Final Project Report

1. Contestant profile

▪ Contestant name:	**MABAFEI Abalo**
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▪ University / Organisation	Lomé University
▪ E-mail:	
▪ Phone (incl. country code):	
▪ Number of people in your team:	**5**

2. Project overview

Title:	Characterization and mapping of natural habitats and ecological corridors around Sika-kondji quarry
Contest:	Togo
Quarry name:	Tabligbo East quarry (Sika-kondji)
Prize category: (select all appropriate)	☐ Education and Raising Awareness ☐ Habitat and Species Research ☐ Biodiversity Management ☐ Student Project ☒ Beyond Quarry Borders

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Abstract

Mining in all its phases, from opening a quarry to his closing causes a huge loss of biodiversity by causing habitats fragmentation and significantly affects the landscape in which it is embedded. This could, in short, medium or long term compromise the well-being or even survival of the populations that depend on this biodiversity almost. In a context of sustainable development which need to take into account of the environmental, social and economic components, this research aims not only the restoration of biodiversity in the landscape of implantation of the career of Sika-Kondj, but also through it the social and economic well-being of the populations of this career. Specifically it aims to characterize and map the natural habitats on the site of the quarry and beyond, as well as potential corridors that connect them. On the other hand, it aims to identify the various relationships that exist between the riparian population and biodiversity. To reach these objectives, Google earth images covering the study area have been photo-interpreted and a digitized through the software Google earth pro coupled with software QGIS in order to have land cover and land use map from which the processes of spatial analysis allowed us to detect and map naturals habitats and ecological corridors which connect them. On the other hand, floristic and ecological inventories were made using Braun-blanquet approach. Phytosociological data have been entered in Excel 2013 and processed using the software CAP (Community Analysis Packages). Ethnobotanical and sociological data have been entered and processed using Excel 2013. At the end of this research, it is clear that the landscape of the study area is essentially an agrarian landscape which still full of great biodiversity hosted by rare natural habitats. 225 species from 55 families have been identified. On the other hand, it is clear that the types of plant formations of the area are mainly due to 2 environmental factors: submersion and soil type. Investigations have revealed that the main activities carried out by the local population in ecosystems is agriculture, exploitation of firewood and timber, hunting and fishing. It also shows that unfortunately these activities are likely to adversely affect the ecosystem if nothing is done.
Summary: Characterization, mapping, Habitat, Corridors, Population, career, Sika-Kondji.

Introduction

The Earth Summit in 1992 raised awareness that biodiversity is seriously threatened by human activities and impoverished every year at an unprecedented rate (SCBD, 2010; Neville A. et al, 2007). Since its appearance there are 100 000 years, humans have had a growing impact on the environment to become the main factor of change (Linda R. et al, 2009). With the industrial revolution, human domination report on nature has become so large that some scientists argue that we entered a in new geological epoch, the Anthropocene (Robert B., 2008) which is materialized often by the loss of species (Berrnard, 2007). Then, five major threats to biodiversity were identified: habitat conversion, invasive species, overexploitation, climate change and pollution (Georgina M. et al, 2005; Neville A. et al, 2007; Adjonou et al, 2009). Among these threats, habitat conversion was the main cause of biodiversity loss last fifty years (Georgina M. et al, 2005; SCBD, 2008 Diwediga et al, 2012). If this conversion main cause is agricultural activities (Georgina M. et al, 2005; SCBD, 2008 Diwediga et al, 2012), the fact remains that mining also contributes. Indeed, the opening of logging sites is accompanied by excessive and uncontrolled deforestation. This massive deforestation is partly responsible for the disappearance of vegetation cover yet necessary for the survival of populations. This deforestation causes habitats fragmentation in these areas. It also causes high degree of land degradation, with high risk of erosion, lack of vegetation cover and in other hand, there is also a relocation of some local communities. This causes a severe shortage of land for housing, agriculture in the resettlement areas. This shortage often causes additional human pressure on vegetation in areas of relocation of these communities, and negatively impacting the environment even beyond the quarry. That is the context of our researches.

Objectives

The general objective of this research is contributing to the restoration of the ecological network around Sika-Kondji quarry.

Specifically, it aims to characterize and map natural habitats and ecological corridors which can connect them and secondly it aims to identify the various relationships between local communities and biodiversity of the study area.

