ECONOMIC OPPORTUNITIES ALONG THE CENTRAL AFRICAN ROAD CORRIDOR

Prepared for UNECA

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fraym

Nations Unies
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Table of Contents

1. Acknowledgements

This report was prepared by Fraym for the Sub-regional Office for Central Africa of the United Nations Economic Commission for Africa (UNECA). The work was directed by Antonio M. A. Pedro, Director of the Sub-regional Office for Central Africa of the UNECA. The principal authors of the report were Marina Tolchinsky, Analytics Team Lead at Fraym, and Geoffrey Tam, Data Analyst at Fraym. This work was funded by the UNECA.

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Contributors from Fraym include Krsna Powell, Jonathan Tan, Erica Turner, and Jonathan Kumaresan. Numerous other individuals at Fraym contributed invaluable work in data acquisition, processing, cleaning, and modeling that made the analysis in this report possible.

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2. Abbreviations and Acronyms

AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AMA	African Medicines Agency
AMV	Africa Mining Vision
AU	African Union
CEMAC	Communauté Economique et Monetaire de l'Afrique Centrale
CIESIN	The Center for International Earth Science Information Network
DRC	Democratic Republic of Congo
ECA	United Nations Economic Commission for Africa
ECCAS	Economic Community of Central African States
EO	Earth Observation
ESA	European Space Agency
ESG	Environmental, Social, and Corporate Governance
FEWS NET	Famine Early Warning Systems Network
GHSL	Global Human Settlement Layer
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
IRENA	International Renewable Energy Agency
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NDVI	Normalized Difference Vegetation Index
NPK	Nitrogen-Phosphorus-Potassium
NOAA	National Oceanic and Atmospheric Association

PADFA	Commodity Value Chain Support Project
PIDA	Programme for Infrastructure Development in Africa
RSME	Root Mean Square Error
SEDAC	Socioeconomic Data and Applications Center
SDG	Sustainable Development Goal
TAH	Trans-African Highway Network
USGS	United States Geological Survey

3. Executive Summary

As the African Continental Free Trade Area (AfCFTA), becomes operational, it promises to unlock the development of regional value chains. In Central Africa, the transport corridor will serve as a vehicle for economic transformation. This report analyzes the region's natural resources and the socio-economic and demographic dynamics of populations with the objective of highlighting areas with economic potential that may be suitable for investment in a variety of priority sectors. The identification of potential economic development zones is concentrated on the agri-business, renewable energy, and mining sectors. These interconnected sectors were selected based on their potential contribution to economic and social development, environmental conservation, and regional integration.

Agri-business: The Central Africa road corridor is critical to supporting the transformation of the agricultural and livestock sectors by linking farmers to agricultural inputs that can improve productivity and enable them to meet consumer demand for agricultural products. Maize and rice are priority commodities poised to benefit from increased regional trade, particularly in the Extreme North region of Cameroon.

Renewable energy: The border area between the Extreme North region of Cameroon and Chad has among the highest potential for wind and solar energy on the African continent. Exploiting this potential can improve the region's progress towards SDG 7 and stimulate demand for locally sourced metals that can be used in wind turbine construction and renewable energy storage. In addition to increasing energy access for the population, a stable energy supply could also benefit areas of livestock production and processing and enhance the transformation of livestock products.

Mining: The global energy sector is undergoing a shift to renewable and sustainable energy sources which has impacted global demand for metals used in rechargeable batteries. Central Africa has abundant deposits of valuable metals used in the production of rechargeable batteries, but limited capacity to process the metals and manufacture the batteries. The region is well suited to develop an integrated regional battery value chain, connecting mining at the base of the supply chain to end-user demand for renewable energy storage and smartphones.

National and sub-national analysis: Geospatial data and analysis has the power to guide decision-making and reveal insights that enable a comprehensive and unbiased evaluation of potential investments at all levels of policymaking. The power of geospatial analysis at the national and sub-national level are showcased in this report through case studies on Cameroon and the Douala-Edéa-Kribi growth triangle. The growth triangle is well suited for the development of a pharmaceutical industries, with an educated and youthful population. Local policymakers in this area should promote technical training specific to the pharmaceutical sector to secure a local labor force that can benefit from and catalyze growth in the nascent industry.

4. Introduction

The African population and economy is dynamic and growing. The African Continental Free Trade Area (AfCFTA), which commenced trading in January 2021, covers a market of 1.2 billion people and across all 55 members states of the African Union (AU), an area with a gross domestic product (GDP) of $2.5 trillion. It is the largest free-trade area in terms of the number of participating countries, and the United Nations Economic Commission for Africa (ECA) suggests that the AfCFTA has the potential to boost intra-African trade by 52.3 percent. Similarly, the World Bank estimates that the AfCFTA could lift an additional 30 million people form extreme poverty by 2035.[1] The opportunities for industrialization and diversification of economic development, as well as the potential to improve population livelihoods because of enhanced continent-wide economic opportunities are substantial.

In Central Africa, the Central Africa Regional Transport Corridor will serve as a vehicle for economic transformation. The region has experienced stagnating economic growth in the past decade as prices and demand for primary commodity exports has decreased.[2] ECA is working with the Economic Community of Central African States (ECCAS) and the Communauté Economique et Monetaire del'Afrique Centrale (CEMAC) to support the coordination between stakeholder agendas and facilitate the development of strategies to spur economic growth in the region with an emphasis on regional integration and trade. In recent history, regional trade among countries in Central Africa has lagged international trade. As the AfCFTA begins to operationalize, it promises to unlock the large potential of regional value chains, particularly in the transformation of minerals and manufacturing activities. The transport corridor will be crucial to the development of new economic zones aimed at diversifying economies and increasing industrial activity.

ECA has engaged Fraym to provide analysis of the proximity of the region's natural resources to the current transport corridor and the socio-economic and demographic dynamics of populations within the corridor to understand gaps of the current transport corridor master plan and answer questions such as: what areas of economic promise are and are not being reached by the current transport corridor master plan? What natural resources near the current transport corridor are available to add value to the region's economic growth? Through this analysis, ECA will be able to assist ECCAS and CEMAC to identify areas of strategic investment in sectors such as infrastructure development, agriculture value chains, and natural resource management that can stimulate economic growth and create an enabling environment for long term stability and development throughout the region.

[1] World Bank. "The African Continental Free Trade Area: Economic and Distributional Effects." Available at: doi:10.1596/978-1-4648-1559-1. License: Creative Commons Attribution CC BY 3.0 IGO

[2] UNECA. "Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l'Afrique centrale pour tirer le meilleur parti de la ZLECAf." Volume 1. 17 December 2020.

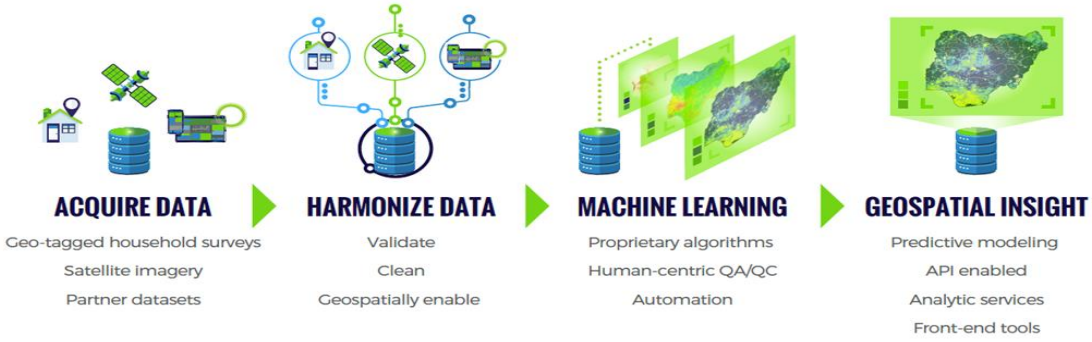
This report analyzed economic growth prospects along the transport corridor at three different levels: regional, national, and sub-national. At the regional level, this report mapped and analyzed biophysical data – such as forests, water bodies, solar radiation, and minerals – to assess natural resource accessibility based on the current transport corridor. Additionally, this report mapped concentrations of high livestock ownership along the corridor, as well as where staple crops are produced. Furthermore, this report analyzed the socio-economic and demographic dynamics of populations along the current transport corridor to better understand the transport corridor's potential to improve the lives and livelihoods of populations in the region.

Cameroon was selected for the national analysis and the Douala-Edéa-Kribi growth triangle was selected for the subnational analysis. The report expounds upon the economic opportunities and socio-demographic characteristics of populations in depth at both the national and subnational levels. In addition, the analysis highlights road corridors that can connect untapped economic resources to markets. These two case-studies highlight the value of geospatial analysis in economic planning at both the national and local levels.

About Fraym

Fraym was created to address unmet demand for accurate and comprehensive geospatial population data in Africa, Asia, and Latin America. Fraym currently produces localized information on people in over 70 countries—including data on demographics, household characteristics, social and demographic variables, spending power, connectivity, asset ownership, financial inclusion, and more. This data is produced with resolution down to one square kilometer.

To do this, Fraym uses machine learning to combine survey data and satellite imagery. First, Fraym accesses, aggregates, cleans, and harmonizes every major source of household survey data in a country. To date, Fraym has acquired 1,000+ household surveys from developing countries. Next, Fraym uses a series of advanced machine learning models to combine this survey data with dozens of types of satellite imagery. The end product is the best possible information about people in a specific community or neighborhood. No one else offers a similar product or capability at this scale, efficiency, or speed.



5. Methodology

Fraym provided the geospatial analysis for this report in close collaboration with experts and practitioners at ECA. The following section provides a brief overview of Fraym's hyperlocal data estimation methodology.

Model Inputs

Fraym generates its socioeconomic and demographic estimates through machine-learning assisted spatial interpolation. At its core, interpolation uses geographic points with known values to estimate points with unknown values. Fraym's models require two main inputs.

The first data input is secondary data from existing high-quality, geo-tagged household surveys. Key indications of a high-quality household survey include the reputation of implementing organization(s), sample design, sample size, and response rates. Fraym has collected, cleansed, and harmonized more than 1,000 of these surveys from around the world. These surveys are considered a "semi-public" data source, e.g. they are obtainable after registration, agreement to terms of use, and receiving permissions. Although specific details vary by survey, they are often implemented by the National Statistics Office of a given country in conjunction with relevant national ministries. Funding and technical assistance for such surveys is commonly provided by US Agency for International Development (USAID), the World Bank, and/or the Bill and Melinda Gates Foundation.

Surveys are designed with stratification and clustering so that they are nationally representative with enough sampled households to provide estimation of key indicators for subnational regions. Sample sizes are normally 10,000+ households with information for 50,000+ respondents. Response rates are very high, normally higher than 95 percent.

The second major data input is satellite imagery and related derived data products, including earth observation (EO) data, gridded population information i.e. human settlement mapping, and biophysical surfaces like soil characteristics. As with the survey data, Fraym data scientists ensure that the software only uses high-quality imagery inputs. Derived products are carefully assessed for model metrics, contextual checking, and pedigree within the geospatial data science community.

Remotely sensed data, such as satellite imagery, are downloaded from long running and frequently quality checked satellites and sensors. Data is provided by respected organizations including the National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), European Space Agency (ESA), the Socioeconomic Data and Applications Center (SEDAC), and the Center for International Earth Science Information Network (CIESIN).

Input Harmonization

Fraym data scientists take painstaking steps to harmonize and clean these data inputs. Over the last seven years, data scientists have built software tools to aid in cleaning household survey data and satellite imagery. For surveys, data scientists inspect the question wording and response categories for reliability. In addition, special attention is paid to non-response bias by question to ensure that each question has adequate sample size, and any non-response can be considered random. Missing values are treated in appropriate, industry standard ways. For example, any missing values in the satellite imagery is filled by the mean of a 5x5 kilometer focal window, a more robust version of nearest neighbors.[3]

For survey data, additional quality assurance is spent on the sample weights. At times, Fraym data scientists make modest adjustments to design weights, for example, post-hoc weight adjustments, to account for any oversampling and ensure survey representativeness. Population parameters are drawn from third-party sources like the United Nations (UN), ensuring comparability across countries.

For every data input, a final human quality assurance occurs after the use of automated tools. Overall, the harmonization and cleansing process ensures that the AI/ML software only ingests highest quality inputs to enable robust outputs.

Spatial Interpolation

To create spatial layers from household survey data, Fraym uses an ensemble-based machine learning approach to predict a continuous surface of the indicator of interest at a 1 square kilometer resolution. This methodology builds upon existing, tested methodologies for interpolation of spatial data.[4] In sum, Fraym's proprietary software creates a model that identifies correlations between the survey data at enumeration clusters and the satellite imagery layers from the same place. The resulting model is used to predict the survey data for all non-enumerated areas. A similar approach was pioneered by USAID's Demographic and Health Surveys program in 2015 and since improved upon by Fraym and others.[5]

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[3] Hagen-Zanker, Alex. 2016. "A computational framework for generalized moving windows and its application to landscape pattern analysis." International Journal of Applied Earth Observation and Geoinformation Vol. 14, pg. 205-2016. https://www.sciencedirect.com/science/article/abs/pii/S0303243415300337

[4] Davies, Molly Margaret, and Mark J. Van Der Laan. "Optimal spatial prediction using ensemble machine learning." The international journal of biostatistics 12.1 (2016): 179-201.

[5] Gething, Peter, Andy Tatem, Tom Bird, and Clara R. Burgert-Brucker. 2015. Creating Spatial Interpolation Surfaces with DHS Data DHS Spatial Analysis Reports No. 11. Rockville, Maryland, USA: ICF International. Other notable, relevant work includes: Weiss DJ, Lucas TCD, Nguyen M, et al. Mapping the global prevalence, incidence, and mortality of *Plasmodium falciparum*, 2000–17: a spatial and temporal modelling study. Lancet 2019; published online June 19. DOI: 10.1016/S0140-6736(19)31097-9 and Tatem A, Gething P, Pezzulo C, Weiss D, and Bhatt S. 2014. Final Report: Development of High-Resolution Gridded Poverty Surfaces. University of Southampton. https://www.worldpop.org/resources/docs/pdf/Poverty-mapping-report.pdf

Ensembling of machine learning algorithms involves using predictions from a set of base-learner models as inputs for a second ensemble or super learner model.[6] By leveraging multiple base models, the software is able to improve final predictions across large geographies. Base-model methods include several forms of linear models as well as various tree-based and neural network architectures. Models are tuned and evaluated using industry-standard cross-validation techniques, and the predictive power of smaller data sets is increased through systems of boosting, bagging, and k-fold cross validation.[7]

Grid cells with no survey data are predicted by applying a model using the parameters generated in the train and tune process. For every data layer, Fraym data scientists examine the standard model metrics such as R-squared and Root Mean Square Error (RMSE) to relay quality. Generally, data layers have very robust indicators of quality. For example, a RMSE value will be 0.025 for a proportional question from the survey (for example, the proportion of adults with secondary education), meaning that roughly the average error between the prediction and the held-out enumeration area data was 2.5 percentage points different. For proportional variables if RMSE is greater than 0.1, then data layers are not used in production because they are too low quality. Similar thresholds are applied to non-proportional variables.

In addition, comparisons are made between the spatial surface and the survey data at the lowest level for which the survey was designed to be representative, e.g. regions. This survey mean is compared against the implied mean of the surface when all grids are appropriately aggregated through population weighted zonal statistics. A difference larger than 10 percentage points for any region indicates that the data layer is not suitable for use in production.

This report does not visualize grid cells in interpolated layers where there are zero people estimated to be inhabiting the $1km^2$ due to the larger risk of error for estimates in sparsely populated areas. Thus, maps using interpolated layers in this report will not show estimates for areas with no population and will, instead, be represented with the following symbol: .

[6] Davies, Molly Margaret, and Mark J. Van Der Laan. "Optimal spatial prediction using ensemble machine learning." The international journal of biostatistics 12.1 (2016): 179-201.

[7] Ghojogh, Benyamin, and Mark Crowley. "The Theory Behind Overfitting, Cross Validation, Regularization, Bagging, and Boosting: Tutorial." arXiv preprint arXiv:1905.12787 (2019).

6. Data

This report highlights areas with economic potential that may be suitable for specific investment to stimulate economic growth and strengthen transnational linkages along the Central African road corridor. A site suitability approach was used to identify areas with potential for investment in priority regional value chains in the agri-business, renewable energy, and mining sectors. These components of economic potential were derived from ECA's priorities as expressed to Fraym. In addition to identifying potential economic zones, this report provides an overview of socioeconomic and demographic indicators in the region. An analysis of these indicators can provide policymakers with an understanding of areas which are lagging on progress towards the SDGs and which could benefit from investment in an economic development zone.

The sources of data on biophysical indicators in this report include NASA's Moderate Resolution Imaging Spectroradiometer (MODIS), WorldClim, the World Bank's Global Wind Atlas, the United States Geological Survey (USGS), the Global Forest Watch, Protected Planet, and FEWS NET Livelihood Zones. Population data was obtained from WorldPop and the Global Human Settlements Layer was used to estimate urban areas.

Table 6.1 provides a summary table of datasets used in this report along with relevant information on sources, vintage, limitations, and notes on how the data was processed.

TABLE 6.1. DATA SUMMARY

Data	Source	Date Last Updated	Data format	What limitations does the dataset have?	How was this dataset processed for use in the report?
Demographic & Socioeconomic	Demographic and Health Survey, Multiple Indicator Cluster Survey	Varies by country[8]	Survey data		Interpolated to 1 km^2 using Fraym's proprietary software
Deforestation	University of Maryland Department of Geographical Sciences	2020	Raster - 30 m^2		Forest cover loss events aggregated by year at the 1 km^2 level
Conservation Areas	Protected Planet	2021	Vector		
Marine Conservation Areas	Protected Planet	2021	Vector		
Electricity Network	Africa - Electricity Transmission And Distribution Grid Map	2017	Vector	Lack of recent data on electricity network	
Livelihood Zones	FEWS NET	Varies by country[9]	Vector	Lack of recent data on livelihoods for certain countries	Harmonized naming and filtered to priority crops
Minerals	USGS global distribution of mines, deposits and districts of critical minerals	2017	Vector	Low confidence in completeness of dataset	Applied 5 km buffer to cobalt and copper sites
Mining Permits	Global Forest Watch	Varies by country	Vector		Harmonized naming and filtered to permits for minerals used in key value chains
Mobile Network Coverage	Collins Bartholomew Mobile Coverage Explorer	2020	Raster - 1km^2		
Population	WorldPop	2020	Raster - 1 km^2		
Urban Settlements	Global Human Settlement Layer (GHSL)	2015	Raster - 1 km^2		Filtered rural grid cells[10] from SMOD rasters
Vegetation	NASA MODIS	2019	Raster - 1 km^2		Calculated annual mean of yearly data
Weather and Climate	WorldClim	2018	Raster - 1 km^2		Calculated annual mean of yearly solar radiation data
Wind Power	World Bank Wind Atlas	2017	Raster - 250 m^2		Aggregated wind power density raster to 1 km^2

[8] Angola DHS 2016, Burundi DHS 2017, Cameroon DHS 2018, CAR MIC 2010, Chad DHS 2015, Congo DHS 2012, Democratic Republic of Congo DHS 2014, Gabon DHS 2012, Rwanda DHS 2015, Sao Tome and Principe MIC 2014
[9] Angola 2013, Burundi 2009, Cameroon 2019, Chad 2011, Democratic Republic of Congo 2016, Rwanda 2012

7. Regional Analysis: Central Africa Road Corridor

7.1 Overview

The identification of potential economic zones along the Central African road corridor is concentrated on the agri-business, renewable energy, and mining sectors, with a particular focus on transnational border areas. This analysis is centered on a value chain approach, which is essential to clarify how best to connect products at the base of the supply chain to transformation activities that increase value and to end-users. Previous literature on economic growth indicates that strong growth is drawn from integration into global value chains.[11]

Regional value chains in agri-business and mining that were analyzed in this report include rice, maize, livestock, and minerals used in fertilizers and batteries. These value chains were selected by the UNECA in Expert Group Meetings based on their potential contribution to economic and social development, environmental conservation, and regional integration, especially regarding projects from the Programme for Infrastructure Development in Africa (PIDA). In line with these criteria, the renewable energy sector, specifically solar and wind energy, was also included in the analysis of potential economic zones.

7.2 Agriculture

Agriculture is perhaps the most important source of economic production in the Central Africa region. The sector accounted for 12 percent of GDP in the region in 2019. The large majority of the population living in Central Africa relies on agricultural production for subsistence and for income. An estimated 92 percent of people living in Burundi, 82 percent in Chad, 73 percent in the Republic of Congo, and 68 percent in the Democratic Republic of Congo are employed in the agriculture sector.[12] The reliance on farming is more notable in rural areas, where agriculture is often the dominant economic activity. Transformation of the sector is essential to stimulate economic growth and increase revenues for rural populations.

