



An Analysis of High Urbanization via Clustering in Central East Africa for Regional Integration

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Abstract:

High capacity and advanced technology mobility is one of the most vital parameter of transportation on today's case. It is a transport choice that produces mobility among cities and settlement clusters within high speed, high capacity, and high volume. This transport way has a crucial role for tourism centers and settlements too. It is an effective way of sustainable mobility engineering that enhances intercity and inter regional scale tourism systematics. It is also an important dynamic for advancement of nationalities. In this paper, a cluster-based analysis was made for Central East Africa by usage of population and related parameters via clustering mathematical connections. Recommendations were given by considering the competitive operation intervals of high capacity transportation between specified clustering cities and lastly results were given on this context.

Keywords: Clustering analysis, urban, high speed, tourism, economy

1. Introduction

Transportation is at the heart of development, attracting tourism, social activity, economic growth, and cultural relations. Transportation services increase the emphasis on tourism travel at city, regional, national, and international levels. Today, tourism is one of the main pillars of economic development for countries. Multi-sectoral improvement is a challenging issue, especially for developing countries. And the mentioned countries strengthen their core sectors such as construction, healthcare, tourism, heavy industry, infrastructure, energy, military, or light industry. The driving force behind tourism is a well-developed transportation system. High-speed systems and well planned urban clusterings are important asset, capacity, and opportunity for national based tourism.

Central East Africa is a very large region. They have a vast natural integration between them in terms of their culture and same/similar ethnolinguistic base. Swahili language is same for a very large Population on Congo, Republic of Congo, Kenya, Somalia, Tanzania, Uganda, Ethiopia, Burundi and Zambia. Also this region has the highest fertility rates and population increase rates all over the World. Besides all of these, young population is very high and the region has very big, important and high populated urban clusters like Mombasa, Kinshasa, Mogadishu, Timbuktu, Dar es Salaam, Zanzibar, Nairobi, Kampala and Entebbe.

These are also Worldwide important cities too. So, because of all of these reasons and conditions the integration and unity of the region has a strategic point of view. And also it is strongly related to infrastructural balanced development. And all of these have closer connections with energy and geography. Finally urbanization and mobilization trends measuring and analysis will be determinant for all of these conditions. These two parameters has a strong, robust, reliable and rational bound with high speed, high capacity and high comfort mobility. High-speed system network proposal developed in this way will integrate East Africa

more quickly with each other and neighbouring countries too. Within the scope of this study, the provinces of Central East Africa were listed according to parameters such as population, gross domestic product, and level of development, and were subjected to cluster analysis using statistical methods in the R Studio program. In this context, priority cities were determined by considering the number of clusters and cluster lists that emerged based on the most suitable clustering method. The aforementioned priority cities were evaluated based on distance, ultimately leading to a high-speed network system proposal for region.



Fig. 1. Big Urbans of Central East Africa (Deposit Photo, 2025)

In Figure 2 region's state map is presented (Arthipo, 2025). Figure 1 shows region's cities' populations and livabilities (OECD, 2020). 3 shows region's Geographical Map (Milliyet Egitim, 2025). Table



Fig. 2. Central East Africa State Map (Arthipo, 2025)



Fig. 3. Central East Africa Geographical Map (Milliyet Eğitim, 2025)

Table 1: Central East Africa Cities Populations And Liveabilities (Oecd, 2020)

City	Liveability	Population
Kinshasa	32	11900000
Bukavu	22	871000
Lubumbashi	22	1790000
Mbuji-Mayi	21	1560000
Kananga	20	1970000
Kisangani	20	936000
Uvira	19	590000
Kolwezi	19	573000
Mbandaka	19	1190000
Tshikapa	18	732000
Likasi	18	423000
Matadi	18	306000
Mbanza-Ngungu	18	100000
Bunia	18	328000
Boma	17	163000
Mwene-Ditu	17	196000
Gandajika	17	146000
Isiro	17	183000
Kikwit	17	187000
Kalemie	17	147000
Kindu	17	172000
Beni	17	232000
Butembo	16	218000
Gemena	15	139000
Bumba	15	103000

