

ETHIODEMOGRAPHY AND HEALTH

CHAPTER 2

POPULATION DISTRIBUTION

Ethiopia Focus with a Global Lens

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Chapter 2 — List of Acronyms and Abbreviations

Acronym	Full meaning / definition
DMSP-OLS	Defense Meteorological Satellite Program–Operational Linescan System
ET99	Code for the separately reported contested analytical geography; not an officially recognized fifteenth region
GHS-POP	Global Human Settlement Population Grid
GHSL	Global Human Settlement Layer
LISA	Local Indicators of Spatial Association
MAUP	Modifiable Areal Unit Problem
NDVI	Normalized Difference Vegetation Index
PDF	Portable Document Format
SAE	Small-Area Estimation
UNHCR	United Nations High Commissioner for Refugees (UN Refugee Agency)
VIIRS	Visible Infrared Imaging Radiometer Suite

Note. ET99 is an analytical geography code rather than an institutional acronym.

PART I — Concepts, National Patterns, Administrative Scale, and Urbanization

2.1 Concepts and measures of population distribution

Population distribution concerns not simply how many people live in a country, but how they are distributed across its territory. In Ethiopia, regional totals conceal striking differences between populous agricultural regions, metropolitan centers, and extensive low-density pastoral areas. An effective account therefore considers population size, land area, settlement form, mobility, and access to services together.

The most familiar measure is arithmetic population density: the number of residents divided by land area in square kilometers. It is an informative starting point but not a measure of crowding experienced by every resident. Mountainous terrain, nonresidential land, protected areas, and large administrative boundaries can make a regional average a poor representation of inhabited settlements. More refined approaches use inhabited land, cropland, or fine-resolution population grids, provided the denominators are stated explicitly.

Population concentration is a different question. A region may contain many residents yet have only moderate average density because its territory is large. Conversely, a compact city can have a small share of the national population and exceptionally high density. Measures such as the Lorenz curve and Gini coefficient summarize unevenness, while spatial autocorrelation identifies clustering among neighboring units. Neither should be estimated from hypothetical values.

For this revision, the 2025 population inputs are reconstruction scenarios aligned to 14 current regions plus a separately reported contested geography, ET99. These values are analytical benchmarks rather than an enumerated census. All calculations in the following tables and graphs preserve that distinction.

2.2 National patterns: the highlands–lowlands contrast

Ethiopia’s population geography has long been shaped by the interaction of elevation, climate, agricultural opportunity, settlement history, and infrastructure. Large portions of the central and northern highlands support dense and often long-established farming communities. Many lowland areas have lower average settlement densities and more mobile pastoral or agro-pastoral livelihoods. The distinction is meaningful, but it should not be treated as a rigid geographical divide: irrigated corridors, market towns, and growing lowland cities create local concentrations within sparsely settled regions.

The 2025 reconstruction illustrates the scale of regional variation. Oromia accounts for approximately 46.41 million residents in the scenario, and Amhara for 30.14 million. Their combined total of 76.56 million represents approximately 59.8% of the 127.94 million analytical total. Their demographic weight is therefore central to any national

distributional interpretation. Nevertheless, a region's share of national population should not be confused with the intensity of settlement in any particular woreda.

At the opposite end of the distribution, Gambella and Harari have scenario populations of 591,000 and 356,100 respectively. Harari's small land area yields an extremely high arithmetic density relative to the much larger Gambella. Afar and Somali have comparatively low region-wide densities, but the regional average does not describe seasonal concentrations near water points, roads, or settlements. An elevation-stratified population analysis would require a verified digital elevation model and gridded population estimates; the original chapter's illustrative elevation-band percentages cannot be interpreted as observations.

