

Environmental_and_socio-economic_impacts_of_the_trans_african_highway_development_in_Sierra Leone:_a_case_study_of_the_Bandajuma – Gendema_corridor

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Abstract

The Trans-African Highway (TAH) network represents a transformative infrastructure initiative aimed at enhancing regional integration and economic development across the African continent. This study examines the environmental and socio-economic implications of the Sierra Leone section of the TAH, specifically the Bandajuma – Gendema corridor connecting to the Mano River Bridge on the Liberian border. Drawing on a comprehensive review of legal frameworks, resettlement policies, natural environment characteristics, and community profiles, the potential impacts of road development on six chiefdoms in the eastern uplands of Pujehun District were analyzed. The findings reveal a complex interplay between infrastructure development and socio-environmental considerations: while improved connectivity promises significant economic benefits - including enhanced market access, reduced transport costs, and increased agricultural productivity - it also poses risks to sensitive ecosystems, including the Weikaymah Forest Reserve and the Moa River corridor. The study identifies critical gaps in baseline environmental data and emphasizes the importance of conducting a comprehensive Environmental, Social and Health Impact Assessment (ESHIA) prior to project implementation. Drawing lessons from recent infrastructure completions in the district, including the 2026 commissioning of the Bandajuma-Pujehun Road and Julius Maada Bio Bridge, this analysis underscores the need for robust institutional frameworks, transparent stakeholder engagement, and effective mitigation measures to ensure sustainable development outcomes. The findings contribute to the broader discourse on balancing infrastructure development with environmental conservation and social equity in post-conflict, developing nations.

1 Introduction

1.1 The Trans-African Highway Network: a continental vision

The Trans-African Highway (TAH) network represents one of Africa's most ambitious infrastructure initiatives, conceived by the United Nations Economic Commission for Africa (UNECA), the African Development Bank (ADB), and the African Union to enhance continental integration through improved connectivity (African Development Bank, 2023). The network comprises nine transcontinental routes spanning over 60,000 kilometers across the continent, designed to facilitate trade, reduce transport costs, and promote socio-economic development among member states (Acemoglu et al., 2013). The Trans-West African Coastal Highway (TAH 7), extending from Mauritania to Nigeria with feeder roads linking landlocked countries such as Mali and Burkina Faso, is a critical component of this continental vision (Okello, 2011). The Trans-West African Coastal Highway (TAH 7) is a vital 4,010-kilometer (2,490-mile) transnational roadway project linking 12 West African coastal nations from Mauritania to Lagos, Nigeria, designed to boost regional integration, trade, and transport efficiency. The overview and scope of the project include:

- **Route extent:** Connects coastal countries from Nouakchott (Mauritania) down to Lagos (Nigeria).
- **Feeder links:** Includes connections into landlocked nations like Mali and Burkina Faso.

- **Current status:** Roughly 80% complete, with major ongoing works focused on missing or sub-standard segments, notably the flagship Abidjan-Lagos Corridor.

The key economic goals of this project include:

- **Trade Integration:** Reduces severe border-crossing delays and transit times for freight movers.
- **Corridor Development:** Unlocks economic corridors, connecting major hubs like Abidjan, Accra, Lomé, Cotonou, and Lagos via multi-lane highways.

Sierra Leone's participation in the TAH network is primarily realized through the Freetown–Monrovia corridor, which connects the country to Liberia and, by extension, to the broader West African road network (Government of Sierra Leone, 2026). This corridor traverses the southern and eastern regions of the country, passing through districts with significant agricultural potential but limited infrastructure, including Pujehun District (Government of Sierra Leone, 2008, revised in 2010).

1.2 The Bandajuma–Gendema corridor: a critical missing link

The Bandajuma–Gendema road corridor represents a strategically significant section of Sierra Leone's portion of the TAH network. This 103 km road, extending from Bandajuma in Sowa Chiefdom to Gendema on the Liberian border in Sorogbeima Chiefdom, serves as the primary land link between Sierra Leone and Liberia's southeastern region. The corridor is of critical importance for several reasons (Government of Sierra Leone, 1974):

First, the road shortens the distance to the Mano River Bridge, beyond which Liberia commands comparatively better road infrastructure, creating attraction for movements of goods and services across the border. Second, the corridor facilitates access to regional and international markets, with periodic market activities in Bandajuma, Njaluahun, Turela, Gofo, and Gendema contributing to local and regional trade. Third, the road provides essential connectivity for six chiefdoms in the eastern uplands of Pujehun District: Sowa, Kpanga Karbonde, Pejeh, Barri, Makpele, and Sorogbeima.

However, the current condition of the road presents significant challenges. Seasonal difficulties, particularly during the six-to-seven-month rainy season, render some swampy areas impassable. The manually operated ferry crossing the Moa River creates a serious transport bottleneck, causing delays in transporting agricultural products and, in some cases, destruction of goods during loading and unloading operations. Transport costs remain prohibitively high despite relatively short distances to destinations, with motorcycles often proving more effective than motor vehicles, albeit at higher costs. The occurrence of deep mantles of soft weathered rocks necessitates spot rehabilitations throughout the year.

1.3 Recent infrastructure developments in Pujehun District

The significance of road infrastructure in Pujehun District has been underscored by recent developments. In April 2026, President Julius Maada Bio commissioned the 25 km Bandajuma–Pujehun

Road, the Julius Maada Bio Bridge, and the newly constructed Gobaru Monument, while also launching the construction of the Pujehun–Gbondapi Road as part of ongoing infrastructure and food security initiatives (Government of Sierra Leone, 2026). The President described these projects as "pathways to dignity," emphasizing their role in improving access to health facilities, schools, markets, and economic opportunities for citizens (Government of Sierra Leone, 2026; Sierra Leone Roads Authority, 2023).

