Final Project Report (to be submitted by 20th September 2018)

Instructions:

- Document length: maximum 10 pages, excluding this cover page and the last page on project tags.
- We welcome the submission of Annexes (i.e. bachelor or master thesis, references, species lists, maps, drawings, pictures) to further HeidelbergCement's understanding and future use of your findings, however they will not be reviewed by the Jury, and we kindly ask for these to be sent separately to the National Coordinators.
- Please use the attached template for species data collected during the project and submit with the project report.
- Word/PDF Final Report files must be less than 10 MB.
- If you choose to submit your final report in your local language, you are required to also upload your final report in English if you wish to take part in the international competition.
- To be validated, your file must be uploaded to the Quarry Life Award website before **20th September** 2018 (midnight, Central European Time). To do so, please log in, click on 'My account'/ 'My Final report'.
- In case of questions, please liaise with your national coordinator.
- You should not publish additional private information in your final report (e.g.: address, day of birth, email-address, phone number), just complete the categories we ask for below under "Contestant profile".

1. Contestant profile

▪ Contestant name:	**AMOUZOU Amégnonna Kokou**
▪ Contestant occupation:	Environmental health Engineer(water and sanitation speciality)
▪ University / Organisation	Department of sanitation and protection of living environment
▪ Number of people in your team:	04

2. Project overview

Title:	**SCANTOGO and lake Tohé of Logokpo: how to ensure a non-confrontational relationship between actors**
Contest: (Research/Community)	Community
Quarry name:	Tabligbo East quarry (Sika – Kondji)

Abstract (max 0.5 page)

Text in Arial 10

ABSTRACT

To understand the problem of eutrophication of Lake Tohé and contribute to the resolution of the conflict that is emerging about it, between SACANTOGO and the populations of Logokpo, steps have been taken. First, an inventory was made through a preliminary visit of the project site followed by visual analyzes of the lake's biodiversity and the land use of the project site including the water drainage canal of the quarry to the lake. This allowed us to know the flora and fauna of the lake and to report on the market gardening activities that take place using chemical fertilizers, herbicides and pesticides around the lake and along the drainage channel of the waters from the quarry. Then two (02) water sampling campaigns were conducted for physicochemical analyzes in laboratory. The results of the analysis of the first campaign samples showed that there is a contribution of organic and nutrients to the lake: Chemical Oxygen Demand (20 mgO2 / L) and total nitrogen (1.4 mgN / L) and that the concentration of nitrogen at the level of the waters of the quarry is negligible. The results of the second sampling campaign in two (02) points in the middle of the lake: total nitrogen (2.8 and 2.8 mgN / L); total phosphorus (0.48 and 0.46 mgP / L) and dissolved oxygen (4.4 and 4.2mgO2 / L) confirms this accumulation of organic and nutritive materials. In view of the results of the inventory and analyzes of the water, it appears that waters of the quarry do not contain nitrogen in a remarkable concentration and there are nutrient inputs like nitrogen and phosphorus, coming from the agricultural environment transiting to the lake. However, waters of the quarry have a turbidity (1.8) slightly higher than the waters of the lake (0.9 to 1). In order to explore possible solutions for mitigating the problem, two interventions were carried out beforehand: one for the local populations and the other for SCANTOGO's quarry respectively: i) education and awareness raising for the management of agricultural fertilizers, herbicides, pesticides and reforestation; ii) the design of a settling basin for the waters of the quarry to be built. Downstream, ways of resuming fish farming activities and preserving local medicinal plants were explored through the work of weeding a part of the lake and the creation of a garden for the conservation of local medicinal plants. Finally, discussions on the results and the tracks explored to prevent the conflict that may occur have made it possible to propose a project followed by recommendations for its implementation.

Final report (max 9 pages)

INTRODUCTION

Context and justification

In the context of activities in quarry, the evaluation of the functioning of ecosystems and their condition is based, above all, on the evaluation of biodiversity and asks, for a given site, to know the interrelations with the neighboring environments of the site or further away in terms of habitat and species conservation (Adam Y et al 2015). Companies and governments continually monitor mining activities to verify environmental performance, and safeguard the interests of mining companies and surrounding communities (PWGSC); 2013). In Togo, and more specifically in the Sika-Kondji limestone quarry, this monitoring is done through the environmental audit. The objectives pursued by the environmental audits are in line with the objectives pursued by the quarry life award competition with regard to the protection of biodiversity in quarries, including that of Sika kondji. In addition, the objectives pursued by the contest quarry life award emphasizes the prevention of conflicts by promoting a good relationship between careers and local populations. It is in this context of promotion of biodiversity and conflict prevention that the present project is realized in order to explore and propose possible solutions to the conflict that may arise between SCANTOGO and the people of the village of Logokpo about their lake (Tohé) which receives waters from the quarry.

