The table below shows the trade cost incurred for each of the top five common OD pairs by taking into consideration the major category of commodities transported by trucks along each route in Tanzania.

**Table 8-8: Trade cost by common top five OD pair by commodity type transported for Tanzania**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average transport cost per trip (USD) | Average transport cost per km (USD/km) |
| 1 | Dar es Salaam | Mwanza | 243 | 15.1% | CC | 1,152.0 | Chemical Products | 3,340.22 | 2.9 |
| 2 | Mtwara | Dar es Salaam | 159 | 9.9% | CC | 556.0 | Foodstuffs | 4,863.64 | 8.7 |
| 3 | Bagamoyo | Dar es Salaam | 118 | 7.3% | CC | 62.8 | Mineral Products | 4,177.20 | 66.5 |
| 4 | Arusha | Dar es Salaam | 110 | 6.8% | CC | 624.0 | Foodstuffs | 4,863.64 | 7.8 |
| 5 | Dar es Salaam | Kigali | 110 | 6.8% | CC | 1,495.0 | Chemical Products | 3,340.22 | 2.2 |

## 8.4 Summary of Key Barriers to Trade, Tanzania

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the study pilot, were excluded, at TMEA's direction, for the full study. However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of 'not a challenge' to 'a severe challenge':

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weighbridge issues.
- Weather conditions.
- Radar speed check issues.

At the Tanzanian national level, the issue most often identified as a 'moderate' or 'severe' challenge was speed radar, which concerned over 30% of drivers. The second most frequently identified issue was the road condition issue.

By contrast, border post, weather, and vehicle condition issues were most frequently identified as either 'not a challenge', or 'a slight challenge'.

## 8.5 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles in Tanzania. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were USD 67.40 per trip for the Tanzania sample, around 1-2% of the average trip cost. Of these, illicit costs to police were the post significant, representing about a third of total illicit costs. This suggests that along with non-monetary NTBs, efforts to reduce illicit payments might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study, did identify radar monitoring as the most pressing item of concern for transporters. Again, this may a fruitful area for TMEA attention, including working to better understand the issue and its impacts, in the future.

# 9. RWANDA RESULTS SUMMARY

This chapter presents the results of the RAATTE Rwanda Survey Analysis. Certain detail on methods and sampling can be found in **Chapter 2**. This chapter focuses on the data and analysis specific to Tanzania. Results for other surveyed countries can be found in the other chapters of this report. A summary of the overall regional results can be found in **Chapter 5**. This section reviews the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis, and the emissions analysis. We then summarize findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 9.1 Rwanda Traffic Census Results

The Rwanda traffic census was carried out for a period of seven days from 8th November 2021 to 14th November 2021 at two counting sites in Kigali. The section below will provide the traffic census analysis by traffic station.

**Table 9-1: Detailed Rwanda truck traffic census results - average daily traffic (ADT)**

| Country | Station number | Node | Survey location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Rwanda | 27 | Kigali | Rugende | 1,628 | 1,500 | 2,846 | 826 | 538 | 251 | 7,588 |
| | 28 | | Mjerwa | 869 | 1,702 | 866 | 429 | 381 | 68 | 4,315 |
| **Total** | | | | **2,497** | **3,202** | **3,711** | **1,255** | **919** | **318** | **11,903** |
| **Percentage** | | | | **21%** | **27%** | **31%** | **11%** | **8%** | **3%** | **100%** |

## 9.2 Assessment of Primary Origins and Destinations and Prevailing Trade Routes – Rwanda Results

### 9.2.1 OD Interviews by Truck Type

A total of 600 truck interviews were conducted during the OD Survey at Rugende and Mjerwa stations in Kigali, Rwanda. As can be observed in the table below, the study obtained a sampling rate of 1% of the total truck volume passing through the survey stations. The low sampling rate was attributed to the following factor:

- COVID-19 restrictions which requires all transit trucks carrying relief goods, transit goods, fuel and perishable goods to be escorted to the final destination free of charge.[65]

The table below shows the result of OD Survey by truck type. The survey results show that the freight vehicle composition was most represented by container trailers (40ft) at (38%) followed by fuel tankers (22%), break bulk trailers (18%), container trailers - 20ft (15%), medium trucks (4%), light trucks (3%) and bulk trailer (2%). The composition of empty trucks was low, standing at 1%.

**Table 9-2:Composition of Rwanda OD truck interviews**

| Country | Vehicle type | Frequency | Percentage |
|---|---|---|---|
| Rwanda | Empty truck | 3 | 1% |
| | Bulk trailer | 9 | 2% |
| | Light truck | 17 | 3% |
| | Medium truck | 21 | 4% |
| | Container trailer (20ft) | 88 | 15% |
| | Break bulk | 105 | 18% |
| | Fuel tanker | 129 | 22% |
| | Container trailer (40ft) | 228 | 38% |
| **Total** | | **600** | **100%** |

[65] https://www.trade.gov/country-commercial-guides/rwanda-trade-barriers

### 9.2.2 Truck Country of Registration

The study results showed that most of the trucks were registered in Rwanda (50%) followed by Tanzania (36%), Kenya (6%), Burundi (5%) and Uganda (3%). Of the trucks interviewed, a paltry (0.3%) were registered in the Democratic Republic of Congo (DRC) and (0.2%) in South Sudan.

**Table 9-3: Composition of Rwanda OD truck interviews**

| Country | Truck country of registration | Frequency | Percentage |
|---|---|---|---|
| Rwanda | Rwanda | 297 | 50% |
| | Tanzania | 216 | 36% |
| | Kenya | 37 | 6% |
| | Burundi | 31 | 5% |
| | Uganda | 15 | 3% |
| | Democratic Republic of Congo (DRC) | 2 | 0.3% |
| | Other (specify) | 1 | 0.2% |
| | South Sudan | 1 | 0.2% |
| **Total** | | **600** | |

### 9.2.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages. The study results showed that the mean age of the drivers was 39 years. The median age was 38 years, the mode age was 35 years, and the maximum age was 73 years.

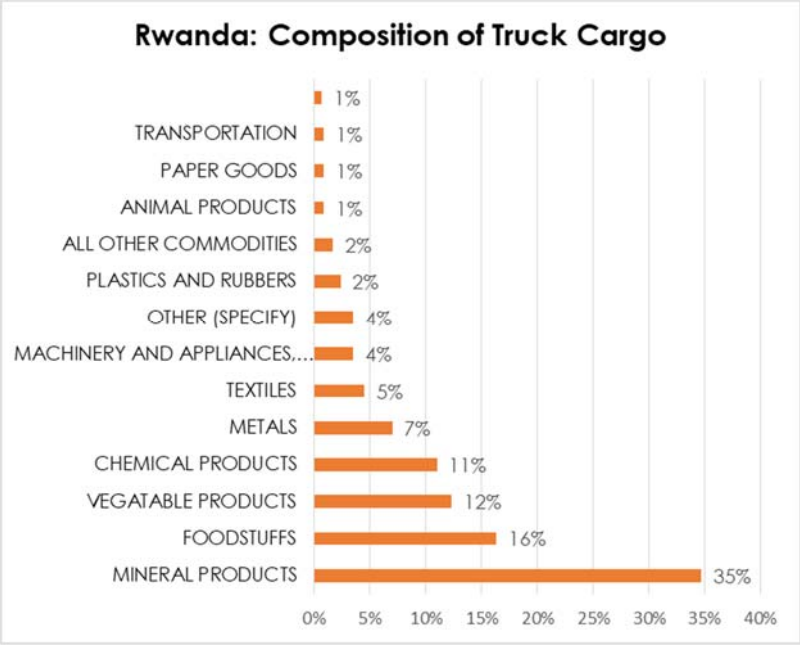
**Table 9-4: Summary statistics of drivers' age in Rwanda**

| Statistics | Value |
|---|---|
| Mean | 39.2 |
| Median | 38.0 |
| Mode | 35.0 |
| Standard deviation | 8.9 |
| Range | 54.0 |
| Minimum | 19.0 |
| Maximum | 73.0 |
| Count | 600.0 |

### 9.2.4 Truck Cargo Distribution

As shown in the figure below, the top 5 most common cargo surveyed at the OD stations in Rwanda were mineral products (35%), foodstuffs (16%), vegetable products (12%), chemical products[66] (11%) and metals (7%).

**Figure 9-1:Composition of Truck Cargo: Rwanda**




### 9.2.5 Top 10 Most Common Origin (Loading) and Destination (Discharge) Points

The survey result for Rwanda include 542 distinct origins, with the top 10 accounting for 90% of the overall trip origins. As shown in Figure 9-2 below, the top ten origins included Dar es Salaam (64%), Mombasa (5%), Kigali (5%), Nairobi (4%), Kahama (2%), Makambako (2%), Songe (2%), Sumbawanga (1%) and Tunduma (1%).

[66] Fuel is included in chemical products.

There were 582 distinct destinations, with the top 10 accounting for 97% of the overall trip destinations. As shown in Figure 9-3 below, the top ten destinations included Kigali (55%), Cyangugu (25%), Gisenyi (5%), Kicukiro (4%), Dar es Salaam (2%), Kibuye (1%), Rwamagana (1%), Byumba (0.3%) and Kigoma (0.3%). This indicates that the strong majority of traffic flowed to and from Kigali and Dar es Salaam along the Central Corridor, with a small portion flowing via the Northern Corridor to and from Mombasa, a significant shift from a decade ago.

The maps below indicate the fairly concentrated spread of traffic across the sample.

**Figure 9-2: Rwanda map of the top 20 truck trip origins (point of loading)**

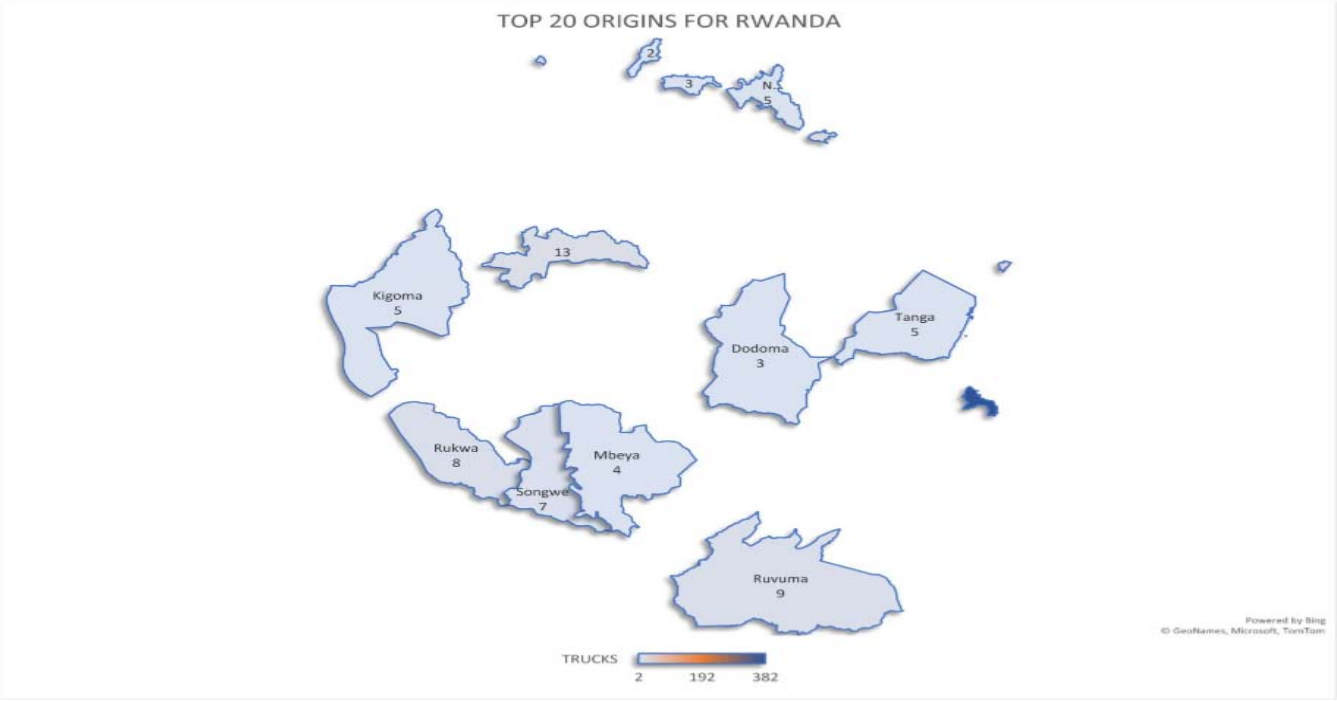
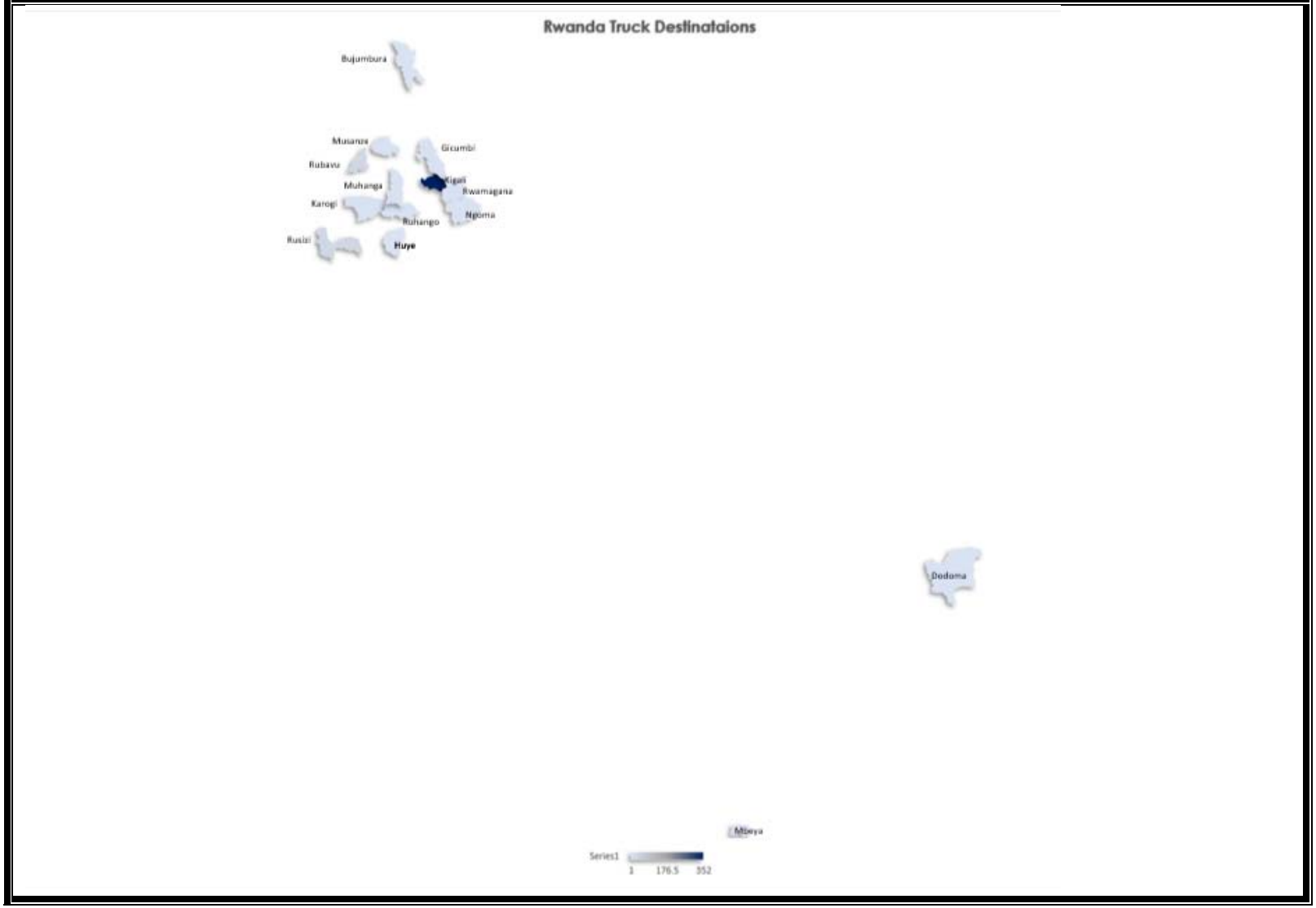


**Figure 9-3: Rwanda map of the top 20 truck trip destinations (point of discharge)**



### 9.2.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most important trade routes in Rwanda were identified by analysing the origin and destination pairs which was derived from the freight origin and destination analysis. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across Rwanda as shown in the table below. The table highlights the most common commodities carried for each OD pair for trips identified in the Rwandan sample.

**Table 9-5: Top 20 most common origin (loading) and destination (discharge) pairs for Rwanda**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road Distance (km) | Category of Commodities Transported by Trucks | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Vegetable products | Mineral products | Foodstuff | Textiles | Chemical Products | Metals | Machinery and electrical appliances | Animal and vegetable products | Animal products | Plastics and rubbers | Paper goods | Transportation |
| 1 | Dar es Salaam | Kigali | 221 | 59.4% | CC | 1,495.0 | 18 | **66** | 50 | 13 | 57 | 25 | 8 | 2 | | 8 | 2 | 5 |
| 2 | Dar es Salaam | Gisenyi | 27 | 7.3% | CC | 1,596.0 | **11** | 6 | 9 | 1 | 5 | | 2 | 1 | 1 | | | |
| 3 | Mombasa | Kigali | 21 | 5.6% | NC | 1,477.0 | 4 | 14 | **15** | 2 | **15** | 1 | 4 | | | 1 | | 1 |
| 4 | Dar es Salaam | Kicukiro | 17 | 4.6% | CC | 1,434.2 | 1 | 4 | 2 | 1 | 2 | **5** | 1 | | | | 1 | |
| 5 | Nairobi | Kigali | 14 | 3.8% | NC | 1,164.4 | | **10** | 8 | | 8 | 6 | 3 | | | 4 | 4 | 1 |
| 6 | Dar es Salaam | Cyangugu | 13 | 3.5% | CC | 1,618.2 | 2 | **4** | 3 | | | 3 | | | | 1 | | |
| 7 | Kahama | Kigali | 8 | 2.2% | CC | 453.0 | 3 | 1 | **4** | | | | | | | | | |
| 8 | Makambako | Kigali | 8 | 2.2% | CC | 1,416.0 | 1 | **3** | 2 | | 1 | | | | | | | |
| 9 | Songea | Cyangugu | 7 | 1.9% | CC | 1,711.0 | | **6** | | | 1 | | | | | | | |
| 10 | Nakuru | Kigali | 5 | 1.3% | NC | 1,001.0 | | **2** | | | 1 | | 1 | | | | | |
| 11 | Tunduma | Kigali | 5 | 1.3% | CC | 1,226.0 | 1 | | **5** | | | | | | | | | |
| 12 | Sumbawanga | Kigali | 4 | 1.1% | CC | 1,004.0 | **2** | 1 | 1 | | | | | | | | | |
| 13 | Dodoma | Kigali | 3 | 0.8% | CC | 998.5 | **1** | | **1** | | | | | | | | | |
| 14 | Kicukiro | Dar es Salaam | 3 | 0.8% | CC | 1,434.2 | | **3** | | | | | | | | | | |
| 15 | Kigali | Kibuye | 3 | 0.8% | CC | 80.0 | | **2** | | | | 1 | | | | | | |
| 16 | Kigali | Kicukiro | 3 | 0.8% | CC | 6.5 | | **1** | | | **1** | | **1** | | | | | |
| 17 | Kigali | Rwamagana | 3 | 0.8% | CC | 60.0 | **2** | | | | | | | | | | | |
| 18 | Mbeya | Kigali | 3 | 0.8% | CC | 1,162.3 | **2** | | | | 1 | | | | | | | |
| 19 | Kigali | Cyangugu | 2 | 0.5% | CC | 239.0 | | **1** | **1** | | | | | | | | | |
| 20 | Kigoma | Kigali | 2 | 0.5% | CC | 467.2 | | | **2** | | | | | | | | | |

From the table above, all the top five trips observed in Rwanda were international trips and they included:

- Dar es Salaam – Kigali (59.4%)
- Dar es Salaam-Gisenyi (7.3%)
- Mombasa-Kigali (5.6%)
- Dar es Salaam-Kicukiro (4.6%)
- Nairobi-Kigali (3.8%)

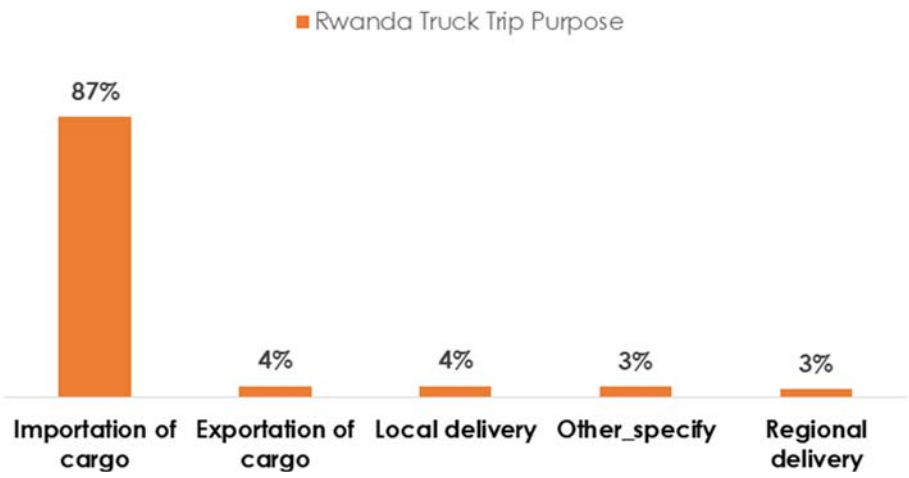
It was established that Rwanda relies on both the Central Corridor, and limited use of the Northern Corridor, for international trade through Dar es Salam Port and Mombasa Port respectively.[67]

### 9.2.7 Truck Trip Purpose

The study classified trip purposes of trucks interviewed in Rwanda at the two survey stations. The results, as shown in the figure below, depicted that most trips were importation of cargo (87%)[68]. The results also showed that very few of the truck trips were involved in exportation of cargo (4%), local delivery (4%), regional delivery (3%) and other purposes (4%). This underscored the point that Rwanda is a net importer.