Brazzaville	25	1830000
Pointe-Noire	20	829000
Kinkala	16	16100
Kayes	15	62500
Madingou	14	27500
Gamboma	13	19700
Nairobi	60	5550000
Thika	42	279000
Machakos	36	114000
Meru	34	1830000
Mombasa	33	1200000
Kisumu	32	410000
Nakuru	32	308000
Eldoret	32	194000
Mumias	29	100000
Malindi	25	120000
Luanda	41	2490000
Benguela	40	562000
Ambriz	40	17000
Huembo	39	844000
Lobito	39	393000
Cabinda	38	739000
Luena	37	357000
N'zeto	35	47800
Kampala	47	1680000
Entebbe	28	70000
Kira Town	28	317000
Jinja	22	72900
Gulu	19	152000
Mbale	19	96200
Tororo	18	41900
Arua	16	62000
Kasese	14	115000
Dar es Salaam	56	4720000
Zanzibar	34	206000
Stone Town	31	18000
Morogoro	29	207000
Arusha	27	416000
Dodoma	27	214000
Moshi	26	145000
Tanga	25	244000
Mbeya	25	292000
Mwanza	23	386000

Mogadishu	17	2120000
Baidoa	11	950000
Hargeisa	11	760000
Borama	8	68100
Lusaka	37	2470000
Kitwe	26	504000
Ndola	26	528000
Chingola	24	147000
Kapiri Mposhi	24	241000
Mufulira	23	122000
Kasama	22	168000
Choma	22	122000
Mansa	22	129000
Bangui	9	889000
Berberati	5	76900
Bria	3	35200

2. Literature Review

In the 21st century, in addition to urbanization, digitalization and sustainability also seem to be at the forefront. What strengthens the trend of digitalization is a continuous and uninterrupted process of technological development and innovation. This has created a constant dynamic of change in our lives. Transportation and urbanization have been and will continue to be affected by this dynamic.

Sustainability trends have strengthened even further today. Western countries and developed countries have a role to play in this regard. In this context, sustainability, digitalization, and urbanization indicate that more investment should be made in high-speed train lines, metro lines, and high-capacity high-speed bus

lines. These three systems could be the initial driving force for autonomous transportation systems in developing countries. As a developed country in this context, the spread of well-planned metropolization and high standard transportation in Italy is an important saving. At the center of all of this, there are well planning, detailed analysis and true approaches (Givoni, 2006).

3. Methodology

Clustering Analysis

Clustering statistical analysis have been conducted via K means method, PAM and Clara method.

1. K Means Method

Here are results for number of clusters and cluster visulation in terms of K means method in Figure 4 and Figure 5.