Problematic

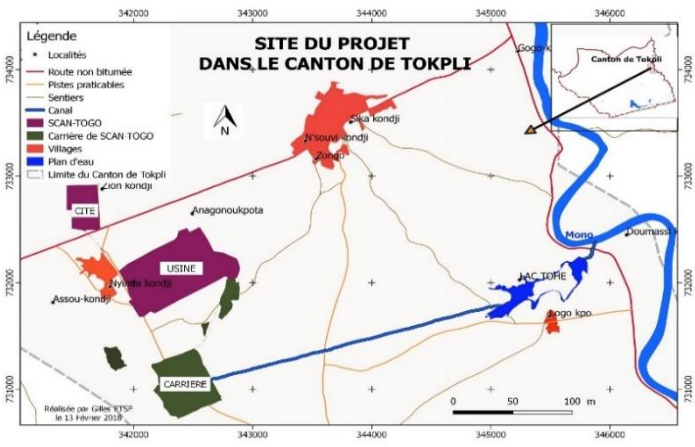
In fact, in the limestone production system in the Sika-kondji quarry, the water pumped for the reduction of the water table is discharged into Lake Tohé in the village of Logokpo. The management plan of these waters coming from the quarry follows the following route: the waters at the exit of the pumping station of the quarry pass through a drainage channel built by SCANTOGO towards Lake Tohé, before continuing their race to the Mono river. The people of the village of Logokpo report an intensification of the eutrophication of the lake, which is remarkable by the improper development of aquatic plants, and they are taking this responsibility to SCANTOGO. The argument put forward by the local population is that the water discharged from the quarry carries an excessive supply of nutrients such as nitrogen from the ammonium nitrate used by SCANTOGO to fire in his quarry. As a result, fish production at the lake level has dropped. The evidence, according to the fishermen supervised by the Togo HeidelbergCement Foundation, the cage culture failed in 2016 at Lake Tohé because of the death after a few days of all tilapia fry. These situations provoke discontent and cause the population and especially the fishermen to convert to other activities of anarchic flora. As a result, there is usually an intensification of deforestation and the disappearance of some local tree species, especially medicinal plants.

Objectives

Based on this issue, the project approach aims to bring the two actors (Logopko and SCANTOGO populations) closer together to work together to find sustainable and profitable solutions for everyone about the lake. The general objective of the project is to contribute to maintaining the climate of understanding and collaboration that exists between SCANTOGO and the people of the village of Logokpo and which risks being weakened by the pollution problem of Lake Tohé. To this end, the project's specific objectives are to: i) investigate the causes of eutrophication of the lake and pinpoint responsibilities with regard to its source of pollution; ii) explore tracks for restoration and preservation of the lake's ecosystem and local medicinal plants; iii) propose a project to implement the tracks explored followed by recommendations for its implementation.

Site, team members and target audience of the project

In general, the company SCANTOGO is located in Togo in the prefecture of Yoto and more precisely in the canton of Tokpli (confer location map). The project site includes four basic elements that are part of our project: the quarry, the quarry drainage channel, Tohé Lake and the village of Logokpo. SCANTOGO's quarry covers the entire limestone area of the plant and has a water pumping station. The canal that carries the pumped water to the lake is about 1.5 m wide, the length of which (about 2 km) varies depending on the water pumping station at the lake. **Figure 1: Location map of the project site**



Lake Tohé has an elongated irregular shape with approximately: a width of 0.5 km and a length of 1 km. The waters of the lake enter the Mono River through the continuity of the canal that brings the water from the quarry to the lake. The village of Logokpo is located about 300m from the lake and has a population of about 750 inhabitants, which are the target populations of the project, the majority of which is engaged in agriculture including fishing activities. The project team is composed of: project leader, President of the Village Development Committee (VDC), the president of the Logokpo women's agricultural group, a representative of the village fish farming group. This report is structured in four (04) parts. The first part describes the activities carried out, followed by the discussion in the second part. The third part focuses on the proposal of a project with recommendations for its implementation. The final part provides the overall conclusions of the project.

ACTIVITIES AND TASKS

Two (02) components group together the activities and tasks carried out under the project: i) Identification of the sources of pollution of the lake and ii) the search for the tracks of durable solutions to mitigate the problem

Component 1: Identification of lake pollution sources

This component discusses the state of play and the physicochemical analyzes of the water used to highlight the possible sources of pollution of the lake and to verify whether the waters coming from the SCANTOGO quarry can contribute to the intensification of its water supply eutrophication.

1-1 - State of play and presentation of the different actors involved in the project

- **Preliminary visit of the project site by the different actors involved**

In order to bring together the various actors involved in the prevention of confit, and to find durable and inclusive solutions, we organized and carried out a field visit on february 8, 2018, from the quarry to Lake Tohé via the canal draining water from the quarry to the lake. The visit was attended by three (03) representatives of SCANTOGO: the representatives of the career service; the health, safety and environment department and the Togo HC-Foundation. Four (04) people represented the population of Logokpo: the project leader, the president of the Village Development Committee (CVD), the president of the Logokpo women's agricultural and environmental group, and the notable who represented the fish farming group. This visit shows that the water pumped from the quarry for the abatement of the water table passes through a drainage channel to reach the lake and market gardening activities take place along this canal**.**

- **In situ and ex situ observations**

In-situ observations consisted of a visual analysis of the elements of the lake's biodiversity and its immediate environment. To this end, visits have been organized and conducted throughout the study area to characterize its biodiversity in general and in particular that of the lake including flora, fauna and activities that take place within a radius of 500 m from the lake. As for the ex-situ observations, it consisted of an analysis of the land use mapping of the project site. To do this, we have downloaded a 2018 Landsat OLI (Operational Land Imager) image covering the study area from the global land cover facility (glcf). After classification from the nomenclature used for Togo, we developed a class of land use and obtained six (06) classes: crops and fallows; palm groves; flooded savannah; area occupied by SCANTOGO; agglomerations; body of water. The results obtained include:--Aquatic Flora: plants such as water hyacinths, typha, and mainly higher plants. - Aquatic fauna: carp, tilapia, protoptera and catfish are among other types of fish noted during fishing activities of the populations. There are also frogs and some waterfowl including water ducks. -Floor flora: Natural forest cover is almost non-existent on the project site. The current natural vegetation consists largely of flooded savannah dotted with palm groves most remarkable on the lake side and along the Mono River.