[67] The trade costs incurred for each of the most common OD pairs by taking into consideration the top 5 major categories of commodity transported by trucks on each route are provided in the next section (See Section 9.3.9).
[68] We note that exportation is relatively limited in Rwanda relative to the other countries surveyed. Rwanda is a net importer. Burundi and Kenya, for example, serve as transit hubs, and hence the reason for high exportation.

**Figure 9-4: Rwanda truck trip purpose**




## 9.3 Freight Transport Cost Analysis: Rwanda Results

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. Refer to **Figure 4-4**: framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

### 9.3.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey results presented in **Section 2.4** of this report. This section will present the overall breakdown of the Rwanda transport costs by vehicle type along the Central and Northern Corridors.

#### 9.3.1.1 Breakdown of Rwanda Direct Transport Costs

The table below shows the breakdown of Tanzania direct transport costs by trucks plying the Central Corridor. The results were derived from the freight cost survey by analysing trucks identified as utilising the Central and Northern corridors and whose origin was Dar es Salaam Port and Mombasa Port respectively.

**Table 9-6: Direct transport costs for Rwanda analysis (USD) - Central Corridor**

| Transport Cost Item | Dry bulk | | Container trailer/Semi | | Overall results for Rwanda | |
|---|---|---|---|---|---|---|
| | Average cost | Percentage | Average cost | Percentage | Average cost | Percentage |
| Vehicle depreciation cost per trip | 330.00 | 7.5% | 390.50 | 8.9% | 378.40 | 8.6% |
| Fuel cost per trip | 825.00 | 18.8% | 876.50 | 20.0% | 866.20 | 19.8% |
| Labour (crew) for vehicle per trip | 165.00 | 3.8% | 184.50 | 4.2% | 180.60 | 4.1% |
| Maintenance and repair cost per trip | 495.00 | 11.3% | 362.50 | 8.3% | 389.00 | 8.9% |
| Tyre cost per trip | 495.00 | 11.3% | 425.50 | 9.7% | 439.40 | 10.0% |
| Management and overhead cost per trip | 330.00 | 7.5% | 338.50 | 7.7% | 336.80 | 7.7% |
| Vehicle and equipment licensing fee per trip | 165.00 | 3.8% | 204.00 | 4.7% | 196.20 | 4.5% |
| Cargo insurance costs per trip | 330.00 | 7.5% | 206.25 | 4.7% | 231.00 | 5.3% |
| Other costs per trip | 165.00 | 3.8% | 136.75 | 3.1% | 142.40 | 3.2% |
| Port authorities bribe cost per trip | 0.00 | 0.0% | 55.05 | 1.3% | 44.04 | 1.0% |
| Weighbridge authorities bribe cost trip | 0.00 | 0.0% | 75.45 | 1.7% | 60.36 | 1.4% |
| Border control authorities bribe cost per trip | 0.00 | 0.0% | 1.25 | 0.0% | 1.00 | 0.0% |
| Police bribe cost per trip | 5.00 | 0.1% | 131.25 | 3.0% | 106.00 | 2.4% |
| **Total freight cost per trip** | **3,300.00** | | **3,125.00** | | **3,160.00** | |
| **Total bribe cost trip** | **5.00** | | **263.00** | | **211.40** | |
| **Total transport cost per trip** | **3,305.00** | | **3,388.00** | | **3,371.40** | |

**Table 9-7: Direct transport costs for Rwanda analysis (USD) - Northern Corridor**

| Transport Cost Item | Break bulk | | Container trailer/Semi | | Overall results for Rwanda | |
|---|---|---|---|---|---|---|
| | Average Cost | Percentage | Average Cost | Percentage | Average Cost | Percentage |
| Vehicle depreciation cost per trip | 400.00 | 9.1% | 327.00 | 7.5% | 339.17 | 7.7% |
| Fuel cost per trip | 1000.00 | 22.7% | 855.00 | 19.5% | 879.17 | 20.1% |
| Labour (crew) for vehicle per Trip | 400.00 | 9.1% | 311.00 | 7.1% | 325.83 | 7.4% |
| Maintenance and Repair Cost Per Trip | 400.00 | 9.1% | 405.00 | 9.2% | 404.17 | 9.2% |
| Tyre Cost Per Trip | 200.00 | 4.5% | 616.00 | 14.1% | 546.67 | 12.5% |
| Management and Overhead Cost Per Trip | 400.00 | 9.1% | 362.00 | 8.3% | 368.33 | 8.4% |
| Vehicle and Equipment Licensing Fee Per Trip | 400.00 | 9.1% | 346.00 | 7.9% | 355.00 | 8.1% |
| Cargo Insurance Costs Per Trip | 520.00 | 11.8% | 410.00 | 9.4% | 428.33 | 9.8% |
| Other Cost Per Trip | 280.00 | 6.4% | 228.00 | 5.2% | 236.67 | 5.4% |
| Port Authorities Bribe Cost Per Trip | 124.00 | 2.8% | 167.80 | 3.8% | 160.50 | 3.7% |
| Weigh Bridge Authorities Bribe Cost Trip | 152.00 | 3.5% | 167.80 | 3.8% | 165.17 | 3.8% |
| Border Control Authorities Bribe Cost Per Trip | 24.00 | 0.5% | 43.20 | 1.0% | 40.00 | 0.9% |
| Police Bribe Cost Per Trip | 100.00 | 2.3% | 141.20 | 3.2% | 134.33 | 3.1% |
| **Total Freight Cost Per Trip** | **4,000.00** | | **3,860.00** | | **3,883.30** | |
| **Total Bribe Cost Trip** | **400.00** | | **520.00** | | **500.00** | |
| **Total Transport Cost Per Trip** | **4,400.00** | | **4,380.00** | | **4,383.30** | |

### 9.3.2 Port Costs

The port costs for Mombasa Port in Kenya and Dar es Salaam Port in Rwanda analysis were derived from **Equation 4** and **Equation 5** in **Chapter 4**.

### 9.3.3 Direct Trade Compliance Cost

The direct trade compliance costs for the Rwanda analysis were derived from **Equation 4** and **Equation 5** in **Chapter 4**.

### 9.3.4 Cost of Trade Time

The 'Cost of Trade Time' for Rwanda analysis was derived using the same approach discussed in **Section 4.4**. For the Rwanda study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tyres, maintenance, insurance) based on annual total expenditures (including for delayed trips), these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the 'Rwanda Direct Cost of Trade Time' is presented in both **Equation 23** and **Equation 24**, based on the average delay with the sample (see **Table 9-8**):

**Table 9-8: Truck Trip Times: Rwanda Average**

| Trip category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 5.24 | 5.17 | 4.21 | 7.52 | 2.95 | 158 |
| **On time trips** | 3.46 | 3.4 | 4.17 | 5.31 | 1.6 | 84 |

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here the cost is calculated for the average trip in the Rwandan sample.

**Equation 23: calculation of cost of trade time for Rwanda (Central Corridor)**

| Cost of time data | Formula/Source | Code | Unit | Rwanda (Central Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 210.17 |
| Trip delay (days) | | TD | Days | 0.17 |
| Route mode time (days) | Source: Freight Transport Cost Analysis Survey | RMT | Days | 4.17 |
| Direct transport cost | Source: Freight Transport Cost Analysis Survey | DTC | USD | 3,160.00[69] |
| Average cost of fuel | Source: Freight Transport Cost Analysis Survey | ACF | USD | 866.20 |
| Average cost of tires per trip | Source: Freight Transport Cost Analysis Survey | ACT | USD | 439.40 |
| Average cost of maintenance per trip | Source: Freight Transport Cost Analysis Survey | ACM | USD | 389.00 |
| Average cost of insurance per trip | Source: Freight Transport Cost Analysis Survey | ACI | USD | 231.00 |
| Actual trip time | Source: Freight Transport Cost Analysis Survey | ATT | Days | 3.46 |

**Equation 24: Calculation of cost of trade time for Rwanda (Northern Corridor)**

| Cost of time data | Formula/Source | Code | Unit | Rwanda (Northern Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 276.68 |
| Trip delay (days) | | TD | Days | 0.17 |
| Route mode time (days) | Source: Freight Transport Cost Analysis Survey | RMT | Days | 4.17 |
| Direct transport cost | Source: Freight Transport Cost Analysis Survey | DTC | USD | 3,883.33[70] |
| Average cost of fuel | Source: Freight Transport Cost Analysis Survey | ACF | USD | 879.17 |
| Average cost of tires per trip | Source: Freight Transport Cost Analysis Survey | ACT | USD | 546.67 |
| Average cost of maintenance per trip | Source: Freight Transport Cost Analysis Survey | ACM | USD | 404.17 |
| Average cost of insurance per trip | Source: Freight Transport Cost Analysis Survey | ACI | USD | 428.33 |
| Actual trip time | Source: Freight Transport Cost Analysis Survey | ATT | Days | 3.46 |

### 9.3.5 Indirect cost of delay (USD)

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. The value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries. **Equation 25**[71]presents the approach used to estimate the indirect costs of delay for the study sample for trucks serving Rwanda.

[69]This is less illicit costs.
[70]This is less illicit costs.
[71]See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

**Equation 25: Approach to calculation of indirect cost of delay for Rwanda**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x shipment value (USD) | = | Indirect delay cost per trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 5.24 | - | 4.21 | | 1.03 | | 100 | | 103.00 |

### 9.3.6 Cost of Illicit Payments

The 'Cost of Illicit Payments' for Rwanda analysis was derived using the same approach discussed in **Section 4.5**. The equation below demonstrates the approach taken to estimate total illicit costs per trip along the Centra lCorridor and Northern Corridor for Rwanda transporters.

**Equation 26: Approach to the calculation of the cost of illegal payments in USD for Rwanda - Central Corridor**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Rwanda) Central Corridor | 44.0 | + | 60.4 | + | 106.0 | + | 1.0 | = | 211.4 |

**Equation 27: Approach to the calculation of the cost of illegal payments in USD for Rwanda - Northern Corridor**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Rwanda) Northern Corridor | 160.5 | + | 165.2 | + | 134.3 | + | 40.0 | = | 500.0 |

The above costs were derived from the overall costs presented In **Tables 9-6** and **9-7**.

Illicit costs reported by Rwandan transport operators are markedly higher than other countries surveyed. This is a result, in part, by the average distances travelled in the Rwandan sample, which are significantly higher than other countries surveyed, and by the number of international borders crossed by trucks going to or coming from Rwanda. These differences mean that Rwandan transporters face more demands for payments, per trip than other countries sampled.

### 9.3.7 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade per average trip along the Central Corridor and the Northern Corridor for Rwanda was calculated as follows:

**Equation 28: Overview of calculation approach for total cost of trade for Rwanda - Central Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[72] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,359 | + | 3,370[73] | + | 375 | + | 103.00 | + | 211.40 | = | 5,419 |

**Equation 29: Overview of calculation approach for total cost of trade for Rwanda - Central Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[74] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|

[72]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[73]This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time
[74]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

### 9.3.8 Trade Costs by Commodity Results,

In the dataset, the primary variance across commodity types is the mix of vehicle types used. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were summed up to create a picture of average cost by commodity basket for the sample dataset.

**Equation 30: Calculation of cost of trade by commodity, Rwanda average - Central Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| | | | | | VALUE BY COMMODITY | | | | | | |
| Cement and clinker connections | 1,359 | + | 3,364.06 | + | 375 | + | 103.00 | + | 211 | = | 5,412.46 |
| Cereals, sorghum, etc. | 1,359 | + | 3,378.92 | + | 375 | + | 103.00 | + | 211 | = | 5,427.32 |
| Clay, minerals, etc. | 1,359 | + | 3,364.06 | + | 375 | + | 103.00 | + | 211 | = | 5,412.46 |
| Edible fruits: | 1,359 | + | 3,378.92 | + | 375 | + | 103.00 | + | 211 | = | 5,427.32 |
| Manufactured goods | 1,359 | + | 3,368.61 | + | 375 | + | 103.00 | + | 211 | = | 5,417.01 |
| Coffee and tea | 1,359 | + | 3,368.61 | + | 375 | + | 103.00 | + | 211 | = | 5,417.01 |
| Construction materials | 1,359 | + | 3,364.06 | + | 375 | + | 103.00 | + | 211 | = | 5,412.46 |
| Petroleum, oils etc. | 1,359 | + | 3,409.00 | + | 375 | + | 103.00 | + | 211 | = | 5,457.40 |
| Iron steel and aluminum- raw | 1,359 | + | 3,389.02 | + | 375 | + | 103.00 | + | 211 | = | 5,437.42 |
| Edible vegetables, roots and tubers | 1,359 | + | 3,378.92 | + | 375 | + | 103.00 | + | 211 | = | 5,427.32 |

**Equation 31: Calculation of cost of trade by commodity, Rwanda average (USD) - Northern Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[75] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| VALUE BY COMMODITY | | | | | | | | | | | |
| Cement and clinker connections | 833 | + | 3,928.79 | + | 115 | + | 103.00 | + | 500 | = | 5,479.79 |
| Cereals, sorghum, etc. | 833 | + | 3,964.17 | + | 115 | + | 103.00 | + | 500 | = | 5,515.17 |
| Clay, minerals, etc. | 833 | + | 3,928.79 | + | 115 | + | 103.00 | + | 500 | = | 5,479.79 |
| Edible fruits: | 833 | + | 3,964.17 | + | 115 | + | 103.00 | + | 500 | = | 5,515.17 |
| Manufactured goods | 833 | + | 3,939.60 | + | 115 | + | 103.00 | + | 500 | = | 5,490.60 |
| Coffee and tea | 833 | + | 3,939.60 | + | 115 | + | 103.00 | + | 500 | = | 5,490.60 |
| Construction materials | 833 | + | 3,928.79 | + | 115 | + | 103.00 | + | 500 | = | 5,479.79 |
| Petroleum, oils etc. | 833 | + | 4,035.79 | + | 115 | + | 103.00 | + | 500 | = | 5,586.79 |
| Iron steel and aluminium - raw | 833 | + | 3,988.20 | + | 115 | + | 103.00 | + | 500 | = | 5,539.20 |
| Edible vegetables, roots and tubers | 833 | + | 3,964.17 | + | 115 | + | 103.00 | + | 500 | = | 5,515.17 |

[75]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

### 9.3.9 Trade Cost for Top 5 Most Common OD Pairs by Most Common Commodity Transported

Finally, the study also calculated a cost per trip for each of the top five major origin-destination pairs in the Uganda sample. These costs are calculated based on the most frequently observed commodity type for each routing. The costs are also estimated per kilometre based on the distances by routing indicated in the Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software.

The estimated costs range from USD 3.40 to 4.70 per km. Mineral products were significantly less expensive per km to transport along the Central Corridor than along the Northern Corridor, which may account for the shift in corridor selection among Rwandan importers.

The table below shows the trade cost incurred for each of the top 5 common OD pairs by taking into consideration the major category of commodities transported by trucks along each route in Rwanda.

**Table 9-9: Trade cost by common top 5 OD pair by commodity type transported for Rwanda**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (Km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average transport cost per trip (USD) | Average transport cost per km (USD/km) |
| 1 | Dar es Salaam | Kigali | 221 | 59.4% | CC | 1,495.0 | Mineral Products | 5,412.46 | 3.6 |
| 2 | Dar es Salaam | Gisenyi | 27 | 7.3% | CC | 1,596.0 | Vegetable Products | 5,427.32 | 3.4 |
| 3 | Mombasa | Kigali | 21 | 5.6% | NC | 1,477.0 | Foodstuffs | 5,515.17 | 3.7 |
| 4 | Dar es Salaam | Kicukiro | 17 | 4.6% | CC | 1,434.2 | Metals | 5,437.42 | 3.8 |
| 5 | Nairobi | Kigali | 14 | 3.8% | NC | 1,164.4 | Mineral Products | 5,479.79 | 4.7 |

Note:

CC- Central Corridor

NC-Northern Corridor

## 9.4 Summary of Key Barriers to Trade, Rwanda

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the Pilot Study, were excluded, at TMEA's direction, for the Full Study. However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of 'not a challenge' to a 'severe challenge':

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weighbridge issues.
- Weather conditions.
- Radar speed check issues.

At the Rwandan national level, the issue most often identified as a 'moderate' or 'severe' challenge was police checks, which concerned over 13% of drivers. The second most frequently identified issue was that of radar speed checks.

By contrast, weather, vehicle condition, and road condition issues were most frequently identified as either 'not a challenge', or 'a slight challenge'.

## 9.5 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles in Rwanda. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements were addressed.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were USD 211.40 per trip along the Central Corridor and USD 500 along the Northern Corridor. Of these, illicit costs to weighbridge and police were the most significant. This suggests that along with non-monetary non-tariff barriers (NTBs), efforts to reduce illicit payments might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study, did identify police checks as the most pressing item of concern for transporters. Again, this may be a fruitful area for TMEA's attention, including working to better understand the issue and its impacts, in the future.

# 10. BURUNDI RESULTS SUMMARY

This chapter presents the results of the RAATTE Burundi Survey Analysis. Certain details on methods and sampling can be found in **Chapter 2**. This chapter focuses on the data and analysis specific to Burundi results. The other surveyed countries can be found in the other chapters of this report. A summary of the overall regional results can be found in **Chapter 5**. This section reviews the survey locations, the vehicle type counts from the census, the origin and destination analysis arising from the OD Survey, the freight transport cost analysis, and the emissions analysis. We then summarize findings and assess any barriers to trade identified that TMEA might choose to consider during future programming efforts.

## 10.1 Burundi Traffic Census Results

The Burundi traffic census was carried out for a period of seven days from 31st October 2021 to 6th November 2021 at one counting site located in Bujumbura – the Nthangwa City oil traffic station in Bujumbura. The section below provides the traffic census analysis for that station.

The traffic census results at Nthangwa City oil traffic station along the Bugarama-Bujumbura road yielded a total average daily truck traffic (ADT) of 437[76]. The table below provides a breakdown of vehicles captured during the traffic census at Nthangwa City oil station in Bujumbura.

[76] Representing freight vehicles only.

**Table 10-1: Detailed Burundi truck traffic census results, average daily Traffic (ADT), freight vehicles**

| Country | Station number | Node | Survey location | Light truck/LGV | Medium/Heavy truck | Container trailer | Fuel tanker | Break bulk trailer | Bulk trailer | Total truck traffic |
|---|---|---|---|---|---|---|---|---|---|---|
| Burundi | 29 | Bujumbura | Station Ntahangwe City Oil | 243 | 67 | 64 | 31 | 17 | 15 | 437 |
| **Total** | | | | **243** | **67** | **64** | **31** | **17** | **15** | **437** |
| **Percentage** | | | | **56%** | **15%** | **15%** | **7%** | **4%** | **3%** | **100%** |

## 10.2 Assessment of Primary Origins and Destinations and Prevailing Trade Routes – Burundi Results

### 10.2.1 OD Interviews by Truck Type

A total of 281 truck interviews were conducted during the OD Survey at Ntahangwe City oil station in Bujumbura. The study obtained a sampling rate of 21% of the total truck volume passing through the survey station. The table below shows the OD Survey count by truck type. The vehicle type composition results show that container trailers (40ft) were most prevalent at (29%) followed by fuel tankers (20%), break bulk trailers (14%), empty trucks (12%), light trucks (10%) and container trailers (20ft) (9%). The prevalence of medium trucks (4%) and bulk trailers (2%) was the lowest.

**Table 10-2:Composition of Burundi OD truck interviews**

| Country | Vehicle type | Frequency | Percentage |
|---|---|---|---|
| Burundi | Bulk trailer | 6 | 2% |
| | Medium truck | 11 | 4% |
| | Container trailer (20ft) | 25 | 9% |
| | Light truck | 27 | 10% |
| | Empty truck | 34 | 12% |
| | Break bulk | 39 | 14% |
| | Fuel tanker | 57 | 20% |
| | Container trailer (40ft) | 82 | 29% |
| **Total** | | **281** | **100%** |

### 10.2.2 Truck Country of Registration

The study results indicate that most of the trucks were registered in Burundi (72%) followed by Tanzania (24%), Uganda (3%) and Kenya (1%). A paltry 0.4% of the trucks were registered in other countries including the Democratic Republic of Congo (DRC) and Rwanda.

**Table 10-3: Composition of Burundi OD truck interviews**

| Country | Truck country of registration | Frequency | Percentage |
|---|---|---|---|
| Burundi | Burundi | 202 | 72% |
| | Tanzania | 68 | 24% |
| | Uganda | 8 | 3% |
| | Kenya | 2 | 1% |
| | Other | 1 | 0.4% |
| **Total** | | **281** | **100.0%** |

### 10.2.3 Drivers' Age

The table below provides the summary statistics of the drivers' ages. The study results showed that the mean age of the drivers was 39 years. The median age was 38 years, the mode age was 35 years, and the maximum age was 74 years.