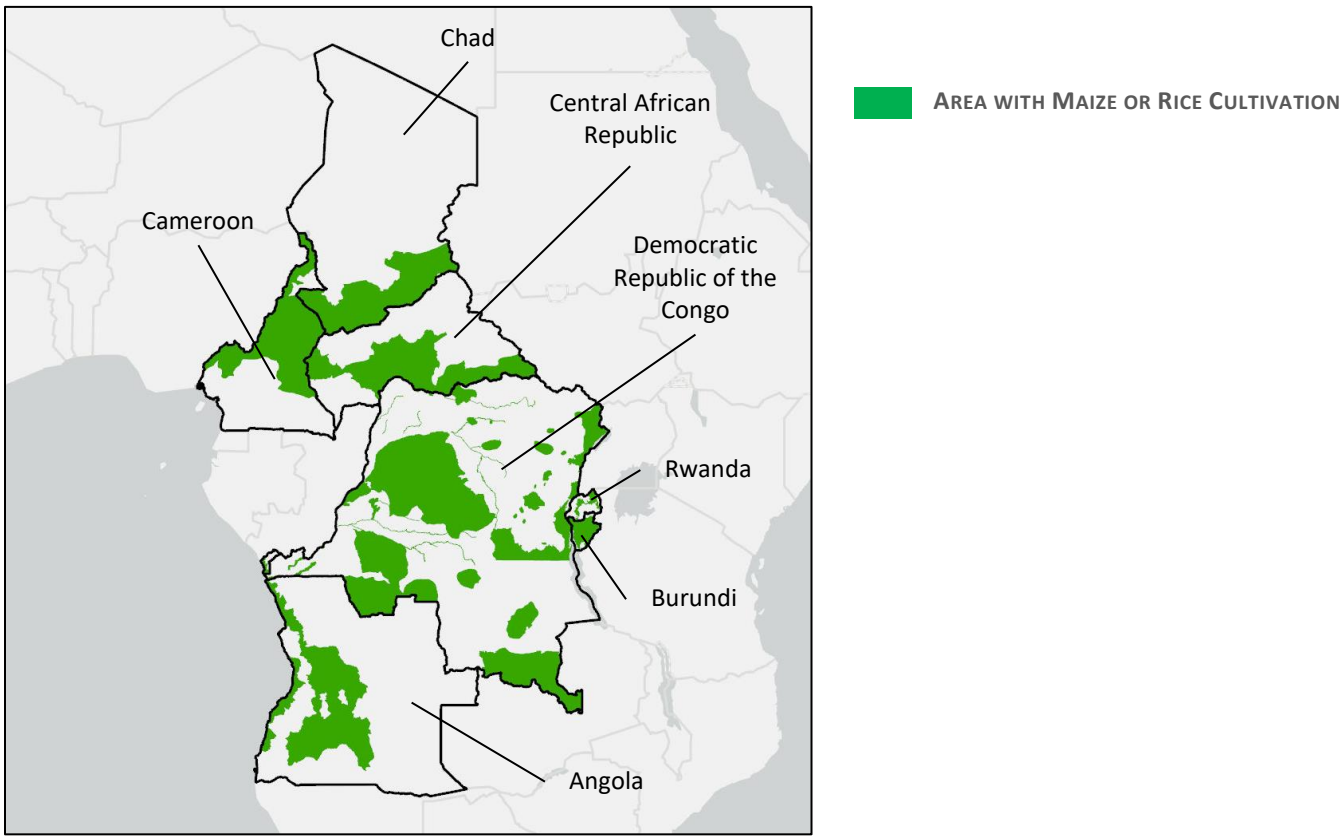
Value-added in agriculture is often low in the region, indicating there is a lost opportunity for transformation of certain key commodities. As the AfCFTA operationalizes, opportunities to develop regional value chains may be unlocked. Rice and maize stand out as agricultural commodities that are commonly produced and traded among countries in Central Africa. The region has favorable climate conditions for rice and maize and the productivity of maize produced in Central Africa, particularly in Cameroon and Rwanda, is often higher than the continent-wide

[10] GHSL classifies raster grid cells according to population size, population density, and contiguity. “Urban areas” are all cells other than those classified as “low density rural grid cells” or “very low-density grid cells” by GHSL.
[11] UNECA. “Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l’Afrique centrale pour tirer le meilleur parti de la ZLECAf.” Volume 1. 17 December 2020.
[12] Ibid.

average. This indicates the region has a comparative advantage in maize that can be drawn on to increase value-added and further boost trade.

Both rice and maize can be transformed to increase value-added. Maize is a valuable agricultural product important for the food security of the population and is also used in livestock feed and in new technologies.[13] Rice can be transformed from paddy rice to cargo rice and other types of food products of higher value. There is a small number of agro-industrial enterprises in the region that are currently engage in rice transformation.[14] The regional road network will be critical to supporting the development of these value chains, especially for rice as principal rice-producing areas are located far from consumption centers.

FIGURE 7.1 REGIONAL DISTRIBUTION OF MAIZE AND RICE CULTIVATION



[13] UNECA "Analyses approfondies des chaines de valeurs régionales et grappes stratégiques pour tirer le meilleur parti de la ZLECAf – Document de Travail." Volume 2. 18 December 2020.
[14] Ibid.

Data on agricultural production is available for Cameroon, Chad, the Central African Republic, the Democratic Republic of Congo, Rwanda, Burundi, and Angola. There are zones where either maize or rice is cultivated in each of these countries. While rice and maize are grown almost everywhere in Burundi, in most countries they are primarily cultivated in certain areas that often cross borders. For example, the Extreme North region of Cameroon produces two thirds of all the rice grown in the country. A large percentage of this rice production is transported to Chad and the Central African Republic.[15] Maize producing areas also cross the Cameroon-Chad and Cameroon-Central African Republic borders.

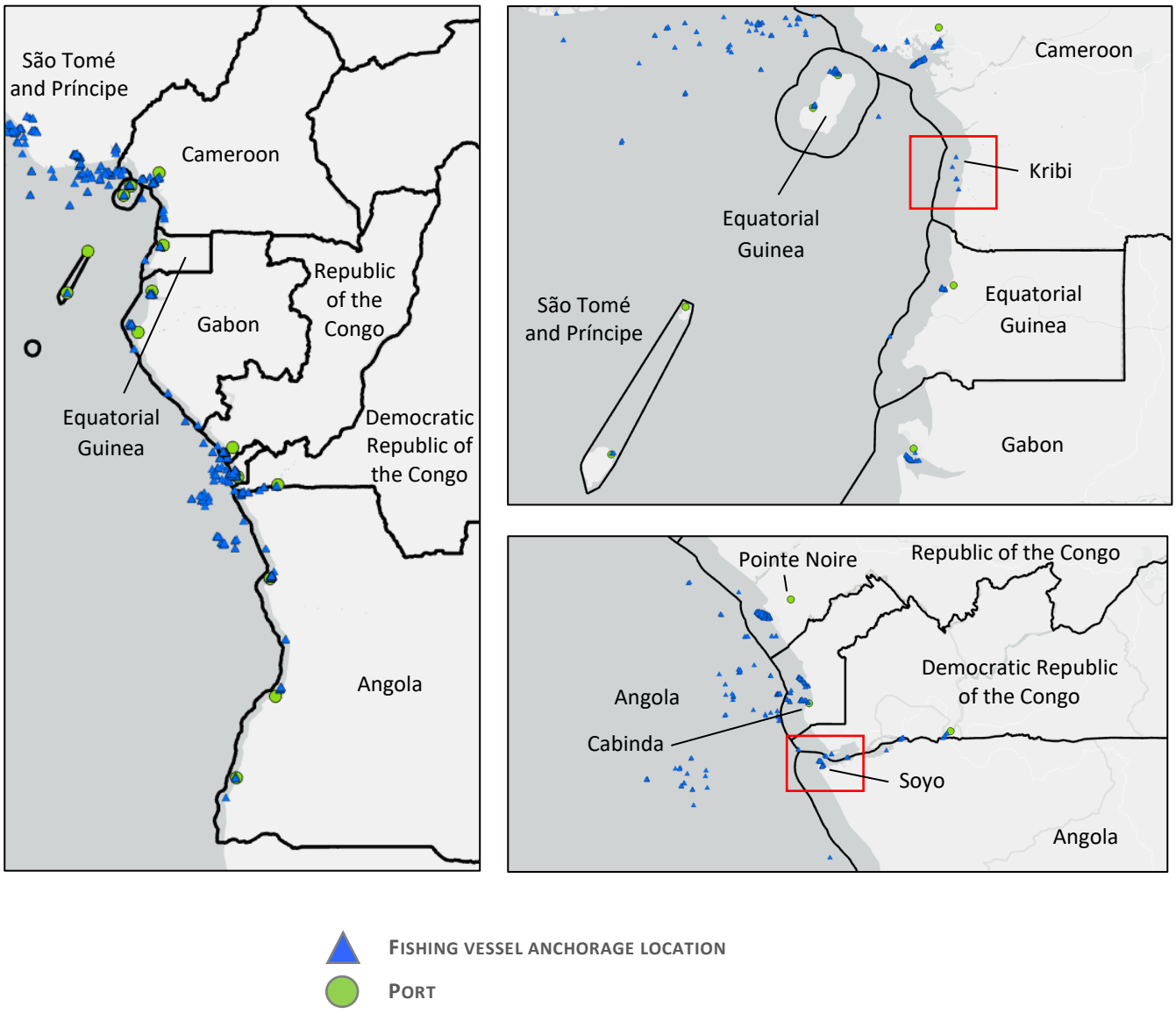
7.3 Fishing

While fishing is a common economic activity for populations living along the coast, the sector is less developed in Central Africa as compared to other regions in Africa. However, there are indications of opportunity to grow this sector through increased regional trade. For example, Angola has had the largest exports of fish and seafood in the region, at $185 million USD in 2018, with African countries accounting for three quarters of export destinations in total value.[16] Increasing connectivity through regional infrastructure could support the expansion of regional trade in fishing products.

According to Global Fishing Watch, there are 884 fishing vessels anchored within the exclusive economic zones of Central Africa countries.[17] The vast majority lie off the coast of Angola (366 anchorages), followed by Republic of Congo (169), Cameroon (135), and Gabon (102). Most anchorages cluster close to large ports with the exception of several groupings near Kribi in Cameroon and the mouth of the Congo River in Soyo, Angola. Investment in infrastructure to connect these fishing hubs to inland markets will be critical to promote development of the fishing sector. In addition, high traffic fishing ports such as those in Cabinda and Pointe Noire will require well-developed road infrastructure to support their continued development.

[15] UNECA. "Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l'Afrique centrale pour tirer le meilleur parti de la ZLECAf." Volume 1. 17 December 2020.
[16] Ibid.
[17] Global Fishing Watch, Anchorages. Available at: https://globalfishingwatch.org/data-download/datasets/public-anchorages:v20200316

FIGURE 7.2 LOCATIONS OF FISHING VESSELS AND PORTS IN THE REGION



7.4 Livestock

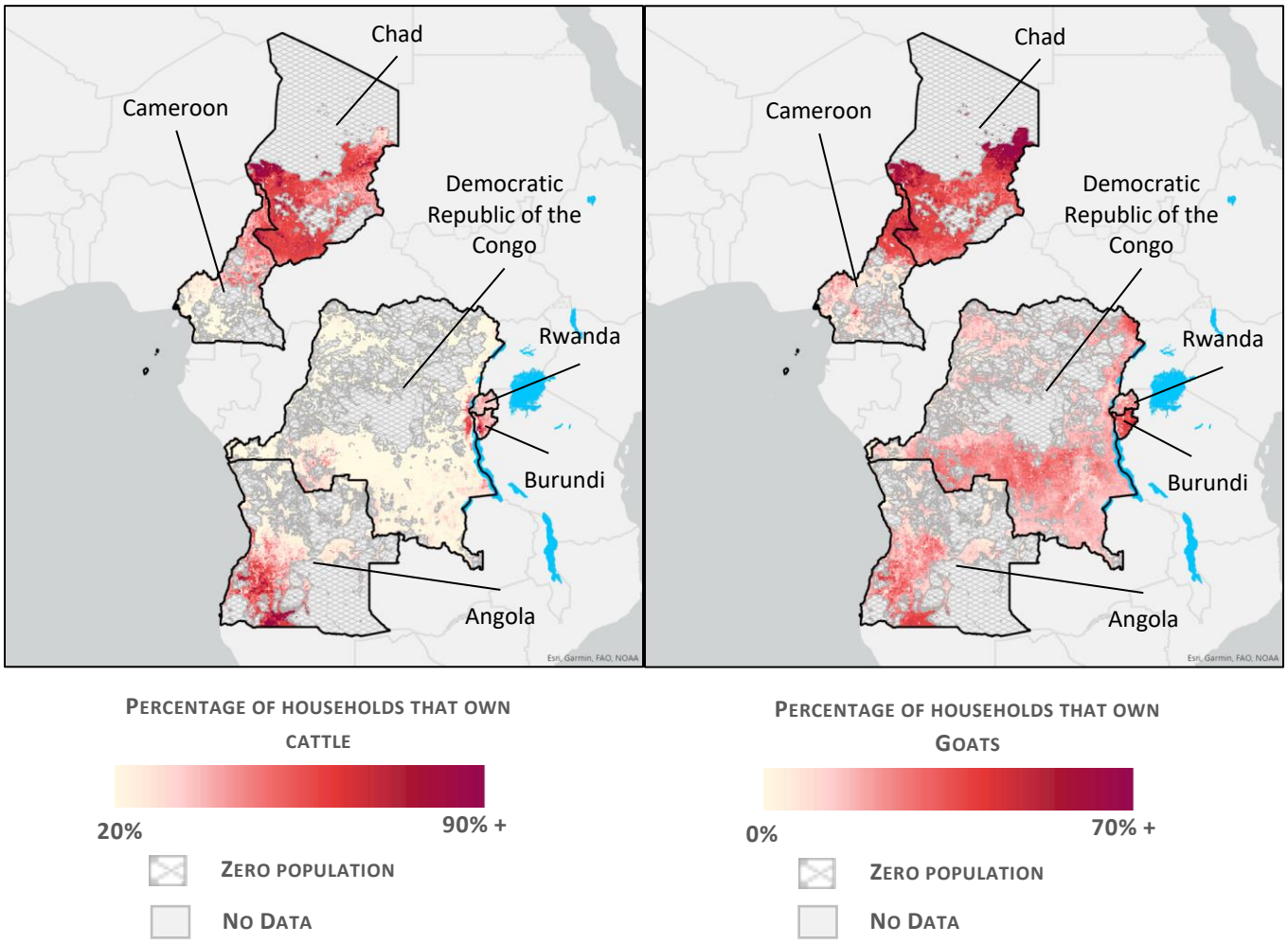
The livestock sector in Central Africa is characterized by transhumance and low levels of modernization due to a lack of capital. There has been little investment from private companies in livestock, which has stunted the number of agri-businesses operating in the sector.[18] However, the sector holds plenty of opportunities for increased value-added from transformation activities. In addition, as with maize and rice, there is existing regional trade in livestock that can be further deepened through the AfCFTA. This analysis will focus on goats and cattle, as these are the most important livestock produced and traded in the region.

Livestock can be transformed to add value at several levels of the value chain. Primary transformation involves the preparation of goat and cattle meat, whereas secondary transformation involves artisanal activities including the preparation of sausages and ham. The tertiary transformation level focuses on products that do not originate from meat, such as leather and skins used in the textile and fashion industries, or other animal-derived food products such as milk, butter, and cheese.

There is often a disconnect between areas where livestock are reared and centers of high consumption. For example, in Cameroon the market for meat consumption is largest in Yaoundé, whereas the largest concentrations of goats and cattle in the country are found in the North and Extreme North. Cameroon's largest trading partner for cattle is Chad, indicating that cattle produced in the North and Extreme North are likely exported to Chad. Key constraints such as transportation costs and the low quality of roads hinder the ability of cattle producers in the Northern regions of Cameroon to efficiently transport meat to consumers in Yaoundé and Douala.[19] Maintaining the quality of transport corridors linking production to consumption demand will be important to support the regional livestock value chains.

[18] UNECA. "Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l'Afrique centrale pour tirer le meilleur parti de la ZLECAf." Volume 1. 17 December 2020.
[19] Ibid.

FIGURE 7.3. REGIONAL DISTRIBUTION OF CATTLE AND GOAT OWNERSHIP



While livestock-rearing is also a significant economic activity for populations throughout Central Africa, cattle ownership is most common in Chad, areas of Angola, and throughout Rwanda, Burundi, and the adjoining portion of the Democratic Republic of the Congo. Goat ownership is more common in the region compared to cattle ownership and especially notable in Chad, the Extreme North region of Cameroon, and Burundi.

7.5 Renewable Energy

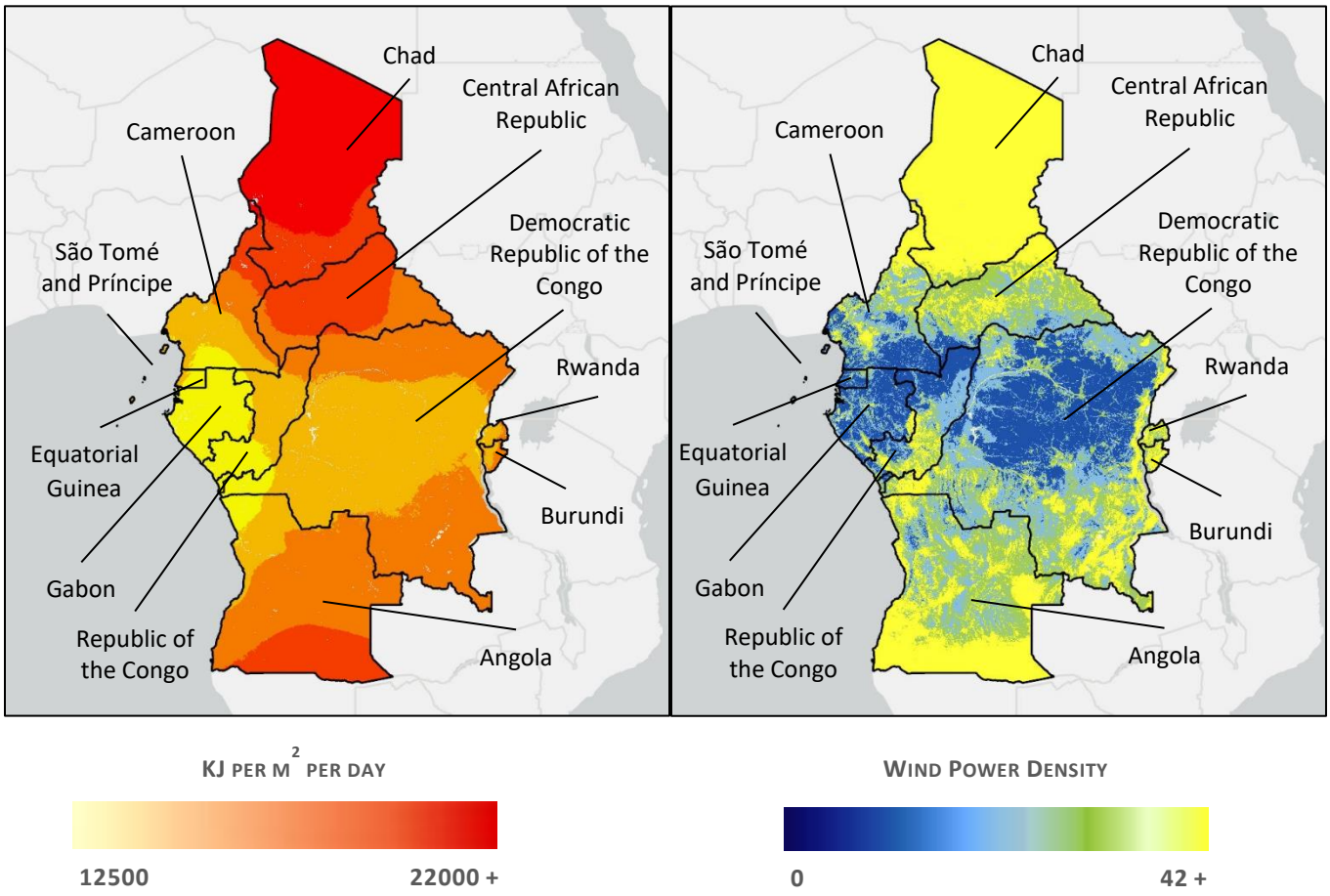
The global energy sector is currently undergoing a transformation with the rise of decarbonization initiatives aimed at reducing carbon emissions and shifting energy production to clean and renewable sources. These initiatives are expected to dramatically increase the demand for renewable energy sources and the application of energy efficiency strategies.[20] To achieve SDG 7— affordable, reliable, sustainable, and modern energy for all—investments in energy production from renewable sources such as solar and wind energy will be critical.

The African continent possesses a large and largely untapped potential in renewable energy sources. The African Development Bank (AfDB) estimates that the continent has 10 Terawatt of solar potential and 110 Gigawatt of wind potential. While there have been a growing number of projects aimed at exploiting this potential, the AfDB notes that "the lack of sufficient innovative and appropriate financing, of bankable projects, of appropriate policy and regulatory environments, of pricing incentives and of coordination severely limits the scale and speed at which energy is provided to the continent." The AfDB established the New Deal on Energy for Africa as a partnership-driven initiative with the goal of reducing these constraints and achieving universal energy access in Africa by 2025.[21]

The Central Africa region has an important role to play in accomplishing the goals of the New Deal on Energy in Africa. While the electrification rate in the region is among the lowest in Africa, the potential is enormous. Several countries have climate conditions favorable to the development of both wind and solar energy production. For example, Chad is listed by the International Renewable Energy Agency (IRENA) as one of the countries with the largest wind capacity on the continent. As part of IRENA's Africa 2030 Roadmap for a Renewable Energy Future, Central Africa is projected to increase renewable energy production in solar and wind energy by a factor of 3.[22]

[20] United Nations. "High-level Dialogue on Energy." 3 February 2021.
[21] AfDB. "The New Deal on Energy for Africa." Available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Brochure_New_Deal_2_red.pdf
[22] IRENA. "Africa 2030: Roadmap for a Renewable Energy Future." Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA_Africa_2030_REmap_2015_low-res.pdf

FIGURE 7.4. REGIONAL SOLAR AND WIND ENERGY POTENTIAL



Indicators of renewable energy potential suggest that the northern part of the Central Africa region, specifically Chad, the Extreme North region of Cameroon, and the Vakaga province of the Central African Republic have the highest potential in both solar and wind energy. The southern part of Angola also has high potential for solar and wind energy, and there are pockets of wind energy potential near Yaoundé in Cameroon, Brazzaville in the Republic of Congo, and in Rwanda and Burundi, as well as along the Eastern border of the Democratic Republic of Congo.

7.6 Mining

While Africa produced about 6 percent of the world's total minerals in 2018, the percentage of deposits located on the continent is much higher.[23] The Central Africa region holds significant deposits of minerals with high and growing demand globally. As the BloombergNEF notes in its report on the *Future of Mining in Africa,* the mining sector is in the midst of a technological transformation. Competition from advanced materials and secondary recycled supplies, as well as emerging frontiers for mining and an increase in Environmental, Social, and Corporate Governance (ESG) and ethical supply chain tracking, are pressuring the industry to move towards a future of sustainability. Like the renewable energy sector, demand for minerals is influenced by decarbonization. There has been a large shift in demand for metals used in the transport sector as the electric car industry has grown.[24]

The Africa Mining Vision (AMV) is the leading policy document guiding the continent's strategy for development and growth in the mining sector. Established by the African Union (AU) in 2009, the vision aims to promote equitable and broad-based development through the creation of local value and strategic use of mineral resources in Africa.[25] To achieve progress towards the ambitious goals outlined in the AMV, ECA has identified two priority value chains that have the potential to increase local value-added in the mining sector in the region: NPK (nitrogen, phosphorous, and potassium) fertilizers and rechargeable batteries. The bases of both these value chains rely on minerals found in significant deposits in Central Africa.

