

ENVIRONMENT IMPACT ASSESSMENT REPORT

Project name: **GENDER TRANSFORMATIVE CLIMATE ADAPTATION (GTCA)**

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Implementing Partners: **Lutheran World Federation**

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The team was supported by staff from Lutheran World Federation (LWF), and respective government stakeholders (both in Cameroon and Chad) in mobilizing communities and collecting data. The study was conducted between July 15 and September 15, 2025.

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ACRONYMS

CLWR	Canadian Lutheran World Relief
CVP	Construction Validation Plan
DEELCPN	Directorate of Environmental Assessments and Pollution and Nuisance Control (Chad)
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP / PGES	Environmental and Social Management Plan / <i>Plan de Gestion Environnementale et Sociale</i> (Cameroon)
FGD	Focus Group Discussion
GAC	Global Affairs Canada
GTCA	Gender Transformative Climate Adaptation Project
HSSE	Hygiene, Security, Safety and Environment
IAA	Impact Assessment Act
IGA	Income Generating Activities
IPM	Integrated Pest Management
LGDI	Local Guidance and Development Initiative
LWF	Lutheran World Federation
MINEPDED	Cameroonian Ministry of Environment, Protection of Nature and Sustainable Development
MINFOF	Cameroonian Ministry of Forestry and Wildlife
NBS	Nature Based Solutions
PPE	Personal Protection Equipment
PSEA	Protection from Sexual Exploitation and Abuse

EXECUTIVE SUMMARY

The Lutheran World Federation (LWF) programs in Chad and Cameroon, in partnership with Canadian Lutheran World Relief (CLWR), and funded by Global Affairs Canada (GAC), have been implementing the “Gender Transformative Climate Adaptation” (GTCA) project, aimed at addressing the needs of communities living along the Lake Chad basin, which are severely affected by climate-induced reductions in livelihoods. Amongst its various activities to restore and strengthen livelihoods, the project includes plans to establish structural works to enhance agricultural production, improve and diversify incomes, and reduce their pressure on local ecosystems and biodiversity. With this in mind, and in line with the regulation of all three countries (Cameroon, Chad and Canada), it was necessary to conduct an Impact Assessment to identify, characterize, and evaluate the potential impacts of its implementation and to propose measures to mitigate, compensate for, or enhance them.

The project’s intervention area is both in Chad and Cameroon. In Cameroon it is in the Far North region (Logone-et-Chari department), and in Chad, in the provinces of Lac, Chari-Baguirmi and N'Djamena. The project area has a Sudano-Sahelian lowland climate, characterized by long, very hot dry season and a short, very wet rainy season with irregular rainfall over time and space. Climate hazards are getting more severe in these areas. Temperatures are getting progressively warmer, with the temperature increase especially pronounced in recent years, and this trend is projected to continue. While precipitation projections are less certain, models predict an increase in the number of heavy precipitation days. Extreme weather events, such as droughts and floods, are increasingly reported-with the number of recorded events doubling in the past three decades¹. Clashes over diminishing water resources often break out between herders, farmers and fishermen. For example, in December 2021, in one incident the situation rapidly deteriorated and the violence lead to 112 villages being burned, over 100 people wounded, and 44 died.²

To address the impacts of climate change, improve adaptation and resilience, the planned structural works include the construction of a) storage facilities for agricultural products, b) small irrigation systems with a borehole, submersible electric pump, solar panels, storage tanks and water distribution systems, c) hatcheries for fry production with retention basins, c) dikes for land restoration, d) irrigation system for nurseries and reforestation watering with a borehole and water tank, e) livestock vaccination centre, and f) water retention ponds. The GTCA project is anticipated to yield significant positive biophysical and socioeconomic impacts, including reversing land degradation, mitigating soil erosion, enhancing biodiversity. Socioeconomically, the project is

¹ <https://www.elibrary.imf.org/view/journals/002/2024/052/article-A003-en.xml>

² <https://reliefweb.int/report/cameroon/cameroon-and-chad-emergency-unhcr-supplementary-appeal-january-june-2022>

poised to improve food security, water availability, and build community resilience to climate change. However, improper implementation could lead to negative biophysical impacts such as increased soil erosion, water pollution, and habitat loss. Potential socioeconomic risks include conflicts over resource access, and social disruption. To mitigate these risks, the project will implement robust environmental management plans for each component, conduct regular monitoring and evaluation, and engage with local communities to address concerns and ensure equity. The positive impacts can be further enhanced through capacity building, technology transfer and sustainable land management practices. A summary of major positive impacts, negative impacts and mitigation measures are presented in the tables below.

Table 1: Summary of positive project impacts

Positive Impacts	Impact Description and Comment
Economic benefits and livelihood improvement	<ul style="list-style-type: none"> • Creation of new income sources from irrigation, aquaculture, hatcheries, nurseries, and livestock vaccination services. • Reduced post-harvest losses and better prices through improved storage facilities. • Income diversification in farming, fish production, maintenance, and related services. • Strengthened local markets, small enterprises, and value chains (agriculture, livestock, and aquaculture). • Increased income security and reduced dependence on imports.
Food security and nutrition benefits	<ul style="list-style-type: none"> • Year-round food availability from irrigation and storage systems. • Improved diet diversity and nutrition from fish, vegetables, fruits, and livestock products. • Enhanced resilience against hunger and malnutrition during droughts and lean seasons. • Increased agricultural and livestock productivity, improving local food supply.
Social and community development benefits	<ul style="list-style-type: none"> • Empowerment of women, youth, and farmer cooperatives through participation and income generation. • Strengthened community cooperation and management of shared resources. • Improved living standards, education, and health due to better income. • Reduced conflicts between farmers and herders through shared water and resource management.
Environmental (energy, water) benefits	<ul style="list-style-type: none"> • Renewable energy use (solar) reduces emissions and fuel costs. • Improved water management through efficient irrigation, ponds, and retention basins. • Reforestation, soil restoration, and biodiversity protection. • Reduced desertification and better climate regulation (shade, moisture, microclimate).

	<ul style="list-style-type: none"> • Groundwater recharge and reduced erosion through water retention systems.
Agricultural productivity	<ul style="list-style-type: none"> • Higher and more stable yields through year-round irrigation. • Diversification of crops (vegetables, fruits, fodder) and livestock watering. • Sustainable seedling and tree production for reforestation and agroforestry.
Conflict Reduction	<ul style="list-style-type: none"> • Reforestation, water access, and livelihood diversification reduce tensions between farmers and herders and promote social cohesion. • Management committees include members from diverse communities that are manage resources to prevent conflict
Climate change adaptation and resilience	<ul style="list-style-type: none"> • Reduced vulnerability to drought through stored water and irrigation. • Increased carbon sequestration and climate regulation via tree planting. • Enhanced ecosystem resilience and soil conservation. • Sustainable, low-emission systems (solar-powered pumps, aquaculture, reforestation). • Strengthened adaptation capacity and long-term livelihood stability.
Knowledge and Skills Transfer	<ul style="list-style-type: none"> • Capacity building in sustainable agriculture, aquaculture, nursery management, and reforestation. • Youth and women benefit from apprenticeships and technical training.
Animal health and production	<ul style="list-style-type: none"> • Reduced livestock diseases through vaccination, improving productivity and food safety. • Lower risk of zoonotic diseases and safer animal products for consumers. • Strengthened veterinary infrastructure, animal health systems, and disease monitoring systems.

Table 2: Summary of potential negative impacts and mitigation measures

Negative Impacts	Comments / Description	Mitigation
Water resource depletion and conflicts	Over-extraction of groundwater for irrigation of vegetables, nurseries or reforestation areas can reduce water availability and create local conflicts.	<ul style="list-style-type: none"> • Conduct hydrogeological assessments • Use water-efficient irrigation • Form and train water user associations • Establish clear water-sharing rules
Soil degradation, compaction, and erosion	Heavy machinery, excavation, and poor land use practices can degrade soils and increase erosion, especially during rainy	<ul style="list-style-type: none"> • Restrict machinery movement • Schedule major works in dry season • Apply contour planting and

	periods.	mulching <ul style="list-style-type: none"> Restore degraded sites
Water and soil contamination	Fuel, oil leaks, and waste mismanagement from machinery	<ul style="list-style-type: none"> Provide sealed maintenance areas with oil sumps Collect and mitigate spills
Loss of vegetation and biodiversity	Clearing, poor site selection, or invasive species introduction reduce native flora and fauna diversity.	<ul style="list-style-type: none"> Restrict clearing to the project footprint Exclude protected zones Replant native vegetation Manage invasive species
Wildlife disturbance	Construction noise, vibration, and site clearing may disrupt wildlife movement and breeding	<ul style="list-style-type: none"> Maintain buffer zones Limit heavy work to daylight Monitor fauna during construction.
Air, dust, and noise pollution	Machinery emissions, traffic, and material transport can degrade air quality and create noise disturbance.	<ul style="list-style-type: none"> Maintain and service machinery Water dusty areas Limit speeds in construction areas Limit work hours
Public health and sanitation risks	Poor site hygiene and labour influx can increase disease transmission and sanitation problems.	<ul style="list-style-type: none"> Provide adequate latrines and waste disposal Health awareness and HIV prevention campaigns Ensure potable water on-site.
Occupational health and safety risks	Construction and maintenance activities pose risks of accidents, dust exposure, and unsafe working conditions.	<ul style="list-style-type: none"> Enforce HSE standards Provide PPE, first aid kits, and training Monitor compliance.
Landscape and quarry degradation	Extraction of construction materials causes loss of topsoil and habitat.	<ul style="list-style-type: none"> Strip and store topsoil; rehabilitate sites after extraction; replant native vegetation.
Livestock and veterinary waste management issues	Poor disposal of manure and biomedical waste at vaccination parks causes pollution and odours.	<ul style="list-style-type: none"> Build incinerators and compost pits; disinfect regularly; provide fire safety and waste-handling training.
Aquatic pollution and invasive species (hatcheries)	Hatchery effluent and introduction of non-native species may degrade aquatic habitats.	<ul style="list-style-type: none"> Use native species only Install filtration or settling systems Manage waste and feed efficiently Conduct routine inspections
Pest and disease proliferation	Monocultures or poorly managed plantations increase pest and disease risks.	<ul style="list-style-type: none"> Apply Integrated Pest Management (IPM) Diversify plant species

		<ul style="list-style-type: none"> • Monitor regularly.
Solid waste accumulation	Improper disposal of construction	<ul style="list-style-type: none"> • Segregate waste • Promote recycling • Establish collection and disposal systems.
Social conflicts and labour tensions	Local resentment may arise from hiring outsiders, unequal access to project benefits or unequal participation by women or youth	<ul style="list-style-type: none"> • Prioritize local recruitment • Promote inclusive hiring • Adopt flexible work schedules • Deliver gender and youth awareness sessions • Establish grievance redress mechanisms.
Cultural heritage disturbance	Construction may inadvertently damage sacred or archaeological sites.	<ul style="list-style-type: none"> • Conduct cultural screening • Stop work on discovery • Notify relevant authorities.
Erosion and infrastructure degradation	Poor drainage or lack of maintenance leads to erosion and sedimentation around structures.	<ul style="list-style-type: none"> • Maintain bunds and drainage channels • Allocate budget for upkeep • Conduct regular maintenance.
Farmer–herder conflicts and land-use disputes	Competition for land and water among users may escalate into local conflicts.	<ul style="list-style-type: none"> • Facilitate dialogue through community platforms • Define clear resource-sharing mechanisms.

The Environmental Management Plan (EMP) has been designed to include strategies to mitigate negative impacts and enhance positive impacts. The EMP also includes plans for regular monitoring of environmental indicators which will be track progress and identify potential issues. Local communities will be actively involved in the planning, implementation, and decision-making processes. The EMP will also prioritize gender inclusivity, ensuring the participation of women and establishing a community complaint mechanism throughout the project's lifespan.

1. DESCRIPTION OF THE PROJECT

1.1. Project description

The Gender Transformative Climate Adaptation (GTCA) project is funded by Global Affairs Canada (GAC) and implemented by Canadian Lutheran World Relief (CLWR) in collaboration with the Lutheran World Federation (LWF).

This project relies on nature-based solutions and operates in two countries in Cameroon, in the Far North region (Logone-et-Chari department), and in Chad, in the provinces of Lac, Chari-

Baguirmi and N'Djamena. The project targets 128,114 direct beneficiaries (46,847 women, 30,375 men, 20,108 boys, 30,124 girls) and 640,570 indirect beneficiaries (234,235 women, 155,725 men, 100,540 boys and 151,070 girls). The project aims to improve low-carbon climate resilient economies in the Logone-Chari river region of Cameroon and Chad, especially for women, girls, and other vulnerable groups. It supports climate change adaptation by improving food systems, livelihoods and environmental well-being in this freshwater surface ecosystem (river basin). The project aims to reduce communities' vulnerability to climate change and enhance their well-being and that of their surrounding ecosystems.

This objective will be achieved through three outcomes that will contribute to restoring ecological functionality, improving human livelihoods and making a vital contribution to global resilience:

- 1) Improved technical capacity of local governance bodies, including increased participation and gender-equitable decision-making, to support nature-based solutions (NBS), climate resilience and biodiversity enhancement.
- 2) Increased adoption of nature-based and gender-responsive solutions to improve biodiversity and climate change adaptation, especially for women and girls, in the Logone-Chari Basin.
- 3) Increased adoption of climate-resilient livelihoods in targeted landscapes, particularly for women and girls, through the sustainable use of energy sources, nature-based solutions and biodiversity.

1.2. Project activities

This project is aimed at addressing the needs of communities living along the Logone-Chari river region of the Lake Chad basin, which are severely affected by climate-induced reductions in livelihoods. The GTCA project is being implemented in the Lac, N'Djamena, and Chari-Baguirmi provinces in Chad, as well as in the Logone-et-Chari department in the Far North region of Cameroon.