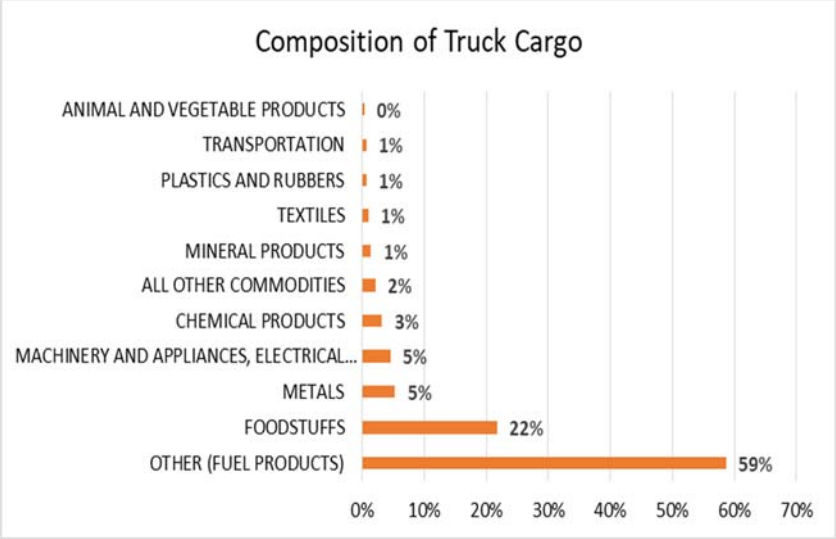
**Table 10-4: Summary statistics of drivers' age in Burundi**

| Statistics | Value |
|---|---|
| Mean | 39 |
| Median | 38.0 |
| Mode | 35.0 |
| Standard deviation | 9.5 |
| Range | 53.0 |
| Minimum | 21.0 |
| Maximum | 74.0 |
| Count | 281.0 |

### 10.2.4 Truck Cargo Distribution

As shown in the figure below, the majority of the cargo identified during the survey at the OD station was other products, mainly fuel products (59%,) followed by foodstuffs (22%), metals (5%), machinery and appliances (5%), chemical products[77] (3%) and all other commodities (2%).

**Figure 10-1: Composition of tuck cargo - Burundi**




[77] Fuel is included in chemical products.

### 10.2.5 Top 10 Most Common Origin (Loading) and Destination (Discharge) Points

The survey results for Burundi include 260 distinct origins, with the top 10 accounting for 93% of the overall trip origins. As shown in **Figure 10-2** below, the top ten origins included Dar es Salaam (40%), Bujumbura (23%), other countries (19%), Arua (1.8%), Kampala (1.8%), Makamba (1.4%), Muyinga (1.4%), Bururi (1.1%) and Ngozi (1.1%).

The survey results recorded 274 distinct destinations with the top 10 accounting for 98% of the overall trip destinations. As shown in **Figure 10-3** below, the top ten destinations included Bujumbura (67%), Other Countries (19%), Dar es Salaam (6%), Gitega (1.4%), Kayanza (1.1%), Ngozi (1.1%), Bubanza (0.4%), Bururi (0.4%) and Cankuzo (0.4%).

The maps below demonstrate a distribution of traffic that has concentrations in Bujumbura and at the Port of Dar.

**Figure 10-2: Burundi map of the top 20 truck trip origins (point of loading)**

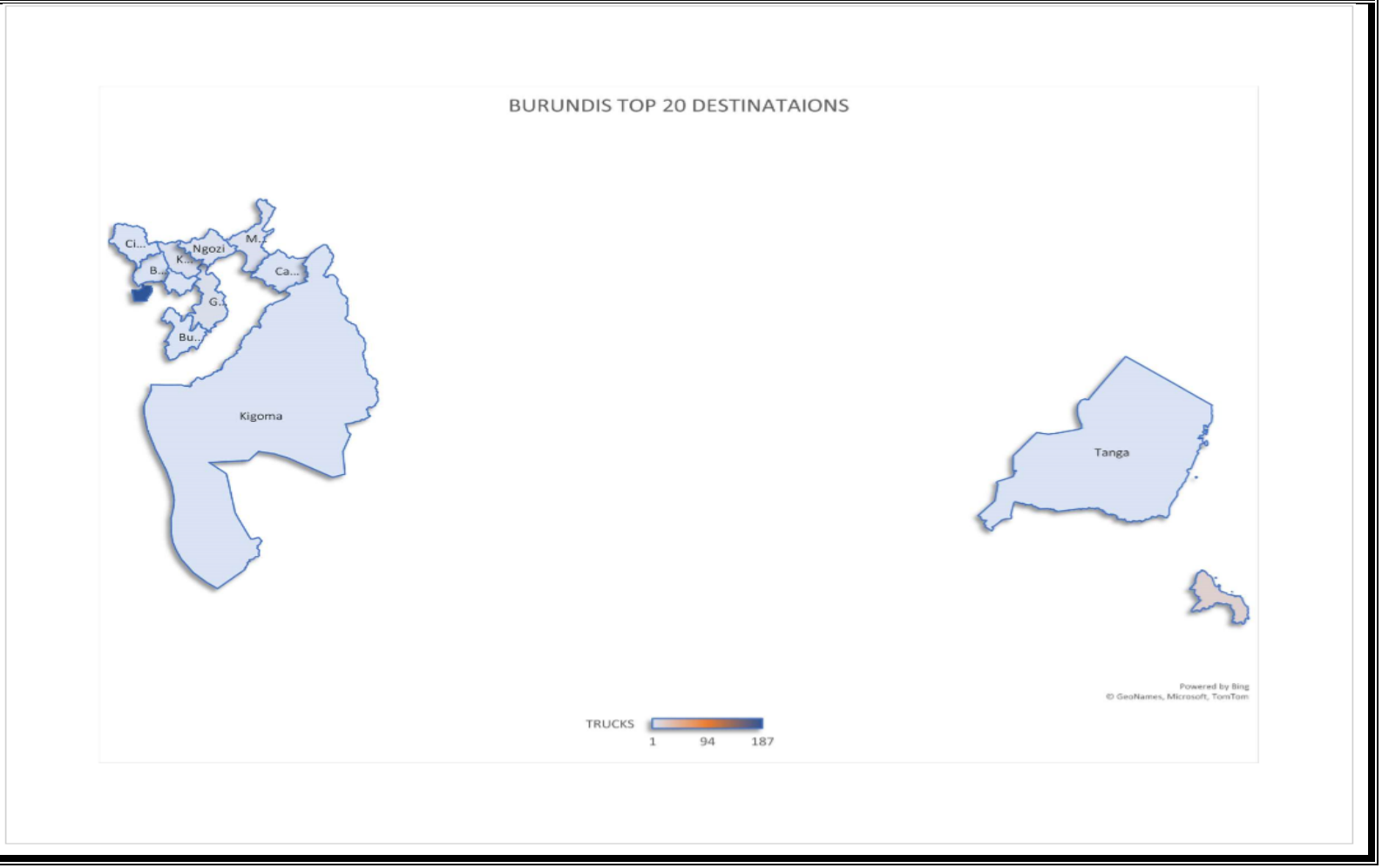


**Figure 10-3: Burundi map of the top 20 truck trip destinations (point of discharge)**

### 10.2.6 Most Common Origin (Loading) and Destination (Discharge) Pairs

The most important trade routes in Burundi were identified by analysing the origin and destination pairs which was derived from the freight origin and destination analysis. The study team summarized the top 20 OD pairs and the major categories of commodities being transported by trucks observed across Burundi as shown in the table below. The table highlights the most common commodity carried for each OD pair for trips identified in the Burundi sample.

**Table 10-5: Top 20 most common origin (loading) and destination (discharge) pairs for Burundi**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Category of commodities transported by trucks | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Mineral products | Foodstuffs | Textiles | Chemical products | Metals | Machinery and electrical appliances | Animal and vegetable products | Animal products | Plastics and rubbers | Paper goods | Transportation |
| 1 | Dar es Salaam | Bujumbura | 107 | 60.8% | CC | 1,494.0 | 1 | **12** | 3 | 2 | 11 | 2 | | | | | 2 |
| 2 | Bujumbura | Dar es Salaam | 14 | 8.0% | CC | 1,494.0 | | 2 | | 1 | | **4** | 1 | | | | |
| 3 | Arua | Bujumbura | 5 | 2.8% | NC | 1,190.2 | | 1 | | | | | | | | | |
| 4 | Gitega | Bujumbura | 5 | 2.8% | CC | 98.9 | | **3** | | | | | | | | | |
| 5 | Kampala | Bujumbura | 5 | 2.8% | NC | 722.0 | | | | | 1 | **1** | | | 1 | | |
| 6 | Bujumbura | Gitega | 4 | 2.3% | CC | 98.9 | | **3** | | 1 | | | | | | | |
| 7 | Makamba | Bujumbura | 4 | 2.3% | CC | 164.3 | | **4** | | | | | | | | | |
| 8 | Muyinga | Bujumbura | 4 | 2.3% | CC | 201.0 | | **4** | | | | | | | | | |
| 9 | Bujumbura | Muyinga | 3 | 1.7% | CC | 201.0 | | **1** | | | 1 | | | | | | |
| 10 | Bujumbura | Ngozi | 3 | 1.7% | CC | 124.6 | | **1** | | 1 | | | | | 1 | | |
| 11 | Ngozi | Bujumbura | 3 | 1.7% | CC | 124.6 | | **3** | | | | | | | | | |
| 12 | Rutana | Bujumbura | 3 | 1.7% | CC | 141.1 | | **3** | | | | | | | | | |
| 13 | Bubanza | Bujumbura | 2 | 1.1% | CC | 41.4 | | **2** | | | | | | | | | |
| 14 | Bujumbura | Kayanza | 2 | 1.1% | CC | 92.0 | | **1** | | | | | | | | | |
| 15 | Bururi | Bujumbura | 2 | 1.1% | CC | 132.0 | 1 | **1** | | | | | | | | | |
| 16 | Kayanza | Bujumbura | 2 | 1.1% | CC | 92.0 | | **1** | | | | | | | | | |
| 17 | Kirundo | Bujumbura | 2 | 1.1% | CC | 197.0 | | **2** | | | | | | | | | |
| 18 | Mombasa | Bujumbura | 2 | 1.1% | NC | 1,515.0 | | **2** | | | | | | | | | |
| 19 | Muramvya | Bujumbura | 2 | 1.1% | CC | 48.0 | | **1** | | | | | | | | | |
| 20 | Tanga | Bujumbura | 2 | 1.1% | CC | 1,567.0 | **1** | | | **1** | | | | | | | |

From the table above, four of the top five trips observed in Burundi were international trips and they included:

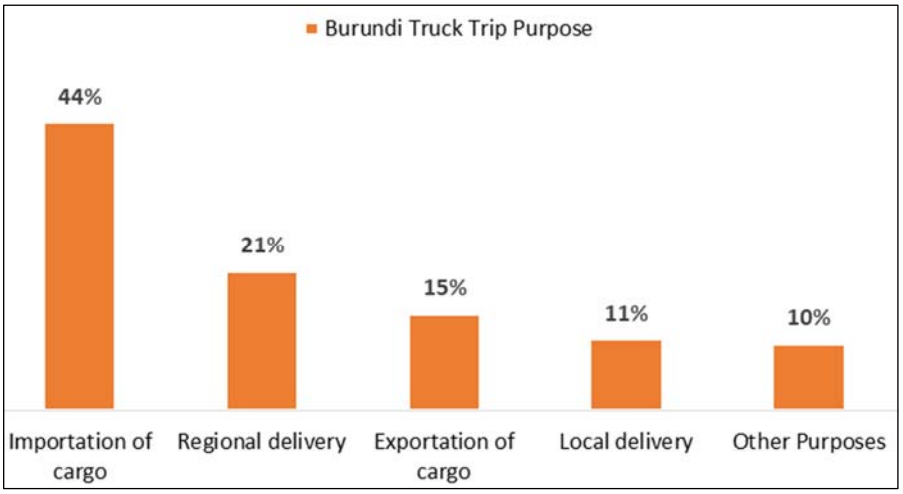
- Dar es Salaam – Bujumbura (60.8%)
- Bujumbura-Dar es Salaam (8.0%)
- Aura City – Bujumbura (2.8%)
- Kampala-Bujumbura (2.8%)

It was established that Burundi relies on the Central Corridor and the Northern Corridor for international trade through the use Dar es Salaam Port and trade with Uganda, respectively.[78]

### 10.2.7 Truck Trip Purpose

The study classified trip purposes of trucks interviewed in Burundi at the survey station. The results as shown in the figure below indicate that most trips were importation of cargo (44%) followed by regional delivery (21%), exportation of cargo (15%), local delivery 11% and other purposes at 10%. This underscores the point that Burundi is a net importer.

**Figure 10-4: Burundi Truck Trip Purpose**




[78] The trade costs incurred for each of the most common OD pairs by taking into consideration the top 5 major categories of commodity transported by trucks on each route are reported in the next section (see Section 9.3.9).

## 10.3 Freight Transport Cost Analysis - Burundi Results

The study team employed the TMEA framework of trade costs that defines trade costs as a sum of port costs, direct transport costs, direct compliance costs, cost of trade time and illicit costs. Refer to **Figure 4-4**: Framework along with sources of data for the calculation of trade costs. It also shows excluded costs based on the TMEA definition of trade costs.

### 10.3.1 Direct Transport Cost

The direct transport cost results were derived from the freight cost survey results presented in **Section 2.4** of this report. This section will present the overall breakdown of the Burundi transport costs by vehicle type along the Central Corridor and the Northern Corridor.

### 10.3.2 Breakdown of Burundi Direct Transport Costs

The table below shows the breakdown of Burundi direct transport costs by trucks plying the Central Corridor and the Northern Corridor. The results were derived from the freight cost survey by analysing trucks plying the Central Corridor and the Northern Corridor whose origin was Dar es Salaam Port and Uganda[79] respectively.

[79]Uganda serves as hub to Burundi. Most of the goods heading to Uganda from Mombasa Port comprises of transit traffic to Burundi.

**Table 10-6: Direct transport costs for Burundi analysis (USD)**

| Transport Cost Item | Northern Corridor | | Central Corridor | | Overall Results for Burundi | |
|---|---|---|---|---|---|---|
| | Container trailer/Semi | | Container trailer/Semi | | | |
| | Average cost | Percentage | Average cost | Percentage | Average cost | Percentage |
| Vehicle depreciation cost per trip | 570.00 | 28.5% | 275.71 | 11.3% | 312.50 | 13.1% |
| Fuel cost per trip | 1,045.00 | 52.2% | 1,314.29 | 53.7% | 1,280.63 | 53.6% |
| Labour (crew) for vehicle per trip | 57.00 | 2.8% | 171.14 | 7.0% | 156.88 | 6.6% |
| Maintenance and repair cost per trip | 95.00 | 4.7% | 159.71 | 6.5% | 151.63 | 6.3% |
| Tyre cost per trip | 38.00 | 1.9% | 144.00 | 5.9% | 130.75 | 5.5% |
| Management and overhead cost per trip | 0.00 | 0.0% | 124.86 | 5.1% | 109.25 | 4.6% |
| Vehicle and equipment licensing fee per trip | 76.00 | 3.8% | 95.43 | 3.9% | 93.00 | 3.9% |
| Cargo insurance costs per trip | 19.00 | 0.9% | 36.57 | 1.5% | 34.38 | 1.4% |
| Other cost per trip | 0.00 | 0.0% | 78.29 | 3.2% | 68.50 | 2.9% |
| Port authorities bribe cost per trip | 85.00 | 4.2% | 8.57 | 0.4% | 18.13 | 0.8% |
| Weighbridge authorities bribe cost trip | 15.00 | 0.8% | 5.71 | 0.2% | 6.88 | 0.3% |
| Border control authorities bribe cost per trip | 0.00 | 0.0% | 0.71 | 0.0% | 0.63 | 0.0% |
| Police bribe cost per trip | 0.00 | 0.0% | 32.14 | 1.3% | 28.13 | 1.2% |
| **Total freight cost per trip** | **1,900.00** | | **2,400.00** | | **2,337.50** | |
| **Total bribe cost trip** | **100.00** | | **47.10** | | **53.80** | |
| **Total transport cost per trip** | **2,000.00** | | **2,447.10** | | **2,391.30** | |

### 10.3.3 Port Costs

The port costs for Mombasa Port in Kenya and Dar es Salaam Port for the Burundi analysis were derived from **Equation 4** and **Equation 5** in **Chapter 4**.

### 10.3.4 Direct Trade Compliance Cost

The direct trade compliance costs for Burundi analysis were derived from **Equation 4** and **Equation 5** in **Chapter 4**.

### 10.3.5 Cost of Trade Time

The 'Cost of Trade Time' for the Burundi analysis was derived using the same approach discussed in **Section 4.4**. For the Burundi study, the team collected information on the frequency of delay within the sample and the direct cost implications of that delay. As the overall trip cost presented above includes these direct costs (labour, tyres, maintenance, insurance) based on annual total expenditures (including for delayed trips, these costs are not also added into the overall trade cost estimate. The formula which was used in the study for calculating the 'Burundi Direct Cost of Trade Time' is presented in **Equation 32** and **33**, based on the average delay with the sample (see **Table 10-7**):

**Table 10-7: Truck trip times – Burundi average**

| Trip Category | Mean trip time (days) | Median trip time | Mode trip time | Upper control limit (1σ) | Lower control limit (1σ) | Count |
|---|---|---|---|---|---|---|
| **Delayed trips** | 4.85 | 4.36 | 4.08 | 7.05 | 2.64 | 57 |
| **On time trips** | 3.41 | 3.5 | 3.5 | 5.26 | 1.57 | 53 |

A delayed trip is considered as any trip whose time > Survey mean + 1σ. Here the cost is calculated for the average trip in the Burundian sample.

### Equation 32: Calculation of cost of trade time for Burundi - Central Corridor

| Cost of time data | Formula/Source | Code | Unit | Burundi (Central Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 19.17 |
| Trip delay (days) | | TD | Days | 0.03 |
| Route mode time (days) | Source: Freight Transport Cost Analysis Survey | RMT | Days | 3.5 |
| Direct transport cost | Source: Freight Transport Cost Analysis Survey | DTC | USD | 2,400.00[80] |
| Average cost of fuel | Source: Freight Transport Cost Analysis Survey | ACF | USD | 1,314.29 |
| Average cost of tires per trip | Source: Freight Transport Cost Analysis Survey | ACT | USD | 144.00 |
| Average cost of maintenance per trip | Source: Freight Transport Cost Analysis Survey | ACM | USD | 159.71 |
| Average cost of insurance per trip | Source: Freight Transport Cost Analysis Survey | ACI | USD | 36.57 |
| Actual trip time | Source: Freight Transport Cost Analysis Survey | ATT | Days | 3.41 |

### Equation 33: Calculation of cost of trade time for Burundi - Northern Corridor

| Cost of time data | Formula/Source | Code | Unit | Burundi (Northern Corridor) |
|---|---|---|---|---|
| Direct cost of trade time per trip | | DCTT | USD | 18.08 |
| Trip delay (days) | | TD | Days | 0.03 |
| Route mode time (days) | Source: Freight Transport Cost Analysis Survey | RMT | Days | 3.5 |
| Direct transport cost | Source: Freight Transport Cost Analysis Survey | DTC | USD | 1,900.00[81] |
| Average cost of fuel | Source: Freight Transport Cost Analysis Survey | ACF | USD | 1,045.00 |
| Average cost of tires per trip | Source: Freight Transport Cost Analysis Survey | ACT | USD | 38.00 |
| Average cost of maintenance per trip | Source: Freight Transport Cost Analysis Survey | ACM | USD | 95.00 |
| Average cost of insurance per trip | Source: Freight Transport Cost Analysis Survey | ACI | USD | 19.00 |
| Actual trip time | Source: Freight Transport Cost Analysis Survey | ATT | Days | 3.41 |

#### 10.3.6 Indirect cost of delay (USD)

However, there is an "indirect cost of trade time" that is not already accounted for in the transport cost analysis. These costs include the cost of carrying debt additional time, prior to settlement, the cost of additional stocks needed to manage uncertainties regarding delivery schedules, among other things. The value can be estimated based on prior studies. This cost is estimated to be about 0.5% of shipment value per day delay for non-landlocked countries. **Equation 34**[82] presents the approach used to estimate the indirect costs of delay for the study sample for trucks serving Burundi.

[80]This is less illicit costs.

[81]This is less illicit costs.

[82]See for example, Hummels and Schaur, Time as a Trade Barrier, Working Paper 17758, National Bureau of Economic Research

**Equation 34: Approach to calculation of indirect cost of delay for Burundi**

| Average time per trip (days) | - | Mode time per trip (days) | = | Average delay per trip (days) | x | Indirect cost rate x shipment value (USD) | = | Indirect delay cost per trip (USD) |
|---|---|---|---|---|---|---|---|---|
| 4.85 | - | 4.08 | | 0.77 | | 100 | | 77.00 |

### 10.3.7 Cost of Illicit Payments

The "Cost of Illicit Payments" for the Burundi analysis was derived using the same approach discussed in **Section 4.5**. The equation below demonstrates the approach taken to estimate total illicit costs per trip along the Central Corridor and Northern Corridor for Burundi transporters.

**Equation 35: Approach to the calculation of the cost of illegal payments in USD for Burundi - Central Corridor**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Burundi) Central Corridor | 8.6 | + | 5.7 | + | 32.1 | + | 0.7 | = | 47.1 |

**Equation 36: Approach to the calculation of the cost of illegal payments in USD for Burundi - Northern Corridor**

| Corridor | Illicit payments at the port per trip (USD) | + | Illicit payments made at the weighbridge per trip (USD) | + | Illicit payments made to police per trip (USD) | + | Illicit payments made to OGA per trip (USD) | = | Total illicit cost (USD) |
|---|---|---|---|---|---|---|---|---|---|
| (Burundi) Northern Corridor | 85.0 | + | 15.0 | + | 0.0 | + | 0.0 | = | 100.0 |

The above costs were derived from the overall costs presented In **Table 10-6**.

