REGIONAL REORGANISATION IN GHANA: IMPLICATION ON SPATIAL EXTENT AND PROXIMITY TO EQUITABLE ACCESS TO CRITICAL PUBLIC SERVICES

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Keywords: regional reorganisation, decentralisation, transport distance, equitable access, sustainability

SUMMARY

Recently, the government of Ghana re-organised some administrative regions to ensure balanced development across the country. Six new regions were carved out of some existing regions, resulting in sixteen regions. Two of the critical issues that informed the reorganisation were spatial extent and access to government institutions or services, measured by the travel distances between communities or towns and the capital of a region. Therefore, reorganisation of the regions sought to inter-alia, reduce the travel distance to improve access to public services and facilitate effective monitoring and supervision. This study employed Geographical Information Systems (GIS) to evaluate the changes in travel distances after the 2018 regional restructuring exercise. We compared the linear distances between communities, towns and villages in the affected regions and municipalities or districts to their respective old and new regional capitals. The results indicate that the reorganisation significantly ($p < 0.01$) decreased the average travel distances in all the regions of interest by 62.4 km (50.2%), with reductions ranging from 8.6 km to 129.3 km (8.1% to 75.3%). Also, significant reductions in travel distance were observed at the district and municipality levels, which suggest a general improvement in accessibility to services and institutions. However, the average travel distance rose by 7.6% to 148.5% in 7 out of the 44 affected districts and municipalities. The present study reveals the impact of the recent restructuring in Ghana on the spatial extent and travel distances from the settlements or towns and district/municipalities in the affected regions to their respective regional capitals. It demonstrates further how GIS tools can aid future decision-making regarding the alteration of regional boundaries and the selection of capital towns.

Keywords: regional reorganisation, decentralisation, transport distance, equitable access, sustainability

1. Introduction

Countries are normally divided into provinces, states, or regions. In principle, these divisions create the functional units necessary for decentralising the decision-making powers of the central government politically or administratively. The rationale has mainly been for “effective and easy administration” and “equitable development” (Ayee, 2012), but there is also the aspect

of opinion leaders who advocate for such restructuring to create mini-empires they can dominate (Kawu, 2012).

Regional reorganisation in Ghana dates to the colonial era. Altering regional boundaries in the colonial days was influenced mainly by cultural, linguistic and kinship bonds. Conversely, post-colonial reorganisations have been driven primarily by the quest for development (Brobbey Commission, 2018). Since independence in 1957, various regions have been created in Ghana, as shown in Table 1. Ghana had operated under ten administrative regions since 1983 when the late Jerry John Rawlings created the Upper West Region (Bening, 2012). In the recent regional reorganisation, six new regions were carved out of the ten existing ones.

Table 1. Sequence of regional restructuring in Ghana since the year of independence.

	Name of Region	Capital	Year of Creation	Political Party	President
1.	Northern	Tamale	1957	Convention Peoples Party	Kwame Nkrumah
2.	Eastern	Koforidua	1957	Convention Peoples Party	Kwame Nkrumah
3.	Western	Takoradi	1957	Convention Peoples Party	Kwame Nkrumah
4.	Volta	Ho	1957	Convention Peoples Party	Kwame Nkrumah
5.	Ashanti	Kumasi	1957	Convention Peoples Party	Kwame Nkrumah
6.	Brong Ahafo	Sunyani	1959	Convention Peoples Party	Kwame Nkrumah
7.	Upper East	Bolgatanga	1960	Convention Peoples Party	Kwame Nkrumah
8.	Central	Cape coast	1960	Convention Peoples Party	Kwame Nkrumah
9.	Greater Accra	Accra	1964	Convention Peoples Party	Kwame Nkrumah
10.	Upper West	Wa	1983	Provisional National Defence Council	Jerry John Rawlings
11.	North East	Nalerigu	2018	New Patriotic Party	Nana Akuffo Addo
12.	Bono East	Techiman	2018	New Patriotic Party	Nana Akuffo Addo
13.	Savannah	Damongo	2018	New Patriotic Party	Nana Akuffo Addo

14.	Oti	Dambai	2018	New Patriotic Party	Nana Akuffo Addo
15.	Ahafo	Goaso	2018	New Patriotic Party	Nana Akuffo Addo
16.	Western North	Wiawso	2018	New Patriotic Party	Nana Akuffo Addo

The 1992 Constitution provides the legal framework for regional restructuring in Ghana. Article 5 of the Constitution provides that the President may create a new region, alter the boundaries of a region, or merge existing ones. However, the restructuring process must be initiated by petitions presented and or based on the Council of State's advice. The 2018 regional reorganisation exercise was the first attempt ever at creating new regions under the 1992 constitution.

Drivers of the recent regional restructuring

In the recent restructuring, in 2018, the President set up the Commission of Inquiry into the Creation of the New Regions (CICNR) upon receiving several written and oral petitions. Based on the petitions and public hearings, the CICNR identified eight thematic issues as the main driving forces of the new regions' creation. They included (1) spatial issues, (2) access to government or public services, (3) road infrastructure, (4) access to education, (5) access to health, (6) cultural, ethnic, and religious issues, (7) governance and participation, and (8) economic and employment opportunities.

