

STUDY OF POTENTIAL HUMAN RIGHTS VIOLATIONS, ENVIRONMENTAL IMPACTS AND FALLOUTS OF GRAPHITE MINING

Case of the Mining Company Gold Sand and its Partners in the Ambahita Commune, Bekily District, Androy Region

April 2025

Transparency International- Initiative Madagascar (TI-MG) is a Malagasy law governed association that works in the fight against corruption. Since 2016, TI-MG has been implementing anti-corruption projects in the mining sector through programmes and projects aimed at strengthening governance. Through its mission of information, awareness and interpellation, the association also carries out advocacy actions for governance transparency and the accountability of all actors in this sector considered as one of the development pillars of the country. This research is part of a project supported by Global Witness aimed at exposing human rights violations and environmental impacts of graphite mining in Madagascar – Case of Gold Sand.

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EXECUTIVE SUMMARY

This cross-sectional study, conducted at the Ambahita, Ambararata and Ankalimboro sites, aims to assess, in a rigorous and integrated manner, the effects of the graphite mining project implemented by Gold Sand and its partners (West International, XINKUANGYE KAIFA and COPAX). The study was based on a methodological multidisciplinary approach, combining field survey, legal analysis, environmental assessment and statistical modelling, in order to understand the effects of the project on human rights, the environment and local socio-economic impacts.

A total of 330 people were interviewed, including 214 households (consisting of 127 fathers, 66 mothers and 21 other adults), 95 employees of the mining company, 4 business leaders, 4 interpreters, 05 local authorities, 04 members of the municipal staff, 4 technical services officers and 1 parliamentarian. Households responded to structured questionnaires, while other categories of responded were surveyed in the form of semi-structured interviews. These data were supplemented by direct observations and analysis of technical and regulatory documents.

Three main analytical tools were used: (i) a rating scale from 1 to 10 to measure perceived impact levels, (ii) the non-parametric Kruskal-Wallis test to detect significant gaps between groups, and (iii) logistic regression (logit model) to assess the influence of explanatory variables on perceived well-being. Regarding human rights, the Kruskal-Wallis test confirmed the existence of significant differences between the categories of rights violated (employment, information, work, culture), thus validating a hierarchy of violations. The second test showed that perceptions are relatively homogeneous between different groups of respondents, reinforcing the credibility of the results. A third test applied to the respondents' level of affiliation with the mining company revealed a tendency of divergence of opinion without reaching the statistical threshold of significance ($p = 0.170$), indicating a potential influence of socio-economic position.

The environmental assessment highlights variating impacts between sites: water pollution, air quality, deforestation and soil erosion. These effects are rated from moderate to concerning, based on the average scores assigned. The Kruskal-Wallis test validated the existence of significant differences between sites. A different test analyzed the influence of the respondents' level of proximity with the mining company on their perceptions, revealing a non-significant trend ($p = 0.073$), but suggesting possible perceptual biases.

Finally, socio-economic impacts were modelled using logistic regression. The results reveal the absence of a statistically significant correlation between socio-economic factors (income, employment, education) and perceived well-being. This lack of congruity suggests a weak integration of the project in local development and an unequal distribution of benefits.

In summary, this study demonstrates that the effects of the Gold Sand mining project on local communities are multiple, scalable and statistically supported. Human rights abuses are the most concerning; environmental impacts require localized responses, and socio-economic benefits appear poorly integrated. The triangulated methodological approach gives this study scientific and operational ground, making it a tool of reference for the evaluation of extractive projects in similar contexts.

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LIST OF ACRONYMS

CAT	CONVENTION AGAINST TORTURE
CEDAW	CONVENTION ON THE ELIMINATION OF ALL FORMS OF DISCRIMINATION AGAINST WOMEN
CEG	COLLÈGE D'ENSEIGNEMENT GÉNÉRAL (PUBLIC MIDDLE SCHOOL)
CMW	CONVENTION ON THE RIGHTS OF MIGRANT WORKERS
CNaPS	CAISSE NATIONALE DE PREVOYANCE SOCIALE (NATIONAL SOCIAL INSURANCE FUND)
CRC	CONVENTION ON THE RIGHTS OF THE CHILD
CRPD	CONVENTION ON THE RIGHTS OF PERSONS WITH DISABILITIES
CSB	CENTRE DE SANTE DE BASE (BASIC HEALTH CENTER)
CSR	CORPORATE SOCIAL RESPONSIBILITY
CTD	COLLECTIVITÉS TERRITORIALES DÉCENTRALISÉES (REGIONAL AND LOCAL COMMUNITIES)
EIA	ENVIRONMENTAL IMPACT ASSESSMENT
EITI	EXTACTIVE INDUSTRIES TRANSPARENCY INITIATIVE
EPP	ECOLE PRIMAIRE PUBLIQUE (PUBLIC PRIMARY SCHOOL)
ESA	ENVIRONMENTAL AND SOCIAL ASSESSMENT
ESIS	ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
FDI	FOREIGN DIRECT INVESTMENTS
FMFP	FONDS MALGACHE DE FORMATION PROFESSIONNELLE (MALAGASY VOCATIONAL TRAINING FUND)
GIS	GEOGRAPHIC INFORMATION SYSTEM
HR	HUMAN RESOURCES
ICCPR	INTERNATIONAL COVENANT ON CIVIL AND POLITICAL RIGHT
ICESCR	INTERNATIONAL COVENANT ON ECONOMIC, SOCIAL AND CULTURAL RIGHTS
IFC	INTERNATIONAL FINANCE CORPORATION
ILO	INTERNATIONAL LABOUR ORGANIZATION
INSTAT	INSTITUT NATIONAL DE LA STATISTIQUE (NATIONAL STATISTICS INSTITUTE)
IUCN	INTERNATIONAL UNION FOR CONSERVATION OF NATURE
IV	INSTRUMENTAL VARIABLES
MECIE	MISE EN COMPATIBILITÉ DES INVESTISSEMENTS AVEC L'ENVIRONNEMENT (ENVIRONMENTAL COMPLIANCE OF INVESTEMENT)

MEDD	MINISTÈRE DE L'ENVIRONNEMENT ET DU DÉVELOPPEMENT DURABLE (MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT)
MoM	MINISTRY OF MINES
MTEFPLS	MINISTRY OF LABOUR, EMPOYMENT, CIVIL SERVICE AND SOCIAL LAWS
NGO/CSO	NON-GOVERNMENTAL ORGANIZATION / CIVIL SOCIETY ORGANIZATION
OECD	ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
OLS	ORDINARY LEAST SQUARES
ONE	OFFICE NATIONAL POUR L'ENVIRONNEMENT (NATIONAL ENVIRONMENT REGULATION AUTHORITY)
PAP	PEOPLE AFFECTED BY THE PROJECT
PGE	PLAN DE GESTION ENVIRONNEMENTALE (ENVIRONMENTAL MANAGEMENT PLAN)
PPE	PERSONAL PROTECTIVE EQUIPMENT
PRA	PARTICIPATORY RURAL APPRAISAL
R^2	COEFFICIENT OF DETERMINATION (R-SQUARED)
RGPH	RECENSEMENT GÉNÉRAL DE LA POPULATION ET DE L'HABITATION (GENERAL CENSUS OF POPULATION AND DWELLINGS)
SDG	SUSTAINABLE DEVEOPMENT GOALS
STD	SERVICES TECHNIQUES DÉCONCENTRÉS (DECENTRALIZED TECHNICAL SERVICES)
TI-MG	TRANSPARENCY INTERNATIONAL INITIATIVE MADAGASCAR
UDHR	UNIVERSAL DECLARATION OF HUMAN RIGHTS
UN	UNITED NATIONS ORGANISATION
UNDP	UNITED NATIONS DEVELOPMENT PROGRAM
UNEP	UNITED NATIONS ENVIRONMENT PROGRAMME
VIF	VARIANCE INFLATION FACTOR

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INTRODUCTION

1.1. *Rationale of the Study*

Madagascar is now positioning itself as one of the strategic countries for global production of graphite, an essential ore for energy transition, particularly for the manufacture of lithium-ion batteries. According to GlobalData projections (2024), the Island of Madagascar is expected to increase its graphite production by 17 % by 2030, mainly exploiting its vast mining belts located in the north and south of the territory. The southwestern part of Madagascar is particularly rich in high-quality graphite, with deposits of international importance, including that of Molo (operated by NextSource) in the district of Ampanihy, Maniry (developed by Evion) and Ambahita, currently operated by Chinese company Gold Sand Sarl.

While mining can be a source of income, employment and local development, it also raises major human rights, environmental and social justice concerns. To better understand these dynamics, an exploratory study was conducted in September-October 2023 on the Molo and Maniry sites, at the request of the international NGO Global Witness. This field survey aimed to collect credible data on the conditions for implementing these projects. It concludes that while some socio-economic benefits are expected (especially in terms of infrastructure, rebates or jobs), these projects also have considerable undesirable effects: loss of agricultural land and grazing areas, displacement of ancestral tombs, even demolition of entire villages. In the specific case of the Maniry project, the prospect of destroying more than 70 traditional tombs caused great concern, with locals expressing their spiritual and cultural attachment to these sacred places.

It is in this context that in 2025 attention is turned to the Gold Sand mining project in Ambahita, a town located in the Bekily district, Androy region. This project is the subject of many controversies, and is worth conducting a specific study focused on the respect of fundamental rights, environmental legal obligations, and the social and economic impacts induced by the mining operations. Several elements motivate the conduct of this study:

- In September 2020, the Labour Court in Toliara was approached by members of the affected local community, who were seeking damages for wrongful dismissal and non-payment of compensation. However, the case was closed following a withdrawal under pressure.
- Reports from the Extractive Industries Transparency Initiative (EITI) (2019–2022) show a low contribution from Gold Sand to the national social funds: an annual average of only MGA 500,000 for the National Social Insurance Fund (CNaPS) and MGA 30,000 for the Malagasy Vocational Training Fund (FMFP) – figures well below other operators in the sector.
- From a fiscal standpoint, the annual mining royalty collected amounts to only 20 million ariary, an amount deemed insufficient considering the exploitation volume informally declared since 2018. Furthermore, no official data on the production or export of graphite by Gold Sand appears in the public reports.
- During visits to the Molo and Maniry sites,

employees of Gold Sand have pointed out the systematic non-compliance with labour law observed in their duty station.