Among its various activities to improve adaptation to climate changes and strengthen livelihoods, the project includes the establishment of infrastructures to enhance agricultural production and diversify livelihoods. The structural works are summarized in this table:

Table 3: Summary of structural works in Cameroon and in Chad

CAMEROON	
Locations	Type of Work
<i>Logone-et-Chari Region:</i> Blangoua Center, Makary Center, Adjaine, Bougouma,	4 storage facilities for agricultural products
<i>Logone-et-Chari Region:</i> Mblame, Sero Abou, Makary Center, Seheba, Kawadij, Honkole, Goulfey Center, Bodo	15 irrigation systems

N, Garouzo, Mougalam, Ngaoupata, Bourgouma, Samakale, Mariam, Houloums	
<i>Logone-et-Chari Region:</i> Makary Center, Kousseri	2 fry production hatcheries
<i>Logone-et-Chari Region:</i> Houloumsa, Mblamé, Honkole, N'Djamena, Moulouang, Bodo N, Tildé	7 soil retaining dikes
CHAD	
Locations	Type of Work
<i>Chari-Baguirmi and N'Djamena:</i> Darda, Bougoumène, Toukra Massa (9th district), Tchentchou	4 irrigation systems
<i>Chari-Baguirmi and N'Djamena:</i> Kabè, Tchentchou	2 fry production hatcheries
<i>Chari-Baguirmi and N'Djamena:</i> Laki, Laki 3, Tchentchou, Maillao, Toukra Massa (9 th District), Dingagali	6 tree nurseries and boreholes for watering reforestation sites
<i>Chari-Baguirmi and N'Djamena:</i> Doralbache, Bandami1, Djamalma1	3 livestock vaccination centers
<i>Chari-Baguirmi and N'Djamena:</i> Dingagali (9 th District)	1 water retention pond
<i>Lac Province:</i> Gally Anoui, Nguelea Mara, Gambia, Matafo2, Ngouri, Baderi, Moune Dossoloum, Moune Koura, Madikimerom, Femy	10 irrigation systems
<i>Lac Province:</i> Bol, Yakoua, Brim, Ngouri	4 tree nurseries each with a borehole for irrigating nursery seedlings and reforestation sites

In collaboration with local communities in the targeted villages, the GTCA project team conducted an initial needs assessment to identify the most suitable types of infrastructure based on local priorities. A multisectoral team composed of LWF staff, community leaders, and municipal representatives conducted site assessments to determine the types of structures to be built and to evaluate their potential environmental and social impacts. Special attention was given to land tenure, gender considerations, and stakeholder engagement. Following these community consultations, a technical feasibility study was carried out in July 2025 by an external consultant. The study assessed the civil engineering, hydrological, topographical, geotechnical, and environmental aspects of the proposed works. Following that study, consultants were engaged to conduct a full ESIA of all planned structural works, in accordance with the legal frameworks of Canada, Cameroon, and Chad, and in compliance with the requirements of the relevant authorities in Chad and Cameroon.

1.2.a. Agricultural product storage facilities (4 in Cameroon)

LWF has many years of experience with warehouse construction in rural communities. Warehouses protect crop production from insects, birds, mice, and rats, thereby reducing post-harvest losses. Additionally, warehouses allow farmers to store harvests when prices are low and

sell them when market prices are higher.

The benefits of storage facilities extend particularly to women. By storing food, women can better manage their families' food security, ensuring access to resources even during periods of scarcity. Adequate storage enables women to sell products when prices are higher, increasing household income, reducing dependence on local markets, and supporting economic empowerment. Managing their own stocks allows women to gain financial independence, make informed financial decisions, and invest in their families and communities. Managing granaries often involves training in resource management, accounting, and sustainable agriculture, thereby strengthening women's skills. Granaries can serve as community hubs where women share ideas, resources, and mutual support, while owning stock can facilitate access to credit, as it provides collateral for loans. Managing their own stocks allows women to gain financial independence, make informed financial decisions, and invest in their families and communities.

1.2.b. Irrigation system infrastructure equipped with solar pumping (14 in Chad and 15 in Cameroon)

Communities in these areas rely primarily on rain-fed agriculture during the short rainy season from July to September. During the long and intense dry season, food production opportunities are limited, except for a small number of households farming along rivers or lakes, where high water tables or boreholes equipped with submersible pumps allow continued crop cultivation.

Expanding access to irrigation for small market gardens enables more people to engage in post-rainy-season agricultural production. This is a key climate adaptation strategy that helps households benefit from higher off-season market prices, increase incomes, and diversify diets. Instead of resorting to environmentally harmful activities such as overfishing or cutting trees for firewood, market gardening provides a climate-friendly livelihood option. It also supports household food security through the production of diverse vegetables and fruits (e.g., tomato, cabbage, lettuce, pepper, and onion).

Women, in particular, benefit from market gardening, as men are often occupied with activities such as fishing in the dry season. These initiatives empower women to feed their families, strengthen their financial autonomy, and reduce exposure to risks such as gender-based violence.

During project initiation, communities are consulted to confirm their needs and identify potential sites for establishing irrigation systems. These sites require land use permits from local authorities. Hydrological and geological assessments are then conducted by hydraulic engineers to determine groundwater levels, water distribution design, feasibility, and suitable drilling locations.

During the construction phase, members of the beneficiary groups—together with local and administrative authorities—play key roles. They will manage construction materials and equipment within their villages, oversee daily progress, and some will be employed as day laborers on-site. They will also help raise community awareness about the project's importance and

coordinate local contributions, often provided in kind, such as sand or rubble, depending on local availability.

Once operational, each irrigation system will be managed by a local committee trained by LWF on the rules and procedures for daily monitoring and maintenance. Each committee allocates 20–30% of the income generated to a maintenance fund. If a breakdown or repair exceeds the resources available in the fund, members contribute additional funds or materials to address the issue.

1.2.c. Hatcheries equipped with borehole and solar pumping systems for fish farming to support fry production (2 in Chad and 2 in Cameroon)

This initiative will promote the development of aquaculture, providing an important source of income while reducing pressure on natural fishery resources and limiting conflicts between farmers and fishermen around waterways. It will also strengthen the food security of beneficiary communities.

In rural areas of Chad, pond construction follows techniques adapted to local conditions. The ponds will be built with cinder blocks, lined with blue tarpaulins, and include a 20-centimeter layer of sand at the bottom. Each pond will measure three meters by two meters, with a depth of two meters.

The hatcheries, designed to produce fry, will play a crucial role in community development. From a food security perspective, they will provide healthy, high-quality fry for aquaculture, increasing fish production and helping meet the growing demand for animal protein. Economically, the hatcheries will generate income for beneficiaries and contribute to local economic growth. The fry produced will be sold to fish farmers and restaurants, creating a sustainable value chain. In terms of natural resource management, the hatcheries will ensure a reliable fish supply for local communities, reduce dependence on traditional fishing, and lessen pressure on wild fish stocks. Overall, they will promote sustainable development by supporting environmentally responsible aquaculture practices.

The facilities will be managed by the members of the Local Guidance and Development Initiative (LGDI), which is structured into three bodies: the General Assembly, the Coordination Office, and the Audit Commission. The General Assembly is the organization's highest decision-making body, composed of all members. It has the broadest powers for administration and management, meeting at least once a year to review activities and adopt the action plan for the coming year. Extraordinary sessions may be convened as needed. The General Assembly also elects and, when necessary, dismisses members of the Coordination Office.

The Coordination Office is responsible for administering and managing LGDI's material and financial resources, including the hatchery. It is composed of a president, vice-president, secretary general, deputy secretary general, treasurer general, deputy treasurer general, and three advisors.

Members of the Coordination Office serve three-year terms, renewable once. Two independent auditors serve on the Audit Commission, providing regular internal monitoring of the organization's accounts.

Each hatchery will produce approximately 15,000 fry per month. The direct beneficiaries of this project are the 42 members of ILOD and their households. In terms of profitability, producing 15,000 fry requires an estimated monthly investment of XAF 225,000. Each fry will be sold for XAF 125, generating total monthly revenue of XAF 1,875,000. This results in a profit margin of XAF 1,650,000 per month (1,875,000 – 225,000).

Finally, the development of hatcheries and fish farming using the fry produced will significantly reduce risk exposure. Many people lose their lives while fishing—either by drowning or through attacks by armed individuals or hippopotamuses. Expanding aquaculture provides a safer, more sustainable alternative livelihood for these communities.

1.2.d. Tree nurseries with boreholes for irrigation (10 in Chad).

Reforestation programs are essential to address the chronic fuel shortages faced by communities—particularly women, who must often travel long distances to collect firewood for cooking. Beyond alleviating fuel scarcity, reforestation provides multiple environmental and social benefits, including increased biodiversity, prevention of desertification, and, with certain species such as moringa, improved nutrition for both people and livestock. Agroforestry systems that integrate perennial and annual crops have also proven effective in strengthening the resilience of food production systems to extreme weather events such as droughts and heavy rains. In Cameroon, LWF has successfully implemented reforestation projects in the MINAWAO refugee camp, demonstrating the effectiveness of this approach.

The nurseries are managed by organized nursery groups, each governed by internal rules and regulations. Every group has established a management or steering committee responsible for the day-to-day monitoring and maintenance of the nursery, with active participation from all members. LWF provides training on nursery management and maintenance, along with essential start-up materials such as office supplies, tools, and spare parts for equipment. Each group allocates a portion of its income—typically between 20% and 30%—to maintain its assets and support ongoing operations. In cases where repair or replacement costs exceed available funds, members contribute additional resources to address the issue.

Tree prices are determined based on production costs, including materials, labor, and time invested, while also considering the purchasing power of local communities to ensure affordability. This balance allows households to access trees for replanting while ensuring that nursery groups remain financially sustainable. Seedlings will be sold to LWF at a reduced price, reflecting the organization's initial investment in materials and technical support. Prices will then be adjusted upward in subsequent cycles to reflect the true cost of production and ongoing group expenses.

The trees produced in the nurseries serve multiple purposes, depending on local needs. The species selected play key roles in fertilizing and restoring arable land, controlling sand encroachment toward villages and farmland, providing shade, and producing fruits for household consumption and income generation. They also contribute to reforestation areas degraded by climate change, preventing soil erosion, and supplying fodder, fruit, and leaves for animal feed and medicinal use. In this way, the trees provide both environmental and economic benefits, supporting ecosystem restoration while improving household incomes.

Tree survival rates will be enhanced through the establishment of management committees for community planting sites, as well as through the involvement of individual households receiving seedlings. Once formed by community members with the support of local authorities, these site management committees will receive training in tree care and maintenance and will be equipped with the necessary tools to ensure proper management of the planted areas.

1.2.e. Construction of livestock vaccination parks (3 in Chad)

The Chari-Baguirmi department is an agro-pastoral area where livestock farming is a major economic activity for many families. However, livestock losses are significant each year, often due to the lack of systematic vaccination against animal diseases. The construction of vaccination parks allows animals to be grouped under proper sanitary conditions, facilitating the administration of vaccines and other veterinary treatments. This directly reduces animal mortality, improves livestock productivity, and helps secure income for livestock farmers.

In a region where transhumance movements are frequent, the risk of rapid disease spread is high. Well-distributed vaccination parks enable veterinary services to carry out vaccination campaigns efficiently and regularly. These facilities play a key role in implementing national and regional programs to combat epizootics, protecting both local livestock and transhumant herds passing through Chari-Baguirmi, thereby strengthening animal health at the national level.

Healthy livestock leads to increased production of meat, milk, and other animal by-products, which enhances food security for local populations. In addition, it supports the marketing of livestock products, creating economic opportunities for farmers, traders, and other actors in the sector. Vaccination parks can also serve as centers for awareness-raising and training, educating livestock farmers on best practices in animal health and husbandry. In this way, these facilities act as important levers for sustainable rural development in Chari-Baguirmi.

1.2.f. Soil restoration dikes (7 in Cameroon)

The construction of retaining dikes reduces water erosion that is seriously affecting the land in the Logone-et-Chari department. This area, which is subject to episodes of intense rainfall followed by long periods of drought, is seeing its soil washed away or compacted, rendering the land infertile and difficult to cultivate. The embankments slow down the flow of runoff, thereby reducing the loss of arable land and helping to stabilize fragile slopes and banks.

By retaining water and sediments, retaining dikes promote the replenishment of organic matter and improve the water retention capacity of soils. This allows local farmers to reclaim land previously abandoned due to infertility or erosion and to restart sustainable agricultural activities. These infrastructures thus strengthen communities' resilience to climate change and contribute to food security in a region often affected by food insecurity.

In the socio-economic context of Logone-et-Chari, where the majority of the population depends on agriculture and livestock farming, the restoration of degraded land through retaining walls is a strategic action for preserving livelihoods. It also creates temporary jobs through construction and maintenance work, while strengthening social cohesion through community management of the structures. In the long term, these initiatives contribute to the sustainable development of the region and poverty reduction.

1.2.g. Water retention pond (1 in Chad)

The 9th district of N'Djamena faces prolonged droughts and irregular rainfall, putting pressure on water resources. The construction of a water retention pond collects and stores rainwater during the wet season, ensuring availability during droughts and strengthening community resilience to climate change.

The pond supports subsistence agriculture, market gardening, livestock farming, and small-scale fishing, promoting livelihood diversification and increasing household incomes. It also contributes to local food security by enabling irrigation during the dry season. Beyond economic benefits, the pond improves sanitary conditions and reduces the burden of water collection for women and children.

Managed sustainably by the community, the pond fosters local ownership, resource conservation, and social cohesion, making it a key tool for integrated and sustainable urban development.

