Appendix 8 Land Use Survey of the Yaoure Gold Project

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Yaoure Gold Project, Côte d'Ivoire




Submitted to

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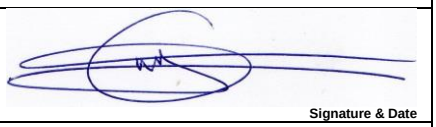
Author	**Dr. Dibi Hyppolite**	 Signature & Date	
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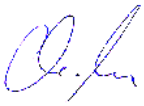
Project Manager	**Dr. Christian Kunze**	 11 November 2015	

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SUMMARY

Land-use surveys and mapping form an important component of an ESIA especially for a company whose activities may have negative impacts on the environmental and socio-economic conditions. The purpose if this study is to determine and map land uses and habitats associated with the Yaoure Gold Project to assist in identifying potential sensitive areas associated with the Project.

The methodology used in this study was:

- A desktop assessment and analysis of a Digital Globe imagery (50cm) satellite image acquired on the 04 January 2014 and the previous land use survey undertaken as part of the 2007 EISA;
- Categorisation of land uses based on the initial desktop assessment, previous land use survey and field verifications;
- Field data-collection and verification survey of land use categories. This land use survey took place from 23 February 2015 to 04 April 2015, 2015 (10 days);
- Development of a land cover and habitat map for the Yaoure Gold Project at a scale of 1:25 000.

The results from the study indicates that the land uses associated with the Project can be divided into two main categories, namely:

- Grassland and shrub land savannahs to the North and Northeast of the area;
- Forested / wooded Savannahs and degraded forests to the South and Southwest. Riparian forests / galleries are also present along the Bandama River.

Anthropological activities led to various types of modified land-use including Lake Kossou, open pit and artisanal mining areas, mining infrastructure, a dense network of roads and tracks, as well as agriculture, dominated by cocoa culture.

Agricultural activities are mainly associated with areas in the North-Northeast (zone around Angovia and Allahou Bazi), to the South-southwest (around Patizia). Almost all of the annual crops are associated with cocoa mainly still at the young stage.

The main land uses and habitats within the Inner Exploration License are:

- Grassland, Shrubland savannah, Dense shrubland savannah and Woodland savannah occupying 48% of the area;
- Degraded/secondary forest and riparian forest covering 26% of the Project area, and agricultural land covering 12%.

In general, the field work was undertaken with a perfect collaboration of the surrounding populations.

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1.0. INTRODUCTION

An assessment of land uses and habitats and the associated development of a land-use and habitat map is one of the first important activities associated with an ESIA as it assists in gaining a better understanding of the spatial background and sensitivities associated with a project.

A land-use and habitat survey and associated mapping is therefore an important decision support tool, especially when Project activities have the potential to impact on the biophysical and socio-cultural environments.

The context of the Amara Mining Côte d'Ivoire SARL Yaoure Gold Project (the Project), for this study is that the Project co-exists with a large number of artisanal miners scattered all over the Project area. In addition, land ownership is customary therefore small scale farm plots and grazing land is associated with the Project. Some farms and land will inevitably be impacted by the extension of the proposed mining operations in the area. Various villages and hamlets are present within the Project boundaries and lead to significant changes to the associated natural environment.

The objectives of this study are to contribute to improving the knowledge base of the Project through the identification of the various habitats and land uses present within the confines of the exploration permit and to produce a map visually representing the findings.

The rest of the report is structured as follows:

Chapter 2: Provides a description of the methodology followed to assess land use and habitat identification;

Chapter 3: Outlines the findings of the various land uses and habitats present in the Project; and

Chapter 4: Provides a conclusion on the land use and habitat findings.

As part of the outcome of the study spatial data was produced representing the various land use and habitat categories. This data will be used to determine the sensitivity of the Project in terms of the location of proposed Project infrastructure.

2.0. METHODOLOGY

2.1. Specialists and Credentials

In addition to the consultant, a technical staff composed of four assistants (Master and PhD students in remote sensing and GIS of the University Felix Houphouet Boigny) and a guide, served as support for the field data collection.

The consultant, Doctor DIBI HYPPOLITE, is a lecturer and researcher at the Faculty of Bioscience, Botanical Laboratory at the Felix Houphouet Boigny University of Abidjan-Cocody (Côte d'Ivoire). He holds a Doctorate Degree in Remote Sensing and GIS Forestry. He is furthermore lectured and research associated to:

- The University Center of Research in Remote Sensing Application (CURAT);
- The African Doctoral School of Remote Sensing (EDAT); and
- The National Centre of Floristic (CNF).

2.2. Equipment

Land use and habitat surveys involve a significant amount of field work and therefore the following technical equipment was used to carry out the study:

- A Digital Globe Imagery image of 04 January 2014 supplied by the Client;
- GPS (Garmin Etrex 20);
- Digital cameras;
- Data collection sheets;
- Laptops; and
- Software ENVI 4.8 and ArcGIS 10.1 respectively for data and image processing and cartographic production.

2.3. Method

The study area covers 12,776.42 hectares and is bounded by UTM coordinates Y: 781488 and 771047m N, and X: 214677 and 226618m W.