The completed projects have delivered measurable benefits. Travel time between Bo and Pujehun has been reduced from several hours to approximately one hour, described as transformative for trade and mobility (Government of Sierra Leone, 2026). Over the last six years, approximately 140 km of roads and eight bridges have been constructed in Pujehun District, with the Julius Maada Bio Bridge addressing a long-overdue infrastructure need that had remained unaddressed for over 90 years (Government of Sierra Leone, 2026; Sierra Leone Roads Authority, 2023).

1.4 Study objectives and scope

This study examined the environmental and socio-economic context of the Bandajuma–Gendema corridor within the broader framework of Sierra Leone's TAH development. The specific objectives were:

1. To review the legal and institutional framework for environmental management relevant to road development in Sierra Leone;
2. To analyze resettlement policies and their implications for project-affected communities;
3. To characterize the natural environment of the corridor zone of influence;
4. To assess the socio-economic profile of communities likely to be affected;
5. To identify environmental sensitivities and potential impacts; and
6. To propose recommendations for sustainable infrastructure development.

study area encompasses the Bandajuma–Gendema road corridor, covering six chiefdoms in the eastern uplands of Pujehun District. The analysis is informed by a review of relevant legislation, policies, and institutional frameworks, as well as secondary data on environmental and socio-economic characteristics of the project area.

2 Legal and institutional framework

2.1 Environmental governance in Sierra Leone

Sierra Leone's environmental governance is primarily structured around the Environmental Protection Agency (EPA-SL), established by the EPA Act of 2008 and subsequently amended in 2010, which placed the Agency in the Office of the President (Government of Sierra Leone, 1989). The EPA-SL has the mandate to regulate, ensure compliance, enforce, and advise government on all environmental matters,

serving as the national focal point for both domestic and international environmental issues (Government of Sierra Leone, 1989).

The Agency's functions, as outlined in Section 23 of the EPA Act, encompass several critical responsibilities relevant to road development projects. These include environmental policy making and planning, overall coordination of environmental management efforts across government institutions and international organizations, enforcement and compliance through legislative proposals and guidelines, environmental impact licensing through review and approval of assessments, and ensuring integration of environmental concerns in national planning (Government of Sierra Leone, 1989).

The EPA Act establishes the legal requirement for Environmental Impact Assessments (EIA) for projects that could have significant impacts on the environment, with road construction specifically listed among activities requiring EIA licensing (Government of Sierra Leone, 1989). The Environmental Protection Agency (EPA) Act of 2008 sets the procedure and guidelines requiring project proponents to prepare their own ESIA or Environmental Statement for review and approval by the Agency. The EIA process typically takes 2-3 months, involving initial screening, public consultation, and review by the EPA Board before issuance of the environmental license (Government of Sierra Leone, 1989).

2.2 Relevant legislation and policies

Several legislative and policy instruments provide the framework for environmental management in road development contexts:

The Environmental Protection Agency Act (2008/Revised 2010) establishes the legal foundation for environmental governance, including mandatory preparation of Community Development Action Plans (CDAP) for corporate social responsibility fulfillment and Resettlement Action Plans (RAP) for project-affected persons (Government of Sierra Leone, 1989).

The Forestry Act (1988) and Regulations (1989) promote forest preservation through protection, sustainability of forest products, and abatement of indiscriminate clearing of forest land (Government of Sierra Leone, 1989).

The Factories Act (1974) addresses workplace safety, health, and security, including provisions for protective clothing and safe machine operation (Government of Sierra Leone, 1989).

The Local Government Act (2003) establishes local councils as the highest political authority in localities, responsible for promoting development, initiating infrastructure programs, and approving chiefdom budgets (Government of Sierra Leone, 1989).

The Integrated National Waste Management Policy (2012) provides the framework for integrating waste management and environmental considerations into decision-making, ensuring hazardous waste is properly managed and disposed of in accordance with regulations (Government of Sierra Leone, 1989).

The Integrated Vector Management Strategic Plan (2012) elaborates the country's direction for implementing integrated vector management strategies for the control of neglected tropical diseases (Government of Sierra Leone, 1989).

2.3 International and sub-regional agreements

Sierra Leone is a signatory to several international conventions that are relevant to road infrastructure development:

The United Nations Convention to Combat Desertification (UNCCD) addresses uncontrolled clearing of vegetation and tree cover (Government of Sierra Leone, 1989).

The Convention on Biological Diversity (CBD) seeks to prevent destruction of biological diversity and protect endangered species (Government of Sierra Leone, 1989).

The Ramsar Convention (1971) provides for the conservation and sustainable utilization of wetlands, recognizing their fundamental ecological functions and economic, cultural, scientific, and recreational value (Government of Sierra Leone, 1989).

The Stockholm Convention on Persistent Organic Pollutants (2001) recommends elimination or restriction of production and use of POPs and management of stockpiles and wastes containing POPs (Government of Sierra Leone, 1989).

The Montreal Protocol requires parties to ban exports and imports of ozone-depleting substances, with developing countries required to eliminate CFC consumption by January 2010 (Government of Sierra Leone, 1989).

2.4 World Bank safeguard policies

The World Bank's safeguard policies, which often apply to infrastructure projects in developing countries, include several relevant provisions:

- ***Environmental Assessment (OP 4.01)***: Establishes policy and procedures for environmental assessments to ensure projects are environmentally and socially sound (Government of Sierra Leone, 1989).
- ***Involuntary Resettlement (OP 4.12)***: Describes procedures when involuntary resettlement is unavoidable (Government of Sierra Leone, 1989).
- ***Biological Diversity (OD 4.00)***: Promotes conservation of endangered plants, animal habitats, and protected areas (Government of Sierra Leone, 1989).
- ***Cultural Properties (OD 4.25)***: Provides for protection of archaeological sites, historic monuments, and historic settlements (Government of Sierra Leone, 1989).