The table below shows the locations of the activities to be implemented in the project;

Table 4: Structural works in Cameroon and Chad

CAMEROON				
<i>Locations</i>	<i>Type of Work</i>	<i>Existing Infrastructure</i>	<i>Components to be constructed and scope of work at each site</i>	<i>Size</i>
Logone-et-Chari Region: Blangoua Center, Makary Center, Adjaine, Bougouma	4 storage facilities for agricultural products	None	<ul style="list-style-type: none"> • 1 warehouse built of cinder blocks with reinforced concrete structure and a metal frame. 	Approximately 156 m ² footprint
Logone-et-Chari Region: Mblame, Sero Abou, Makary Center, Seheba, Kawadij, Honkole, Goulfey Center, Bodo N, Garouzo, Mougalam, Ngaoupata, Bourgouma, Samakale, Mariam, Houloumsa	15 irrigation systems	None	<ul style="list-style-type: none"> • 1 borehole ~40 m deep • Submersible electric pump • Solar panels • 2 storage tanks (5,000 l) • Buried water distribution system • Perimeter dike and 2 m high protective fence 	1-2 ha
Logone-et-Chari Region: Makary Center, Kousseri	2 fry production hatcheries	None	<ul style="list-style-type: none"> • 1 borehole • 3 m³ metal water tank • Solar panel • Submersible electric pump • 22 water retention basins (3m x 2m x 2m) from concrete blocks • 4 concrete lined fishponds (4 m x 5 m) • Protective fencing 1.8 m high with steel posts and cement base 	264 m ²

Logone-et-Chari Region: Houloumsa, Mblamé, Honkole, N'Djamena, Moulouang, Bodo N, Tildé	7 soil retaining dikes	None	<ul style="list-style-type: none"> • Soil dike for erosion control and soil restoration 	200 m to 1370 m in length. Estimated total length is 4,782 m.
CHAD				
<i>Locations</i>	<i>Type of Work</i>	<i>Existing Infrastructure</i>	<i>Components to be constructed and scope of work at each site</i>	<i>Size</i>
Chari-Baguirmi and N'Djamena: Darda, Bougoumène, Toukra Massa (9th district), Tchentchou	4 irrigation systems	None	<ul style="list-style-type: none"> • 1 borehole ~40 m deep • Submersible electric pump • Solar panels • 2 storage tanks (5,000 l) • Buried water distribution system • Perimeter dike and 2 m high protective fence 	1-2 ha
Chari-Baguirmi and N'Djamena: Kabè, Tchentchou	2 fry production hatcheries	None	<ul style="list-style-type: none"> • 1 borehole • 3 m³ metal water tank • Solar panel • Submersible electric pump • 22 water retention basins (3m x 2m x 2m) from concrete blocks • 4 concrete lined fishponds (4 m x 5 m) • Protective fencing 1.8 m tall with steel posts and cement base 	264 m ²
Chari-Baguirmi and N'Djamena: Laki, Laki3, Tchentchou, Maillao, Toukra	6 tree nurseries and boreholes for watering	None	<ul style="list-style-type: none"> • 1 borehole • Solar panel 	1 ha

Massa (9 th District), Dingagali	reforestation sites		<ul style="list-style-type: none"> • Submersible electric pump • 3,000 l elevated water tank • Protective 1.5 m high wire mesh fencing 	
Chari-Baguirmi and N'Djamena: Doralbache, Bandami1, Djama1	3 livestock vaccination centers	None	<ul style="list-style-type: none"> • 1 holding pen • 15 m long vaccination corridor • 3 metal sliding doors 	150 m ²
Chari-Baguirmi and N'Djamena: Dingagali (9 th District)	1 water retention pond	None	<ul style="list-style-type: none"> • 1 concrete lined pond 20 m x 30 m and 2 m deep • Protective netting fence 	225 m ²
Lac Province: Gally Anoui, Nguelea Mara, Gambia, Matafo2, Ngouri, Baderi, Moune Dossoloum, Moune Koura, Madikimerom, Femy	10 irrigation systems	None	<ul style="list-style-type: none"> • 2 boreholes ~40 m deep • Submersible electric pump • Solar panels • 2 storage tanks (5,000 l) • Buried water distribution system • Perimeter dike and 2 m high protective fence 	2 ha
Lac Province: Bol, Yakoua, Brim, Ngouri	4 tree nurseries each with a borehole for irrigating nursery seedlings and reforestation sites	None	<ul style="list-style-type: none"> • 1 borehole • Solar panel • Elevated water tank (3000 l) with metal support structure • Protective 1.5 m high wire mesh fencing 	1 ha

1.3. Analysis of alternatives

The project explored various alternatives for its implementation, considering factors such as location, potential impacts and their likelihood,. The selection of sites for interventions was based on factors such as the availability of natural resources, the needs of local communities, and the potential for sustainable development. The no-go alternative, which would involve continuing with current practices, was considered less desirable due to its limited potential for long-term economic growth and environmental sustainability. The project's implementation is expected to yield significant benefits, including improved livelihoods, increased food security, and enhanced environmental conservation.

1.4 Project location

The project activities are carried out in five departments in Chad, namely Kaya, Mamdi, Wayi, Chari and the 9th arrondissement, and five communes in Cameroon, namely Goulfy, Blangoua, Kousseri, Logone-Birni, and Makary. The departments are within three provinces in Chad and one department of Cameroon, namely the provinces of Lac, Chari-Baguirmi and N'Djamena, and the Logone-et-Chari department.

1.4.1 Lac Province (Chad)

The GTCA project works in the departments of Kaya, Mamdi, and Wayi.

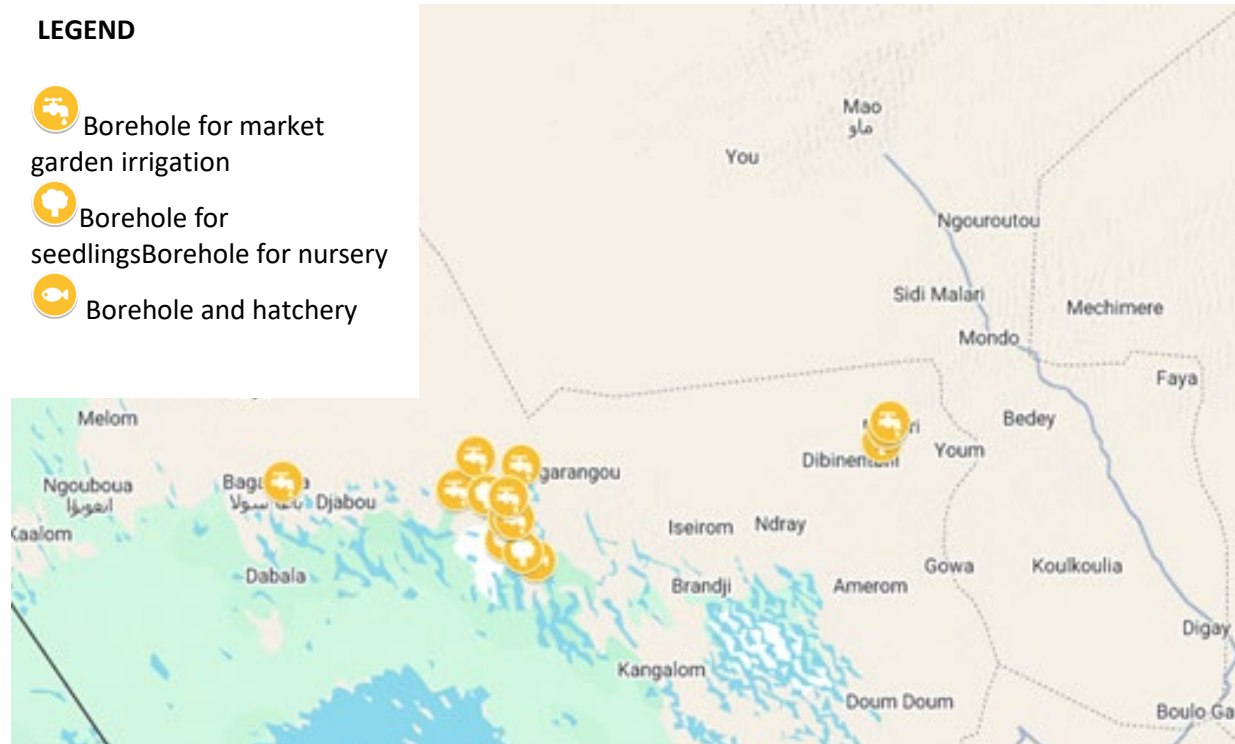
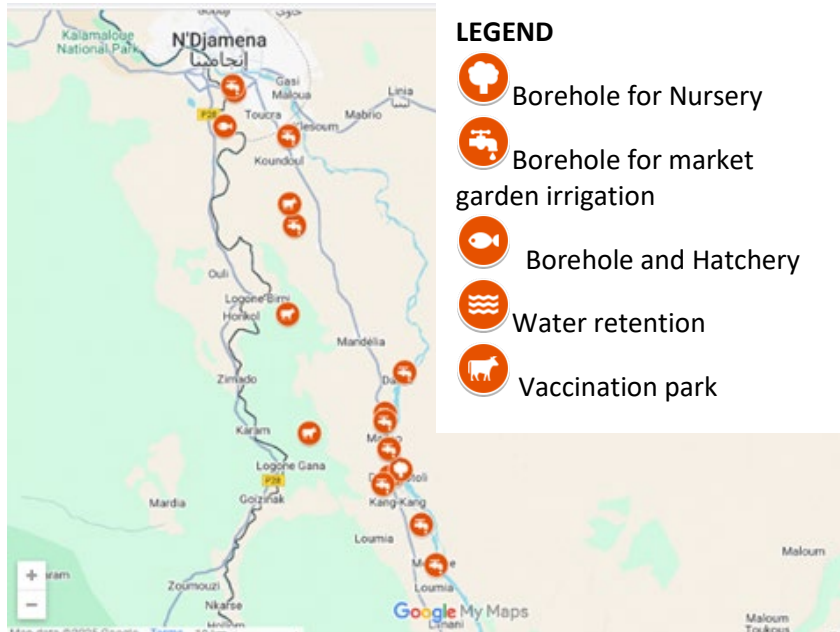


Figure 1: GTCA structural works sites in Lac Province³

³ <https://www.google.com/maps/d/u/0/edit?mid=12rHFWUJo6uPV16bWo04CZUDhZnABCa8&usp=sharing>

1.4.2 Chari-Baguirmi and N'Djamena Provinces (Chad)



The GTCA project works in the department of Chari in Chari-Baguirmi and the department of the 9th arrondissement in N'Djamena.

Figure 2: GTCA structural works sites in Chari-Baguirmi and N'Djamena Provinces⁴

1.4.3 Logone-et-Chari Department (Cameroon)

The GTCA project works in five communes of Goulfey, Blangoua, Kousseri, Logone-Birni, and Makary.

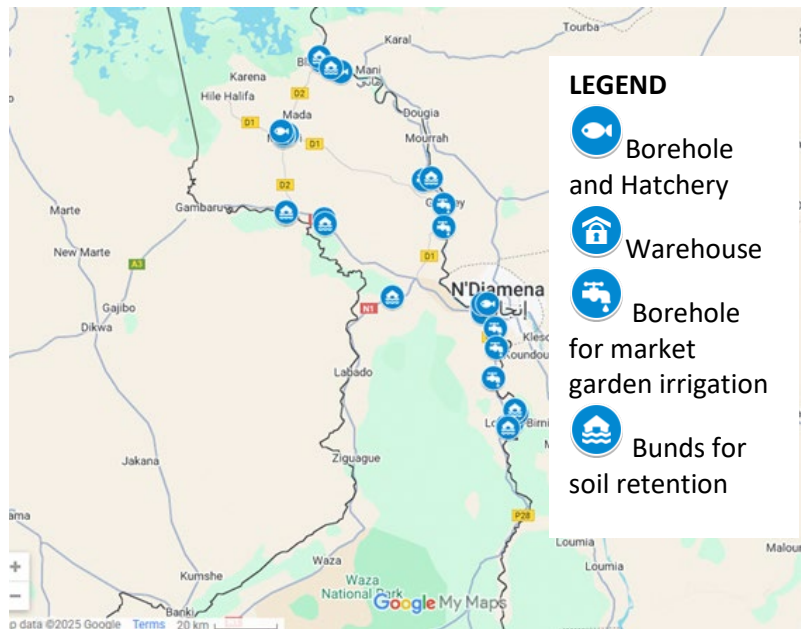


Figure 3: GTCA structural works sites in the Logone-et-Chari Department⁵

⁴ <https://www.google.com/maps/d/u/0/edit?mid=12rHFWUJo6uPV16bWo04CZUDhZnABCa8&usp=sharing>

⁵ <https://www.google.com/maps/d/u/0/edit?mid=12rHFWUJo6uPV16bWo04CZUDhZnABCa8&usp=sharing>

2. METHODOLOGY

2.1. Objectives of the ESIA

The overall objective was to carry out an Environmental and Social Impact Assessment to support the implementation of Nature-based Solutions for Climate Change Adaptation in Chad and Cameroon, in order to meet the requirements of Global Affairs Canada and Canadian government for impact assessment.

The key objectives of this study included:

- a) To determine the compatibility of the proposed GTCA project components and evaluate the local environmental conditions.
- b) Conduct a comprehensive Environmental and Social Impact Assessment (ESIA) to assess the potential environmental and social impacts of the GTCA project.
- c) To evaluate and select the best project alternative from the various options.
- d) To incorporate environmental management plans and monitoring mechanisms during implementation and operation phases of the project.
- e) Develop mitigation measures to reduce negative impacts, enhance positive outcomes, and ensure sustainable development.
- f) Assess and predict potential adverse social and environmental impacts of the GTCA project.
- g) Ensure compliance with relevant international, Chadian and Cameroonian environmental regulations and standards (regulatory framework).
- h) Ensure compliance with Canadian government ESIA requirements and Global Affairs Canada standards.
- i) Support the project's sustainability and positive contributions of the GTCA project to climate resilience, biodiversity conservation, and livelihood enhancement.
- j) Prepare a comprehensive ESIA report that addresses all relevant aspects of the project, and its environmental impacts, and provides a detailed environmental management plan.