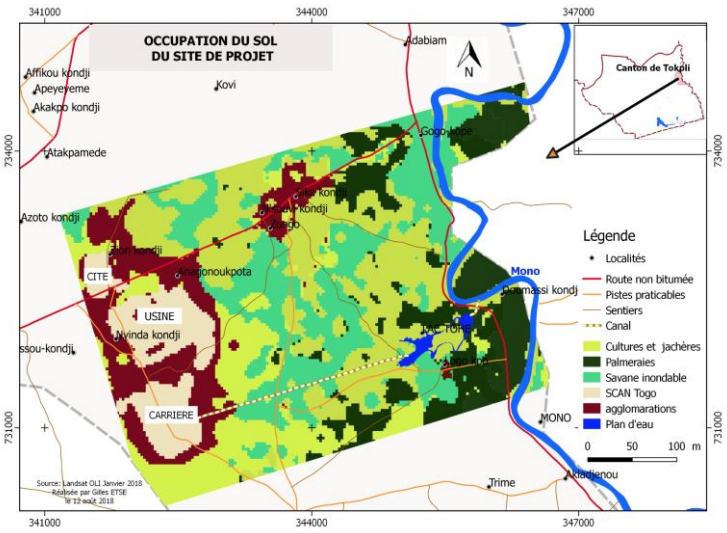


Figure 2: Land cover map of the Project Site

Agricultural activities: The agricultural activity is dominated by the cultivation of maize and market gardening. Market gardening takes place in and around the lake's catchment areas with the use of chemical fertilizers and pesticides.

- **State of knowledge of farmers in fertilizer, herbicide and pesticide management**

An assessment of the state of knowledge (level of awareness) of people based on deforestation and the use of chemical fertilizers, herbicides and pesticides related to the health of an aquatic ecosystem has been planned and done scheduled and done as a survey on July 14, 2018. For this purpose, a data collection sheet was prepared and administered to 95 farmers who have their field in the lake catchment area (radius of about 500 m from the lake) and along the drainage channel of quarry's waters. The collected data were processed with the "Epi info version 3.5.2" software in tables and the tables were exported for reprocessing in Excel in order to obtain figures.

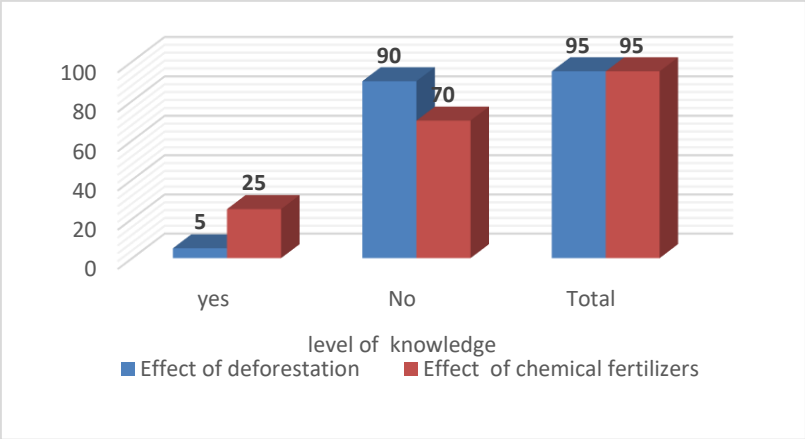


Figure 3: State of knowledge in fertilizer and wood management

As a result, 70 out of 95 farmers are unaware of the harmful effect these chemicals may have on the health of the lake and fish life.

1-2-Water Analysis

- **Sampling**

In order to take samples of water for analysis in laboratory, two campaigns were conducted. For both campaigns we sampled from upstream to downstream of the lake (direction of flow of water from the quarry to the Mono River through the lake). The first campaign was carried out on June 28, 2018 for the characterization of the physico-chemical composition of the waters of the quarry, the drain (canal) and the lake. For this purpose, four (04) sampling sites were selected. The second campaign only on the lake, was effective September 03, 2018 to better understand its trophic state. On this occasion, two (02) sampling sites were chosen in the middle of the lake.

Table 1: Selection of sampling sites

Sites	Name of the site	Reasons for choosing the site
First campaign: Identify sources of pollution of the lake		
1	Water from the quarry	to know the physicochemical composition of the water pumped to the quarry
2	Drain water (canal)	Compare the physicochemical composition of water at this level to that of site 1
3	Water at the entrance of the lake	Compare the physicochemical composition of water at this level with those of sites 1 and 2
4	Water at the lake exit	Compare the physicochemical composition of water at this level to that of site 3
Second campaign: Knowing the trophic status of the lake and the dissolved oxygen available for fish		
5	Water 500m from the lake entrance	Site located at the place intended for fish farming
6	Water 550m from the lake entrance	Site located at the place intended for fish farming

- **Sampling and methods of analysis of desired parameters**

A total of six (06) samples of water taken from plastic bottles in accordance with the above mentioned sites were sent for analysis to the water chemistry laboratory of the University of Lomé.

Table 2: Requested parameters, associated methods and quantification limits

Settings	Methods	Quantization limit
First campaign: 04 samples (quarry's water, drain water, lake water (inlet and outlet))		
pH	Electrometry	-
Conductivity at 25 degree us / cm	conductivity	-
Salinity mg / L	conductivity	-
Turbidity (NTU)	nephelometry	-
Suspended solids (SS), -mg / L	Filtration, drying 1050 / weighing	10
Chemical Oxygen Demand(COD)	Digestion with K2CrO7	2
Biochemical oxygen demand after five days (BOD5) -mgO2 / L	respirometry	2
Total Nitrogen (NTK) -mgN / L	Mineralization / distillation	1.4
Second campaign : 02 samples (mid-lake water only)		
Temperature (T) 0C	Electrometry	
pH	Electrometry	
Dissolved Oxygen (O2) -mgO2 / L	Iodometry / oximetry	
Total phosphorus (P) mgP / L	Mineralization / spectrometry	
Total Nitrogen (NTK) -mgN / L	Mineralization / distillation	1.4

- **Analysis results and interpretation**
  - **First campaign**
    - **Physical parameters: pH, turbidity, Suspended solids (SS), conductivity and salinity**

-pH, turbidity and Suspended solids (SS)

The pH expresses the H^+ ion concentration and measures the acidity or alkalinity of a water read on a scale from 0 to 14.