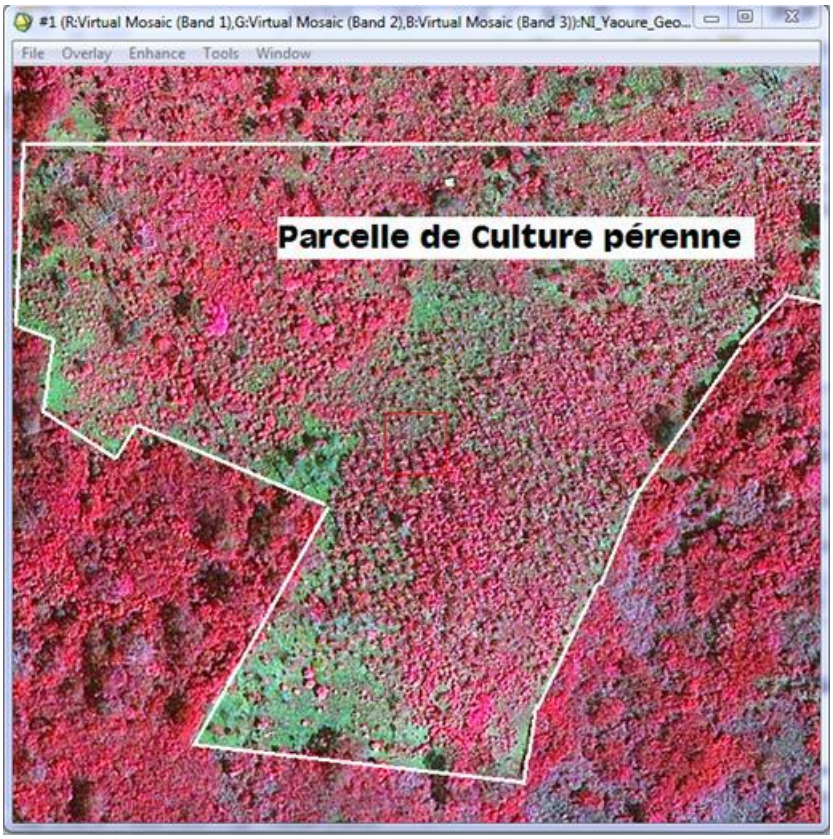
2.3.1. Digital processing of satellite imagery (Phase 1)

This operation aimed at manipulating spatial data and satellite imagery to improve information retrieval. The process also assists in gaining a first grasp of the various land uses and habitats, gives an indication of unknowns and assists in focussing field data collection. In complement to image processing, other related information (sacred site, cemetery, artisanal mine) identified by the Project (shapefiles) have been incorporated into the database.

Identification of map units having a regular geometrical structure

To assist in the identification of structures with a geometrical shape, a Red Green Blue (RGB) colourful composition raw image technique Near-Infra-red, red and green) was produced. This operation, which exploits the image spatial accuracy, allowed extracting items (impact of human activities) such as: farms (Figure 2-1), the buildings of different villages and hamlets, roads and tracks, mining infrastructures and high voltage lines.

Figure 2-1 : Example of perennial crops (cocoa plots)



Source: DigitalGlobe, Inc, 2014

Identification of land units not having a regular spatial geometry

Land units not having a definite geometrical shape are usually associated with more natural land uses. These include savannahs (woodland, shrubland and grassland), and forests (degraded, gallery/riparian). For the identification and visual interpretation of non-geometrical shapes, a spatial re-analysis of the satellite image of 50cm to 5m was conducted. This operation met the need to change the image from the scale appreciation of a tree, to forest stand as a cartographic unit's base. To optimize the spectral parameters for the characterization of land-use units, neo channels were created in addition to those existing. Thus, an image-enhancement operation that is the Main Component Analysis (MCA) on the four Digital Globe Imagery raw strips (near Infra-red,

red, green and blue) was applied. It is a technique of image enhancement, improving visual quality of the image to facilitate its visual interpretation.

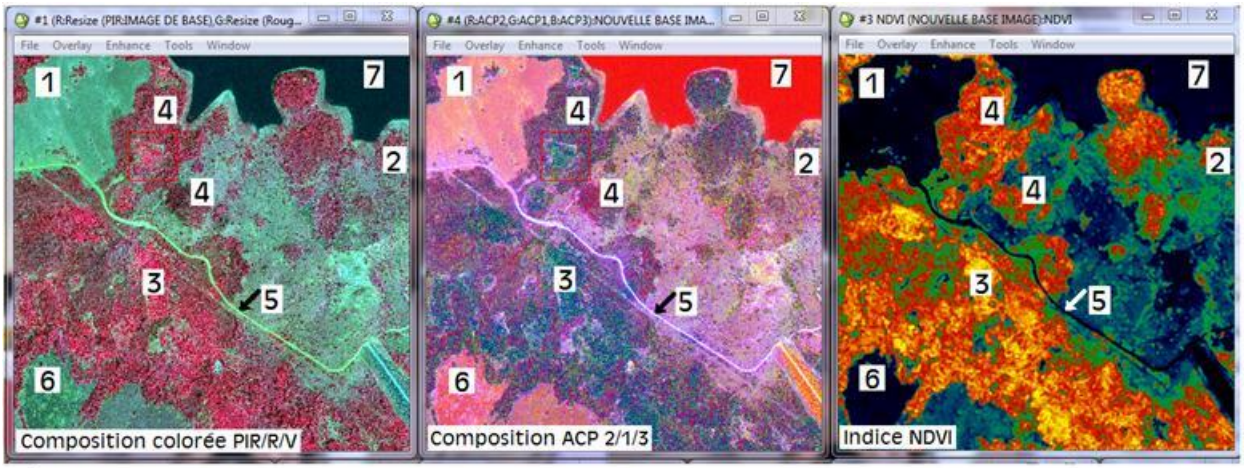
The Normalized Difference Vegetation Index (NDVI) or vegetation index standard that categorizes the plant formations depending on their photosynthetic intensity was also calculated. It allows distinguishing between open surface and covered areas of vegetation, but also between the dense vegetation (degraded forest, forested/wooded savannah and perennial crop) and savannah.