2.2. Summary of methodology

The study evaluated and characterized the potential impacts of the proposed project. To achieve this, the study team employed multiple methodologies, including literature review, field visits, and consultations with stakeholders and community members, to gather comprehensive baseline information that would serve as a benchmark for assessing potential impacts and developing the Environmental Management Plan (EMP). A reconnaissance visit was made to the project area by the study team. Based on this, the team set out key areas of observation which was followed by detailed visits to the project areas and neighboring facilities, taking records of observations as well as interviewing community members. Interviews were conducted with a range of stakeholders to gather their perspectives on the anticipated impacts of the project. In addition, a comprehensive literature review was undertaken, including an examination of the Impact Assessment Act (IAA) and other relevant statutes directly applicable to the proposed project. Further reports and reference materials containing physical and biological data on the study area were also reviewed

and analyzed. The general steps followed during the assessment were as follows:

- a) Environmental screening, in which the project was identified as among those requiring impact assessment act, and the Global Affairs Canada Standards.
- b) Environmental scoping that identified key environmental issues; studies and interviews.
- c) Physical inspection of the site and surrounding areas.
- d) ESIA Public participation by the use of interviews and open stakeholder consultation meetings
- e) Baseline Surveys, and
- f) Development of the ESIA report

2.3. Detailed methodology

2.3.1. Scoping

To initiate the environmental assessment process, a literature review and stakeholder consultations was conducted to identify key environmental concerns and potential impacts. The scope of the EIA was defined, encompassing the project's geographical area, activities, and potential impacts. Additionally, communication with LWF was engaged to gather essential information on the GTCA project's background, objectives, outcomes, and targets.

2.3.2. Site survey and baseline survey

Baseline data were collected to assess the environmental conditions of the project area, focusing on biodiversity, land use, water quality, and soil health. This process combined secondary data review with extensive field visits to all project components.

Field observations covered various aspects of the biophysical and socio-economic environment, including landscape, geology, soils, flora, fauna, and existing environmental challenges. GPS coordinates were recorded to map project locations, and photographs were taken with prior consent from community members.

The findings from these field assessments and stakeholder consultations were synthesized and integrated into the Environmental and Social Impact Assessment (ESIA) report.

2.3.3. Public participation

Public consultations are a stage in the ESIA process during which interviews and meetings are held in consultation with the various project stakeholders. The aim is to explain to stakeholders, including local communities, traditional, administrative and municipal authorities, sectoral services and local associations, the components and activities of the Project and their impact on

the physical and biological human environment, in order to gather their opinions, concerns and wishes.

In short, public participation is a key element of the ESIA. It allows the public's perceptions, concerns, expectations, and recommendations regarding the implementation of the project to be taken into account.

Public consultations have the following objectives:

- To clearly present the project's components and activities to stakeholders, enabling a better understanding of the project and its potential impacts.
- To identify the potential impacts in a participatory manner with stakeholders and propose mitigation, compensation, or optimization measures that are effective and adapted to the local context.
- To provide an opportunity for stakeholders to express their concerns, apprehensions, and expectations regarding the project, in order to develop appropriate and responsive solutions.
- To anticipate potential problems the project may cause and address them proactively by integrating the perspectives of local communities.
- To collect relevant information that will inform and strengthen the study.

2.3.4. Legal framework

Secondary data, including relevant Cameroonian and Chadian legislation and regulations pertaining to environmental protection and impact assessment, was reviewed. Additional statutes were obtained through stakeholder consultations and analyzed their relevance to the project. The project's compliance with these requirements was assessed.

2.3.5. Impact assessment

Data was collected through site assessments and focus group discussions. The study identified and evaluated potential positive and negative environmental, social, and economic impacts, taking into account both short-term and long-term effects. It also examined the project's cumulative impacts in relation to other local activities. Impact identification was guided by an inductive analysis of focus group discussions and key informant interview, and by consideration of the district's geographic location, socio-economic dynamics, and existing vulnerabilities.

2.3.6. Mitigation measures and environmental management plan

A comprehensive plan was developed to mitigate negative environmental impacts and strengthen resilience to potential challenges. The study team identified appropriate mitigation measures, including biodiversity management, habitat restoration, soil conservation, and water resource management strategies, to minimize adverse effects and promote environmental sustainability.

2.3.7. ESIA report preparation

A comprehensive ESIA report was prepared, addressing all relevant aspects of the project and its potential environmental and social impacts. The report was developed in compliance with the requirements of both the Ministries of Environment in Cameroon and Chad, and Canadian government guidelines.

3. CAMEROON AND CHAD LEGAL FRAMEWORK

3.1. Legislation in Cameroon

Cameroon's environmental legal framework is robust and grounded in the 1996 Constitution, which guarantees every citizen the right to a healthy environment and obliges the State and citizens to protect it. The Framework Law No. 96/12 of 5 August 1996 on Environmental Management is the cornerstone of environmental protection. It mandates Environmental and Social Impact Assessments (ESIAs) for any project likely to affect the environment. This is reinforced by Decree No. 2013/0171/PM, which details procedures for conducting ESIs, including four types: environmental notice, summary of ESIA, detailed ESIA, and strategic environmental assessment. The GTCA project requires a detailed ESIA.

Additional decrees strengthen environmental governance:

- Decree No. 2012/0882/PM assigns environmental responsibilities to municipalities.
- Decrees No. 2012/2808–2809/PM regulate waste management, environmental inspections, and hazardous waste transport, requiring environmental permits and traceability manifests.
- Decrees No. 001–002/MINEPDED (2012) defines conditions for waste management and industrial waste control.
- Decrees No. 2011/2582–2585/PM (2011) govern air quality, noise, odour, soil, and water pollution, prohibiting harmful discharges and activities that degrade land or public health.

Environmental monitoring structures include the Interministerial Committee on the Environment (CIE), created under Decree No. 2006/1577/PM, and Departmental Monitoring Committees established by Decree No. 001/MINEP (2013) to oversee Environmental and Social Management Plan (ESMP) implementation and promote community consultation.

Sectoral laws complement this framework:

- The Forests, Wildlife and Fisheries Law No. 94/01 (1994) mandates sustainable management of forests and aquatic environments and requires EIAs for projects affecting forests or aquatic environments.
- The Water Law No. 98/005 (1998) regulates water conservation and pollution prevention,

requiring measures against contamination of surface and groundwater.

- The Mining Code (Law No. 0001 of 16 April 2001) and related decrees govern quarrying and extraction, ensuring environmental protection and worker safety.
- Decree No. 2007/0004/MINEP sets accreditation rules for consulting firms authorized to conduct EIAs.

Other relevant laws cover cultural heritage, labour, health, and social protection:

- Law No. 91/008 (1991) protects cultural and natural heritage during construction works.
- Labour Code (Law No. 92/007, 1992) and related decrees ensure worker health, safety, and fair conditions.
- Health laws (1964–1996) regulate public hygiene and occupational safety.
- Law No. 83/013 (1983) protects persons with disabilities and promotes their inclusion.

Finally, Law No. 98/015 (1998) regulates classified establishments that may pose risks (e.g., fuel storage, cement use), requiring proper authorization and control. Agricultural and public works regulations, such as Decree No. 2010/0242/PM, promote sustainable rural development and responsible use of natural resources. At the central government level, the Ministry of Economy, Planning and Regional Development (MINEPAT) serves as the lead promoter, coordinating national land-use planning and ensuring coherence with development policies. The Ministry of Environment, Nature Protection and Sustainable Development (MINEPDED) oversees environmental compliance, public awareness, and the validation of ESIA through the Interministerial Committee on the Environment (CIE).

The Ministry of Domains, Cadastre and Land Affairs (MINDCAF) ensures lawful land acquisition and compensation for affected populations. MINADER (Agriculture) supports rural development and crop protection, while MINEPIA (Livestock and Fisheries) oversees sustainable animal and fishery resource management. The Ministry of Forests and Wildlife (MINFOF) ensures biodiversity conservation and prevents habitat destruction.

MINTSS (Labour) guarantees worker protection and labour law compliance; MINPROFF (Women and Family) promotes gender equality and women's empowerment, central to the project's approach; and MINAS (Social Affairs) monitors social safeguards for vulnerable groups. MINTP (Public Works) ensures infrastructure safety, while MINSANTE (Public Health) oversees health measures for communities and workers.

Other key ministries include MINH DU (Housing and Urban Development) for sanitation and urban standards, MINT (Transport) for road safety and meteorological data, MINDEF (Defence) for security in conflict-affected zones, MINATD (Territorial Administration) for local coordination, and MINEE (Water and Energy) for regulating water and energy use.

Two oversight bodies strengthen implementation:

- The CIE, which reviews and validates environmental studies.

- The Departmental Committee for Monitoring Environmental and Social Management Plans, ensuring local compliance and community consultation.

Together, these institutions ensure that the project aligns with national priorities, environmental safeguards, and gender-responsive development.

Together, these instruments provide a comprehensive framework ensuring that all development projects in Cameroon, especially those with environmental and social implications, are conducted sustainably, transparently, and in compliance with national and international standards.

3.2. Legislation in Chad

Chad's environmental management framework is founded on several legislative and regulatory instruments that ensure sustainable development and resource protection. The Constitution of 2018, revised in 2020, recognizes the right of all citizens to a healthy environment and makes environmental protection a duty of the State and citizens.

The institutional and legal framework for environmental management in Chad is built on a solid foundation of national laws, ministerial mandates, and international commitments aimed at promoting sustainable development and safeguarding natural resources.

The cornerstone of Chad's environmental policy is Law No. 14/PR/98 of 17 August 1998, which defines the general principles of environmental protection and sustainable management. It requires Environmental and Social Impact Assessments (ESIAs) for all projects likely to affect the environment. This law is supported by Decree No. 630/PR/PM/MEERH/2010, which regulates EIA procedures, and Order No. 039/2012, which guides public consultations. Complementary legislation includes Law No. 14/PR/2008 on forests, wildlife, and fisheries, promoting biodiversity conservation and local participation, and Law No. 16/PR/99 (Water Code), which governs water use, protection, and pollution control. Land tenure is governed by Laws Nos. 23, 24, and 25 of 1967, defining public and private property rights and customary ownership systems.

At the institutional level, several ministries play key roles in implementing environmental and social safeguards. The Ministry of Environment, Fisheries, and Sustainable Development (MEFSD) leads the formulation, implementation, and monitoring of national environmental policy. It validates ESIAs in line with Law No. 14/PR/98 and coordinates international environmental cooperation. Its responsibilities include developing environmental protection master plans, ensuring rational resource management, and encouraging public participation in environmental governance.

The Ministry of Water and Sanitation develops and implements policies related to water supply, sanitation, and resource protection. It oversees water production, quality monitoring, and infrastructure development in rural and urban areas. The Ministry of Agricultural Production and Processing ensures food security and rural development by designing and evaluating agricultural programmes, strengthening producer support, and managing public food stocks.

The Ministry of Public Health and Prevention safeguards public health by enforcing hygiene standards and preventing waterborne diseases, while the Ministry of Land Use Planning, Housing, and Urban Development regulates urban planning, housing, and land use based on the 1967 land laws. The Ministry of Livestock and Animal Production promotes sustainable livestock development and contributes to food security.

Internationally, Chad has ratified several key environmental conventions, demonstrating its commitment to global sustainability. These include the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, the Stockholm and Rotterdam Conventions, and the Ramsar Convention on Wetlands. Additionally, Chad has endorsed the Rio Declaration on Environment and Development and the Yaoundé Declaration on tropical forest management.

At the regional and sub-regional levels, Chad collaborates with organizations such as the Central African Forest Commission (COMIFAC) and the Lake Chad Basin Commission, which promote joint management of transboundary ecosystems, forest conservation, and the fight against desertification.

Together, these laws and institutions provide a comprehensive foundation for environmental governance, ensuring the sustainable management of natural resources in Chad.

4. DESCRIPTION OF THE ENVIRONMENT

4.1. Cameroon

The baseline (initial) condition of the project site in Cameroon represents the pre-project environmental state against which potential impacts will be measured. It aims to identify the physical, biological, and socio-economic components likely to be affected. Data were collected from existing documentation, field surveys, and in situ measurements within the project's study area, encompassing all zones of direct and indirect influence. The direct area of influence includes the construction and activity zones of the GTCA project in Logone and Chari, while the indirect area of influence extends to the municipalities of Blangoua, Goulfey, Kousseri, Logone Birni, and Makary.

4.1.1. Physical Environment

Cameroon's far north region's climate is tropical, with a long dry season of about seven months and a rainy peak in August. Annual rainfall ranges between 400–1,100 mm, and average temperatures vary between 26–27 °C, reaching up to 47 °C during the hottest months. Humidity averages 48%, and prevailing winds (mainly the Harmattan from the north and northeast) contribute to high dust levels. These conditions influence construction materials, work schedules,

and pollution dispersion. Air quality is mainly affected by dust, especially during the dry season. Industrial emissions are negligible, and noise levels are low, limited to road traffic. The area is a flat plain within the Lake Chad basin, favouring water stagnation and seasonal ponds. Soils include luvisols (clayey, suitable for crops and grazing), planosols and vertisols (“Hardé” soils used for sorghum and grazing), fluvisols (along rivers, ideal for rice), and fersiallitic soils (poorly drained and prone to waterlogging). The areas bordered by Logone & Chari rivers, with seasonal ponds, are used for irrigation but are also prone to flooding due to flat terrain. Vegetation is Sahelian savannah; sparse shrubs (2–4 m) and grasses. Common species include *Guiera senegalensis*, *Acacia albida*, *Balanites aegyptiaca*. Trees are very useful, and serve for Soil enrichment, medicine, food, and livestock feed, but deforestation due to firewood and grazing threatens woody cover. Fauna here include; *Aquatic*: Rich fish diversity (≈100+ spp.) declining from overfishing and eutrophication. Also hippos, crocodiles, *Mammals*: Elephants, lions, gazelles, hyenas, giraffes, etc, and *Birds*: Migratory species—storks, falcons, sparrowhawks—abundant post-harvest.