Contest

The study area have approximately 112.25 km^2 and is around Tabligbo East quarry (Sika-Kondji quarry) at southeast of Togo. This area is composed of Tokpli and some of its neighboring townships located within 1km around it. These are Esse Godjin, Gboto, Amoussime, Kini-Kondji, Kpetsou, Afagnangan and Agomé Glozou. This area consists of vast agricultural land around villages, dotted with plantation teak and palm trees. The eastern boundary is represented by the Mono River (560km long) which forms the border between Togo and Benin. Altitudes in this area vary between 16 to 60m. The area have Guinean tropical climate with two dry seasons and two rainy seasons, rainfall level vary between 800mm and 1200mm / year. In this area we can find wetlands, many ponds and lakes where the many animal and vegetable species like *Nymphaea guineensis, Ceratophyllum demersum, Lymnophyton obtusifolium, Typha australis, Ipomoea Aquatica, Drepanocarpus lunatus, ficus trichopoda*. In the fields and fallow we have some species like *Adansonia digitata, Vitex doniana, Elaeis guineensis, Tectona grandis, Azadirachta indica.* The fauna is characterized by species such as lizards (*Agama agama*), chameleons (*Chameleo gracilis*, *Chameleo senegalensis*), turtles (*Kinixys belliana*), and snakes (Psammophis elegans, Psammophis sibilans, Naja nigricollis and Varanidae (Varanus exanthematicus). We can also find mammals, including mice, cane rats, and various species of birds scattered in the bush, fishes and crocodiles.

Method

Our methodology is based on three approaches: mapping approach, phytosociological approach and sociological approach.

Mapping approach

The work took place in two steps: a first step in Laboratory and the second step consist to visit study area in order to remove uncertainty and thus increase the reliability of the mapping.

Mapping was by making photo-interpretation of Google earth images directly from the software interface of Google Earth Pro in offline mode after having taken care of properly zoom on the area of interest to allow the registration of these images in the software memory (Cédric VENARDet al). This interpretation help us to map land cover and land use units of study area by digitizing it. The vectors resulting from the digitalization are obtained in the format " .kml " (Keyhole Markup Language) which is converted into ".shp " (Shapefile) through QGIS software for optimal use of these vectors in this software which are used to make the rest of the map treatments.

Thus, using the QGIS software, the superposition of different thematic layers (boundaries of the study area, hydrography, and vegetation) was made and permit us to have land cover and land use map. Using this map, prospection points were selected randomly to make field surveys.
To highlight the potential ecological corridors which may connect natural habitats, the procedure of spots dilation-erosion (Allag-Dhuisme et al., 2010) (Fig 1) was used.
It involves dilating the spots constituting each habitat type by defining a distance of buffer zone around the initial spots. In our case we choose 100m to make it. Second time, it consist to erode dilated spots by defining a negative buffer zone with the same value around dilated spots, and this allows highlight potential corridors between these spots.

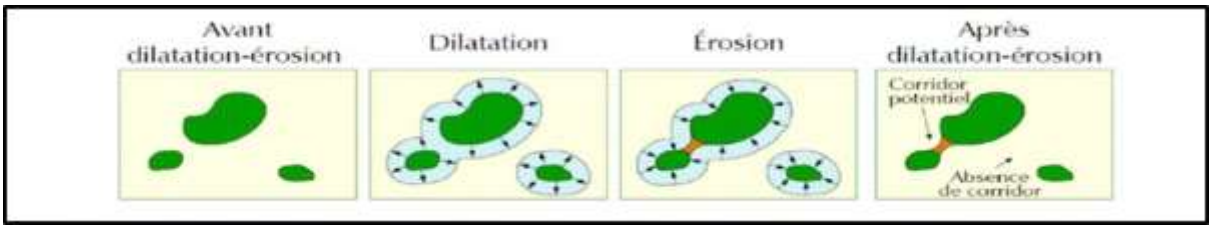


Fig.1 dilation-erosion procedure in order to determine the location of potential corridors between patches (Allag-Dhuisme et al., 2010)