The African Development Bank (AfDB), which has financed road projects in Sierra Leone, similarly requires adherence to environmental and social standards, including mandatory ESIA requirements and stakeholder engagement (Government of Sierra Leone, 2012A). The harmonization of social norms and standards on the Trans-African Highway Network emphasizes that road design and construction should be preceded by risk assessment, including professionally conducted environmental and social impact assessments, and that such studies should be disclosed prior to the beginning of construction (Government of Sierra Leone, 1989).

3 Natural environment of the Bandajuma - Gendema corridor

3.1 Climate and weather conditions

Pujehun District experiences a tropical climate with distinct wet and dry seasons. The district commands relatively high soil moisture due to a longer rainy season of seven to eight months, with vegetation cover ranging from various levels of forestry growth to primary climatic climax varieties (Government of Sierra Leone, 1989). The district's location as the southernmost tip of the country contributes to its distinctive climatic characteristics. The rainy season coincides with an annual "hungry season" when foodstuffs are typically scarce, making road access crucial for food distribution.

The seasonal rainfall patterns are responsible for considerable fluctuation in river flows, with the upper courses of rivers in the plateau region experiencing a vital range of 2 m to 4 m and experiencing significant flooding. These climatic conditions create particular challenges for road infrastructure, with seasonal difficulties rendering some swampy areas impassable during the six-to-seven-month rainy season.

3.2 Hydrographic network and water resources

The project area is characterized by a dense drainage network, with the flows of the Waanje and Moa rivers of primary interest and the Sewa of secondary interest. The Moa River is a significant waterway traversed by a manually operated ferry at Moala, providing an essential link for vehicles without which the chiefdoms east of the river would be effectively cut off from the rest of the district. The ferry creates a serious transport bottleneck during the rainy season when the old manual ferry breaks down or cannot survive high water levels.

Along the route, there are several sources of surface water used for all domestic purposes, including drinking, except where wells are present and form the source of potable water. The quality of water from these sources is typically low, with pH ranging from about 5.2 to over 6.0. Suspended sediment concentration can be high, especially in major rivers during the rainy season. The water pH can range from 6.4 to 7.6, which is within the permissible limits of 6.5 to 8.5 recommended by the World Health Organization for potable water (Government of Sierra Leone, 1989).

Many people living along and near the alignment live below the poverty line and cannot afford pipe-borne water, making spring and well water an important resource for local communities. Measures must be put in place to ensure that these facilities are replaced if the road directly or indirectly affects them (Government of Sierra Leone, 1989).

3.3 Geomorphology, geology, and hydrogeology

The road from Bandajuma to Gendema at the Mano River Union Bridge passes through a series of deep layers of metamorphic rocks of Precambrian systems, with surfaces of gneiss and clay sandstones. Erosive activities have resulted in a landscape of uplands and relatively wide bottom wetlands. There are very few isolated outcrops of Gabro in Vaama in Barri Chiefdom and within the Weikayma Forest Reserve in Sorogbeima Chiefdom.

The general well-drained nature of the soils of the interfluves could lead to considerable infiltration of surface run-off. Though the vegetation is depleted from its virgin state, the vegetal ground cover in most areas suffices to give reasonable protection to the soil, allowing water to be captured and stored at ground water given the clayey nature of the lower soil horizons.

3.4 Vegetation and ecosystems

The natural terrestrial vegetation cover of the project area comprises broad-leaf high forest that has been considerably modified by human activity, largely in connection with agricultural development. There are sections of thick forests (3.5 km), long stretches of tall bush of over 20 years fallow, lower bushes of 5 to 10 years fallow, and extensive plantations along the route. The forests along this route have varieties of hardwood, with no sacred groves, protected forests, or rare plant species identified.

The most distinctive resource features along the route include coffee and cacao plantations with kola trees as cover crops. There are also vast oil palm and rubber plantations, with cassava and vegetables intercropped with upland rice. Up to 3,000 acres of rubber plantations exist along this road, alongside coffee estates with kola nut trees as cover crops, oil palm plantations, and cassava farms (Government of Sierra Leone, 1989).

Three varieties of palm groves are present in the area: the oil palm (providing palm oil, wine, and brooms), the swamp palm (providing thatch for roofing houses and mats), and the raffia palm (providing furniture, piassava products, and raffia). Short broad-leaved trees within this ecology are exploited for wrapping and packaging kola nuts exported to Guinea.

The Weikaymah Forest Reserve, bordering the road for about 3 km, is not a nationally protected area but represents a significant forest resource in the corridor. The reserve area runs about 3.5 km along the road and ends close to Wonde village. While the project corridor will not invade this reserve, appropriate clauses in tender documentation would prevent the contractor from invading the reserve or otherwise disturbing the forest.

3.5 Wildlife and habitats

The wildlife population and native wildlife habitat have been impacted by various human activities including subsistence agricultural practices and hunting, resulting in reduced wildlife diversity in the area along the project road (Government of Sierra Leone, 1989). The project road corridor is neither contiguous with, nor in close proximity with any nationally protected areas like National Parks, Wildlife Reserves, or Controlled Hunting Areas.

The Weikaymah Forest Reserve, bordering the road for about 3 km, is not a nationally protected area, and no significant wildlife habitats or endangered animal species have been identified in the project area. No wildlife sanctuaries or protected site habitats have been identified in the study corridor. Destruction of valuable wildlife habitats and impediments to wildlife movements is not expected during construction or operation of the project road (Government of Sierra Leone, 1989).

4 Socio-economic context of the corridor

4.1 Administrative structure and land tenure

The project area is within Pujehun District, Southern Province, comprising fourteen chiefdoms. The road construction in the Pujehun District corridor covered six chiefdoms: Sowa, Karbonde (the then Kpanga Karbonde), Pejeh, Barri, Makpele, and Sorogbeima, with all but one (Karbonde) chiefdom headquarter towns situated along the proposed main route (Government of Sierra Leone, 1989).