An analysis of the various calculated parameters (MCA and NDVI) in colourful compositions RGB (MAC 2/1/3, and the NDVI index) assisted to differentiate between grassland, bush land, wooded Savannah / degraded forests and crops (perennial and annual) without regular geometric form. The quality of the imagery also allowed to distinguish burned savannahs. The problem with irregular geometric shapes is that it sometimes hide perennial crops which grows underneath.

Thus, prior to the field trip, it was possible to characterize and identify the various land use cartographic units (Figure 2-2 and Figure 2-3) including:

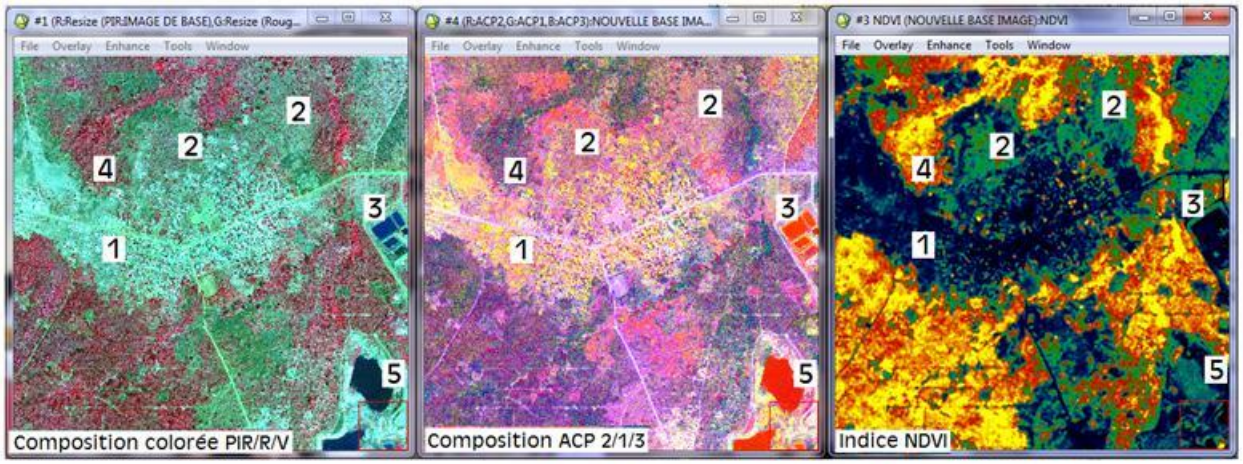
- The dense plant formations consisting of: forests; forested/wooded savannah, and perennial crops;
- The less dense plant formations consisting of bush land and annual crops;
- Grassland, and wetland covered with grassy vegetation along the dam and Lake Kossou;
- Expose surfaces without vegetation formed by settlements, soil denuded by human activities (artisanal mining and agricultural deforestation) or outcrops and mining infrastructure; and
- Infrastructure, including roads, tracks and power lines.

Figure 2-2 : Identification (example 1) of the land-use types using colourful compositions of bands (PIR/R/V) and MCA 2/1/3 and the NDVI vegetation index



Data Source: DigitalGlobe, Inc, 2014

Figure 2-3 : Identification (example 2) of land-use types using colourful compositions of bands (PIR/R/V) and MCA 2/1/3, and the NDVI vegetation index



Data Source: DigitalGlobe, Inc, 2014

2.3.2. Selection of the sites to visit

On the basis of the foregoing process, two hundred (200) points or sites representing all land-use types were selected. The selection of the 200 points was based on the following parameters:

- Identification of the type of occupancy / land use on the coloured composition;
- The number of points in relation to the area occupied by this entity;

- The randomness of choice within a class of occupancy / land use; and
- The accessibility of the site.

The selected land-use types are summarized in Table 2-1. GPS coordinates of these sites are summarized in Annexure A.

Table 2-1: Land use and habitat categories

ID	Land-use and habitat types
1	Degraded forests (islets)/ secondary Forest
2	Riparian forests / galleries
3	Woodland savannah
4	Shrubland savannah
5	Dense shrubland savannah[1]
6	Grassland
8	Waterbody (Lake and river)
9	Perennial crops
10	Annual crops / recent fallow
11	Seasonally flooded areas
12	Settlements and hamlets
13	Artisanal mining
14	Historic Mining infrastructure and footprints
15	Roads and tracks
16	High voltage power line
17	Cemetery
18	Sacred Forests

[1]Please note the difference between bush land and dense bush land are: Shrublands/ bushland has a woody stratum with a low recovery (15-30%), while the dense bushland have a dense shrub layer (40 to 60% and more).

2.3.3. Survey and verification

A reconnaissance and ground truthing survey was undertaken. It is a phase of recognition and description of the land-use types (on the basis of their GPS coordinates). The satellite image used for the initial desktop land use and habitat classification is the dry season (as of 04 January 2014), therefore it was important that the ground reconnaissance mission was done for the same dry period between December and February. To view relative annual and seasonal changes in plant physiognomy, the reconnaissance field mission was carried out in February 2015.

The survey was undertaken through travelling the area of study with a GPS. A descriptive analysis was also done to allow for characterization of, among others, the absence or the presence of vegetation, the number and density of woody and grassy strata, the relief and the soil moisture, etc. Some photographs of representative land use and habitats on site were also taken for illustration.