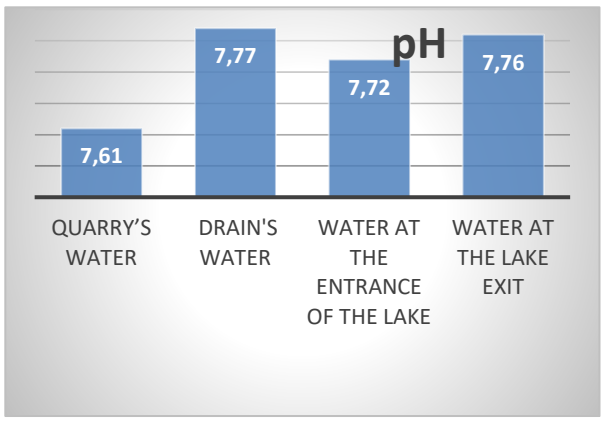


Figure 4: pH variation of analyzed waters

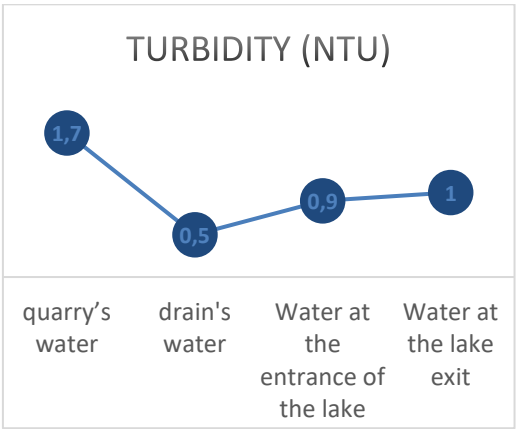


Figure 5: Turbidity variation of analyzed waters

The pH measured at the four points varies from 7.61 to 7.76. In general, the turbidity of the water in the quarry is higher than the turbidity of the lake water. As for the suspended solids, they are detected at the entry of the lake (28) and negligible at the exit and the drainage channel and at the level of the waters of the quarry (values lower than 10).

-Conductivity and salinity

The conductivity of a water indicates its ability to conduct the current, which depends on the content of water in mineral salts. This measurement mak es it possible to quickly evaluate the degree of salinity of the water and its mineralization, that is to say the quantity of ionized dissolved substances present. In general, the waters of the quarry have a conductivity and salinity more removed than the waters of the lake: they are more ionized than the waters of the lake.

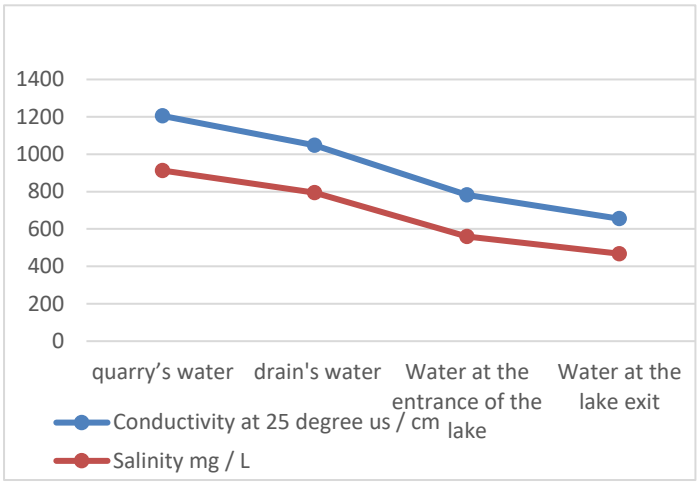


Figure 6: Conductivity and salinity of analyzed waters

• Pollution parameters: COD, BOD5, Total nitrogen (NTK)

Table 3: Change in concentrations of COD, BOD5, Total Nitrogen (NTK)

Parameters	Quarry's Water	Drain's water	Lake Entrance	Lake Exit
BOD5- mgO2/L	<2	<2	<2	<2
DCO- mgO2/L	<2	<2	20	20
Total Nitrogen (NTK) -mgN	<1.4	<1.4	1.4	1,4

The biological oxygen demand in 5 days (BOD5) is negligible in all samples of water withdrawn. However, even if the chemical oxygen demand (COD) is negligible in the waters of the quarry and the water of the drain, it is remarkable (20 mgO2 / L) at the level of the lake water (inlet and outlet). The waters of the lake are therefore more loaded with organic matter than the waters of the quarry.

The "total" nitrogen concentration, which corresponds to the sum of the organic nitrogen, the ammoniacal nitrogen, the nitrite and the nitrate, is negligible in the waters of the quarry and the waters of the drain, but at the Water Level Lake (inlet and outlet), there is a total nitrogen concentration of 1.4mg N / L.

➢ **Second campaign**

Table 4: Variation of measured parameter concentrations at second campaign

Sampling sites	Required parameters				
	Temperature	pH	Dissolved Oxygen	Total Phosphorus	Total Nitrogen
Water 500m from the lake entrance	31,2	7,46	4,4	0,48	2,8
Water 550m from the entrance to the lake	30,8	7,39	4,2	0,46	2,8

The pH values are lower than the values found during the first campaign (7.61 to 7.76). On the other hand, the concentrations in nitrogen doubled of values being 1,4mgN / L in the first campaign against 2, 8mgN / L in the second campaign. This supposes an accumulation of nutrients in the middle of the lake. The phosphorus values not previously measured during the first campaign are 0.48 and 0.46 mgP / L.