We note that the illicit costs reported by Burundian transport operators are generally lower than most other countries surveyed. There is no clear evidence to indicate why this might be – if it is a cultural unwillingness to disclose payments or an actual differential in payments made. TMEA may consider investigating this issue as a component of addressing non-tariff barriers (NTBs across East Africa).

### 10.3.8 Cost of Trade

In summary of the foregoing sections, the aggregate average cost of trade per average trip along the Central Corridor and Northern Corridor for Burundi was calculated as follows:

**Equation 37: Overview of calculation approach for total cost of trade for Burundi (Central Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[83] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,359 | + | 2,419[84] | + | 375 | + | 77.00 | + | 47.1 | = | 4,277 |

**Equation 38: Overview of calculation approach for total cost of trade for Burundi (Northern Corridor)**

| Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[85] | + | Direct compliance cost (USD) | + | The indirect cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 833 | + | 1,918[86] | + | 115 | + | 77.00 | + | 100.0 | = | 3,043 |

[83]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[84]This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time
[85]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.
[86]This figure is a summation of Direct Transport Cost (less illicit cost) and Cost of Trade Time

### 10.3.9 Trade Costs by Commodity Results,

In the data set, the primary variance across commodity types is the mix of vehicle types used. Where cost categories were expected to be consistent across commodity baskets, the sample averages (as discussed in the proceeding sections) were applied. The variable and consistent costs were summed up to create a picture of average cost by commodity basket for the sample data set.

**Equation 39: Calculation of cost of trade by commodity, Burundi average (USD) - Central Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[87] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| | | | | | VALUE BY COMMODITY | | | | | | |
| Cement and clinker connections | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Cereals, sorghum, etc. | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Clay, minerals, etc. | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Edible fruits: | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Manufactured goods | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Coffee and tea | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Construction materials | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Petroleum, oils etc. | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Iron steel and aluminum - raw | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |
| Edible vegetables, roots and tubers | 1,359 | + | 2,419.17 | + | 375 | + | 77.00 | + | 47 | = | 4,277.31 |

[87]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

**Equation 40: Calculation of cost of trade by commodity, Burundi average (USD) - Northern Corridor**

| **Cost category** | Port costs (USD) | + | Cost of Trade Time (USD) + Direct transport costs (USD)[88] | + | Direct compliance cost (USD) | + | Cost of delay (USD) | + | Illicit costs (USD) | = | Trade costs (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | Constant | | Variable | | Constant | | Constant | | Constant | | |
| | | | | | VALUE BY COMMODITY | | | | | | |
| Cement and clinker connections | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Cereals, sorghum, etc. | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Clay, minerals, etc. | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Edible fruits: | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Manufactured goods | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Coffee and tea | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Construction materials | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Petroleum, oils etc. | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Iron steel and aluminium - raw | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |
| Edible vegetables, roots and tubers | 833 | + | 1,918.08 | + | 115 | + | 77.00 | + | 100 | = | 3,043.08 |

[88]The Direct Transport Cost used in the Calculation of Cost of Trade is less illicit cost.

### 10.3.10 Trade Cost for Top 5 Most Common OD Pairs by Most Common Commodity Transported

Finally, the study also calculated a cost per trip for each of the tip five major origin-destination pairs in the Burundi sample. These costs are calculated based on the most frequently observed commodity type for each routing. The costs are also estimated per kilometre based on the distances by routing indicated in the Open Street Maps shapefile data ("places" and "roads" dataset) and QGIS software.

The estimated costs range from USD 2.60 to 43.20 per km. Each represent movements of food stuffs to Bujumbura, but the per km cost for food coming from Gitega is high due to the relatively small distance over which to spread fixed costs.

The table below shows the trade cost incurred for each of the top five common OD pairs by taking into consideration the major category of commodities transported by trucks along each route in Burundi.

**Table 10-8: Trade cost by common Top 5 OD pair by commodity type transported for Burundi**

| No | Origin | Destination | Number of trips | Percentage of trips | Corridor | Road distance (km) | Most common commodity transported | Trade Cost | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Average transport cost per trip (USD) | Average transport cost per km (USD/km) |
| 1 | Dar es Salaam | Bujumbura | 107 | 60.8% | CC | 1,494.0 | Foodstuffs | 4,277.3 | 2.9 |
| 2 | Bujumbura | Dar es Salaam | 14 | 8.0% | CC | 1,494.0 | Machinery and appliances | 4,277.3 | 2.9 |
| 3 | Arua | Bujumbura | 5 | 2.8% | NC | 1,190.2 | Foodstuffs | 3,043.1 | 2.6 |
| 4 | Gitega | Bujumbura | 5 | 2.8% | CC | 98.9 | Foodstuffs | 4,277.3 | 43.2[89] |
| 5 | Kampala | Bujumbura | 5 | 2.8% | NC | 722.0 | Machinery and appliances | 3,043.1 | 4.2 |

Note:

CC- Central Corridor

NC-Northern Corridor

[89]Note that the extremely high per km cost suggests that the methodology used does not account well for very short – distance trips, or should at least result in careful interpretation at the per km terms.

## 10.4 Summary of Key Barriers to Trade, Burundi

The study team was directed to focus on the collection of transport data and, as such, focus group sessions that looked at barriers to trade, that were tested in the study pilot, were excluded, at TMEA's direction, for the Full Study.

However, the OD Survey did include questions that aimed to understand what the biggest transport obstacles were for transporters. The respondents were asked to rate the following categories of barriers on a scale of not a challenge to a severe challenge:

- Border post issues.
- Police checks.
- Port access or egress issues.
- Road conditions.
- General security.
- Vehicle condition and breakdowns.
- Weigh bridge issues.
- Weather conditions.
- Radar speed check issues.

At the Burundi national level, the issue most often identified as a 'moderate' or 'severe' challenge was police checks. The second most frequently identified issue was road conditions.

Compared to the overall region, the frequency of 'no or slight challenge' categories was much lower. However, the areas of least concern to Burundi freight carriers were vehicle condition and speed radar issues.

## 10.5 Conclusion

The RAATTE study successfully collected and assessed key transport data for freight vehicles in Burundi. TMEA's key concerns – understanding vehicle types and volumes, understanding their origins and destinations and developing a picture of overall costs for freight movements.

Cost information proved challenging to collect. Though the study did capture a valid sample, it was less than originally hoped for, despite additional time and expenditure on improving the sample size. Transporters are simply reluctant to share cost information. Despite this challenge, however, the study captured quality data on certain cost categories that have been less well-studied to-date. Among these is illicit costs. These were USD 47.10 per trip along the Central Corridor and 100 along the Northern Corridor. Of these, illicit costs at the port and to police were the most significant. This suggests that along with non-monetary non-tariff barriers (NTBs), efforts to reduce illicit payments might be a more fruitful place for TMEA to focus its efforts in the future. Future studies may also consider tracking and benchmarking this cost to track change over time in rent extraction.

One interesting, and unexpected finding of the Burundi analysis is that, while central corridor traffic dominates trade to and Burundi, there is still substantial Northern Corridor traffic. This traffic, however, primarily originates in Uganda, suggesting a growing roll for Kampala for trans-shipment, beyond South Sudan, Rwanda and DRC.

Lastly, while TMEA directed the team to exclude trade issue focus groups, the data collected in the study, did identify police checks and road conditions as the most pressing items of concern for transporters. Again, this may a fruitful area for TMEA attention, including working to better understand the issue and its impacts, in the future.

# 11. CONCLUSIONS

TMEA can consider this first RATTE study to have successfully met its objectives. Though, not without problems, the study successfully captured volume, movement, commodity, and cost data, to an extent never previously accomplished by TMEA. The data are largely consistent, usable, and useful. And to that end, the study has met its goals. The study has catalogued traffic, route preference, costs, and certain non-tariff barriers (NTBs) across East Africa in a comprehensive way.

The study identified the key trade routes being used for freight movements in East Africa, established that Rwanda has largely shifted to use of the Central Corridor for imports, and catalogued a variety of costs that are not well-studies in East Africa. The study also resulted in an emissions inventory for the region which can be built on and used to identify intervention opportunities in the future.

Key observations arising from the data collected include:

1. A full 25% of truck traffic is using the Mombasa-Kampala corridor and terminating in Nairobi (5.9%) or Kampala (19.1%).
2. Despite the concentration of traffic on the Mombasa-Kampala route, the majority of destinations use the Central Corridor. This includes Kigali which has largely shifted to using the Central Corridor over the past decade.
3. Trade cost data collected includes comprehensive direct transport cost estimates by operators. These show that other than fuel tankers, container trucks were the most expensive to operate. However, they are also the most efficient by shipment tonnage, in terms of fuel consumption and emissions.
4. Reporting of illicit costs varied substantially across countries surveyed, ranging from just over USD 7 in Kenya up to USD 500 for trips to Rwanda using the Northern Corridor. The study team views these results with some scepticism and suggest these are best used as a baseline for future benchmarking.
5. Costs to trade varied substantially across the two corridors, with the average trip on the Central Corridor costing USD 4,883 while the average trip on the Northern Corridor cost 3,065, a 37% difference, accounted for, in part by the lower average distances travelled. However, the per km cost on the Central Corridor tended to be lower for trips to Bujumbura and Kigali resulting in a near balance of total cost across the two options.
6. While TMEA directed the study team to exclude focus group-based assessment of trade barriers from the full study, some data were collected via the OD Survey. These suggest that road condition improvements and resolution of policing issues are the most pressing trade barriers according to operators and may therefore be considered for future assessment of potential impacts, if resolved.

# 12. APPENDICES

## Appendix I: Study Plan

The Pilot Study successfully demonstrated 'proof of concept' for the full rollout of the RATTE study in Burundi, Kenya, Rwanda, Tanzania and Uganda. However, the results also indicate certain changes to implementation needed to successfully complete the study. These include the following goals:

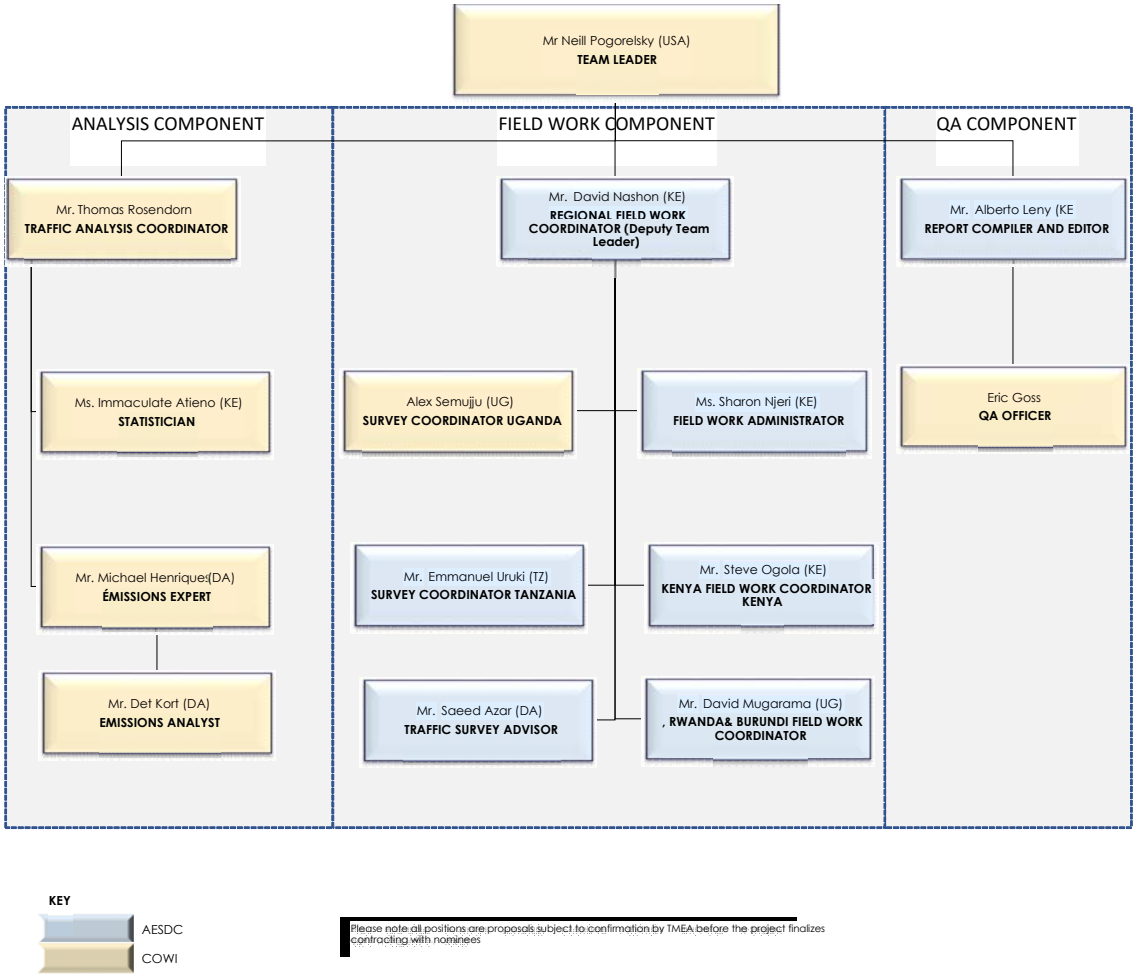
1. Improvement of cost data collection response rate.
2. Focusing the collection tools to the key areas of interest to TMEA.
3. Improving the study time management to ensure data collection completion in 2021.
4. Improvement of quality control of technical deliverables.

To achieve these goals, the study team has developed a work plan for the remainder of the study (Full Study rollout) and a revised study team.

### 1 Revised Study Team

In response to TMEA request, COWI and AESDC agreed to revise its team structure. The revisions are designed, in part, to strengthen the oversight role of COWI through the inclusion of a Team Leader and Technical Analysis experts from the COWI office in Denmark. COWI will take on additional responsibilities for Quality Assurance as illustrated in the revised organizational structure for the project team going forward. All submissions and communication to TMEA will go through a COWI filter to ensure that documents have been reviewed by an independent reviewer who will review outputs and give feedback to the expert who has prepared the document before these are submitted to TMEA. The organogram below illustrates changes made by the COWI AESDC consortium. It includes key new resource persons such as Team Leader (COWI), Traffic Analysis Coordinator (COWI) and Regional Field Work Coordinator (AESDC).

**Figure 12-1: Revised Team Structure**




## 2 Work Plan for Full Study

The remainder of the study will kick off upon TMEA approval of this Preliminary Report. Preparation for mobilization has begun, but certain activities can only commence once an exact date of approval is known – this is because permits must be requested for specific dates. The section below describes the planned work through delivery of the final report.

### 2.1.1 TMEA Review and Approval of Preliminary Draft Report

This report constitutes the final draft of the Preliminary Draft Report. Upon approval by TMEA, the study team will commence the remaining rollout of the Full Study.[90] The study team's understanding is that approval to commence the Full Study will either be given by the end of August or TMEA will determine and notify the team that full rollout is not possible. Given this, should TMEA have comments that require revision of this revised report, the study team will undertake such revisions during the rollout phase of the Full Study.

[90]Certain rollout activities are scheduled for the last week of August, prior to expected TMEA approval.

### 2.1.2 Mobilization for Traffic Census and OD Survey

As shown in Section 10: Project Timeline for the Full-Scale Study, mobilization for the study team will take place during the last week of August 2021 in preparation for the field work. The mobilization will be staged as follows in the five East African Community (EAC) member states.

- Kenya, Tanzania and Uganda: From 23rd August 2021
- Rwanda and Burundi: From 30th August 2021

The study team will mobilize the personnel who will undertake the Freight Cost Survey, Traffic Census and OD Survey during the same period in the five East African Community (EAC) member states.

### 2.1.3 Field Work

**Simplified Freight Cost Survey**

The Simplified Freight Cost Survey has been designed to overcome the resistance of respondents to undertake a time-consuming collection of cost data by reducing the complexity of data collection and by addressing the seeming unwillingness of fleet operators in sharing what most may consider proprietary information on important direct transport cost drivers. These included:

1. Vehicle depreciation cost.
2. Fuel costs.
3. Labour (crew) costs.
4. Maintenance and repair costs.
5. Tyre costs.
6. Management and overhead costs.
7. Vehicle and equipment licensing fee costs.
8. Cargo insurance costs.
9. Other costs.

The Simplified Freight Cost Survey is designed to determine non-granular direct transport costs and give a broader sense of the sub-category costs. It will ask for data on the following parameters:

1. Commodity type.
2. Commodity origin.
3. Commodity destination.
4. Type of vehicle used.
5. Total freight price.
6. Number of trips truck makes per year.
7. Total bribes and illicit payments made.
8. Fuel expenditures.
9. Illicit costs by category.

The simplified survey will supplement this by ask respondents to estimate within 5% of the allocation of those costs to depreciation, labour, tyres, licensing, maintenance and repair, overhead, insurance and other costs.

The Full Study, then, would ask the majority of respondents to complete the simplified survey, but will seek to identify five respondents in each country who will complete the full survey. The study team believes the Bayesian approach, when supplemented with a small number of full surveys, will result in sufficiently useable data.

The Simplified Freight Cost Survey will be administered online during the mobilization period for the OD and Traffic Census surveys. The study team will target at least 500 transport fleet operators across the entire region to complete the simplified survey, with survey respondents disaggregated according to the surveys' transport nodes. This sample size should provide for 95% confidence limits and a 5% margin of error. Primary data will be collected using a semi-structured questionnaire. In each company, one respondent, who should be an officer who participates in setting freight transport prices for the company, will be selected.

The collected data will be analysed and summarized using the SPSS package to obtain descriptive statistics for this analysis. This survey will be carried out for five (5) days for 16 hours each day from 6am to 10pm and two (2) days (one weekday and one weekend) for 24 hours from 6am to 6am. The results from the night shift on the two days will be used to extract the 24-hour conversion factor (on weekdays and weekend days).

**Traffic Census**

The study team will use cameras to undertake traffic census. The cameras shall be suitably placed to capture traffic volumes passing at the different survey locations which will be similar to the OD stations. The specifications for the cameras, which the study team will adopt, will have the following features:

- Adapted for tropical African conditions (poor lighting, high temperatures).
- Semi-compact.
- Expensive components.
- Improved battery life – 24hrs.
- Shorter recharge time – 6hrs.
- Medium memory usage – 4GB/hr.
- Solar power capable.
- 4G capable (for remote connection and fault alerts).

The figure below shows the field work methodology and back-office process, which the study team will employ.

**Table 9: Video camera field work methodology and back-office process**

| Field Work Methodology | Back Office Process |
|---|---|
| Ensure permissions are obtained | Read project brief |
| Read project brief | Refer to field notes |
| Locate site from map, site visit, survey report etc | Download date/ video from servers |
| Mobilise security and traffic management | Process/ count and classify as necessary |
| Make equipment requisition from store | Post enumeration results to supervisor |
| Travel to site(s) | Undertake quality checks on enumerated results |
| Ensure security and traffic management are present | Post enumerated data to reporting team |
| Install equipment | Build reports in standard/ requested format |
| Manage site for survey days | Build data report |
| Work with security team to ensure equipment is operational | Post results to client |
| Uninstall equipment | |
| Upload video/ data and field notes to Study Team servers | |
| Move to next site/ cluster if required | |

*Source:* Study Team 2021

The study team will adopt the vehicle classification shown in the figure below:

**Figure 12-2: Traffic census vehicle classification**

| Container Trailers | Commercial Buses: | Personal vehicles: |
|---|---|---|
| • Bulk Trailers<br>• Fuel Tankers<br>• Light trucks<br>• Medium trucks<br>• Break Bulk<br>• Empty trucks | • Coach<br>• Coaster<br>• Minibus | • Sedans, Station Wagons and Mini vans<br>• Pick-ups<br>• Tuk-tuks |

With the video capturing method, the enumerators will not be required, but only personnel to ensure safety of the equipment.

**Freight OD Survey**

This survey will be carried out for seven (7) days for 12 hours each day from 6am to 6pm. The enumerators will be working in two shifts: from 6am to 12.00pm and 12.00pm to 6.00pm. The study will only stop vehicles carrying goods, which will include:

- Containerised goods.
- Bulk goods.
- Break bulk goods.
- Goods carried in reefer trucks/reefer containers.
- Liquid bulk.

The study team will use traffic police officers to stop the trucks. Depending on the available space for parking, the study team will be stopping three (3) trucks after every 15 minutes. The study team will put up pre-warning boards up to 400-500m before the survey station.

The Origin and Destination Survey will be carried out by way of a purpose-built, web-based Digital Traffic Origin and Destination (DTOD)application. Data shall be recorded in both directions of travel.

The survey stations will be the same as those for the Traffic Census.

OD Survey and Traffic Census will be undertaken contemporarily. This will enable the following:

- It will ease the safety precautions.
- It will give the exact figure for the percentage of trucks stopped at the single

stations.

- It will also enable estimation of Sample Response Rate

The survey questionnaire has been adjusted as per the experience of the pilot survey (Refer to Appendix 1: Freight OD Survey Questionnaire.

The enumerators will be provided with all the necessary equipment to fulfil their job, and depending on the weather forecast, we will provide raincoats, umbrellas, etc. The surveys will be located near to places which offer the enumerators easy access to refreshments, toilets etc.

**Commodity Valuation Data Collection**

In order to ensure data sufficiency for the analysis of delay costs, the study team will collect commodity valuation data for the top ten commodities in the sample from a variety of sources, including, the United Nations International Trade Statistics database, Food and Agriculture Organization (FAO) of the United Nations, and national fuel cost recording depositories. These will be used to estimate the average value of shipments by commodity type, for the most represented commodities in the sample to calculate the time value of delay by commodity type.