NPK Fertilizers

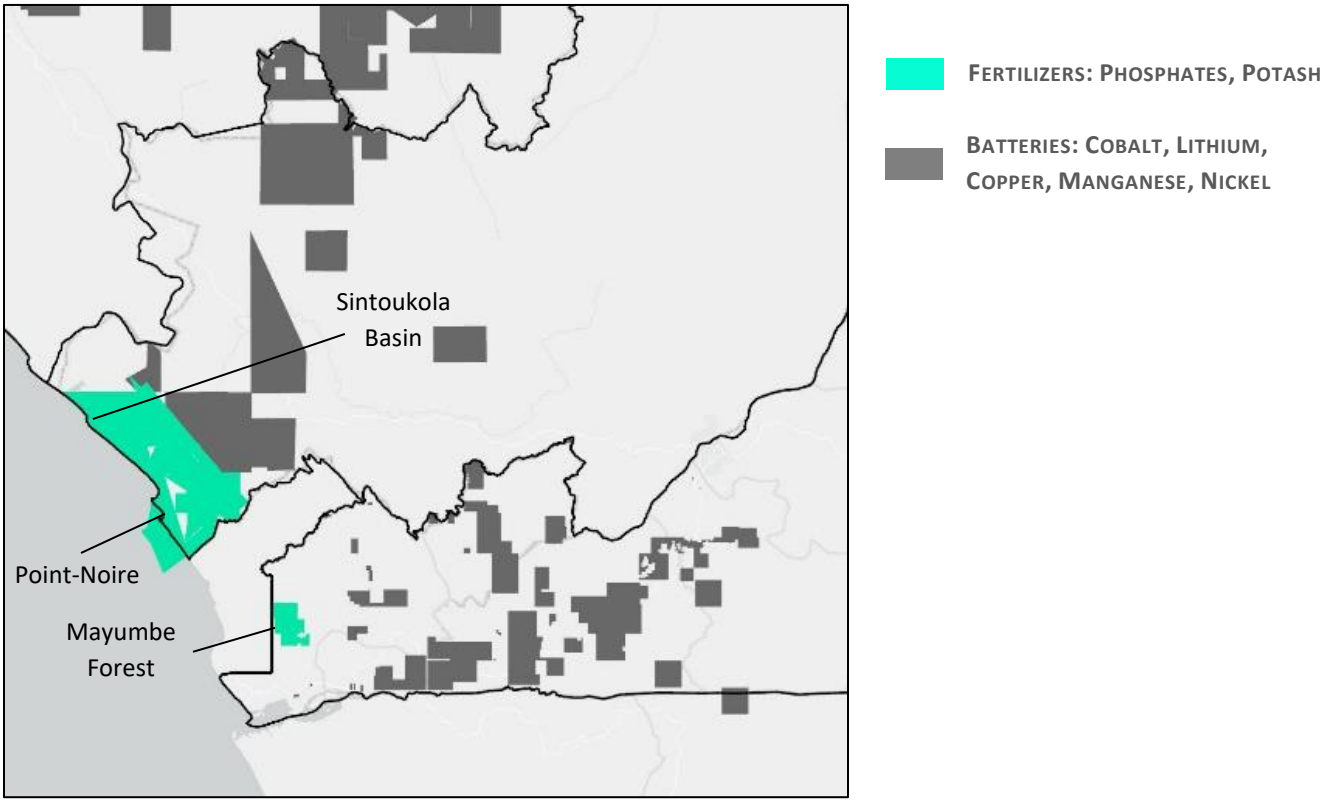
Use of chemical fertilizers such as NPK fertilizers in farming across much of the Central Africa region is low, and investments in fertilizer production are rare. The African continent overall has by far the lowest consumption of NPK fertilizers in the world.[26] According to ECA research, lack of access to fertilizers is often cited as a constraint to agricultural productivity in Central Africa. Use is further hindered by the high cost of chemical fertilizers due to importation and transportation costs and the poor quality of the fertilizers that do enter the region.[27] NPK fertilizers have the potential to greatly increase farming productivity, especially in key crops such as maize.

In addition, Central Africa possesses substantial deposits of Phosphates and Potash, two key ingredients in NPK fertilizers. Currently, the production of Phosphates and Potash are dominated

[23] The International Organizing Committee for the World Mining Congresses. "World Mining Data 2020."
[24] Ampofo, Kwasi. BloombergNEF. "Future of Mining in Africa."
[25] Oxfam. "From Aspiration to Reality." Available at: https://www-cdn.oxfam.org/s3fs-public/bp-africa-mining-vision-090317-en.pdf
[26] Gro Intelligence. "The World's Most Expensive Fertlizer Market: Sub-Saharan Africa." Available at: https://gro-intelligence.com/insights/articles/fertilizers-in-sub-saharan-africa
[27] UNECA. "Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l'Afrique centrale pour tirer le meilleur parti de la ZLECAf." Volume 1. 17 December 2020.

by Canada and China—Canada produces nearly one third of all the Potash in the world and China produces 40 percent of all phosphates.[28] With a recent Potash mining project launching in the Sintoukola Basin, the Republic of Congo is set to enter the lucrative and growing Potash market. The basin is estimated to have an annual production capacity of 2 million tons of Potash a year,[29] and it holds deposits of high-quality Potash ideal for use in fertilizers.[30] Mining permits for Phosphates and Potash have been issued in the Republic of Congo and the Democratic Republic of Congo, although the overall number of permits is relatively low with only 18 concessions.

FIGURE 7.5. REGIONAL DISTRIBUTION OF MINING PERMITS FOR POTASH AND PHOSPHATES



[28] The International Organizing Committee for the World Mining Congresses. “World Mining Data 2020.”
[29] Jamasmie, Cecilia. "Potash is a diamond in the rough for the Republic of Congo.” Available at: https://www.mining.com/potash-could-be-the-new-diamond-for-the-republic-of-congo/
[30] Kore Potash. "Kola Project.” Available at: https://korepotash.com/projects/kola/

Rechargeable Batteries

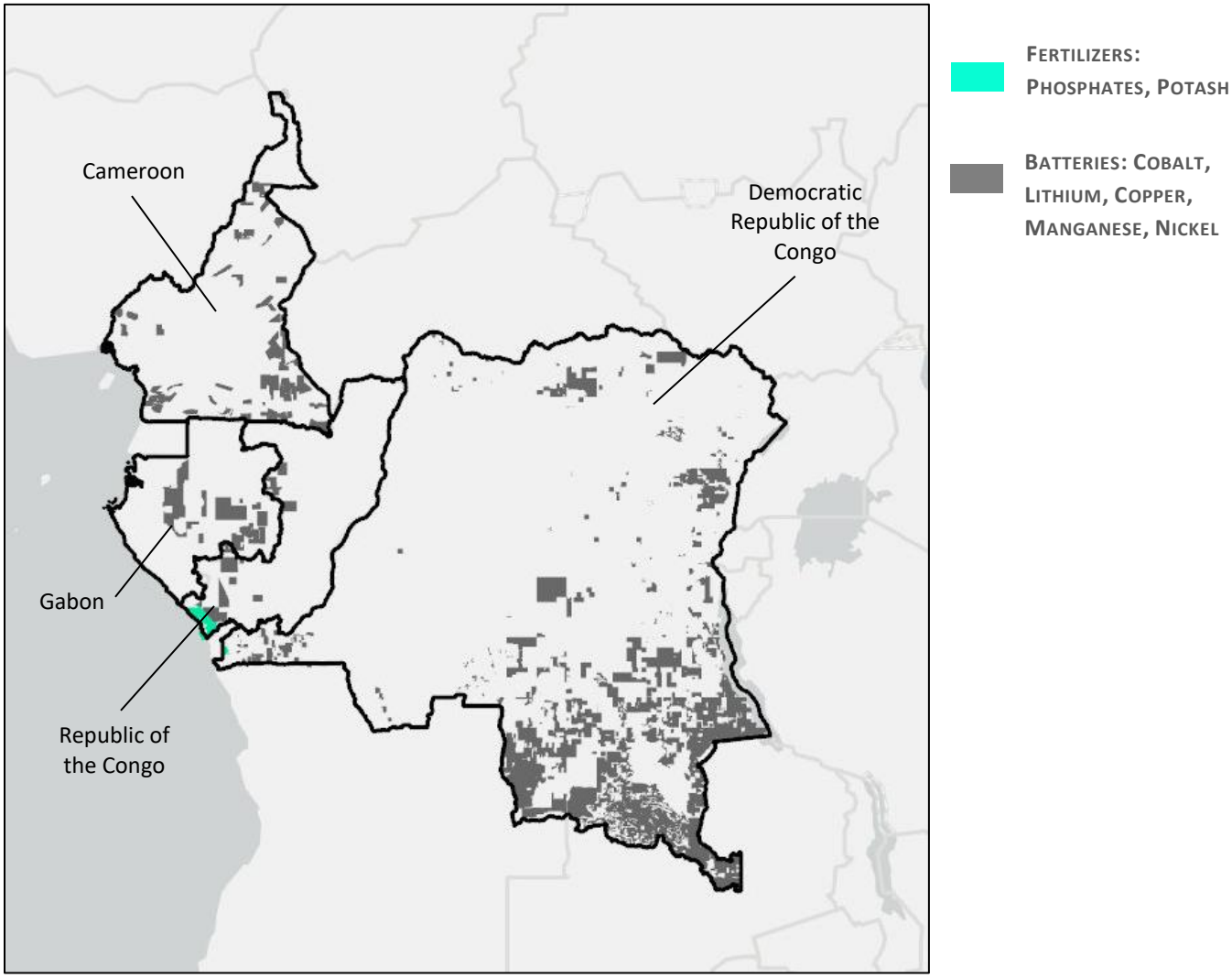
While Phosphates and Potash are concentrated in the Republic of Congo, metals used in the production of rechargeable batteries are scattered in large deposits throughout the Central Africa region. The growth in demand for rechargeable batteries is forecasted to increase exponentially with the rise of electric transport, smartphone use, and storage demand for renewable energy. The metals which form the base of this supply chain include Cobalt, Lithium, Copper, Manganese, and Nickel. Cobalt is used in lithium-ion batteries, which have experienced rising demand as they have become the technology of choice for off-grid energy storage.[31] In addition to Cobalt, Manganese and Nickel are also used in energy storage for wind power and solar photovoltaics and Copper is used in wind turbines and for electric connections. Demand for these metals is also forecasted to increase significantly as development of solar and wind energy grows.[32,33]

Central Africa holds a significant percentage of the world's reserves in metals used for rechargeable batteries, most notably in Cobalt. An estimated 70 percent of the global supply of Cobalt is in the Democratic Republic of Congo, and the country produced 100,000 tons of Cobalt in 2019. Gabon is also a top producer of Manganese, accounting for nearly 15 percent of all manganese produced worldwide. The Democratic Republic of Congo is also a large copper exporter, producing about 6 percent of the global cotton supply in 2018.[34]

In addition to holding large reserves of metals used for batteries, local demand for batteries is forecasted to increase sevenfold by 2030. Batteries will support Africa's progress towards reaching SDG 7, by providing access to clean and reliable energy storage from renewable sources.[35] The battery value chain is a highly profitable one, with large increases in value at later stages of the value chain as metals are transformed and batteries are manufactured. While battery manufacturing capacity in Central Africa is currently low, this sector offers a strong case for the development of a regional value chain. Currently, although the Democratic Republic of Congo produces most of the Cobalt in the world, the country has only a 3 percent share of the global market value.[36] The move from processing, smelting, and refining of metals to semi-fabrication and final product manufacturing is essential for increasing its global market value for this metal. BloombergNEF forecasts the global value of cobalt, lithium, and nickel mining to be 11 billion in 2025, the value of cell production to be 280 billion, the value of cell assembling to be 1 trillion, and the value of the electric vehicle market to be 7 trillion.[37]

[31] Ampofo, Kwasi. BloombergNEF. "Future of Mining in Africa."
[32] Ericsson, Magnus and Lof, Olof. United Nations University. "Extractive dependency in lower-income countries."
[33] UNCTAD. "Digital Economy Growth and Mineral Resources." UNCTAD Technical Notes on ICT for Development Number 16.
[34] The International Organizing Committee for the World Mining Congresses. "World Mining Data 2020."
[35] Global Battery Alliance. "Closing the Loop on Energy Access: interim findings and project update."
[36] UNECA. Cobalt Infography.
[37] Ampofo, Kwasi. BloombergNEF. "Future of Mining in Africa."

FIGURE 7.6. REGIONAL DISTRIBUTION OF MINING PERMITS FOR MINERALS USED IN FERTILIZERS AND BATTERIES



There are about 2,400 mining permits for metals used in the production of batteries in Cameroon, Gabon, the Republic of Congo, and the Democratic Republic of Congo. Mining sites are scattered throughout the region, with a particularly large concentration in the Southeastern corner of the DRC. Several mining areas cross borders, notably in the border area between the Niari department of the Republic of Congo and Gabon.

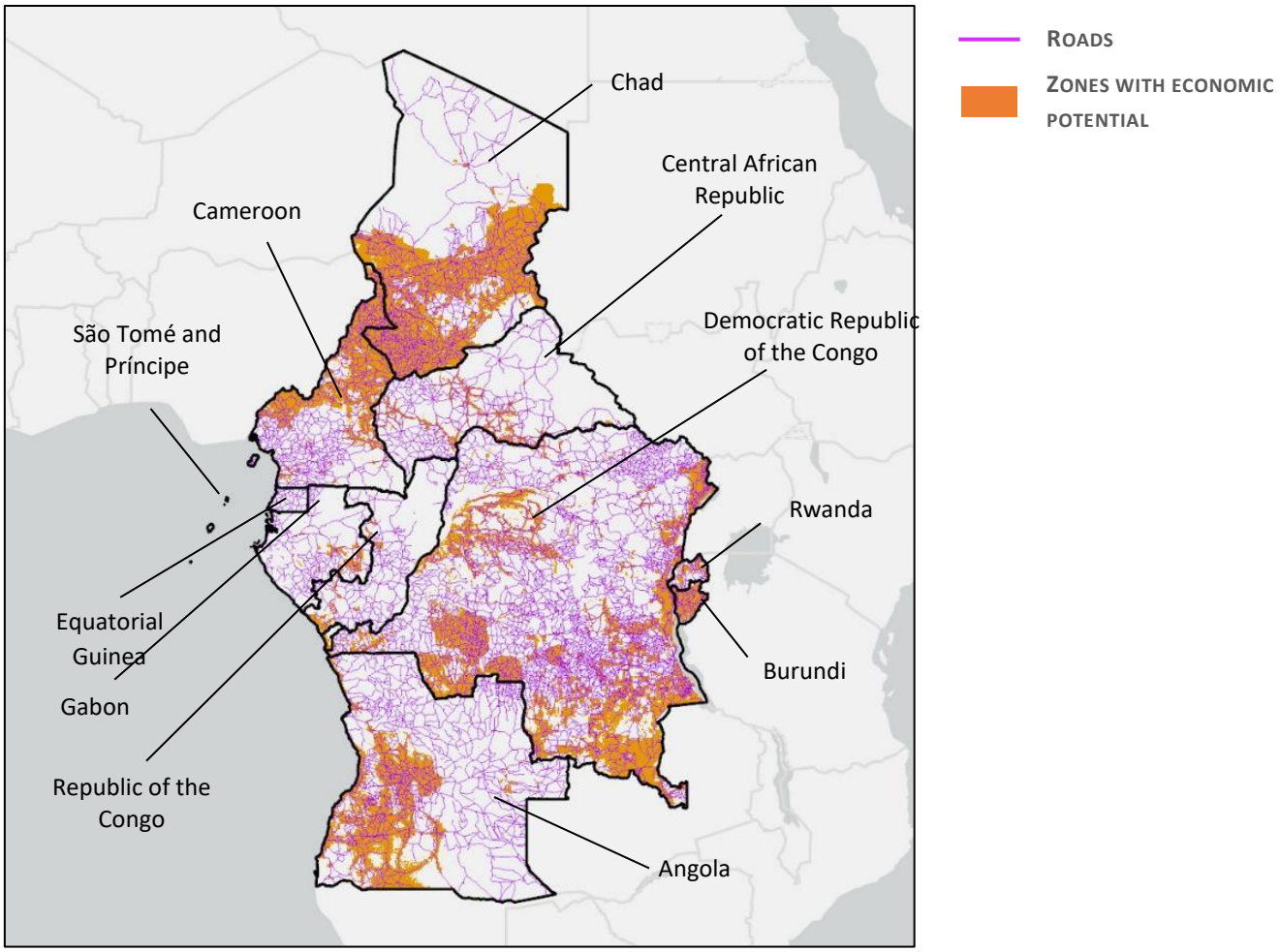
7.7 Potential Economic Zones

The combination of indicators of potential economic development in the agri-business, renewable energy, and mining sectors can provide insights into the spatial distribution of areas with high potential for increased economic activity in Central Africa. This analysis combines the spatial distributions of maize and rice-producing zones with the distribution of goats and cattle, renewable energy potential, and location of mining permits for minerals used in NPK fertilizers and rechargeable batteries. A potential zone for economic development is defined as an area where there is either production of maize or rice, the percentage of households owning goats or cattle is in the top quintile of the data distribution, the solar radiation or wind power density is within the top quintile of the data distribution, or there is a mining permit for Phosphates, Potash, Cobalt, Lithium, Copper, Manganese, or Nickel. This analysis was done at the $1km^2$ resolution, meaning economic potential was evaluated for each $1km^2$ grid in the Central Africa region.

Data constraints

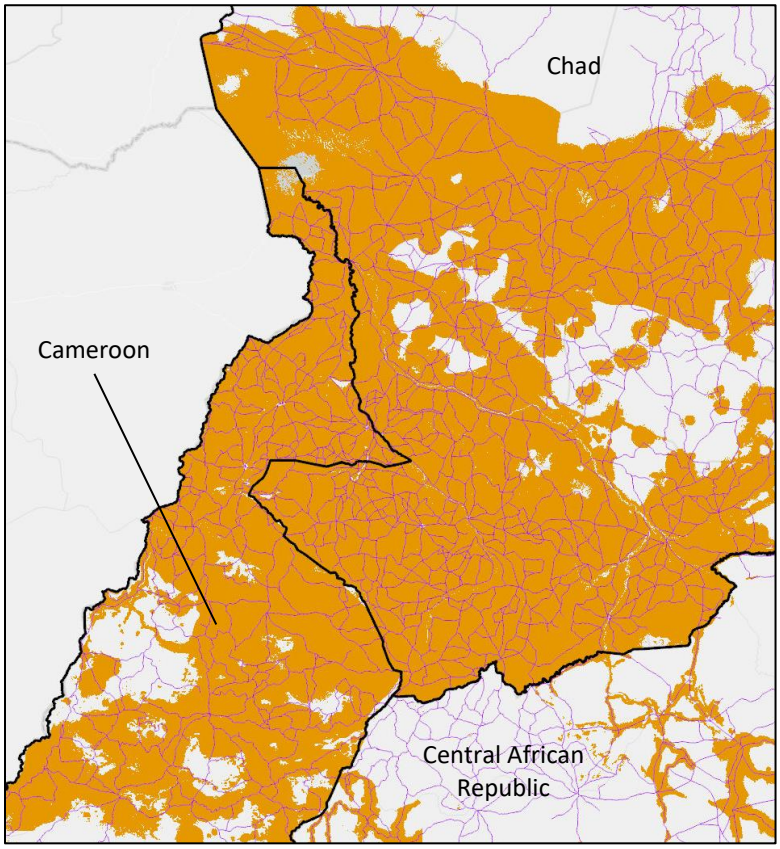
Due to lacking data availability, certain countries within the region are only evaluated on their renewable energy potential. The Republic of Congo, Equatorial Guinea, and Sao Tome and Principe are missing data on agri-business indicators (agriculture and livestock). Gabon is missing data on agriculture, while the Central African Republic is missing data on livestock. Detailed and comprehensive mining data is lacking for many countries. Chad, the Central African Republic, Rwanda, Burundi, Angola, Equatorial Guinea and Sao Tome and Principe are missing data on mining.

FIGURE 7.7. POTENTIAL ZONES FOR ECONOMIC DEVELOPMENT



Several border areas stand out as potential zones for economic development, particularly the northeastern Cameroon border with Chad, the border between Cameroon and the Central African Republic and the western borders of Rwanda and Burundi with the Democratic Republic of Congo.

FIGURE 7.8. ECONOMIC DEVELOPMENT ZONE: CAMEROON-CHAD BORDER AREA

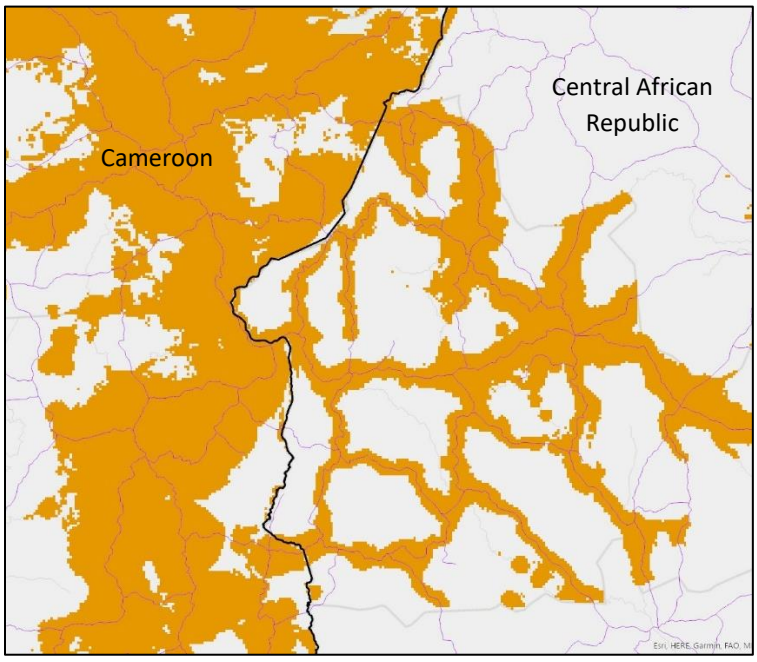


The Extreme North region of Cameroon and the southwest regions of Chad have high potential for development of renewable energy and investment in maize and livestock value chains. Maize is an important staple crop cultivated in this area and rates of livestock ownership are high. Over half of households living along the border own either goats or cattle. Cattle ownership is especially high on the Chad side the border. Finally, wind and solar energy potential in this border area are the highest in the Central Africa region.

ROADS

ZONES WITH ECONOMIC POTENTIAL

FIGURE 7.9. ECONOMIC DEVELOPMENT ZONE: CAMEROON-CENTRAL AFRICAN REPUBLIC BORDER AREA

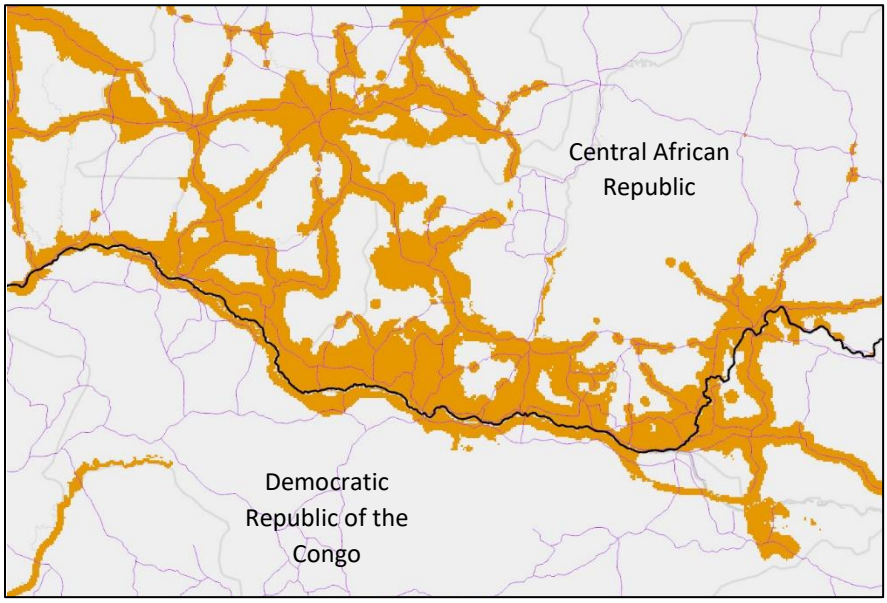


Maize is an important staple crop for the livelihoods of populations living on either side of the border between the Eastern region of Cameroon and Nana-Mambéré prefecture in the Central African Republic. This area presents opportunities to strengthen regional linkages and cross-border trade in the maize value chain.