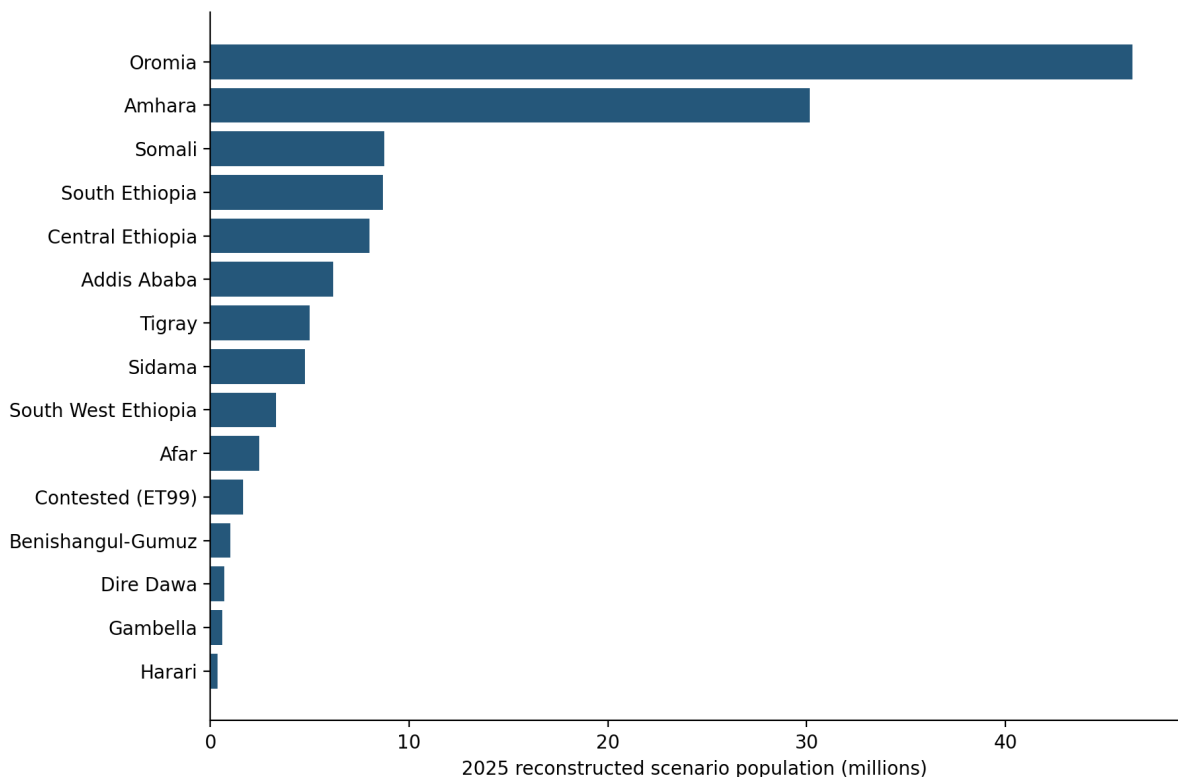


Figure 2.1. Regional population, Ethiopia, 2025 reconstructed scenarios (15 analytical geographies). Source: user-supplied regional reconstruction table; ET99 displayed separately. Values are scenario estimates, not census enumerations.

2.3 Administrative scale matters: region, zone, woreda, and kebele

Administrative geography determines what a population statistic means. Regional averages support broad resource allocation, but the zone, woreda, and kebele are often more relevant for local service delivery. The modifiable areal unit problem (MAUP) arises because a measured pattern can change when the same underlying population is aggregated into different spatial units. This is particularly important in Ethiopia, where

boundary changes and the creation of successor regions complicate historical comparisons.

This chapter adopts 15 analytical geographies: 14 current regions plus the separately reported contested area ET99. ET99 is not presented as a fifteenth officially recognized region; it is retained as an explicit analytical geography to prevent omission or double counting. The reconstructed total is 127,935,000 people. Population totals and land areas must be aligned to the same geography before density is calculated.

The accompanying table combines scenario population values from the first supplied screenshot with geographic areas from the second. Density is recalculated as population divided by area rather than transcribed from the healthcare table, whose density column appears to reflect a different population baseline in some rows. Values are rounded to the nearest whole person per square kilometer.

Table 2.1. Reconstructed population, area, and arithmetic density, 2025

Analytical geography	Population	Area (km ²)	People/km ²
Tigray	5,000,000	33,930	147
Afar	2,461,000	94,889	26
Amhara	30,144,000	155,638	194
Oromia	46,411,400	323,034	144
Somali	8,738,800	311,104	28
Benishangul-Gumuz	1,014,000	50,217	20
Central Ethiopia	7,987,000	15,106	529
Sidama	4,748,300	6,776	701
South West Ethiopia	3,285,400	39,035	84
South Ethiopia	8,684,000	48,292	180
Gambella	591,000	31,245	19
Harari	356,100	370	962
Addis Ababa	6,183,700	539	11,473
Dire Dawa	683,900	1,053	649
Contested (ET99)	1,646,400	18,698	88
Analytical total	127,935,000	1,129,926	113

Note. Tigray excludes ET99. The 15-geography total includes ET99 once. Areas are transcribed from the supplied healthcare-infrastructure screenshot; population values are from the supplied reconstruction screenshot. Density = population ÷ area. The reported national analytical density is area-weighted, not the average of regional densities.

Screenshot transcription and geographic boundaries should be checked against source files before publication.