2.3.4. Digital processing (Phase 2): mapping through directed classification

The synthesis of data collected on the ground or the land-use typology served as point of support for the directed classification of Digital Globe Imagery image. The study area is located in a semi-deciduous zone, the trees shed part of their foliage during the dry season, thus the appearance of vegetation will have a different structure in the dry season. To further enhance the accuracy of the classification an additional hundred (100) plots were selected undertake classification of the imagery through the method of the minimum distance.

2.3.5. Assessment and validation of the land-use map

The classification was followed by another validation based on a new field survey to collect data of areas of uncertainty. Also, a renewal of the data collection team was done with the arrival of two new assistants. This new team was assigned to survey the site again, and identify land use where information gaps exist, using GPS coordinates (with photo in support). Thus, one hundred (100) additional points representing the classes of less obvious land-use were identified.

This approach is related to the fact that certain land uses and habitat types, e.g. rivers and streams, lakes and water bodies, trails and villages are readily identifiable on the image data and therefore require no specific validation. On the other hand, the different vegetation types (different types of savannahs, degraded forests and farms) require more attention in the validation phase.

The new data collected (GPS coordinates) were added to the map to enhance the level of accuracy and consistency with field data. Thus, a class of land-use will be validated if and only if the level of agreement between the points collected on the ground and the cartographic data is between 90 to 100% range. Also, land-use types mapped with an accuracy less than 90% are reprocessed (visual reinterpretation and/or reclassification), for optimization of the cartographic accuracy. It should be noted that if the score of 100% of precision is quickly reached for the obvious land cover classes such as lakes or water bodies and roads (already reported above), this level of accuracy is not the case for map units having close spectral signatures. This concerns the different types of crops (annuals and perennials) and different types of forests (degraded, riparian/gallery).

2.3.6. Improvement of the map and calculation of the different cartographic entities

The next step was to filter the validated map by applying a median filter (5 x 5), then importing it in ArcGIS as additional layers (contours of farms, quarries, high voltage lines, roads and paths). Subsequently, the areas of the various land use and habitat types are calculated for a data analysis. The results are included in Section 3.

2.3.7. Cartographic drafting

Final land use mapping was done, including orienting the map, editing the legend, applying the grid coordinates, etc.

3.0. RESULTS

3.1. Land-use Characterisation

Several land uses and habitat types were identified. These include degraded or secondary forests, riparian and gallery forests, perennial and annual crops, Lake Kossou, the Bandama River, villages and hamlets, open surfaces (bare soil, outcrops), roads and tracks, high voltage lines, artisanal mining activities, mining activities and seasonally flooded areas.

Degraded or secondary forests are primary forests which have been altered beyond the normal effects of natural processes and are classified either as degraded primary forest, secondary forest or degraded woodlands. Thus, they will be considered as degraded forest, primary forest whose original cover has been affected by unsustainable exploitation of wood and non-timber forest products (NTFPs[1]) which cause that its structure, its processes, its functions and its dynamics are altered at the point of compromising the ability to adapt in the short or medium term of ecosystem. On the other hand, the secondary forest is woody vegetation restored on land which the original forest cover has been largely cleared (at least at 90%). In general, secondary forests grow naturally on land abandoned after shifting agriculture, sedentary agriculture, pasture, or tree plantations failure (FAO, 2002; OIBT, 2005).

In our study, secondary forests and degraded forest (Photo 3-1) are the same entity. Because even though regarding their definition, these two formations differ in their origin, they become very close in their structure.

Photo 3-1: Degraded forests

Source: 2D CONSULTING AFRIQUE, March 2015

[1] NTFP : "goods of biological origin other than wood, derived from forests, other wooded land and trees outside forests"

Riparian forests are specific forest formations which are associated with rivers. These formations are located in ecological transitions between aquatic habitats and land areas. The riparian forests are subject to frequent flooding. Unlike riparian forests, gallery forests are characterized by their joined canopy above a river or stream, or a wetland area of which the presence of water may be temporary. In this study based on the analysis of the Digital Globe image, the main feature for the differentiation of the riparian (Photo 3-2) and gallery (Photo 3-3) forests was their proximity to the river Bandama.

Photo 3-2 : Riparian forests

Photo 3-3 : Gallery forests

Source: 2D CONSULTING AFRIQUE, March 2015

Savannahs are grassy formations with a carpet of large grass forbs measuring, at the end of the growing season, at least 80 cm in height, with flat leaves arranged at the base or stubble, smaller weeds and grasses (Yangambi, 1956; Letouzey, 1982). These herbs are usually annually burned within the Project area. On this grasses carpet, there are generally trees and shrubs, that draw a **woodland** (trees and shrubs scattered on the grasses carpet), a **shrubland savannah** (shrubs only, on the grasses carpet), and a **grassland savannah** (trees and shrubs absent, only carpets grasses).