- Finally, the 2016 environmental specifications documents, revised in 2023, and signed with the communities of Ambahita, delineated clear commitments: construction of schools, rehabilitation of communal infrastructure, among others. However, no record of these social and environmental expenditures is mentioned in the EITI reports or confirmed in the field.

Faced with these worrying findings, this study has been initiated, focusing on the "In-depth and well-founded assessment of potential or actual violations of human rights, environmental, social and land obligations, as well as their impact on the well-being of the populations of the Ambahita commune".

1.2. *Objectives of the Study*

This study aims to empower targeted advocacy actions aimed at increasing accountability of all actors involved, including the mining company, public authorities and local authorities. Ultimately, this approach is part of a social and environmental justice discussion, in favour of a more transparent, responsible and genuinely beneficial mining development model for local communities. Specifically, it pursues the following objectives:



Review and document allegations of violations of human rights and breaches of legal obligations in connection with mining activities carried out by the company Gold Sand in Ambahita;



Identify and assess direct and indirect environmental impacts related to graphite mining and company operations on the local ecosystem;



Analyse the socio-economic fallouts of the mining project on local communities, highlighting the effects on living conditions, employment, infrastructure and the social fabric.

1.3. *Research hypotheses*

In order to guide the analysis and interpretation of the data, the study is based on the following research hypotheses:

H1

The graphite mining project conducted by Gold Sand company in Ambahita involves ***proven violations of the fundamental and procedural rights*** of local communities.

H2

The activities of the Gold Sand company generate ***significant environmental impacts***, negatively affecting the quality of the environment and local natural resources.

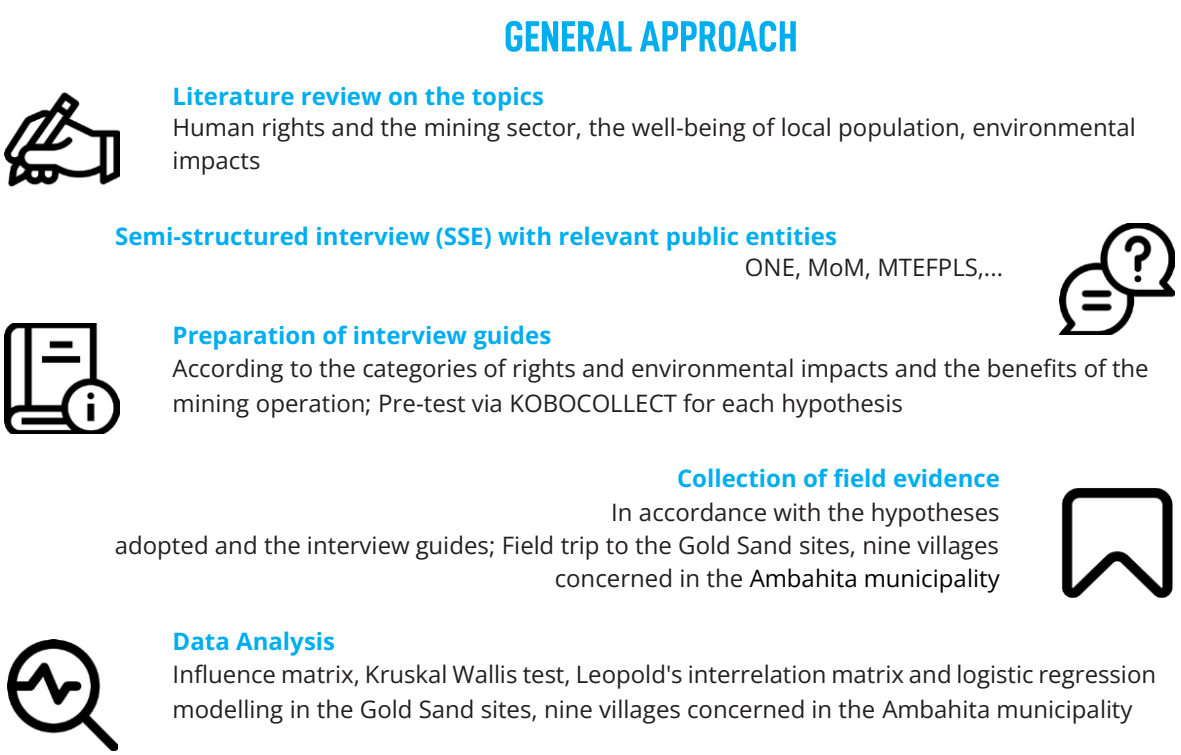
H3

The graphite mining project by the Gold Sand company produces ***limited and unevenly distributed effects on the social well-being*** of the inhabitants of the Ambahita rural municipality.

RESEARCH METHODOLOGY

2.1. *Overall approach*

Throughout this study, a comprehensive approach is adopted and illustrated in the following figure for a better understanding.



SPECIFIC APPROACHES

For Hypothesis 1 Verification	For Hypothesis 2 Verification	For Hypothesis 3 Verification
• Typology of rights violations: 13 headings • Identification of legal instruments • KoboCollect Survey : 200 households and 100 employees in 09 villages* • Interview with 06 heads of wards (fokontany), 03 municipal staff and 03 STDs and 01 parliamentarian. **Analysis:** • Cross-analysis approach of legal aspects and statistical data • Prioritization of cases of rights violations • Influence Radar • Kruskal-Wallis test	• Identification of environmental components; Inventory of impacting activities • KoboCollect Survey<: 200 households and 100 employees Interview with 06 heads of wards, 03 municipal staff **Analysis:** • Leopold's Interrelationship Matrix: Cross-referencing the elements from the areas and impact-source activities • Impact weighting based on field observations of the facts • Table of Influence • Kruskal-Wallis test	• Assessment of factors influencing mining activity on the well-being of populations • Collecting target groups' perceptions of the impacts of mining on income • KoboCollect Survey : 200 households and 100 employees (staff, managers, and senior executives) • Interview with 06 heads of wards, 03 municipal staff **Analysis:** • Logistic regression model: Analysis of influencing factors the social welfare of mining.

** Survey conducted in the 9 villages concerned: Ambararata, Ambatomena, Ankalimboro, Soakibany, Ampisopiso, Andakato, Antsomotsoy, Antaly and Anaviavy*

2.2. Specific Approaches

2.2.1. Specific Approach for Verifying Hypothesis 1

The methodological approach applied for this study is based on an approach structured around three complementary phases: field data collection, multidimensional statistical analysis, and legal prioritization of identified violations.

The indicative steps were as follows:

- Development of a typology of rights violations likely to have a negative impact on populations: More than ten categories of fundamental rights and collective freedoms were selected
- Identification of related legal instruments: international convention, constitution, laws, decrees, orders, specifications;
- Design and deployment of a digital questionnaire, for the structured household survey and semi-structured interviews, using the KOBOCollect application.



- Mobilization of local surveyors to conduct structured surveys and lead semi-structured interviews
- Conducting a structured household survey, accompanied by semi-structured interviews with site employees (workers, executives, top management), local authorities, Ambahita municipal representatives, as well as a parliamentarian, technical officials at the Bekily district level and the Anosy region (Fort-Dauphin).
- Processing of data collected using Excel software and statistical software JASP019.0, with a view to analysing the perceptions of target groups regarding human rights violations.

A. Data collection



As part of the analysis of human rights violations, a total of 330 people representing a diverse range of profiles directly or indirectly affected by the mining activities, were interviewed. The main sample consists of 214 riparian households, surveyed through structured questionnaires. Among them were people affected by the project (PAPs), whose property or living conditions were disrupted by extractive activities.

Other categories of respondents include 95 employees, working at the Ankalimboro and Ambatomena sites, holding various positions (workers, guards, cooks, masons, security guards, welders, etc.). No employees were active at the Ambararata site, in the stand-by phase. In addition, four (4) senior managers were met on three sites, as well as four (4) interpreters. Institutional representatives including local authorities, municipal officials, decentralized technical managers and a parliamentarian were also interviewed. Their selection was based on their level of involvement in the project.

The collection was based on semi-structured interview guides, adapted to the profiles concerned. The topics covered included employment-related human rights, working conditions, access to information, environmental protection, public consultation, non-discrimination and access to justice. This methodology allowed a rigorous crossing between quantitative data (households) and qualitative data (institutional, professional and community actors), reinforcing the reliability and depth of the triangulation analysis.

B. For analysis: crossover approach of legal aspects and statistical data is adopted, such as:

- **Legal Prioritization:**

This method is based on objective criteria such as the severity score (assigned by the respondents), the frequency of occurrence of violations, their social, economic or psychological impact, as well as whether or not they comply with the relevant legal standards. The references used include the Malagasy Constitution, the Labour Code, the revised Mining Code, the Decree on the Environment Compliance of Investments (MECIE), and the international instruments ratified by Madagascar (International Covenant on Economic, Social and Cultural Rights (ICESCR), International Covenant on Civil and Political Rights (ICCPR), Universal Declaration of Human Rights (UDHR), Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), Convention on the Rights of Persons with Disabilities (CRPD), Conventions of the International Labour Organization (ILO), etc.). Violations were classified on a scale of

normative severity and impact, taking into account national (Constitution, Labour Code, Mining Code, MECIE decree) and international (ICESCR, ICCPR, CEDAW, CRDPH, UDHR, ILO Conventions) legal frameworks. This cross-hierarchization (score, frequency, legal severity, violation of human dignity) helped establish a prioritized table of violations found.

The legal prioritization of violations is a step in the integrated analysis of human rights violations. It enables the cross-referencing of perceptions on the ground with national and international legal obligations, by offering a structured and strategic reading of the severity of the violations found.

- **Use of the RADAR diagram in the analysis of perceptions:**

As part of this analysis, the use of a radar diagram allows for a synthetic and comparative visualization of the severity scores assigned to the different categories of human rights. This graphical tool makes it easy to immediately identify trends, breaking points and areas of balance or disparity in perceptions. The radar diagram summarizes perceived human rights violations by graphically representing the level of severity assigned to each category of right, on a scale of 1 to 10. The scores displayed result from an analytical aggregation of the data collected by surveys and interviews, taking into account the frequency, intensity and consistency of the expressed perceptions.