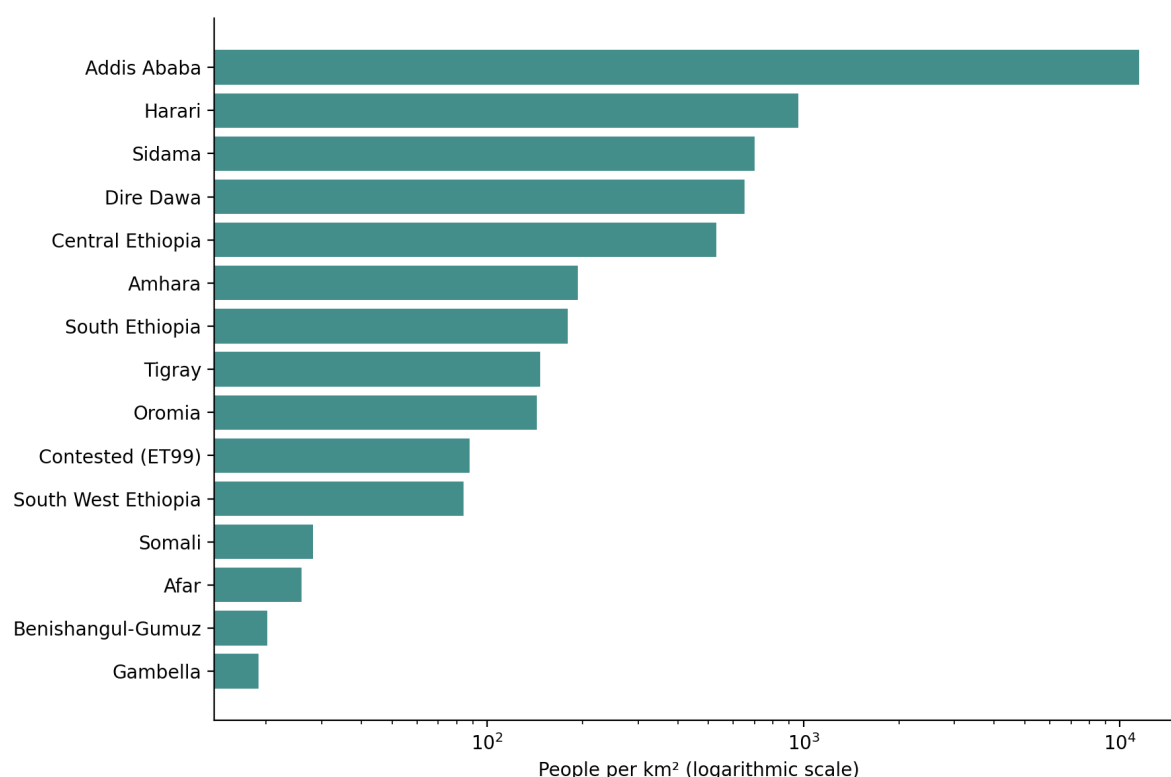


Figure 2.2. Arithmetic population density by analytical geography, 2025 scenario. Logarithmic horizontal axis is used to display both metropolitan and low-density geographies. Calculated from Table 2.1.

2.4 Urbanization and the settlement system

Ethiopia’s settlement system encompasses the dominant metropolitan role of Addis Ababa, established secondary cities such as Dire Dawa and Mekelle, and expanding smaller towns and transport corridors. Urban growth involves multiple processes: natural increase, rural-to-urban migration, administrative reclassification, and expansion of the built-up footprint. These processes cannot be distinguished from a single population snapshot, but they should be separated in any historical account of urbanization.

In the 2025 reconstruction, Addis Ababa has a scenario population of 6.18 million across 539 km², producing an arithmetic density of approximately 11,473 persons per km². Dire Dawa has 683,900 residents over 1,053 km², or about 649 persons per km². Harari’s corresponding figure is about 962 persons per km². These are administrative-area densities, not densities for comparable built-up footprints, and they should not be interpreted as direct measures of residential crowding or metropolitan extent.

The sharp difference between Addis Ababa and the other urban administrations makes the definition of the urban boundary especially consequential. Administrative jurisdictions and functional urban areas do not necessarily coincide. A defensible rank—

size plot of Ethiopian cities would require a harmonized city-level population dataset; the synthetic rank–size curves in the 2025 chapter have therefore not been carried forward.

Planning implications follow from this geography. Large regional populations create substantial absolute demand for schools, clinics, and infrastructure; high urban densities create concentrated demand within relatively small territories; and sparsely populated areas require service models that account for travel time and mobility. The next part develops rural, pastoral, migration, and displacement dimensions of this argument.

Data provenance and editorial limitations

The chapter’s original 2025 PDF labels many figures as illustrative placeholders. None of those synthetic series is reproduced here. Figures 2.1 and 2.2 are derived exclusively from the two screenshots supplied for this revision. The first screenshot supplies the 2025 reconstructed population scenarios; the second supplies land area. The published healthcare-table density values are not used as the calculation input. No elevation-specific, woreda-level, city-rank, or historical trend data were supplied for this installment, so those claims are treated conceptually rather than illustrated with invented observations.

PART II — Rural Settlements, Pastoral Mobility, Internal Migration, and Displacement

2.5 Rural settlement patterns and agricultural potential

Rural population distribution is inseparable from the geography of agricultural production. Ethiopia’s long-settled farming highlands contain dense networks of homesteads, villages, market towns, and cultivation plots. The spatial pattern is not uniform: soils, elevation, rainfall reliability, transport connectivity, irrigation, and historical settlement all shape where households live and how intensively land is occupied. A regional mean can conceal both heavily cultivated districts and sparsely inhabited terrain.

The original chapter distinguishes high-potential grain highlands, mid-altitude mixed farming, lowland irrigated or cash-crop pockets, and pastoral rangelands. These categories are useful as an interpretive framework, not as a measured classification of every woreda. To estimate the actual relationship between population and agricultural potential, one would need to overlay a consistent population surface with cropland, agricultural suitability, and land-cover layers from comparable years. The original illustrative density-versus-cropland scatterplot cannot establish an observed correlation.