1-3- Identification of sources of pollution of Lake Tohé

The results of analysis of samples from the first sampling campaign show that there is a contribution of organic and nutrients to the lake: COD (20 mgO2 / L) and total nitrogen (1.4) mgN / L). The results of the second campaign justify this accumulation of organic and nutritive materials at the lake level (500m and 550m from the entrance):

dissolved oxygen (4.4 and 4.2 mgO2 / L); total phosphorus (0.48 and 0.46 mgP / L); total nitrogen (2.8 and 2.8 mgN / L). However, the results of the quarry water analysis show that the total nitrogen (cause of the conflict) found at the lake level cannot come from the waters of the quarry which does not contain it in a detectable concentration. The results of observations show that the majority of farmers (especially market gardeners) use chemical fertilizers and pesticides around the lake and all along the drainage channel from the quarry to the lake. The majority of these farmers are unaware of the sensitivity of the aquatic environments to the nutrients and toxic products contained in the chemical fertilizers, herbicides and pesticides they use. In addition, a deforestation phenomenon is also remarkable. Increasing deforested areas can reduce the ability to filter nutrients and pollutants before they are transported into the lake. These pollutants can also enter the drainage channel of the quarry waters by rushing at the time of the rains. Fertilizers carried in watercourses favor the overproduction of aquatic plants, which can reduce the concentration of dissolved oxygen required for fish. These pollutants contribute to the destruction of the ecosystem, destruction that essentially results in the disappearance or scarcity of fish in the lake.

Component 2: Exploring tracks for durable solutions to the problem

The activities of this component bring together the solutions that have been explored for an integrated and sustainable management of this ecosystem threatened by chemical substances and the restoration of medicinal plants which are disappearing, aggravated by deforestation resulting from the fall of fish production.

2.1 Interventions for Logokpo Populations: Awareness raising and education for reducing the use of fertilizers, herbicides and pesticides.

The purpose of this intervention is to make people understand that they have a direct impact on the quality and life of the lake's ecosystem with respect to deforestation and the use of chemical fertilizers, herbicides and pesticides during activities market garden along the canal and around the lake. Already following the results of the inventory in general, it was organized and conducted four (04) sessions of education and sensitization of the population on the subject on March 31; April 21th ; May 08 and June 05, 2018 (World Environment Day). Then after the results of water analyzes, a session was organized for the communication of the results of water analyzes to the populations followed by two (02) sessions of education and sensitization of the populations on the ecosystem services of the biodiversity and in particular the impact of agricultural fertilizers, herbicides and pesticides on the life of the aquatic ecosystem on July 31st and August 1st, 2018. To always advance in the direction of improving the state of knowledge of the populations in the matter, that can be translated into actions (reforestation and reduction of the use of chemical fertilizers, herbicides and pesticides along the drain and near the lake), an endogenous committee for the preservation of the lake ecosystem and culture of the lake and peace with SCANTOGO at the turn of the lake issue was put in place on August 1, 2018. This committee will continue the actions of education, sensitization at the end of the project and.

2.2 Interventions for SCANTOGO: Proposal to create a quarry pit settling basin.

Although the test results showed that the quarry station water did not contain any remarkable nitrogen, we held a working session with the Career Service staff on August 16, 2018 in SCANTOGO. This session allowed to share and discuss with the quarry staff the results from the water analysis at the different sampling points. On this occasion, reflections were also made on the feasibility of creating a basin for settling quarry waters that have a higher turbidity than the waters of the drainage canal and the lake.

- **Field Review**

After the working session with the career service manager and his collaborators, a field visit took place on the same day with two (02) career service technicians to determine the appropriate location for the construction of a basin, which preferably will not interfere with current and future operations. We proposed to build a pool with a vegetated buffer zone. The structure will be constructed northeast of the pumping station and towards the end of SCANTOGO's operating area, approximately 200 m from the lake, whose geographic coordinates located by GPS on the drainage channel are: 0343549; 0731363. After the examination of the ground and the choice of the most convenient place, we started the dimensioning stage.

- **Basin dimensioning**

For the design of the basin, we used daily water volume data pumped from the quarry for the reduction of the water table. Data for the months of June and July were provided by the career service. The minimum daily volume of water pumped over the two months is 2080 m^3 and the maximum is 5 200 m^3. It is suggested that the retention time for wetlands with fluctuating water levels should be at least two (02) days for proper nutrient removal. To reach a retention time of two and a half days, the minimum volume of the wetland should be 5,200 m^3 with a maximum volume of 13,000 m^3, or an average of 9100 $m.^3$

The vegetated area (herbal plants commonly known as typha) will occupy a large part of the wetland (2/3). For a length of about 90 m along the drain and a depth of 1.5m we have a width of 67.4m or about 70 m for the basin.

2.3 Joint interventions involving Scantogo and populations of Logokpo

- **Preparatory activities for the resumption of fish farming**

Thanks to the technical and financial support of SCANTOGO through the HC Togo foundation, we have been carrying out weeding of part of the lake necessary for the resumption of fish farming activities by the local populations (young, men and women). This weeding was accompanied by the production and implantation of six (06) nesting boxes (attached photos) for the water duck whose numbers increased because they were already attracted by the visible surface of the lake after weeding. Then plants of kaya sennegalensis provided by SCANTOGO were planted around the weeding part of the lake for educational purposes to emphasize the importance of trees to lake ecosystems. After the weeding works, the Togo HC Foundation, in collaboration with the populations, requested the technical support of the Ministry of Agriculture, Livestock and Fisheries, through the submission of a project document on June 7, 2018 , the "resumption of fish farming in the logokpo fish farm" developed jointly with the local population as part of a call for the Agricultural Sector Support Project (PASA) in Togo. After analysis and review of this document, an inventory visit was organized and made by the Prefectural Directorate of Agriculture on July 31, 2018 and another conducted by the PASA project team on August 1, 2018 to record the availability of fish farming equipment and materials and study the feasibility of the project.