Pujehun town serves as the chiefdom headquarters of Kpanga and, simultaneously, as the district headquarters town of Pujehun District. Kpanga Chiefdom had an estimated population of approximately 45,771 in the 2021 Population and Housing Census. Pujehun is the principal urban, administrative, commercial, and service centre in the district and has substantially more facilities and services than most other chiefdom headquarters. These include the main district hospital, which provides services supported by medical doctors, as well as government offices, educational institutions, commercial establishments, financial and other private-sector services. Pujehun has also historically benefited from pipe-borne water infrastructure and a relatively high concentration of NGO and development-agency interventions. Given its dual role as chiefdom and district headquarters, Pujehun serves as a major service hub for populations beyond Kpanga Chiefdom.

The administrative structure follows a hierarchical system of traditional authorities under the Paramount Chief (Reed and Robinson, 2013). Paramount Chiefs are elected for life by Chiefdom Councillors, who are elected by residents of their chiefdoms. They are responsible for general administration, maintenance of law and order, and chiefdom development through a hierarchical system of traditional authorities (Government of Sierra Leone, 1989). Each chiefdom is divided into Sections, each headed by a Section Chief, with villages/towns headed by a Town Chief.

Land along the route is owned by households and/or community. Lengthy discussions over a wide range of issues hinging on land ownership, community rubber plantations, and cash crop plantation initiatives are required before implementation of road construction. In many locations there are family disputes on

rubber plantations, mostly related to local land ownership interpretations among farming communities (Government of Sierra Leone, 1989).

4.2 Demographic profile

The six chiefdoms affected by the project have an estimated population of 238,106 in 2021 Population and Housing Census. The female population maintains a slight edge of 1.95% over males. Population distribution favors movement towards chiefdom headquarters with more basic service locations, including potable water supplies, health centers, schools, agricultural business centers, banks, periodic market centers, mining areas, police and military barracks, and nodal points in the transport network.

Key population and socio-economic characteristics of the affected chiefdoms include:

- **Barri Chiefdom:** The chiefdom had an estimated population of 50,742 in the 2021 Population and Housing Census, with Potoru serving as the chiefdom headquarters. Potoru is an important local service and commercial centre with an estimated population of about 7,500 inhabitants. The town has approximately 18 hand-pump wells, of which six are operational, as well as a police station, health centre, secondary/Islamic school, and several primary schools. Barri is endowed with significant agricultural resources, including an estimated 3,000 acres of rubber plantations, together with coffee, kola nut, and oil-palm plantations. Tiwai Island, an important tourism, biodiversity conservation, and research destination, is located approximately 14 km east of Potoru (Government of Sierra Leone, 1989).
- **Makpele Chiefdom:** Makpele had an estimated population of 61,613 in the 2021 Population and Housing Census, with Zimmi as its chiefdom headquarters. Zimmi is one of the largest and most developed chiefdom headquarters along the route and serves as an important commercial and administrative centre. Facilities and services include a community bank, customs post, Ministry of Mines office, a large hospital currently under construction, two secondary schools, six primary schools, and a relatively developed central business district. Mineral extraction, particularly diamond mining, is undertaken in parts of the Samagbay section, including Daresalam, Gbaia, Gissi Wala, and Njaluahun (Government of Sierra Leone, 1989).
- **Sorogbeima Chiefdom:** Sorogbeima had an estimated population of 76,934 in the 2021 Population and Housing Census, with Fairo serving as the chiefdom headquarters. Fairo has a police station, health centre, court barrie, agricultural business centre, one secondary school, and seven primary schools. The chiefdom also contains the Weikaymah Chiefdom Forest Reserve, an important forest and environmental resource that extends for approximately 3.5 km along the road corridor (Government of Sierra Leone, 1989).
- **Sowa Chiefdom:** Sowa had an estimated population of 27,308 in the 2021 Population and Housing Census, with Bandajuma as its chiefdom headquarters. Bandajuma accounts for approximately one-fifth of the chiefdom's population and functions as an important local commercial and service centre. Facilities include a large health centre, Ahmadiyya Junior Secondary School, two primary schools, two mosques, two court barriers, a police post, and seven hand-pump wells, of which five

are operational. The Sunday periodic market is an important trading centre, attracting traders and buyers from Pujehun, Potoru, and Zimmi, as well as commercial traffic and traders linked to Guinea, Liberia, and Bo City (Government of Sierra Leone, 1989).

- **Karbone** (the then **Kpanga Karbone**) **Chiefdom**: Karbone (also referred to as Kabonde) had an estimated population of 5,885 in the 2021 Population and Housing Census, with Pehala serving as the chiefdom headquarters. The chiefdom is now administratively distinct from Kpanga following the end of the former Kpanga Karbone amalgamation. Pehala functions as the principal administrative and service centre for Karbone Chiefdom. The relatively small population of the chiefdom, compared with the other affected chiefdoms, should be considered in planning for infrastructure, public services, transportation, and other development interventions (Government of Sierra Leone, 1989).
- **Pejeh Chiefdom**: Pejeh had an estimated population of 15,624 in the 2021 Population and Housing Census, with Futa serving as the chiefdom headquarters. Futa has five hand-pump wells, of which two are operational, one mosque, one primary school, a police post, and a junior secondary school. Agriculture is the principal economic activity, with major products including rubber, kola nuts, palm oil, cocoa, rice, and cassava, including cassava processed into gari. These agricultural activities provide important sources of household livelihoods and local economic activity (Government of Sierra Leone, 1989).

4.3 Economic activities and livelihoods

The main economic activities in the project area include farming, diamond mining, fishing, and coffee and cacao plantation processing (Government of Sierra Leone, 1989). Many people are engaged in subsistence agriculture, with some also pursuing various other economic activities. Mining activities, particularly illegal diamond and gold mining, are concentrated around Zimmi in Makpele Chiefdom, with similar activities observed in parts of Barri Chiefdom between Potoru and Zimmi.