The reconstructed 2025 population scenarios give an initial sense of scale. Oromia contains 46.41 million people and Amhara 30.14 million; together they account for about

59.8% of the 127.94 million analytical total. These large populations imply substantial aggregate demand for agricultural land, rural roads, water, schools, and primary care. Yet the regional figures alone cannot establish the share engaged in farming, the distribution of landholdings, or the extent of rural land fragmentation.

Rural density should therefore be interpreted jointly with agricultural carrying capacity and access to markets. Two districts with the same number of residents per square kilometer may face very different livelihood constraints if one contains productive cropland and the other contains steep slopes or drought-prone grazing land. In high-density farming areas, land scarcity and fragmentation may heighten livelihood pressure; elsewhere, remoteness rather than physical crowding can be the principal barrier to opportunity.

For public planning, the most useful next analytical unit is the woreda, supplemented where feasible by population grids and mapped cropland. A credible figure would show population per inhabited or cultivated square kilometer and identify its source year. No such woreda-by-cropland dataset was supplied for this revision, so a synthetic relationship has not been substituted.

2.6 Pastoralist and mobile populations

Pastoral and agro-pastoral population distribution differs from the relatively fixed settlement pattern often assumed by conventional population maps. In Afar, Somali, Borena and other lowland settings, household movements can respond to grazing conditions, water availability, rainfall, markets, conflict, and livestock health. A resident count at one reference date is useful for demographic accounting, but it may not describe the population physically present at a service location throughout the year.

In the 2025 reconstruction, Afar has 2.461 million residents across 94,889 km², or approximately 26 persons per km². Somali has 8.739 million across 311,104 km², or approximately 28 persons per km². These region-wide averages are low relative to densely settled agricultural regions, but they do not imply that people are evenly scattered or that no local population concentrations exist. Settlements and seasonal gathering points can create demand that a regional density map obscures.

The original chapter proposes analyzing vegetation greenness, water-point proximity, seasonal presence, and travel times. Those are legitimate research questions, but the original graphs are explicitly illustrative. Without observed seasonal mobility or environmental time series aligned to population presence, it would be misleading to publish monthly curves or claim a measured relationship between NDVI and human mobility.

The policy implications are concrete. Static population denominators can underestimate the temporary service load at seasonal gathering sites while overstating it in places experiencing out-migration. Mobile health teams, flexible school provision, vaccination campaigns, and drought response need information on seasonal movement as well as

usual residence. Where mobility data are collected, aggregation, informed safeguards, and avoidance of sensitive location disclosure are essential.

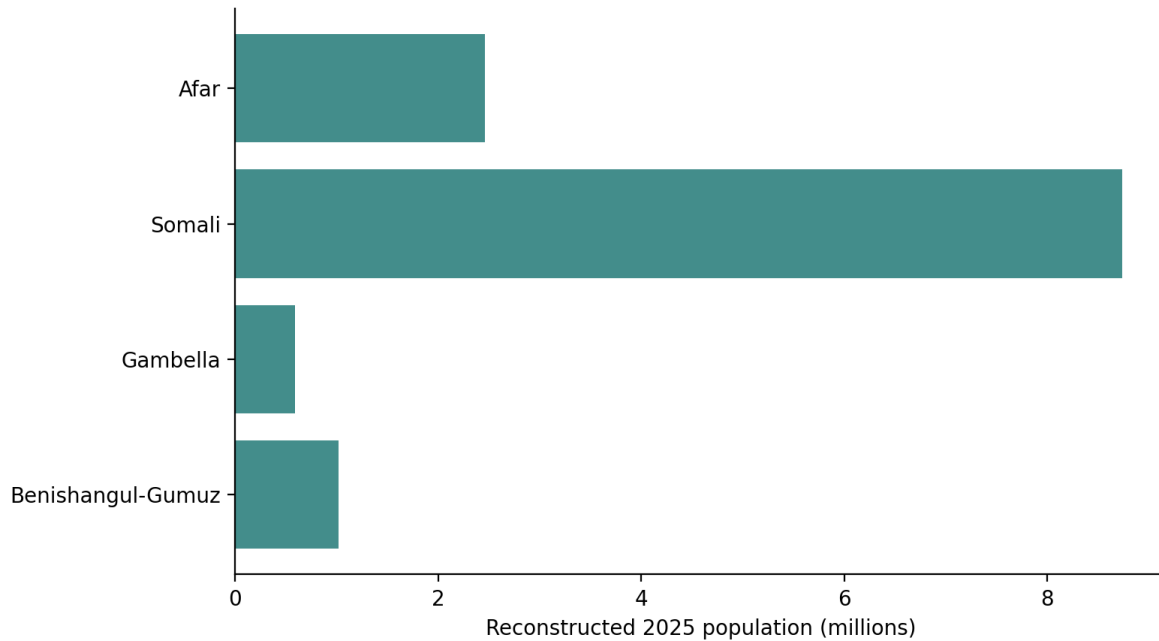


Figure 2.3. Reconstructed 2025 populations of four selected low-density analytical regions. Source: user-supplied regional population scenarios. These are regional resident benchmarks, not measured pastoralist populations or seasonal presence.