Phytosociological Approach

In order to obtain correct information on the vegetation of a region, both fieldwork and laboratory observations has been undertaken. Representative samples of the entire study zone has been taken on the basis of stratified sampling that consists of first classifying the study region into different types of formations, then choosing a sample (plots of 30×30m) within each type taken randomly. In these samples, phytosociological observations were done with coefficients calculated for each species to express their respective weight and frequency using Braun-blanquet scale (+, r, 1, 2, 3, 4 and 5). On each inventoried site, key information was collected. The most important data are: date, author of the observations, plant formations present as well as their coverage, pedological and topographic characteristics, signs of human activities, submersion, and geolocalisation coordinates. Note that for water bodies, inventories were made in plots of 10 × 10m following transects perpendicular to the water body.

Sociological Approach

In this approach, socioeconomical surveys were conducted among the population. These surveys were made by individual semi-structured interview or focus group on the basis of questionnaire. The questionnaire focused on the activities done in ecosystems by population and the socio-economic importance level of these activities.

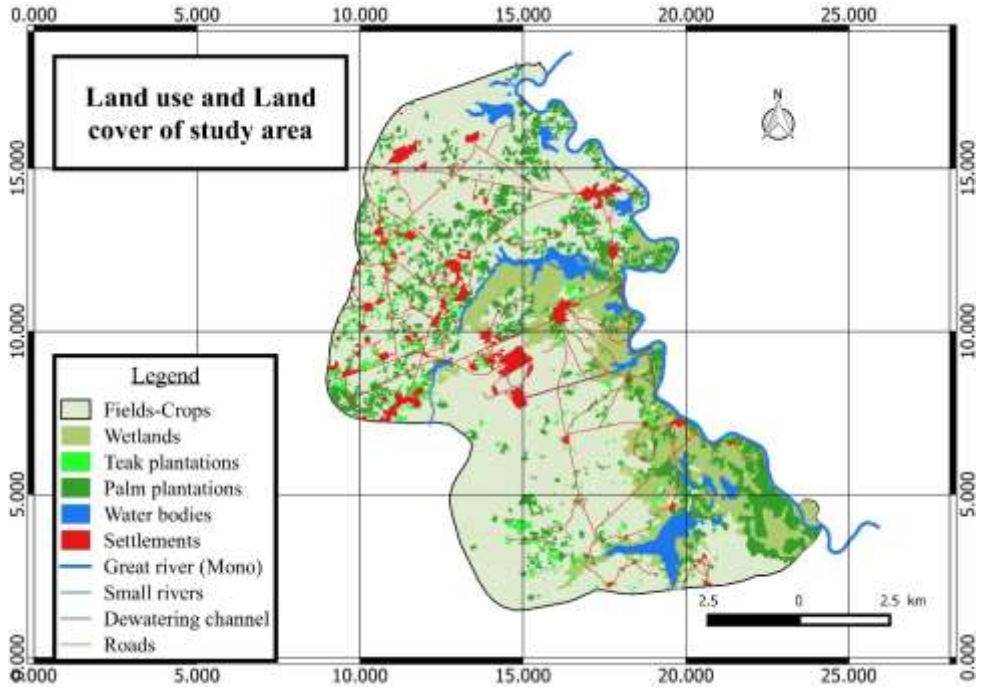
Data processing

The cartographic data were processed with the Google Earth Pro software, QGIS 2.8.9 and Excel 2013.

Phytosociological data were entered and processed into Excel 2013 and also with the CAP (Community Analysis Packages) software used to make an Ascending Hierarchical Clustering (AHC) and Principal Component Analysis (ACP) in order to discriminate the various statements based on environmental parameters. Socio-economic data have been processed with Excel 2013.