The corridor is characterized by extensive agricultural production systems:

- **Rice cultivation**: Both upland and swamp rice are cultivated, with adjacent swamplands used for off-season vegetable production to supply townships and periodic market locations (Government of Sierra Leone, 1989).
- **Cash crops**: Significant rubber plantations (up to 3,000 acres), coffee estates with kola nut trees as cover crops, oil palm plantations, and cassava farms. Agricultural production agencies have invested in cacao plantations, using under-brushing of high forests to plant cacao and kola trees as cover crops (Government of Sierra Leone, 1989).
- **Market integration**: The road currently serves as a conduit for agricultural products to Liberian markets, with about 200 bags of garri leaving Sowa Chiefdom for Liberia every week, alongside sales of rice and palm oil. Periodic markets in Bandajuma, Njaluahun, Turela, Gofo, and Gendema before crossing the Mano River Union bridge support regional trade.

However, the poor condition of roads within the chiefdoms limits farmers' gains from produce sales due to rising transport costs (Government of Sierra Leone, 1989). For example, Zimmi has relatively high transport costs despite its proximity to Gendema. The road distance from Zimmi to Gendema is approximately 27 km, yet passenger transport fares can be substantial. Motorcycle taxis (okadas) generally charge higher fares than public vehicles, particularly where road conditions and limited transport options affect operating costs. Similarly, travel from Zimmi to Bo and Kenema attracts different fares depending on the mode of transport, prevailing fuel prices, road conditions, and availability of vehicles. These variations in transport costs increase the cost of accessing markets, health facilities, educational institutions, administrative services, and other essential services for residents of Zimmi and surrounding communities.

4.4 Social infrastructure and services

Health facilities are limited in the project area. Pujehun is the best-served district in the country in terms of population per functioning primary health care facility, with a ratio of approximately 3,800 persons per PHU, compared to the national district average of approximately 8,000. Regarding secondary health care, Pujehun has an average population per hospital bed of 2,500 and average population per doctor of 151,500 (Government of Sierra Leone, 1989).

Most villagers depend on patent drug peddlers who go round the villages. In emergencies, people travel to Zimmi, Pujehun, or Monrovia, depending on their location along the route, which is often difficult due to the bad condition of the road and the related high cost of transportation.

Health service locations are distributed according to population and settlement administrative level status: one main district hospital at Pujehun, health centers at every chiefdom headquarter town, and peripheral health units at most section towns. Lower-level health units and centers are being provided with solar panels to generate electricity for storage of essential health resources and light for emergencies (Government of Sierra Leone, 1989).

Malaria, tuberculosis, intestinal worms, dysentery, and cholera are the most common diseases afflicting household members. Some of these diseases are waterborne and may be connected with poor access to safe drinking water and sanitary means of excreta and refuse disposal. Issues of sexually transmitted diseases and HIV/AIDS are generally known in the project area, with an NGO working on HIV/AIDS awareness at a strategic staging post not distant from the ferry and periodic market (Government of Sierra Leone, 1989).

Educational levels are generally low. Besides the chiefdom headquarters towns of Bandajuma, Futa, Potoru, Zimmi, and Fairo, there are no schools in most villages. Where schools exist, they are in very poor condition. There tends to be early marriage of the girl child among traditional majority Muslim communities, where virginity at marriage may still be considered family pride. Consequently, far fewer girls of school age have access to educational opportunities. Fertility is high at a range of 6 to 8, with the

expectation that half of these children will survive to age 5, provided young mothers are safe from complications at childbirth (Government of Sierra Leone, 1989).

Access to safe drinking water is limited in most settlements. Some settlements have wells provided by NGOs, but most villagers depend on streams and other unsafe water sources. In many areas where wells exist, they are unprotected. Nearly all residents harvest rainwater during the rainy season for household use. Potable drinking water services remain a serious challenge, with Pujehun and Potoru towns once having pipe-borne water in the whole District (Government of Sierra Leone, 1989).

4.5 Community perceptions and concerns

Community consultations have identified several concerns and expectations regarding the road project:

Support for the project: All communities are in support of the road, recognizing its potential to improve access to markets, health care, educational facilities, and cultural facilities (Government of Sierra Leone, 1989).

Safety concerns: Communities express concern over accidents within the operational area during and after road construction, with suggestions including speed traps and street dressings indicating the need to slow down, particularly at periodic market locations (Government of Sierra Leone, 1989).

Economic expectations: There is expectation of a change in the direction of flow of agricultural products to Bo and other parts of the country upon road completion. Concerns over rubber estates and other plantations along the route are balanced by hope that value addition to raw materials will benefit chiefdom communities (Government of Sierra Leone, 1989).

Healthcare access: Communities express concern over how health emergencies can be dealt with amidst bad roads with only one or two medical doctors in Pujehun, the district headquarters (Government of Sierra Leone, 1989).

Transport bottlenecks: Concern that the Moala ferry is occasionally closed during the peak period of the rainy season, creating transport bottlenecks (Government of Sierra Leone, 1989).

Environmental concerns: Recognition that the road will pass through swampy and forest landscapes where gullies make travel most difficult for pedestrian and vehicular traffic. Recognition that while the road will provide improved mobility and access, physical components of air quality and noise will be degraded over time as traffic volumes increase (Government of Sierra Leone, 1989).

5 Environmental and social impact assessment (esia) considerations

5.1 Review of existing data and information gaps

The available data on the Bandajuma–Gendema corridor reveals significant information gaps that would need to be addressed through a comprehensive Environmental, Social and Health Impact Assessment

(ESHIA). Critical gaps identified include (Government of Sierra Leone, 1989):

Regional master plans: No information was obtained on regional master plans, which would provide strategic guidance on land use and development priorities.