2.7 Internal migration and population redistribution

Population distribution changes through births, deaths, and migration, but administrative reclassification and boundary changes can also alter the reported location of residents without any physical move. Internal migration is particularly important for the development of metropolitan areas, secondary cities, education centers, commercial corridors, and agricultural frontiers. A sound account of redistribution therefore distinguishes population growth within places from movement between them.

The original chapter defines lifetime migrants as persons living outside their place of birth and recent migrants as those whose usual residence changed within a specified interval. In-migration and out-migration are directional flows; net migration is their difference. These indicators are not interchangeable. A large stock of lifetime migrants may reflect decades of movement, whereas a recent-flow measure can capture contemporary changes in labor demand or displacement.

Rural-to-urban migration can reshape age structure and service demand at both origins and destinations. Students and working-age adults may move toward cities for education and employment, while other movements connect rural districts, irrigation projects, and market centers. However, attributing a particular regional population total to migration

requires observed flows or a demographic accounting framework; the supplied 2025 scenario table contains neither.

For Ethiopia, comparisons are complicated by the creation of successor regions and changes in urban administrative status. An apparent gain in an urban jurisdiction may partly reflect annexation or reclassification. Before producing an origin–destination matrix or a regional net-migration graph, census or survey data must be harmonized to consistent boundaries, residence definitions, reference periods, and population denominators.

The original PDF includes illustrative net-migration bars and an illustrative age profile. They have been omitted because they do not represent observed migration counts. A future empirical version could draw on census place-of-birth and previous-residence questions or properly weighted survey estimates, with uncertainty and small-cell disclosure protections clearly documented.

2.8 Displacement, returns, and changing population presence

Forced displacement introduces another, sometimes rapid, source of population redistribution. Conflict, insecurity, environmental shocks, and other crises can change the number of people present in host communities over short periods. Internally displaced persons remain within national borders; refugees cross an international border in search of protection. Returnees are people who have returned after displacement, but a return does not necessarily mean that housing, livelihoods, and essential services have been restored.

A key measurement distinction is between a stock and a flow. The stock of displaced persons refers to those displaced at a specified date; new displacements and returns are movements during an interval. A stock cannot be interpreted as the cumulative total of every displacement event, because the same person may move repeatedly, return, or be counted under different operational systems. Site-based registration can also miss displaced households living within host communities.

Displacement has immediate implications for population denominators. A health center serving a host *woreda* may face an increase in demand that is not reflected in a pre-crisis population projection. Conversely, areas of origin may have fewer people present than their resident population estimate suggests. For planning, it is often necessary to display the baseline resident population and the most recent independently documented displacement stock separately rather than merging them into an apparently precise revised census count.

Humanitarian monitoring systems such as the International Organization for Migration’s Displacement Tracking Matrix and UNHCR operational statistics can help describe movements and protection needs. Their estimates have differing geographic coverage,

definitions, observation dates, and access constraints. The original chapter proposes hosting-pressure measures—such as displaced persons per 1,000 baseline residents—but no verified displacement observations were supplied here. Consequently, no displacement time series or hosting-pressure map is presented as empirical evidence.

Publication of displacement geography requires particular care. Precise locations can expose vulnerable communities to harm. Analytical products should use the least granular geography compatible with the planning purpose, explain the limitations of incomplete access, and coordinate with relevant protection and statistical authorities. Ethical safeguards are part of measurement quality, not an optional afterthought.