4.1.2. Socio cultural, economic and political environment

The Logone and Chari Department, located in Cameroon’s Far North Region and bordered by the Logone River separating it from Chad, comprises ten municipalities, five of which—Kousséri, Blangoua, Goulfey, Logone-Birni, and Makary—are directly affected by the project. The population is estimated at 367,253 inhabitants, including 177,091 women (INS 2019). The area is ethnically diverse, home to Kotoko, Choa Arabs, Buduma, Fulbe (Bororo), Makari, and minority groups such as Bamiléké, Béti, and Bamoun, as well as foreigners from Chad, Nigeria, Niger, Mali, and China. Fulfulde serves as the main interethnic communication language. The socio-political system is traditionally hierarchical, organized into cantons, tribes, and villages, with chiefs, land custodians (“blamas”), and elders playing key roles in governance, land allocation, and conflict resolution. The family structure is patriarchal and patrilineal, though modern inheritance practices are evolving. Land management is dual—urban land is overseen by municipal authorities, while rural land remains under customary control, considered communal and inalienable. Land is primarily customarily owned, with the blama (village land chief) allocating land through inheritance or lease. Urban areas are municipally supervised but lack formal urban plans. Access rights, especially for grazing and water points, are often overlapping or unclear. Women face disadvantages under customary land systems, though access is sometimes granted. To avoid disputes, formal land agreements, documented and registered, are recommended before project interventions.

Livelihoods rely heavily on subsistence farming, fishing, and livestock rearing, supported by seasonal floodplains and rivers. Women often engage in petty trade and small-scale food processing. However, the population remains vulnerable to climatic shocks, land disputes, and declining natural resources. The community is predominantly Muslim, with peaceful coexistence among Christians and animists. Housing types vary from modern cement houses in towns, in contrast with traditional mud and straw dwellings in rural areas.

Agriculture is a key economic activity in both rural and peri-urban areas. Crops include cowpeas, sorghum, maize, groundnuts, soya, rice, and vegetables (onions, tomatoes, peppers). Cotton is the

main cash crop. Farming is mostly subsistence, on small plots ($\approx 1\text{--}2.75$ ha). Oxen are used for ploughing, but it is common for youths to be employed labor in farms. Generally, Community and private nurseries grow Eucalyptus, Neem, Acacia, and fruit trees (mango, guava, lemon). These Trees provide timber, fuelwood, and shade; fruit trees contribute to livelihoods. Livestock rearing is predominantly extensive/traditional systems; cattle are common in rural areas; small ruminants, pigs, and poultry in residential areas. It generates employment, though professionalization is still developing. Fishing is practiced in the lake, rivers, and ponds. Fish species include carp, catfish, tilapia, and eels. Some of the challenges include lack of cold storage, fish markets, processing facilities, transport, and proper equipment. Also, overfishing and harassment by authorities. Hunting is marginal due to religious and legal restrictions, but when practiced, includes mainly hares, antelopes, birds, and reptiles. Trade includes communities selling agricultural, livestock, fish, and craft products. Larger towns trade with neighboring countries (Nigeria, Chad and Niger). Unfortunately, Poor roads hinder commercial activities. Crafts Includes pottery, blacksmithing, and shoemaking for local use and sale. Sand and clay mining is also done for construction and crafts. More creative crafts include product processing (millet, rice, earth blocks, charcoal....etc).

Sacred sites include cemeteries, chiefdoms, and places of worship. They are of considerable importance strongly backed by cultural and spiritual beliefs. Vulnerable groups include women, youth, and people with disabilities. Young people, though numerous, suffer high unemployment and limited education, increasing vulnerability to armed recruitment.

Patriarchal and religious norms limit women's access to education, decision-making, land, and income-generating activities. Women carry heavy responsibilities in agriculture, household management, and childcare. Early marriage and polygamy contribute to low female schooling and socio-economic vulnerability. Gender-based violence (GBV)—including forced marriages, abductions, and sexual exploitation—remains widespread, intensified by conflict and displacement.

The department faces high insecurity due to Boko Haram (JAS), ISWAP, and BAQOURA, who engage in terrorism, looting, and smuggling. Incursions cause displacement, disrupt livelihoods, and pose challenges for some project implementation. Special security arrangements are necessary even in areas currently considered safe, as threats may shift rapidly. Vulnerable groups are disproportionately affected by Boko Haram crisis.

4.1.3. Education, health, water and energy

Primary and nursery education is widely spread, but enrollment and literacy levels are low, especially for girls. Secondary education exists (general and technical), but attendance is low, and lack of birth certificates affects continuation. There are limited health infrastructure: district medical centres, integrated health centres, and private facilities. Challenges include staff shortages, poor access, low-quality care, reliance on alternative medicines, and frequent epidemics (cholera).

Water is supplied mainly through boreholes and wells; towns like Makary and Kousseri have partial

municipal water distribution systems. But access remains limited; many rely on rivers, swamps, or unprotected wells, causing waterborne diseases. Makary, Blangoua, and Logone Birni have no electricity grid; communities rely on the use of generators and solar lamps. Kousseri and Goulfey on the other hand have limited ENEO grid coverage, frequent power cuts, at a very high cost. Fuel products often smuggled from Nigeria, with price fluctuations. There are National, departmental, and rural roads, but are often degraded. Rural roads are unnavigable during rainy seasons; transport is mainly via donkeys or small vehicles.

There are a good number of Civil Society and Development Actors in the region. The area hosts various community organizations—associations, cooperatives, Community Initiative Groups (GICs), alert and vigilance committees, farmers and religious groups—though many, particularly in villages, are inactive and require support. National and international NGOs, including UN agencies, provide humanitarian assistance sustainably. Local elites and political representatives also influence decision-making and connect communities to external actors.

4.2. Chad

The baseline (initial) condition of the project site in Chad represents the pre-project environmental state against which potential impacts will be measured. It aims to identify the physical, biological, and socio-economic components likely to be affected. Data were collected from existing documentation, field surveys, and in situ measurements within the project's study area, encompassing all zones of direct and indirect influence.

The direct impact zone includes the area where infrastructure construction will take place. This zone will be centered around the construction sites. The indirect and/or diffuse zone of influence refers to the immediate surroundings of the direct impact zone—areas that will not be directly affected by the construction works. This zone includes the localities of Bagasola, Bol, and Ngouri. The expanded area of influence covers a much larger territory, extending well beyond the boundaries of the core study area. It encompasses the departments of Kaya (Nguelea Mallah, Gally-Anoui, and Femi), Mamdi (Gambia, Bol, Yakoua, Matafo2, Moune Dossoloum, Moune Koura, and Birim), Wayi (Ngouri and Badéri), Chari Baguirmi (Darda, Laki, Tchentchou Maraîcher, Tchentchou Pépinière, Tchentchou Piscicole, Bougoumène, Laki3, Mailao, Bandami1, Doralbache, and Amdjamalma1), as well as the 9th arrondissement of N'Djamena (Toukra Massa, Toukra, Kabé, and Ndingagali)

4.2.1. Physical environment

The construction sites share a Sahelian biophysical environment, marked by a long dry season (mid-October to mid-June) and a short rainy season (mid-June to early November). Three main seasons are distinguished; Dry and cool (Nov–Feb): average temperature around 23°C, Dry and hot (Mar–mid-Jun): average maximum of 38°C, and Rainy (mid-Jun–Nov): moderate temperatures of 28–30°C. These conditions allow up to two or three annual harvests when proper irrigation and farming techniques are applied. Rainfall averages 300–500 mm/year, though irregularities and early rains often lead to crop loss. Relative humidity ranges from 10–20% in dry months to 30–

80% during the rainy season, peaking in August. In recent years, heatwaves exceeding 44°C have become frequent, worsening health risks, water scarcity, and vegetation evapotranspiration. Winds blow at speeds between 5–10.4 m/s, with stronger gusts (over 7 m/s) between January–May and November–December, sometimes causing sandstorms and dune formation that reduce arable land. The terrain around Lake Chad features dunes, depressions, and wadis, while the hydrography is dominated by Lake Chad and its tributaries, mainly the Chari and Logone rivers. Lake Chad’s level fluctuates seasonally by about one metre, with an average depth of 4 m (up to 10 m in some places). The Soils in Chari Baguirmi are predominantly clay and sandy, with hydromorphic soils along riverbanks. Groundwater is recharged mainly by rainfall, with semi-permanent ponds lasting three to five months. Vegetation is mainly sparse Sahelian savannah, comprising shrubs, woody and shrubby species such as *Acacia spp.*, *Balanites aegyptiaca*, *Ziziphus spp.*, *Calotropis procera*, *Boscia senegalensis*, and *Azadirachta indica* (Neem), which provides village shade. These are widely used by local communities for firewood, timber, medicinal purposes, and livestock feed, with the sale of wood providing an important source of household income. *Eucalyptus*, *Prosopis*, *Ficus*, and *Neem*—is planted around homes for fruit, shade, and household use. Herbaceous vegetation is abundant, including species such as *Cenchrus biflorus*, *Pennisetum reticulatum*, and *Calotropis procera*. These are used for roof construction, weaving, fodder, and traditional medicine.

Field surveys show that vegetation near Lake Chad is denser and in relatively good condition, supporting wildlife such as squirrels, monkeys, and birds. In contrast, areas near N’Djamena and Chari Baguirmi face heavier agricultural pressure, deforestation, and soil degradation due to greater human activity. The removal of vegetation is closely linked to erosion and sand encroachment, highlighting the need for reforestation near watercourses. The faunal population has declined drastically over the past decades, mainly because of deforestation and human disturbance. Large mammals have almost disappeared, while remaining wildlife consists mostly of hyenas, jackals, gazelles, hares, monkeys, squirrels, monitor lizards, and numerous bird species, especially during the rainy season. Lake Chad is a UNESCO World Heritage Site, has a rich and diverse biodiversity, vital for fish, birds, and cultural heritage, but rising population pressures threaten conservation efforts.

4.2.2. Socio cultural, economic and political environment

According to the 2009 census and 2012 projections, the project area had 118,885 inhabitants (42,864 in Lac, 26,034 in Chari Baguirmi, 40,940 in the 9th arrondissement). Using RGPH growth rates (2.6–3%), the 2012 estimate was 159,408, but field surveys suggest these official estimates are often lower than actual population figures. Field surveys indicate populations in main villages range between 8,000–9,000, with an average family size of 6–7 people. From Sept 2022 to Oct 2024, Lac Province recorded 200,031 internally displaced persons (IDPs), 22,599 returnees from abroad and 16,946 former IDPs. Displacements are mainly due to armed attacks (35%), kidnappings/fear (35% and 28%), and flooding (2%). Most displaced people (96%) stayed within their sub-prefecture. Immediate needs for displaced populations include food, shelter, and non-food items.

Agriculture relies heavily on rainfall, with low mechanization, limited irrigation, and lack of diversification. Farmers usually experience post-harvest losses; Livestock rearing is highly practiced, but competition for resources, and insufficient veterinary care are hinderances. Customary rules dominate, with inequalities in access for newcomers and vulnerable groups, and rising land prices due to private investment. In the Lake Province, Fishing is widespread and important for local/national income. Mostly artisanal using traditional methods with limited storage/processing. Same in Chari Baguirmi communities purely rely on artisanal fishing in rivers and ponds; it offers potential for complementary income.

Land ownership is a determinant of wealth, and land ownership depends on arrival timing, alliances with local chiefs, access to prime land (riverbanks, berberé⁶ land), and ownership of animals. Land is available, since population density is low; farming intensification is discouraged. Bérébéré crops yield 1–1.5 tonnes without inputs. Land is owned by Inheritance, borrowing, renting, and purchasing, and land governance combines traditional and modern laws. High refugee/displaced population increases land competition, leading to tensions. Land chiefs largely control allocation; however, large-scale projects fall under administrative authority. In terms of land type, Traditional polders dominate (75.4%), followed by plains (61%) and faux polders (54.4%). Developed polders/wadis are rare. Land ownership is owned by: Ownership (87.2%), leasing (74.9%), sharecropping (62.6%), tenant farming (33.8%). Disputes exist in 13.8% of sites but are mostly resolved locally. Recent Trends show that Land sales are rising due to economic pressures, often partially recorded; chiefs' involvement varies. Little cadastral planning exists.

Women face significant inequalities compared to men. 62% female illiteracy rate, nearly double that of men. Female-headed households earn 25% less than male-headed households. Vulnerable groups include widows and single mothers, who face the greatest economic and social disadvantages followed by youths and people living with disabilities. Women bear a heavier workload than men: ~6 hours/day on domestic and care tasks, in addition to productive work, versus ~2 hours for men. Women fear unequal access to jobs, compensation, and natural resources due to their key household roles. Social norms limit women's public participation and decision-making, requiring targeted measures to facilitate involvement. Women play a Central role in household and income, yet socially marginalized. Child Labour rate is Significant, especially in rural areas. There are high activity rates among 6–14-year-olds. Sexual violence is widespread, exacerbated by Boko Haram activities. Customary practices (levirate, sororate) and forced marriages exist. FGM prevalent is 34.1% of women (15–49 years), 7% of girls (0–14 years). Early marriage rates are declining but remain high.

The area is ethnically diverse, including Kanembu, Boudouma, Arabs, Fulani, Saras, and others. Both indigenous people and internally displaced persons coexist peacefully, with strong inter-

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- ⁶ **“berbéré land”** (also spelled *berbéré*, *berberé*, or *berbere*) is land that lies along rivers, lake shores, or floodplains (especially around **Lake Chad**). During the rainy season, these areas are flooded, and as the water recedes, the soil remains rich in moisture and nutrients — ideal for growing sorghum, maize, millet, and sometimes vegetables..

ethnic marriages and community solidarity. Project planning must ensure equitable participation and avoid ethnic tensions, with consultations tailored to each group's cultural practices. The population practices Islam, Christianity, and traditional beliefs (animism). Project impacts on places of worship, religious practices, and freedom of religion must be considered as they are of great importance to communities. Collaboration with local religious leaders is necessary to respect religious customs during implementation. Most homes are built with permanent materials (cement, tin), reflecting access to cross-border resources. However, rural groups may live in mud or temporary houses, highlighting low income and limited housing capacity.