In this study three types of savannahs have been distinguished, namely:

- **Grassland** (Photo 3-4) which are established in small areas, or on the edge of Lake Kossou and surface areas which are degraded by human activities;

Photo 3-4 : Grassy savannahs

Source: 2D CONSULTING AFRIQUE, March 2015

- **Shrubland** with two variants depending on the density of shrubs. Indeed, a distinction was made between shrubland (photo 3-5) with a woody stratum of low coverage (15-30%), and dense shrubland with a more dense shrub layer reaching at least 40 to 60% coverage (photo 3-6);

Photo 3-5 : Shrubland savannahs

Source: 2D CONSULTING AFRIQUE, March 2015

Photo 3-6 : Dense shrubland savannahs

Source: 2D CONSULTING AFRIQUE, March 2015

- **Forested/woodland savannah** (Photo 3-7) differs from the other two types as a result of the presence of a forested/wooded stratum (30 to 40% of coverage) and irregular but closed shrub stratum (60 to 70% coverage and more), forming with the herbaceous stratum an arch which height varies between 2 and 5 m. Often this lower woody stratum consists of perennial crops including cocoa-culture.

Photo 3-7 : Woodland savannahs

Source: 2D CONSULTING AFRIQUE, March 2015

After forest and savannah, we have agricultural land: perennial crops, annual crops, mixed crops and fallow land.

- **Perennial crops** (Photo 3-8) consist of cultures of woody plants, perennials (trees, shrubs) performing their biological cycle (or living) over several years. In this study it was essentially about cocoa culture plots.

Photo 3-8 : Perennial crops

Source: 2D CONSULTING AFRIQUE, March 2015

- **Annual crops** consist of annual plants, i.e. plants whose life (from seedling to seed production) cycle lasts only a year. The observation made on the ground is that, an important part of the cultivated areas identified as annual crops are mixed crops.
- **Mixed crops** are a system of culture that consist of cultivating several plant species or varieties on the same plot at the same time (Andrews & Kassam 1976). The field work enabled us to note that the mixed crop is dominated by cocoa (Photo 3-9). Indeed, the latter is accompanied by (or associated with) crops such as plantains, taro, cassava in its early years. For crops such as corn or rice, there is rarely an association with the cocoa culture. Also, areas identified as annual crops over a given year are left fallow the following year (Photo 3-10).

It is important not to become confused between annual crops and young fallow land (one or two years).

- **Fallows** are plots or land which could produce but are temporarily abandoned (one or two years) for a best production (Duhamel du Monceau, 1758; Robinson, 1962). This land use has been included in the land use and habitat map as part of the annual crops.

Photo 3-9 : Annual crops (mixed crops)

Photo 3-10 : Recent fallow land (one year)

Source: 2D CONSULTING AFRIQUE, Mars 2015

The villages and hamlets (Photo 3-11) consist of inhabited sites that are the villages of Angovia, Allahou Bazi, Kouakougnanou, Akakro, Da Koffi Yobouekro and Bokasso.

The seasonally flooded areas on the edge of the Lake (Photo 3-12) can be defined as areas of marsh, fen, peat land or natural or artificial water, permanent or temporary, where the water is stagnant or flowing, fresh, brackish or salty, including areas of marine water which depth at low tide does not exceed six metres (Ramsar Convention, 1971).

In this study, the seasonally flooded areas are associated with the Bandama River, Lake Kossou, and their borders made up of gallery/riparian forests, and shores covered with herbaceous vegetation and degraded forests. For the purpose of this study it was therefore mainly the edges of the lake and the river that are temporarily flooded during the rainy season that were identified as seasonally flooded areas.

Lake Kossou (Photo 3-13) is the main water body feeding in the hydroelectric dam on the Bandama River, one of the two main rivers of Cote d'Ivoire.

Another type of land use is represented by linear infrastructures: high-voltage lines, roads and dirt tracks.

- **High voltage power lines** (Photo 3-14) are infrastructure for the transmission of electricity from the production site to the sites of consumption. Generally, these high-voltage lines are rights-of-way areas which are maintained (cleaned). This situation gives rise to dense herbaceous vegetation but without wooded vegetation.

Photo 3-11 : Locality (village)

Photo 3-12 : Seasonally flooded areas on the edge of the Lake

Photo 3-13 : Lake Kossou

Photo 3-14 : High voltage line

Source: 2D CONSULTING AFRIQUE, March 2015

- **Roads and tracks** (Photo 3-15) are the elements of the road network of the study site.

The quarries (Photo 3-16) are the most important ore mining sites (ditches).

Bare soil (photo 3-17) consist of open soil and outcrops.

Cemetery, sacred forests and artisanal mining locations were provided through shapefiles by the Project.