- **Creation of a garden for the conservation of local medicinal plants**

This activity took place in three (03) stages. The first step consisted of documentary research and consultation with local stakeholders. At this stage, the inventory of existing medicinal plants that are easily recoverable on the spot and which conservation is considered necessary was also discussed. At this first phase, 25 species were identified at the working session of April 21, 2018 with the populations. The literature search retrieved a reference document that contains photographs of samples of sub-Saharan medicinal plants. The second step allowed to deepen the search through photos of the samples of medicinal plants contained in the reference document of the first phase. The photos were presented to local stakeholders during the working session of May 19, 2018 so that they identify through them, the plants that they remember and estimate today endangered.
Then the photos of the selected plants were presented in a document and made available to the population for further research. In the third stage, research, harvesting and planting of samples of the plants identified in the first and second steps were discussed in a garden of approximately 50 m^2 laid out for this purpose which began on June 23, 2018. As of September 3, 2018, a total of 50 species of medicinal plants are kept in the garden (photos in appendices).

DISCUSSION

Referring to Figure 6, the difference between salinity and conductivity between quarry waters and lake waters can be explained by the influence of ions, favored by the dissolution of calcium carbonates (CaCO3) from limestone rocks in the water that would release more calcium ion into the water. Although lacking data on calcium ion (Ca2 +) concentrations, it could be expected that the geological nature of the geological formation influences the load of dissolved salts. The levels of the geological base in calcium carbonates would be high since this water is pumped to extract limestone. In India, Sarkar et al. (2007) also explained this situation by the influence of natural inputs.
As for the assessment of the trophic state of the lake, the fact that the nitrogen values obtained in the first campaign (1.4mgN / L) at the entry and exit of the lake doubled in the second campaign (2.8mgN / L) indicates that there is a considerable deposit of nutrients when they are dragged by the stream of water to the outlet of the lake and that there is input nutrients on both sides that reach the lake. In light of the analysis according to the phosphorus and nitrogen content assessment scales (MDDELCC 2015c), a concentration greater than 1 mg / l of total nitrogen in surface water is, however, considered as an over-fertilization indicator in the middle. Similarly for phosphorus, surface water with a concentration greater than 100 micrograms / L is considered hyper-eutrophic. On this basis, the lake is at an advanced stage of eutrophication for either phosphorus (0.46-0.48) or 460-480 micogram / L much greater than 100; and for total nitrogen (2.8). Dissolved oxygen is also low, but it may be favorable to some species of fish and intolerable by others. These results may have adverse effects on the lake ecosystem. Nitrogen and phosphorus, which are nutrients, promote the overproduction of aquatic plants that subsequently decompose using the oxygen in the environment that is responsible of the eutrophication of lakes (S. AHRIZ et al. , 2011). (Brahim Ould Ahmed, 2017). These nutrients, which are essential for plant growth, induce a disturbance of aquatic ecosystems (Powlson, et al.). The optimal management of fertilizers, herbicides and pesticides minimizes the intake of undesirable compounds in water bodies.
The planned and upstream interventions, in particular education and awareness and the proposal for the construction of the basin, will help to remedy the problem of eutrophication of the lake and preserve its biodiversity.

The preservation committee set up as part of the Tohé Lake ecosystem preservation actions will continue to raise awareness and educate the population, even at the end of the project. The implementation of our proposal to build a quarry pit settling basin will increase the retention of nutrients from agricultural activities that will eventually pass through the quarry drainage channel and at the same time contribute to the decantation of the waters in general before its root to the lake. This intervention will limit the pollution of the lake. The basin design for this project requires a large portion to be covered with vegetation. The vegetation cover is one of the main structuring factors of wetlands, influencing both nutrient retention and sedimentation rate.
Four (04) nest boxes out of the six (06) installed are used by birds (water ducks and others). The two (02) other nest boxes are occupied by bees that prevent other birds from using them. The bees have thus found a favorable place for their reproduction and will produce honey for the local populations.

The added value of the project for biodiversity, society and enterprise

In terms of biodiversity: The sensitization and education of the population on the reduction of pollution of the lake through the limitation of the use of chemical fertilizers, herbicides, pesticides in the lake catchment and the weeding of the lake will contribute to a reduced pollution and increased oxygenation of the lake, favorable for the conservation of local fish. The installation of nesting boxes for water ducks offers an alternative to bees that already find a favorable environment for their reproduction (two (02) nesting boxes of six (06) already occupied). This situation is the same for water ducks and other bird species that usually nest in natural cavities, already using the rest of the nest boxes. This will increase biodiversity at the local level, resulting in an increase in global biodiversity. The establishment of the local medicinal plant garden will contribute to the preservation of the endangered medicinal plant species.
On the social level: The project will promote the development of sustainable income generating activities (fish farming) that can fight against poverty and that can flow to other surrounding populations. The implantation of nesting boxes for water ducks, which led to their use by the bees, will provide honey to the populations and stimulate reflection on the design of a bee breeding project for the benefit of the populations of Logopko. Conservation of biodiversity through medicinal plants and endangered local fish will contribute to the culture of knowledge and educational practices. The medicinal plants will serve for primary care to the population.
For the company: The water analyzes carried out and the communication of their results to the population, as well as the education and sensitization sessions carried out on them, led them to understand some of their responsibility for the pollution of the lake. The support of SCANTOGO for the recovery work of the fish farming confirms in the eyes of local populations its commitment to the protection of biodiversity and socio-economic development of local populations. Behavioral change across all these activities will contribute to the development of the concept of peace culture and put an end to discontent that could undermine collaboration between the two parties. This new situation will favor the smooth running of SCANTOGO's activities.