The area's administration involves state representatives (sub-prefects), traditional authorities (canton chiefs), and law enforcement agencies. Traditional authorities are key partners in the development of initiatives and community management. Law enforcement maintains public order and security, supporting project implementation. NGO support is limited. Village and business groups collaborate for farming projects.

4.2.3. Cultural heritage, Education, health, water and energy

One popular Cultural & Heritage Site is in Chari Baguirmi, Sao mounds (e.g., Mgada mound near Lamadji) with significant archaeological remains needing protection.

Education in Lac Province is characterized by low Primary school enrolment at 14%; secondary enrolment only 3%. Over 77% of the population has only primary education. And Schools often lack permanent buildings, furniture, and textbooks; teacher-pupil ratios are high. In Chari Baguirmi there are 18 primary schools with 10% enrolment overall. Classrooms made of non-durable materials, and lessons were often disrupted by weather. Teachers are insufficient in numbers and often unqualified. Girls' enrolment is consistently lower than boys'.

There are sparse healthcare facilities; Lake Province has 97 health centres, 5 hospitals; average distances are 8 km to centres, 37 km to hospitals. While Mandalia district has 1 doctor, 15 nurses for ~61,634 people. Malaria and diarrhea are the most common epidemics.

There's only partial coverage of drinking water from municipal distribution (37–70%). Rural households mostly do not treat water. Boreholes and wells exist but are often poorly maintained; management committees are absent. Water access is insufficient for livestock; requires new infrastructure and maintenance.

5. PUBLIC AND STAKEHOLDER CONSULTATION

5.1. Consultation of public and stakeholders

A wide range of key stakeholders were consulted through stakeholder meetings, FGDs and one-on-one interviews to gain their views about the social, economic and environmental impacts of the project. To ensure broad stakeholder engagement, consultations were held with government agencies, local authorities, traditional leadership, and community members. Key informant

interviews were conducted to gather insights from experts and local leaders. Public consultations were conducted through Focus Group Discussions to discuss the GTCA project components with community members. These discussions aimed to gather their views on the importance and relevance of the project, as well as potential negative environmental and social impacts. The feedback from these consultations was used to address concerns and ensure the project's social acceptability. The feedback and insights gathered from these engagements were analyzed to inform the project's design and implementation. The table below shows the issues raised by the community and its leaders about the project and the possible mitigation measures to be employed.

Public consultations were conducted through Focus Group Discussions to discuss the GTCA project components with community members. All the communities were unanimously in favor of the project and were pleased and grateful that the project's activities were on their land. Male and female participants were present on an average of 54% and 46 % respectively. They expressed some concerns and recommendations as seen in the table below:

Table 5: Concerns and recommendations from communities

<i>Concerns / expectations expressed</i>	<i>Recommendations expressed</i>	<i>Response</i>
We expect high-quality infrastructure and, above all, that deadlines are met.	Involve the communities, and raise awareness among local residents on HIV/AIDS	The proponent ⁷ will prioritize implementation of construction activities to ensure timelines are met. The proponent should provide comprehensive training and mentorship in IGAs, WASH and HIV/AIDS
Train women's groups and youth associations on IGAs (Income Generating Activities); recruit local young people as laborers.	There should be a committee for the long-term monitoring of infrastructures.	The proponent will provide comprehensive support and training on IGAs to women and other vulnerable groups, including youth. The proponent will set up community management committees to oversee each of the structural infrastructures built. The proponent will prioritize recruiting local labour, including youth.
There's still scarcity of drinking water sources, could the boreholes be used as a	Project activities on the field should be identical to project description on paper.	The proponent acknowledges the concern scarcity of safe drinking water. However, the boreholes that will be constructed are designed solely for irrigation and do not meet potable water standards.

⁷ The proponent refers LWF, however in some cases these responses will be contracted out to the construction company

source of drinking water?		Proponent will carry out the construction of structural works as planned.
Recruit local young people during the works.	Involve youths as much as possible	The proponent will prioritize recruiting local labour, including youth.
Would Women be granted access to plots of land after the construction of infrastructure	Integrate gender issues into awareness campaigns	The proponent will ensure that women have equitable access to land that is improved through the construction of infrastructure. The proponent will integrate gender into all awareness campaigns and activities. The proponent
The problem of flooding that persists in the area despite the investments already made, hope the boreholes and other infrastructure will still be accessible during flooding.	Improvement of access roads within the perimeters to facilitate the distribution of agricultural products	The proponent should work with local communities and leaders to identify the best sites for infrastructure to ensure accessibility in the event of flooding.
The risk of loss of property following the rehabilitation of the footpath along the dyke envisaged by the project.	Protection of local labourers in accordance with relevant regulations	The proponent should work with local communities and leaders to identify the most appropriate site for dykes that do not impact private property. Proponent will abide by all relevant regulations related to the health and safety of labourers.
Install a borehole for the benefit of the population and not for a small group of people.	Take precautions to reduce machine noise and dust.	The proponent should work with the local authorities, leaders and community members to ensure infrastructures are in locations that are accessible to the community and managed long term by a community committee that will ensure communal access. The proponent will implement necessary mitigation measures to reduce noise and dust.
We want non-local workers to respect the	Development of high-yield improved seeds;	The proponent should respect the community's cultural values and traditions

customs and traditions of our village		and will incorporate them into project implementation
Recruit local young people during the works	Support for vulnerable people and the elderly	The proponent will prioritize recruiting local labour, including youth. The proponent will prioritize supporting women and vulnerable people, including the elderly.

During public consultations, communities went as far as expressing their wish to see future phases provide support in more clean energy sources for their livelihoods, more potable water sources to reduce epidemics and waterborne diseases, more support in the provision of high yield improved seeds, and capacity building in value chains (storage conservation, and transformation) of agricultural produce.



Figure 5: Participants in the public consultation from the villages Bol



Figure 4: Public consultations with technical and administrative bodies, and communities in Cameroon

6. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1. Introduction

This section presents an analysis of the potential positive and negative socio-economic and biophysical impacts of the GTCA project. It also outlines strategies designed to mitigate adverse effects and enhance the project's positive contributions to the environment and local communities. The GTCA interventions are expected to generate substantial benefits across environmental, social, and economic dimensions. Anticipated positive impacts include improved soil health, access to water for irrigation, climate change adaptation, increased agricultural productivity, and strengthened sustainable livelihoods. The interventions also support biodiversity conservation, poverty reduction, and overall community well-being. At the same time, the project may give rise to unintended negative impacts. To minimize these, careful planning, effective implementation, and continuous monitoring are essential to ensure that mitigation measures remain responsive and context appropriate.

A matrix-based approach was employed to assess the significance of identified impacts, taking into account factors such as likelihood, severity, extent, and duration. Likelihood was rated as *low*, *moderate*, or *high*, representing the probability of occurrence. Severity and duration were evaluated to determine the overall magnitude of each impact. These assessments were informed by the specific environmental and socio-economic context of the project areas, as well as insights gathered through focus group discussions. Each impact was then assigned a significance rating, *high*, *medium*, or *low*, with high-significance impacts characterized by a high likelihood, extended duration, and severe consequences, while low-significance impacts were those of minor importance and limited duration.

Table 6: Cross-Border Potential Positive Impacts – Chad & Cameroon

Intervention	Positive Impacts	Significance Low/Mod/High	Likelihood Low/Mod/High	Enhancement Measures
Irrigated Agriculture and Boreholes	Increased agricultural yields and diversification of crops	High	High	<ul style="list-style-type: none"> • Implement participatory water user management committees • Ensure regular maintenance of irrigation and boreholes • Train farmers on efficient water use • Train farmers on NBS techniques • Promote women’s participation in local committee that manages borehole governance
	Improved access to irrigation	High	High	
	Improved soil fertility and reduced erosion through use of NBS techniques	Moderate	High	
	Strengthened women’s roles in water management and reduced workload	Moderate	Moderate	
	Enhanced household income and opportunities for youth employment through increased production and market opportunities	High	High	
	Strengthened food security and nutrition, especially during the rainy season	High	High	
Fish Hatcheries and Aquaculture Systems	Local value chain development	Moderate	High	<ul style="list-style-type: none"> • Train hatchery operators in biosecurity and water quality • Train producers in integrated multi-trophic aquaculture • Promote local feed production • Develop cold chain and market systems • Strengthen coordination between Chad and Cameroon fisheries services. • Exchanges organized with other communities utilizing solid
	Diversification of income sources through hatcheries and aquaculture	High	Moderate	
	Strengthened food security and improved nutrition in project zones especially during the lean season during low rainfall	Moderate	High	
	Capacity building in aquaculture management and technology transfer	Moderate	High	
	Reduced pressure on wild fisheries	Low	Low	
	Improved soil fertility	High	High	

				waste for compost production to improve soil fertility
Tree Nurseries with boreholes for irrigation	Diversification of income sources	High	High	<ul style="list-style-type: none"> Establish nursery cooperatives Train staff in seed selection and NBS pest management strategies Support seed exchanges between nurseries Supervise quality control of seedlings.
	Supply of quality seedlings for reforestation and agroforestry	Moderate	High	
	Development of local technical expertise in propagation and seed management	Moderate	High	
Reforestation	Restoration of degraded lands, improved soil stability and reversal of desertification	High	Moderate	<ul style="list-style-type: none"> Engage communities in reforestation programs Select native drought-tolerant species Conduct replanting where survival is low Create and train reforestation committees to care for young seedling and manage the forests long-term
	Enhancement of local biodiversity and carbon sequestration	High	Moderate	
	Increased vegetation cover improving microclimate	Moderate	High	
	Increased opportunity for livelihoods based on non-timber forest products	Moderate	Moderate	
Agroforestry	Improved soil fertility, water retention, and decreased erosion	High	High	<ul style="list-style-type: none"> Train farmers on intercropping and contour planting Promote nitrogen-fixing and fruit-bearing species Support cooperatives for product marketing
	Diversification of income through sale of agroforestry products	Moderate	High	
	Increased resilience to climate variability	High	High	
	Strengthened food security and nutrition through the inclusion of fruit trees.	Moderate	High	
Livestock Vaccination Parks (Chad)	Improved livestock health and reduction of disease outbreaks	High	High	<ul style="list-style-type: none"> Train veterinary staff in biosafety
	Increased livestock productivity and	High	High	

	market value			<ul style="list-style-type: none"> Promote farmer awareness on animal health management
	Strengthened veterinary infrastructure and services	Moderate	High	
Bunds and Dykes for Soil Restoration (Cameroon)	Reduction of erosion and improved soil fertility	High	High	<ul style="list-style-type: none"> Involve local communities in bund maintenance Combine structures with vegetation Train on contour alignment Monitor retention effectiveness after each rainy season.
	Increased agricultural productivity on restored lands	High	Moderate	
	Improved groundwater recharge and drought resilience	Moderate	High	
Agricultural Product Storage Facilities (Cameroon)	Reduction in post-harvest losses	High	High	<ul style="list-style-type: none"> Train cooperatives in storage management Promote community-led maintenance funds Install ventilation and cooling systems
	Increased food security and market stability	High	Moderate	
	Empowerment of women through managing their own stocks	High	Moderate	
Retention Pond (Chad)	Improved water storage and irrigation capacity	High	High	<ul style="list-style-type: none"> Establish committees to oversee pond management Integrate ponds with irrigation systems Stabilize banks with vegetation
	Flood control and groundwater recharge	High	Moderate	
	Increased options for livelihood diversification	Moderate	High	
Construction of Structural Works	Job creation and skill development for local workers	High	High	<ul style="list-style-type: none"> Prioritize local hiring Ensure compliance with safety standards Develop maintenance schedules Encourage use of local materials to boost economies.
	Opportunities for local businesses to provide goods and services	Low	High	
	Strengthened local economic activity through improved infrastructure	Moderate	Moderate	

Table 7: Cross-Border Potential Negative Impacts – Chad & Cameroon

Intervention	Negative Impacts	Significance Low/Mod/High	Likelihood Low/Mod/High	Mitigation Measures
Irrigated Agriculture and Boreholes	Over-extraction of groundwater for irrigation leading to depletion	High	Low	<ul style="list-style-type: none"> Assess water availability and quality before final site selection Monitor groundwater levels Promote water-saving irrigation techniques
	Soil salinization and degradation from poor irrigation management	Moderate	Moderate	<ul style="list-style-type: none"> Conduct regular soil testing Install adequate drainage Apply organic matter to improve soil structure Train farmers on the importance of leaching salts out of profile through extra irrigation if salinization becomes an issue
	Conflicts between users over shared water sources	High	High	<ul style="list-style-type: none"> Work closely with local leaders to choose an appropriate location for a shared resource Create and train cross-border water user associations Facilitate community mediation mechanisms
	Water from boreholes used for drinking water causing gastrointestinal diseases	Low	Low	<ul style="list-style-type: none"> Raise awareness with community members and local authorities on the exclusive intended use of water for irrigation Provide training to water management committees on the risks of using boreholes as a source of drinking water
Fish Hatcheries and Aquaculture Systems	Discharges from hatcheries can cause eutrophication and sedimentation of watercourses	High	Moderate	<ul style="list-style-type: none"> Design efficient water recycling or drainage systems Incorporate settling ponds Design with raised platforms or contouring for flood prevention Optimize feed rates
	Introduction of invasive or	Moderate	Moderate	<ul style="list-style-type: none"> Use only native fish species