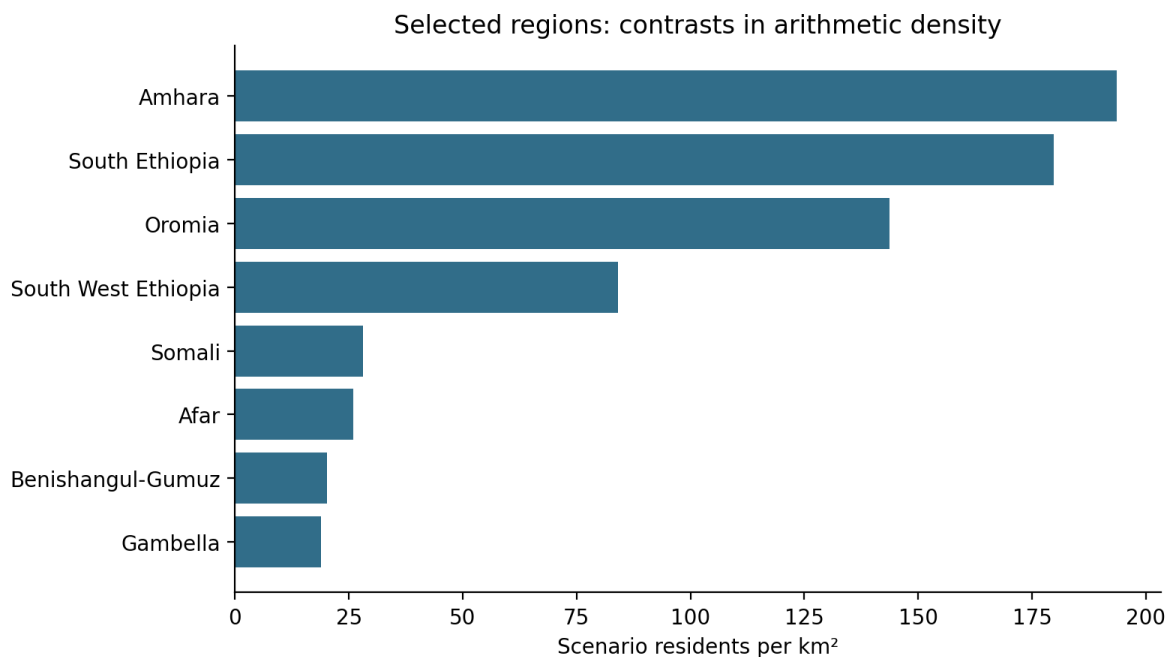


Figure 2.4. Arithmetic density contrasts in selected regions, 2025 reconstructed scenario. Density is population divided by region area; values describe administrative averages, not actual mobility, rural-only density, or displaced populations.

Part II synthesis: fixed denominators, mobile realities

Rural settlement, pastoral mobility, internal migration, and displacement demonstrate why a single map of population density cannot describe every dimension of where people live. The reconstructed regional scenarios establish a common accounting baseline, while land cover, mobility records, census migration questions, and humanitarian assessments answer different questions about land use and changing presence.

For Ethiopia, the central methodological requirement is to keep these quantities distinct: resident population, people present at a particular time, migration flows, and displaced-person stocks. They can be analyzed together, but not substituted for one another. This distinction will become particularly important in Part III, which examines accessibility, gridded population, night-time lights, and environmental exposure.

PART III — Accessibility, Gridded Population, Night-Time Lights, and Environmental Exposure

2.9 Accessibility, catchments, and service areas

Population distribution becomes a planning variable when the location of residents is considered alongside the location of services. In Ethiopia, straight-line distance is often an inadequate measure of access: escarpments, road quality, rivers, seasonal rainfall, and the availability of transport all affect the time needed to reach a clinic, school, or market. Two households equally distant from a health center can face markedly different journeys. A defensible accessibility analysis therefore measures travel time along realistic networks or friction surfaces, rather than assuming that geographic proximity guarantees access.

A service catchment is the population that can plausibly reach a facility within a defined time or cost threshold. Isochrones delineate areas accessible within, for example, 30, 60, or 120 minutes. These thresholds are analytical choices, not universal standards. Their interpretation depends on the service being studied, mode of travel, and the conditions of the local transport system. A hospital catchment also differs from that of a health post: referral capacity, staff, operating hours, and service readiness affect practical access beyond distance alone.

The reconstructed 2025 population benchmarks provide an essential regional denominator for describing potential demand. Oromia contains 46.41 million people, Amhara 30.14 million, and Somali 8.74 million in the supplied scenarios. These totals do not reveal how many residents are within a one-hour journey of care. That percentage requires geocoded facility records, a travel-cost model, and a spatial population surface aligned to the same year. The original chapter's illustrated 60- and 120-minute coverage percentages are not observed estimates and are deliberately omitted.

For policy, the relevant measure is not simply how many facilities exist, but how many people can reach functioning services. Location-allocation models can compare the additional population served by alternative facility sites, while population-weighted travel times can identify underserved clusters. All such results require sensitivity checks for road assumptions, seasonal conditions, security restrictions, and the reliability of facility coordinates.

2.10 Gridded population and built-environment layers

Administrative averages summarize a region but conceal where its inhabitants actually reside. A gridded population surface distributes estimated residents across small geographic cells and allows population to be intersected with roads, settlements, hazards, or facility catchments. WorldPop, the Global Human Settlement Layer (including GHS-

POP), and other population products use different input data and modeling approaches. They should not be treated as interchangeable observations or as replacements for a census.

In Ethiopia, this distinction matters especially for geographically extensive lowland regions and rapidly expanding urban fringes. A region may have a low average density while containing densely settled market towns and river corridors. Conversely, a high regional density does not imply equal crowding throughout the territory. The supplied 2025 reconstruction, combined with regional land areas, yields approximate arithmetic densities of 26 people/km² in Afar, 28 in Somali, 144 in Oromia, 194 in Amhara, and more than 11,000 in Addis Ababa. These are administrative ratios, not grid-cell estimates.

Gridded products can support population exposure calculations and spatially explicit service planning, but their accuracy depends on settlement detection, census calibration, displacement patterns, and model vintage. A product calibrated to an older census may miss recent expansion or population movement. Researchers should report the exact product, release, resolution, reference year, and any rescaling used to reconcile its totals with the chosen population benchmark.

Built-up layers, including GHSL and the World Settlement Footprint, add information about settlement morphology. Built-up area is not equivalent to residential population: industrial sites, transport facilities, and unoccupied buildings may appear in imagery. Combining built-up maps with gridded estimates is valuable precisely because the two measure related but different aspects of settlement.

2.11 Night-time lights and economic density

Satellite observations of night-time illumination provide an additional lens on the geography of settlement and economic activity. VIIRS radiance products can identify lit urban cores, transport corridors, and changes in electrified areas. Earlier DMSP-OLS records provide historical coverage, but differences in sensor design and calibration complicate direct comparisons across eras. Night-time light intensity should be interpreted as a proxy rather than a direct measure of population, gross domestic product, or household welfare.