Photo 3-15 : Kossou Angovia main road

Photo 3-16 : Quarries

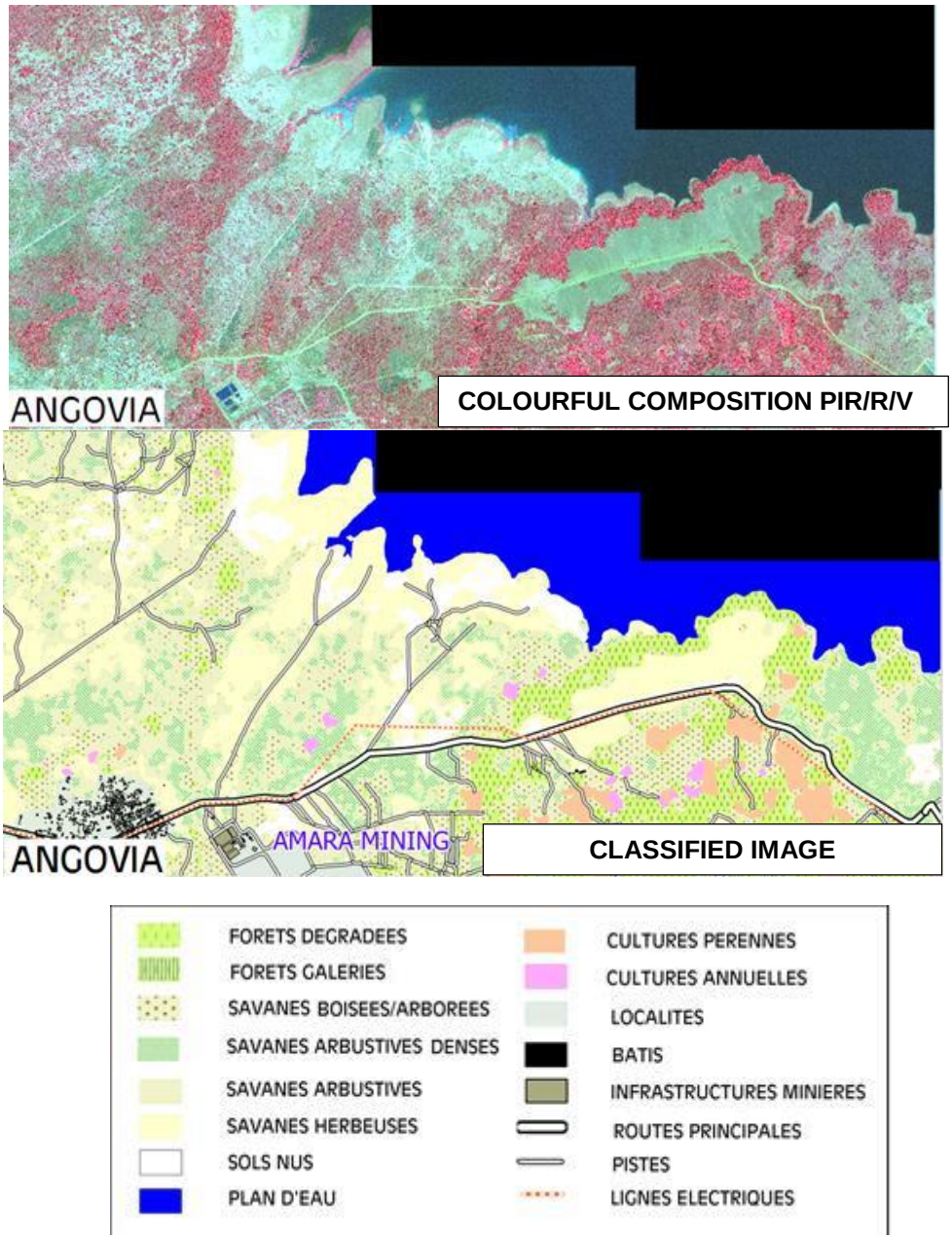
Photo 3-17 : Bare soils and outcrops

3.2. Mapping data accuracy

3.2.1. Thematic accuracy

The comparative visual analysis of the image of the colourful composition PIR/R/V and that field classification indicates a faithful translation of the reality (Figure 3-1).

Figure 3-1 : Visual thematic analysis of the image classification and the basic colourful composition (PIR/R/V)



Source: 2D CONSULTING AFRIQUE, March 2015

3.2.2. Statistical accuracy of image processing

Two groups of data identification and entities can be identified based on accuracy. Units that can be easily identified (Table 3-1) and those not as easily identifiable and which needs more intense site verification (Table 3-2).

Table 3-1 : Comment on the map units accuracy level (90-100%)

Land use	Cartographic accuracy ranging from 90 to 100%
Riparian and gallery forests	No confusion regarding their particular location along the river but in practice it is difficult to make a spectral difference between a gallery forest and riparian forest on this satellite image.
Shrubland	No particular confusion with the other two types of savannahs that are either without a woody stratum, or with a very dense woody stratum.
Grassland	No particular confusion.
Bare soils and outcrops	No particular confusion.
Villages and hamlets	Good determination (villages shape files were digitized on image and hamlets shape files were imported from the previous land use given by the Project).
River	No confusion with the other classes.
Lake	No confusion with the other classes.

Table 3-2 : Comment on the map units accuracy level (70-80%)

Land use	Cartographic accuracy ranging from 70 to 80%
Degraded forests	Slight confusion with gallery forests that are distinguished by their location along the Bandama River.
Forested/woodland savannah	Confusion with shrubland when they become very dense.
Dense shrubland	Confusion with the forested/woodland savannahs when they become less dense.
Perennial crops	Class dominated by cocoa-culture. It is generally well discriminated in the savannah area. In forest zone, its discrimination becomes a bit more complex probably for the following two reasons: • cocoa-culture hidden under shelter (under the trees); • the similarity of the spectral signature between the mature cocoa culture and degraded forests
Annual crops	Strong confusion with perennial crops. This could be explained by the fact that annual crops serve as cover for perennial crops in the juvenile stage. These latter end up after a few years by imposing their physiognomy.

3.3. Land-use map

See attached document (Annexure C).

3.4. Spatial distribution of the different land-use types

The study area covers an area of 12,776.42ha (Table 3-3), which is a square of about 12km by 10km. Table 3-3 reporting the total areas covered by the different land use types indicate that savannahs occupy approximately 48% of the Project area, forests approximately 26%, crops (perennial and annual) about 12% and only 2.36% for bare soil.