Among the eight thematic areas, the spatial extent of the existing regions was paramount in the petitions and stakeholder consultations. Spatial extent, in this context, refers to the size, elongated nature and vastness of a region's jurisdiction. However, in the petitions, a simple and main indicator used to assess this parameter was the travel distance from the towns within a region to the capital. For instance, appeals for the creation of the Western North region indicated that Oseikojokrom, a town in the northern part of the previously Western region, was about 380 km from the capital, Takoradi (located down South), and thus posed accessibility challenges. On the one hand, long distances affected equitable access to government and public services or state institutions, such as education, judicial, security services (police, armed forces, immigration, fire and prisons), utility services, etc. (Brobbey Commission, 2018). Also, access to specialised services, such as referral hospitals, which are mostly located in the regional capitals, becomes difficult for residents in areas far away from the capital. Moreover, official engagements, such as meetings and workshops for government workers, are usually held in the capital; this presents both cost and health (stress) implications for participants from the upper division of the region. Again, spatial issues influenced public perception about the government's presence and access in their daily lives. These challenges contravene the 1992 Constitution (article 35 section 3), which says it is the government's responsibility to promote just and reasonable access by all citizens to public facilities and services per the law. Thus,

addressing accessibility challenges linked to the spatial extent needed critical attention from the government.

On the other hand, long travel distance reduces effective administration and supervision, as regional government officials could not quickly attend to issues in some communities, especially remote areas, within their catchment areas promptly. Additionally, during the stakeholder consultations, some government officials opined that the cost of long travels by regional coordinators for monitoring and supervision constituted significant portions of their limited budgets. They claimed that such funds could be used for some developmental projects (Brobbey Commission, 2018).

To this end, the need for regional reorganisation to help in the decentralization process has been a popular decision for long (Gyampo, 2018), and the two major political parties in the country hinted at this during the 2016 national elections. The New Patriotic Party (NPP) captured it in its 2016 manifesto (New Patriotic Party, 2016), while the then President and flagbearer of the National Democratic Congress (NDC) also promised to create five additional regions if re-elected (Dadzie, 2016). However, there exist dissenting opinions on the idea of regional reorganisation as a vehicle for equitable development. For instance, some argued that creating the Brong Ahafo Region from the Ashanti Territory in 1957 was fanciful, capricious, and merely to fulfil political campaign promises. Similarly, Gyampo (2018) described the recent creation of the new regions as unnecessary and a "mere political luxury." He opined that effectively implementing other flagship programs stated in the governing NPP's 2016 manifesto could ensure the needed development across Ghana without regional restructuring. Amidst the contrasting opinions, studies that present a scientific perspective of how the restructuring exercise could address inequitable accessibility or otherwise are limited to date.

Regional capital as epicentres of development

Local governments' performance, to a large extent, must be efficient and meet the demand, economies of scale and policy of the local communities (Hooghe & Marks, 2009). Spatial accessibility has been defined as road distance not longer than 60–90 min (Cinnamon et al., 2008; ESPON, 2007). However, the bad nature of the roads in most towns connecting to regional capitals has increased travel time, and this goes a long way to affect the decentralization process.

The current decentralization process in Ghana has established four key levels of authority: (1) National government (including line ministries and deconcentrated entities); (2) Regional Coordinating Councils (RCCs), which are the regional governance institutions; (3) Metropolitan, Municipal and District Assemblies (MMDAs); and (4) Sub-district structures, comprising Urban, Zonal and Town Councils, and Unit Committees (Ayee, 2012). Traditionally, a regional capital hosts the regional offices of most state institutions and public services, such as courts, the Ghana Armed Forces, Immigration Service, Fire Service, Prison Service, utility service providers, Driver and Vehicle Licensing Centres, Food and Drugs Authority, Ghana Standards Authority, Ghana Highway Authority, Ghana Revenue Authority,

and so on. Moreover, private businesses also set up offices in the regional capitals. Therefore, a regional capital becomes the centre for development in the region in terms of infrastructure, job creation and improved quality of life. Hence, accessibility to the capital is vital for development. Moreover, areas closer to the capital are more likely to experience growth as compared to farther towns.

Despite the critical nature of the location of regional capitals in regional development, Ghana lacks a legal framework for siting its regional capitals to date. The situation is similar to the creation of districts and siting their capitals (Ayee, 2012). However, the sector ministry (Ministry of Local Government, Rural Development) employs criteria, which consider population, centrality, accessibility, social infrastructure, resource base, etc., in the selection process. Despite the existing criteria, the paucity of reliable data to clearly define these parameters makes the whole process vulnerable to manipulations and arbitrary decisions by the government (Ayee, 2012). While the regional capital somewhat becomes an 'automatic' candidate for development, the proximity of other towns could substantially influence balancing growth across the territory. Therefore, siting regional capitals without proper consideration of the travel distances and time may create inequitable access to critical services, increased cost of operation of businesses, etc., ultimately affecting the region's development holistically. Spatial extent plays vital roles in two aspects of governance: the provision of public goods and services and the transmission of regional and local policy. These two have implications for development and may change non- spatial solutions as well as the equilibrium state (Hooghe & Marks, 2009).

Sustainable transportation and travel distance

Over the years, environmental pollution and climate change have worsened the woes of humanity. As a result, sustainable development practices have become imperative for a sustainable earth. Sustainable development hinges on the so-called triple bottom line; the economic, environmental, and social impacts to safeguard people and the environment. Any development that falls short of any of these three dimensions is considered unsustainable.

Travel time to local service must be available near major towns and the epicentre or capital cities. This reduces time loss and tilts the economy of scale to favour decision making and access to major amenities. The provision of goods and services at specified distances has a positive spatial external effect on other local communities that may not be generating the needed resources at the other end (Kopczewska, 2013)

Improving mobility is a part of development, as the movement of people, goods and services becomes necessary. However, the transportation sector is a significant contributor to greenhouse gas emissions, posing adverse impacts on the environment and people through climate change and global warming. For example, 28% of the USA's greenhouse gas (GHG) emissions in 2016 were attributed to transportation (Aultman-hall, 2018). In Europe, car trips still account for the largest proportion of long-distance passenger travel (Aparicio, 2016). In Ghana, the transportation sector accounted for 17% of GHG emissions in 2016 (Ghana EPA,

2019). The sector's emissions rose by 490% (from 1.41 $MtCO_2e$ to 7.17 $MtCO_2e$) from 1990 to 2016, with road transportation accounting for 84.5%. Hence, in recent times, sustainable transportation has become a topical issue in development. Presently, the road transport sector heavily depends on fossil fuels globally, and these sources release huge tonnes of GHGs into the atmosphere every year. Longer travel distances increase the burning of fossil fuels, increasing the GHG footprint and associated air pollution and vice versa. Hence, the alteration of regional borders and the selection of regional capitals indirectly affect GHG emissions.