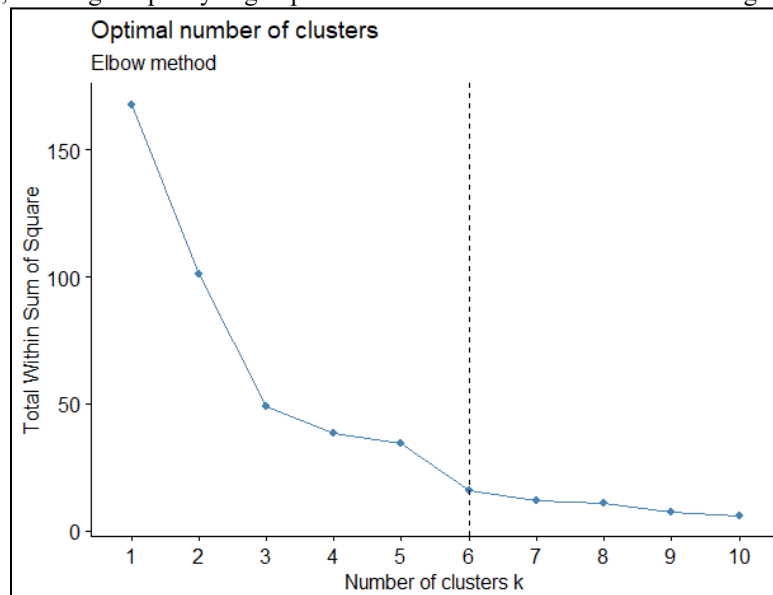


Fig. 4. Number of Clusters in Terms of K Means Method

Cluster Visulation

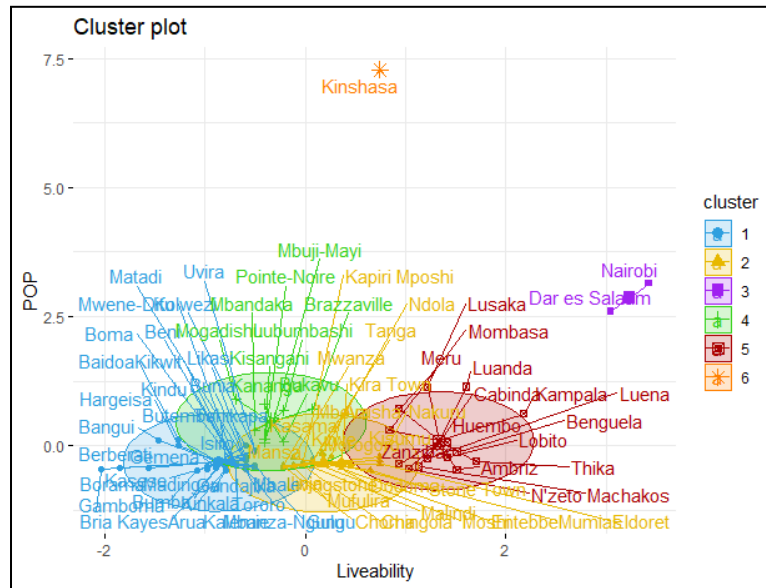


Fig. 5. Cluster Visulation in Terms of K Means Method
terms of PAM in Figure 6 and Figure 7.

2. PAM

Here are results for number of clusters and cluster visulation in

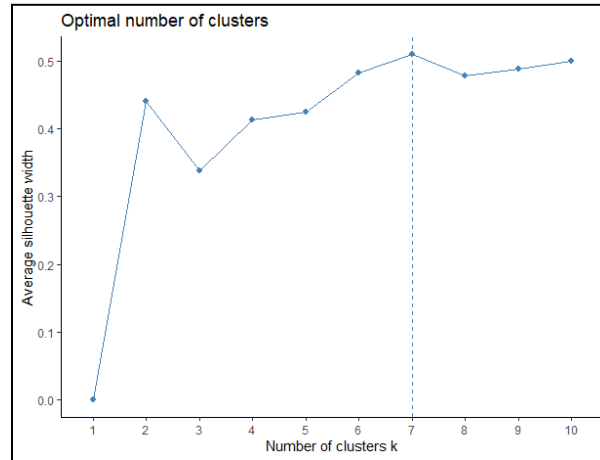
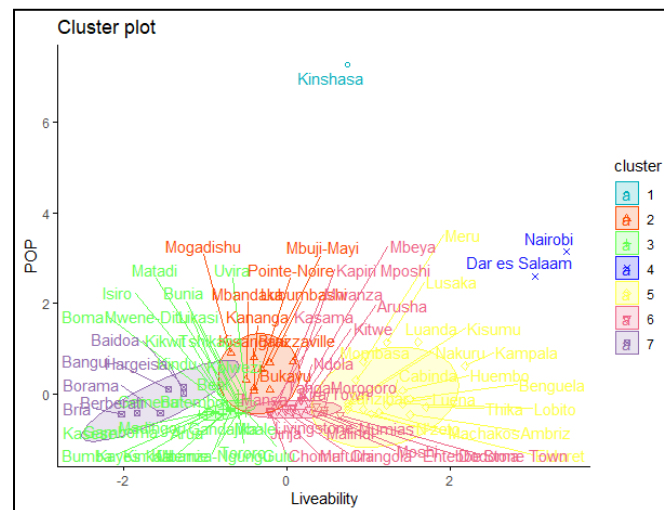


Fig. 6. Number of Clusters in Terms of PAM

Cluster Visulation

**Fig. 7.** Cluster Visulation in Terms of PAM

3. Clara Method

terms of Clara method in Figure 8 and Figure 9.