- **Statistical Analysis:**

Data analysis relied on robust statistical tools, including the Kruskal-Wallis test, adapted to ordinal variables and independent groups. In this study, the statistical test was mobilized at two distinct but complementary levels, reinforcing the scientific soundness of the analysis.

1. Kruskal-Wallis test applied to the objectivity of responses according to the status of the respondents

This first use of the Kruskal-Wallis test aims to assess whether the status of respondents (households, mining company employees, local authorities, institutional representatives, etc.) influenced how they perceived the severity of human rights violations. The variable analysed corresponded to the severity scores attributed to the various attacks identified.
The null hypothesis (H0) posited that the distributions of perceptions were identical between groups, i.e. the respondent's status did not affect the assessment of the severity of violations. Conversely, the alternative hypothesis (H1) postulated that at least one group had a significantly different distribution.

2. Kruskal-Wallis test applied to the significance of perceptions between categories of human rights:

The second use of the test was to determine whether certain categories of rights (employment, environment, justice, non-discrimination, etc.) were seen as to be more violated than others. The null hypothesis (H0) posited that the distribution of severity perceptions was equivalent between all categories of rights while the alternative hypothesis (H1) suggested significant differences between these categories.

3. *Kruskal-Wallis test applied to the influence of affiliation with the mining company on the perception of human rights violations*

This third test aims to assess if respondents' level of affiliation with the Gold Sand mining company – whether they are direct employees, contractors/subcontractors or unaffiliated - influences their view of the severity of human rights violations.
The hypotheses made were as follows:

- H0 (null hypothesis): There is no significant difference in severity scores attributed to human rights violations based on respondents' level of affiliation with the mining company.
- H1 (alternative hypothesis): At least one group (employees, subcontractors, non-affiliates) has a significantly different perception of the severity of violations.

In summary, these Kruskal-Wallis tests made it possible to validate both the objectivity of the data collected (neutrality of respondents) or not and the generalization of violations (homogeneity of perceptions between categories of rights or not).

The following diagram summarizes the crossover approach of legal aspects and statistical data.

Legal severity: Evaluates the level of violation of the applicable legal framework, whether national (Constitution, MECIE decree, Labour Code) or international (UDHR, ICCPR, ICESCR, ILO standards).

Economic impact: Measures the impact on income, employment, access to economic resources, and the ability of local populations to improve their living conditions.

Social impact: Evaluates the effects on social cohesion, human dignity, feelings of exclusion or frustration, or potential conflicts between communities. Frequency of violation: Looks at how widespread or recurrent the violation is in the affected population.

Avenues for recourse and redress: Measures the effective ability of victims to obtain justice, reparation, compensation or restoration of their rights, through legal or institutional mechanisms.



Source: Office of the High Commissioner for Human Rights (OHCHR) and the work of Prof. Philip Alston and Manfred Nowak (former UN Special Rapporteurs on Economic, Social and Cultural Rights)

Table 1 - Assessment grid for human rights violations: UN – Office of the High Commissioner for Human Rights (OHCHR)

	Legal severity	*Economic Impacts*	*Social impact*	*Frequency of violation*	*Avenues for recourse and redress*
High score (8–10)	Direct, formal and documented violation of a fundamental right	Loss of access to employment, exclusion from the local economic market and absence of compensation	Strong social tensions, breach of trust, marginalization of a group	More than 70% of people concerned	Existence of accessible, effective and transparent procedures
Average score (5–7)	Indirect or partial violation, legal or regulatory loophole	Limited benefits but existence of alternatives or mitigations	Moderate social dissatisfaction or disengagement	Between 40% and 70%	Existing but limited or difficult procedures
Low Score (1–4)	Ethical or moral breach without clear legal framework	One-off or symbolic economic effect	Limited effect, no significant community impact	Lower than 40% isolated case or not representative	Lack of redress mechanisms, lack of transparency or institutional blockage

The scale adopted to assess the right to an effective remedy follows a reverse logic: the higher the score, the more severe the situation. It is based on international standards such as Article 8 of the UDHR and Article 2 of the ICCPR. A score between 8 and 10 indicates a severe violation (absence or ineffectiveness of remedies), while a score between 1 and 4 indicates effective compliance with the law. This approach is legally sound, methodologically consistent with UN standards, and harmonized with other evaluation criteria, facilitating cross-cutting analyses and prioritization of interventions.

2.2.2. Methodological approach to assessing the environmental impacts of the graphite mining project in Ambahita: Hypothesis 2

The evaluation of environmental impacts related to graphite mining in the municipality of Ambahita, covering the Ambararata, Ankalimboro and Ambatomena mining sites, is based on an integrated methodological approach. This combines qualitative and quantitative analytics, mobilizing both the perceptions of local populations, data from direct observations in the field, and the examination of the compliance of mining practices with contractual commitments and environmental standards in force. This methodological triangulation makes it possible to comprehensively and contextually understand the nature and extent of the pressures exerted on the environment.

Data collection

The main survey involved 214 riparian households, identified as the populations most directly exposed to the effects of mining operation, and took place as follows:

- Questionnaires, designed and deployed through the KOBO platform, covered several environmental components, including air quality, water pollution, noise pollution, and soil degradation.
- Field surveyors have been specifically trained to ensure the reliability and neutrality of the responses collected.
- At the same time, semi-structured interviews were conducted with mine employees, senior managers and institutional representatives on this aspect.
- These interviews were aimed at gathering information on the environmental management systems, the preventive measures implemented, and compliance with the commitments set out in the environmental specifications.
- The study covered three mining sites: Ambararata (stand-by), Ankalimboro and Ambatomena (in construction phase) and Ampisopiso base camp.



Preliminary session with local communities: Ampisopiso

For the analysis

This method helps produce a chart of influence prioritizing the most significant impacts.
By offering a combined reading of the temporal, spatial and perceptual dimensions, this grid constitutes a rigorous tool adapted to the environmental analysis of mining activities in the context studied. This method allowed the production of a chart of influence prioritizing the impacts according to their perceived intensity.

1. Evaluate by Leopold's Interrelationship Matrix

The Leopold Interrelationship Matrix was used to analyse the interactions between mining activities and environmental components at the Ambararata, Ankalimboro and Ambatomena sites. It allowed to map the effects of operations on the physical environment (air, water, soil, vegetation) and the human environment (agriculture and noise pollution).

In the context of this project in the municipality of Ambahita, this matrix enables to map the effects of mining operations on the various elements of the local ecosystem, taking into account the specificities of the Ambararata, Ankalimboro and Ambatomena sites.

2. Develop an impact assessment grid

The environmental assessment approach used in this study is based on the Facteau grid (1999), which structures impacts according to four key dimensions: intensity, extent, duration and importance.

- The intensity criterion measures the magnitude of the observed effect;
- The scope specifies the geographical scope, from local to regional;
- The duration allows to distinguish temporary impacts from persistent effects;
- Finally, the score of significance, scored out of 10, summarizes these three criteria while taking into account the vulnerability of the environment and local perceptions.

3. Apply the Kruskal-Wallis Test between mine sites

This test was applied to the severity scores of environmental impacts (air pollution, water pollution, soil degradation, deforestation) to verify whether perceptions significantly vary between the three mine sites studied. Each of these sites has a distinct stage of progress: Ambararata is currently on standby, while Ankalimboro and Ambatomena are in the construction phase.

These operational differences warrant a comparative analysis. The hypotheses of the test are worded as follows:

H0 (null hypothesis): the distributions of perceptions of environmental impacts are identical between the three sites.

H1 (alternative hypothesis): at least one of the distributions differs significantly between sites

4. Apply the Kruskal-Wallis Test | according to the respondents' level of affiliation with the Gold Sand company and its partners

A second Kruskal-Wallis test was applied to check if responses are influenced by respondents' affiliation status with Gold Sand and its partners. The Kruskal-Wallis test was applied to a set of severity scores attributed to environmental impacts, from questionnaires distributed among three levels of proximity to the mining company: direct employees, subcontractors/ intermediaries, and non-affiliated populations. The sample thus stratified allowed to test the potential influence of professional or institutional affiliation on the nature of the responses.

For this analysis, the following hypotheses were theorized:

- • *H0*: There is no significant difference in the responses according to the status of affiliation of the respondents with Gold Sand and its partners.
- • *H1*: There is at least one significant difference in the responses according to the affiliation status of the respondents to Gold Sand company.

5. Develop a Radar Diagram of environmental impacts

A radar diagram was used to visually represent the perceived impact levels on several environmental components (air, water, soil, noise, forest stripping.). Based on a scale from 1 to 10, this tool facilitates the comparison of the average scores assigned by respondents and allows a synthetic reading of the most affected environmental dimensions.

6. Confirmation of Hypothesis

The combination of field observations, cross-perceptions and statistical analysis ensures the relevance, reliability and representativeness of the results obtained. It constitutes a credible basis for confirming or invalidating our hypothesis.

The ratings attributed to environmental impacts are based on perceptions collected from respondents. These are not scores priorly defined but structured aggregations of the respondents' judgments, organised in such a way as to faithfully reflect their assessment of the effects of the project.

2.2.3 Econometric approach to assess the impact of graphite mining on the well-being of riparian populations: Hypothesis 3

To assess the impact of graphite mining on the well-being of riparian populations, a structured econometric approach is recommended. This is based on defining the relevant variables, specifying the statistical model, interpreting the results, and verifying the robustness of the model.

I. DEFINITION OF VARIABLES

The dependent variable used is the well-being indicator, coded in a binary way: 1 if the well-being has improved since the beginning of the operation, 0 otherwise. This variable is based on self-reported assessment by respondents.

Explanatory variables include:

- Income_increase: binary indicator (1 = income has increased, 0 = no)
- Health_access: 1 if the access to care has improved, 0 otherwise
- Education_access: 1 if the access to school has improved, 0 otherwise
- Infra_access: indicator of perception on infrastructure (roads, lighting, water)
- Employment_access: binary (1 = household member employed through the mine, 0 otherwise)
- Gender, age, education, marital status: control variables

II. ECONOMETRIC MODEL: LOGISTIC REGRESSION (LOGIT)

Since the dependent variable is binary, a logistic regression is the most appropriate method. The model is specified as follows: Logit (well_being) = $\alpha + \beta_1 *$ income_increase $+ \beta_2 *$ health_access $+ \beta_3 *$ education_access $+ \beta_4 *$ infra_access $+ \beta_5 *$ employment_access $+ \beta_6 *$ gender $+ \beta_7 *$ age $+ \beta_8 *$ education $+ \varepsilon$ where

- α is the model constant,
- βi are the coefficients to be estimated,
- ε is the error term.