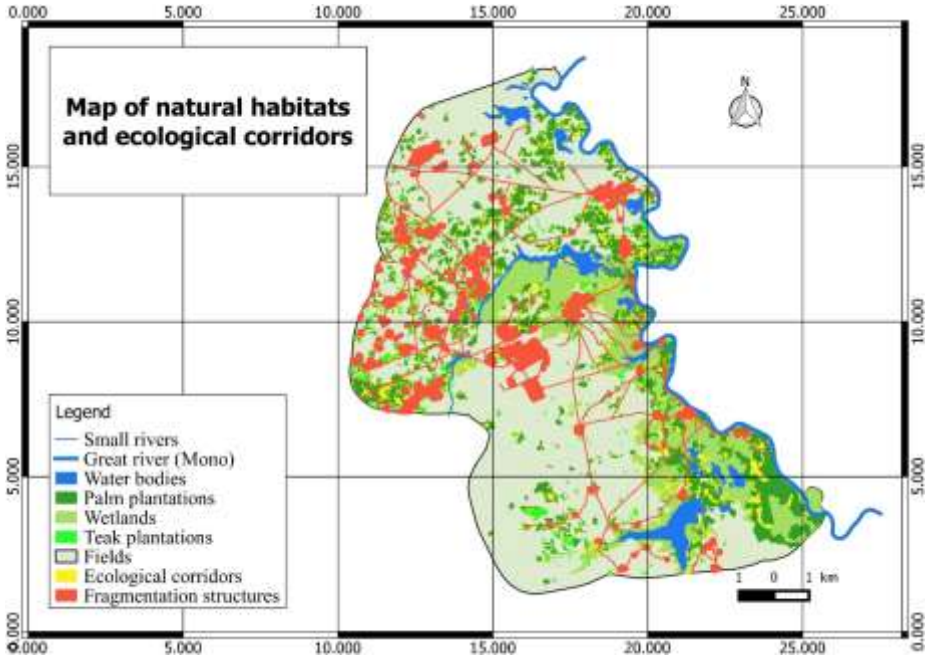
Results

Map of land cover and map of naturals habitats and ecological corridors have been made.



Map 1: Map of land cover and land use

6 land cover classes were identified and their proportions were calculated: fields (58%), wetlands (16%), teak plantations (3%), palm plantation (16%), water bodies (ponds and lakes) (4%) and settlements (4%).



Map 2: Map of natural Map N° 2: Map of habitats and ecological corridors

For phytosociological approach, 225 species belonging to 55 families were identified. The most common species are: *Leersia hexandra, Commelina erecta, Elaeis guineensis, Azadirachta indica, C. odorata, Nymphaea guineensis, Typha australis, Panicum maximum, Andropogon gayanus, Mallotus oppositifolius, Mitragyna inermis, Phyllanthus amarus, Corchorus olitorius, Imperata cylindrica, Synedrella nodiflora. The families most represented are: Fabaceae, Poaceae, Malvaceae, Asteraceae, Convolvulaceae, Euphorbiaceae, Rubiaceae, Cyperaceae, Amaranthaceae, Sapindaceae and Verbenaceae.*