Here are results for number of clusters and cluster visulation in

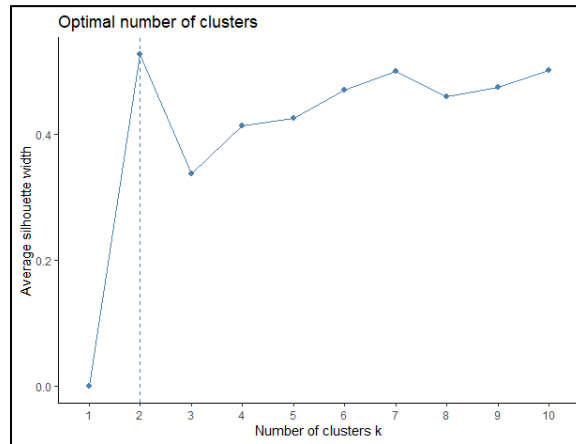


Fig. 8. Number of Clusters in Terms of Clara Method

Cluster Visulation

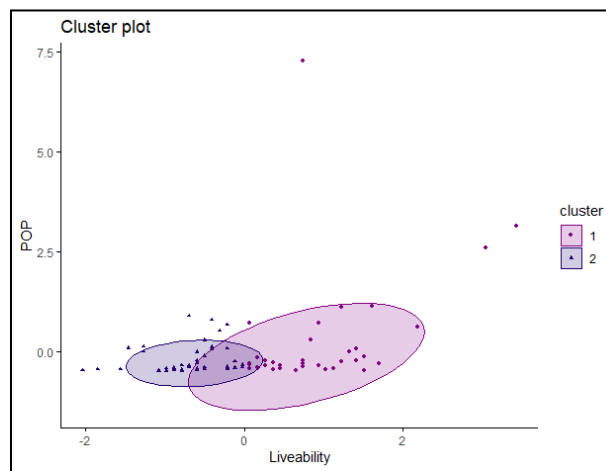


Fig. 9. Cluster Visulation in Terms of Clara Method

As a result of all methods and agglomerations, the biggest cities for these dataset. On Table 2, clustering list of the cities has been has been emerged into two clusters, 4 main clusters has emerged given.

Table 2: Cluster List Of Central East African Cities

City	Liveability	Cluster
Kinshasa	32	6
Bukavu	22	4
Lubumbashi	22	4
Mbuji-Mayi	21	4
Kananga	20	4
Kisangani	20	4
Uvira	19	1
Kolwezi	19	1
Mbandaka	19	1
Tshikapa	18	1
Likasi	18	1
Matadi	18	1
Mbanza-Ngungu	18	1
Bunia	18	1

Boma	17	1
Mwene-Ditu	17	1
Gandajika	17	1
Isiro	17	1
Kikwit	17	1
Kalemie	17	1
Kindu	17	1
Beni	17	1
Butembo	16	1
Gemena	15	1
Bumba	15	1
Brazzaville	25	4
Pointe-Noire	20	4
Kinkala	16	1
Kayes	15	1
Madingou	14	1
Gamboma	13	1
Nairobi	60	3
Thika	42	5
Machakos	36	5
Meru	34	5
Mombasa	33	5
Kisumu	32	2
Nakuru	32	2
Eldoret	32	2
Mumias	29	2
Malindi	25	2
Luanda	41	5
Benguela	40	5
Ambriz	40	5
Huembo	39	5
Lobito	39	5
Cabinda	38	5
Luena	37	5
N'zeto	35	5
Kampala	47	5
Entebbe	28	2
Kira Town	28	2
Jinja	22	2
Gulu	19	1
Mbale	19	1
Tororo	18	1
Arua	16	1

Kasese	14	1
Dar es Salaam	56	3
Zanzibar	34	5
Stone Town	31	2
Morogoro	29	2
Arusha	27	2
Dodoma	27	2
Moshi	26	2
Tanga	25	2
Mbeya	25	2
Mwanza	23	2
Mogadishu	17	4
Baidoa	11	1
Hargeisa	11	1
Borama	8	1
Lusaka	37	5
Kitwe	26	2
Ndola	26	2
Chingola	24	2
Kapiri Mposhi	24	2
Mufulira	23	2
Kasama	22	2
Choma	22	2
Mansa	22	2
Bangui	9	1
Berberati	5	1
Bria	3	1

4. Results

After statistical analysis, prior urbans were gathered on 6, 3 and 5

Table 3. Selected cities via clustering analyse

no clusters' urbans. On Table 3 selected cities are listed below.

City	Liveability	Cluster	Country
Kinshasa	32	6	Dem. Rep. Congo
Nairobi	60	3	Kenya
Thika	42	5	Kenya
Machakos	36	5	Kenya
Meru	34	5	Kenya
Mombasa	33	5	Kenya
Luanda	41	5	Angola
Benguela	40	5	Angola
Ambriz	40	5	Angola
Huambo	39	5	Angola
Lobito	39	5	Angola
Cabinda	38	5	Angola

Luená	37	5	Angola
N'zeto	35	5	Angola
Kampala	47	5	Uganda
Dar es Salaam	56	3	Tanzania
Zanzibar	34	5	Tanzania
Lusaka	37	5	Zambia