This model enables the estimation of the probability that an improvement in well-being is perceived, based on the explanatory variables. Interpretation of coefficients is done in terms of logarithmic variation in probability.

For better readability, we can also interpret the Odds Ratio (e^β), which measures the multiplicative effect on the probability of improved well-being.

The null hypothesis (H_0) used in this study is as follows:
H_0: Gold Sand's graphite mining company and its partners has no significant effect on the well-being of riparian households.
The alternative hypothesis (H_1) is:
H_1: Gold Sand's graphite mining and its partners has a significant effect on the well-being of riparian households.

III. VALIDITY TESTS

- Overall significance test (likelihood ratio test)
- Individual significance of coefficients (Wald test)
- Verification of co-linearity between explanatory variables (VIF)
- Model accuracy: Pseudo R^2 (McFadden), correct classification rate
- Confusion Matrix and Predictive Power Analysis

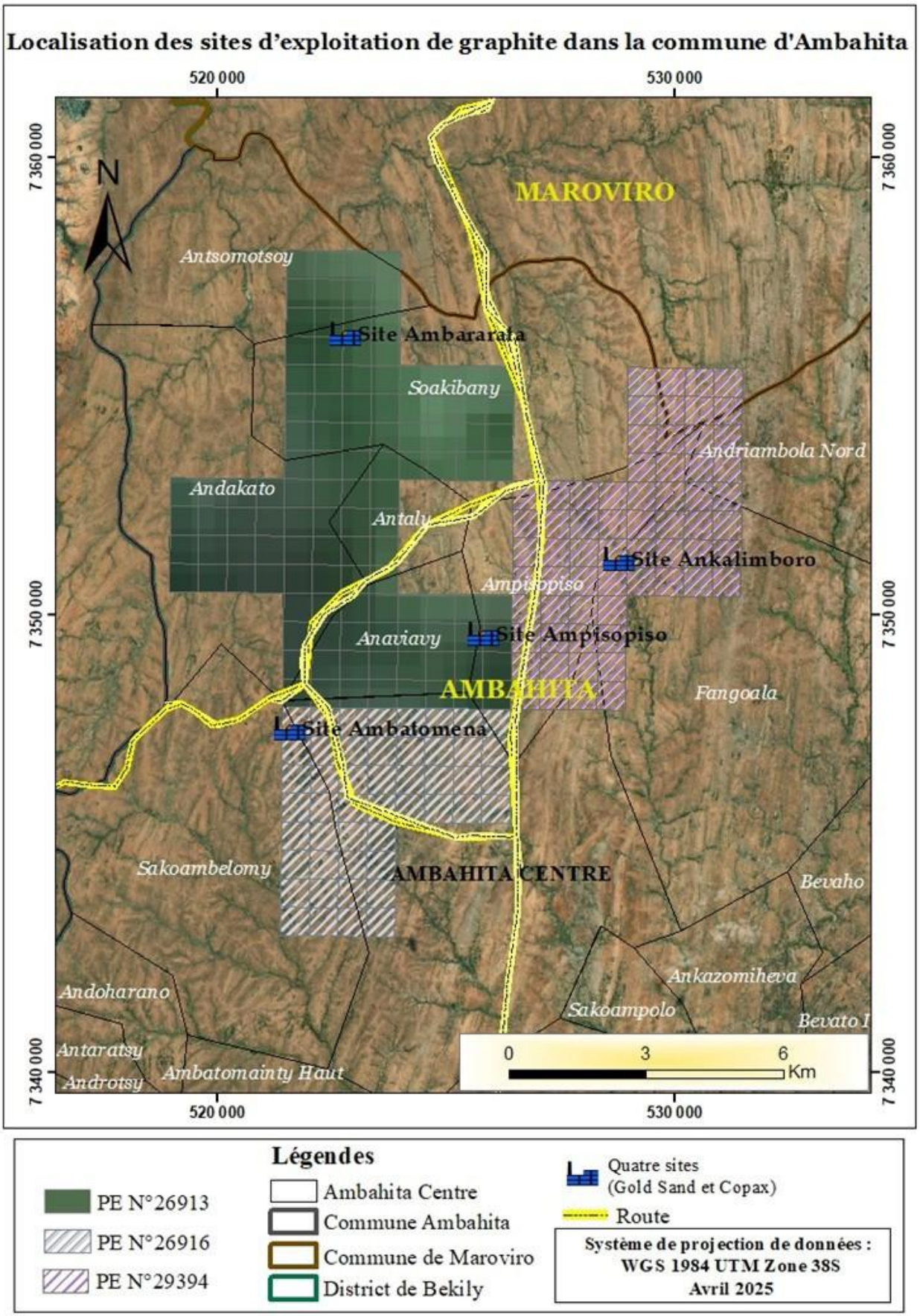
IV. ROBUSTNESS

It is recommended to gradually introduce the variables to check the robustness of the results. A sensitivity analysis can also be conducted by comparing the results of the Logit model to a Probit model.

V. INTERPRETATION RECOMMENDATIONS

A positive significant coefficient ($\beta i > 0$) indicates that the explanatory variable increases the probability of improved perceived well-being. For the case, a $\beta_1 > 0$ and significant for income_increase means that respondents who have seen their income increase are more likely to consider their well-being as having evolved positively.
This econometric approach enables to move from a descriptive logic to an explanatory logic, based on validated statistical models. It provides a rigorous framework to inform political, social and environmental decisions in mining areas.

LOCATION OF THE AREA OF STUDY



MAIN FINDINGS

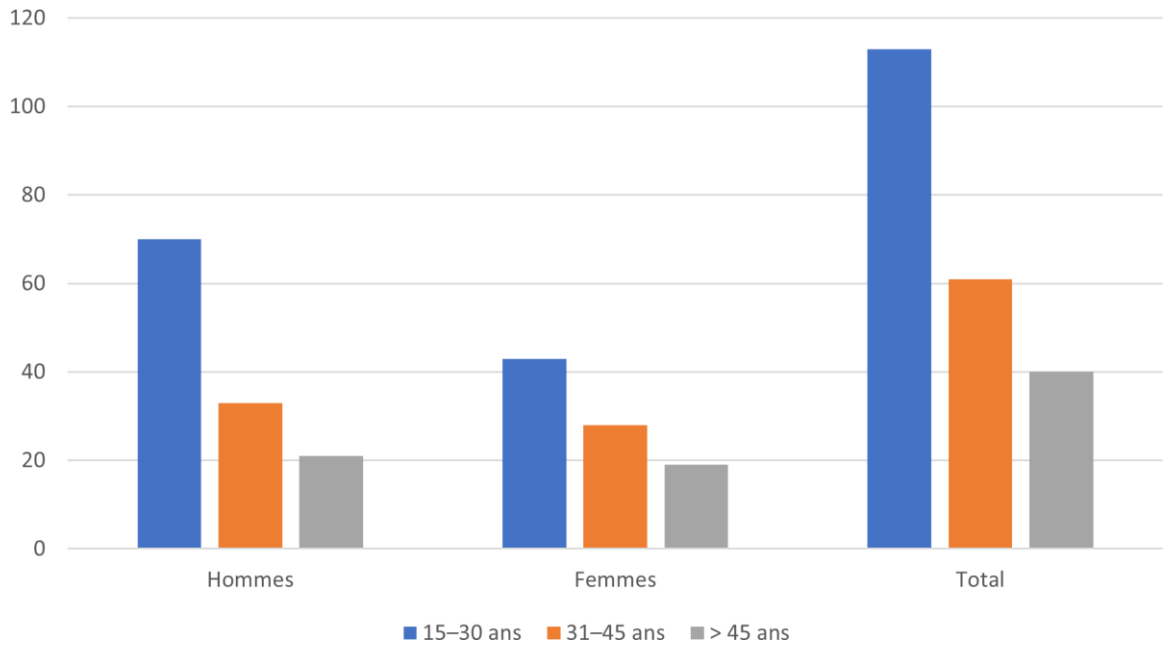
3.1 Socio-demographic profile of target groups

3.1.1 Households surveyed

A. Cross-distribution of respondents by gender and age group

The 214 households surveyed in the municipality of Ambahita provide a representative overview of the socio-demographic profiles of the communities living near the mining project. Individual respondents included 124 fathers (59.3%), 66 mothers (30.8%), and 24 other adult household members (9.8%), such as younger siblings and uncles. They refer to individuals residing in households who are not heads of the household (fathers or mothers), such as brothers, sisters and uncles. Their participation allowed to compensate for the absence of some heads of household while broadening the perspectives collected, thereby contributing to the rigour and diversity of the analysis. In terms of gender, the sample includes 127 men (57.9%) and 87 women (42.1%). The age distribution reveals a predominance of young adults (15-30 years), representing 53.02% of the sample (113 households). Those aged 31-45 account for 28.37% (61 households), while over 45 year olds account for 18.60% (40 households). This figure far exceeds the theoretical sample of 96 households, established based on a municipal population of 22,090 inhabitants (source RGPH, in 2018), with a tolerated error margin of 10%.