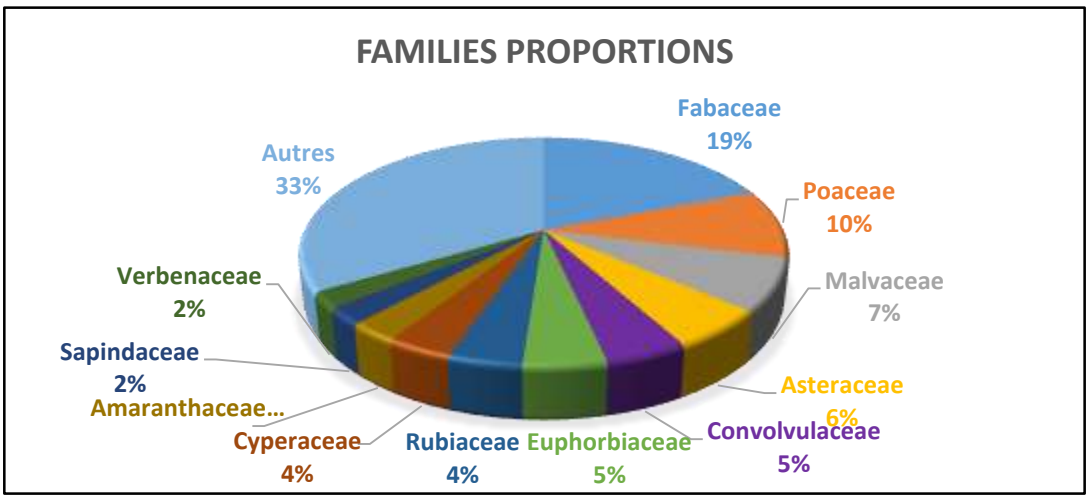


Fig.2 Families proportions

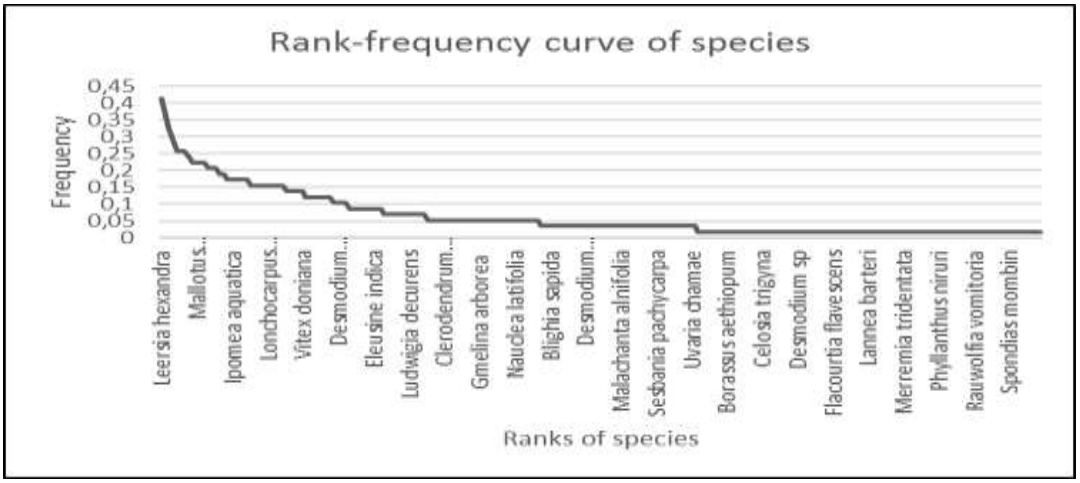


Fig.3 Rank-frequency curve of species

Ascending Hierarchical Clustering (AHC) gave the following dendrogram:

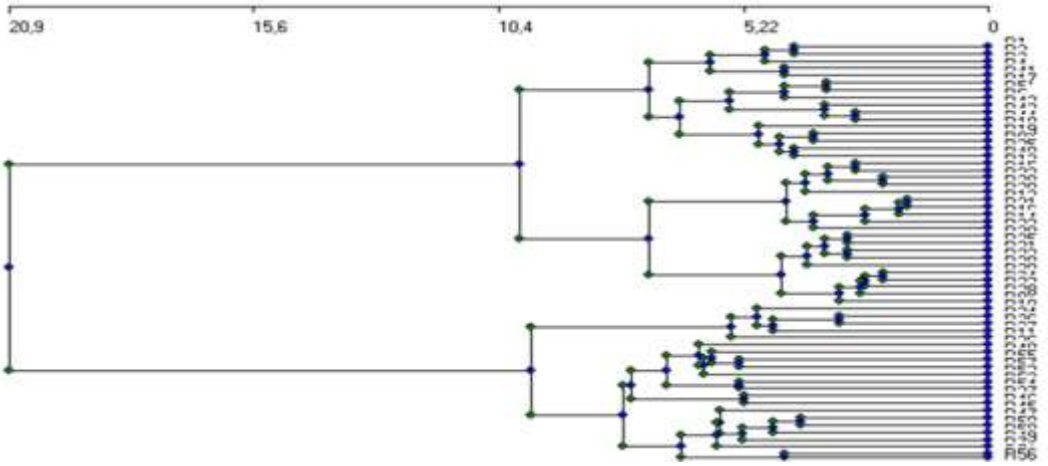


Fig.4 Dendrogram of Ascending Hierarchical Clustering (AHC)

Analysis of this dendrogram shows that there are 2 main groups of vegetation: GI which corresponds to the vegetation of dry and wetlands (fallow-fields, wetlands, teak and palm plantations) and GII which corresponds to the vegetation of water bodies (ponds and lakes). Each group can be decompose into 2 subgroups: GI decomposes into GI1 (vegetation of ponds on clay), GI2 (vegetation of ponds on silty soils) and GII decomposes into GII1 (wetlands) and GII2 which corresponds to field-fallow, palm and teak plantations.