### 2.1.4 Data Cleaning

Data cleaning will commence in tandem with data collection, using SPSS, R and/or STATA software to analyse missing responses, fix typos, identify duplicates, detect and correct outliers, clean spaces between digits etc. In order to perform these cleaning checks, statistical descriptive analysis such as count, mean, min, max, mode/histogram or density graphs will be applied. Data imputation may be applied to outliers that may occur in variables of value type, e.g., reporting of costs.

Database properties will be provided during the analysis to include the following information:

I. Name of survey.
II. Size of the dataset i.e., total number of responses received.
III. Variable types.
IV. Range of values for each variable.
V. Date the response was collected.

### 2.1.5 Preparation of the Draft Analysis Report and Dataset

Data analysis will constitute provision of basic descriptive statistics related to the specific survey indicators; cost analysis as deemed appropriate. Statistical software will be used for the analysis. The report will outline in detail all the analysis done by survey type.

**Traffic Volumes by Route**

The study team will collect traffic data in the five East African Community (EAC)member states[91] of Burundi, Kenya, Rwanda, Tanzania and Uganda along the major trade

[91]Inclusion of Burundi to be confirmed by TMEA

routes. The data collection tools include the Traffic Census and the Origin Destination Survey.

- The Traffic Census will survey vehicles traveling in both directions at each survey point. The vehicles will be classified into three major categories, which will include trailers, commercial buses and personal vehicles. The classification for trailers will include dry bulk, fuel tankers, light trucks, medium trucks, break bulk and empty trucks.
- The OD Survey will seek to collect vehicle trip details and will mainly focus on freight traffic. Collected information will include trip origin and destination, journey duration, commodities carried, direction of travel, trip costs incurred, age of vehicle, number of stops made at particular areas and duration and challenges encountered when transporting freight in the region. The full OD study survey instrument is included in the appendices to this report.

The information obtained will be used to correlate traffic volumes in terms of average annual daily traffic with trip routes, commodities carried, direction of travel and transport costs. This will be disaggregated by vehicle type, and by direction of travel so as to establish the volume of imports and exports.

**Table10: Sources and uses of data for traffic analysis**

| Analysis Component | Data Source | Data |
|---|---|---|
| **Traffic forecast** | | |
| Traffic volumes | Census | • Traffic volume by classification, route, direction and time<br>• Estimation of Annual Average Daily Traffic (AADT)[92] for various vehicle classifications |
| Freight origin destination survey | OD survey | • Vehicle trip route by type and direction<br>• Vehicle registration country and age<br>• Commodities carried by vehicle type, volume, point of loading and point of discharge<br>• Vehicle estimated journey duration in terms of hours and days<br>• Delays encountered by vehicles by number of stops and duration at particular points<br>• Transport costs by vehicle type and cost item by direction<br>• Challenges encountered during the journey. |

**Cost of Trade**

To estimate the cost of trade, the study team will take into account TMEA's definition of Trade, which can be illustrated as follows:

Trade Costs = Port Costs + Direct Transport Cost + Direct Trade Compliance Cost + Cost of Trade Time + Illicit Costs.

[92] Traditionally, total volume of vehicle traffic of a highway or road for a year divided by 365 days. A measure of how busy a roadway is.

Transit Time = Port Dwell Time + Inland Transport Times + Clearance Time at Destination.

This data required to report against the cost and time indicators includes traffic flows of commodities and associated costs of movement along the major trade corridors by different modes of travel in Eastern Africa.

The matrix below illustrates the source of data on trade cost given that the study team is implementing a mixed methodology. The table below shows the data requirements, the data collection methodology and the data sources.

**Table 11: Sources and uses of data for trade cost analysis**

| Analysis component | Data source | Data |
|---|---|---|
| **Cost of trade** | | |
| Transport costs | • Simplified Freight Cost Survey<br>• Traffic Census, OD Survey | • Aggregate trip cost by vehicle type per v/km<br>• Fuel cost<br>• Volumes by truck type and route<br>• Fuel consumption |
| Illicit costs | • Simplified Freight Cost Survey | • Police bribe<br>• Port bribe<br>• Weighbridge bribe<br>• OGA bribe |
| Delay cost | • OD Survey<br>• Simplified Freight Cost Survey<br>• Focus group discussion | • Trip volume by route<br>• Trip time by route<br>• Trip time, mean, mode, standard deviation (calculation)<br>• Commodities by route<br>• Vehicle type, by route, by commodity<br>• Average shipment value<br>• Indirect cost types, scale by country and direction of trade |
| Compliance cost | • Desk review | • Average compliance cost by country |
| Port cost | • Desk review | • Port tariff by route, country |

### Emissions

Energy consumption and $CO_2$ emissions will be calculated based on the information about trucks and fuel consumption obtained from the OD surveys. This information will entail information on the truck type and make, including the age of the truck and its mileage. These data will be used to generate preliminary estimates, which will be checked against data from the model for transport energy consumption developed for the Danish Ministry of Transport (TEMA) looking at the same types of vehicles.

As described in **Section 5**, the procedure for emission estimation adopted is:

1. Make a classification of vehicle types in order to distinguish energy consumption and emissions. This was then programmed into the data collection application.
2. Conduct the traffic census. The results of the census list the mix of vehicles classes in order to describe the actual composition/number and types on different routes (OD pairs).
3. Identify the listed energy consumption for the different vehicle types based on accessible data form manufacturers and other, official sources.
4. Adjust official/generic consumption figures (often form European sources) with factors for loaded/unloaded, road conditions, congestion, wear and tear of vehicles etc. The correction factors must be based on experience among truck operators and will be adopted in the form of a factor. Experiences from the Northern Corridor study will also be used.
5. Data on expenditure for fuel per truck per corridor are applied as a "corrective factor" in order to get the most correct consumption picture as well as a better understanding of the factors determining the difference between generic data and real-life data.
6. The corrected fuel factors will be applied to the "traffic" (vehicle kilometres) produced by each category of trucks in the OD sample.
7. The actual fuel consumption for each corridor will be calculated.

The $CO_2$ emissions will be established using a fixed conversion factor between consumption of diesel and $CO_2$ emissions (2.66kg $CO_2$ per litre diesel).

**Table 12: Sources and uses of data for emissions analysis**

| Analysis Component | Data Source | Data |
|---|---|---|
| **Emissions** | | |
| Traffic volumes | Census | Vehicles by route by type by direction |
| Fleet composition | OD Survey<br>Simplified Freight Cost Survey | Vehicle mix<br>Vehicle age<br>Vehicle mileage |
| Fuel consumption | Both OD and Simplified Freight Cost surveys | Fuel consumption by route by vehicle type (weighted loaded/unloaded rate) |
| $CO_2$ production/litre | Desk review | CO2 output by vehicle type, age, condition |

### 2.1.6 Mobilization for Stakeholder Workshop

The mobilization for the stakeholder workshop is scheduled to take place from 3rd November to 16th November 2021. During this period, the study team shall identify critical stakeholders in each sector that have the respect and confidence in the sector, are knowledgeable, and can engage in discussions on trade and transport factors. The different stakeholders will have different interests and different perceptions of what might be problems or opportunities for the trade and transport sector in the region. Some of the targeted individuals and groups who will be mapped out include:

- Members of the node's local municipality.
- Importers and exporters.
- Clearing and forwarding agents.
- Road transport operators.
- Railway operators.
- Port and terminal operators.
- CFS and ICD operators.
- Transportation authorities.
- Customs authorities.
- Single window operators.
- Weighbridge operators.
- Border authorities.
- Corridor authorities.

**COVID-19 Health and Safety Protocols**

Preserving the safety and confidentiality of respondents is paramount for this study. The study team will as far as be possible avoid face-to-face meetings during the period of the COVID-19 pandemic. The study team will in most cases engage in virtual meetings and employ video conferencing, preferably Microsoft Teams during these sessions.

Face-to-face interviews carry the risk of exposing the participants to infection by the COVID-19 virus in view of the delivery mechanism. Hence, it is important to ensure that any face-to-face interaction follow guidelines that ensure the safety and health aspects to contain the transmission and spread of the disease are accorded priority during the implementation of the study.

Any face-to-face meetings will be conducted according to the AESDC technical protocol and standard operating procedures for face-to-face surveys during the COVID 19 pandemic. This protocol provides recommended preventive measures for study team members conducting social Interviews within and without AESDC's premises during the COVID-19 pandemic scenario. Measures include screening at entrances, meeting room guidelines, traveling to and from meetings outside the office, along with permanent personal hygiene, physical distancing and visitor induction and training guidelines.

### 2.1.7 Preparation and Submission of Final Analysis Report and Database

The study team will prepare a Draft Final Report for TMEA's review and remarks. The analysis will include specific components on (1) traffic volumes by route, including commodity densities on each route based on the agreed route structure (2) costs of trade by cost component (see **Figure 39** below) and (3) network emissions volumes. These components will be based on a database that will be prepared and submitted to TMEA. See **Appendix 4**, for a description of database properties.

**Figure 12-3: Trade cost components to be included in the final analysis**


### 2.1.8 TMEA Review and Approval of Final Analysis Report and Database

The study team will adjust the draft report based on TMEA comments and submit a Final Report. Along with the final report, the team will transmit the final data set, inclusive of analysis tables. These will be considered final upon receipt of TMEA approval.

## Appendix II: Commodity Cluster List

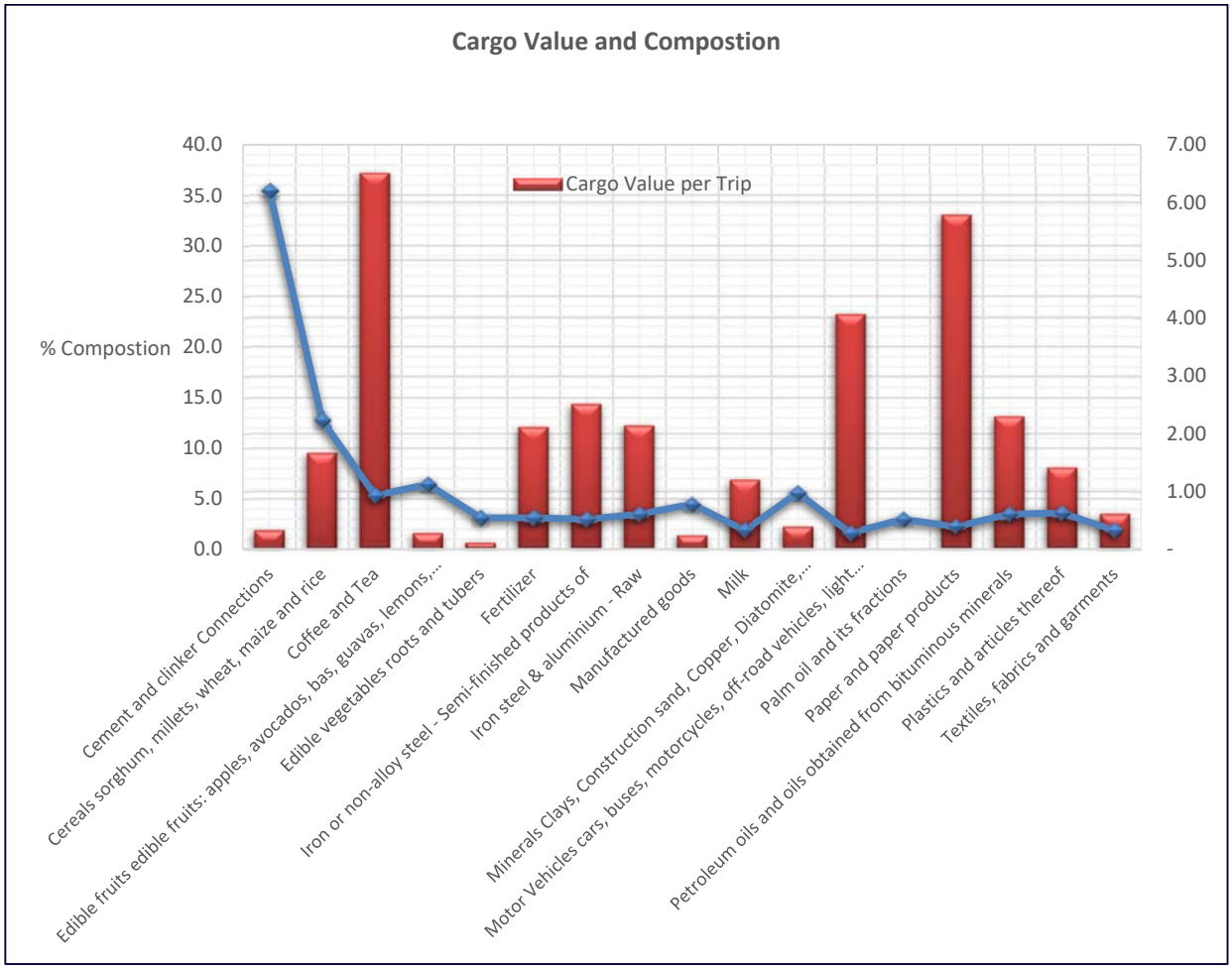
| Commodity Cluster | HS2 IDs | HS2 Des | 2020 Trade Value in USD | Cumulative % |
|---|---|---|---|---|
| 1. **Vegetable Products** | 209, 206, 207, 208, 212, 210, 213, 214, 211, | Coffee, tea, mate, and spices; Trees and other live plants; Vegetables and certain roots and tubers; edible; Fruit and nuts, edible; peel of citrus fruit or melons; Oil seeds and oleaginous fruits; Cereals; Lac; gums, resins and other vegetable saps and extracts; Vegetable plaiting materials; Products of the milling industry; malt, starches, inulin, wheat gluten; | 2,622,630,078 | 41.34% |
| 2. **Mineral Products** | 527, 526, 525, | Mineral fuels, mineral oils, and products of their distillation; Ores, slag, and ash; Salt; sulphur; earths, stone; plastering materials, lime, and cement | 727,157,396 | 52.80% |
| 3. **Foodstuffs** | 424, 420, 421, 417, 422, 423, 419, 418, 416, | Tobacco and manufactured tobacco substitutes; Preparations of vegetables, fruit, nuts, or other parts of plants; Miscellaneous edible preparations; Sugars and sugar confectionery; Beverages, spirits, and vinegar; Food industries, residues and wastes thereof; prepared animal fodder; Preparations of cereals, flour, starch, or milk; pastrycooks' products; Cocoa and cocoa preparations; Meat, fish or crustaceans, molluscs, or other aquatic invertebrates; | 521,929,020 | 61.03% |
| 4. **Textiles** | 1162, 1161, 1153, 1163, 1155, 1152, 1156, 1151, 1160, 1159, 1154, 1158, 1157, 1150, | Non-knit or crocheted apparel and clothing accessories, Knitted or crocheted apparel and clothing accessories, Vegetable textile fibres; paper yarn and woven fabrics of paper yarn; Textiles, made-up articles; sets; worn clothing and worn textile articles; rags; Man-made staple fibres; Cotton; Wadding, felt and nonwovens, special yarns; twine, cordage, ropes and cables and articles thereof; Wool, fine or coarse animal hair; horsehair yarn and woven fabric; Knitted or crocheted fabrics; Textile fabrics; Man-made filaments; Woven fabrics; Carpets and other textile floor coverings; Silk | 483,935,373 | 68.66% |
| 5. **Chemical Products** | 630, 634, 628, 638, 633, 632, 631, 635, 629, 636, 637, | Pharmaceutical products; Soap, organic surface-active agents; washing, lubricating, polishing or scouring preparations; artificial or prepared waxes, candles and similar articles, modelling pastes, dental waxes" and dental preparations with a basis of plaster"; Inorganic chemicals; organic and inorganic compounds of precious metals; of rare-earth metals, of radioactive elements and of isotopes; Essential oils and resinoids; perfumery, cosmetic or toilet preparations; Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints, varnishes; putty, other mastics; inks; Fertilizers; Albuminoidal substances; modified starches; glues; enzymes; Organic chemicals; Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations; Photographic or cinematographic goods; | 455,363,562 | 75.84% |
| 6. **Metals** | 1572, 1573, 1574, 1583, 1576, 1582, 1579, 1578, 1580, 1581, 1575 | Iron and steel; Iron or steel articles; Copper and articles thereof; Metal; miscellaneous products of base metal; Aluminium and articles thereof; Tools and cutlery; Zinc and articles thereof; Lead and articles thereof; Tin; articles thereof; Metals; and articles thereof; Nickel and articles thereof; | 359,588,947 | 81.51% |
| 7. **Machines** | 1684, 1685 | Machinery and appliances; Electrical machinery and equipment; | 223,899,475 | 85.04% |

| Commodity Cluster | HS2 IDs | HS2 Des | 2020 Trade Value in USD | Cumulative % |
|---|---|---|---|---|
| **8. Animal and Vegetable by-products** | 315 | Animal or vegetable fats and oils and their cleavage products | 144,375,160 | 87.31% |
| **9. Animal Products** | 102, 103, 101, 105, 104, | Meat and edible meat offal; Fish and crustaceans, molluscs, and other aquatic invertebrates; Live animals; Animal originated products; not elsewhere specified or included; Dairy products and other edible products of animal origin; | 137,204,162 | 89.48% |
| **10. Plastics and Rubbers** | 739, 740, | Plastics and articles thereof; Rubber and articles thereof; | 120,083,151 | 91.37% |
| **11. Paper Goods** | 1048, 1049, 1047, | Paper and paperboard; articles of paper pulp, of paper or paperboard; Printed books, newspapers, pictures, and other products of the printing industry; manuscripts, typescripts, and plans; Pulp of wood or other fibrous cellulosic material; waste and scrap of paper or paperboard; | 113,877,930 | 93.16% |
| **12. Transportation** | 1787, 1788, 1789, 1786 | Vehicles and their parts, Aircraft, spacecraft, and parts thereof, Ships, boats and floating structures, Railway, and other rolling stock | 111,627,742 | 94.92% |
| **13. Precious Metals** | 1471 | Precious metals, gems, and jewellery | 88,804,111 | 96.32% |
| **14. Miscellaneous** | 2094 | Furniture, Miscellaneous manufactured articles, Toys, and games | 68,893,147 | 97.41% |
| **15. Footwear and Headwear** | 1264, 1267, 1265, 1266, | Footwear; gaiters and the like; parts of such articles; Feathers and down, prepared; and articles made of feather or down; artificial flowers; articles of human hair; Headgear and parts thereof; Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding-crops; and parts thereof; | 51,453,803 | 98.22% |
| **16. Animal Hides** | 841, 842, 843, | Raw hides and skins (other than fur skins) and leather; Articles of leather; saddlery and harness; travel goods, handbags, and similar containers; articles of animal gut (other than silkworm gut); Fur skins and artificial fur; manufactures thereof; | 43,021,672 | 98.90% |
| **17. Stone and Glass** | 1370, 1369, 1368, | Glass and glassware; Ceramic products; Stone, plaster, cement, asbestos, mica, or similar materials; articles thereof; | 32,394,824 | 99.41% |
| **18. Instruments** | 1890, 1891, 1892 | Instruments and apparatus, Clocks and watches, Musical instruments | 24,288,278 | 99.79% |
| **19. Wood Products** | 944, 946, 945, | Wood and articles of wood; wood charcoal; Manufactures of straw, esparto, or other plaiting materials; basket ware and wickerwork; Cork and articles of cork | 11,846,720 | 99.98% |
| **20. Arts and Antiques** | 2197 | Works of art; collectors' pieces and antiques | 1,314,234 | 100.00% |
| **21. Weapons** | 1993 | Arms and ammunition | 26,841 | 100.00% |
| **TOTAL TRADE** | | | **6,343,715,626** | **100.00%** |

## Appendix III: Vehicle Classification and Configuration

| Vehicle category | Description |
|---|---|
| **1. Container Trucks:** | |
| Container Trailers | All trucks transporting removable containers (20 ft. and 40 ft). This includes the articulated trucks and the truck and trailer configurations |
| Bulk Trailers | All trucks transporting bulk cargo |
| Fuel Tankers | All commercial fuel transporting vehicles |
| Light trucks | Pickups, lorries, and small trucks carrying goods of capacity up to 8 T |
| Medium trucks | Trucks with equivalent carrying capacity from 8 T up to 15 T |
| Break bulk | All other trucks larger than medium trucks |
| Empty trucks | The study team will identify and segregate data to distinguish the number of empty trucks for each of the specified categories. |
| **2. Commercial Buses:** | |
| Coach | All commercial buses transporting 45 or more passengers |
| Coaster | All commercial buses transporting a maximum of 30 passengers |
| Minibus | All buses transporting 8 to 14 passengers |
| **3. Personal vehicles:** | |
| Sedans, Station wagons and Mini vans | Passenger vehicles of the capacity of up to 7 passengers |
| Pick-ups | Passenger pickups – Not carrying goods |
| Tuk Tuks | Passenger vehicles – Not carrying goods |

## Appendix IV: Cargo Flow Composition



## Appendix V - RAATTE Tools - OD Questionnaire



# ORIGIN AND DESTINATION SURVEY

A Regional Analytical Analysis of Trends in Trade and Transport in East Africa

1. 1.0 Enumerator name?

_____

2. 1.1 Which country are you conducting this survey from?

*Mark only one oval.*

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ Rwanda
- ◯ Burundi
- ◯ Dr Congo
- ◯ South Sudan

VEHICLE PARTICULARS

3. 2.1 Vehicle Classification?

*Mark only one oval.*

- ◯ Break Bulk
- ◯ Bulk Trailer
- ◯ Container Trailer
- ◯ Empty truck
- ◯ Fuel Tanker
- ◯ Light truck Medium
- ◯ truck

4. 2.2 Make of Vehicle?