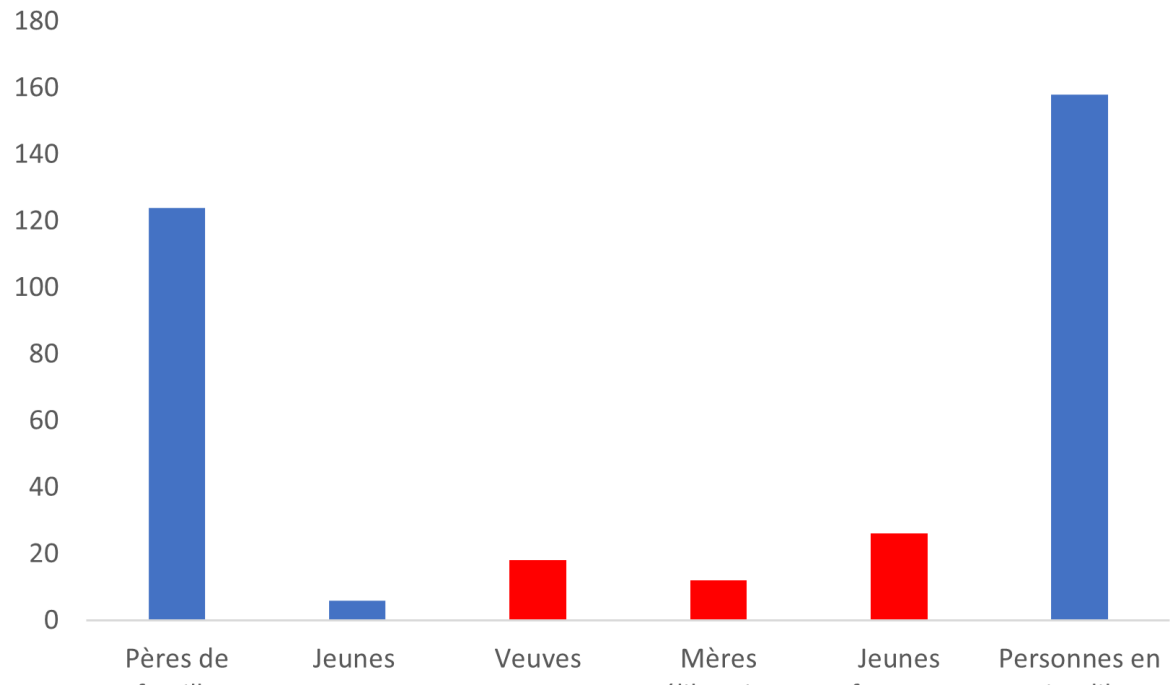
Cross-distribution of respondents by gender and age group



B. Cross-distribution of respondents by gender and family status

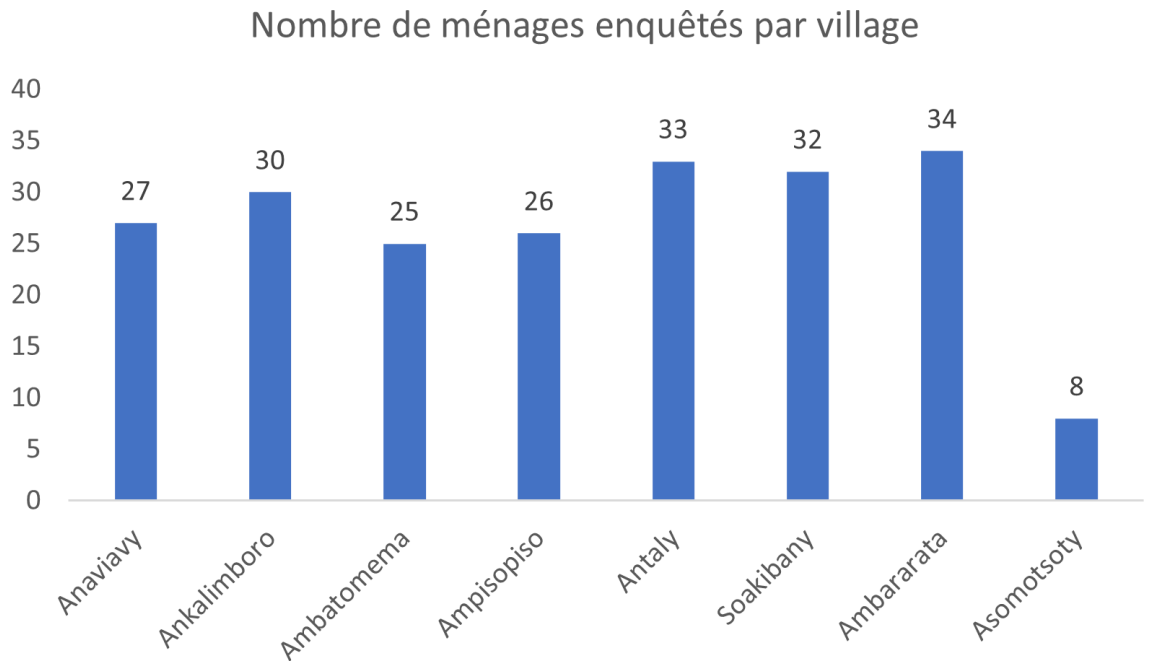
The graph illustrates the diversity of family status observed among the 214 respondents interviewed in the municipality of Ambahita. The majority of men present themselves as fathers (n = 124), confirming their dominant role as reference figures in the households surveyed. A marginal number of young single boys are also identified, indicating limited participation of this category in the interviews. On the women's side, the profiles are more varied: 18 widows, 12 single mothers, and 26 young single women have been identified, highlighting a significant presence of women in situations of family vulnerability. In addition, 158 people (men and women combined) report living in a non-marital union or cohabitation, a status that emerges as a majority and characteristic of the dominant forms of union in the study area. This distribution highlights family structures strongly marked by informal unions, with significant implications for social security, access to land rights or community representation. It also contributes to a better understanding of social dynamics and gender-differentiated responsibilities, which are essential to guide development or compensation actions related to the mining project.

Cross-distribution of respondents by gender and family status



C. Distribution of households by village

Analysis of the distribution of the 214 households surveyed reveals a variable representation by villages. The localities of Ambararata (34 households), Antaly (33 households) and Soakibany (32 households) alone have 99 households, or 46% of the total sample. This over-representation is explained by their proximity to mining and mining development sites, as well as by the local perception of more pronounced environmental and social impacts. Ambararata, where 34 households were surveyed, is a mining site that is currently on standby, but whose activities began in 2018. The villages of Ankalimboro (30 households) and Ambatomena (25 households), despite being in the construction phase, offer complementary perspectives on the anticipated or developing impacts. The geographical and functional diversity of these villages allows a differentiated territorial interpretation of the effects of the project, without claiming a strict statistical representativeness at the communal level, due to the lack of disaggregated demographic data by village.

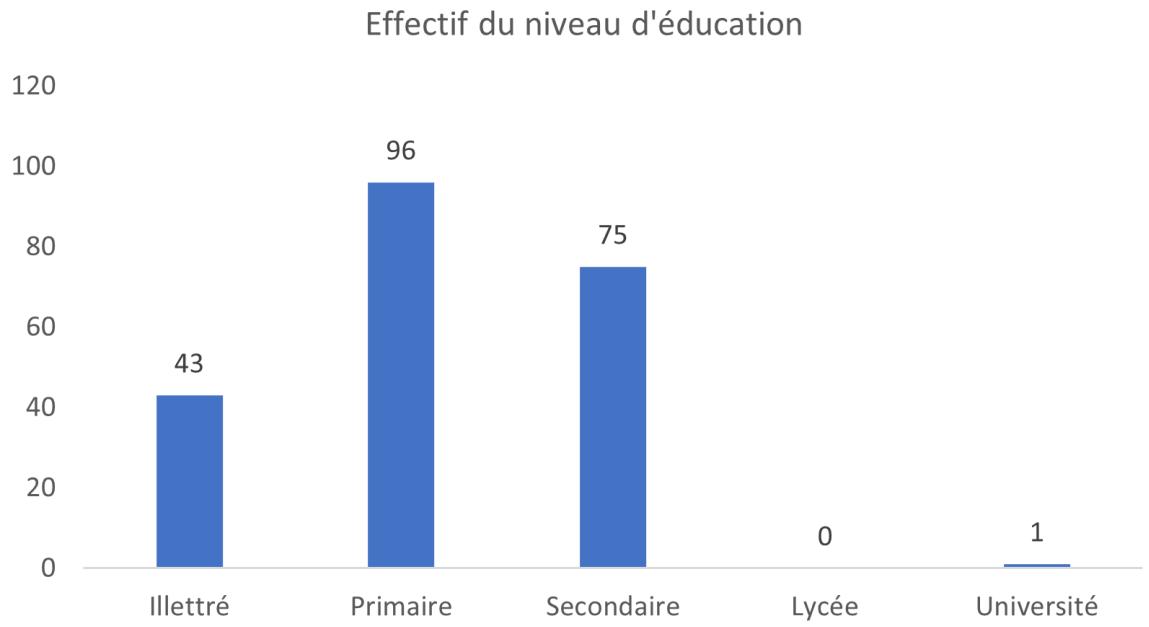


D. Household education level

Regarding the level of education, the results of the survey reveal that the majority of respondents (45%) have reached a primary education level. This group is supervised by people with a secondary education (35%), while 20% of respondents say they have not received any formal education. None of the respondents have reached high school level (0.00%), which marks a significant break in the educational continuum. This absence calls for special attention to identify obstructive factors.

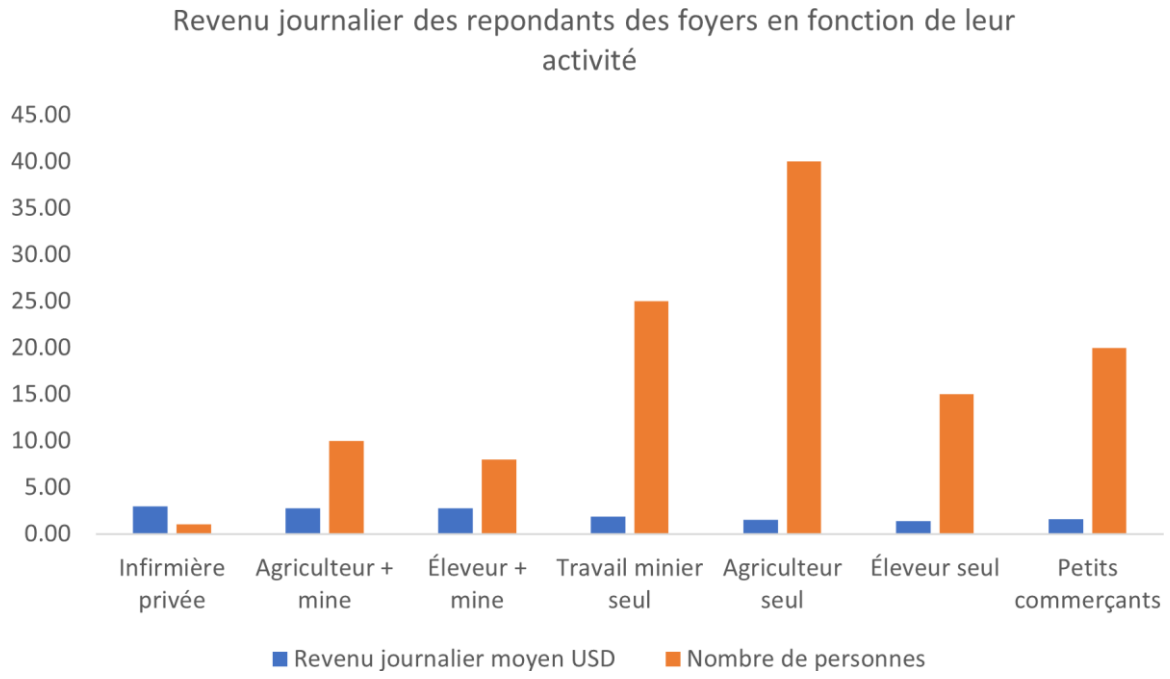
Finally, only one person (0.47%) went to a university. This marginal figure demonstrates the gap between the local population and the highest levels of education, reflecting persistent inequalities in access to higher education.