ROADS

ZONES WITH ECONOMIC POTENTIAL

FIGURE 7.10. ECONOMIC DEVELOPMENT ZONE: CENTRAL AFRICAN REPUBLIC-DEMOCRATIC REPUBLIC OF CONGO BORDER AREA

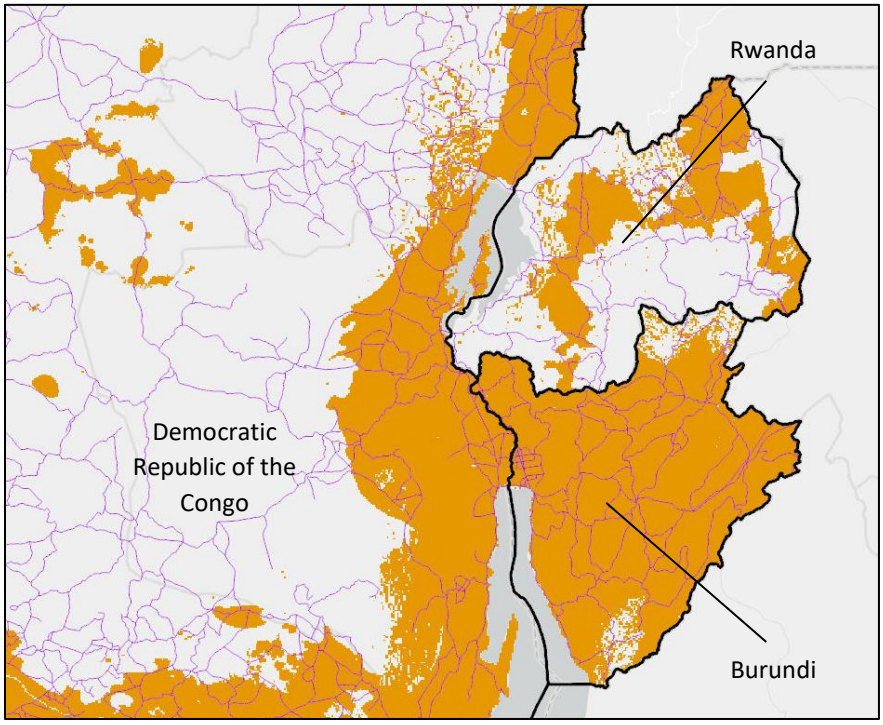


Maize value chains have the potential to strengthen regional linkages in the border area between the Central African Republic and the Nord-Ubangi province of the Democratic Republic of Congo (DRC). Rice is also cultivated in the border area close to the Bas-Uele province of the Democratic Republic of Congo.

ROADS

ZONES WITH ECONOMIC POTENTIAL

FIGURE 7.11. ECONOMIC DEVELOPMENT ZONE: DEMOCRATIC REPUBLIC OF CONGO-BURUNDI BORDER AREA



The border between the Democratic Republic of Congo (DRC) and Burundi holds potential for development of the livestock value chain and in the mining of metals used in batteries. Cattle ownership is notably high on the DRC side of the border, and maize and rice are cultivated by populations living in this border area.

ROADS

ZONES WITH ECONOMIC POTENTIAL

7.8 Regional Infrastructure

The regional transport corridor will be crucial to supporting the development of any economic zone in Central Africa. In January 2012, the Heads of State of the African Union adopted PIDA, setting the strategic framework for regional infrastructure development on the continent for the short- and medium-term future. In 2015, Agenda 2063 built upon this foundation with its 15 flagship projects that included plans for the establishment of the Africa Continental Free Trade Area (AfCFTA). This report's area of focus includes key PIDA and Agenda 2063 initiatives such as four sections of the Trans-African Highway Network (TAH), DRC's third Inga Dam, the Kinshasa-Brazzaville Bridge, and the ICT broadband and fiber optic network in Rwanda's neighboring states. Various missing road links fall in the study area as well, including Lagos to Mombasa links in Cameroon, Central African Republic, and the DRC.

Maintaining and bolstering infrastructure is critical to the initiatives aimed at strengthening regional integration in Central Africa and in the broader continent. While the current road network in the region succeeds in connecting populated areas throughout the region, the electricity network in the region is concentrated in a handful of corridors and urban areas, according to the World Bank's Electricity Transmission and Distribution Grid Map. Similarly, 2G network covers most populated areas, while 3G and 4G coverage is rare outside of a handful of corridors and large cities, according to the Collins Bartholomew Mobile Coverage Explorer. Investments in the electricity network and mobile network coverage could support regional value chains aimed at industrialization. A mid-term review of PIDA's overall portfolio conducted in 2019 also revealed that only 35 percent of its projects are currently under construction or operational and 20 percent of the TAH contains missing links.[38] These metrics must improve in order for the integration and development goals of the region to be realized.

[38] Robert Tama Lisinge, "The Belt and Road Initiative and Africa's regional infrastructure development: implications and lessons," July 27, 2020. Available at: https://doi.org/10.1080/19186444.2020.1795527

FIGURE 7.12. REGIONAL ROADS AND ELECTRICITY NETWORK

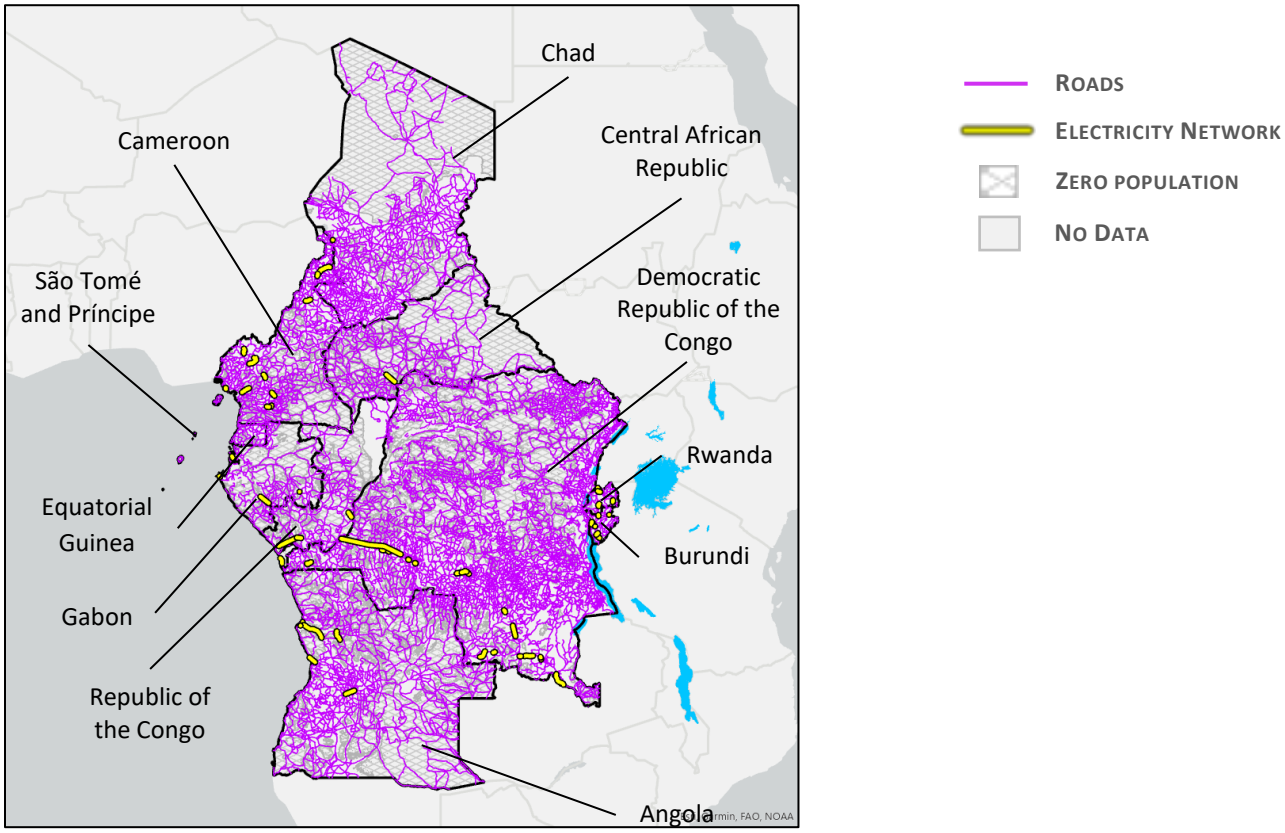
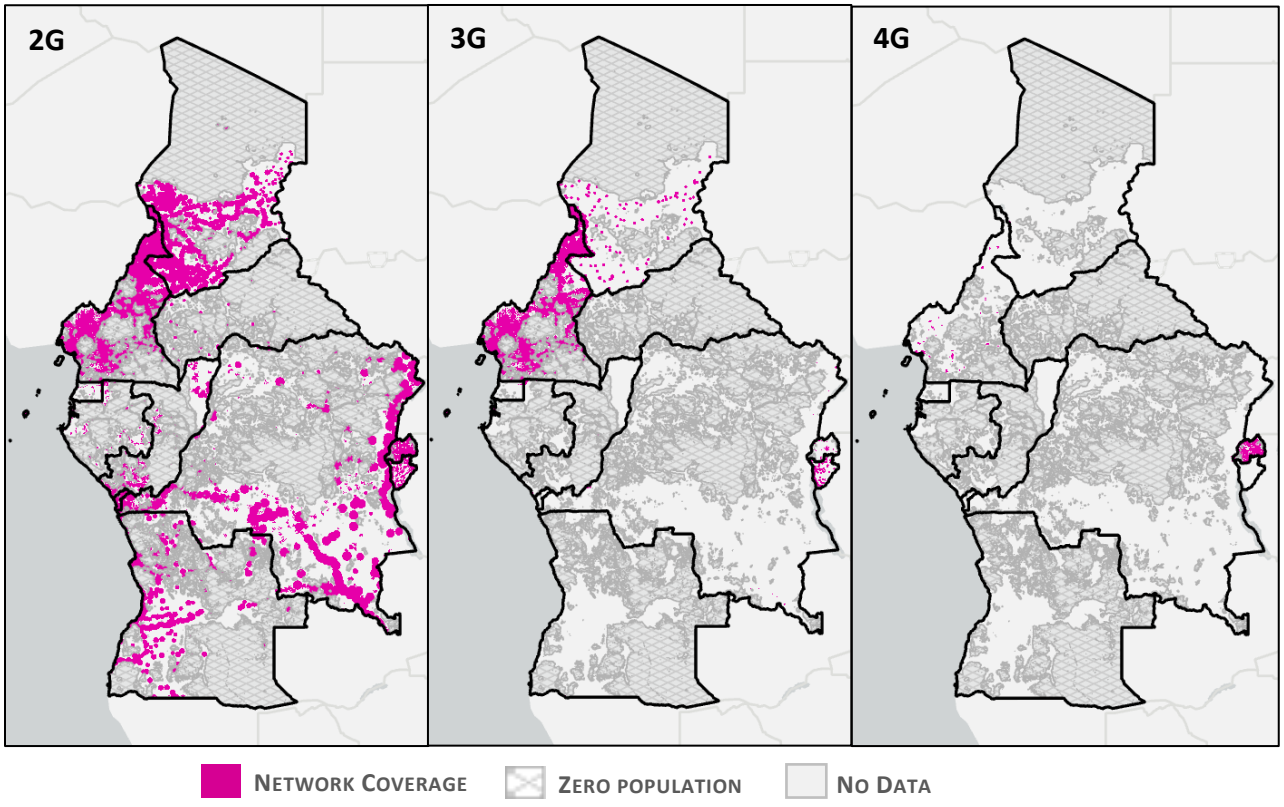


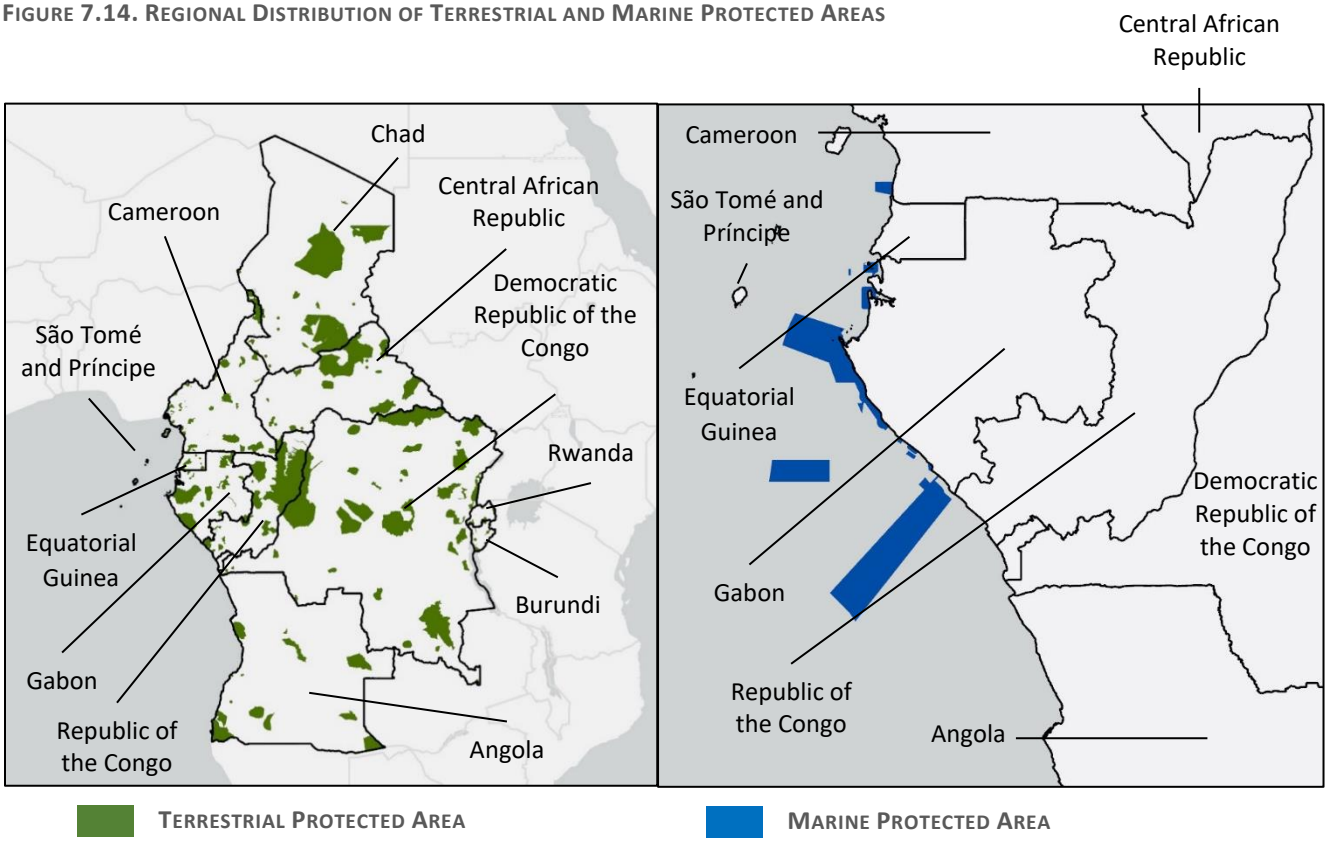
FIGURE 7.13 REGIONAL MOBILE NETWORK COVERAGE



7.9 Conservation Areas

The conservation of biodiverse areas and areas with protected status should be an important consideration in the selection of areas for economic development zones. Terrestrial protected areas, including national forests, wetlands and conservation areas are abundant throughout the region, especially in several border areas around the Republic of Congo-DRC border and the Chad-Central African Republic border. There are also several marine protected areas off the coast of Gabon and Cameroon. Challenges such as continued petroleum exploration activities, seaport degreasing, and overgrowth of the invasive species *Pontederia crassipes* (water hyacinth) threaten the integrity of these precious marine resources.[39]

FIGURE 7.14. REGIONAL DISTRIBUTION OF TERRESTRIAL AND MARINE PROTECTED AREAS



[39] Abubakar, Babagana. "Gulf of Guinea Resources, Economy and Development: Yesterday, Today and Tomorrow." 11 November, 2020. Available at: https://www.researchgate.net/publication/320806876_Gulf_of_Guinea_Resources_Economy_and_Development_Yesterday_Today_and_Tomorrow

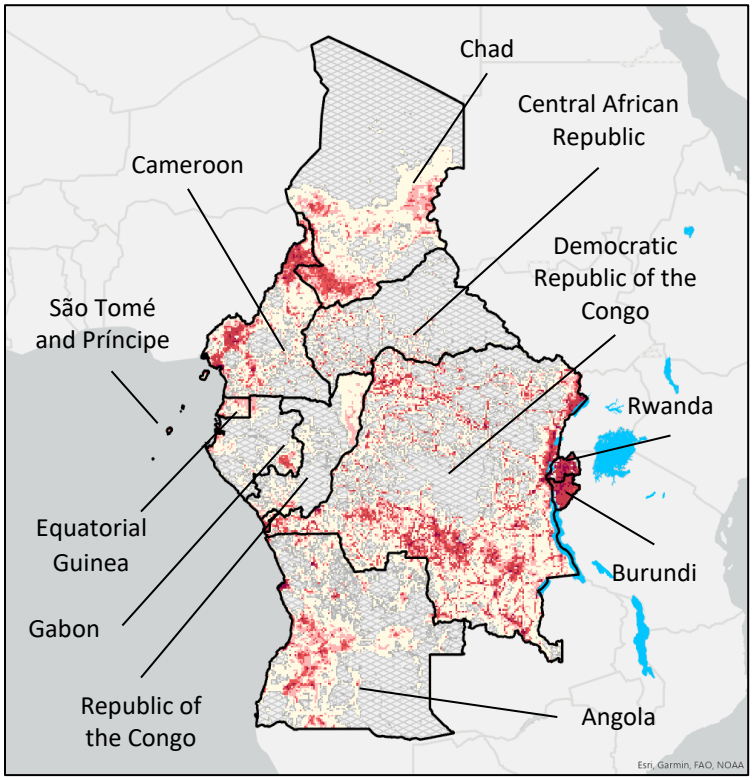
7.10 Socioeconomic and Demographic Indicators

The consideration of socioeconomic and demographic indicators in the evaluation of potential economic zones provides insights into the potential impact of investments on poverty reduction, and the human capital resources available for the development of new industries. For example, labor needed in the transformation of metals and manufacturing of batteries includes production line workers, engineers, and managers.[40] For the development of a regional value chain in battery production, technical training will be necessary to ensure local populations have the skills and qualifications necessary to benefit from employment in the new industry.

The following mapping of socioeconomic and demographic indicators provides an overview of indicators available and relevant to the evaluation of economic zones.

[40] Ampofo, Kwasi. BloombergNEF. "Future of Mining in Africa."

FIGURE 7.15. POPULATION IN THE REGION



Rural areas in Chad, Congo, DRC, and Central African Republic appear especially populated compared to other nations. The border region between Chad, Cameroon and Central African Republic is especially populous. Rwanda and Burundi stand out as the most densely populated countries in the region.

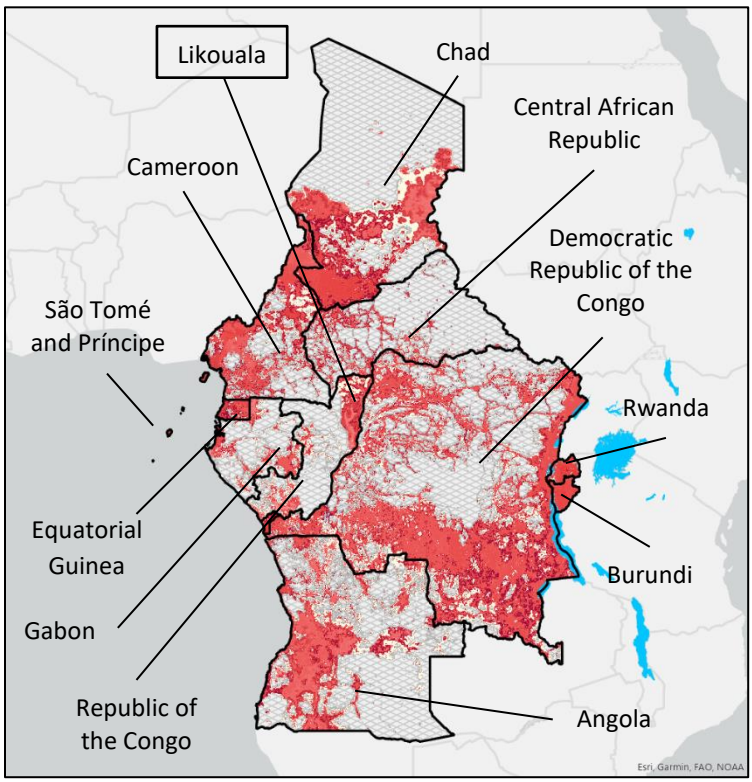
POPULATION

0 — 500 +

ZERO POPULATION

NO DATA

FIGURE 7.16. YOUTH POPULATION IN THE REGION



Peri-urban and rural areas show higher levels of youth as proportions of the population. This pattern appears particularly strong throughout Equatorial Guinea and the Likouala department of Congo.