Objective of the study

The objective of this study was to employ Geographic Information System (GIS) tools to assess the changes in the spatial extents and the travel distances from human settlements to the regional capitals in the affected regions following the recent regional reorganisation in Ghana.

-2. Methodology

Study areas

This study focussed on the old regions from which the six new regions were created. The altered regions included the Northern, Brong-Ahafo, Western and Volta regions. The North East and Savannah regions were carved from the old Northern region, Oti region from the Volta region, Bono East and Ahafo out of the Brong Ahafo region, and the Western North region from the Western region, as shown in Fig. 1.

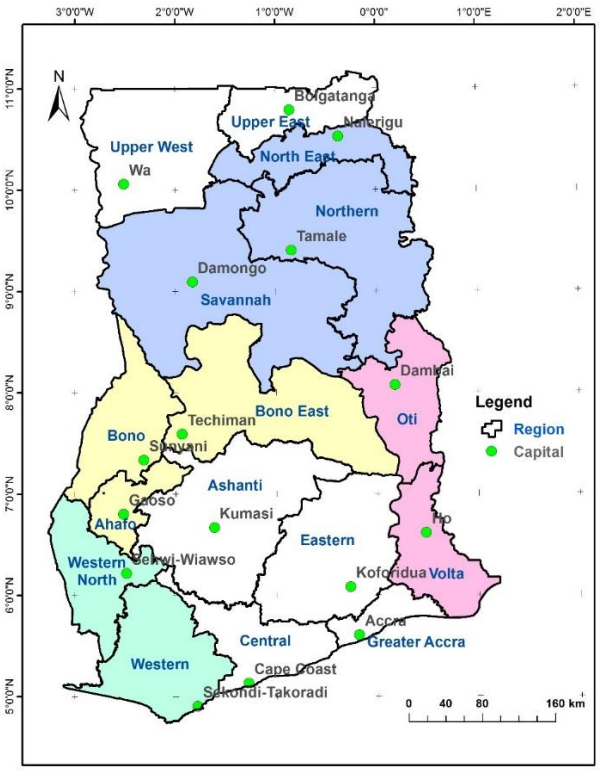

Figure 1. Map of Ghana after the 2018 regional reorganisation. Regions with the same colour code (excluding white) initially constituted one region.

- Data collection and analysis

The spatial analysis was conducted based on information contained in various open access shapefiles available online. The shapefile for towns in Ghana was obtained from the Mapcruzin open-source database. However, the shapefile delineating the new regions were sourced from the GIS Unit of the Ghana Statistical Service. For this study, the term 'town' generically refers to all forms of settlements (cities, towns, villages, etc.).

The spatial analysis was conducted using ArcMap (version 10.5). The communities and towns within a region were extracted by using the shapefile of the region to clip the data from the town's shapefile in ArcMap. Overall, 7,343 and 3,471 towns were extracted for the old regions of interest (ORoIs) and new regions of interest (NRoIs), respectively. To evaluate the spatial extent, landmasses of the regions of interest (both old and new) were obtained in the GIS environment.

Various GIS methods and techniques for evaluating accessibility exist. In increasing order of accuracy level, they include Euclidean or linear distance, network distance, travel time in traffic simulation, and travel time from real data methods (Li, 2018). Euclidean and Manhattan metrics provides flexibility within a single class of metrics when limited parameters exist for measuring and ensuring optimality (Shahid et. al,2009). This study therefore adopted the Euclidean distance technique though other accurate methods exist to incooperate many more parameters because of the scarcity of data and the objective of this study to obtain a fair overview of the spatial outlook of the epicenters of the towns and its impact of the reorganisation, i.e., percentage change in travel distances. Hence, the linear distance approach was considered appreciably robust for this study. The linear distances between each community or town to the capital were computed for each region. The data was analysed to ascertain the differences in spatial extent and travel distances before and after creating the new regions. A paired *T*-test was conducted to ascertain the significance of the changes in linear distance at 95% confidence interval. The procedure was repeated for the district/municipality-level spatial analysis. In addition, the population densities of the areas of interest were calculated based on data from the 2021 HPC (Ghana Statistical Service, 2015) to ascertain changes brought about by the reorganisation.

-3. Results

Effect on spatial extent and population density

The land sizes and population densities of all the regions before and after the 2018 restructuring are presented in Table 2. Formerly, the landmasses and population densities ranged from 3,721 km^2 to 70,217 km^2 and 34.8 cap/km^2 to 1,044.8 cap/km^2, respectively. However, at present, they range from 3,721 km^2 to 36,075 km^2 and 12.8 cap/km^2 to 1,044.8 cap/km^2, respectively. The Savannah region is currently the largest (landmass = 36,075 km^2) and is about half (51%)

the size of the former largest region, the old Northern region, which covered 70,217 km^2. It is also Ghana's most sparsely populated region (density = 12.8 cap/km^2). Moreover, Greater Accra remains the smallest and most densely populated region, with an area of 3,721 km^2 and a density of 1,044.8 cap/km^2.

Table 2. Landmass and population density of the regions of interest before and after the 2018 reorganisation.