The cities and urban areas selected above are regions that exhibit region's highest level of metropolitanization and have the trend of producing the most life expectancy and motion. Rely on to the important role, these urbans are going to play a significant role on region's economic, cultural, technic, national safety and wealth and Social aspects in mid term future period. Also a high speed and high capacity mobility network occurrence is crucial and a priority for this region's countries to be unit, integrated and advanced. Sustainability, urbanization, and digitalization are among the mobility phenomena of the 21st century. These phenomena can best take place in developed countries. Central Africa must take significant steps regarding these mobility phenomena. Central Africa still constitutes one of the most important centers in the world. Sustainable transportation, reducing traffic congestion, increasing traffic safety, decreasing noise and air pollution, expanding railway investments, advancing autonomous vehicle technologies, equipping infrastructure facilities with current advanced technologies, and the integrated renewal of cities are the most important aspects of modern transportation and urbanization (Kiziltas, 2020).

Along with emerging technology, there are many alternative modes

of transportation that provide high-quality service at high inter-city speeds. These can be classified as magnetically driven trains (Maglev), high-speed trains, airlines, high-comfort road transport. These modes of transport are highly competitive in cross-city travel, but their interconnections are combined or isolated accordingly.

- Competitiveness
- Integration
- Residence instead of each other
- Transformative transportation

These modes of transportation involve the priority, integration or substitution of cities according to their size, human characteristics, demand for transportation, urban features, interconnected spatial and technical locations, requirements, distances between cities and a number of fundamental parameters. Among the various cities in Western Europe, this is the case with high-speed trains and airlines (Marta et al, 2010).

5. Discussion And Conclusions

In this context, Figure 10 shows metropolization map of Central East Africa.

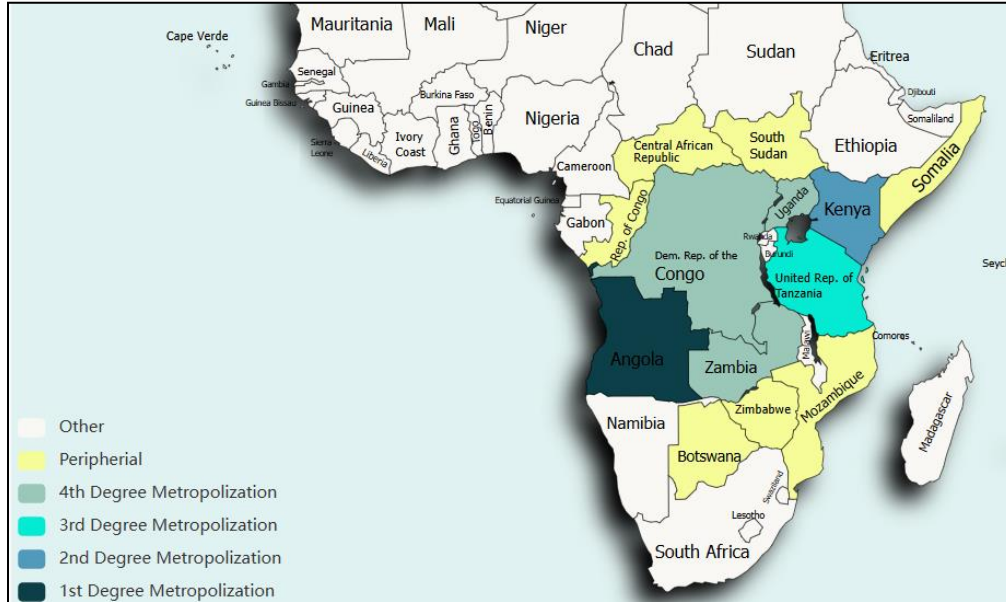


Fig. 10. Central East Africa Metropolization Map (Dark Legend: The highest metropolization)

As shown in the map, the cities proposed as a result of deep analysis on this paper are cumulated mainly on south west and mid-south part of the region which are also include most central and densely populated areas of Central East Africa. When these areas are equipped a reliable regional planning perspective and high standard mobility services according to national principles, a regional metropolization unique map will emerge that trigger

international integration of east Africa, central Africa and west Africa. On the other hand, with the completion of all the proposed planning and execution, a big integration will occur on south of continent, center of continent and north of continent too. Due to the region's wide geography, the extension of the proposal clusters will accelerate a variety of various strategic dynamics.

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