The relationship between illumination and population is especially heterogeneous in Ethiopia. A densely settled rural district may remain dim because household electricity access is limited, while an industrial facility or major road junction may produce a strong light signal despite having relatively few permanent residents. Differences in energy access, lighting technology, and electricity reliability can generate changes in brightness unrelated to migration or population growth.

An empirical comparison would align annual VIIRS composites with contemporaneous population grids and built-up boundaries, mask unstable observations, and test relationships separately for urban and rural areas. A lights-per-person statistic may help compare places but must not be interpreted mechanically as productivity or income. The

original chapter's night-light scatterplots are illustrative; no verified radiance dataset accompanied this revision, so no invented brightness series has been introduced.

2.12 Environment, climate hazards, and population exposure

Population distribution determines who is exposed to floods, drought, landslides, heat, and other environmental hazards. Exposure is the intersection of people and a hazard footprint; it is not synonymous with vulnerability or realized harm. A floodplain may contain a large exposed population but relatively strong protective infrastructure, while a smaller remote settlement may face greater consequences because evacuation routes, health services, or emergency supplies are inadequate.

Ethiopia's diverse terrain and livelihoods require hazard-specific analysis. Flood exposure along rivers and in urban drainage basins calls for different spatial inputs from drought exposure in pastoral lowlands or landslide risk in steep highland terrain. The temporal dimension is equally important: annual population benchmarks cannot by themselves represent seasonal pastoral movements, temporary displacement, or daily urban commuting.

A defensible population-at-risk estimate overlays a validated hazard map with a population surface for the same reference period and reports the threshold used to classify exposure. Uncertainty arises from hazard modeling, population allocation, geographic resolution, and administrative boundaries. Results should distinguish absolute counts from percentages: a populous region may have the largest number exposed even if a smaller region has the highest exposed share.

The supplied regional scenarios can establish the overall population denominator, but cannot determine the fraction living in flood zones, drought-affected areas, or landslide-prone cells. Such proportions require observed or modeled hazard footprints and suitable geospatial population data. Consequently, the original synthetic hazard-exposure charts are excluded from this installment.

PART III methodological note

The population figures are user-supplied 2025 reconstruction scenarios for 14 current regions plus separately reported ET99. Density is population divided by regional land area. The two figures are derived from those supplied inputs; they do not estimate travel-time access, satellite radiance, or hazard exposure. All analyses requiring external geospatial layers remain explicitly conditional on obtaining and validating those data.

PART IV — Inequality, temporal change, estimation, boundaries, and policy

2.13 Inequality and Vulnerability Mapping

Population distribution becomes a public-health concern when geography is linked to unequal exposure, resources, and opportunity. A map showing where people live is not, by itself, a map of deprivation. Regional density may indicate pressure on land, housing, transport, and facilities, but it does not reveal household poverty, age structure, disability, disease burden, or the quality of services. Each of those outcomes requires its own observed indicator and denominator.

The 2025 reconstruction reveals pronounced differences in the scale of regional populations. Oromia (46.41 million) and Amhara (30.14 million) together account for about 59.8% of the 127.94 million analytical total. This concentration matters for the absolute number of residents potentially affected by a policy or disruption. Yet a region with fewer inhabitants can have a greater share of vulnerable residents, more severe geographic isolation, or a higher per-capita service deficit. Population share should therefore be interpreted alongside measures of need rather than substituted for them.

A defensible vulnerability atlas would combine the population surface with age-specific counts, poverty and deprivation estimates, disability indicators, access to essential services, and hazard exposure. The analyst must distinguish absolute burden (number of affected people) from relative burden (percentage of a defined population). A populous region may have the largest absolute caseload even when another region has a higher prevalence. Both measures are needed to allocate resources fairly.

For maternal and child health, suitable examples include the number of women of reproductive age, children under five, births requiring services, and the proportion of households beyond a defined travel-time threshold. Where survey-based rates are applied to reconstructed populations, the resulting counts are modeled estimates; sampling error, population uncertainty, and any mismatch between survey and geographic boundaries must be made explicit. Woreda-level estimates should not be inferred mechanically from regional means.

2.14 Change Over Time: Interpreting Redistribution Without Inventing Trends

The original chapter proposes comparison across 2007, 2017/2019, and the 2020s. That is an important analytical objective, but the supplied 2025 regional scenario table is a single-period reconstruction. It cannot, on its own, establish how much any current region grew, which woredas experienced the fastest growth, or how much change was attributable to migration, natural increase, or administrative reclassification.

Temporal comparisons in Ethiopia are complicated by the reorganization of the former Southern Nations, Nationalities and Peoples' Region into successor regions, changes in lower-level boundaries, and the separate treatment of ET99 in the current analytical geography. Directly comparing counts reported under unlike boundaries can create spurious growth or decline. A valid trend requires population estimates reconstructed to a common geography and consistent definitions of residence and coverage.