*Mark only one oval.*

- Bedford
- DAF
- Fiat
- Isuzu Iveco
- Leyland
- Mercedes
- Mitsubishi
- Renault
- Scania
- Volvo
- Other:

5. 2.3 What is the truck's Engine Capacity (Cc)?

6. 2.4 In which country is the truck is registered? /Gari limesajiliwa nchi ipi?

*Mark only one oval.*

- Burundi
- Kenya
- Rwanda
- South Sudan
- Tanzania
- Uganda
- Dr Congo Other:

7. 2.5 What is the age of the vehicle? / Gari lina umri upi?

8. 2.6 What is the mileage of the vehicle? (in Kilometers)

_____

DRIVER PARTICULARS

9. 3.1 What is the driver's age? /Una umri upi?

_____

10. 3.2 What is the driver's gender?

*Mark only one oval.*

- ◯ Female
- ◯ Male

11. 3.3 What is the driver's nationality? /Utaifa wako ni upi?

*Mark only one oval.*

- ◯ Burundian
- ◯ Kenyan
- ◯ Rwandese
- ◯ South Sudanese
- ◯ Tanzanian
- ◯ Ugandan Congolese
- ◯ Other:

_____

CARGO PARTICULARS

12. 4.1 What type of cargo are you carrying? /Umebeba mizigo ya aina ipi?

*Mark only one oval.*

_____

- ◯ VEGETABLE PRODUCTS
- ◯ MINERAL PRODUCTS
- ◯ FOODSTUFFS
- ◯ TEXTILES
- ◯ CHEMICAL PRODUCTS
- ◯ METALS
- ◯ MACHINERY AND APPLIANCES, ELECTRICAL MACHINERY AND EQUIPMENT
- ◯ ANIMAL & VEGETABLE BY PRODUCTS
- ◯ ANIMAL PRODUCTS
- ◯ PLASTICS & RUBBERS
- ◯ PAPER GOODS
- ◯ TRASPORTATION ALL OTHER
- ◯ COMMODITES
- ◯ Other:

13. 4.2 What is the weight of the cargo (excluding the weight of truck) in KG /Je, mizigo unayobeba ni ya uzito upi?

14. 5.1 Point of Loading (Country)? / Ulipakia mizigo katika nchi ipi?

*Mark only one oval.*

- ◯ Kenya *Skip to question 19*
- ◯ Uganda *Skip to question 16*
- ◯ Tanzania *Skip to question 22*
- ◯ Rwanda *Skip to question 25*
- ◯ Burundi *Skip to question 28*
- ◯ South Sudan *Skip to question 31*

POINT OF DISCHARGE

15. 5.1 Point of discharge (Country)? / Upakua mizigo katika nchi ipi?

*Mark only one oval.*

- ◯ Kenya *Skip to question 21*
- ◯ Uganda *Skip to question 18*
- ◯ Tanzania *Skip to question 24*
- ◯ Rwanda *Skip to question 27*
- ◯ Burundi *Skip to question 30*
- ◯ South Sudan *Skip to question 33*

UGANDA point of loading

Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- Arua City
- Fort Portal City
- Gulu City
- Hoima City
- Jinja City
- Kabale City
- Kampala Capital City
- Lira City
- Masaka City
- Mbale City
- Mbarara City
- Nakasongola City
- Soroti City
- Other:

17. 5.1.1 Point of Loading ?/ Eneo la Kupakia mizigo?

*Mark only one oval.*

- Port
- Container Depot
- Warehouse/Godown
- Other:

*Skip to question 15*

UGANDA point of discharge

18. 5.1 Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi?

*Mark only one oval.*

- Arua City
- Fort Portal City
- Gulu City
- Hoima City
- Jinja City
- Kabale City
- Kampala Capital City
- Lira City
- Masaka City
- Mbale City
- Mbarara City
- Nakasongola City
- Soroti City
- Other:

*Skip to question 34*

KENYA point of loading

19. Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- [ ] Athi River Baringo
- [ ] Bungoma
- [ ] Busia
- [ ] Eldoret
- [ ] Embu
- [ ] Garrisa
- [ ] Homabay
- [ ] Isiolo
- [ ] Kainuk
- [ ] Kajiado
- [ ] Kakamega
- [ ] Kapenguria
- [ ] Kericho
- [ ] Kerugoya
- [ ] Kiambu
- [ ] Kibwezi
- [ ] Kisii
- [ ] Kisumu
- [ ] Kitale
- [ ] Kitengela
- [ ] Kitui
- [ ] Lodwar
- [ ] Lokichar
- [ ] Lokichogio
- [ ] Lunga Lunga
- [ ] Machakos
- [ ] Malaba
- [ ] Malindi
- [ ] Mandera
- [ ] Marsabit
- [ ] Meru
- [ ]

- Migori
- Mombasa
- Moyale
- Muranga
- Nairobi
- Naivasha
- Nakuru
- Namanga
- Nanyuki
- Nyandarua
- Nyeri
- Oloitoktok
- Siaya
- Taveta
- Thika
- Voi
- Wajir
- Other:

20. 5.1.1 Point of Loading? / Eneo la Kupakia mizigo?

*Mark only one oval.*

- Port
- Container Depot
- Warehouse/Godown
- Other:

*Skip to question 15*

KENYA point of discharge

Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi? *Mark only one oval*

- [ ] Athi River Baringo
- [ ] Bungoma
- [ ] Busia
- [ ] Eldoret
- [ ] Embu
- [ ] Garrisa
- [ ] Homabay
- [ ] Isiolo
- [ ] Kainuk
- [ ] Kajiado
- [ ] Kakamega
- [ ] Kapenguria
- [ ] Kericho
- [ ] Kerugoya
- [ ] Kiambu
- [ ] Kibwezi
- [ ] Kisii
- [ ] Kisumu
- [ ] Kitale
- [ ] Kitengela
- [ ] Kitui
- [ ] Lodwar
- [ ] Lokichar
- [ ] Lokichogio
- [ ] Lunga Lunga
- [ ] Machakos
- [ ] Malaba
- [ ] Malindi
- [ ] Mandera
- [ ] Marsabit
- [ ] Meru
- [ ]

- Migori
- Mombasa
- Moyale
- Muranga
- Nairobi
- Naivasha
- Nakuru
- Namanga
- Nanyuki
- Nyandarua
- Nyeri
- Oloitoktok
- Siaya
- Taveta
- Thika
- Voi
- Wajir
- Other: _____

*Skip to question 34*

TANZANIA point of loading

22. Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- Arusha
- Bagamoyo
- Bukoba
- Dar es Salaam
- Dodoma
- Iringa
- Kahama
- Kasulu
- Kibaha
- Kigoma
- Lindi
- Mafinga
- Makambako
- Mara
- Mbeya
- Morogoro
- Moshi
- Mtwara
- Musoma
- Mwanza
- Ruvuma
- Shinyanga
- Singida Songea
- Sumbawanga
- Tabora
- Tanga
- Tunduma
- Other:

23. 5.1.1 Point of Loading ?/ Eneo la Kupakia mizigo?

*Mark only one oval.*

- [ ] Port
- [ ] Container Depot
- [ ] Warehouse/Godown
- [ ] Other:

_____

*Skip to question 34*

TANZANIA point of discharge

24. Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi?

*Mark only one oval.*

- Arusha
- Bagamoyo
- Bukoba
- Dar es Salaam
- Dodoma
- Iringa
- Kahama
- Kasulu
- Kibaha
- Kigoma
- Lindi
- Mafinga
- Makambako
- Mara
- Mbeya
- Morogoro
- Moshi
- Mtwara
- Musoma
- Mwanza
- Ruvuma
- Shinyanga
- Singida
- Songea
- Sumbawanga
- Tabora
- Tanga
- Tunduma
- Other: _____

*Skip to question 15*

RWANDA point of loading

25. 5.1 Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- Butare
- Byumba
- Cyangugu
- Gisagara
- Gisenyi
- Kamonyi
- Kibungo
- Kibuye
- Kicukiro
- Kigali
- Muhanga
- Nyamagabe
- Nyanza
- Nyaruguru
- Ruhango
- Ruhengeri
- Rutongo
- Rwamagana
- Other
- Other: _____

26. 5.1.1 Point of Loading ?/ Eneo la Kupakia mizigo?

*Mark only one oval.*

- Port
- Container Depot
- Warehouse/Godown
- Other: _____

*Skip to question 15*

RWANDA point of discharge

27. 5.1 Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi?

*Mark only one oval.*

- Butare
- Byumba
- Cyangugu
- Gisagara
- Gisenyi
- Kamonyi
- Kibungo
- Kibuye
- Kicukiro
- Kigali
- Muhanga
- Nyamagabe
- Nyanza
- Nyaruguru
- Ruhango
- Ruhengeri
- Rutongo
- Rwamagana
- Other
- Other:

*Skip to question 34*

BURUNDI point of loading

28. Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- Bubanza
- Bujumbura
- Bururi
- Cankuzo
- Cibitoke
- Gitega
- Isale
- Karuzi
- Kayanza
- Kirundo
- Makamba
- Muramvya
- Muyinga
- Mwaro
- Ngozi
- Rumonge
- Rutana
- Ruyigi
- Other:

29. 5.1.1 Point of Loading ?/ Eneo la Kupakia mizigo?

*Mark only one oval.*

- Port
- Container Depot
- Warehouse/Godown
- Other:

*Skip to question 15*

BURUNDI point of discharge

30. 5.1 Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi?

*Mark only one oval.*

- Bubanza
- Bujumbura
- Bururi
- Cankuzo
- Cibitoke
- Gitega
- Isale
- Karuzi
- Kayanza
- Kirundo
- Makamba
- Muramvya
- Muyinga
- Mwaro
- Ngozi
- Rumonge
- Rutana
- Ruyigi
- Other:

*Skip to question 34*

SOUTH SUDAN point of loading

31. Point of Loading (Closest Commercial center)? / Ulipakia mizigo katika mji upi?

*Mark only one oval.*

- [ ] Akobo
- [ ] Aweil
- [ ] Ayod
- [ ] Bentiu
- [ ] Bor
- [ ] Cueibet
- [ ] Gogrial
- [ ] Juba
- [ ] Kapoeta
- [ ] Kodok
- [ ] Kuacjok
- [ ] Leer
- [ ] Maiwut
- [ ] Malakal
- [ ] Maridi
- [ ] Mayen Abun
- [ ] Mundri
- [ ] Nasir
- [ ] Pajok
- [ ] Pariang
- [ ] Pibor
- [ ] Raja
- [ ] Renk
- [ ] Rumbek
- [ ] Tambura
- [ ] Terekeka
- [ ] Tonj
- [ ] Torit
- [ ] Waat
- [ ] Wau
- [ ] Winejok
- [ ] Yambio

- Yei
- Yirol
- Other: _____

32. 5.1.1 Point of Loading? / Eneo la Kupakia mizigo?

*Mark only one oval.*

- Port
- Container Depot
- Warehouse/Godown
- Other: _____

*Skip to question 15*

SOUTH SUDAN point of discharge

33. Point of discharge (Closest Commercial center)? / Unapakua mizigo katika mji upi?

*Mark only one oval.*

- [ ] Akobo
- [ ] Aweil
- [ ] Ayod
- [ ] Bentiu
- [ ] Bor
- [ ] Cueibet
- [ ] Gogrial
- [ ] Juba
- [ ] Kapoeta Kodok
- [ ] Kuacjok
- [ ] Leer
- [ ] Maiwut
- [ ] Malakal
- [ ] Maridi
- [ ] Mayen Abun
- [ ] Mundri
- [ ] Nasir
- [ ] Pajok
- [ ] Pariang
- [ ] Pibor
- [ ] Raja
- [ ] Renk
- [ ] Rumbek
- [ ] Tambura
- [ ] Terekeka
- [ ] Tonj
- [ ] Torit
- [ ] Waat
- [ ] Wau
- [ ] Winejok
- [ ] Yambio Yei
- [ ] Yirol
- [ ] Other:

*Skip to question 34*

JOURNEY PARTICULARS

34. 5.3 What is the purpose of your trip? / Lengo la safari yako ni ipi?

*Mark only one oval.*

- Importation of cargo
- Exportation of cargo
- Local delivery
- Regional delivery
- Other:

35. 5.4 Date Journey Started? / Safari ilianza tarehe ipi?

*Example: January 7, 2019*

36. 5.4.1. Estimated date of arrival? / Unatarajia kuwasili tarehe gani?

*Example: January 7, 2019*

37. 5.5 Time Journey Started? / Safari ilianza saa ngapi?

*Example: 8:30 AM*

38. 5.5.1 Estimated Time of arrival? / Unatarajia kuwasili saa ngapi?

*Example: 8:30 AM*

39. 5.6 Number of Stops? / Idadi ya Kusimamishwa ? *

*Mark only one oval per row.*

| | 0 | 1 | 2 | 3 | 4 | 5 | More than 5 |
|---|---|---|---|---|---|---|---|
| Rest stop /ya kupumzika | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Police checks /Ukaguzi wa waeka usalama/Polisi | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Customs stop /kituo cha forodha | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Weighbridge stop /Daraja ya kupima uzito | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| O.G.A stops / mashirika mengine ya kiserekali | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Breakdown of vehicle /kuharibika kwa gari | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |

40. 5.7 How often do you make this trip? / Unafanya safari hii mara ngapi?

*Mark only one oval.*

- Daily
- Weekly
- Bi -weekly
- monthly
- quarterly
- yearly
- Other: _____

41. 5.8 What is the waiting time at the weighbridge? Muda wa kusubiri kwenye daraja la kupima uzito ni upi?

*Mark only one oval.*

- less than one hour
- 1-2 hours
- 2-6 hours
- 6 hours to 1 day
- 1 day
- 2 days
- 3 days
- more than 3 days

Other: _____

42. 5.9 How much time is spent resting? / Ni muda upi unatumika kupumzika?

*Mark only one oval.*

- less than one hour
- 1-2 hours
- 2-6 hours
- 6 hours to 1 day
- 1 day
- 2 days
- 3 days
- more than 3 days
- Other

43. 5.10 How much time is spent during checks by police or O.G.A? / Ni muda upi unatumika wakati wa ukaguzi na polisi au mashirika mengine ya kiserekali ?

*Mark only one oval.*

- less than one hour
- 1-2 hours
- 2-6 hours
- 6 hours to 1 day
- 1 day
- 2 days
- 3 days
- more than 3 days
- Other:

44. 5.11 What is the waiting time at the port? / Muda wa kusubiri bandarini ni upi?

*Mark only one oval.*

- Less than one day
- 1 day
- 2 days
- 3 days
- more than 3 days
- Other:

45. 5.12 Did you cross or do you expect to cross a border post control? / Ulivuka au unatarajia kuvuka udhibiti wa mpakani?

*Mark only one oval.*

- Yes
- No

46. 5.13 If Yes, What border post control did you cross? / Kama Ndio, ulipita au unatarajia kupita udhibiti gani wa mpaka?

47. 5.14 What day do you expect to cross the border? if applicable / Unatarajia kuvuka mpaka tarehe gani?

*Example: January 7*

48. 5.15 What time do you expect to cross the border? if applicable / Unatarajia kuvuka mpaka saa ngapi?

*Example: 8:30 AM*

UNOFFICIAL PAYMENTS

49. 6.1 Did the driver make any unofficial payments to any of these agents? (select all applicable) / Je dereva alifanya malipo yoyote yasiyo rasmi kwa yeyote kati ya mawakala hawa?

*Check all that apply.*

- [ ] Port officers /Afisa wa bandari
- [ ] Customs officers / Afisa wa forodha
- [ ] Police /Polisi/Waeka Usalama
- [ ] O.G.A / Mashirika mengine ya kiserekali

Other: [ ] _____

50. 6.2 In which country did the driver make unofficial payments? (Select all applicable) / Ni nchi ipi dereva alifanya malipo yasiyo rasmi? (Teua zozote zinazotumika)

*Check all that apply.*

- [ ] Burundi
- [ ] DR Congo
- [ ] Kenya
- [ ] Rwanda
- [ ] South Sudan
- [ ] Tanzania
- [ ] Uganda

Other: [ ] _____

51. 6.3 How much did they pay the port officers in these countries ( in local currencies) if applicable / Ulilipa kiasi kipi maafisa wa bandari katika nchi hizi ? (katika sarafu za ndani)

_____

52. 6.4 How much did they pay the customs officers in these countries ( in local currencies) if applicable / Ni kiasi kipi uliwalipa maafisa wa forodha katika nchi hizi? (katika sarafu za ndani)

_____

53. 6.5 How much did they pay the police in these countries ( in local currencies) if applicable / Ni kiasi kipi uliwalipa maafisa wa polisi katika nchi hizi? (katika sarafu za ndani)

_____

54. 6.6 How much did they pay O.G.A in these countries ( in local currencies) if applicable / Ulilipa kiasi kipi mashirika mengine ya kiserikali katika nchi hizi ( katika sarafu za ndani)

_____

55. 6.7. How much time is spent settling the unofficial payments?

_____

CHALLENGES

56. 7.1 Please rank the following challenges in order of their severity (1 =Not a challenge , 5 =Severe challenge) /Tafadhali weka Changamoto zifuatazo kwa utaratibu wa ugumu wao

*Mark only one oval per row.*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Border Post Issues /Udhibiti wa mpaka | ◯ | ◯ | ◯ | ◯ | ◯ |
| Police Checks /Ukaguzi wa polisi | ◯ | ◯ | ◯ | ◯ | ◯ |
| Port Issues /Masuala ya bandari | ◯ | ◯ | ◯ | ◯ | ◯ |
| Road Conditions / Hali ya barabara | ◯ | ◯ | ◯ | ◯ | ◯ |
| Security / Usalama | ◯ | ◯ | ◯ | ◯ | ◯ |
| Vehicle Conditions and breakdown /Kuharibika kwa gari | ◯ | ◯ | ◯ | ◯ | ◯ |
| Weigh Bridge Issues / Masuala ya Daraja ya kupima uzito | ◯ | ◯ | ◯ | ◯ | ◯ |
| Weather Conditions /hali ya anga | ◯ | ◯ | ◯ | ◯ | ◯ |

57. 7.2 Any other information on challenges during transportation of the goods? (describe here)
/ Taarifa nyingine yoyote juu ya changamoto ya usafirishaji wa mizigo? (Elezea hapa)