Old region	Land size (km^2)	Population density (cap/km^2)	Newly created region	Land size (km^2)	Population density (cap/km^2)
Northern	70,384	51.5	Northern	26,524	87.1
			North East	9,070	72.7
			Savannah	34,790	18.8
Brong-Ahafo	39,557	75.3	Bono	11,113	108.8
			Bono East	23,248	51.8
			Ahafo	5,196	108.7
Western	24,457	123.0	Western	13,842	148.9
			Western North	10,079	72.7
Volta	20,990	117.0	Volta	9,504	174.7
			Oti	11,066	67.5
Greater Accra	3,721	1,681.3	-	-	-
Ashanti	24,542	223.1	-	-	-
Eastern	19,087	151.4	-	-	-
Central	9,726	217.3	-	-	-
Upper East	8,702	118.9	-	-	-
Upper West	18,913	36.4	-	-	-

Effect on travel distance to the regional capitals at the regional level

As shown in Fig. 2a, many towns surrounded all the regional capitals within a 30 km radius before the reorganisation. A similar pattern was observed after the restructuring. However, Fig. 2b shows that the Savannah region has a unique characteristic, as the towns are sparsely distributed with no clustering around the regional capital, Damongo. Evidently, settlements were close to the former capital, Tamale, in the old Northern region.

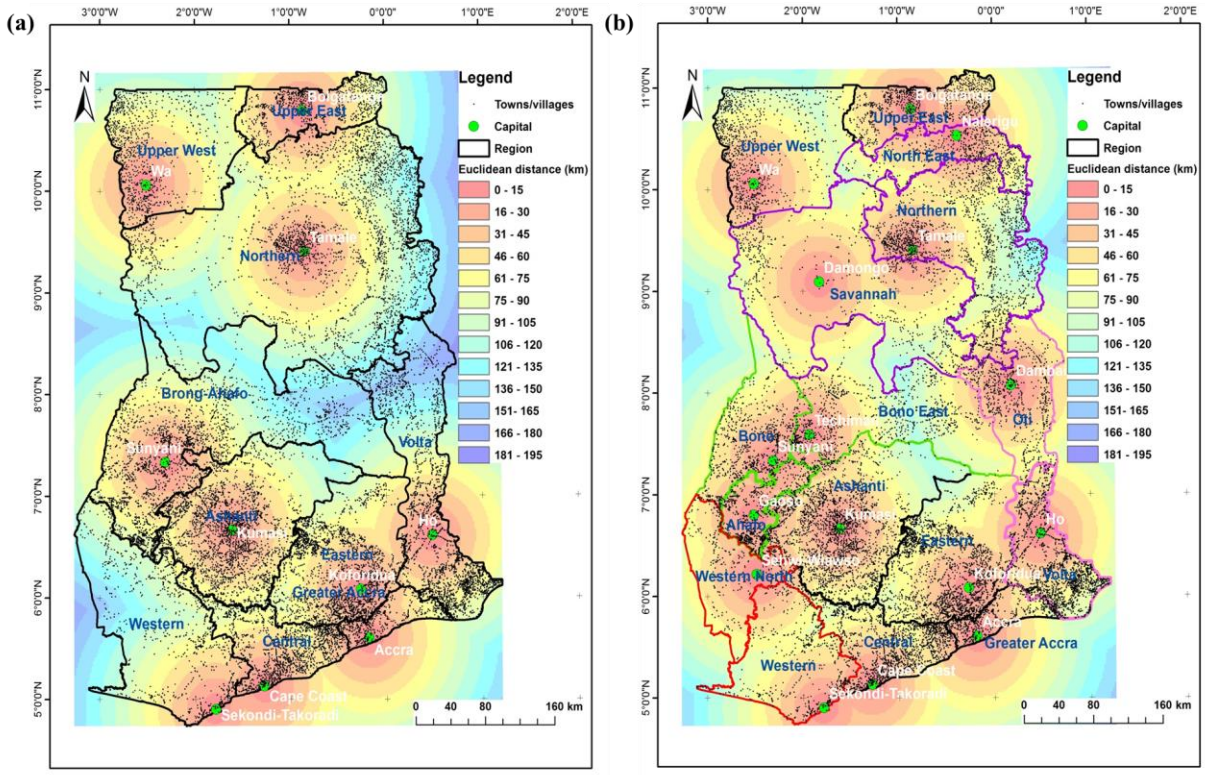

Figure 2. Map showing Euclidean distances from regional capitals to towns/villages in the regions (a) before and (b) after the 2018 regional reorganisation. Regions with the same border colours in (b) initially constituted one region.

Generally, the affected regions had a reduction in the average travel distances from the towns and villages within their boundaries after the creation of the new regions. On the regional scale, the median of the average linear distances from the towns to the capitals of the ROIs was 92.1 km, but this decreased to 48.1 km after the reorganisation (Fig. 3). The decrease in travel distance was averagely 62.5 km (50.22%) and ranged from 8.8 km (8.1%) to 129.3 km (75.3%) across the ROIs, as shown in Appendix 1. The reduction in linear distance was highest in the Western North region (75.3%), followed by the Oti (72.9%), North East (62.1%), Ahafo (51.3%), Bono East (31.6%), and lastly the Savannah region (8.1%), as shown in Fig. 4. A paired *T*-test indicated that the decrease in linear distance after the restructuring was statistically significant ($t = 3.340$, $p = 0.02$).