This distribution suggests a prevalence of basic education within riparian communities, but also a significant share of adults without access to formal schooling, which may affect their ability to assert their rights or actively engage in participatory processes related to extractive projects.



E. Daily income: estimate

Analysis of daily income by occupation in the municipality of Ambahita shows significant disparities, closely related to the type of activity carried out. The highest income observed is that of a private nurse, with MGA 13,000 per day (about USD 2.86). However, this profile is very uncommon, as it only applies to one person in the sample. Profiles combining agriculture or livestock with employment in the mine generate MGA 12,100 (USD 2.66) and MGA 12,000 (USD 2.64) per day, respectively. These amounts clearly indicate the economic advantage of a mixed activity integrating the mining sector. Conversely, exclusively mining-related work generates an average income of MGA 8,000 (USD 1.76) per day, a competitive amount but lower than that of mixed or commercial profiles.
By comparison, according to World Bank standards, the extreme poverty line is set at about USD 2.15 per day. This means that the majority of activities generating income below this threshold do not meet the basic needs of a household. Therefore, only mixed profiles or those relating to rare jobs (such as nursing) reach or exceed this critical threshold.

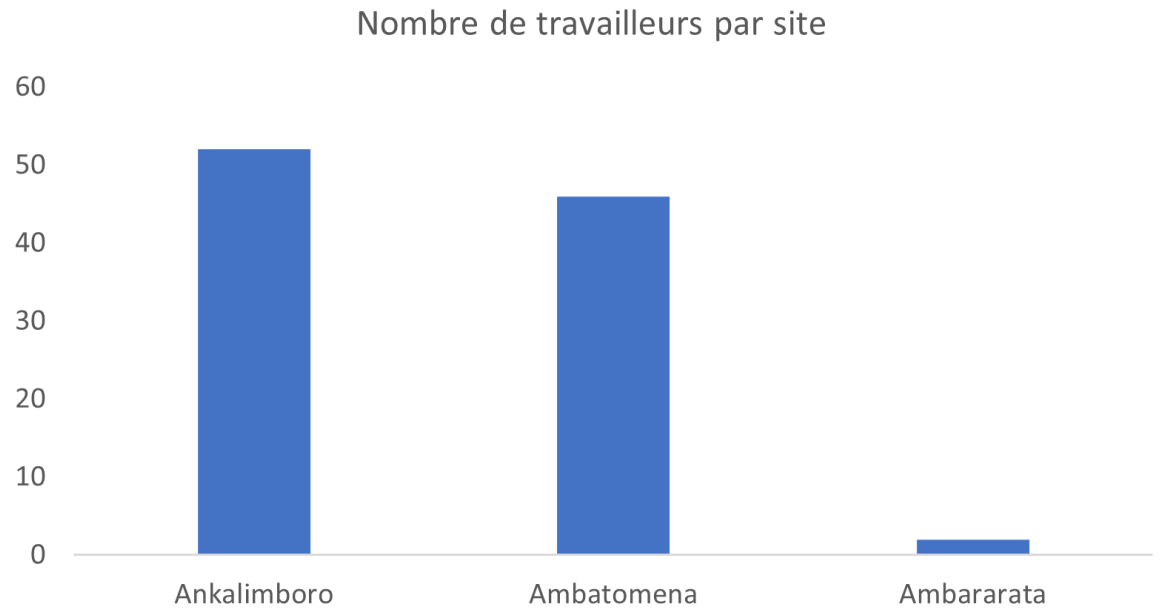


3.1.1 Households surveyed

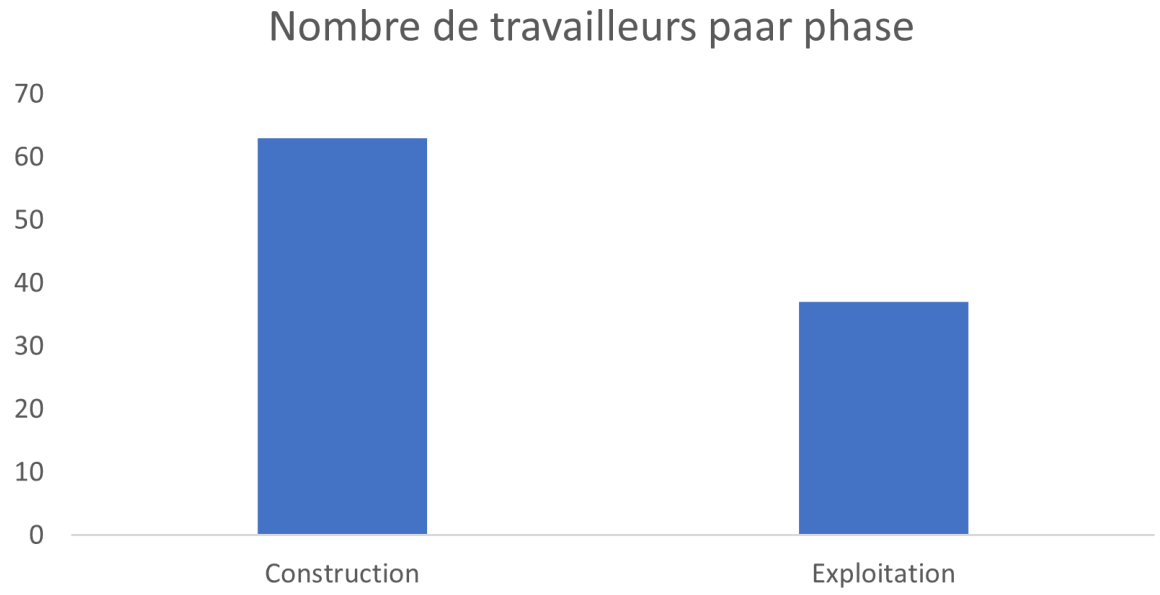
A. Workforce by site, phase and origins

Analysis of daily income by occupation in the municipality of Ambahita shows significant disparities, closely related to the type of activity carried out. The highest income observed is that of a private nurse, with MGA 13,000 per day (about USD 2.86). However, this profile is very much in the minority, since it involves only one person in the sample. Profiles combining agriculture or livestock with employment in the mine generate MGA 12,100 (USD 2.66) and MGA 12,000 (USD 2.64) per day, respectively. These amounts clearly indicate the economic advantage of a mixed activity integrating the mining sector. Conversely, work involving mining exclusively generates an average income of MGA 8,000 (USD 1.76) per day, a competitive amount but lower than that of mixed or commercial profiles.

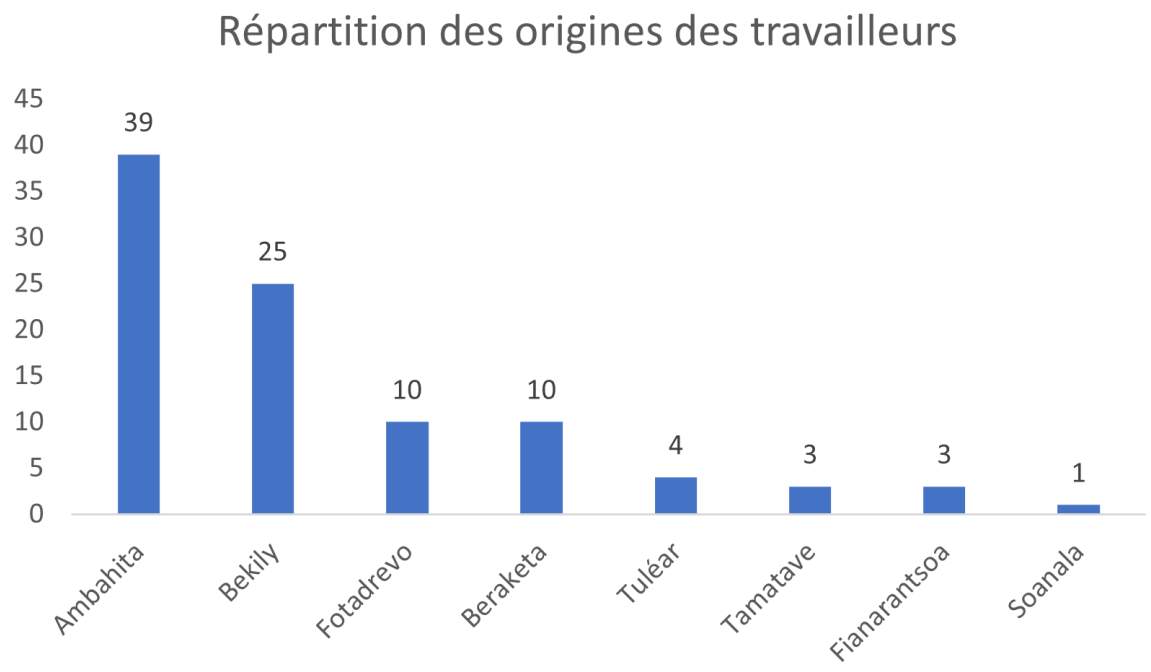
By comparison, according to World Bank standards, the extreme poverty line is set at about USD 2.15 per day. This means that the majority of activities generating income below this threshold do not meet the basic needs of a household. Therefore, only mixed profiles or those relating to rare jobs (such as nursing) reach or exceed this critical threshold.