	exotic fish species			<ul style="list-style-type: none"> Collaborate with national fisheries authorities for genetic monitoring
	Organic waste accumulation and poor effluent disposal poses both an environmental and human risk due to potential algal blooms in the irrigation systems as well as exposure to pathogens.	High	High	<ul style="list-style-type: none"> Ensure periodic cleaning of settling ponds Provide training on effluent management Provide training on integrated multi trophic aquaculture Utilize discharge from settling ponds to fertigate field crops and process solid organic materials into compost for soil fertilization
Tree Nurseries with boreholes for irrigation	Overharvesting of seeds from natural forests	Moderate	Low	<ul style="list-style-type: none"> Establish collective nursery funds to be used for nursery maintenance and purchase of seeds Promote use of nursery-propagated material
	Groundwater depletion from excessive watering	Low	Moderate	<ul style="list-style-type: none"> Adopt water-efficient irrigation methods Reuse runoff Schedule watering in early morning or evening
	Loss of native species diversity due to non-local species use	Moderate	Low	<ul style="list-style-type: none"> Prioritize local and drought-tolerant species Verify provenance through forestry services
Reforestation	Soil disturbance and erosion during planting	Moderate	Moderate	<ul style="list-style-type: none"> Avoid clearing on steep slopes Use contour planting Stabilize with mulch or grass cover
	Low seedling survival and mismatch of species to site	Moderate	High	<ul style="list-style-type: none"> Plant at the beginning of rainy season and in areas less prone to flooding Select native species adapted to local ecology Implement post-planting care and replanting as needed Establish reforestation committees to care for reforested areas
	Temporary disturbance to	Low	Moderate	<ul style="list-style-type: none"> Phase planting to minimize disturbance

	wildlife habitat			<ul style="list-style-type: none"> • Maintain refuge areas • Monitor wildlife movement
Agroforestry	Competition between trees and crops for sunlight, water and nutrients	Low	Moderate	<ul style="list-style-type: none"> • Optimize spacing and pruning • Select compatible species • Promote soil fertility enhancement practices
	Trees can create breeding groups for various pests	Moderate	Moderate	<ul style="list-style-type: none"> • Plant a variety of tree and crop species to disrupt pest and disease cycles • Use Integrated Pest Management (IPM) practices.
Livestock Vaccination Parks	Soil and water contamination from animal waste	High	High	<ul style="list-style-type: none"> • Design efficient water recycling or drainage systems • Include measures for wastewater management and pollution control • Include manure management plan • Train staff in safe disposal
	Odour nuisance and vector proliferation near settlements	Moderate	High	<ul style="list-style-type: none"> • Include biosecurity fencing • Plan separate zones to limit cross-contamination • Install vegetative buffers • Conduct regular cleaning and disinfection
	Occupational health risks for veterinary workers	High	Moderate	<ul style="list-style-type: none"> • Provide PPE • Train on biosecurity measures • Enforce hygiene protocols
	Unsafe disposal of biohazardous waste	Moderate	Moderate	<ul style="list-style-type: none"> • Ensure Ministry of Livestock vaccination teams take responsibility to manage the disposal of biohazardous waste • Dispose of all biohazardous waste at government operated incinerators • Train vaccination park management committees on safety protocols, including the safe handling and temporary storage of biohazardous waste.
Bunds and	Soil erosion and	High	Moderate	<ul style="list-style-type: none"> • Construct during dry season

Dykes for Soil Restoration	sedimentation downstream during works			<ul style="list-style-type: none"> • Install sediment traps • Vegetate slopes post-construction
	Flooding due to obstruction of natural drainage	Moderate	Moderate	<ul style="list-style-type: none"> • Include spillways and overflow channels • Inspect after heavy rainfall • Maintain drainage regularly
	Disturbance to aquatic habitats downstream	Low	Low	<ul style="list-style-type: none"> • Limit excavation in sensitive areas • Restore vegetation along watercourses
	Soil erosion if soil surface not protected with vegetation	Moderate	Moderate	<ul style="list-style-type: none"> • Plant shrubs and grasses the dykes immediately after construction to stabilize the surface and prevent erosion. • Plant trees on the dykes to ensure long-term stability
Agricultural Product Storage Facilities	Dust and noise emissions during construction	Moderate	High	<ul style="list-style-type: none"> • Use well-maintained machinery • Restrict working hours • Water access roads to control dust
	Solid waste generation from packaging and spoilage	Moderate	Moderate	<ul style="list-style-type: none"> • Install waste segregation bins • Promote recycling • Maintain hygiene inspections
	Air pollution from generator use and transport vehicles	Low	High	<ul style="list-style-type: none"> • Encourage cleaner energy use • Maintain engines regularly • Enforce no-idling policies.
Retention Pond	Mosquito breeding and vector-borne disease risk	High	High	<ul style="list-style-type: none"> • Introduce larvivorous fish • Ensure proper drainage and aeration • Conduct community health awareness campaigns
	Sediment accumulation reducing pond capacity	Moderate	Moderate	<ul style="list-style-type: none"> • Conduct periodic dredging • Implement upstream erosion control • Install sediment traps.
Construction of Structural Works	Air, dust, and noise pollution affecting nearby communities	High	High	<ul style="list-style-type: none"> • Water construction sites and roads • Use low-noise machinery • Conduct maintenance on machinery regularly

				<ul style="list-style-type: none"> • Limit works to daylight hours.
	Occupational accidents and worker injuries	High	Moderate	<ul style="list-style-type: none"> • Provide PPE • Implement site safety training • Ensure first aid kits and emergency response plans • Limit speed on the site to 30 km/h and 20 km/h within the base camp • Hold weekly safety briefings • Prohibit the consumption of prohibited substances on site
	Loss of vegetation, soil compaction and destruction of wildlife habitats	Moderate	High	<ul style="list-style-type: none"> • Restrict clearing to project footprint • Rehabilitate cleared areas • Replant native vegetation post-construction • Prohibit non-standard discharges into watercourses • Preserve wildlife habitats as much as possible
	Destruction of cultural or archaeological heritage	Moderate	Low	<ul style="list-style-type: none"> • Conduct pre-construction surveys • Halt work upon discoveries • Notify appropriate authorities
	Social conflicts from labour influx and land pressure	High	Moderate	<ul style="list-style-type: none"> • Prioritize local recruitment • Establish grievance redress mechanisms • Coordinate with local leaders.
	Risks of spreading contagious diseases (STIs, HIV/AIDS, etc.)	High	Moderate	<ul style="list-style-type: none"> • Inform and raise awareness among the population about the risks associated with STIs/HIV/AIDS and other infectious diseases • Distribute condoms and make them easily accessible to workers • Put up an awareness sign about contagious and pandemic diseases • Train peer educators to raise awareness about STIs/HIV/AIDS within the contractor company

	Contamination related to spills of hydrocarbons, oils and greases from the maintenance of equipment and materials	Moderate	Moderate	<ul style="list-style-type: none"> • Train and raise awareness among site personnel about keeping the work environment clean • Collect and recycle accidentally spilled hydrocarbons • Set up sealed areas to house technical workshops • Set up a containment site around fuel unloading areas • Carry out regular checks on construction equipment
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7. ENVIRONMENTAL MANAGEMENT PLAN

7.1. Introduction

The Environmental Management Plan (EMP) provides a structured framework for managing the environmental and social dimensions of the GTCA project in Chad and Cameroon. It defines the strategies, responsibilities, and procedures required to mitigate potential negative impacts while enhancing the project's positive environmental, social, and economic impacts. The EMP ensures that the GTCA project is implemented in accordance with environmental best practices and complies with relevant national regulations and safeguard standards.

This EMP integrates the findings and recommendations from the Environmental and Social Impact Assessment (ESIA) reports prepared for both countries. It presents detailed, intervention-specific plans that address the environmental considerations of each project component. The EMP identifies specific actions, monitoring mechanisms, and responsible entities to ensure that mitigation and enhancement measures are effectively implemented and tracked.

The Plan also incorporates a comprehensive environmental and social monitoring framework, detailing measurable indicators, monitoring frequency, and reporting procedures. This ensures that environmental safeguards remain active throughout all phases of project implementation and that corrective actions are taken promptly when necessary. CLWR and LWF, hold primary responsibility for overseeing the EMP. However, national environmental authorities, DEELCPN in Chad and the Municipal Environmental Assessment Units in Cameroon, together with local authorities and monitoring committees, will play key roles in supervision and compliance.

This EMP aims to:

- Minimize adverse environmental and social impacts;
- Maximize positive and sustainable environmental outcomes;
- Ensure compliance with national and international environmental standards;
- Promote ecosystem restoration and climate-resilient development.

The GTCA project adheres to stringent environmental standards to ensure that climate adaptation efforts contribute positively to local ecosystems and communities. In all instances where environmental and technical specifications may conflict, environmental protection requirements shall take precedence. Key safeguards prioritized under this EMP include:

- Community health, safety, and inclusion;
- Biodiversity protection and restoration;
- Land and soil conservation;
- Sustainable water resource management;
- Climate change mitigation and resilience.

7.2. Cross-Border Environmental and Social Management Plan Summary (by project component, for key impacts)

Table 8: Irrigated Agriculture and Boreholes

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Over-extraction of groundwater	Moderate	Continuous pumping from boreholes	<ul style="list-style-type: none"> Assess water availability and quality before final site selection Monitor groundwater levels Promote water-saving irrigation techniques Rotate irrigation schedules 	Groundwater levels	Quarterly	Meter reading and hydro-surveys	DEELCPN / Municipal Units / CLWR / LWF / Monitoring Committee
Soil salinization and degradation	Moderate	Over-irrigation, poor drainage	<ul style="list-style-type: none"> Conduct regular soil testing Install adequate drainage Apply organic matter to improve soil structure Train farmers on leaching salts out of profile through extra irrigation if salinization becomes an issue 	Soil EC, fertility	Biannual	Soil sampling and field analysis	CLWR / LWF / Contractor (HSSE) / Local Authorities
Conflicts over shared water use	High	Competing irrigation & domestic uses	<ul style="list-style-type: none"> Work closely with local leaders to choose an appropriate location for a shared resource 	Water use agreements ; grievances	Biannual	Community consultation records	CLWR / LWF / Local Authorities / Monitoring Committee

			<ul style="list-style-type: none"> • Create and train cross-border water user associations • Facilitate community mediation mechanisms 				
Hydrocarbon contamination around bases	Moderate	Fuel/oil spills during construction	<ul style="list-style-type: none"> • Install oil traps • Build impermeable floors • Dispose of used oils properly 	Condition of containment facilities	Monthly	Site inspections ; records	Contractor / Monitoring Committee / DEELCPN / Municipal Units
Gastrointestinal disease from using boreholes to supply drinking water	Low	Low drinking water availability	<ul style="list-style-type: none"> • Awareness raising and training on the risks of drinking untreated water. 	Use of boreholes	Monthly	Community consultation records	CLWR / LWF / Local Authorities / Water Use Committee

Table 9: Fish Hatcheries and Aquaculture Systems

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Eutrophication of water bodies	High	Discharge of nutrient-rich effluents	<ul style="list-style-type: none"> • Design efficient water recycling or drainage systems • Incorporate settling ponds • Design with raised platforms or contouring for flood prevention • Utilize discharge for irrigating field crops 	Nutrient levels (N, P, DO); Visible signs of algal blooms	Quarterly	Water sampling and lab analysis; Visual monitoring	DEELCPN / Municipal Units / Contractor / Monitoring Committee/ CLWR / LWF

Organic waste buildup	High	Overfeeding, sludge accumulation	<ul style="list-style-type: none"> • Ensure periodic cleaning • Provide training on effluent management • Provide training on integrated multi trophic aquaculture • Optimize feed rates 	Sludge volume and management	Quarterly	Site inspections; record reviews	Hatchery committee / LWF / CLWR /
Introduction of invasive species	Moderate	Unregulated stock import	<ul style="list-style-type: none"> • Use only native fish species • Collaborate with national fisheries authorities for genetic monitoring 	Species registry	Annual	Registry audits	CLWR / LWF / Local Authorities / Monitoring Committee / Hatchery committee
Disease spread	Moderate	Poor hygiene and stagnant water	<ul style="list-style-type: none"> • Disinfection schedules • Hygiene training • PPE provision. 	Disease incidence; hygiene levels	Quarterly	Health inspections; sampling	CLWR / LWF / Local Health Authorities / Monitoring Committee / Hatchery committee

Table 1010: Tree Nurseries with boreholes for irrigation (Chad)

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Overharvesting of seeds	Moderate	Unregulated seed collection	<ul style="list-style-type: none"> • Establish collective nursery funds to be used for nursery maintenance and purchase of seeds 	Seed sourcing documentation	Annual	Inventory review; site audit	DEELCPN / CLWR / LWF

			<ul style="list-style-type: none"> Promote use of nursery-propagated material 				
Groundwater depletion	Low	Over-watering of seedlings	<ul style="list-style-type: none"> Adopt water-efficient irrigation methods Reuse runoff Schedule watering in early morning or evening 	Water consumption levels	Monthly	Meter readings; site checks	DEELCPN / CLWR / LWF/ Nursery Committee
Land-use conflicts	Moderate	Nursery siting near communities	<ul style="list-style-type: none"> Obtain authorization Prioritize low-value land 	Permits; grievance records	Quarterly	Administrative review; consultations	Local Authorities / CLWR / LWF / Monitoring Committee

Table 1111: Reforestation

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Loss of existing vegetation before planting and erosion during planting	Moderate	Clearing during site preparation	<ul style="list-style-type: none"> Minimize clearing Use contour planting Stabilize with mulch or grass cover Retain native vegetation Mark and protect natural regeneration areas. 	Vegetation retained vs cleared	Quarterly	Field inspection	CLWR / LWF / Contractor / Monitoring Committee/ Reforestation Committee
Use of inappropriate species leading to	Moderate	Selection of non-native or low-resilience	<ul style="list-style-type: none"> Prioritize native, drought-tolerant species Verify provenance with forestry services. 	Species list and planting density	Annual	Nursery inspection; field verification	DEELCPN / Municipal Units / CLWR / LWF / Reforestation

low seedling survival		trees	<ul style="list-style-type: none"> • Implement post-planting care and replanting as needed • Establish reforestation committees to care for reforested areas • Plant at the beginning of rainy season and in areas less prone to flooding 				Committee
Grazing pressure on plantations	High	Free grazing and browsing by livestock	<ul style="list-style-type: none"> • Sensitize herders • Establish bylaws for protection • Establish reforestation committees to care for reforested areas 	Vegetation damage	Quarterly	Site inspection; community consultation	Local Authorities / CLWR / LWF / Reforestation Committee
Fire risk to plantations	High	Uncontrolled burning in dry season	<ul style="list-style-type: none"> • Establish firebreaks • Conduct awareness campaigns 	Existence and condition of firebreaks	Dry season	Visual inspection; local reports	Local Authorities / Monitoring Committee / LWF / CLWR / Reforestation Committee