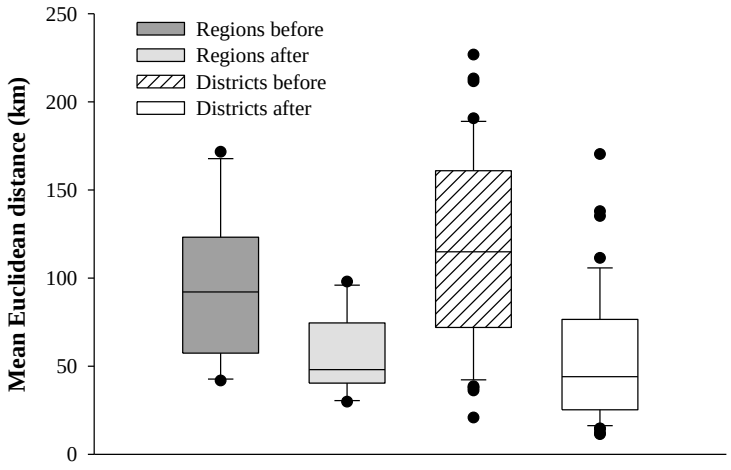

Figure 3. Box plots of the mean Euclidean distances from regional capitals to towns/villages at the regional and municipal/district levels before and after the 2018 regional reorganisation.

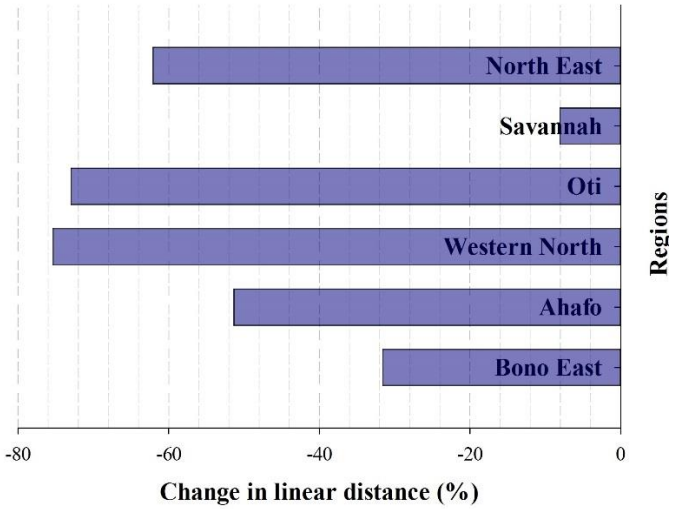

Figure 4. Percentage change in linear distances from towns to the old and new regional capitals.

Effect on travel distance to the regional capitals at the district and municipality levels

At the district and municipality levels, the median value of the average linear distances declined from 122.0 km to 46.4 km after the restructuring (Fig. 3). As detailed in Appendix 2, many of the districts and municipalities were positively affected. All the Bono East and Western North districts saw appreciable decreases in travel distances, ranging from 24.1 km to 143.9 km. The Bia East district had the highest distance reduction (148.2 km). As illustrated in Fig. 4, the percentage reduction in linear distance ranged from 0.6% in the Jaskian District to 148.2% in

the Sefwi-Wiawso municipality and was 43.8 % on average. The paired *T*-test showed that the distance reduction was statistically significant ($t = 7.356$, $p = 0.00$).

Despite the general reduction across the districts and municipalities, the reorganisation also resulted in an increase in travel distance in some areas. For instance, although the average travel distance in the Ahafo region decreased by 31.5 km (51.3%), two out of its six districts were adversely affected. The average distances for the Tano North and Tano South districts increased by 148.5% (30.9 km) and 68.1% (26.2 km), respectively, as shown in Fig. 4 and Appendix 2. Similarly, in the Savannah region, three out of the six districts were negatively impacted. The average travel distance appreciated by 65.3% (54.5 km), 38.7% (21.9 km), and 7.6% (5.3 km) in the East Gonja, Gonja Central, and North Gonja districts, respectively. Marginal increases were observed in the Mamprugu-Maugduri district (1.2 km, 1.2%) in the North East region and the Biakoye district (4.1 km, 5.7%) in the Oti region.