The Principal Component Analysis (PCA) gave the following dendrogram:

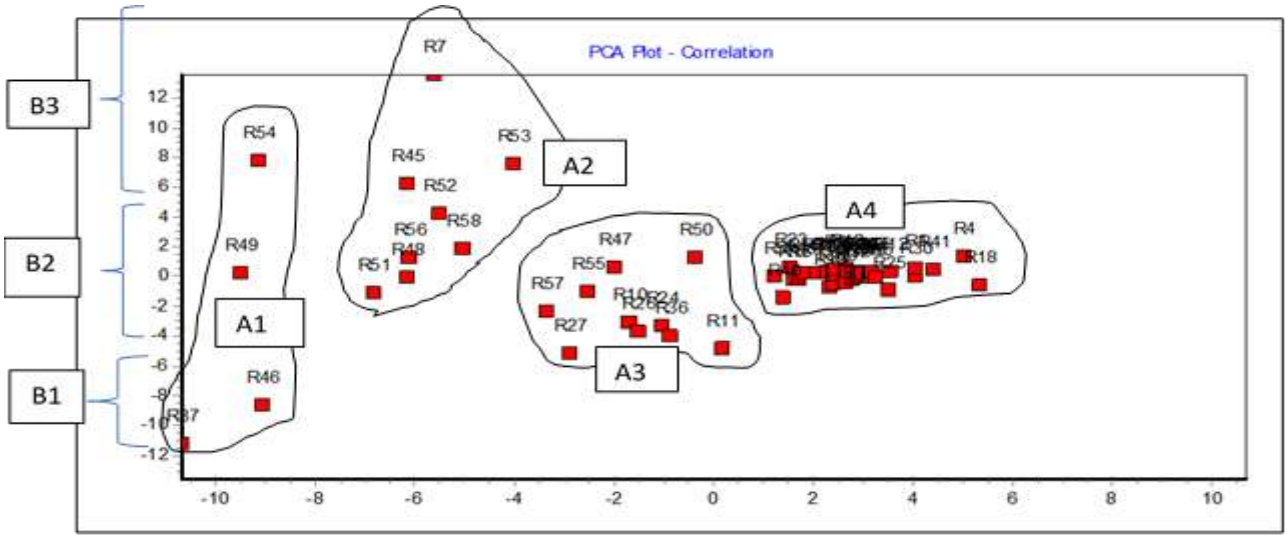
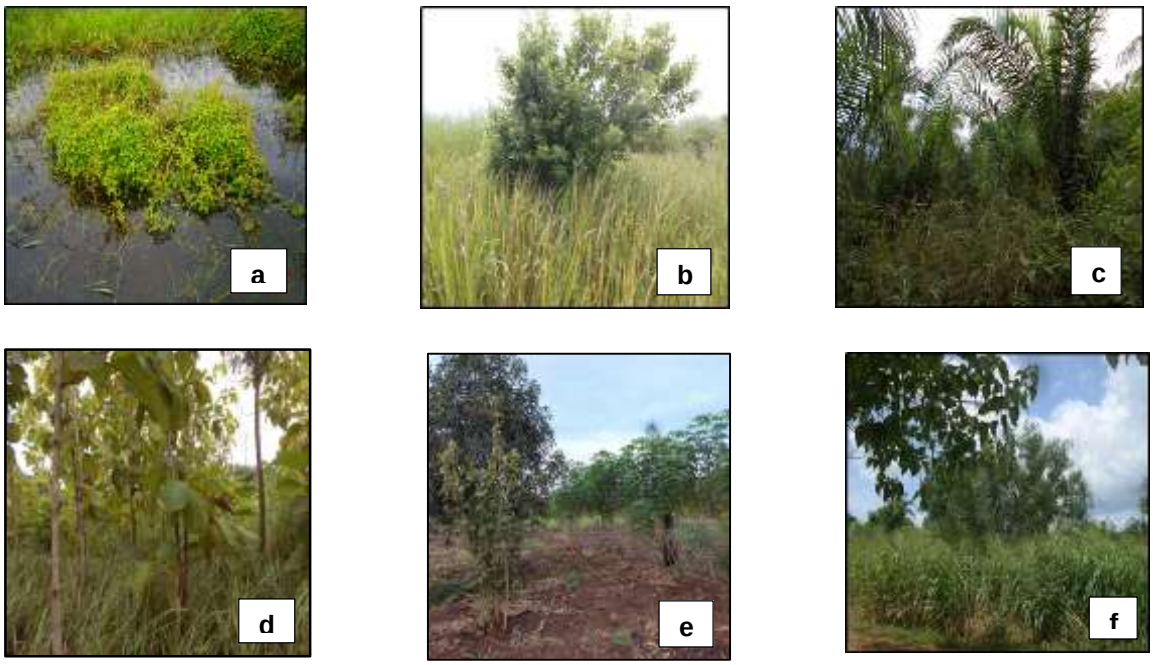