## Appendix VI - RAATTE Tools - TCC Questionnaire

**STATION:**

**DIRECTION :**

| | Time | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | |
| SATURDAY | | DIRECTION : | | | | | | | | | | | | | |
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | |
| Day 1 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | Total |
| | 06:00 - 06:15 | | | | | | | | | | | | | | 0 |
| | 06:15 - 06:30 | | | | | | | | | | | | | | 0 |
| | 06:30 - 06:45 | | | | | | | | | | | | | | 0 |
| | 06:45 - 07:00 | | | | | | | | | | | | | | 0 |
| | 07:00 - 07:15 | | | | | | | | | | | | | | 0 |
| | 07:15 - 07:30 | | | | | | | | | | | | | | 0 |
| | 07:30 - 07:45 | | | | | | | | | | | | | | 0 |
| | 07:45 - 08:00 | | | | | | | | | | | | | | 0 |
| | 08:00 - 08:15 | | | | | | | | | | | | | | 0 |
| | 08:15 - 08:30 | | | | | | | | | | | | | | 0 |
| | 08:30 - 08:45 | | | | | | | | | | | | | | 0 |
| | 08:45 - 09:00 | | | | | | | | | | | | | | 0 |
| | 09:00 - 09:15 | | | | | | | | | | | | | | 0 |
| | 09:15 - 09:30 | | | | | | | | | | | | | | 0 |
| | 09:30 - 09:45 | | | | | | | | | | | | | | 0 |
| | 09:45 - 10:00 | | | | | | | | | | | | | | 0 |
| | 10:00 - 10:15 | | | | | | | | | | | | | | 0 |
| | 10:15 - 10:30 | | | | | | | | | | | | | | 0 |
| | 10:30 - 10:45 | | | | | | | | | | | | | | 0 |
| | 10:45 - 11:00 | | | | | | | | | | | | | | 0 |
| | 11:00 - 11:15 | | | | | | | | | | | | | | 0 |
| | 11:15 - 11:30 | | | | | | | | | | | | | | 0 |
| | 11:30 - 11:45 | | | | | | | | | | | | | | 0 |
| | 11:45 - 12:00 | | | | | | | | | | | | | | 0 |
| | 12:00 - 12:15 | | | | | | | | | | | | | | 0 |
| | 12:15 - 12:30 | | | | | | | | | | | | | | 0 |
| | 12:30 - 12:45 | | | | | | | | | | | | | | 0 |
| | 12:45 - 13:00 | | | | | | | | | | | | | | 0 |
| | 13:00 - 13:15 | | | | | | | | | | | | | | 0 |
| | 13:15 - 13:30 | | | | | | | | | | | | | | 0 |
| | 13:30 - 13:45 | | | | | | | | | | | | | | 0 |
| | 13:45 - 14:00 | | | | | | | | | | | | | | 0 |
| | 14:00 - 14:15 | | | | | | | | | | | | | | 0 |
| | 14:15 - 14:30 | | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | | 0 |
| DAY & TIME | 18:00 - 18:15 | | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20:15 - 20:30 | | | | | | | | | | | | | | 0 |
| 20:30 - 20:45 | | | | | | | | | | | | | | 0 |
| 20:45 - 21:00 | | | | | | | | | | | | | | 0 |
| 21:00 - 21:15 | | | | | | | | | | | | | | 0 |
| 21:15 - 21:30 | | | | | | | | | | | | | | 0 |
| 21:30 - 21:45 | | | | | | | | | | | | | | 0 |
| 21:45 -22:00 | | | | | | | | | | | | | | 0 |
| 22:00 - 22:15 | | | | | | | | | | | | | | 0 |
| 22:15 - 22:30 | | | | | | | | | | | | | | 0 |
| 22:30 - 22:45 | | | | | | | | | | | | | | 0 |
| 22:45 - 23:00 | | | | | | | | | | | | | | 0 |
| 23:00 - 23:15 | | | | | | | | | | | | | | 0 |
| 23:15 - 23:30 | | | | | | | | | | | | | | 0 |
| 23:30 - 23:45 | | | | | | | | | | | | | | 0 |
| 23:45 - 00:00 | | | | | | | | | | | | | | 0 |
| 00:00 - 00:15 | | | | | | | | | | | | | | 0 |
| 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| 02:00 - 02:15 | | | | | | | | | | | | | | 0 |
| 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 Hour Weekend Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| SUNDAY | DIRECTION : | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | Total |
| Day 2 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | |
| | 06:00 - 06:15 | | | | | | | | | | | | | | 0 |
| | 06:15 - 06:30 | | | | | | | | | | | | | | 0 |
| | 06:30 - 06:45 | | | | | | | | | | | | | | 0 |
| | 06:45 - 07:00 | | | | | | | | | | | | | | 0 |
| | 07:00 - 07:15 | | | | | | | | | | | | | | 0 |
| | 07:15 - 07:30 | | | | | | | | | | | | | | 0 |
| | 07:30 - 07:45 | | | | | | | | | | | | | | 0 |
| | 07:45 - 08:00 | | | | | | | | | | | | | | 0 |
| | 08:00 - 08:15 | | | | | | | | | | | | | | 0 |
| | 08:15 - 08:30 | | | | | | | | | | | | | | 0 |
| | 08:30 - 08:45 | | | | | | | | | | | | | | 0 |
| | 08:45 - 09:00 | | | | | | | | | | | | | | 0 |
| | 09:00 - 09:15 | | | | | | | | | | | | | | 0 |
| | 09:15 - 09:30 | | | | | | | | | | | | | | 0 |
| | 09:30 - 09:45 | | | | | | | | | | | | | | 0 |
| | 09:45 - 10:00 | | | | | | | | | | | | | | 0 |
| | 10:00 - 10:15 | | | | | | | | | | | | | | 0 |
| | 10:15 - 10:30 | | | | | | | | | | | | | | 0 |
| | 10:30 - 10:45 | | | | | | | | | | | | | | 0 |
| | 10:45 - 11:00 | | | | | | | | | | | | | | 0 |
| | 11:00 - 11:15 | | | | | | | | | | | | | | 0 |
| | 11:15 - 11:30 | | | | | | | | | | | | | | 0 |
| | 11:30 - 11:45 | | | | | | | | | | | | | | 0 |
| | 11:45 - 12:00 | | | | | | | | | | | | | | 0 |
| | 12:00 - 12:15 | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| DAY & TIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12:15 - 12:30 | | | | | | | | | | | | | 0 |
| | 12:30 - 12:45 | | | | | | | | | | | | | 0 |
| | 12:45 - 13:00 | | | | | | | | | | | | | 0 |
| | 13:00 - 13:15 | | | | | | | | | | | | | 0 |
| | 13:15 - 13:30 | | | | | | | | | | | | | 0 |
| | 13:30 - 13:45 | | | | | | | | | | | | | 0 |
| | 13:45 - 14:00 | | | | | | | | | | | | | 0 |
| | 14:00 - 14:15 | | | | | | | | | | | | | 0 |
| | 14:15 - 14:30 | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | 0 |
| | 18:00 - 18:15 | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | 0 |
| | 22:15 - 22:30 | | | | | | | | | | | | | 0 |
| | 22:30 - 22:45 | | | | | | | | | | | | | 0 |
| | 22:45 - 23:00 | | | | | | | | | | | | | 0 |
| | 23:00 - 23:15 | | | | | | | | | | | | | 0 |
| | 23:15 - 23:30 | | | | | | | | | | | | | 0 |
| | 23:30 - 23:45 | | | | | | | | | | | | | 0 |
| | 23:45 - 00:00 | | | | | | | | | | | | | 0 |
| | 00:00 - 00:15 | | | | | | | | | | | | | 0 |
| | 00:15 - 00:30 | | | | | | | | | | | | | 0 |
| | 00:30 - 00:45 | | | | | | | | | | | | | 0 |
| | 00:45 - 01:00 | | | | | | | | | | | | | 0 |
| | 01:00 - 01:15 | | | | | | | | | | | | | 0 |
| | 01:15 - 01:30 | | | | | | | | | | | | | 0 |
| | 01:30 - 01:45 | | | | | | | | | | | | | 0 |
| | 01:45 - 02:00 | | | | | | | | | | | | | 0 |
| | 02:00 - 02:15 | | | | | | | | | | | | | 0 |
| | 02:15 - 02:30 | | | | | | | | | | | | | 0 |
| | 02:30 - 02:45 | | | | | | | | | | | | | 0 |
| | 02:45 - 03:00 | | | | | | | | | | | | | 0 |
| | 03:00 - 03:15 | | | | | | | | | | | | | 0 |
| | 03:15 - 03:30 | | | | | | | | | | | | | 0 |
| | 03:30 - 03:45 | | | | | | | | | | | | | 0 |
| | 03:45 - 04:00 | | | | | | | | | | | | | 0 |
| | 04:00 - 04:15 | | | | | | | | | | | | | 0 |
| | 04:15 - 04:30 | | | | | | | | | | | | | 0 |
| | 04:30 - 04:45 | | | | | | | | | | | | | 0 |
| | 04:45 - 05:00 | | | | | | | | | | | | | 0 |
| | 05:00 - 05:15 | | | | | | | | | | | | | 0 |
| | 05:15 - 05:30 | | | | | | | | | | | | | 0 |
| | 05:30 - 05:45 | | | | | | | | | | | | | 0 |
| | 05:45 - 06:00 | | | | | | | | | | | | | 0 |
| | Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 24 Hour Weekend Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MONDAY | | DIRECTION : | | | | | | | | | | | | | |
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | Total |
| Day 3 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | |
| | 06:00 - 06:15 | | | | | | | | | | | | | | 0 |
| | 06:15 - 06:30 | | | | | | | | | | | | | | 0 |
| | 06:30 - 06:45 | | | | | | | | | | | | | | 0 |
| | 06:45 - 07:00 | | | | | | | | | | | | | | 0 |
| | 07:00 - 07:15 | | | | | | | | | | | | | | 0 |
| | 07:15 - 07:30 | | | | | | | | | | | | | | 0 |
| | 07:30 - 07:45 | | | | | | | | | | | | | | 0 |
| | 07:45 - 08:00 | | | | | | | | | | | | | | 0 |
| | 08:00 - 08:15 | | | | | | | | | | | | | | 0 |
| | 08:15 - 08:30 | | | | | | | | | | | | | | 0 |
| | 08:30 - 08:45 | | | | | | | | | | | | | | 0 |
| | 08:45 - 09:00 | | | | | | | | | | | | | | 0 |
| | 09:00 - 09:15 | | | | | | | | | | | | | | 0 |
| | 09:15 - 09:30 | | | | | | | | | | | | | | 0 |
| | 09:30 - 09:45 | | | | | | | | | | | | | | 0 |
| | 09:45 - 10:00 | | | | | | | | | | | | | | 0 |
| | 10:00 - 10:15 | | | | | | | | | | | | | | 0 |
| | 10:15 - 10:30 | | | | | | | | | | | | | | 0 |
| | 10:30 - 10:45 | | | | | | | | | | | | | | 0 |
| | 10:45 - 11:00 | | | | | | | | | | | | | | 0 |
| | 11:00 - 11:15 | | | | | | | | | | | | | | 0 |
| | 11:15 - 11:30 | | | | | | | | | | | | | | 0 |
| | 11:30 - 11:45 | | | | | | | | | | | | | | 0 |
| | 11:45 - 12:00 | | | | | | | | | | | | | | 0 |
| | 12:00 - 12:15 | | | | | | | | | | | | | | 0 |
| | 12:15 - 12:30 | | | | | | | | | | | | | | 0 |
| | 12:30 - 12:45 | | | | | | | | | | | | | | 0 |
| | 12:45 - 13:00 | | | | | | | | | | | | | | 0 |
| | 13:00 - 13:15 | | | | | | | | | | | | | | 0 |
| | 13:15 - 13:30 | | | | | | | | | | | | | | 0 |
| | 13:30 - 13:45 | | | | | | | | | | | | | | 0 |
| | 13:45 - 14:00 | | | | | | | | | | | | | | 0 |
| | 14:00 - 14:15 | | | | | | | | | | | | | | 0 |
| | 14:15 - 14:30 | | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | | 0 |
| DAY & TIME | 18:00 - 18:15 | | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22:15 - 22:30 | | | | | | | | | | | | | | 0 |
| 22:30 - 22:45 | | | | | | | | | | | | | | 0 |
| 22:45 - 23:00 | | | | | | | | | | | | | | 0 |
| 23:00 - 23:15 | | | | | | | | | | | | | | 0 |
| 23:15 - 23:30 | | | | | | | | | | | | | | 0 |
| 23:30 - 23:45 | | | | | | | | | | | | | | 0 |
| 23:45 - 00:00 | | | | | | | | | | | | | | 0 |
| 00:00 - 00:15 | | | | | | | | | | | | | | 0 |
| 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| 02:00 - 02:15 | | | | | | | | | | | | | | 0 |
| 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 Hour Weekday Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

[redacted]

| TUESDAY | DIRECTION : | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | |
| Day 4 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | Total |
| 06:00 - 06:15 | | | | | | | | | | | | | | | 0 |
| 06:15 - 06:30 | | | | | | | | | | | | | | | 0 |
| 06:30 - 06:45 | | | | | | | | | | | | | | | 0 |
| 06:45 - 07:00 | | | | | | | | | | | | | | | 0 |
| 07:00 - 07:15 | | | | | | | | | | | | | | | 0 |
| 07:15 - 07:30 | | | | | | | | | | | | | | | 0 |
| 07:30 - 07:45 | | | | | | | | | | | | | | | 0 |
| 07:45 - 08:00 | | | | | | | | | | | | | | | 0 |
| 08:00 - 08:15 | | | | | | | | | | | | | | | 0 |
| 08:15 - 08:30 | | | | | | | | | | | | | | | 0 |
| 08:30 - 08:45 | | | | | | | | | | | | | | | 0 |
| 08:45 - 09:00 | | | | | | | | | | | | | | | 0 |
| 09:00 - 09:15 | | | | | | | | | | | | | | | 0 |
| 09:15 - 09:30 | | | | | | | | | | | | | | | 0 |
| 09:30 - 09:45 | | | | | | | | | | | | | | | 0 |
| 09:45 - 10:00 | | | | | | | | | | | | | | | 0 |
| 10:00 - 10:15 | | | | | | | | | | | | | | | 0 |
| 10:15 - 10:30 | | | | | | | | | | | | | | | 0 |
| 10:30 - 10:45 | | | | | | | | | | | | | | | 0 |
| 10:45 - 11:00 | | | | | | | | | | | | | | | 0 |
| 11:00 - 11:15 | | | | | | | | | | | | | | | 0 |
| 11:15 - 11:30 | | | | | | | | | | | | | | | 0 |
| 11:30 - 11:45 | | | | | | | | | | | | | | | 0 |
| 11:45 - 12:00 | | | | | | | | | | | | | | | 0 |
| 12:00 - 12:15 | | | | | | | | | | | | | | | 0 |
| 12:15 - 12:30 | | | | | | | | | | | | | | | 0 |
| 12:30 - 12:45 | | | | | | | | | | | | | | | 0 |
| 12:45 - 13:00 | | | | | | | | | | | | | | | 0 |
| 13:00 - 13:15 | | | | | | | | | | | | | | | 0 |
| 13:15 - 13:30 | | | | | | | | | | | | | | | 0 |
| 13:30 - 13:45 | | | | | | | | | | | | | | | 0 |
| 13:45 - 14:00 | | | | | | | | | | | | | | | 0 |
| 14:00 - 14:15 | | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| DAY & TIME | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14:15 - 14:30 | | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | | 0 |
| | 18:00 - 18:15 | | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | | 0 |
| | 22:15 - 22:30 | | | | | | | | | | | | | | 0 |
| | 22:30 - 22:45 | | | | | | | | | | | | | | 0 |
| | 22:45 - 23:00 | | | | | | | | | | | | | | 0 |
| | 23:00 - 23:15 | | | | | | | | | | | | | | 0 |
| | 23:15 - 23:30 | | | | | | | | | | | | | | 0 |
| | 23:30 - 23:45 | | | | | | | | | | | | | | 0 |
| | 23:45 - 00:00 | | | | | | | | | | | | | | 0 |
| | 00:00 - 00:15 | | | | | | | | | | | | | | 0 |
| | 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| | 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| | 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| | 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| | 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| | 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| | 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| | 02:00 - 02:15 | | | | | | | | | | | | | | 0 |
| | 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| | 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| | 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| | 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| | 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| | 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| | 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| | 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| | 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| | 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| | 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| | 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| | 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| | 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| | 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| | Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 24 Hour Weekday Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| WEDNESDAY | DIRECTION : | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | |
| DAY 5 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | Total |
| | 06:00 - 06:15 | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |

| DAY & TIME | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 06:15 - 06:30 | | | | | | | | | | | | | 0 |
| | 06:30 - 06:45 | | | | | | | | | | | | | 0 |
| | 06:45 - 07:00 | | | | | | | | | | | | | 0 |
| | 07:00 - 07:15 | | | | | | | | | | | | | 0 |
| | 07:15 - 07:30 | | | | | | | | | | | | | 0 |
| | 07:30 - 07:45 | | | | | | | | | | | | | 0 |
| | 07:45 - 08:00 | | | | | | | | | | | | | 0 |
| | 08:00 - 08:15 | | | | | | | | | | | | | 0 |
| | 08:15 - 08:30 | | | | | | | | | | | | | 0 |
| | 08:30 - 08:45 | | | | | | | | | | | | | 0 |
| | 08:45 - 09:00 | | | | | | | | | | | | | 0 |
| | 09:00 - 09:15 | | | | | | | | | | | | | 0 |
| | 09:15 - 09:30 | | | | | | | | | | | | | 0 |
| | 09:30 - 09:45 | | | | | | | | | | | | | 0 |
| | 09:45 - 10:00 | | | | | | | | | | | | | 0 |
| | 10:00 - 10:15 | | | | | | | | | | | | | 0 |
| | 10:15 - 10:30 | | | | | | | | | | | | | 0 |
| | 10:30 - 10:45 | | | | | | | | | | | | | 0 |
| | 10:45 - 11:00 | | | | | | | | | | | | | 0 |
| | 11:00 - 11:15 | | | | | | | | | | | | | 0 |
| | 11:15 - 11:30 | | | | | | | | | | | | | 0 |
| | 11:30 - 11:45 | | | | | | | | | | | | | 0 |
| | 11:45 - 12:00 | | | | | | | | | | | | | 0 |
| | 12:00 - 12:15 | | | | | | | | | | | | | 0 |
| | 12:15 - 12:30 | | | | | | | | | | | | | 0 |
| | 12:30 - 12:45 | | | | | | | | | | | | | 0 |
| | 12:45 - 13:00 | | | | | | | | | | | | | 0 |
| | 13:00 - 13:15 | | | | | | | | | | | | | 0 |
| | 13:15 - 13:30 | | | | | | | | | | | | | 0 |
| | 13:30 - 13:45 | | | | | | | | | | | | | 0 |
| | 13:45 - 14:00 | | | | | | | | | | | | | 0 |
| | 14:00 - 14:15 | | | | | | | | | | | | | 0 |
| | 14:15 - 14:30 | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | 0 |
| | 18:00 - 18:15 | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | 0 |
| | 22:15 - 22:30 | | | | | | | | | | | | | 0 |
| | 22:30 - 22:45 | | | | | | | | | | | | | 0 |
| | 22:45 - 23:00 | | | | | | | | | | | | | 0 |
| | 23:00 - 23:15 | | | | | | | | | | | | | 0 |
| | 23:15 - 23:30 | | | | | | | | | | | | | 0 |
| | 23:30 - 23:45 | | | | | | | | | | | | | 0 |
| | 23:45 - 00:00 | | | | | | | | | | | | | 0 |
| | 00:00 - 00:15 | | | | | | | | | | | | | 0 |

| | |
|---|---|
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| 02:00 - 02:15 | | | | | | | | | | | | | | 0 |
| 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 Hour Weekday Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| THURSDAY | DIRECTION : | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | Total |
| DAY 6 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | |
| 06:00 - 06:15 | | | | | | | | | | | | | | 0 | |
| 06:15 - 06:30 | | | | | | | | | | | | | | 0 | |
| 06:30 - 06:45 | | | | | | | | | | | | | | 0 | |
| 06:45 - 07:00 | | | | | | | | | | | | | | 0 | |
| 07:00 - 07:15 | | | | | | | | | | | | | | 0 | |
| 07:15 - 07:30 | | | | | | | | | | | | | | 0 | |
| 07:30 - 07:45 | | | | | | | | | | | | | | 0 | |
| 07:45 - 08:00 | | | | | | | | | | | | | | 0 | |
| 08:00 - 08:15 | | | | | | | | | | | | | | 0 | |
| 08:15 - 08:30 | | | | | | | | | | | | | | 0 | |
| 08:30 - 08:45 | | | | | | | | | | | | | | 0 | |
| 08:45 - 09:00 | | | | | | | | | | | | | | 0 | |
| 09:00 - 09:15 | | | | | | | | | | | | | | 0 | |
| 09:15 - 09:30 | | | | | | | | | | | | | | 0 | |
| 09:30 - 09:45 | | | | | | | | | | | | | | 0 | |
| 09:45 - 10:00 | | | | | | | | | | | | | | 0 | |
| 10:00 - 10:15 | | | | | | | | | | | | | | 0 | |
| 10:15 - 10:30 | | | | | | | | | | | | | | 0 | |
| 10:30 - 10:45 | | | | | | | | | | | | | | 0 | |
| 10:45 - 11:00 | | | | | | | | | | | | | | 0 | |
| 11:00 - 11:15 | | | | | | | | | | | | | | 0 | |
| 11:15 - 11:30 | | | | | | | | | | | | | | 0 | |
| 11:30 - 11:45 | | | | | | | | | | | | | | 0 | |
| 11:45 - 12:00 | | | | | | | | | | | | | | 0 | |
| 12:00 - 12:15 | | | | | | | | | | | | | | 0 | |
| 12:15 - 12:30 | | | | | | | | | | | | | | 0 | |
| 12:30 - 12:45 | | | | | | | | | | | | | | 0 | |
| 12:45 - 13:00 | | | | | | | | | | | | | | 0 | |
| 13:00 - 13:15 | | | | | | | | | | | | | | 0 | |
| 13:15 - 13:30 | | | | | | | | | | | | | | 0 | |
| 13:30 - 13:45 | | | | | | | | | | | | | | 0 | |
| 13:45 - 14:00 | | | | | | | | | | | | | | 0 | |
| 14:00 - 14:15 | | | | | | | | | | | | | | 0 | |
| 14:15 - 14:30 | | | | | | | | | | | | | | 0 | |
| 14:30 - 14:45 | | | | | | | | | | | | | | 0 | |
| 14:45 - 15:00 | | | | | | | | | | | | | | 0 | |
| 15:00 - 15:15 | | | | | | | | | | | | | | 0 | |
| 15:15 - 15:30 | | | | | | | | | | | | | | 0 | |
| 15:30 - 15:45 | | | | | | | | | | | | | | 0 | |
| 15:45 - 16:00 | | | | | | | | | | | | | | 0 | |
| 16:00 - 16:15 | | | | | | | | | | | | | | 0 | |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| DAY & TIME | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16:15 - 16:30 | | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | | 0 |
| | 18:00 - 18:15 | | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | | 0 |
| | 22:15 - 22:30 | | | | | | | | | | | | | | 0 |
| | 22:30 - 22:45 | | | | | | | | | | | | | | 0 |
| | 22:45 - 23:00 | | | | | | | | | | | | | | 0 |
| | 23:00 - 23:15 | | | | | | | | | | | | | | 0 |
| | 23:15 - 23:30 | | | | | | | | | | | | | | 0 |
| | 23:30 - 23:45 | | | | | | | | | | | | | | 0 |
| | 23:45 - 00:00 | | | | | | | | | | | | | | 0 |
| | 00:00 - 00:15 | | | | | | | | | | | | | | 0 |
| | 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| | 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| | 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| | 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| | 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| | 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| | 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| | 02:00 - 02:15 | | | | | | | | | | | | | | 0 |
| | 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| | 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| | 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| | 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| | 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| | 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| | 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| | 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| | 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| | 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| | 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| | 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| | 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| | 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| | 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| | Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 24 Hour Weekday Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| FRIDAY | DIRECTION : | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | ?? | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER | Total |
| DAY 7 | Time | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/ Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER | |
| | 06:00 - 06:15 | | | | | | | | | | | | | | 0 |
| | 06:15 - 06:30 | | | | | | | | | | | | | | 0 |
| | 06:30 - 06:45 | | | | | | | | | | | | | | 0 |
| | 06:45 - 07:00 | | | | | | | | | | | | | | 0 |
| | 07:00 - 07:15 | | | | | | | | | | | | | | 0 |
| | 07:15 - 07:30 | | | | | | | | | | | | | | 0 |
| | 07:30 - 07:45 | | | | | | | | | | | | | | 0 |
| | 07:45 - 08:00 | | | | | | | | | | | | | | 0 |
| | 08:00 - 08:15 | | | | | | | | | | | | | | 0 |