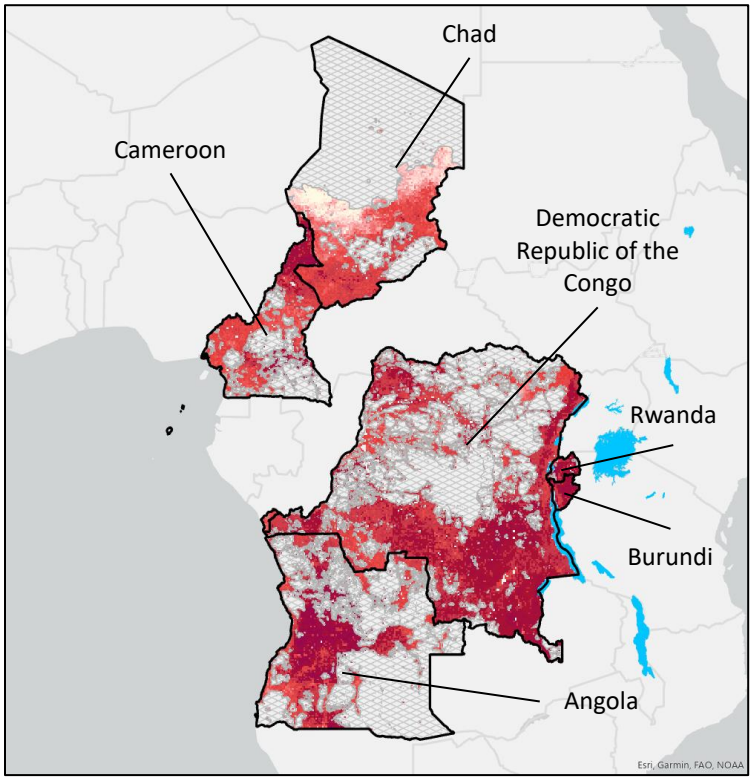
PERCENTAGE OF THE POPULATION AGES 15-34 YEARS OLD

25% — 40% +

ZERO POPULATION

NO DATA

FIGURE 7.17. ADULT EMPLOYMENT IN THE REGION



Adults, who are classified as individuals aged 15-49, are considered employed if they are currently working, including self-employment in farming. Compared to other nations in the region, Chad lags in this indicator. On the other hand, adults in the Extreme North region of Cameroon have a high rate of employment, predominately in agricultural.

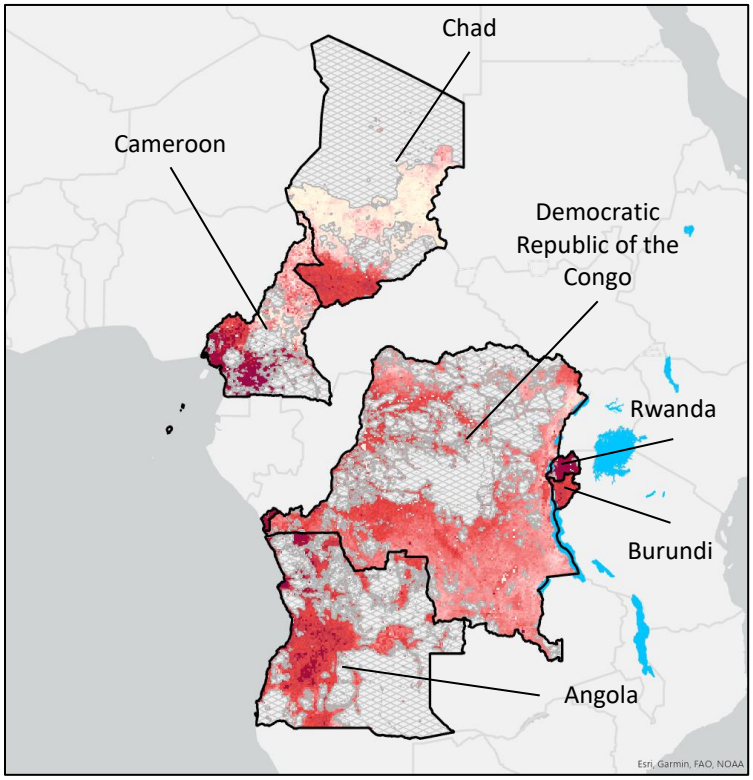
PERCENTAGE OF ADULTS THAT ARE EMPLOYED

50% — 80% +

ZERO POPULATION

NO DATA

FIGURE 7.18. PRIMARY EDUCATIONAL ATTAINMENT IN THE REGION



Educational achievement varies widely in the region and within countries. Rwanda, Burundi, and the western regions of Cameroon display high rates of primary educational attainment, while primary school completion in Chad is concentrated in the southeast regions of the country near the borders with Cameroon and the Central African Republic.

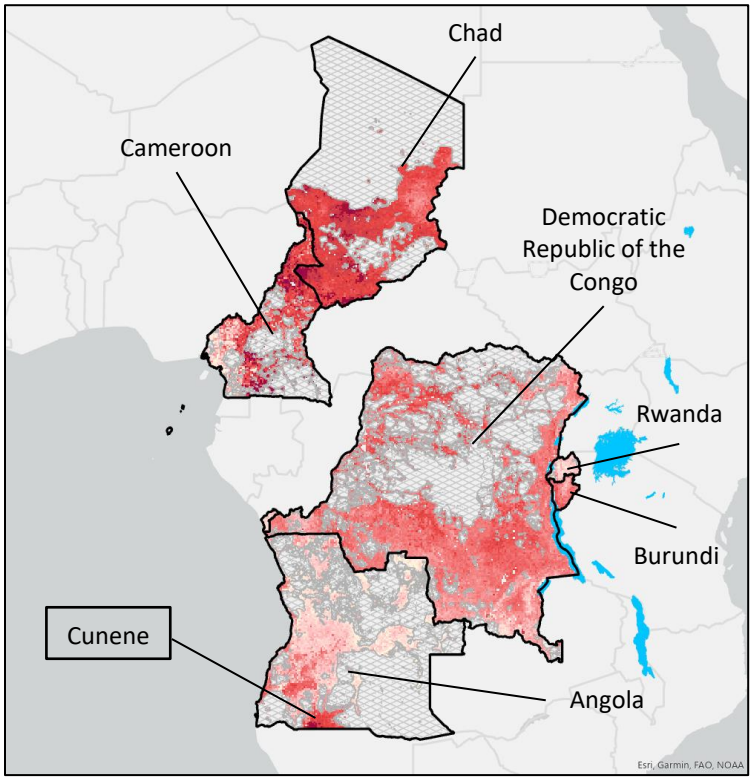
PERCENTAGE OF POPULATION 15 AND OLDER THAT HAS COMPLETED PRIMARY SCHOOL

20% — 95% +

ZERO POPULATION

NO DATA

FIGURE 7.19. HOUSEHOLD SIZE IN THE REGION



Average household size appears highest along the border between Cameroon and Chad, the inland regions of Cameroon, and in the Cunene department of Angola. Highly populated countries like Rwanda and Burundi do not demonstrate higher average household sizes.

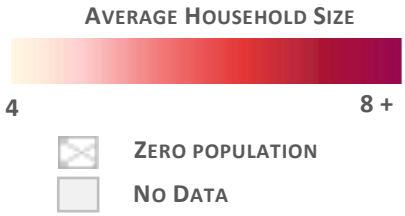
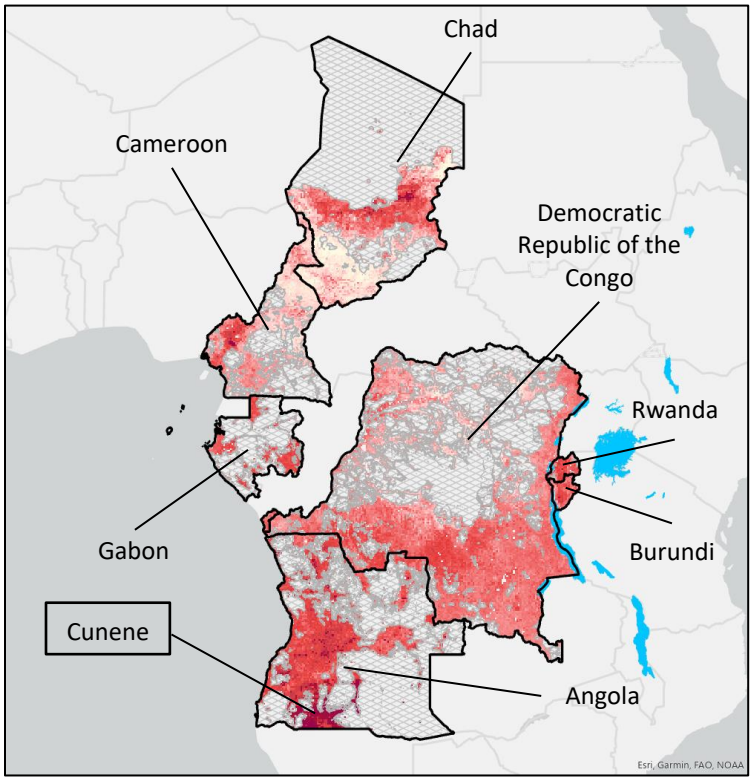


FIGURE 7.20. FEMALE-HEADED HOUSEHOLDS IN THE REGION



Pockets of communities in northern chad, western Cameroon, and the Cunene department of Angola show higher rates of households headed by a female. Several of these regions are notable for humanitarian situations stemming from civil conflict and natural disasters.

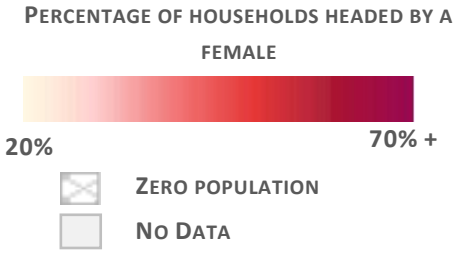
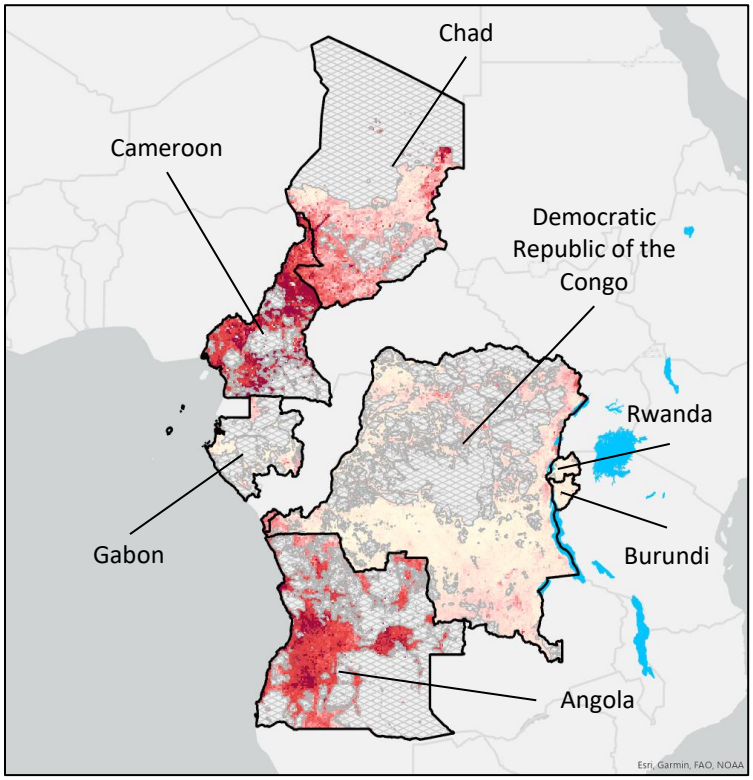


FIGURE 7.21. ACCESS TO MOTORIZED TRANSPORT IN THE REGION



Access to motorized transportation, including cars and motorcycles, is highly variable in this Central Africa. Angola, Cameroon, and Chad show high levels of access to motorized transport, while the DRC, Equatorial Guinea, Rwanda, and Burundi exhibit low access.

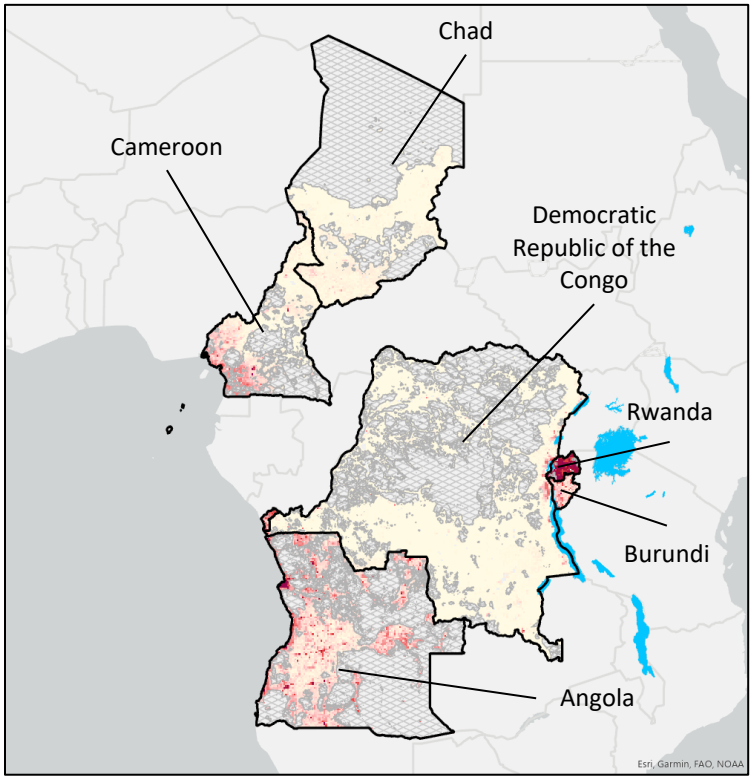
PERCENTAGE OF HOUSEHOLDS WITH ACCESS TO MOTORIZED TRANSPORTATION

5% — 50% +

ZERO POPULATION

NO DATA

FIGURE 7.22. ACCESS TO BANK ACCOUNTS IN THE REGION



Financial inclusion is particularly strong in Rwanda. On the other hand, few communities appear to have access to formal bank accounts in Chad and the DRC.

PERCENTAGE OF HOUSEHOLDS WITH BANK ACCOUNT ACCESS

0% — 85% +

ZERO POPULATION

NO DATA

8. National Analysis: Cameroon

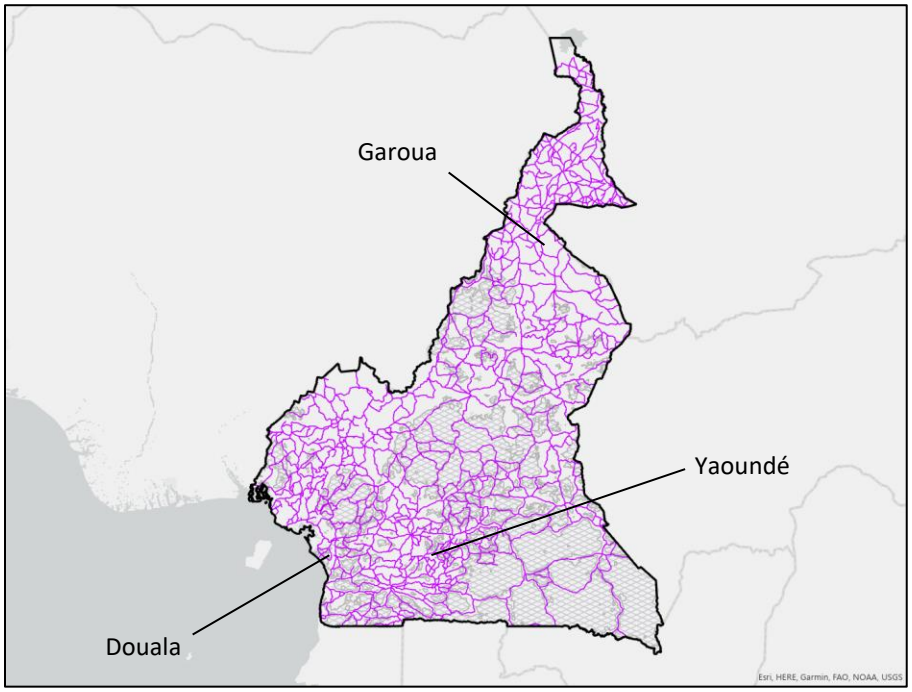
8.1 Country Overview

The largest economy in the Central African Economic and Monetary Community (CEMAC), Cameroon has a rich endowment of natural resources including mineral deposits (USGS) and high-value timber and agricultural products.[41] Several major PIDA projects cross through the capital city of Yaoundé including fibre-optic links to Abuja, Malabo, and Libreville and transportation linkages to N'Djamena and Brazzaville. Cameroon's national development plan 2020-2030 includes priorities for economic development that align closely with regional strategies, such as the development of agro-industry, increased agricultural productivity and the promotion of renewable energy solutions.[42]

Overall trends differ between Cameroon's northern regions and the rest of the country. Communities in the North and Extreme North regions show high levels of employment and renewable energy potential and low levels of educational attainment, internet access, and financial inclusion. These regions are also at high risk of violence from extremist groups operating in neighboring countries. The remaining regions[43] of Cameroon, however, show opposite trends with higher levels of education and lower levels of employment, particularly in urban areas.

[41] World Bank, "The World Bank in Cameroon," Available at: https://www.worldbank.org/en/country/cameroon/overview
[42] Republique du Cameroun. Ministère de l'Economie, de la Planification et de l'Aménagement du Territoire. "Elaboration du Schema National d'Aménagement et de Développement Durable du Territoire du Cameroun."
[43] DHS did not collect data in the rural parts of the South-West region in 2018 due to security concerns, thus this region is not represented in this analysis.

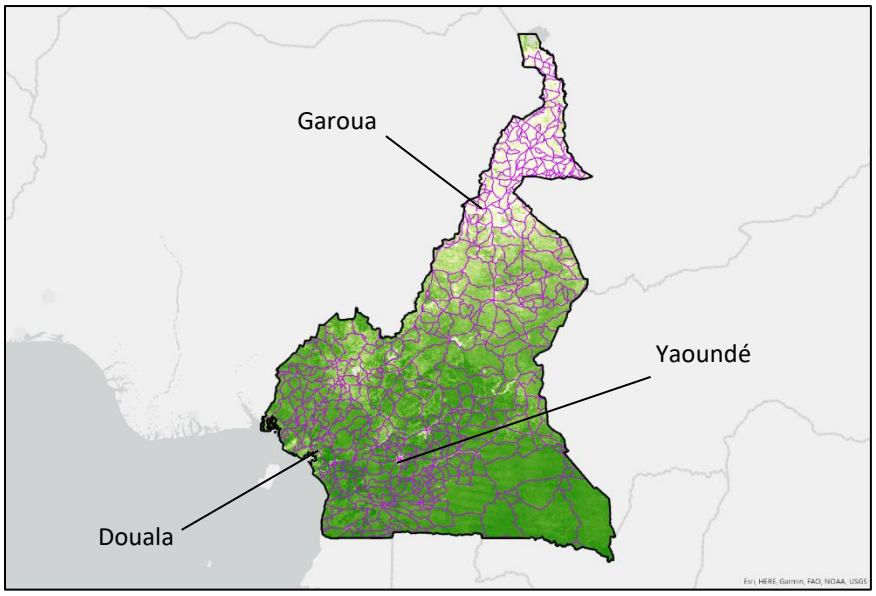
FIGURE 8.1. ROAD NETWORK IN CAMEROON



8.2 Biophysical Indicators

The North and Far-North regions of Cameroon contain less vegetation but higher potential for solar and wind energy production compared to the country's other regions. Investments in these renewable resources in the northern regions of the country could be well-supported by the existing roads network.

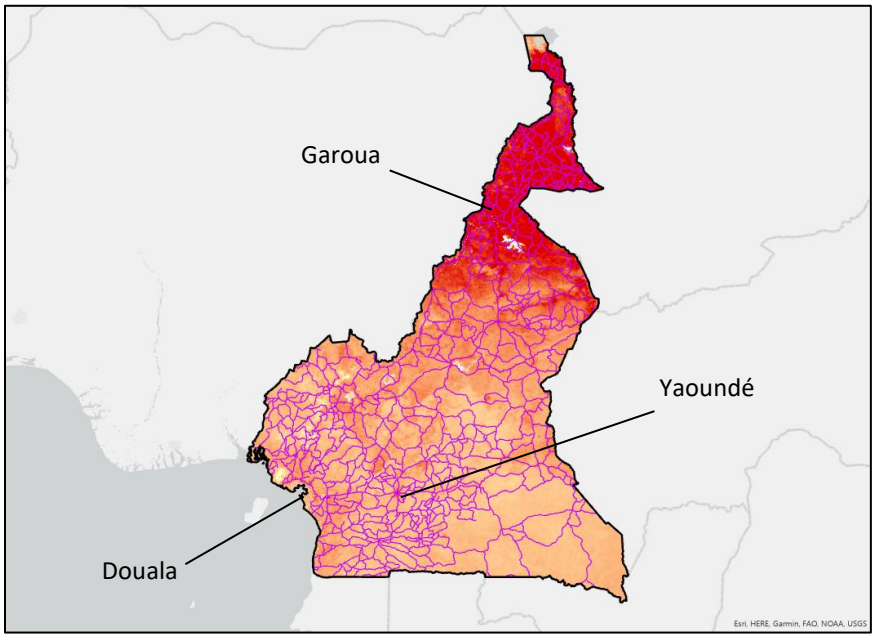
FIGURE 8.2. VEGETATION IN CAMEROON[44]



Cameroon's rich vegetation is concentrated in the Center and South of the country. The national development plan prioritizes the protection of the environment and prevention of risks to biodiversity.

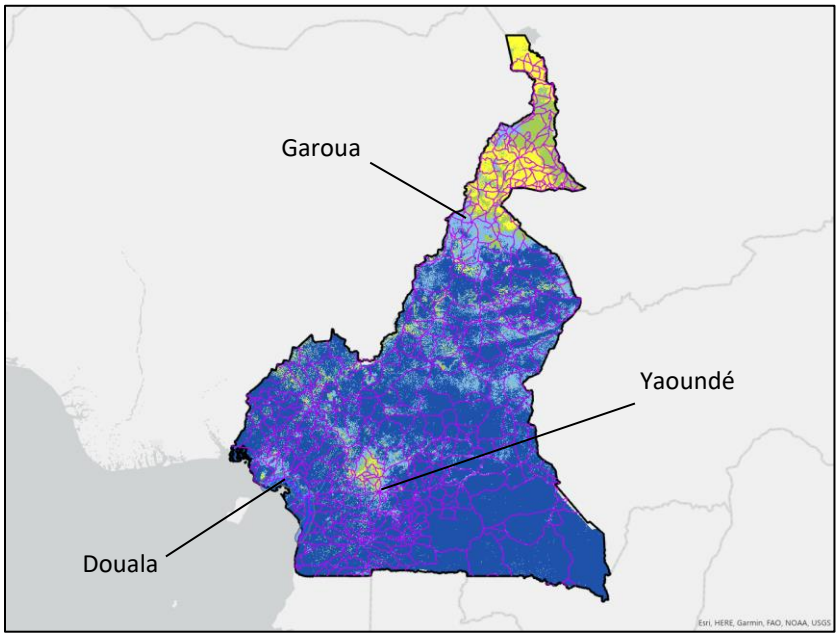
[44] To estimate forest cover, this report used the MODIS normalized difference vegetation index (NDVI). NDVI scores range from -1 to 1. Negative values represent manmade structures, rocks, or snow. Bare soil falls between 0.1 and 0.2. Plants range between 0.2 and 1. More information is available on the Earth Observing System blog.