IMPLEMENTATION PROJECT AND RECOMMENDATIONS

We propose to implement a “Pilot Project of Lake Tohé Ecosystem Enhancement ". This project is structured in three (03) components: (i) capacity building of market gardeners to reduce the use of pesticides, herbicides and chemical fertilizers; (ii) resumption of fish farming activities; (iii) construction of a settling basin for the drainage channel of the SCANTOGO quarry. The implementation of the project is planned for twelve (12) months with a total cost of 11,800,000 CFA francs.

Table 5: Summary of Project Activities and Estimated Cost Estimate

Activities	**State of progress**	**Cost**
Component 1: Capacity building of market gardeners		**1 000 000**
1-Awareness raising and education of populations	Partially realized	350 000
2- Training courses on the production of compost and bio insecticide	Not realized	650 000
Component 2: Fish Farming		**8 900 000**
1- Weeding	Already realized	-
2- Purchase of equipment and equipment	Already realized	-
3- Canoe and other clothing	Not realized	500 000
4- Training in fish farming	Not realized	1 650 000
5-Purchase Fry and feed (for 12 months) Not realized	Not realized	5 500 000
6- Operation and external support	Not realized	1 250 000
Component 3: Water Settlement pond Construction		**700 000**
1-Plan design of the basin	Already realized	-
2-Topographical work Not realized	Not realized	-

3-Excavation and earthworks	Not realized (quarry)	-
4-Harvesting and planting of plants	Not realized	700 000
Component 4: Monitoring, evaluation, project coordination		**1 200 000**
Total		**11 800 000**

As recommendations, it is necessary to:

- Based on the results of lake water analysis already available through this project to select fish species that can adapt to this ecosystem for fish farming. For fish species that are more sought after in the market but cannot possibly adapt to the environment, external support for fish culture in basins constructed above the soil outside the lake should be used.

-Command a technical and summary study for the construction of the settling basin

-Commend a dredging study of Lake Tohé for its ecotourism revaluation that will be beneficial to the two (02) parties (income to the people of Logokpo and tourist place for SCANTOGO visitors).

CONCLUSION

This report presents the results of analyzes of the biodiversity of Tohé Lake and the land use of its watershed including along the water drainage channel of the SCANTOGO quarry at the lake. It also presents the results of physicochemical analyzes of the lake and the waters of the pumping station of the quarry. After analysis of the results (inventory and water analysis), it appears that the quarry waters do not contain nitrogen which should show traces of nitrate in the water of the quarry pumping station and against lake waters contain it. However, nutrients and toxic substances from market garden activities along the canal pass through the lake. Nutrient values such as nitrogen and phosphorus from laboratory water analyzes indicate that the lake is at an advanced stage of eutrophication. The eutrophication of the lake would therefore be mainly caused by the development of market gardening activities around the lake and intensified by the same activities along the drainage channel of the quarry's water using chemical inputs, herbicides and pesticides. The deforestation phenomenon in the watershed could also contribute by adding nutrients and sediments to the lake through soil erosion. Thus, it is necessary to: reduce the input of fertilizers to the lake from market gardening activities; increase wooded areas in the lake watershed. The implementation of the proposed project and the consideration of the recommendations can help to solve the problem of eutrophication of the lake and maintain a good collaboration between the populations of Logokpo and SCANTOGO.

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To be kept and filled in at the end of your report

Project tags (select all appropriate):

This will be use to classify your project in the project archive (that is also available online)

Project focus:

- ☐Beyond quarry borders
- ☐Biodiversity management
- ☐Cooperation programmes
- ☒Connecting with local communities
- ☒Education and Raising awareness
- ☐Invasive species
- ☐Landscape management
- ☐Pollination
- ☐Rehabilitation & habitat research
- ☐Scientific research
- ☐Soil management
- ☐Species research
- ☐Student class project
- ☐Urban ecology
- ☒Water management

Flora:

- ☒Trees & shrubs
- ☐Ferns
- ☐Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☐Amphibians
- ☒Birds
- ☐Insects
- ☒Fish
- ☐Mammals
- ☐Reptiles
- ☐Other invertebrates
- ☐Other insects
- ☐Other species

Habitat:

- ☐Artificial / cultivated land
- ☐Cave
- ☐Coastal
- ☐Grassland
- ☐Human settlement
- ☐Open areas of rocky grounds
- ☐Recreational areas
- ☐Sandy and rocky habitat
- ☐Screes
- ☐Shrub & groves
- ☐Soil
- ☐Wander biotopes
- ☐Water bodies (flowing, standing)
- ☒Wetland
- ☐Woodland

Stakeholders:

- ☒Authorities
- ☒Local community
- ☐NGOs
- ☐Schools
- ☐Universities

APPENDIXES

Appendix 1: Daily volume of water pumped from the quarry for the months of June and July 2018