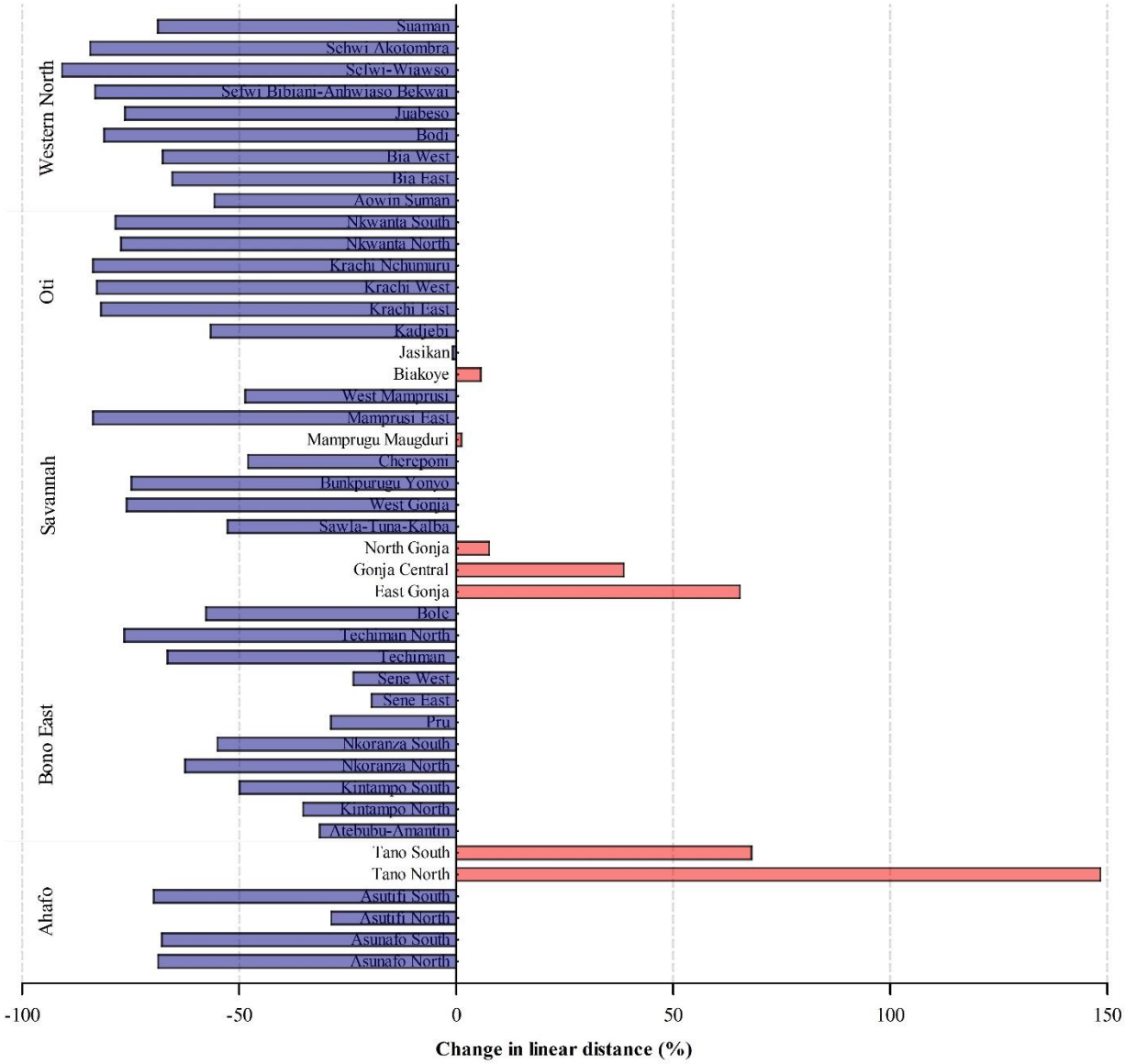

Figure 4. Percentage change in linear distances from towns to the old and new regional capitals in the districts.

-4. Discussion

Effects of the reorganisation on equitable access to development

From the results, the 2018 regional restructuring has generally reduced the travel distances from the various human settlements to the regional capitals at the regional and district levels. The reduction offers both economic and social advantages, as it results in decreases in transportation cost and associated health impacts (long travel-related stress) for both the populace and the local government representatives. Moreover, travel in our society is increasingly becoming associated with quality of life; hence, those without intercity access may

miss the opportunity and social capital (Aultman-hall, 2018). Therefore, inequitable access to services only available in the regional capitals will decrease. However, it must be noted that the extent of reduction will depend on other factors, such as good road network systems (Brobbey Commission, 2018).

Notwithstanding the merits noted above, the results show that the restructuring increased the travel distances in seven (7) out of the forty-four (44) districts studied. The affected districts included Biakoye, Mamprugu-Maugduri, North Gonja, Gonja Central, East Gonja, Tano North, and Tano South and are inhabited by nearly 540,000 people, according to the 2010 Population and Housing Census (HPC). Therefore, special interventions would be needed to mitigate the negative impacts.

On the other hand, the reorganisation has also resulted in several corporate entities establishing new regional branches in the new regional capitals. For example, initially, the Jospong Group of Companies, a major player in Ghana's environmental sanitation industry, planned to construct ten Integrated Recycling and Compost Plants (IRECOPs) to improve solid waste management across the ten regions in Ghana. However, the number was increased to sixteen after the reorganisation, and construction of the facilities was at various stages at the time of this study. Aside from the Western North and North East regions, where the plants were sited in Sefwi-Bekwai and Sagadugu, respectively, the IRECOPs are in the regional capitals of the newly created regions, i.e., Goaso (Ahafo region), Techiman (Bono East region), Dambai (Oti region), and Damongo (Savannah region). These plants are expected to not only improve sanitation in the regions but also create more jobs.

4.2. Effects of the restructuring on road transport emission cuts

Despite the consistent increase in the transportation sector's carbon footprint over the years (Ghana EPA, 2019), GHG emission cut has received little or no attention in Ghana's regional reorganisation discourse. The country must explore all avenues to minimize its land transport carbon emissions as part of its contribution towards the global sustainability agenda. Sustainable transportation entails strategies that eliminate or decrease carbon emissions from transportation (Ogryzek et al., 2020). Banister (2008) proposed four main paradigms for sustainable transit: (1) eliminating or reducing the need to travel; (2) shifting in modes of transport; (3) increasing efficiency through technological innovation (e.g., shift from fossil fuels to renewable energy sources); and (4) decreasing transport distance. Although scholars agree that reducing travel distance has positive implications on sustainable transit, there seems to be no consensus on the definition of long travel distance because inter-generational and country-specific definitions exist. For instance, in the 1950s, long-travels basically referred to out-of-town and overnight travels. However, some have used thresholds of 50, 75 or 100 miles (80, 120 or 160 km) in the USA and 100 km in Europe for land travels (Aultman-hall, 2018).

That notwithstanding, it could be said that since the recent reorganisation significantly minimized travel distances, Ghana's carbon emissions will decrease, although estimating the amount of GHG cut was beyond the scope of this study. Road transport dominates Ghana's

transportation sector, accounting for 96% of passenger and freight traffic (GIPC, 2022); the remainder represents rail, air, and water travels. Road transport is by motorcycle and tricycles, private and commercial vehicles, minibus and vans, buses and coaches, heavy-duty trucks and articulated trucks (Saisirirat et al., 2022), but buses contribute to 60% of passenger travels (GIPC, 2022). Also, the existing 950-km railway network is mainly for mineral, cocoa and timber transport (GIPC, 2022). Hence, minimising road travel distances will influence GHG emission reductions positively.