FIGURE 8.3. SOLAR POTENTIAL IN CAMEROON



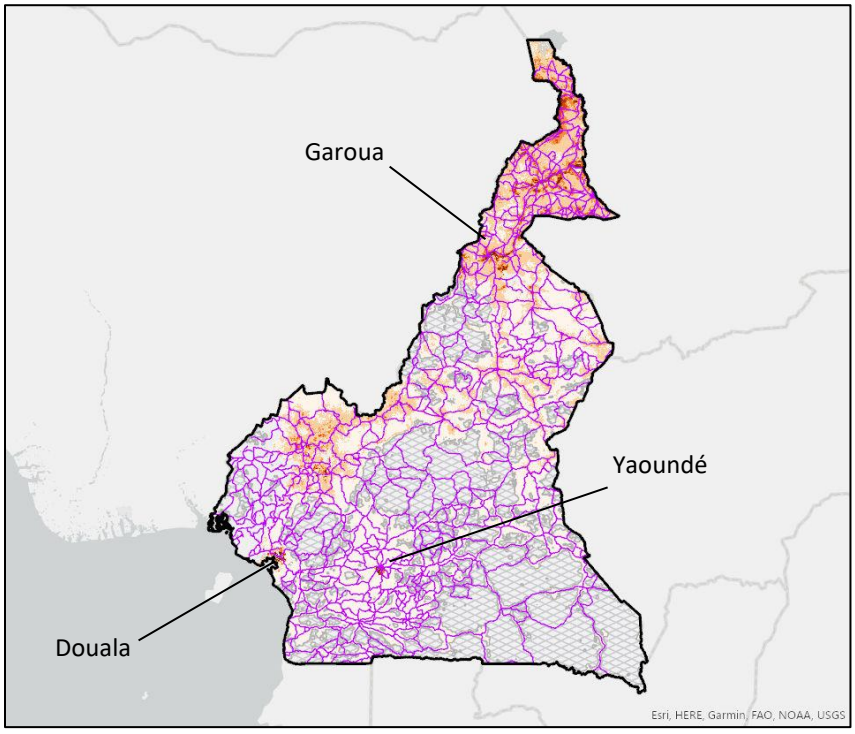
Solar energy potential is notably stronger in Cameroon's northern regions.

FIGURE 8.4. WIND POTENTIAL IN CAMEROON



The northern regions, similarly, show high wind energy potential as do the northern outskirts of the capital, Yaoundé.

FIGURE 8.5. CATTLE OWNERSHIP IN CAMEROON



The northern regions also display higher concentrations of livestock ownership than the rest of the country. These regions have a comparative advantage in their strong supply of high-quality cattle. There are several meat agropoles in these regions.

PERCENTAGE OF HOUSEHOLDS THAT OWN CATTLE

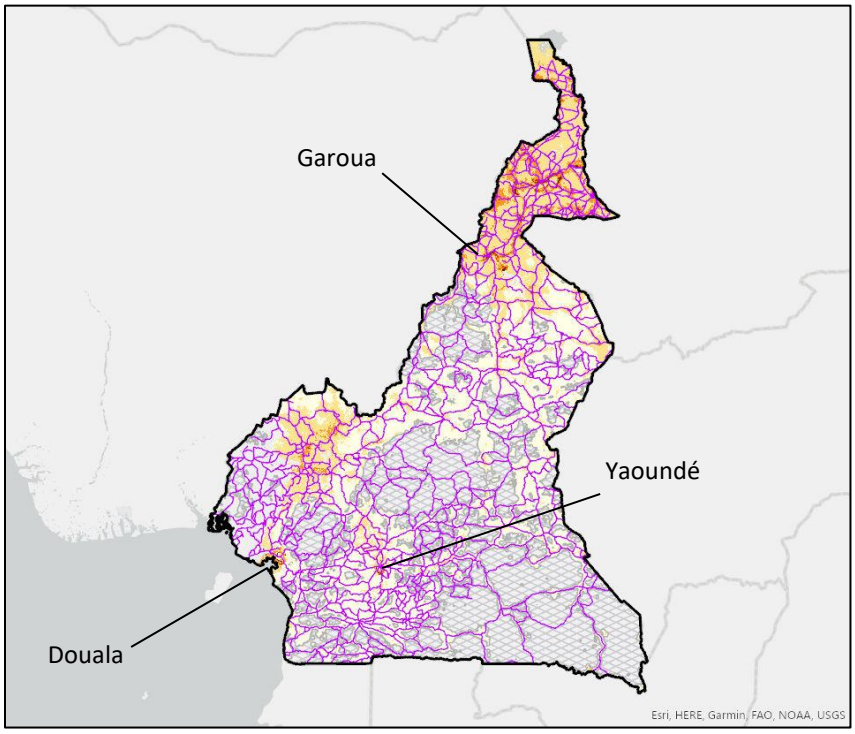
0% 60% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.6. GOAT OWNERSHIP IN CAMEROON



Further developing the cattle and goat values chains will rely on maintaining quality roads in the region to facilitate the movement of animals and byproducts.

PERCENTAGE OF HOUSEHOLDS THAT OWN GOATS

15% 90% +

ROAD

ZERO POPULATION

NO DATA

Livelihood zones in Cameroon are largely defined by agricultural products outside of the fishing and shrimping communities on the Gulf of Guinea coast and in urban areas surrounding Douala and Yaoundé. Despite underdevelopment of the commercial farming sector, the country has high potential for increased domestic food production and rural development.

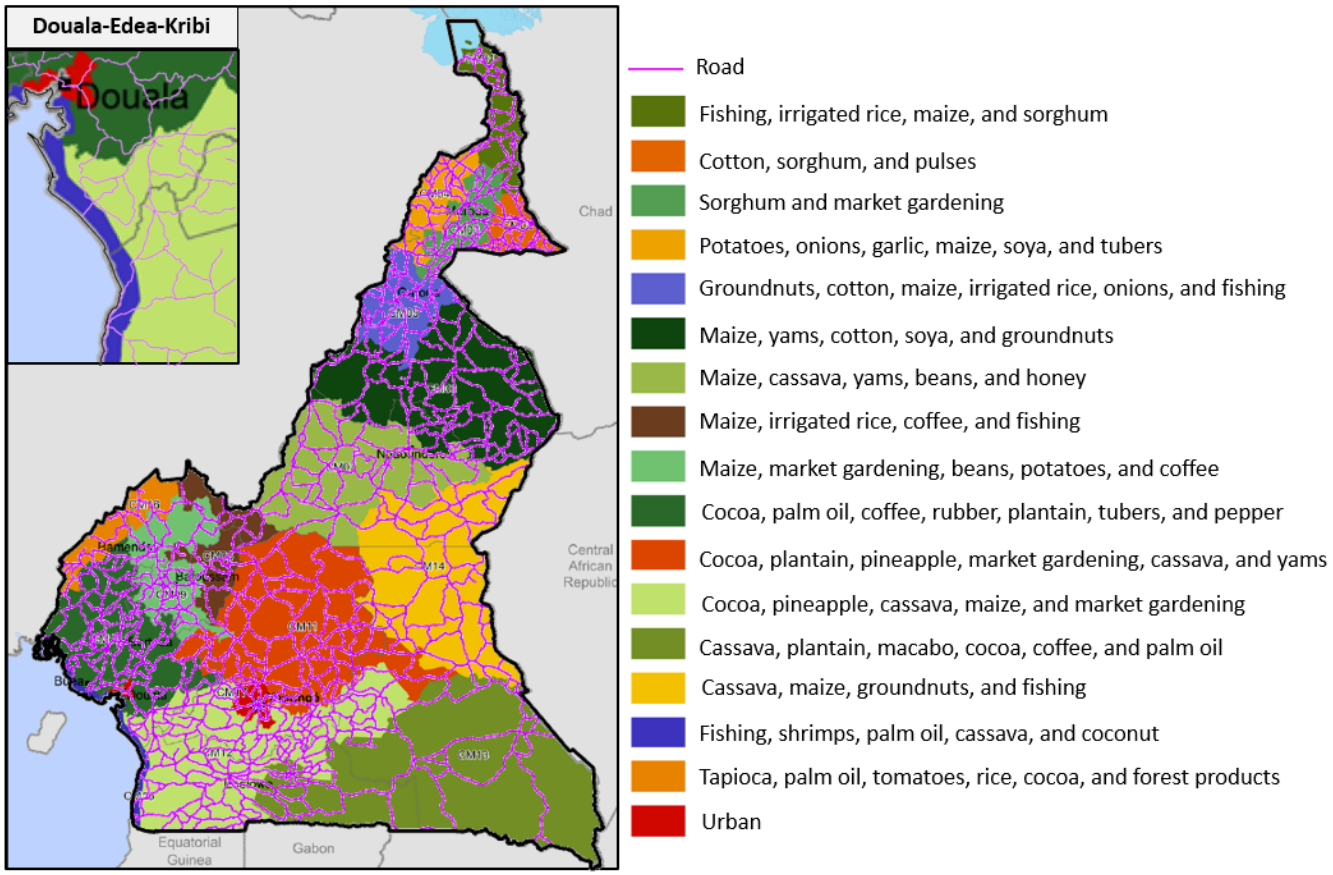
Development projects by the International Fund for Agricultural Development (IFAD) have focused primarily on rice and onion production in the Extreme North, North, North-West, and West regions via two phases of the $84.5 million Commodity Value Chain Support Project (PADFA). In 2020, production of coffee and cocoa dropped by 5.5 percent due to setbacks related to the conflict in the North-West and South-West regions, COVID-19, and the unfavorable effects of climate change.[45] Bolstering the value chains for these two key cash crops will support the recovery of their production and further commercialization.

There are currently a handful of agropoles in Cameroon, whose goals are to increase agricultural production and provide revenue-generating activities for rural populations. Rice agropoles are primarily located in the Central region, with several also located in the East and Littoral. There is a fishing agropole north of Douala along the coast, an oyster farming agropole in Douala, and a shrimp farming agropole in Kribi.[46]

[45] CEMAC Finance, "Cameroon hopes to increase cocoa and coffee production as 2020 – 2021 season take off," Available at: https://cemac-eco.finance/cameroon-hopes-to-increase-cocoa-and-coffee-production-as-2020-2021-season-take-off

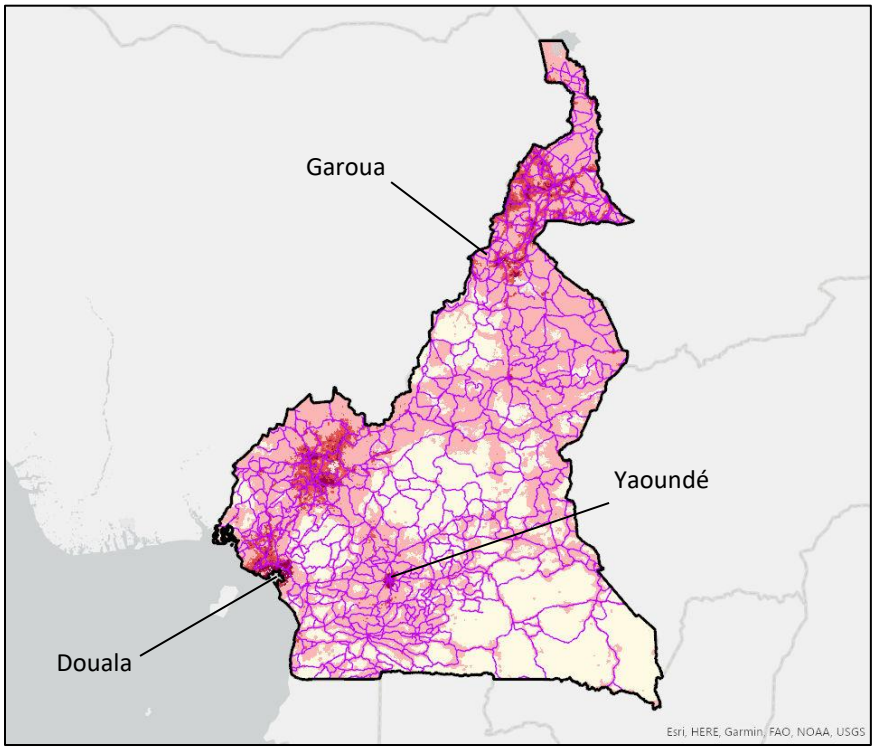
[46] Republique du Cameroun. Ministère de l'Economie, de la Planification et de l'Aménagement du Territoire. "Elaboration du Schema National d'Aménagement et de Développement Durable du Territoire du Cameroun."

FIGURE 8.7. LIVELIHOODS ZONES IN CAMEROON



8.3 Socioeconomic and Demographic Indicators

FIGURE 8.8. POPULATION DISTRIBUTION IN CAMEROON



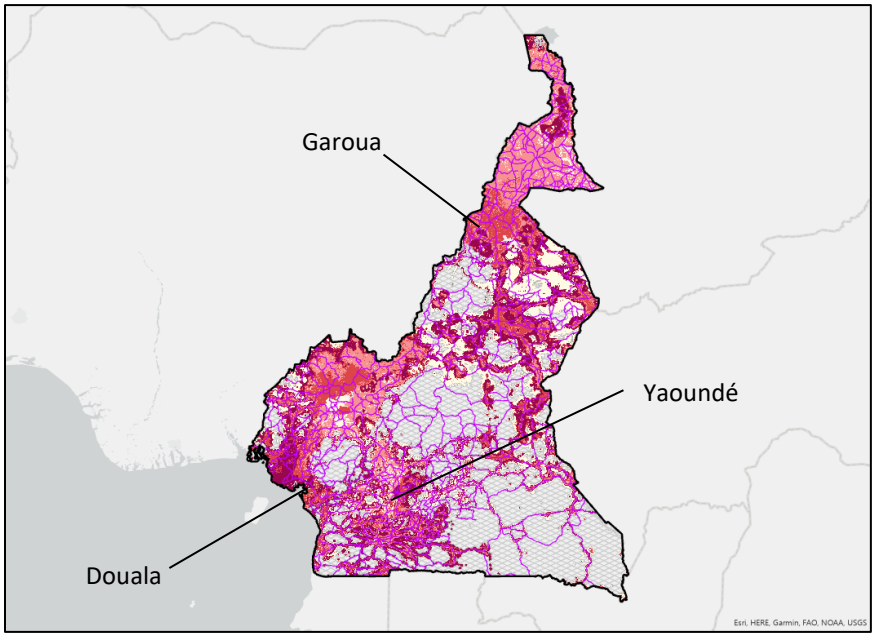
Population is concentrated around urban areas, most notably around Yaoundé in the Central region, Douala in the Littoral, and Bamenda in the Northwest. The North and Extreme North regions also exhibit high concentrations of people living outside of urban areas. Access to roads will be critical to unlocking the economic potential of these communities.

POPULATION

0 — 400 +

ROAD

FIGURE 8.9. YOUTH PROPORTION OF POPULATION IN CAMEROON



Douala, Yaoundé, and the lower portion of the South-West region exhibit high levels of youth as a proportion of the population. Elsewhere, peri-urban areas tend to be more youthful. Strong access to roads will be important for linking young people to areas with economic opportunity.

PERCENTAGE OF POPULATION AGES 15-34 YEARS OLD

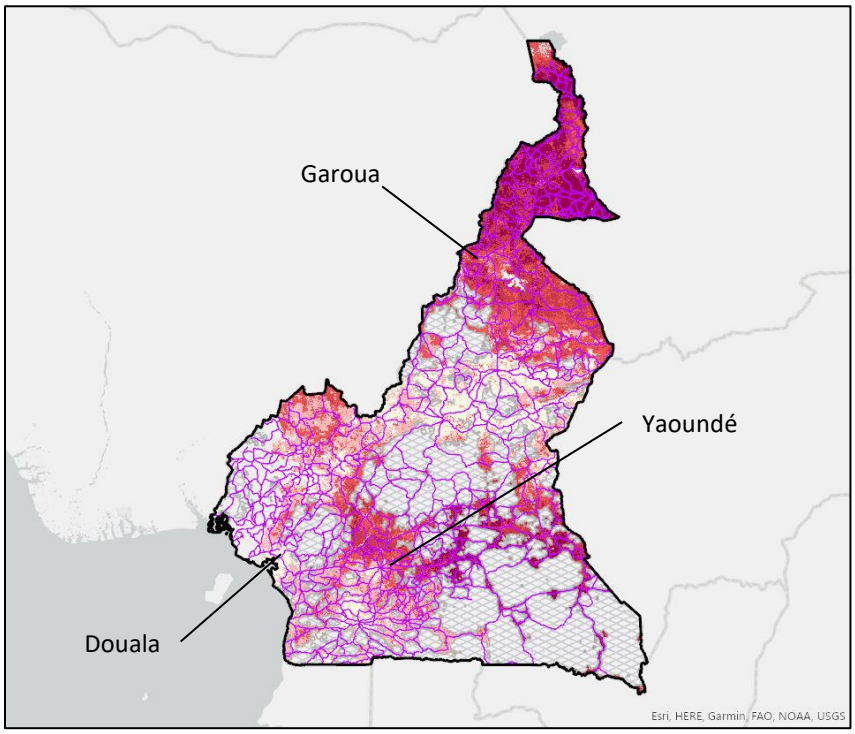
25% — 40% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.10. ADULT EMPLOYMENT IN CAMEROON



Cameroon's Northern regions and the less populous Eastern region have the highest proportions of adult employment while coastal regions have the lowest.

PERCENTAGE OF ADULTS WHO ARE EMPLOYED

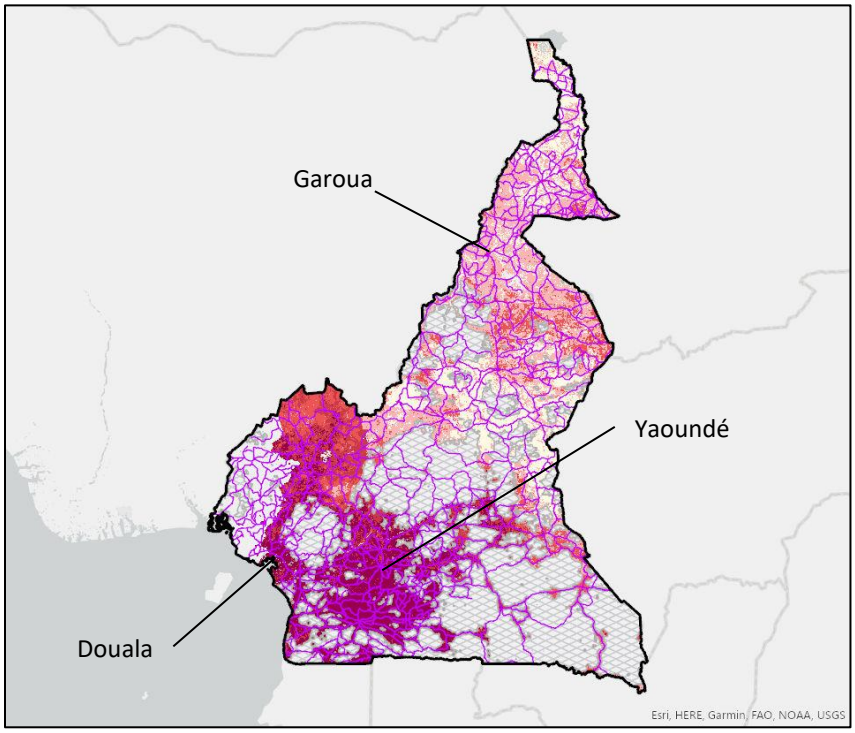
60% — 85% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.11. EDUCATIONAL ACHIEVEMENT IN CAMEROON



Primary educational attainment is lowest in northern Cameroon. Lower educational achievement may be due to these regions' more rural nature.

PERCENTAGE OF POPULATION 15 AND OLDER WHO HAVE COMPLETED PRIMARY SCHOOL

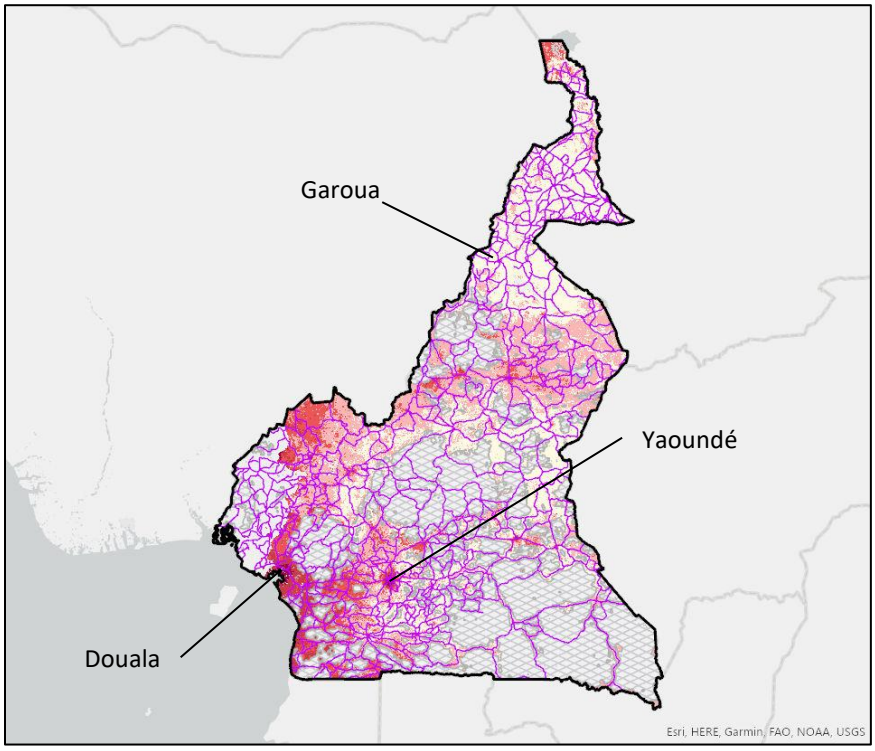
20% — 70% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.12. INTERNET ACCESS IN CAMEROON



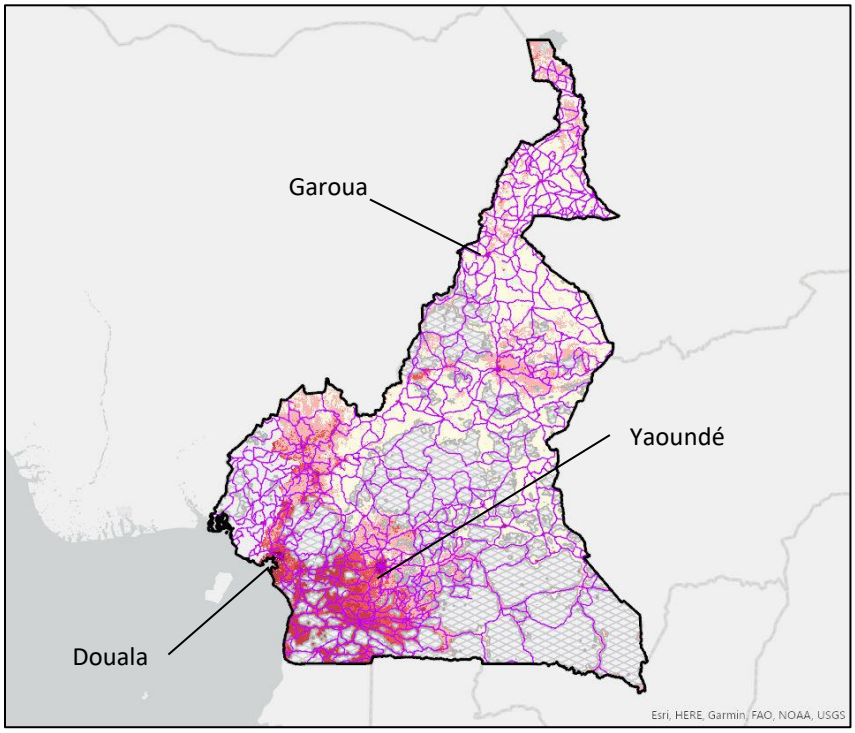
Internet access is uncommon throughout Cameroon. The Littoral region has the highest proportion of individuals living in households that have internet access at 3 out of every 10 people, while access to internet in the Extreme North is limited to 1 in 100 individuals.