Decomposing observed change

Conceptually, population change between two dates reflects births minus deaths, plus in-migration minus out-migration, with adjustments for boundary changes and enumeration differences. These components should be estimated independently wherever possible. Built-up land expansion, for example, can indicate settlement growth but is not identical to population growth; urban status changes may raise an administrative urban count without anyone moving. Satellite products can strengthen interpretation, but only when their reference dates and estimation methods are documented.

For this revision, a historical regional growth chart has intentionally not been generated: no harmonized, verified time series for all 15 analytical geographies was supplied. The 2025 scenario is instead used as a transparent current benchmark for the spatial comparisons in this installment.

2.15 Methods Corner: Small-Area Estimation and Spatial Smoothing

National and regional surveys are indispensable for describing fertility, mortality, household welfare, and service use, but their samples may be too small to support stable estimates for individual woredas or kebeles. Small-area estimation (SAE) addresses this problem by combining direct survey evidence with auxiliary information such as census characteristics, administrative records, settlement layers, and environmental covariates. Its purpose is to improve precision while preserving an honest accounting of uncertainty—not to manufacture local observations.

A practical workflow begins by defining the target indicator and eligible population, identifying the survey design and direct estimates, and assembling auxiliary variables available consistently for the same units and reference period. Model-based predictions are then validated against held-out observations or independent benchmarks. Analysts should examine sensitivity to covariate selection, spatial assumptions, boundary vintages, and population denominators. Estimates should be published with uncertainty intervals or other suitable measures of precision.

Density is not a small-area estimate

Dividing the reconstructed regional population by the reported land area produces an average regional density. It does not reveal within-region population clusters, and it does not provide an estimate for every woreda or raster cell. Addis Ababa's average density,

for example, is substantially higher than that of most regions, while its internal distribution remains heterogeneous. Conversely, sparse regional averages can conceal dense towns, irrigated corridors, and temporary concentrations of mobile populations.

2.16 Data Quality, Boundaries, and Reconciliation

Reliable spatial demography depends on geographic consistency as much as numerical precision. The author's 2025 framework includes 14 current regions and ET99 as a separately counted contested analytical area. This is an explicit accounting convention. It should not be read as a definitive adjudication of territorial status or assumed to match every government or international dataset. Boundary files, population benchmarks, and area calculations must refer to the same geographic definitions.

For each region, the present chapter pairs the 2025 scenario population with the area transcribed from the healthcare-infrastructure table. Density is recalculated from these two inputs rather than borrowed from that table's earlier population-per-square-kilometer column, which was based on a different population benchmark. The analytical total is 127,935,000 residents over 1,129,926 km², yielding approximately 113.2 persons per km². This national-scale average should not be confused with the typical density experienced by an individual resident.

A reproducible reconciliation protocol

Before using these figures for a published regional atlas, the underlying boundary geometry should be checked for topology, overlaps, omissions, coordinate reference system, and land-area calculation. Regional totals should sum to the national analytical total; ET99 should be excluded from the 14-region subtotal and included once in the 15-geography total. Labels such as Central Ethiopia, South Ethiopia, South West Ethiopia, and Sidama should be standardized consistently across tables, maps, and citations.

The most important uncertainty is not the arithmetic of density, which is straightforward, but the evidentiary status of the underlying population and area inputs. The 2025 numbers represent a reconstruction with region-specific assumptions. The chapter should preserve those assumptions in a data appendix and avoid presenting the figures as an official census or a directly observed count.

2.17 Policy Applications: Turning Distribution into Planning Evidence

Population geography informs decisions about where to place schools, health centers, roads, water systems, and emergency resources. The appropriate metric varies by decision. For national budget allocation, the number of residents and their age composition may be central. For facility siting, travel time, referral routes, service capacity, and the location of settlements matter more than regional density alone. For

climate adaptation, the relevant quantity may be the population exposed to a specified hazard under a defined scenario.

The 2025 reconstruction illustrates why a single national strategy cannot assume homogeneous settlement conditions. Oromia and Amhara dominate the absolute population denominator, while densely settled Central Ethiopia and Sidama pose different land-use and service-network questions. Afar, Somali, Gambella, and Benishangul-Gumuz have comparatively low average densities, making distance, seasonal mobility, and network accessibility especially important considerations. These are planning hypotheses grounded in broad spatial contrasts, not measured estimates of service shortfalls.

From maps to accountable decisions

A decision-ready atlas should make its logic traceable: identify the planning question, select the relevant population at risk, map the service or hazard, calculate an interpretable measure of need, assess uncertainty, and test whether the ranking of priority areas changes under alternative assumptions. It should also distinguish short-term operational population presence from usual-residence counts, particularly where displacement or pastoral mobility affects demand. Publishing source metadata, methods, and boundary vintages allows planners to revise the analysis when better evidence becomes available.

The central conclusion of this chapter is that population distribution is more than a cartographic description. It is a framework for understanding how the location of people intersects with access, vulnerability, environmental exposure, and public investment. Ethiopia's emerging regional reconstruction and spatial datasets offer a stronger foundation for this work—provided that modeled populations, observed indicators, and geographic assumptions remain clearly distinguished.

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