Fig.5 Dendrogram of Principal Component Analysis (PCA)

This dendrogram discriminates also 4 groups along the axis 1: A1 (vegetation on soil never submerged), A2 (vegetation on soil submerged in the rainy season), A3 (vegetation on soil submerged part of the dry season) and A4 (vegetation on soil permanently submerged). According to the axis 2, there are 3 groups: B1 (vegetation on clay soil), B2 (vegetation on loamy soil) and B3 (vegetation on sandy soils). Then the discrimination made by the Ascending Hierarchical Clustering considering soil and submersion parameters is confirms.

Floristic description of vegetation:

- Ponds vegetation (a): the most common species (Fr≥25%) are: *Leersia hexandra, Nymphaea guineensis, Typha australis, Commelina erecta, Ipomea aquatica, Polypodium sp., Cyperus sp., Lemna minor* and *Pentodon pentandrus.*
- Wetlands vegetation (b): the most common species (Fr≥25%) are: *Cissampelos micronata, Mitragyna inermis, Flueggea virosa, Paullinia pinnata, Phyllanthus amarus, Andropogon gayanus, Aspilia africana, Chromolaena odorata, Commelina erecta, Lonchocarpus sericeus, Azadirachta indica* and *Triclisia subcordata.*
- The palm groves (c): the most common species (Fr≥25%) are: *Azadirachta indica, Elaeis guineensis, Chassalia kolly, Mallotus oppositifolius, Allophyllus africanus, Chromolaena odorata, Rourea coccinea, Bridelia ferruginea, Morinda lucida, Paullinia pinnata, Synedrella nodiflora* and *Triclisia subcordata.*
- Teak plantations (d): the most common species (Fr≥50%) are: *Panicum maximum, Tectona grandis, Albizia adianthifolia, Anchomanes difformis, Azadirachta indica, Imperata cylindrica, Mallotus oppositifolius, Rourea coccinea, Annona senegalensis, Blighia sapida, Bridelia ferruginea, Chromolaena odorata, Elaeis guineensis, Holarrhena floribunda, Macrosphira longistyla, Paullinia pinnata, Rytigynia umbellulata, Sporobolus pyramidalis* and *Vitex doniana.*
- Fields (e) and fallow (f): the most common species (Fr>50%) are: *Corchorus aestuans, Tridax procumbens, Azadirachta indica, Elaeis guineensis, Imperata cylindrica, Calopogonium mucunoides, Chromolaena odorata, Commelina benghalensis* and *Mallotus oppositifolius.*



Concerning socio-economic aspect, the level of socio-economic importance of the activities in ecosystems is illustrated by the following figure:

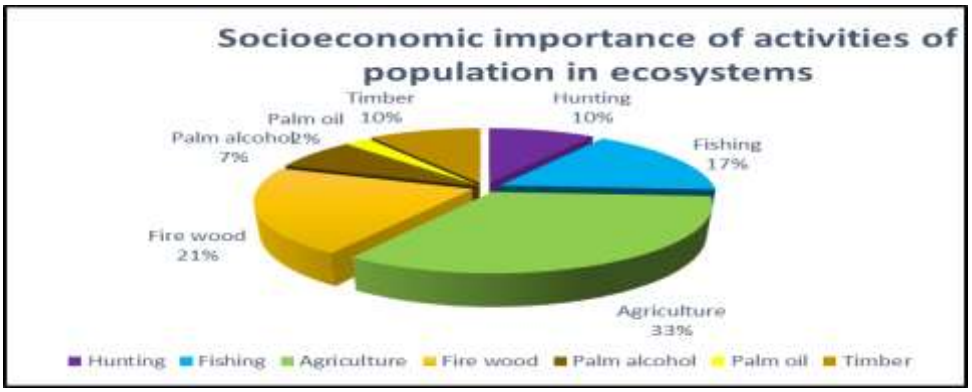


Fig.6 Socioeconomic importance of activities of population in ecosystem

Discussions

The mapping results allow us to say that the landscape in which Sika-Kondji quarry has registered is essentially agrarian landscape in which are found some natural habitats hosting a high biodiversity. In such a landscape, these rare natural or semi-natural habitats are very important for the conservation of biodiversity (Billeter et *al*, 2008).

On the other hand, note that the diversity of phytosociological groups is indicative of a great diversity of these different habitats and this is also important for biodiversity conservation. This diversity must be maintained in order to sustain the ability of these habitats to support life in all its diversity.

The survey results clearly illustrate the importance of agriculture, fishing, hunting, firewood and timber exploitation for the local population. Due to the fact that the area in which lives this population is poor in wood resources apart from some small bushes found in wetlands, we can deduce that this scarcity of wood resources is the result of over-exploitation of this resource, which also explains the absence of forests in the area. Moreover these wood resources may also have other utilities such as ecosystem services, food or medicinal values. Then the scarcity of this resource negatively affects the lives of local people which in most cases as in most underdeveloped countries depend on these resources for survival (Atato *et al*, 2011).

Moreover, the importance of hunting is a threat not only to animal diversity, but also for plant diversity, especially for plants need animals to spread their seeds (Ahimsa Campos-Arceiz et *al*, 2011). Note also that the food chain is embedded in an ecosystem, vulnerability or extinction of a link can negatively affect all others.

Conclusion

It is clear from our work that the landscape in which Sika-Kondji career has registered is essentially agrarian landscape in which the rare natural habitats hosting great biodiversity. It is also important to note that different types of vegetation found in this landscape are mainly explained by two environmental factors: submersion and soil type. Moreover agriculture, hunting, fishing, firewood and timber exploitation are the important activities of population in the study area. But unfortunately these activities may adversely affect the rare natural habitats and compromise their ability to host biodiversity if adequate measures are not taken. It is urgent to take action in favor of those rare habitat that remains.

As perspectives, we plan to:
- sensitize the local population about the need for conservation of natural habitats,
- mobilize the local population around project of setting up village community interest areas in order to conserve and sustainably manage the existing rare small groves included in wetlands and great ponds.

The implementation of this project could be done during 2 years using 15267.17 €.

Possible use of the results

For Biodiversity:

• Restoration of the existing ecological network in the area;

• Facilitating migration of species;

• Increase the gene pool of populations of species;

For the Society:

• Sustainability of ecosystem services;

• Restoration and sustainability of relations between the local community and biodiversity;

For the Company:

• Acquisition of a good reputation which relates to " social license " mining companies and which can positively influence the perceptions of communities, NGOs and other stakeholders;

• Confidence and increased loyalty from investors;

• Reduced risks and responsibilities.

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Project tags (select all appropriate):

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

Project focus:

- ☒Biodiversity management
- ☐Cooperation programmes
- ☐Education and Raising awareness
- ☐Endangered and protected species
- ☐Invasive species
- ☒Landscape management - rehabilitation
- ☐Rehabilitation
- ☒Scientific research
- ☐Soil management
- ☐Urban ecology
- ☐Water management

Flora:

- ☒Conifers and cycads
- ☐Ferns
- ☒Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☒Amphibians
- ☐Birds
- ☐Dragonflies & Butterflies
- ☒Fish
- ☒Mammals
- ☒Reptiles
- ☐Spiders
- ☐Other insects
- ☐Other species

Habitat:

- ☐Cave
- ☐Cliffs
- ☒Fields - crops/culture
- ☐Forest
- ☒Grassland
- ☒Human settlement
- ☐Open areas of rocky grounds
- ☐Recreational areas
- ☐Screes
- ☒Shrubs & groves
- ☐Soil
- ☐Wander biotopes
- ☒Water bodies (flowing, standing)
- ☒Wetland

Stakeholders:

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