Regarding the distribution of workers by activity phase, 65 people are mobilized for construction work, compared to 35 for jobs related to operations (drivers, welders, guards, etc.). This indicates that the mining project remains in an active implementation phase, with a high demand for unskilled labour, mainly for infrastructure and site development.



With regard to the geographical origin of workers, the data shows that 41% (or 39 out of 95 people identified) come from Ambahita, which highlights a certain level of local inclusion. In addition, there are 25 workers from Bekily, as well as 10 each from Fotadrevo and Beraketa. Furthermore, 11 workers come from other regions of the country (Tuléar, Tamatave, Fianarantsoa, Soanala), to occupy technical or specialized positions. This trend is common in mining projects, where skilled functions are often outsourced. In general, recruitment remains predominantly local and regional, especially for construction-related positions. However, the predominance of non-local experts in technical and management functions raises questions about the efforts made in terms of training and upskilling of local human resources. A sustainable integration strategy should be accompanied by skills transfer and local promotion mechanisms to ensure better long-term inclusion.



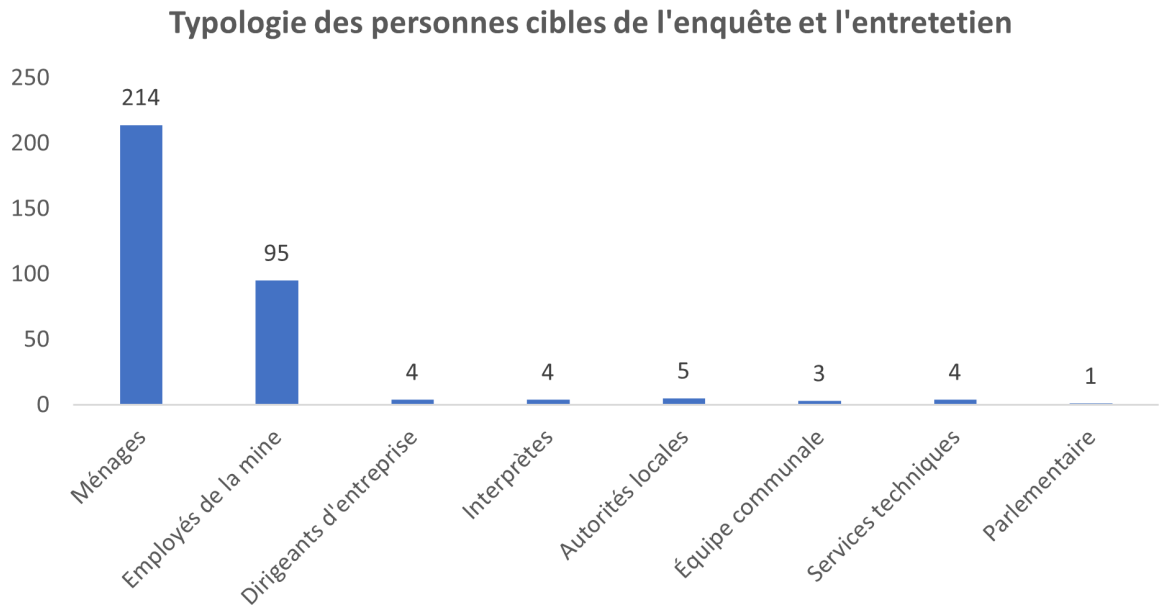
3.1.1 Households surveyed

The survey conducted in the municipality of Ambahita collected data from 330 people, distributed according to diversified profiles, directly or indirectly related to the graphite mining project. However, only the 214 riparian households constituted the main sample of the study, rigorously selected to ensure statistical representation. These households, representing 64.85% of the total respondents, were surveyed through structured questionnaires. The interviewees in this context were mainly fathers, mothers or other referring adults, which allows a refined reading of the impacts of mining on income, access to basic social services, the quality of housing and the perception of well-being.

Alongside this socio-demographic sample, 95 employees of the mining company were surveyed, representing 28.79% of the total respondents. These workers are distributed among the sites in Ankalimboro, Ambatomena and, to a lesser extent, Ambararata (currently on standby). They perform various functions such as guarding, driving, welding, cooking, masonry, etc. Their inclusion in the survey enables to assess working conditions, identify the direct economic benefits of mining

activities, as well as to compare the realities experienced by wage earners and non-affiliated households.
In addition, eight representatives of the mining company were interviewed in semi-structured interviews: four executives from Gold Sand and its partners, and four interpreters. Although their number is limited (1.21% of the total workforce each), their qualitative contribution is strategic for understanding the project's orientations, management priorities and inter-institutional and intercultural communication logics.

Finally, local institutional actors were approached through semi-directive interviews. These are five local authorities (heads of wards and sub-wards), three members of the municipal staff, four decentralized technical service officials, as well as a parliamentarian. Their contribution aims to shed light on territorial governance issues, the monitoring level of contractual commitments, and institutional involvement in managing the effects of the project, particularly in terms of corporate social responsibility (CSR). This diversity of actors, combined with a differentiated collection methodology (structured questionnaires for households, targeted interviews for other profiles), allows rigorous triangulation of data and gives the analysis scientific and contextual robustness adapted to the multisectoral issues of the mining project.



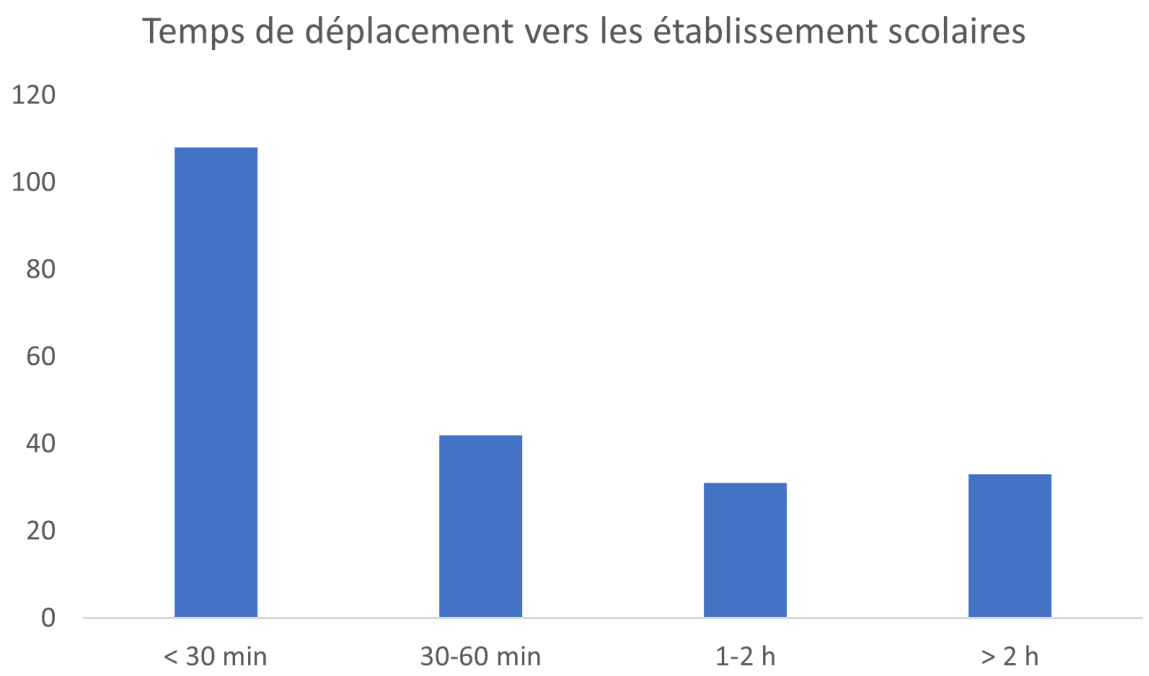
3.2 *Infrastructural conditions and social commitments of the company*

3.2.1 *Travel time to schools (EPP, CEG)*

The analysis of school travel times highlights significant inequalities in terms of accessibility to education. Approximately 50.47% of respondents say that the journey to the school takes less than 30 minutes. This relatively high proportion is a factor in the regularity of school attendance.

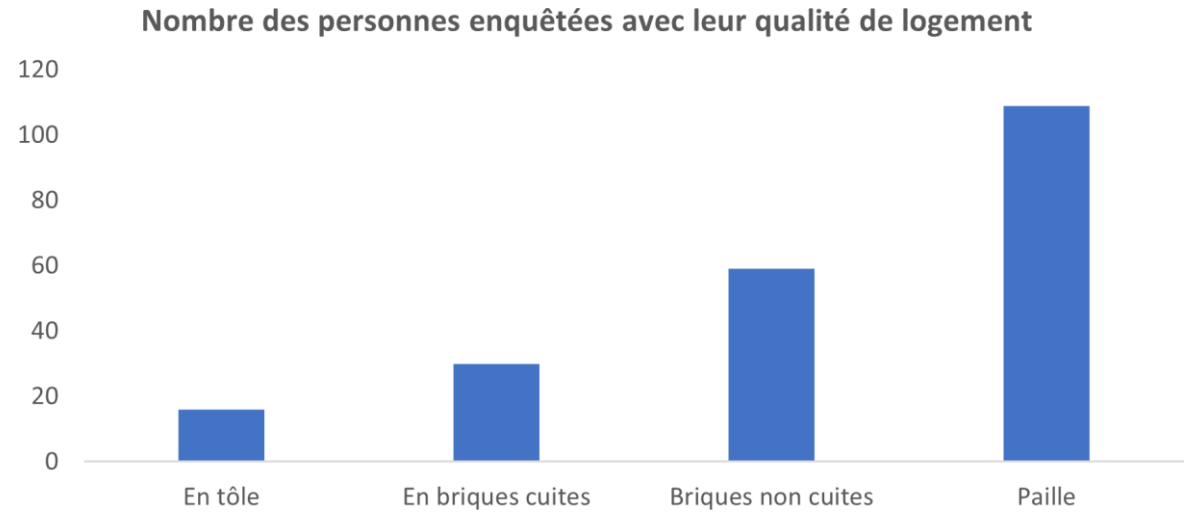
On the other hand, 19.63% of respondents reported a commute time of between 30 and 60 minutes. In addition, 14.49% of respondents say that children take between one and two hours to get to school, which represents a significant travel time likely to cause fatigue, frequent delays, or even absenteeism. Even more concerning, 15.42% of respondents mentioned a journey of more than two hours. These long distances are a major barrier to schooling, especially for younger children.