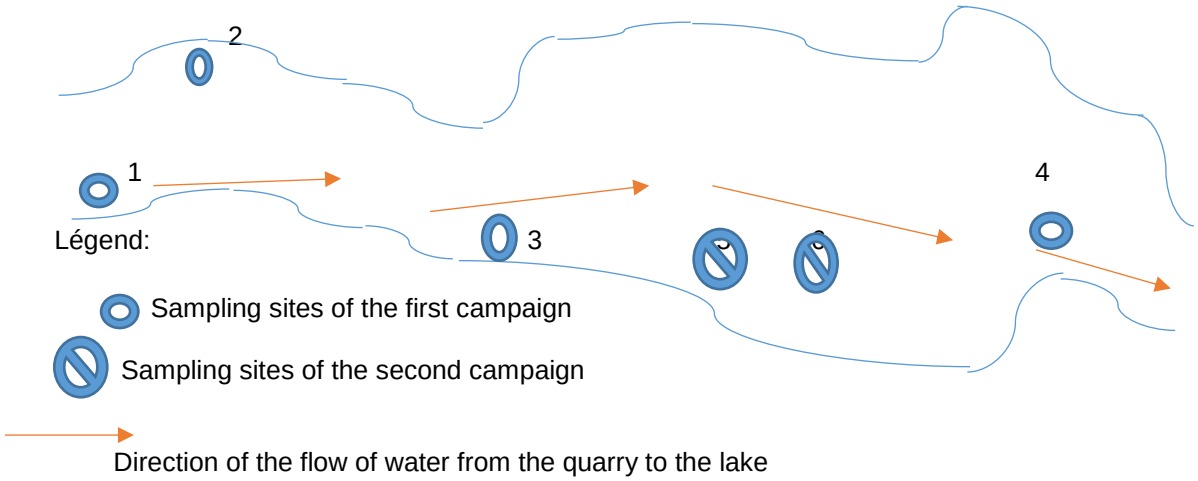
Date	volume pompé (m3)
01/06/2018	2080
02/06/2018	3900
03/06/2018	4940
04/06/2018	0
05/06/2018	3640
06/06/2018	3510
07/06/2018	3380
08/06/2018	2340
09/06/2018	3510
10/06/2018	0
11/06/2018	2990
12/06/2018	4290
13/06/2018	4290
14/06/2018	3380
15/06/2018	2860
16/06/2018	3250
17/06/2018	2730
18/06/2018	2860
19/06/2018	2990
20/06/2018	2990
21/06/2018	4940
22/06/2018	5200
23/06/2018	3640
24/06/2018	3120
25/06/2018	2340
26/06/2018	2340
27/06/2018	2600
28/06/2018	2470
29/06/2018	2990
30/06/2018	3120

Date	volume pompé (m3)
01/07/2018	2730
02/07/2018	2340
03/07/2018	4290
04/07/2018	3640
05/07/2018	2600
06/07/2018	3510
07/07/2018	3380
08/07/2018	2860
09/07/2018	2990
10/07/2018	4160
11/07/2018	3250
12/07/2018	2990
13/07/2018	2990
14/07/2018	3380
15/07/2018	2990
16/07/2018	2860
17/07/2018	3640
18/07/2018	3380
19/07/2018	3510
20/07/2018	3250
21/07/2018	2730
22/07/2018	3120
23/07/2018	2730
24/07/2018	2600
25/07/2018	2990
26/07/2018	2990
27/07/2018	3250
28/07/2018	2730
29/07/2018	2600
30/07/2018	2730
31/07/2018	2990

Appendix 2: Summary of Water Analysis Results of Six (06) Samples

	Results by sampling location

Requested parameters						
	Quarry's Water	Drain's water	Lake Entrance	Lake Exit	Water 500m from the lake entrance	Water 550m from the entrance to the lake
pH	7,61	7,77	7.72	7,76	7,46	7,39
Temperature(T) ^{0}C					31,2	30,8
Conductivity at 25 degree us / cm	1205	1048	783	655	932	923
Salinity mg/L	913	794	560	468	-	-
Turbidity (NTU)	1,7	0,5	0,9	1.0	-	-
Suspended solids (SS), -mg / L	<10	<10	28	<10	-	-
Chemical Oxygen Demand(COD)	<2	<2	20	20	-	-
Biochemical oxygen demand after five days (BOD5) -mgO2 / L	<2	<2	<2	<2	-	-
Total Nitrogen (NTK) -mgN / L	<1,4	<1,4	1,4	1,4	2.8	2,8
Dissolved Oxygen (O2) -mgO2 / L					4,4	4,2
Total phosphorus (P) mgP / L					0,48	0,46



Schematic drawing of the location of sampling sites

Appendix 3 : Community works

Preliminary site visit of the project by the actors

Session of production of birdhouses

Part of the Weeded Lake

Education and Outreach Session

Nesting boxes set up for water ducks

Members of the education and awareness committee

Appendix 4 : Proposals for the construction of the quarry water settling basin

Field visit for the location of the appropriate place for the construction of quarry water settling basin

Appendix 5: List of some species of endangered medicinal plants listed

1- Cyperus articulatus L.
2- Khaya senegalensis
3- Rauvolfia vomitoria
4- Anthocleita nobilis
5- Alstonia boonei
6- Bridelia ferruginea
7- Chloclospermum Tinctorinm
8- Fluggea virosa
9- Combretum micrantum
10- Alchornea cordifolia
11- Nauclea latifolia
12- Newbouldia laevis
13- Afzelia africana
14- Terminalia glaucencens
15- Vitex doniana
16- Annona enegalensis
17- Guiera senegalensis
18- Azadiracha indica
19- Tectona grandis,
20- Erythrophleum suaveolens
21- Annogeissus leiocarpus
22- Eucalyptus spp
23- Dacryodes edulis
24- Dalbergia lactea
25- Desplatsia dewevrei
26- Dialium pachyphyllum
27- Diospyros physocalycina
28- Entandrophragma utile
29- Eriocoelum macrocarpum
30- Erythrophleum suaveolens
31- Ficus asperifolia
32- Ficus exasperata
33- Ficus mucuso
34- Ficus thonningii
35- Ficus vallis-choudae
36- Gardenia ternifolia
37- Gilbertiodendron dewevrei
38- Heinsia crinita
39- Jatropha curcas L.
40- Landolphia owariensis P.
41- Leptoderris fasciculata
42- Macaranga saccifera
43- Macaranga spinosa