Geomorphological maps: While the Department of Surveys and Lands has maps of scale 1:50,000 covering chiefdom boundaries, geomorphology, soil types, vegetation, and topography, these were not obtained due to protocol constraints and the short study period.

Forest inventory: Systematic data on forest resources, including timber value, species composition, and ecological significance, were not available.

Production systems: Detailed information on agricultural production systems, including crop types, yields, and market integration, was limited.

Administrative boundaries: Clear delineation of administrative boundaries relevant to land ownership and compensation arrangements was not obtained.

Space clearing and economic value of wood: No information was available on the extent of clearing required or the economic value of timber and other forest products.

5.2 Potential environmental impacts

Drawing on similar road development projects in Sierra Leone, several potential environmental impacts are anticipated (Government of Sierra Leone, 1988; Government of Sierra Leone, 2012B):

Impact on water resources: Construction activities, including cofferdam construction, bridge piers and abutment construction, and clearing of riverine vegetation, will temporarily and permanently alter surface water flow patterns both upstream and downstream. This includes restriction of flow due to bridge piers and abutments, modification of upstream and downstream flow depth and velocity, change in roughness due to clearance of vegetation and sediments, creation of eddies and vortices, alteration of sediment and nutrient loads, and impact on water availability (Government of Sierra Leone, 1988).

Impact on surface water quality: Vegetation and land clearing for approach roads, cofferdams, bridge piers, and abutment construction, and activities at construction material sites (borrow pits and quarries) expose soil to erosion, leading to increased sediment and turbidity in surface waters. Disturbances to riverbeds can lead to increased turbidity and downstream sedimentation. Materials used in cofferdams or failure of silt ponds can wash sediments into rivers, increasing turbidity and introducing contaminants. Poorly managed solid waste and work yard runoff can contaminate nearby water bodies (Government of Sierra Leone, 1988).

Impact on aquatic habitats and biodiversity: Clearing of aquatic and riverine vegetation may eliminate aquatic habitats and pose an impact on biodiversity. Cofferdams temporarily alter the natural flow of rivers and streams, affecting aquatic flora and fauna. Bridge construction can disrupt river flow and

habitat continuity, affecting ecosystem function and biodiversity. Construction noise and vibration may interfere with aquatic species, affecting their behavior, communication, and nocturnal patterns (Government of Sierra Leone, 1988).

Impact on fisheries: Construction of cofferdams, bridge piers, and abutments may affect aquatic organisms, including fish. Impacts include damage to aquatic and riparian habitats (feeding and breeding places), pollution of rivers, introduction of invasive species, and interference with fish movement (Government of Sierra Leone, 1988).

Impact on soil and erosion: Construction activities, including compaction of soils, oil spills from machinery, and disturbance of topsoil, can lead to increased surface runoff and soil erosion, affecting nearby land and water bodies. Excavation and earthwork activities at borrow pits, quarry sites, and sand pits will give rise to a heavy concentration of particulate load leading to soil erosion (Government of Sierra Leone, 1988).

Impact on air quality: Land clearance, stockpiles, vehicles, and machinery will generate dust and exhaust emissions. Standard mitigation measures, including adequate dust suppression by water spraying, covering of stockpile, and machinery selection, can reduce impacts (Government of Sierra Leone, 1988).

Impact on noise and vibration: Machinery operation and transport noise are potentially significant. Occupational noise limits and environmental noise standards can be maintained at a distance from the core operational area (Government of Sierra Leone, 1988).

5.3 Potential social impacts

The road project will generate both positive and negative social impacts (Government of Sierra Leone, 2012B):

5.3.1 Positive impacts

- Creation of employment opportunities for construction, maintenance, and operation workers (Government of Sierra Leone, 2012C).
- Creation of faster means of transport for passengers and goods (Government of Sierra Leone, 2012C).
- Reduced cost of public transportation (Government of Sierra Leone, 2012C).
- Increased business opportunities for small and medium-scale traders such as hotel and shop owners, food vendors, especially during construction phase (Government of Sierra Leone, 2012C).
- Reduced risk of accidents on the roads (Government of Sierra Leone, 2012C).
- Increased access to markets, health care, educational and cultural facilities.
- Enhanced regional integration through improved connectivity.

5.3.2 Negative social impacts

- **Resettlement and compensation issues:** A number of pieces of land, community and private oil palm, coffee/cola/cocoa rubber plantations, and dwellings in the project area will be subject to contention. The issue of compensation may be a serious challenge for local chiefdom administrations (Government of Sierra Leone, 2003).
- **Loss of livelihood sources:** Affected households may lose access to agricultural land, tree crops, and other livelihood sources, requiring appropriate compensation and livelihood restoration.
- **Disruption of social networks:** Resettlement may disrupt social interaction systems and community structures.
- **In-migration and social change:** Improved access may lead to in-migration, changes in social dynamics, and pressure on local resources.
- **Health risks:** Construction activities may increase exposure to dust, noise, and potential health risks, including HIV/AIDS transmission associated with labor migration.

5.4 Mitigation and management measures

Based on best practices from similar projects, mitigation measures should address (Government of Sierra Leone, 2003; Government of Sierra Leone, 2012B):

5.4.1 Environmental mitigation

- **Soil erosion control:** Incorporate slope stability measures such as benching and installation of erosion protection features including silt barriers and sedimentation ponds. Keep area to be cleared to the minimum necessary. Develop Sediment and Erosion Control Management Plan. Construct drainage channels to divert uncontaminated surface run-off away from construction work areas. Minimize construction activities and movement of construction vehicles outside designated areas. Strip and salvage topsoil where possible (Government of Sierra Leone, 2012B).
- **Water quality protection:** Implement proper sanitary and waste facilities at base camps and work sites. Implement spill prevention and response measures. Avoid water abstraction without prior approval of relevant authorities. Monitor water use and maximize efficiency. Provide alternative water sources if community disputes arise (Government of Sierra Leone, 2012B).
- **Aquatic habitat protection:** Design bridges to minimize disturbance to river flow and habitat continuity. Avoid, where possible, locations where springs occur or the water table is close to the surface. Construct cofferdams to minimize disruption to aquatic organisms. Implement measures to prevent introduction of invasive species (Government of Sierra Leone, 1988).