Table 1212: Agroforestry

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Competition between trees and	Moderate	Improper spacing or dense	<ul style="list-style-type: none"> • Optimize spacing and pruning • Select compatible species 	Crop yield and tree growth	Biannual	Field measurement; farmer	CLWR / LWF / Monitoring Committee /

crops		planting	<ul style="list-style-type: none"> Promote soil fertility enhancement practices 	records		interviews	Local Authorities
Pest and disease spread	Moderate	Mixed cropping without management	<ul style="list-style-type: none"> Plant a variety of tree and crop species to disrupt pest and disease cycles Use Integrated Pest Management (IPM) practices. 	Incidence of pest and disease	Quarterly	Field inspection; extension reports	CLWR / LWF / DEELCPN / Municipal Units

Table 1313: Livestock Vaccination Parks (Chad)

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Soil and water contamination from animal waste	Moderate	Uncontrolled manure disposal	<ul style="list-style-type: none"> Design efficient water recycling or drainage systems Include measures for wastewater management and pollution control Include manure management plan Train staff in safe disposal 	Cleanliness of vaccination area; manure volume	Monthly	Field inspections	Contractor / Local Authorities / Monitoring Committee
Spread of zoonotic diseases	High	Lack of disinfection and hygiene measures	<ul style="list-style-type: none"> Regular cleaning and disinfection Provide PPE for workers Veterinary oversight. 	Hygiene conditions; recorded disease cases	Quarterly	Veterinary inspection; record review	Local Veterinary Services / CLWR / LWF / Monitoring Committee
Conflicts over	Moderate	Siting	<ul style="list-style-type: none"> Select sites through 	Community	Annual	Consultations;	Local

land use		vaccination parks near farms or homes	<ul style="list-style-type: none"> participatory consultations • Include biosecurity fencing • Plan separate zones to limit cross-contamination 	acceptance; fencing condition		field observation	Authorities / CLWR / LWF / Monitoring Committee
Unsafe disposal of hazardous waste	Moderate	Poor management	<ul style="list-style-type: none"> • Coordination with local authorities responsible for managing biohazardous waste and education of vaccination park management committee 	Cleanliness of vaccination area	Monthly	Field inspections	Authorities / CLWR / LWF / Vaccination management Committee

Table 1414: Bunds and Dykes for Soil Restoration (Cameroon)

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Soil erosion during works	High	Excavation and runoff from unprotected slopes	<ul style="list-style-type: none"> • Construct during dry season • Install sediment traps • Vegetate slopes post-construction • Construct contour drains 	Erosion indicators; vegetation cover	Quarterly	Visual inspection; photo documentation	Contractor / CLWR / LWF / Monitoring Committee
Flooding due to obstruction of natural drainage	Moderate	Improper drainage design or maintenance	<ul style="list-style-type: none"> • Include spillways and overflow channels • Inspect after heavy rainfall • Maintain drainage regularly 	Sediment buildup in drainage channels	Biannual	Visual checks; site supervision reports	CLWR / LWF Monitoring Committee / Local Authorities
Occupational safety risks	Moderate	Manual labor on steep or unstable	<ul style="list-style-type: none"> • Provide PPE • Safety briefings • Enforce worksite supervision 	Incidents reported; PPE compliance	Quarterly	Safety audits; field observations	Contractor / CLWR / LWF / Monitoring Committee

		terrain					
Conflict with farmers over land use	Moderate	Construction on cultivated plots	<ul style="list-style-type: none"> Engage communities in site selection Choose degraded and unused land Provide compensation where applicable 	Grievance records; community satisfaction	Annual	Consultation meetings; grievance review	CLWR / LWF / Local Authorities / Monitoring Committee
Soil erosion on dyke surface	Moderate	Soil exposure due to lack of soil cover	<ul style="list-style-type: none"> Plant shrubs, grasses, and trees to protect surface and stabilize structure 	Erosion indicators; vegetation cover	Monthly	Visual inspection; photo documentation	CLWR / LWF / Monitoring Committee/ DDR committee

Table 1515: Agricultural Product Storage Facilities (Cameroon)

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Air pollution from dust during construction	Low	Clearing and materials handling	<ul style="list-style-type: none"> Regular watering of dusty areas Provide PPE to workers. 	Dust levels; PPE usage	Weekly	Site inspection; observation reports	Contractor / Monitoring Committee / CLWR / LWF
Fire hazard from poor electrical installation	High	Use of uncertified materials; lack of safety equipment	<ul style="list-style-type: none"> Ensure certified electrical installation Provide fire extinguishers and signage 	Condition of wiring; fire protection availability	Biannual	Electrical inspection; safety checklist	Contractor / Monitoring Committee / Local Authorities / LWF / CLWR
Spoilage of stored	Moderate	Inadequate storage	<ul style="list-style-type: none"> Maintain hygiene inspections Regular cleaning 	Storage cleanliness;	Quarterly	Visual inspection;	CLWR / LWF / Local Authorities

agricultural products		hygiene and ventilation	<ul style="list-style-type: none"> • Maintain ventilation 	pest signs		record review	/ Monitoring Committee
Solid waste accumulation	Low	Neglect in managing packaging or residue waste	<ul style="list-style-type: none"> • Implement solid waste management plan • Designate collection points. 	Waste collection and disposal records	Monthly	Site audit; waste log verification	Contractor / Monitoring Committee / LWF / CLWR

Table 1616: Retention Pond (Chad)

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Vector-borne disease risk	High	Sediment inflow and livestock access	<ul style="list-style-type: none"> • Install sediment traps • Fence pond • Prohibit livestock entry. 	Water quality; sediment levels	Quarterly	Water sampling; visual inspection	LWF / CLWR / DEELCPN / Monitoring Committee
Mosquito breeding	Moderate	Stagnant water and vegetation overgrowth	<ul style="list-style-type: none"> • Ensure proper drainage and aeration • Introduce larvivorous fish • Community awareness. 	Presence of larvae; vegetation condition	Monthly	Field observation; community health reports	Local Health Authorities / CLWR / LWF / Monitoring Committee
Safety hazards for people and animals	Moderate	Unfenced pond; proximity to residences	<ul style="list-style-type: none"> • Erect fencing • Install warning signs • Monitor access. 	Fence integrity; presence of safety signs	Quarterly	Site inspection; visual checks	Contractor / Local Authorities / Monitoring Committee / LWF / CLWR
Erosion of pond embankments	Moderate	Wave action and rainfall	<ul style="list-style-type: none"> • Reinforce embankments with vegetation and stone lining 	Structural stability; erosion	Biannual	Field inspection; photographic	Contractor / CLWR / LWF / Monitoring

		runoff	<ul style="list-style-type: none"> • Routine maintenance. 	marks		documentation	Committee
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Table 1717: Construction of Structural Works

Impact	Overall Significance	Cause / Source	Management and Mitigation Measures	Aspect to be Monitored	Frequency	Method of Monitoring	Responsibility
Noise and dust nuisance	Moderate	Heavy machinery use and site clearing	<ul style="list-style-type: none"> • Maintain equipment • Restrict work hours • Spray water regularly to suppress dust • Ensure PPE use 	Noise and dust levels; worker PPE use	Weekly	On-site measurement and field inspection	Contractor (HSSE Manager) / Monitoring Committee / CLWR / LWF
Occupational health and safety risks	High	Inadequate safety measures and supervision	<ul style="list-style-type: none"> • Provide PPE • Conduct safety induction and daily briefings • Maintain first-aid kits • Post safety signage • Limit speed on the site to 30 km/h and 20 km/h within the base camp • Prohibit the consumption of prohibited substances on site 	Number of incidents; PPE availability; safety signage	Weekly	Site inspection; safety audits	Contractor (HSSE Manager) / CLWR / LWF / Monitoring Committee
Loss of vegetation, soil compaction and	Moderate	Heavy machinery use, site clearing, pollution from	<ul style="list-style-type: none"> • Restrict clearing to project footprint • Rehabilitate cleared areas • Replant native 	Area and percentage of vegetation cleared	Weely	Site inspection; water sampling; vegetation and soil condition	Contractor (HSSE Manager) / CLWR / LWF / Monitoring

destruction of wildlife habitats		water discharge	<p>vegetation post-construction</p> <ul style="list-style-type: none"> Prohibit non-standard discharges into watercourses <p>Preserve wildlife habitats as much as possible</p>	<p>versus project footprint; evidence of soil compaction and erosion on cleared sites; effectiveness of replanting and habitat restoration measures; quality and compliance of water discharge (absence of pollutants or sediments)</p>		surveys	Committee
Spread of communicable diseases (including HIV/AIDS)	High	Worker influx and community interaction	<ul style="list-style-type: none"> Partner with local health services for awareness Distribute PPE and condoms Include health clauses in contracts Conduct monthly sensitization sessions 	<p>Number of awareness campaigns; attendance records; health reports</p>	Quarterly	Health reports; supervision of sessions	Contractor (HSSE Manager) / CLWR / LWF / Local Health Authorities / Monitoring Committee

			with peer educators				
Disturbance or damage to cultural and archaeological sites	Moderate	Excavation near sensitive areas	<ul style="list-style-type: none"> • Conduct pre-construction cultural screening • Demarcate no-go areas • Stop work upon chance finds • Notify appropriate authorities 	Number of chance-find reports; condition of protected sites	Continuous	Field inspection; photographic documentation	Local Authorities / CLWR / LWF / DEELCPN (Chad) / Municipal Units (Cameroon) / Monitoring Committee
Contamination of soil or ground water	Moderate	Through spills of hydrocarbons, oils and greases from the maintenance of equipment and materials	<ul style="list-style-type: none"> • Train and raise awareness among site personnel about keeping the work environment clean • Collect and recycle accidentally spilled hydrocarbons • Set up sealed areas to house technical workshops • Set up a containment site around fuel unloading areas • Carry out regular checks on construction equipment 	Integrity and condition of fuel storage tanks and refueling areas; presence of oil stains, spills, or hydrocarbon residues on soil surfaces; Condition and maintenance records of construction equipment and vehicles	Weekly	Visual inspection of workshop, fuel, and equipment maintenance zones for leaks or spills; verification of containment systems and impermeable flooring in technical areas; review of spill response logs and waste oil disposal	Contractor (HSSE Manager) / CLWR / LWF / Monitoring Committee

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8. CONCLUSION AND RECOMMENDATIONS

8.1. Conclusion

The GTCA cross border project addresses critical environmental, social, and economic challenges in climate-vulnerable areas of Chad and Cameroon. The Environmental and Social Impact Assessment (ESIA) process for both countries evaluated the potential environmental and social effects of the project and informed the design of this Environmental Management Plan (EMP). The EMP provides a coordinated framework for implementing mitigation and enhancement measures, ensuring that the project is both environmentally responsible and socially inclusive. The ESIA findings demonstrate that the GTCA project is ecologically sound, socially acceptable, and economically beneficial. The interventions, covering irrigated agriculture, aquaculture, tree nurseries, reforestation, agroforestry, livestock vaccination parks, bunds and dykes, storage facilities, retention ponds, and structural works, are expected to deliver long-term benefits such as improved livelihoods, food security, gender equality, and climate resilience.

While certain construction-phase activities may lead to localized negative impacts are moderate and manageable through the application of the mitigation measures outlined in the EMP. None of the residual impacts are expected to be of major significance if environmental safeguards are consistently implemented. Several conclusions can be drawn from the ESIA process:

- The proposed project is technically feasible and environmentally desirable in both countries.
- The project will generate both positive and negative environmental and social impacts.
- Major negative impacts include vegetation loss, soil erosion and compaction, pollution of surface and groundwater, air and noise emissions, occupational and community health risks, and potential social conflicts.
- All identified negative impacts require mitigation and are manageable through the proposed measures, including monitoring.
- Major positive impacts include job creation, livelihood diversification, gender empowerment, improved food security, infrastructure enhancement, and local capacity development.
- The positive impacts outweigh the negative impacts when mitigation and monitoring measures are properly applied.
- The project is ecologically sustainable with consistent application of the EMP and active participation of local stakeholders. The GTCA project is anticipated to integrate harmoniously into its host environments and contribute to long-term climate-resilient development in the Lake Chad basin.

8.2. Recommendations

- 1) **Implement EMP Measures Effectively:** Apply all proposed environmental and social mitigation measures systematically throughout project implementation to minimize negative impacts. Additionally, coordinate exchanges with other NGOs in the region who already have developed an EMP to understand how best to implement their own and be prepared for similar challenges.
- 2) **Strengthen Monitoring and Supervision:** Enhance environmental oversight through regular joint inspections by DEELCPN, municipal units, LWF and CLWR.
- 3) **Coordinate Across Institutions:** Ensure effective collaboration between CLWR, LWF, local authorities, and contractors for consistent implementation of safeguards.
- 4) **Promote Community Engagement:** Involve communities, including women and youth, in awareness campaigns, environmental protection, and local monitoring activities.
- 5) **Enforce Occupational Health and Safety:** Maintain strict adherence to HSSE standards on all sites, providing PPE, safety training, and access to medical support.
- 6) **Prevent Social Conflicts and Risks:** Strengthen grievance redress and prevention of gender-based violence, ensuring fair employment and respect for community norms.
- 7) **Support Ecosystem Restoration:** Rehabilitate degraded areas promptly, replant native species, and control invasive plants to restore ecological balance.
- 8) **Advance Gender and Inclusion:** Integrate gender-transformative actions and equitable benefit-sharing across all project interventions.
- 9) **Build Local Capacity:** Train project staff, local authorities, and monitoring committees to enhance environmental management and reporting skills.
- 10) **Ensure Long-Term Sustainability:** Establish maintenance plans, budgets, and local management structures to sustain infrastructure and ecosystem gains beyond the project's lifetime.