| Vehicle Type | Total Traffic |
|---|---|
| TUKTUK | 0 |
| Personal Vehicles/Small Vehicles | 0 |
| Pick-Up | 0 |
| Commercial Bus-Minibus | 0 |
| Commercial Bus - Coaster | 0 |
| Commercial Bus -Coach | 0 |
| Light Truck/LGV | 0 |
| Medium/Heavy Truck | 0 |
| Container Trailer | 0 |

| DAY & TIME | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 08:15 - 08:30 | | | | | | | | | | | | | | 0 |
| | 08:30 - 08:45 | | | | | | | | | | | | | | 0 |
| | 08:45 - 09:00 | | | | | | | | | | | | | | 0 |
| | 09:00 - 09:15 | | | | | | | | | | | | | | 0 |
| | 09:15 - 09:30 | | | | | | | | | | | | | | 0 |
| | 09:30 - 09:45 | | | | | | | | | | | | | | 0 |
| | 09:45 - 10:00 | | | | | | | | | | | | | | 0 |
| | 10:00 - 10:15 | | | | | | | | | | | | | | 0 |
| | 10:15 - 10:30 | | | | | | | | | | | | | | 0 |
| | 10:30 - 10:45 | | | | | | | | | | | | | | 0 |
| | 10:45 - 11:00 | | | | | | | | | | | | | | 0 |
| | 11:00 - 11:15 | | | | | | | | | | | | | | 0 |
| | 11:15 - 11:30 | | | | | | | | | | | | | | 0 |
| | 11:30 - 11:45 | | | | | | | | | | | | | | 0 |
| | 11:45 - 12:00 | | | | | | | | | | | | | | 0 |
| | 12:00 - 12:15 | | | | | | | | | | | | | | 0 |
| | 12:15 - 12:30 | | | | | | | | | | | | | | 0 |
| | 12:30 - 12:45 | | | | | | | | | | | | | | 0 |
| | 12:45 - 13:00 | | | | | | | | | | | | | | 0 |
| | 13:00 - 13:15 | | | | | | | | | | | | | | 0 |
| | 13:15 - 13:30 | | | | | | | | | | | | | | 0 |
| | 13:30 - 13:45 | | | | | | | | | | | | | | 0 |
| | 13:45 - 14:00 | | | | | | | | | | | | | | 0 |
| | 14:00 - 14:15 | | | | | | | | | | | | | | 0 |
| | 14:15 - 14:30 | | | | | | | | | | | | | | 0 |
| | 14:30 - 14:45 | | | | | | | | | | | | | | 0 |
| | 14:45 - 15:00 | | | | | | | | | | | | | | 0 |
| | 15:00 - 15:15 | | | | | | | | | | | | | | 0 |
| | 15:15 - 15:30 | | | | | | | | | | | | | | 0 |
| | 15:30 - 15:45 | | | | | | | | | | | | | | 0 |
| | 15:45 - 16:00 | | | | | | | | | | | | | | 0 |
| | 16:00 - 16:15 | | | | | | | | | | | | | | 0 |
| | 16:15 - 16:30 | | | | | | | | | | | | | | 0 |
| | 16:30 - 16:45 | | | | | | | | | | | | | | 0 |
| | 16:45 - 17:00 | | | | | | | | | | | | | | 0 |
| | 17:00 - 17:15 | | | | | | | | | | | | | | 0 |
| | 17:15 - 17:30 | | | | | | | | | | | | | | 0 |
| | 17:30 - 17:45 | | | | | | | | | | | | | | 0 |
| | 17:45 - 18:00 | | | | | | | | | | | | | | 0 |
| | 18:00 - 18:15 | | | | | | | | | | | | | | 0 |
| | 18:15 - 18:30 | | | | | | | | | | | | | | 0 |
| | 18:30 - 18:45 | | | | | | | | | | | | | | 0 |
| | 18:45 - 19:00 | | | | | | | | | | | | | | 0 |
| | 19:00 - 19:15 | | | | | | | | | | | | | | 0 |
| | 19:15 - 19:30 | | | | | | | | | | | | | | 0 |
| | 19:30 - 19:45 | | | | | | | | | | | | | | 0 |
| | 19:45 - 20:00 | | | | | | | | | | | | | | 0 |
| | 20:00 - 20:15 | | | | | | | | | | | | | | 0 |
| | 20:15 - 20:30 | | | | | | | | | | | | | | 0 |
| | 20:30 - 20:45 | | | | | | | | | | | | | | 0 |
| | 20:45 - 21:00 | | | | | | | | | | | | | | 0 |
| | 21:00 - 21:15 | | | | | | | | | | | | | | 0 |
| | 21:15 - 21:30 | | | | | | | | | | | | | | 0 |
| | 21:30 - 21:45 | | | | | | | | | | | | | | 0 |
| | 21:45 -22:00 | | | | | | | | | | | | | | 0 |
| | 22:00 - 22:15 | | | | | | | | | | | | | | 0 |
| | 22:15 - 22:30 | | | | | | | | | | | | | | 0 |
| | 22:30 - 22:45 | | | | | | | | | | | | | | 0 |
| | 22:45 - 23:00 | | | | | | | | | | | | | | 0 |
| | 23:00 - 23:15 | | | | | | | | | | | | | | 0 |
| | 23:15 - 23:30 | | | | | | | | | | | | | | 0 |
| | 23:30 - 23:45 | | | | | | | | | | | | | | 0 |
| | 23:45 - 00:00 | | | | | | | | | | | | | | 0 |
| | 00:00 - 00:15 | | | | | | | | | | | | | | 0 |
| | 00:15 - 00:30 | | | | | | | | | | | | | | 0 |
| | 00:30 - 00:45 | | | | | | | | | | | | | | 0 |
| | 00:45 - 01:00 | | | | | | | | | | | | | | 0 |
| | 01:00 - 01:15 | | | | | | | | | | | | | | 0 |
| | 01:15 - 01:30 | | | | | | | | | | | | | | 0 |
| | 01:30 - 01:45 | | | | | | | | | | | | | | 0 |
| | 01:45 - 02:00 | | | | | | | | | | | | | | 0 |
| | 02:00 - 02:15 | | | | | | | | | | | | | | 0 |

| | |
|---|---|
| Fuel Tanker | 0 |
| Break Bulk Trailer | 0 |
| Bulk Trailer | 0 |
| OTHER | 0 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 02:15 - 02:30 | | | | | | | | | | | | | | 0 |
| 02:30 - 02:45 | | | | | | | | | | | | | | 0 |
| 02:45 - 03:00 | | | | | | | | | | | | | | 0 |
| 03:00 - 03:15 | | | | | | | | | | | | | | 0 |
| 03:15 - 03:30 | | | | | | | | | | | | | | 0 |
| 03:30 - 03:45 | | | | | | | | | | | | | | 0 |
| 03:45 - 04:00 | | | | | | | | | | | | | | 0 |
| 04:00 - 04:15 | | | | | | | | | | | | | | 0 |
| 04:15 - 04:30 | | | | | | | | | | | | | | 0 |
| 04:30 - 04:45 | | | | | | | | | | | | | | 0 |
| 04:45 - 05:00 | | | | | | | | | | | | | | 0 |
| 05:00 - 05:15 | | | | | | | | | | | | | | 0 |
| 05:15 - 05:30 | | | | | | | | | | | | | | 0 |
| 05:30 - 05:45 | | | | | | | | | | | | | | 0 |
| 05:45 - 06:00 | | | | | | | | | | | | | | 0 |
| Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 Hour Weekday Ratio | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Grand Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| | | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SATURDAY | Station ????? | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER |
| | Total 12 Hour Count (6am to 6pm) | | | | | | | | | | | | | |
| | Total 12 Hour Count (6pm to 6am) | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | |
| | 24 Hour Weekend Ratio | | | | | | | | | | | | | |

| | | PASSENGER VEHILCES | | | | | | GOODS VEHICLES | | | | | | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WEDNESDAY | Station ????? | TUKTUK | Personal Vehicles/Small Vehicles | Pick-Up | Commercial Bus-Minibus | Commercial Bus - Coaster | Commercial Bus - Coach | Light Truck/LGV | Medium/Heavy Truck | Container Trailer | Fuel Tanker | Break Bulk Trailer | Bulk Trailer | OTHER |
| | Total 12 Hour Count (6am to 6pm) | | | | | | | | | | | | | |
| | Total 12 Hour Count (6pm to 6am) | | | | | | | | | | | | | |
| | Total | | | | | | | | | | | | | |
| | 24 Hour Weekday | | | | | | | | | | | | | |

| Vehicle Type | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|
| TUKTUK | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Personal Vehicles/Small Vehicles | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pick-Up | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commercial Bus-Minibus | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commercial Bus - Coaster | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Commercial Bus -Coach | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Light Truck/LGV | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Medium/Heavy Truck | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Container Trailer | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fuel Tanker | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Break Bulk Trailer | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bulk Trailer | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| OTHER | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Appendix VII - RAATTE Tools - Freight Cost Questionnaire

Africa Economic and Social Development Consultants Ltd

Dear Respondent,

RE: **REGIONAL ANALYTICAL ANALYSIS OF TRENDS IN TRADE AND TRANSPORT IN EAST AFRICA**

You are invited to take part in the above-referenced survey.

The permanent secretariats of the East African Community (EAC), the Northern Corridor Transit Transport Coordination Authority (NCTTCA), the Central Corridor Transit Transport Facilitation Agency (CCTTFA) and Dar es Salaam Corridor Committee (DCC) with support of TradeMark East Africa have commissioned Africa Economic and Social Development Consultants (Nairobi, Kenya) and COWI A/S (Copenhagen Denmark) to undertake a study on regional trends in trade and transport in East Africa.

This survey collects information on key drivers of the cost of freight transport across East Africa and the results will be used to enhance transport efficiency, including reduction of costs of transport across the region. In this survey, we will ask you to complete an electronic survey and upload a completed a Microsoft excel spread shit both which are attached at the bottom of this email.

The survey should take only 30 minutes to complete. You will, however, need to work with your organizations finance, transport, human resource, maintenance, and commercial functions in your organization to effectively complete this survey.

The survey collects no identifying information of any respondent. All the response in the survey will be recorded anonymously.

For any clarifications kindly contact:

Mr. David Adolwa Project Director — Tell: 0722754969 — Email: David.adolwa@aesdc.com

Yours Faithfully

David Adolwa
Managing Director

INFORMED • CONNECTED • COMPETITIVE • SUSTAINABLE

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You are invited to take part in the above-referenced survey. *

The permanent secretariat's of the East African Community (EAC), the Northern Corridor Transit Transport Coordination Authority (NCTTCA), the Central Corridor Transit Transport Facilitation Agency (CCTTFA) and Dar es Salaam Corridor Committee (DCC) with support of TradeMark East Africa have commissioned Africa Economic and Social Development Consultants (Nairobi, Kenya) and COWI A/S (Copenhagen Denmark) to undertake a study on regional trends in trade and transport in East Africa.

This survey collects information on key drivers of the cost of freight transport across East Africa and the results will be used to enhance transport efficiency, including reduction of costs of transport across the region.

The survey should take only 30 minutes to complete. You will, however, need to work with your organizations finance, transport, human resource, maintenance, and commercial functions in your organization to effectively complete this survey.

The survey collects no identifying information of any respondent. All the response in the survey will be recorded anonymously.

If you have any questions regarding the survey in general, please contact Mr David Adolwa the Project Director at Email : david.adolwa@aesdc.com & telephone number: +254702998877.

Do you consent to proceed with the interview?

- ○ No
- ◉ Yes

Would you mind telling us why you do not feel able to proceed with the questionnaire? *

- No time
- Not interested
- Don't think it's useful
- No reason given

Specify: *

.....

## Regional Analytical Analysis of Trends in Trade and Transport in East Africa

**» Respondent Details**

0.1. Respondent name? *

0.2. What is your email address? *

0.3 Which country do you reside? *

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ Rwanda
- ◯ Burundi
- ◯ Other (specify)

Please specify this other country: *

**» FREIGHT COSTS**

Q1. How many trucks does the company have? *
*[RECORD NUMBER OF ALL OPERATIONAL TRUCKS]*

Q2. What is the main origin of cargo for Trucks ? *
*[SELECT COUNTRY]*

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ Rwanda
- ◯ Burundi
- ◯ Other (specify)

Please specify this other country: *

Q2. What is the main destination of cargo for Trucks? *

*[SELECT COUNTRY]*

- ◯ Kenya
- ◯ Uganda
- ◯ Tanzania
- ◯ Rwanda
- ◯ Burundi
- ◯ Other (specify)

Please specify this other country: *

Q4. What is the most frequent cargo transported by the trucks? *

*[SELECT CORRECT OPTION BELOW]*

- ◯ VEGETABLE PRODUCTS: Cereals, Coffee, Fruit and nuts, Inulin, Malt, Oil seeds and oleaginous fruits, Products of the milling industry, Resins and other vegetable saps and extracts, Spices, Starches, Tea, Trees and other live plants, Vegetable plaiting materials, Vegetables and certain roots and tubers; edible, Wheat,
- ◯ MINERAL PRODUCTS: Cement, Lime, Mineral fuels, Mineral oils and products of their distillation, Ores, Salt; sulphur; earths, Slag and ash, Stone; plastering materials,
- ◯ FOODSTUFFS: Beverages, Cocoa and cocoa preparations, Fish or crustaceans, Flour, Food industries residues and wastes thereof, Fruits, Meat, Milk powder, Miscellaneous edible preparations, Nuts or other parts of plants, Preparations of vegetables, Prepared animal fodder, Spirits and vinegar, Starch, Sugars and sugar confectionery, Tobacco and manufactured tobacco substitutes.
- ◯ TEXTILES: Carpets and other textile floor coverings, Cotton, Knitted or crocheted apparel and clothing accessories, Knitted or crocheted fabrics, Man-made filaments, Man-made staple fibres, Non-knit or crocheted apparel and clothing accessories, Silk, Textile fabrics, Textiles made up articles; sets; worn clothing and worn textile articles; rags, Vegetable textile fibres; paper yarn and woven fabrics of paper yarn, Wadding felt and nonwovens special yarns; twine, cordage, ropes and cables and articles thereof, Wool, fine or coarse animal hair, horsehair yarn and woven fabric, Woven fabrics
- ◯ CHEMICAL PRODUCTS: Albuminoidal substances; modified starches; glues; enzymes, Candles and similar articles, cosmetic or toilet preparations, Dental waxes" and dental preparations with a basis of plaster", Essential oils and resinoids; perfumery, Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations, Fertilizers, Inorganic chemicals; organic and inorganic compounds of precious metals; of rare earth metals of radio-active elements and of isotopes, Lubricating polishing or scouring preparations; artificial or prepared waxes, Modelling pastes, Organic chemicals, other mastics; inks, Pharmaceutical products, Photographic or cinematographic goods, pigments and other colouring matter; paints, Soap, organic surface-active agents, Tanning or dyeing extracts; tannins and their derivatives; dyes, varnishes; putty,
- ◯ METALS: Aluminium and articles thereof, Copper and articles thereof, Iron and steel and articles thereof, Lead and articles thereof, Metal; miscellaneous products of base metal, Metals; cermets and articles thereof, Nickel and articles thereof, Tin; articles thereof, Tools and cutlery, Zinc, and articles thereof.
- ◯ Machinery and appliances, Electrical machinery, and equipment,
- ◯ ANIMAL & VEGETABLE BY PRODUCTS: Animal or vegetable fats and oils and their cleavage products
- ◯ ANIMAL PRODUCTS: Meat and edible meat offal, Fish and crustaceans, molluscs and other aquatic invertebrates, Live animals, Animal originated products; not elsewhere specified or included, Dairy products and other edible products of animal origin,
- ◯ PLASTICS & RUBBERS: Plastics and articles thereof, Rubber and articles thereof,
- ◯ PAPER GOODS: Paper and paperboard; articles of paper pulp, of paper or paperboard, Printed books, newspapers, pictures, and other products of the printing industry; manuscripts, typescripts and plans, Pulp of wood or other fibrous cellulosic material; waste and scrap of paper or paperboard,
- ◯ TRANSPORTATION: Vehicles and their parts, Aircraft, spacecraft, and parts thereof, Ships, boats and floating structures, Railway, and other rolling stock,
- ◯ ALL OTHER COMMODITES: Precious metals, gems, and jewellery, Furniture, Miscellaneous manufactured articles, Toys, and games, Footwear; gaiters and the like; parts of such articles, Feathers and down, prepared; and articles made of feather or of down; artificial flowers; articles of human hair, Headgear, and parts thereof, Umbrellas, sun umbrellas, walking-sticks, seat sticks, whips, riding crops; and parts thereof, , Raw hides and skins (other than fur skins) and leather, Articles of leather; saddlery and harness; travel goods, handbags, and similar containers; articles of animal gut (other than silk-worm gut), Fur skins and artificial fur; manufactures thereof, , Glass and glassware, Ceramic products, Stone, plaster, cement, asbestos, mica, or similar materials; articles thereof, , Instruments and apparatus, Clocks and watches, Musical instruments, , Wood and articles of wood; wood charcoal, Manufactures of straw, esparto, or other plaiting materials; basket ware and wickerwork, Cork, and articles of cork, Works of art; collectors' pieces and antiques

Q5. Please estimate the cargo weight when transporting cargo? *

*[INDICATE WEIGHT IN TONS]*

.....

Q6. What is the main truck type owned by the company? *

- ◯ CONTAINER TRAILER/SEMI : The container trailer category includes 20 ft (feet) / 40 ft skeletal trailers, and container flatbed trailers. These trailers can be used to transport containers. The flatbed trailers have stable structure and lightweight. To reduce the weight, this trailer type can be produced as a skeleton type. It includes the gooseneck and ordinary type. The customized flatbed trailer can be used to transport special equipment. Flatbed semi-trailers are mainly used in ports, and a container side loader can be installed on the flatbed to make it easier to unload the container.
- ◯ DRY BULK TRAILERS: Dry Bulk Tanker Trailer are manufactured in the form of a large body tank. The main materials that dry bulk trailers are transporting are food products, chemical products, and building materials. These trailers are manufactured in a way that they have a single compartment that serves for loading into and unloading. The most common material choice for dry bulks' is aluminium or steel. Dry bulk trailers can handle the following materials: dry chemicals, plastic pellets;, Cement, ash, sand, lime;, Sugar, Grains, Flour, Starch.
- ◯ LIQUID BULK TANK TRAILERS: Liquid bulk tank trailers are typically made of stainless steel or aluminium and can be insulated or non-insulated. It may consist of a single compartment or be divided into two-to-four compartments for hauling different commodities at once. There are also special food-grade trailers for products such as fruit juice, vegetable oil and food ingredients. Like with dry bulk
- ◯ BREAK BULK: All other trucks larger than medium trucks
- ◯ MEDIUM TRUCKS: Trucks with equivalent carrying capacity from 8 tons up to 15 tons
- ◯ LIGHT TRUCKS: Lorries and small trucks carrying goods of capacity up to 8 tons
- ◯ PICKUP TRUCKS: These are light-duty trucks that have an enclosed cabin and an open cargo area with low sides and tailgate.

Q7. Please estimate the fuel cost per trip (one way from the origin to destination)? *

*[INDICATE COST IN USD]*

.....

Q8. Please estimate the total Freight cost (price the transporter will charge the shipper) inclusive of fuel costs? *

*[INDICATE COST IN USD]*

.....

**BASED ON THE TOTAL FREIGHT COST PROVIDED ABOVE, ESTIMATE PERCENTAGE OF FREIGHT COST BY CATEGORIES INDICATED BELOW**

.....

| | |
|---|---|
| Q8a. Estimate percentage of Vehicle depreciation cost per year from the total freight cost? *[INDICATE VALUE]* ..... | * ..... |
| Q8b. Estimate percentage of Fuel cost per truck per year from the total freight cost? *[INDICATE VALUE]* ..... | * ..... |

| | |
|---|---|
| Q8c. Estimate percentage of Labour (crew) for vehicle per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8d. Estimate percentage of Maintenance and repair cost per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8e. Estimate percentage of Tyre Cost per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8f. Estimate percentage of Management and overhead cost per annum from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8g. Estimate percentage of Vehicle and equipment licensing fee per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8h. Estimate percentage of Cargo insurance costs per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |
| Q8i. Estimate percentage of Other cost per truck per year from the total freight cost?<br>*[INDICATE VALUE]*<br>..... | *<br>..... |

| | |
|---|---|
| The sum of percentages recorded in the matrix table (NaN) is not equal to 100! Please re-check! | |
| Q9. Please estimate average number of trips a Truck makes per year * | |
| Q10. Please estimate total bribe cost per trip<br>*[INDICATE COST IN USD]* | |
| **BASED ON THE TOTAL BRIBE COST PROVIDED ABOVE, ESTIMATE PERCENTAGE OF BRIBE COSTS BY CATEGORIES INDICATED BELOW** | |
| Q10a. Estimate percentage of bribe required by authorities per Trip at the PORT? | |
| Q10b. Estimate percentage of bribe required by authorities per Trip at the WEIGH BRIDGES? | |
| Q10c. Estimate percentage of bribe required by authorities per Trip at the BORDERS? | |
| Q10d. Estimate percentage of bribe required by authorities per Trip at the POLICE? | |
| The sum of percentages recorded in the matrix table (NaN) is not equal to 100! Please re-check! | |

## Appendix VIII - Distribution of average fuel efficiency of Heavy Good Vehicles (l/km) calculated from survey data, before correction of average values (3855 observations)

| Fuel efficiency range (l/km) | Number of values | % |
|---|---|---|
| 0-0.25 | 153 | 4% |
| 0.25-0.75 | 1273 | 33% |
| 0.75-1.5 | 2059 | 53% |
| 1.5-10 | 343 | 9% |
| >10 | 27 | 1% |