PERCENTAGE OF POPULATION WITH INTERNET ACCESS

0% — 25% +

ROAD
ZERO POPULATION
NO DATA

FIGURE 8.13. BANK ACCOUNT ACCESS IN CAMEROON



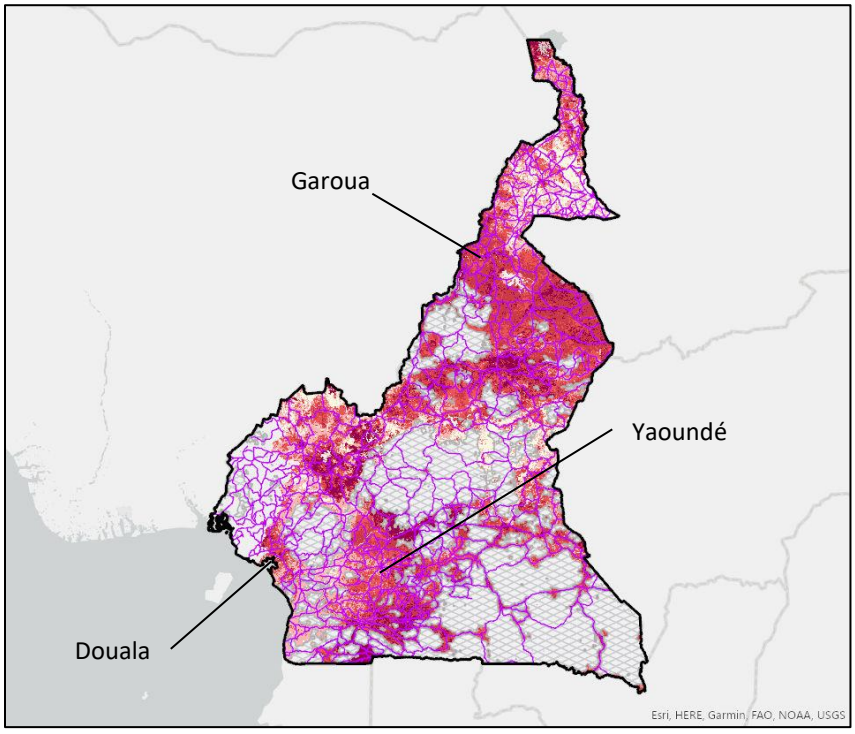
Financial inclusion is low outside of the Littoral, Central, and Southern regions of Cameroon. Less than 6 percent of the rural population lives in a household in which at least one member has a bank account.

PERCENTAGE OF POPULATION WITH BANK ACCOUNT ACCESS

5% — 30% +

ROAD
ZERO POPULATION
NO DATA

FIGURE 8.14. ACCESS TO MOTORIZED TRANSPORT IN CAMEROON



In most of the country, populations living close to the existing road network have a higher rate of access to motorized transport, including cars and motorcycles. In the Extreme North, this pattern is reversed, indicating that there may be barriers to acquiring motorized modes of transportation such as high cost and poor quality of roads.

PERCENTAGE OF POPULATION WITH ACCESS TO MOTORIZED TRANSPORTATION

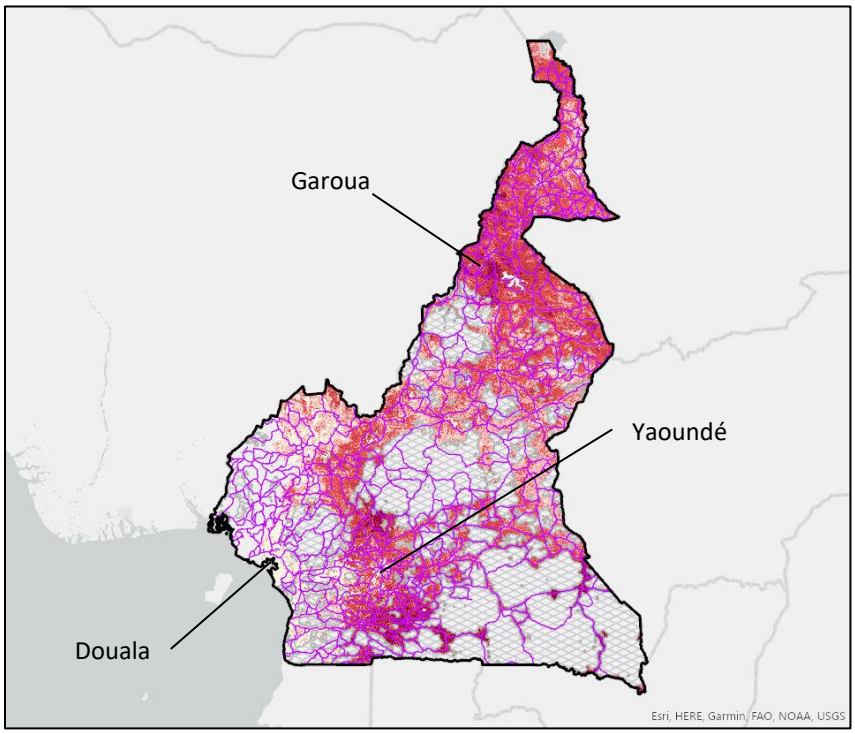
20% 35% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.15. HOUSEHOLD SIZE IN CAMEROON



The Littoral and North-West regions, on average, have smaller households compared to other parts of Cameroon, with an average of 5 members per household compared to 7 members or more per household in other regions.

AVERAGE HOUSEHOLD SIZE

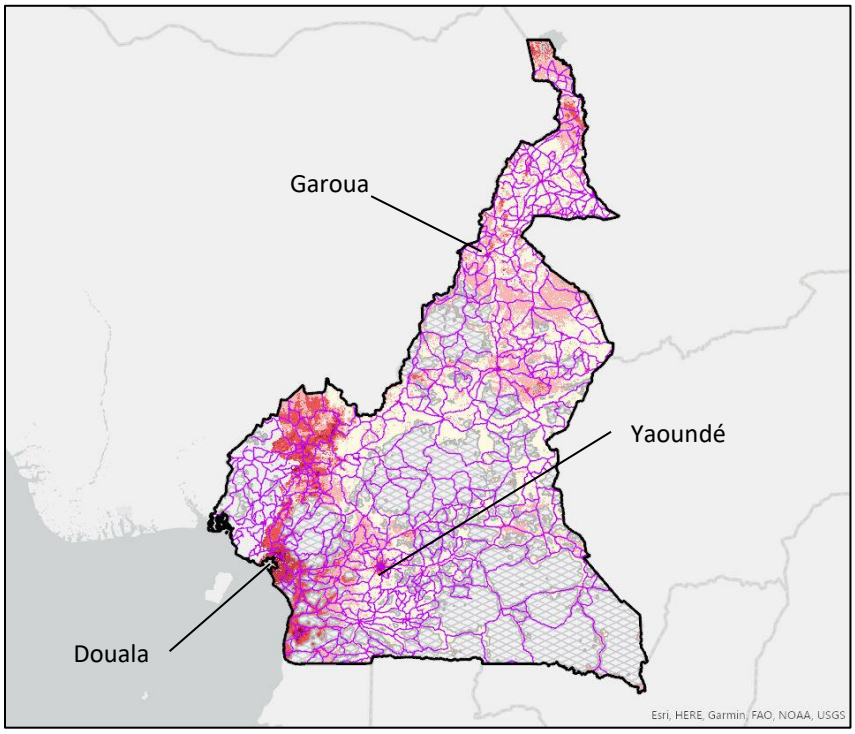
4 7 +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.16. ACCESS TO PIPED-IN DRINKING WATER IN CAMEROON



Piped-in drinking water is also more common in Littoral and North-West regions compared to elsewhere.

PERCENTAGE OF POPULATION WITH ACCESS TO PIPED-IN DRINKING WATER

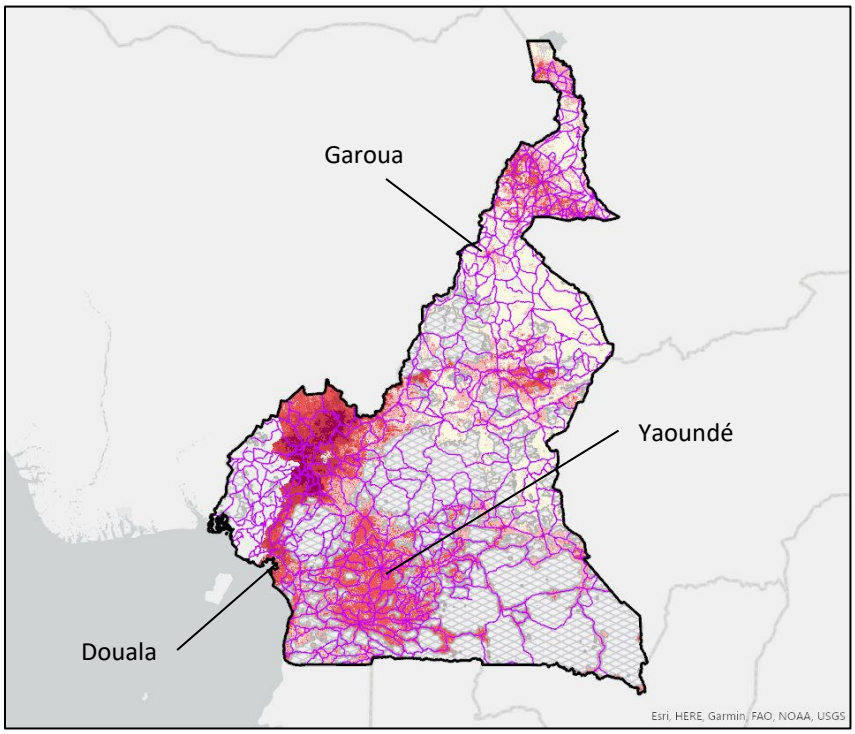
0% 30% +

ROAD

ZERO POPULATION

NO DATA

FIGURE 8.17. FEMALE-HEADED HOUSEHOLDS IN CAMEROON



The Littoral and the North-West regions also have the highest percentage of female-headed households in the country. Opportunities that leverage road networks may exist for improving the economic livelihoods of these women.

PERCENTAGE OF HOUSEHOLDS HEADED BY A FEMALE

15% 35% +

ROAD

ZERO POPULATION

NO DATA

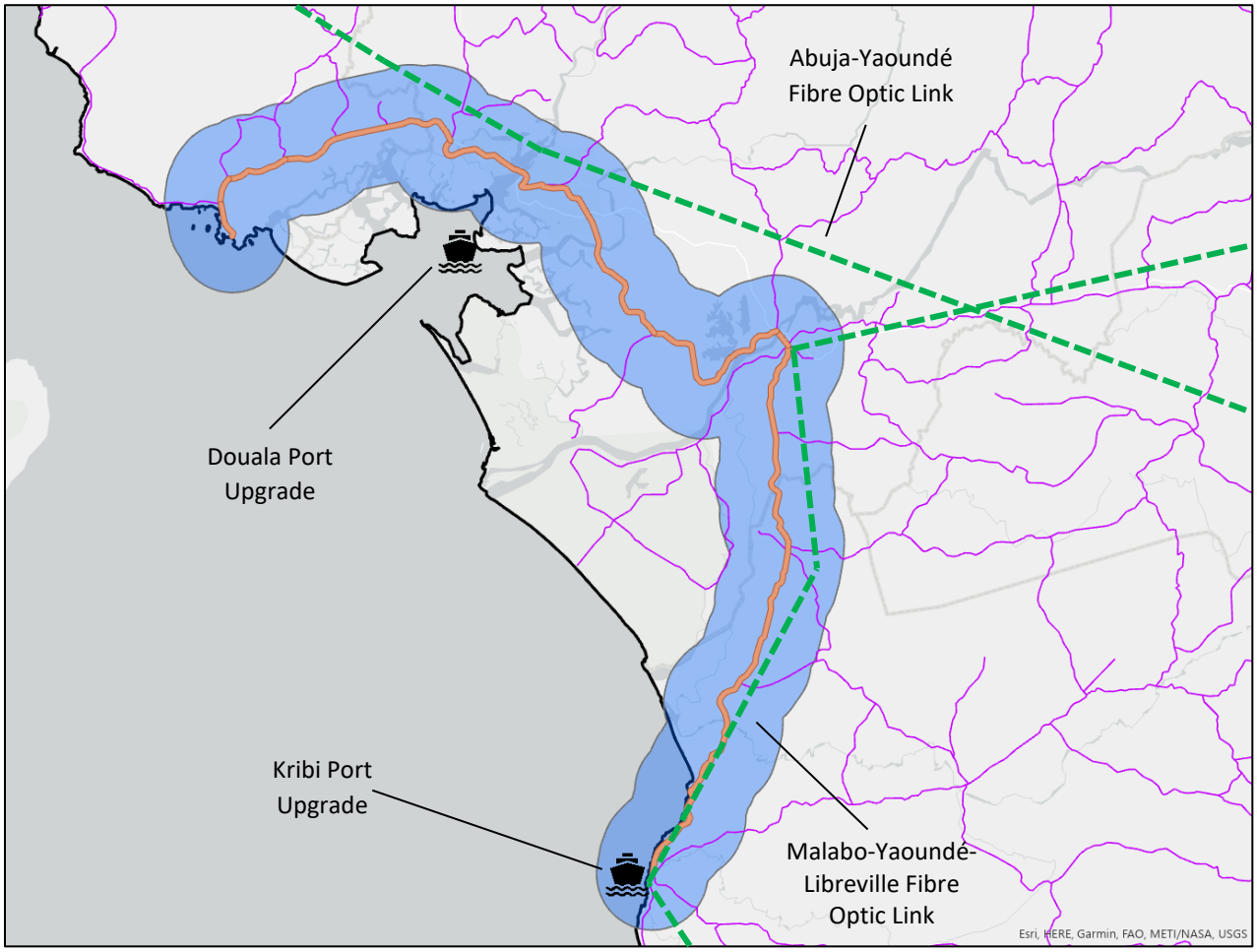
9. Sub-National Analysis: Douala-Edea-Kribi Growth Triangle

9.1 Sub-National Overview

The Douala-Edéa-Kribi (DEK) triangle boasts high levels of human capital, natural resources, and regional connectedness through major highways and ports. Investment in the digital and pharmaceutical sectors align well with the objectives of Cameroon's national development plan 2020-2030. Pillar 2 of the national development plan emphasizes increasing the supply of technical and professional training and promoting research and development in the industrial and chemical industries. Development of a pharmaceutical industry in the triangle could present major opportunities to improve the livelihoods of populations living in this area.

Cattle and goat ownership are high in the area around Douala, indicating potential for connecting livestock owners with opportunities to export higher value products such as leather. Markets for these products may be further bolstered by the development of the deep seaport at Kribi, the Douala Port Upgrade project, and the construction of the Kribi-Campo-Bata coastal road to Equatorial Guinea.

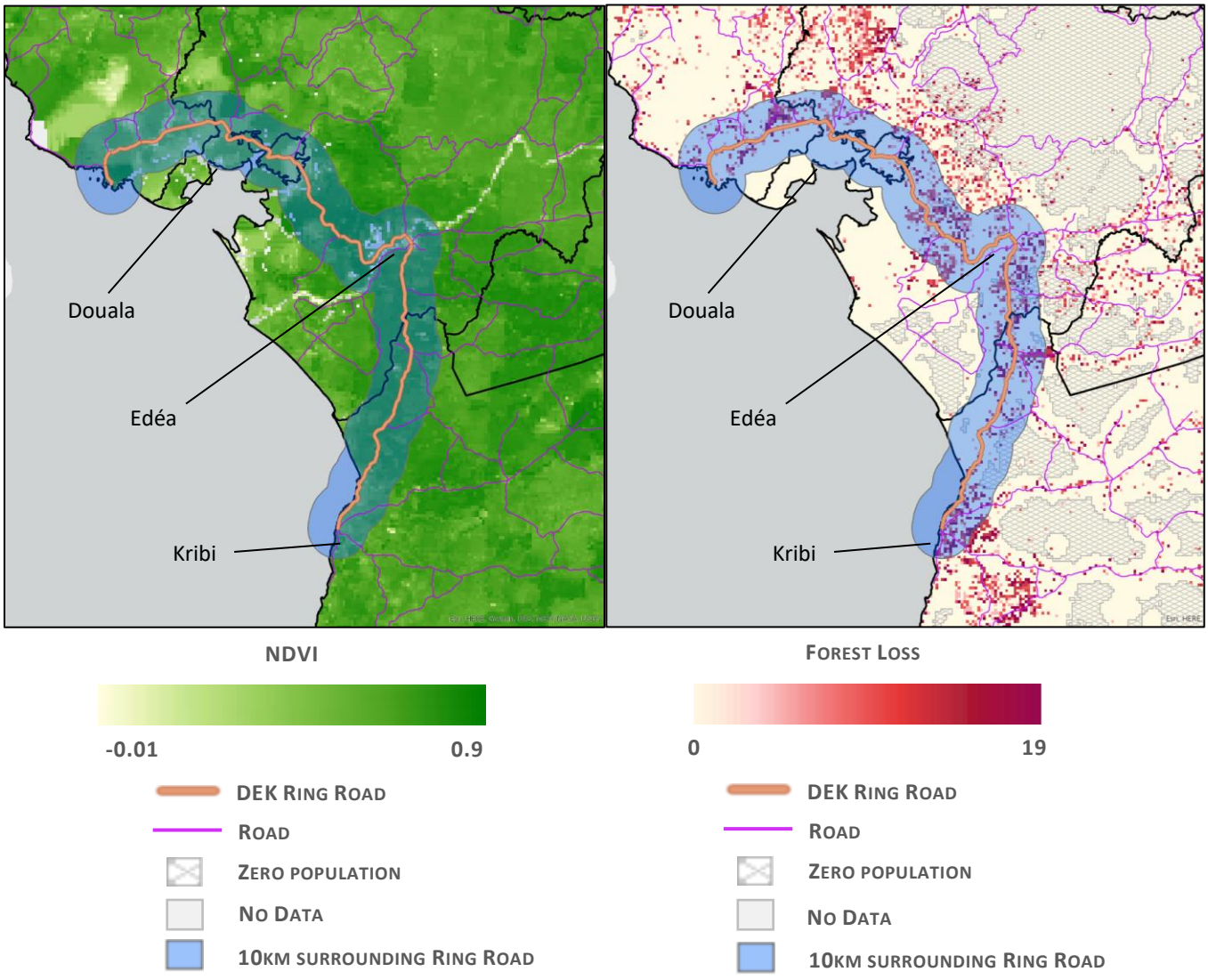
FIGURE 9.1. PIDA PROJECTS IN THE DOUALA-EDÉA-KRIBI TRIANGLE



9.2 Biophysical Indicators

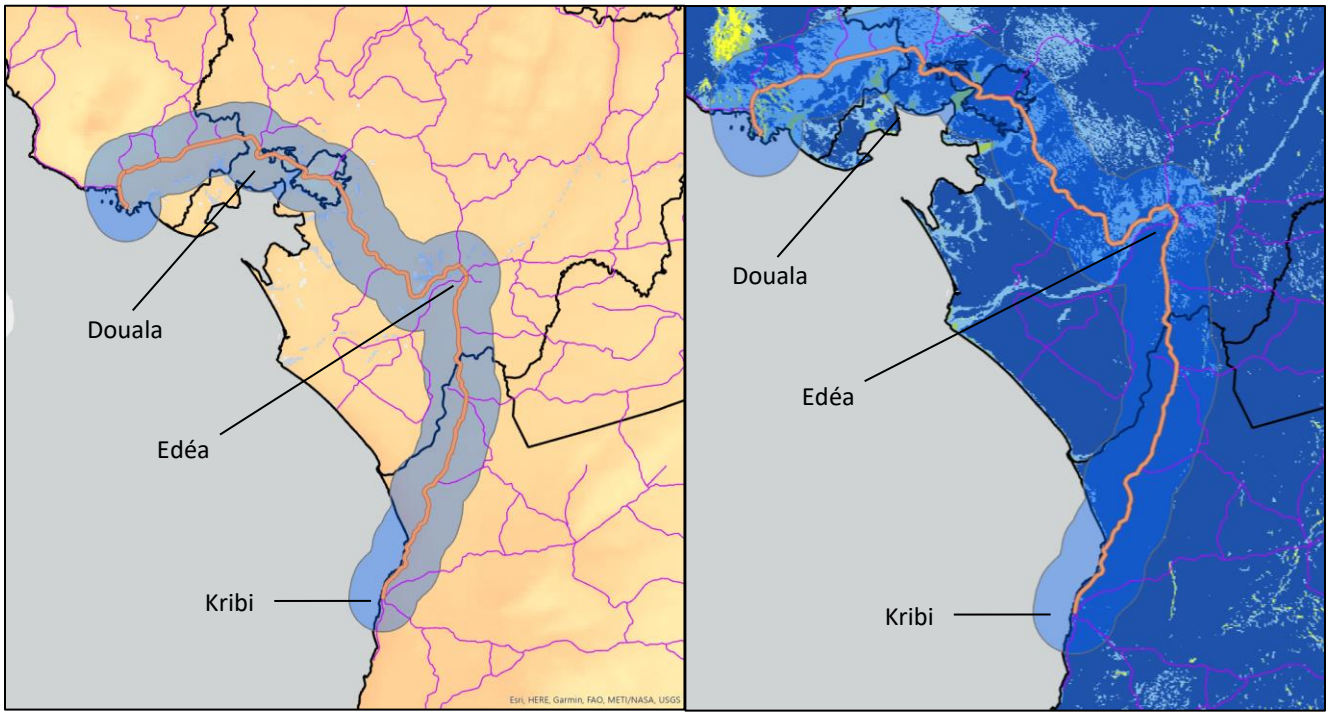
Overall, the DEK triangle has a high level of vegetation, and there are several wildlife reserves in the area. Mitigation measures to limit negative environmental impacts arising from economic development activities in this area will be important to preserve the biodiversity of the Douala-Edéa wildlife reserve. Areas of high deforestation already pocket the inland area of the triangle.