Additionally, only about 17% of Ghana's estimated 67,291 km road network is paved (DLCA, 2022), increasing travel times and, thereby, increasing fossil fuel consumption. Thus, improving the quality of the existing roads will minimize transport times and subsequently transport-related carbon emissions. Other scholars have also proposed biofuel bioethanol and biodiesel) integration in Ghana's road transportation (Saisirirat et al., 2022) and the extension of its railway system (mass transportation) to reduce its carbon emissions. Lastly, the need to travel could be avoided or decreased if goods and services can be accessed remotely. Hence, systems should be put in place to promote non-face-to-face transactions as much as possible (Aparicio, 2016; Banister, 2008). Meetings, training sessions and conferences, which are usually held at the regional capitals, could be organized on virtual platforms, and online applications portals and digital signing of documents could be adopted to eliminate travels as much as practicable.

-5. Conclusion

The present study evaluated the impact of the recent regional reorganisation in Ghana on the spatial extent and travel distances from the settlements or towns and district/municipalities in the affected regions to their respective regional capitals using GIS. The two parameters were crucial issues that dominated the petitions for the restructuring as they were considered barriers to balanced development in the country. We computed and compared the linear distances between settlements for each jurisdiction and the old and new regional capitals. The results indicate that the spatial extent of the regions has reduced considerably. Currently, the land size of the Greater Accra region remains the smallest region (3,721 km^2) while the largest region, the Savannah region (36,075 km^2), is about half the size of the old Northern region (70,217 km^2). Additionally, the reorganisation significantly ($p < 0.01$) decreased the average travel distances in all the regions of interest by 62.4 km (50.2%), with reductions ranging from 8.6 km to 129.3 km (8.1% to 75.3%) on the regional scale. However, the district or municipal level analysis revealed that the creation of the new regions rather increased the average travel distances in 7 out of the 44 affected local government areas by 7.6 to 148.5%. The districts worst affected were in the Savannah region (East Gonja = +54.5 km and Gonja Central = +21.9 km) and the Ahafo region (Tano North = +30.9 km and Tano South = +26.2 km). The general reduction in travel distance also has intrinsic benefits regarding the country's transport sector GHG emissions. This study demonstrates how GIS tools can contribute to informing decisions regarding decentralisation, as in the case of regional reorganisation.

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Old region	New region	New regional capital	No. of towns	Euclidean distance (km)				Old regional capital	No. of towns	Euclidean distance (km)				Change (km)
				Mean	Std Dev	Max	Min			Mean	Std Dev	Max	Min	
Northern	North East	Nalerigu	539	45.41	26.25	133.23	0.10	Tamale	539	119.76	18.67	150.28	63.63	-74.36
	Northern*	Tamale	646	77.72	41.37	153.19	0.12	Tamale	-	-	-	-	-	-
	Savannah	Damongo	699	97.97	38.29	186.37	1.12	Tamale	699	106.56	51.04	191.96	10.36	-8.59
Brong Ahafo	Ahafo	Gaoso	702	29.81	16.18	80.57	0.28	Sunyani	702	61.26	21.56	98.13	9.13	-31.45
	Bono East	Techiman	912	73.50	52.80	200.29	62.09	Sunyani	855	107.40	55.21	234.99	26.37	-33.90
	Bono *	Sunyani	773	41.80	21.52	104.15	1.31	Sunyani	-	-	-	-	-	-
Western	Western *	Sekondi-Takoradi	581	59.64	34.24	134.14	1.21	Sekondi-Takoradi	-	-	-	-	-	-
	Western North	Sehwi-Wiaoso	304	42.33	24.32	97.63	0.71	Sekondi-Takoradi	211	171.58	32.97	245.08	102.58	-129.25
Volta	Oti	Dambai	613	58.27	8.56	85.66	48.69	Ho	534	131.70	13.54	156.03	102.58	-73.43
	Volta*	Ho	1574	50.71	20.71	93.29	0.93	Ho	-	-	-	-	-	-

Appendix 1. Average Euclidean distances from locations in the NROIs to their capitals before and after the reorganisations.

Appendix 2. Average Euclidean distances from locations in the Districts and Municipals of the NROIs before and after the reorganisation.

New region	District/Municipal	New regional capital	No. of towns	Euclidean distance (km)				Old regional capital	No. of towns	Euclidean distance (km)				Change (km)
				Mean	Std Dev	Max	Min			Mean	Std Dev	Max	Min	
Ahafo	Asunafo North	Gaoso	181	20.49	8.74	38.24	0.28	Sunyani	181	65.41	9.10	44.73	44.73	-44.91
	Asunafo South	Gaoso	276	26.06	6.03	44.67	5.58	Sunyani	276	81.00	6.35	98.13	61.80	-54.94
	Asutifi North	Gaoso	66	26.78	5.76	36.87	14.67	Sunyani	66	37.59	8.11	53.64	23.22	-10.81
	Asutifi South	Gaoso	51	14.50	6.86	31.54	2.94	Sunyani	51	47.91	7.23	67.11	34.66	-33.41
	Tano North	Gaoso	59	51.73	8.35	68.01	37.60	Sunyani	59	20.82	7.11	33.76	9.13	30.91
	Tano South	Gaoso	69	64.75	9.65	80.57	44.86	Sunyani	69	38.53	4.46	47.53	26.59	26.22
Bono East	Atebubu-Amantin	Techiman	118	91.55	12.16	113.72	62.09	Sunyani	118	133.54	12.48	158.05	106.60	-41.99
	Kintampo North	Techiman	66	74.02	23.34	125.65	50.47	Sunyani	66	114.32	23.33	165.65	89.04	-40.30
	Kintampo South	Techiman	101	42.36	10.50	58.71	14.21	Sunyani	101	84.62	10.71	103.85	56.13	-42.25
	Nkoranza North	Techiman	56	27.01	8.44	55.93	12.76	Sunyani	56	71.99	8.34	100.90	58.40	-44.98
	Nkoranza South	Techiman	91	27.94	7.52	50.80	12.63	Sunyani	91	62.06	8.28	91.81	48.81	-34.12
	Pru	Techiman	103	111.39	27.37	146.14	62.14	Sunyani	103	156.65	27.28	191.27	107.59	-45.27
	Sene East	Techiman	61	170.34	11.27	200.29	150.68	Sunyani	61	211.63	10.84	234.99	192.61	-41.29