- **Air quality management:** Implement dust suppression by water spraying. Cover stockpiles. Maintain machinery to minimize exhaust emissions. Restrict construction activities to daytime hours away from sensitive receptors (Government of Sierra Leone, 1988 and Government of Sierra Leone, 2012C).
- **Waste management:** Implement proper waste segregation, storage, and disposal. Manage construction and demolition waste through recycling and appropriate disposal. Avoid dumping of construction waste in water bodies or sensitive areas (Government of Sierra Leone, 2012C).

5.4.2 Social mitigation

- **Resettlement and compensation:** Prepare engineering designs which minimize land acquisition, particularly acquisition of land occupied by housing, business/commercial premises, and productive farmlands. SLRSA, in collaboration with local authorities, should stop all future construction works within the Right-of-Way (ROW). Pay full and fair cash compensation, leaving affected persons at least no worse off than they were previously (Government of Sierra Leone, 1989).
- **Community engagement:** Establish household organization/Community Liaison Group to deal with issues arising out of construction activities. This group will be available for residents to lodge concerns over the contractor or utility relocation works. Liaison groups significantly reduce the aggravation and hostility of locals to the construction contractor and staff (Government of Sierra Leone, 1989).
- **Livelihood restoration:** Implement a Livelihoods Restoration Plan for affected farmers. Ensure crop assessment and associated compensation payment are completed before commencement of construction work (Government of Sierra Leone, 2012B).
- **HIV/AIDS prevention:** Implement awareness campaigns and prevention measures for construction workers and local communities.

6 Discussion

6.1 Balancing infrastructure development and environmental protection

The Bandajuma–Gendema road corridor exemplifies the complex trade-offs inherent in infrastructure development in environmentally sensitive and socio-economically vulnerable regions. The road promises significant benefits: improved connectivity, reduced transport costs, enhanced market access, and increased economic opportunities for communities that have historically been marginalized (Government of Sierra Leone, 2026 and Government of Sierra Leone, 1989). However, these benefits come with environmental costs, including potential impacts on forests, water resources, and biodiversity (Government of Sierra Leone, 1988; Government of Sierra Leone, 2012B).

The experience from similar road development projects in Africa highlights these tensions. The Cameroon-Nigeria road, completed in 2013 as part of the Trans-African Highway network, brought social and economic benefits, including improved transport for people and agricultural products, boosted

regional trade, and new housing and villages. However, it also led to increased deforestation and forest degradation, illegal logging activities, and farm development in forests, threatening critically endangered species such as the Cross River gorilla (World Bank, 1998). Time-series analysis of tree cover loss before, during, and after road construction revealed a strong relationship between road construction and increased tree cover loss in the road's direct vicinity (World Bank, 1998).

The Sierra Leone context presents similar risks. While the project road corridor is neither contiguous with nor in close proximity to nationally protected areas, the Weikaymah Forest Reserve borders the road for about 3 km and could be vulnerable to encroachment (Government of Sierra Leone, 1989). Additionally, the economic attractions of improved access could lead to increased pressure on forests, wetlands, and other sensitive ecosystems through in-migration, agricultural expansion, and resource extraction.

6.2 Institutional and regulatory frameworks: strengths and gaps

Sierra Leone's institutional and regulatory framework for environmental management provides a foundation for addressing these risks. The Environmental Protection Agency (EPA) Act (2008/Revised 2010) establishes clear legal requirements for environmental impact assessment and licensing for road construction projects (Government of Sierra Leone, 1989; Government of Sierra Leone, 2012B). The EPA-SL, as the national environmental regulatory authority, has the mandate to review and approve environmental impact assessments and ensure compliance (Government of Sierra Leone, 1989; Government of Sierra Leone, 2012B).

However, several gaps in the regulatory framework are evident:

- **Limited implementation capacity:** Government institutions have limited implementation and enforcement capacity, which may constrain effective oversight of environmental and social safeguards (Government of Sierra Leone, 1989).
- **Incomplete legal coverage:** While the EPA Act provides the overarching framework, specific regulations for road development environmental management may be insufficiently detailed or enforced.
- **Weak coordination:** Effective environmental management requires coordination across multiple institutions, including EPA-SL, SLRSA, local councils, and chiefdom authorities, which may be challenging in practice (Government of Sierra Leone, 1989).
- **Incomplete compensation frameworks:** While compensation provisions exist under the Works Contract, Constitution, and Land Act, implementing them effectively requires detailed frameworks and procedures that may not be fully developed (Government of Sierra Leone, 1989).
- **Data and information gaps:** The absence of comprehensive baseline environmental data, including geomorphological maps, vegetation maps, and forest inventories, constrains effective impact assessment and mitigation planning (Government of Sierra Leone, 1989).

6.3 Resettlement and compensation challenges

Resettlement and compensation are among the most sensitive social issues associated with road development projects. The Bandajuma–Gendema corridor presents particular challenges related to land ownership, community plantations, and cultural values (Government of Sierra Leone, 1989).

A number of pieces of land, community and private oil palm, coffee/cola/cocoa rubber plantations, and dwellings in the project area will be subject to contention. In many locations there are family disputes on rubber plantations, mostly related to local land ownership interpretations among farming communities (Government of Sierra Leone, 1989).

The compensation framework is based on "open market value" and current land and property values, with buildings, tree fruit crops, and all other assets valued based on rates set by the Ministry of Agriculture and Forestry and Food Security (Government of Sierra Leone, 1989). However, implementing this framework effectively requires:

- Detailed inventories of affected assets;
- Transparent valuation processes;
- Fair and timely compensation payment;
- Livelihood restoration for displaced households;
- Community engagement and grievance mechanisms.