FIGURE 9.2. VEGETATION AND DEFORESTATION IN THE DOUALA-EDÉA-KRIBI TRIANGLE



While large scale solar and wind energy potential are low in the triangle compared to other areas of the region, certain areas of the DEK triangle may still be suitable for small-scale solar or wind energy production.

FIGURE 9.3. WIND AND SOLAR POTENTIAL IN THE DOUALA-EDÉA-KRIBI TRIANGLE



KJ PER M 2 PER DAY

12500 20000 +

DEK RING ROAD

ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

WIND POWER DENSITY

0 2000 +

DEK RING ROAD

ROAD

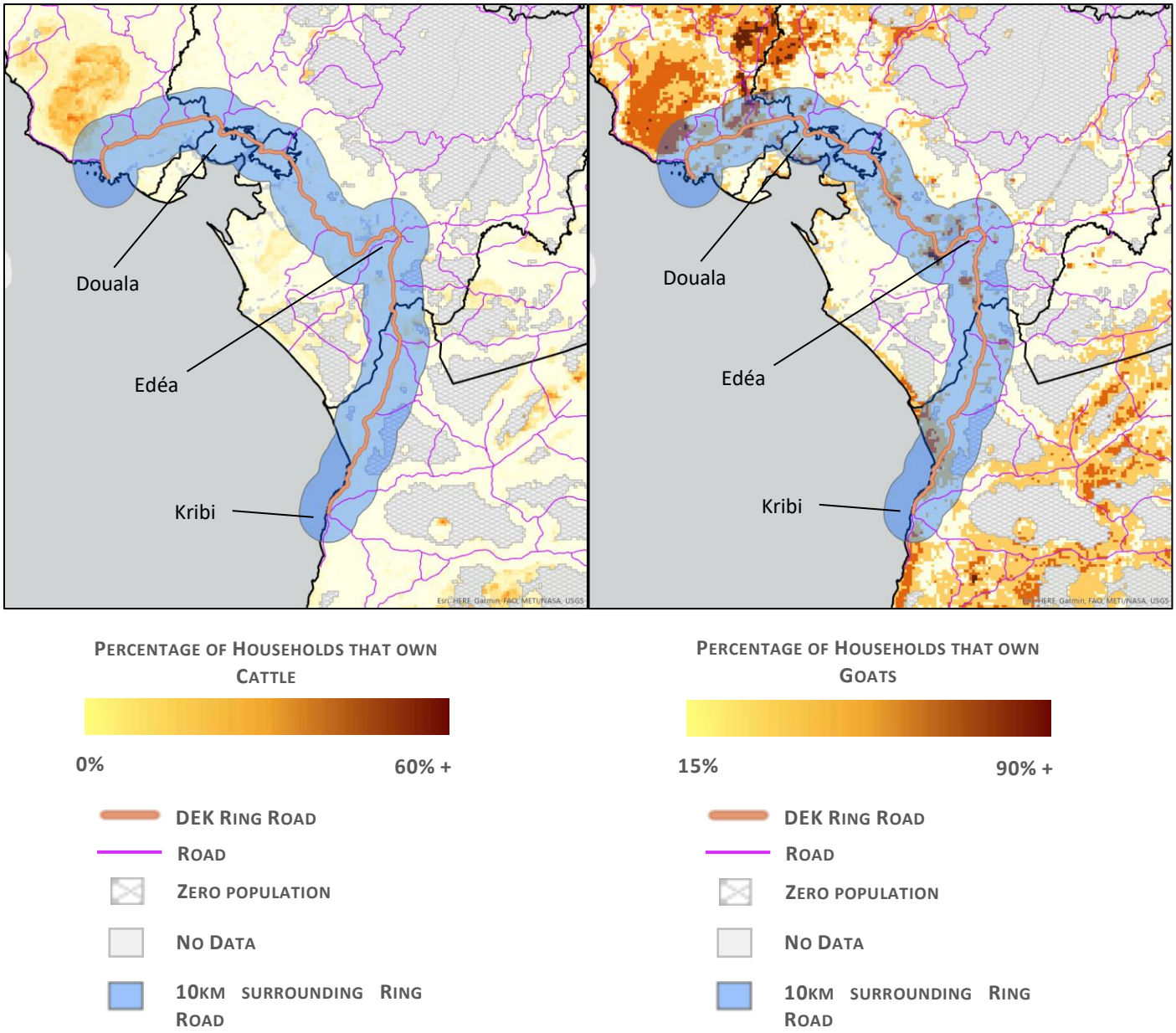
ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

Compared to other areas of the country, the DEK triangle has less potential for investments in the cattle value chain since few households living near the road own cattle. However, there are several pockets with high goat ownership, indicating there may be potential to invest in the goat value chain.

FIGURE 9.4. CATTLE AND GOAT OWNERSHIP IN THE DOUALA-EDÉA-KRIBI TRIANGLE

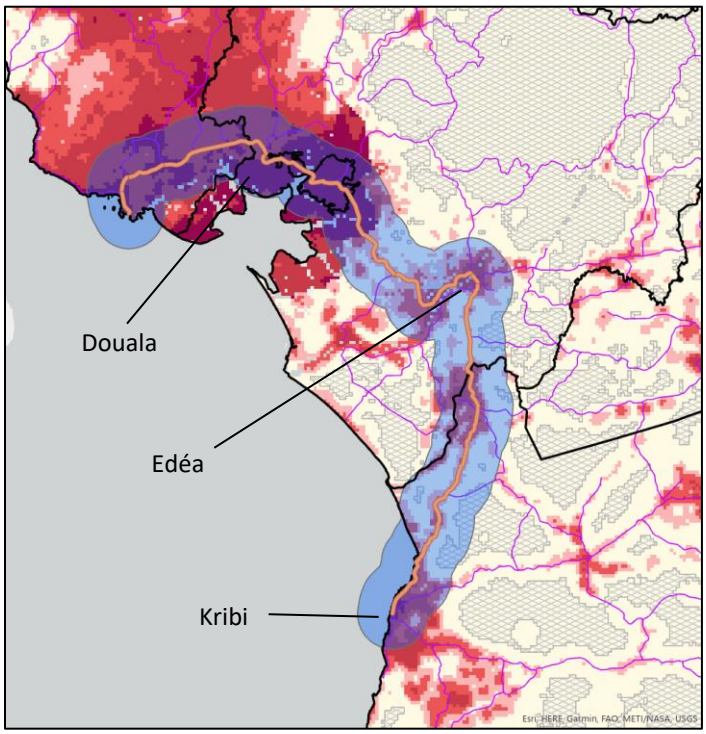


9.3 Socioeconomic and Demographic Indicators

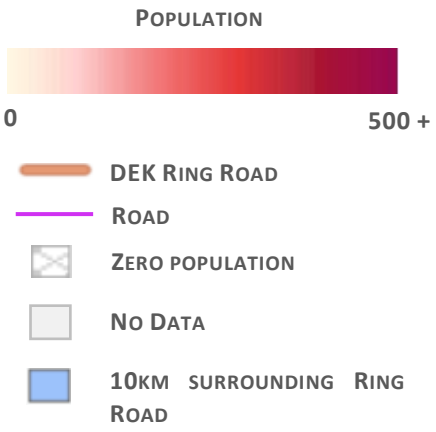
With high rates of education, youth population, access to internet and formal banking in tandem with an employment deficit, the Douala-Edéa-Kribi (DEK) triangle is an area with high unrealized human capital and strong potential return on investment in the digital sector and the pharmaceutical industry. Populations living in the triangle have among the highest primary school attainment rates in the country, but also have the lowest levels of adult employment. Moreover, the population in this area is more youthful than other areas of the country. The high level of internet access in this area indicates that it might be suitable for investments in the digital sector, which could catalyze youth employment in ICT.

Regarding pharmaceutical manufacturing, a recent McKinsey report highlighted key barriers to pharmaceutical manufacturing in sub-Saharan Africa as "a small, if growing market; . . . unreliable infrastructure; and an underdeveloped talent base."[47] Investment in specialized training and improved infrastructure may help overcome these barriers especially in the context of the COVID-19 pandemic, which has underscored the benefit of localized pharmaceutical value chains.

FIGURE 9.5. POPULATION IN THE DOUALA-EDÉA-KRIBI TRIANGLE

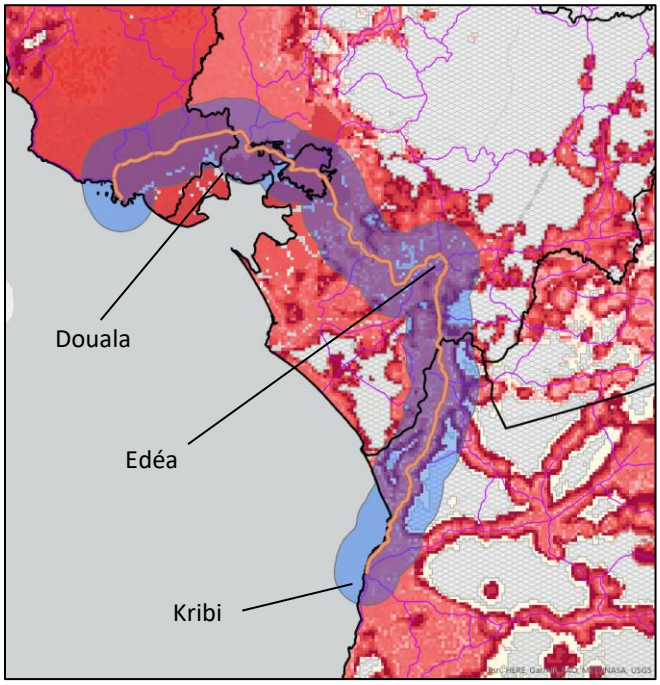


An estimated 4.2 million people live within 10 km of the DEK ring road, which represents 15 percent of Cameroon's estimated total population of 28 million in 2020.



[47] McKinsey & Company, "Should sub-Saharan Africa make its own drugs?" Available at: https://www.mckinsey.com/industries/public-and-social-sector/our-insights/should-sub-saharan-africa-make-its-own-drugs#

FIGURE 9.6. YOUTH POPULATION IN THE DOUALA-EDÉA-KRIBI TRIANGLE



The population in the ring road is younger than the national average. About 42 percent of people living near the road are youth.

PERCENTAGE OF POPULATION AGES 15-34 YEARS OLD

25% 40% +

DEK RING ROAD

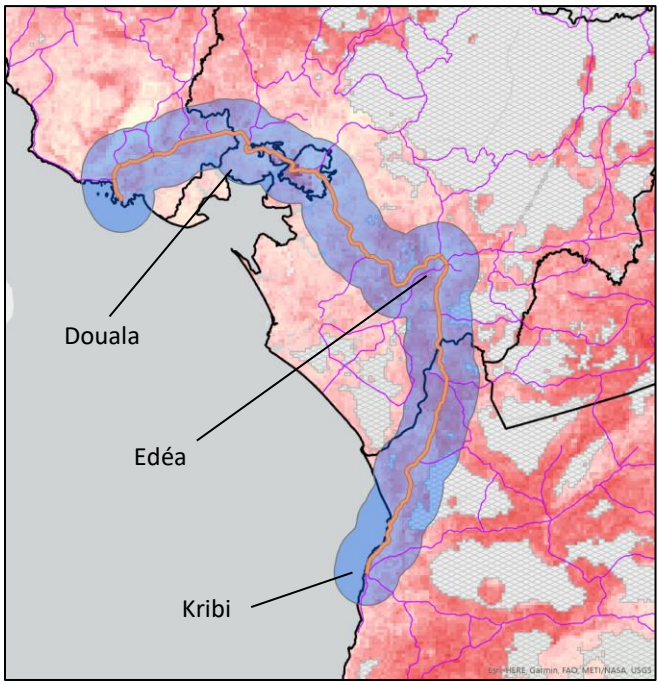
ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

FIGURE 9.7. ADULT EMPLOYMENT IN THE DOUALA-EDÉA-KRIBI TRIANGLE



An estimated 62 percent of adults aged 15-49 years old in this area are currently working, which is lower than the national average of 70 percent.

PERCENTAGE OF ADULTS WHO ARE EMPLOYED

65% 80% +

DEK RING ROAD

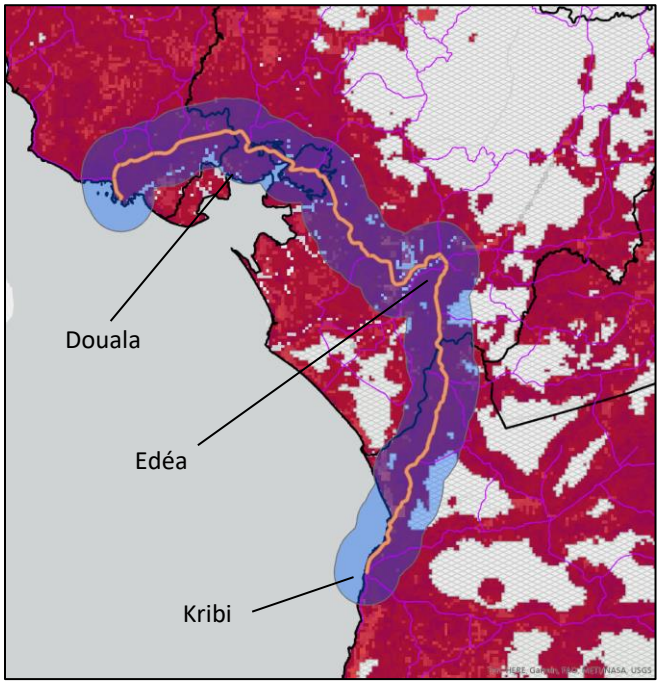
ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

FIGURE 9.8. PRIMARY EDUCATIONAL ATTAINMENT IN THE DOUALA-EDÉA-KRIBI TRIANGLE



Roughly 90 percent of individuals aged 15 and older have completed primary school or higher in the communities near the Douala-Edéa-Kribi ring road, which far outpaces the national average of 65 percent.

WHO HAVE COMPLETED PRIMARY EDUCATION

0% 100%

DEK RING ROAD

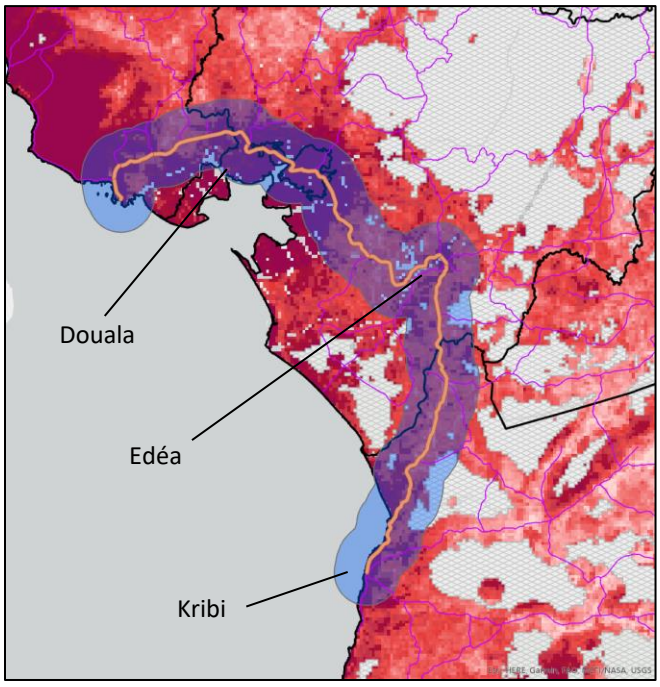
ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

FIGURE 9.9. INTERNET ACCESS IN THE DOUALA-EDÉA-KRIBI TRIANGLE



About one third of the population living near the DEK road has access to the internet at home, which is significantly higher than the national average of 14 percent.

PERCENTAGE OF POPULATION WITH INTERNET ACCESS

0% 80% +

DEK RING ROAD

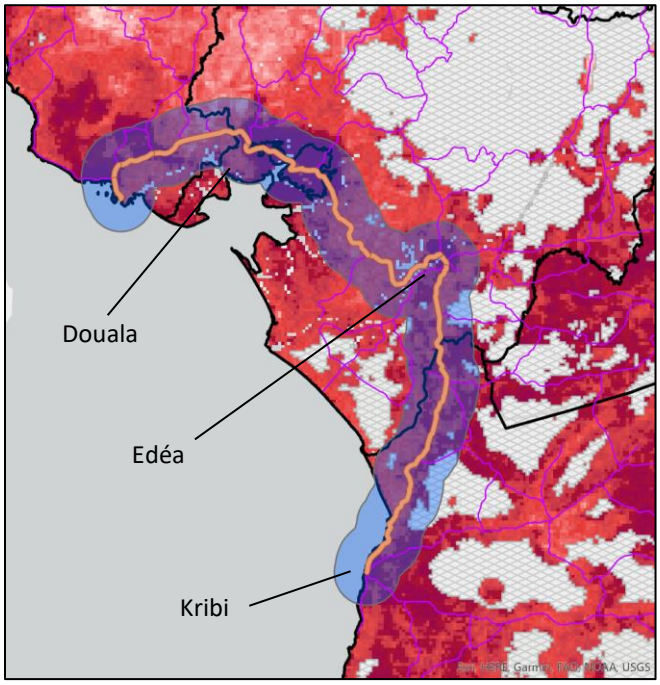
ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

FIGURE 9.10. BANK ACCOUNT ACCESS IN THE DOUALA-EDÉA-KRIBI TRIANGLE



Access to a formal bank account is more than twice as high near the Douala-Edéa-Kribi compared to nationally, at 34 percent and 16 percent, respectively.

PERCENTAGE OF POPULATION WITH BANK ACCOUNT ACCESS

0% 90% +

DEK RING ROAD

ROAD

ZERO POPULATION

NO DATA

10KM SURROUNDING RING ROAD

10. Key Recommendations

The key recommendations from this report focus on the development of interconnected regional value chains as a means of stimulating economic growth in Central Africa.

1. **Unlock the maize, rice, and livestock value chains.**

According to ECA research, key constraints inhibiting growth and value addition in agriculture and livestock production and transformation include tariff and non-tariff barriers, transportation costs, and low access to inorganic fertilizers.[48] As the AfCFTA is operationalized, barriers to regional trade can be reduced through increased cooperation between Central African countries, facilitating an efficient trading system. The transport corridor in the region should be configured to connect areas of rice production to urban centers with high consumer demand. While this network design involves a focus on highways connecting capital cities, rural roads should not be completely overlooked. As maize is a critical crop for food security in the region, rural roads are important to connect populations to staple crops.

Two border areas stand out as key links in the regional production of maize and rice: 1) the border between the Central African Republic and the Nord-Ubangi province of the Democratic Republic, and 2) the border between the Eastern region of Cameroon and Nana-Mambéré prefecture in the Central African Republic. The border between the Extreme North region of Cameroon and the Southwest regions of Chad is perhaps the most important border crossing for trade in livestock. The transport corridors surrounding these borders, as well as the border crossings in these areas, should be strengthened to unlock the full potential of the regional value chain.

2. **Invest in wind and solar energy in the Cameroon-Chad border area.**

The border area between the Extreme North of Cameroon and Chad has among the highest potential for wind and solar energy on the African continent. Exploiting this potential can bring the region closer to meeting SDG 7. In addition, this region is particularly favorable for renewable energy development as there are several opportunities to connect to the development of adjacent industries. For example, the construction of a center for wind energy production in this area can stimulate the demand for metals used in wind turbine construction and energy storage, which can be sourced locally in the region.

In addition to increasing energy access for the population, livestock agropoles in this cattle-rich area could benefit from the stable energy supply necessary for the transformation of livestock to products with high value.

[48] UNECA. “Analyses approfondies des chaines de valeurs régionales et grappes stratégiques de l’Afrique centrale pour tirer le meilleur parti de la ZLECAf.” Volume 1. 17 December 2020.

3. Develop an economic zone focused on the manufacturing of rechargeable batteries.

Central Africa has abundant deposits of valuable metals in high demand for rechargeable batteries, but currently no capacity to add value by processing the metals and manufacturing batteries. Global demand for rechargeable batteries is forecasted to increase exponentially as the electric transport industry takes off and demand for longer-lasting batteries continues to be an important driver of technological advances in the smartphone industry. The market value of activities along the battery supply chain increases substantially with activities such as fabrication and manufacturing. Central Africa is well suited to develop an integrated regional value chain for the manufacture of batteries where the mining of metals at the base of the supply chain connects to manufacturing without the need for costly exports and imports outside of the region.

Moreover, demand for end-products such as smartphones and renewable energy storage is projected to increase in the Central Africa region, and in Africa overall. The battery sector is interconnected with the development of renewable energy and the growth of the digital sector in the region.

4. Promote technical training for the pharmaceutical industry in the Douala-Edéa-Kribi growth triangle.

The Douala-Edéa-Kribi growth triangle is poised for the development of nascent industries, with an educated and youthful population and relatively high internet access. To prepare for pharmaceutical production, local authorities should inventory productive technical capacity, resources, and raw materials available in the area.[49] The current pharmaceutical value chain includes import, packaging and labelling, product manufacturing, active pharmaceutical ingredient manufacturing, and research and development. Technical training for populations living in the area will be critical to ensure a local labor force for the industry at all levels of the value chain.

Cameroon can replicate initiatives that have been successful in other countries, such as Ethiopia's National Strategy and Plan of Action for Pharmaceutical Manufacturing Development (2015-2025). The plan focuses investment in relevant and comprehensive human capital development including increased enrollment in science and technology post-secondary education, short-term training programs for current professionals along the continuum of necessary skills such as research and development, general management, and technical operations.[50]

[49] Council on Foreign Relations, "Scaling Up African Pharmaceutical Manufacturing in a Time of COVID-19." Available at: https://www.cfr.org/blog/scaling-african-pharmaceutical-manufacturing-time-covid-19

[50] Federal Democratic Republic of Ethiopia: Ministry of Health and Ministry of Industry. "National Strategy and Plan of Action for Pharmaceutical Manufacturing Development in Ethiopia (2015-2025)." Available at: https://www.who.int/phi/publications/NatStrategyPlanActionPharmManufEthiopia2015-2025.pdf?ua=1

5. Incorporate geospatial analysis to policymaking at the regional, national and local levels.

Geospatial data and analysis has the power to guide decision-making in an unbiased way and reveal insights on population dynamics that enable fast, precise, and comprehensive evaluation of potential investments. By understanding the spatial distribution of economic opportunities and population characteristics, policymakers at all levels (regional, national, and local) can formulate strategies that most effectively connect opportunities to the populations most at need. Moreover, policymakers can customize strategies to the unique needs of specific geographic areas. For example, the educational attainment and employment levels of youth living in the Douala-Edéa-Kribi growth triangle are unique in Cameroon and require tailored strategies to ensure youth benefit from the development of nascent industries in the growth triangle.