New region	District/Municipal	New regional capital	No. of towns	Euclidean distance (km)				Old regional capital	No. of towns	Euclidean distance (km)				Change (km)
				Mean	Std Dev	Max	Min			Mean	Std Dev	Max	Min	
	Sene West	Techiman	141	135.21	9.85	153.42	114.40	Sunyani	141	177.12	9.90	195.24	157.52	-41.90
	Techiman	Techiman	128	12.11	4.48	19.91	0.47	Sunyani	128	36.21	7.06	55.49	26.37	-24.10
	Techiman North	Techiman	47	11.38	4.46	22.43	2.70	Sunyani	47	48.44	4.71	56.51	39.15	-37.05
Savannah	Bole	Damongo	80	71.35	12.23	95.64	36.13	Tamale	80	168.40	9.96	188.05	132.93	-97.05
	East Gonja	Damongo	267	137.89	22.72	186.37	91.42	Tamale	267	83.40	35.00	139.70	10.36	54.49
	Gonja Central	Damongo	110	78.65	21.03	118.33	33.78	Tamale	110	56.72	27.87	135.02	14.83	21.93
	North Gonja	Damongo	60	75.15	22.46	110.80	37.75	Tamale	60	69.83	14.96	112.95	43.08	5.32
	Sawla-Tuna-Kalba	Damongo	155	78.54	13.00	47.01	47.01	Tamale	155	166.01	12.14	191.96	131.80	-87.48
	West Gonja	Damongo	27	22.99	13.67	46.29	1.12	Tamale	27	95.64	18.63	138.96	61.18	-72.64
North East	Bunkpurugu Yonyo	Nalerigu	132	33.86	10.52	56.42	15.82	Tamale	132	134.68	7.87	148.75	118.06	-100.82
	Chereponi	Nalerigu	128	69.34	9.87	92.95	48.54	Tamale	128	133.21	8.27	150.28	107.98	-63.88
	Mamprugu Maugduri	Nalerigu	40	97.23	16.71	133.23	72.71	Tamale	40	96.08	11.11	120.03	74.15	1.15
	Mamprusi East	Nalerigu	147	18.71	8.93	41.34	0.10	Tamale	147	114.90	7.67	133.91	97.51	-96.20
	West Mamprusi	Nalerigu	92	48.81	13.67	78.57	28.08	Tamale	92	94.96	13.66	121.50	63.63	-46.15
Oti	Biakoye	Dambai	53	76.78	12.20	97.33	50.02	Ho	53	72.67	12.34	101.70	52.00	4.11
	Jasikan	Dambai	30	76.52	9.80	91.49	63.33	Ho	30	77.14	7.54	90.55	61.75	-0.62
	Kadjebi	Dambai	46	48.87	6.72	61.67	37.92	Ho	46	112.74	10.72	129.84	91.78	-63.87
	Krachi East	Dambai	141	23.45	14.95	57.16	0.23	Ho	141	129.14	16.87	161.01	91.78	-105.69
	Krachi West	Dambai	98	24.26	7.11	40.94	8.96	Ho	98	141.26	9.58	157.61	124.39	-117.00
	Krachi Nchumuru	Dambai	112	27.01	12.31	57.58	2.20	Ho	112	165.37	7.43	182.91	151.08	-138.36
	Nkwanta North	Dambai	22	43.32	10.05	66.66	27.53	Ho	22	190.63	10.04	213.36	174.00	-147.31
	Nkwanta South	Dambai	111	34.63	10.21	59.67	11.03	Ho	111	160.87	15.80	189.77	130.86	-126.24
Western North	Aowin Suman	Sehwi-Wiaoso	27	58.27	8.56	85.66	48.69	Sekondi-Takoradi	27	131.70	13.54	156.03	102.58	-73.43
	Bia East	Sehwi-Wiaoso	49	78.51	12.14	97.63	61.10	Sekondi-Takoradi	49	226.72	11.75	245.11	209.35	-148.21
	Bia West	Sehwi-Wiaoso	30	68.94	11.37	89.33	54.24	Sekondi-Takoradi	30	213.17	10.20	233.43	199.14	-144.22
	Bodi	Sehwi-Wiaoso	24	31.95	8.63	46.65	22.02	Sekondi-Takoradi	24	169.54	5.00	178.60	158.16	-137.59
	Juabeso	Sehwi-Wiaoso	34	44.04	5.38	52.63	33.60	Sekondi-Takoradi	34	186.21	5.80	197.85	177.08	-142.16
	Sefwi Bibiani-Anhwiaso Bekwai	Sehwi-Wiaoso	76	25.23	5.64	39.04	13.66	Sekondi-Takoradi	76	150.41	10.03	167.83	132.07	-125.18

New region	District/Municipal	New regional capital	No. of towns	Euclidean distance (km)				Old regional capital	No. of towns	Euclidean distance (km)				Change (km)
				Mean	Std Dev	Max	Min			Mean	Std Dev	Max	Min	
	Sefwi-Wiawso	Sehwi-Wiaoso	37	14.58	9.11	34.77	0.71	Sekondi-Takoradi	37	158.52	12.26	182.55	141.33	-143.93
	Sehwi Akotombra	Sehwi-Wiaoso	26	23.57	11.91	45.87	9.97	Sekondi-Takoradi	26	150.64	7.16	164.85	136.05	-127.07
	Suaman	Sehwi-Wiaoso	11	54.27	5.21	62.00	47.00	Sekondi-Takoradi	11	173.91	5.81	185.00	167.00	-119.64

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