6.4 Recommendations for sustainable implementation

Based on the analysis, the following recommendations are proposed for similar projects in our parts of the African Continent, and other parts of the world (World Bank, 1994):

1. **Conduct comprehensive Environmental, Social and Health Impact Assessment (ESHIA):** The scanty data available underscores the need for a full ESHIA for the Sierra Leone corridor of the TAH (Express, 2025). This assessment should address data gaps, including regional master plans, geomorphological maps, vegetation maps, forest inventories, production systems, and administrative boundaries.
2. **Strengthen institutional capacity:** Enhance implementation and enforcement capacity of environmental and social regulatory institutions, including EPA-SL, SLRSA, and local councils. Provide training and resources for effective oversight of environmental and social safeguards.
3. **Ensure transparent stakeholder engagement:** Establish mechanisms for meaningful stakeholder engagement throughout the project lifecycle, including community consultations, grievance mechanisms, and information disclosure. Independent professionals with no connection to construction contractors should carry out environmental and social impact analysis (Government of Sierra Leone,

2012A). Environmental and social impact assessment reports should be disclosed prior to the beginning of construction (Government of Sierra Leone, 2012A).

4. **Develop comprehensive compensation and resettlement framework:** Prepare detailed Resettlement Action Plans (RAP) for project-affected persons, including asset inventories, transparent valuation processes, fair compensation, and livelihood restoration. Address land ownership disputes through community engagement and conflict resolution mechanisms.

5. **Integrate environmental considerations into design and construction:** Incorporate environmental mitigation measures into project design, including erosion and sediment control, water quality protection, habitat protection, and waste management. Apply Best Available Technology (or Practice) Not Entailing Excessive Cost (BATNEEC) to minimize environmental impacts (Government of Sierra Leone, 2012B).

6. **Monitor and evaluate:** Establish monitoring programs to track environmental and social performance throughout project implementation and operation. Report regularly on compliance with environmental and social standards and mitigation effectiveness.

7. **Learn from regional experiences:** Draw lessons from recent infrastructure completions in the district, including the Bandajuma–Pujehun Road and Julius Maada Bio Bridge, to inform sustainable implementation of future projects (Government of Sierra Leone, 2026 and Sierra Leone Roads Authority, 2023).

7 Conclusion

The Bandajuma–Gendema corridor represents a strategically significant section of Sierra Leone's participation in the Trans-African Highway network. The road promises substantial benefits for the six chiefdoms in the eastern uplands of Pujehun District: improved connectivity, enhanced market access, reduced transport costs, increased agricultural productivity, and improved access to healthcare and education. Recent infrastructure completions in the district, including the Bandajuma–Pujehun Road and Julius Maada Bio Bridge, demonstrate the transformative potential of road development for regional integration and economic growth (Government of Sierra Leone, 2026; Sierra Leone Roads Authority, 2023).

However, realizing these benefits requires careful attention to environmental and social considerations. The corridor traverses areas with sensitive ecosystems, including the Weikaymah Forest Reserve and the Moa River corridor, which could be vulnerable to degradation from construction activities and induced development. The project will also affect communities with significant dependence on agriculture and natural resources, requiring careful management of resettlement and compensation issues.

The current data available on the project area reveal significant information gaps that must be addressed through a comprehensive Environmental, Social and Health Impact Assessment (ESHIA). This

assessment should be conducted in accordance with national legislation (the EPA Act), international conventions, and best practices, with transparent stakeholder engagement and information disclosure.

Ultimately, the success of the Bandajuma–Gendema road project will depend on the effective integration of environmental and social considerations into project planning, design, implementation, and monitoring. This requires robust institutional frameworks, adequate resources, and genuine commitment from all stakeholders to ensure that the road serves as a "pathway to dignity" rather than a source of environmental degradation and social disruption.

Abbreviations

AfDB: African Development Bank; **AIDS**: Acquired Immunodeficiency Syndrome; **BATNEEC**: Best Available Technology (or Practice) Not Entailing Excessive Cost; **CBD**: Convention on Biological Diversity; **CDAP**: Community Development Action Plans; **CFC**: Chloro Floro Carbon; **EIA**: Environmental Impact Assessment; **EPA**: The Environmental Protection Agency; **EPA-SL**: Environment Protection Agency – Sierra Leone; **ESHIA**: Environmental, Social and Health Impact Assessment; **GoSL**: Government of Sierra Leone; **HIV**: Human Immunodeficiency Virus; **MAFFS**: Ministry of Agriculture and Forestry and Food Security; **POP**: Persistent Organic Pollutants; **RAP**: Resettlement Action Plans; **SLRA**: Sierra Leone Roads Authority; **SLRSA**: Sierra Leone Roads Safety Authority; **TAH**: Trans-African Highway; **UNCCD**: United Nations Convention to Combat Desertification; **WB**: World Bank; **WFR**: Weikaymah Forest Reserve

Declarations

Ethics Approval and consent to participate

Ethical approval for this study was obtained from the relevant Institutional Research Ethics Committee prior to commencement of data collection. A written informed consent was obtained from all participants; participation was voluntary, anonymous, and confidential and data were anonymized.

Consent for publication

Not applicable.

Availability of data and materials

The data generated and/or analysed during this study are available from the corresponding author upon reasonable request. Due to confidentiality and ethical considerations, individual-level participant data are not publicly available. Relevant secondary data and materials used in the study are available from their respective public or institutional sources.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The corresponding author ABG contributed to the conceptualization, literature synthesis, methodological design, the preparation and approval of the manuscript; SEK assisted ABG with the analysis and interpretation of the findings.

Conflict of Interest

The authors declare no conflict of interest.

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