Table 3-3 : Spatial distribution of the different land-use types

Land use/Land cover	Area (ha)	Percentage
Degraded/secondary forest	3,218.49	26.29
Riparian and gallery forest	140.28	
Wooded savannah	2,700.74	48.17
Dense shrubland savannah	887.27	
Shrubland savannah	1,784.67	
Grassland	781.24	
Perennial agricultural lands	1,278.52	12.37
Annual agricultural lands	302.49	
Bare soil	301.01	2.36
Rivers and water bodies	797.24	6.24
Villages and hamlets	352.34	2.76
Sacred Forests	122.78	1.82
Cemeteries	109.35	
TOTAL	12,776.42	100.00

Mining Infrastructure	2.49	0.02
Seasonally flooded areas	125.74	0.98
Quarries	527.93	4.13

It should also be noted that the open surface area is to be taken with extreme caution. It is a very variable data depending on the season. Indeed, the basic image of this study is dated from the dry period (4 January 2014) where fires, land preparation for crops, as well as gold panning activities contributed to maximize their extent.

Another important remark is the lack of primary forests, i.e. a forest not yet affected by human activities. Indeed, even if this area was initially a mosaic of savannahs and dense semi-deciduous forests, traces of human activities were noted in all of the visited forests. Thus, they have a fairly degraded physiognomy.

Regarding agricultural lands, they are sometimes difficult to identify, and therefore, their spectral discrimination was offset by a manual interpretation/digitalization. It is however not excluded that some farms escaped to this combination of methods for extracting information from spatial images (image classification and digitalization of information by visual interpretation). Indeed, this case is very likely, especially for cocoa-growing under

forest cover. Another point to report is the probable conversion within a few years of a very significant part of annual crops to perennial crops. Indeed, annual crops are largely associated with other crops, i.e. perennial crops at a juvenile stage covered by subsistence crops.

3.5. Observations on the working environment

The study was carried out in collaboration with the officials of the Project and a local guide of the region. The local guide provided significant support in negotiations with the local communities when it came to crossing villages or farms.

4.0. CONCLUSION

In conclusion to this study, it is appropriate to note the following:

- Spatial data processing (Image Digital Globe Imagery of January 2014) completed and validated by field data collection (10 days) helped achieve the main objective of this study, which was to improve knowledge on the land use and habitat types in the Project area by the production of a map;
- A land use map was developed with various cartographic units whose surfaces are estimated. The different cartographic units are as follows:
    - Forest (degraded/secondary and riparian/gallery forest);
    - Savannahs (woodland savannah, dense shrubland savannah, shrubland savannah, Grassland);
    - Agricultural land (perennial and annual agricultural lands, and fallow lands);
    - Bare soil;
    - Rivers and water bodies (Kossou Lake, Bandama River, water reservoir);
    - Localities (villages and hamlets);
    - Sacred sites (Sacred Forests and Cemeteries);
    - Mining Infrastructure;
    - Seasonally flooded areas;
    - Quarries;
    - Artisanal mining (orpailleur survey);
    - Socioeconomic Infrastructures (roads and tracks, high voltage line);
    - Archaeological sites.

Gap analysis:

Although all plots of the selected control sites for the verification of crops were visited on the ground, it must be noted that the detection of cocoa cultivation under forest cover is a bit more complex, so it is likely that the mapped-cocoa crop plots surfaces are underestimated.

All the villages that were identified as part of the desktop imagery assessment have been verified, it might be that smaller family hamlets might have been overlooked. Also, hamlets shape files were imported and integrated into the card.

Limited wetlands were identified within the study area. The wetland classification mainly included seasonally flooded areas. The wetland classification itself will have to be updated with the findings from the soil and flora investigations.

5.0. REFERENCES

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6.0. ANNEXURES

Annexure A : GPS coordinates of the initial 200 visited sites for land use verification

DEGRADED FORESTS

ID	Y	X
1	775773	217348
2	775773	217346
3	775994	216854
4	774902	215486
5	774880	215514
6	775123	220419
7	775032	220710
8	776064	216786
9	775504	220322
10	775562	220115
11	774947	217987
12	771989	226326
13	772571	224992
14	772487	224572
15	773345	225992

RIPARIAN / GALLERY FORESTS

ID	Y	X
1	775065	215337
2	775597	218303
3	771226	223649
4	771354	223659
5	771550	223662
6	771932	223890
7	772158	223754
8	772675	223859
9	773453	223739
10	773915	223949
11	775229	224784
12	776432	225381
13	771255	223822
14	772498	223976
15	772355	223763
ID	776386	225559
16	776245	225386
17	772161	223937
18	771819	223877
19	771913	223699

SHRUBLAND

ID	Y	X
1	777473	214846
2	780866	221352
3	779550	224242
4	779752	224116
5	778799	226402
6	778468	225882
7	779024	222170
8	780554	218283
9	781214	218650
10	781355	220737
11	779485	218385
12	779248	226068
13	779029	225594
14	781282	217231
15	781295	216451
16	778480	218104
17	778937	216015
18	779667	223397

GRASSLAND

ID	Y	X
1	780866	221352
2	779550	224242
3	781356	221060
4	778577	219145
5	780376	221797
6	780283	222794
7	780204	223104
8	780248	222205
9	778292	224653
10	779850	215019
11	779802	224858
12	779311	223643
13	780085	223352
14	780816	221596
15	781027	221024

DENSE SHRUBLAND

ID	Y	X
1	779049	226540
2	788788	226551
3	778570	226163
4	778771	225631
5	779159	225263
6	779000	222576
7	778898	221706
8	779016	221015
9	779234	219082
10	781348	215833
11	774035	222631
12	774317	221504

LAKE WATER BODY

ID	Y	X
1	781376	221750
2	780964	222377
3	781345	223091
4	781337	224329
5	780710	223202
6	780170	223806
7	779940	226449
8	781281	226409
9	780662	225647
10	780726	224647

RIVER WATER BODY

ID	Y	X
1	771093	223631
2	771998	223818
3	772839	223925
4	773453	223814
5	773818	223955
6	774116	224232
7	774766	224431
8	775819	225451
9	777510	225789
10	777766	226295

WOODED SAVANNAHS

ID	Y	X
1	775093	215043
2	775077	215113
3	775072	215161
4	775099	215262
5	775140	215269
6	775588	218246
7	775389	219112
8	775095	219466
9	771966	222647
10	777978	219208
11	776330	218172
12	780568	216276
13	777724	217184
14	776972	215351
15	771376	216847
16	771078	224287
17	777196	219522
18	776360	216217
19	775089	215006
20	775007	215031

PERENNIAL CROPS

ID	Y	X
1	778895	225177
2	779193	224819
3	779143	224125
4	771638	222465
5	779820	215502
6	780707	215679
7	778637	222721
8	777612	222192
9	776005	222985
10	773978	221994
11	773213	220012
12	771225	220276
13	771809	219467
14	772084	219313
15	773252	220061
16	779942	225221
17	779545	225149
18	777563	221493
19	777513	219241
20	777667	218745

	ANNUAL CROPS	
ID	Y	X
1	778174	226054
2	778915	224985
3	778802	223788
4	779052	221483
5	778125	218617
6	778529	217263
7	779683	216063
8	776674	215841
9	777241	215010
10	772971	222985
11	774100	222088
12	775158	220271
13	776633	219957
14	779645	216438
15	780223	216328

	SEASONALLY FLOODED AREAS	
ID	Y	X
1	780600	221811
2	780276	222017
3	775029	220657
4	775054	220486
5	773137	223657
6	777867	226316
7	779917	225943
8	780372	222077
9	777049	225758
10	777233	220749

RECENT FALLOW

ID	Y	X
1	772023	222710
2	772361	222817
3	772402	222877
4	772960	223083
5	775163	220000
6	775300	221057

VILLAGES AND HAMLETS

ID	Y	X
1	771644	219745
2	775051	214951
3	774514	222451
4	775698	217571
5	778366	219877

MINING INFRASTRUCTURE

ID	Y	X
1	778274	220893
2	778242	221041
3	777630	221113
4	777515	220760
5	777011	220851

ROAD AND TRACK

ID	Y	X
1	771137	223999
2	776272	225939
3	778435	226365
4	779097	223158
5	779612	217097
6	776720	215705
7	775052	221756
8	776954	220461
9	780358	220503
10	775652	218694

HIGH VOLTAGE LINE

ID	Y	X
1	774669	222099
2	774896	222375
3	779345	224734
4	776264	216582
5	772500	219044

Annexure B : GPS coordinates of the sites visited for validation

DEGRADED FORESTS		
ID	Y	X
1	781334	215676
2	780316	213970
3	778371	213758
4	779654	222317
5	777008	214697
6	776770	216430
7	777961	222899
8	776215	224328
9	774786	214102

RIPARIAN FORESTS/GALLERIES		
ID	Y	X
2	776183	224473
3	775277	223878
4	774523	223369
5	779611	223401
6	777930	225016
7	777793	224666
8	779645	224603
9	777020	224317
10	779550	222063

WOODED SAVANNAHS		
ID	Y	X
2	781003	219222
3	780752	216867
4	780130	214300
5	779628	216629
6	778874	222833
7	777299	213731
8	777961	217634
9	776625	222767
10	776109	213705

DENSE SHRUB LAND		
ID	Y	X
1	781308	214313
2	781228	216853
3	779879	213546
4	779363	218282
5	779376	220267
6	777590	213414
7	777498	218878
8	779376	224090
9	777141	222727
10	776228	213837

	PERENNIAL CROPS	
ID	Y	X
1	780633	214208
2	780646	215875
3	779509	214009
4	778516	215015
5	779191	223362
6	777908	223918
7	777379	214694
8	776294	222145
9	775394	222145
10	774601	220240

	ANNUAL CROPS	
ID	Y	X
1	781162	213758
2	780858	215795
3	780368	214380
4	779032	214194
5	779098	217264
6	779469	221550
7	778834	222979
8	777961	214221
9	777868	217832
10	777921	221444

VILLAGES AND HAMLETS		
ID	Y	X
1	778371	218123
2	776148	214856
3	775593	216047
4	774984	213268
5	774402	220888

MINING INFRASTRUCTURE		
ID	Y	X
1	778377	220622
2	778326	220561
3	778309	220658
4	778260	220590
5	778211	220637

ROAD AND TRACK		
ID	Y	X
1	781272	213725
2	781096	215621
3	778477	216521
4	775760	215074
5	779884	219198

BARE SOIL		
ID	Y	X
1	780952	214169
2	780936	216518
3	781159	218947
4	780285	214391
5	780285	220646

LAKES AND RIVERS		
ID	Y	X
1	781397	219582
2	781254	221122
3	781095	224091
4	780095	221630
5	778269	218741

HIGH VOLTAGE LINE		
ID	Y	X
1	781233	213764
2	778712	215504
3	779142	220430
4	778164	224124
5	777070	212611

GRASSLAND		
ID	Y	X
1	781142	213779
2	780435	214672
3	780784	219307
4	780054	216116
5	781102	213862
6	780768	219466
7	779133	216005
8	780784	219498
9	780242	221699
10	778570	217720

Annexure C : Land use and habitat map of Yaoure Gold Project