However, in the context of the mining project implementation, 67.01% of respondents indicate that a school was built in Ampisopiso (base camp), and that a CEG was rehabilitated in Ambahita.



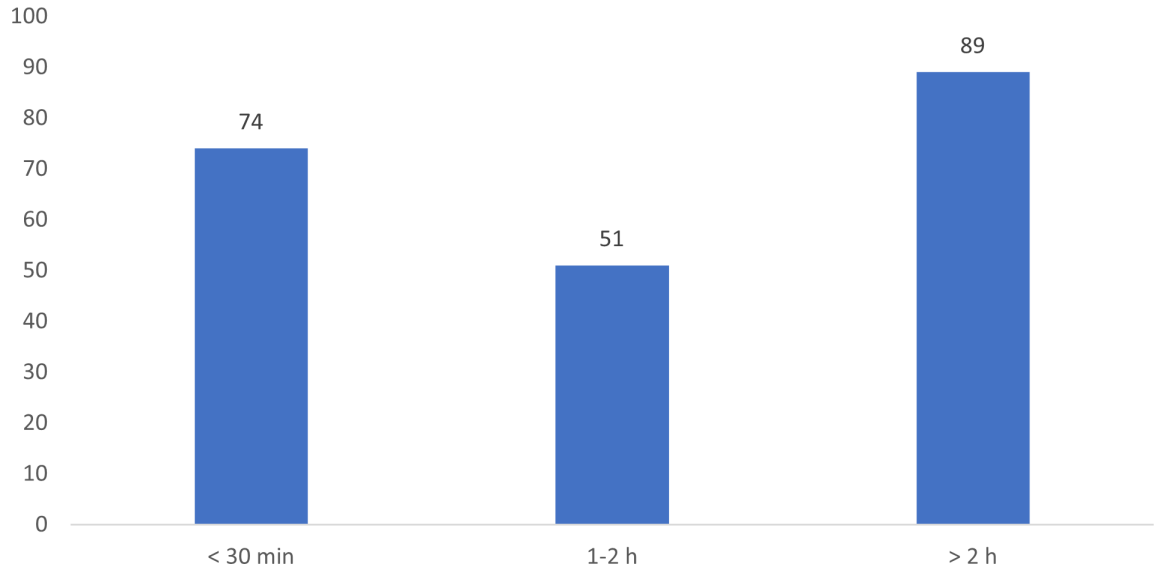
3.2.2 *Housing quality during graphite mining*

The analysis of housing conditions in the municipality of Ambahita highlights a predominantly precarious standard of living: 50.93% of households live in straw dwellings and 27.57% in unfired brick dwellings, or more than 78% in habitats considered rudimentary. Only 14.02% of households have houses made of fired bricks, and 7.48% have tin roofs. This observation raises questions about the effectiveness of the redistribution of wealth generated by graphite mining. It reflects either a limited impact of mining activity on housing conditions, or exploitation that is still recent or insufficiently inclusive to generate tangible effects on the material well-being of the majority of the population.



3.2.3 Travel time to access health services

Analysis of accessibility to health services during graphite mining in the municipality of Ambahita reveals inequalities in access to health care in the municipality of Ambahita: only 34.58% of respondents live within 30 minutes of a health centre, while 41.59% have to travel more than two hours. Despite this, 80% of inhabitants claim to attend health facilities, although persistent reliance on self-medication and traditional healers remains, due to remoteness, the cost of care or cultural factors. No health facilities have been built by the Gold Sand company, despite supposed CSR commitments. The developments observed (tracks) have not significantly improved sanitary accessibility, calling into question the respect of the company's social obligations towards the surrounding communities.



3.2.4 Analysis of road conditions in Ambahita

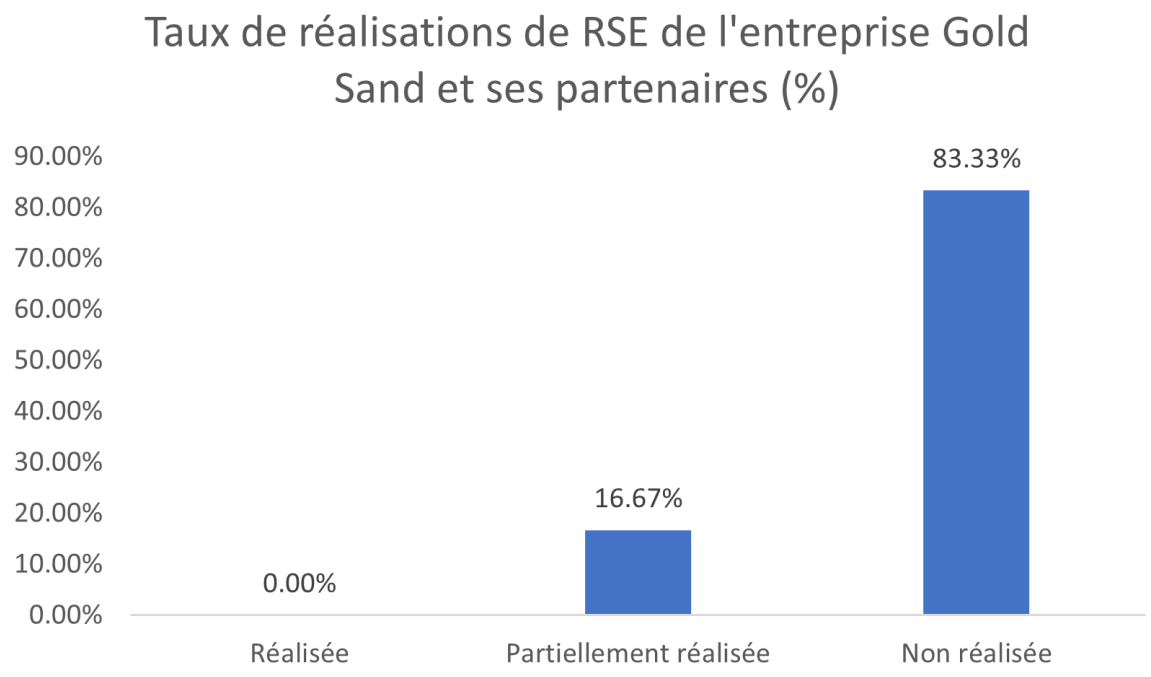
Before mining began, 99% of respondents said that roads were in poor condition, especially those linking villages to the commune's capital. This reflected a significant isolation of local communities as well as a structural deficit in basic infrastructure, impacting mobility and access to essential services.

However, according to the same proportions, meaning 99% of respondents, the road conditions have not improved noticeably since the beginning of the operation. This persistence of difficulties, despite the contractual commitments made by the mining company in its specifications, is due to the total lack of fulfilment, or at least, punctual and very localized interventions, insufficient to produce a tangible effect on the entire population.
Certainly, some tracks have been opened towards the mining sites of Ankalimboro, Ambararata and Ambatomena. However, their use remains mainly limited to extractive activities and does not seem to directly benefit the local inhabitants. The lack of positive impact on the general condition of roads used by the population is a worrying factor. It affects daily mobility, access to basic social services such as education or health, and compromises the marketing of agricultural products. In addition, non-compliance with contractual infrastructure commitments is likely to fuel tensions with local communities and undermine the legitimacy of the mining project in question.

3.2.5 Updated assessment of CSR commitments

During this survey, the level of achievement of corporate social responsibility (CSR) commitments stated in the environmental and social specifications of operating permits PE No.26913 (Gold Sand) and PE No.29394 (COPAX) was analysed.

The finding indicates 18 formal commitments to meet the basic needs of the communities of Ambahita and its wards in terms of infrastructure, health, education and local governance. Of these 18 commitments, no action has been fully achieved, while 3 have been partially implemented. The remaining 15 remained unaccomplished. The graph below illustrates the corresponding proportions. This poor performance, marked by a non-achievement rate of 83.3% and partial implementation limited to 16.7%, highlights a clear gap between the commitments made and the results observed on the ground. It testifies to a failure to realize contractual promises within the CSR framework, affecting the credibility of mining actions and fuelling community frustrations.



3.3 Result of the analysis of the typology of human rights violations for the graphite mining project by Gold Sand and its partners

Based on the facts found on the ground, the evaluation approach is based on an objective grid on a scale of 1 to 10: legal severity, cultural and social impact, frequency of violations and accessibility of remedies. Consolidated results are reported as follows:

3.3.1 Results by typology of human rights violations

A. Barriers to access to employment and local recruitment

1. Findings

The Access to Employment Survey reveals that, of the 214 households surveyed, 52 reported that at least one household member had applied for a job with the mining company, or **24.3% of the sample**. On the other hand, **75.7%** did not do so. This abstention is mainly due to a lack of information or confidence, a feeling of exclusion, or the conviction that their application will be systematically rejected. Of the 52 households that reported an application, 42.3% (or 22 people) actually got a job, while 57.7% (or 30 people) had their application refused. The reasons given by these unsuccessful households are particularly revealing. Indeed, **56.7%** of them attribute this refusal to a lack of skills, which underlines the urgency of a locally adapted vocational training system.
In addition, **33.3% report** a form of perceived discrimination in the recruitment process. Finally, **10% say** they have anticipated their rejection, which highlights a phenomenon of resignation or latent exclusion. On the other hand, an **overwhelming majority of 85.23%** of respondents believe that the required competency criteria do not correspond to local realities, which contributes to excluding many potential candidates. In addition, **90.12 %** of respondents point to the total lack of training or support for better professional integration. This perception is confirmed by **95.78%** of respondents who consider that the conditions of access to positions are unsuitable for the local context, particularly with regard to the level of diploma required and the technical skills required.

In addition, **70.71%** denounce a clear preference given to migrant workers, especially for executive positions and technical roles. At the same time, **76.17%** of respondents (people) say they have never had access to job offers or received official information about available opportunities. Ultimately, only 22 of the 214 households surveyed, or about 11%, currently have at least one person employed within the mining company.

2. Evaluation

Box 1 Evaluation of violations related to access to local employment

The assessment of violations related to access to local employment is based on a scale of severity and impact established according to stringent criteria. The practices observed include inadequate recruitment (score 7.0), lack of local training (7.2), unattainable qualification requirements (8.0), preference for external workers (6.8), lack of communication of job offers (7.4) and a very low local integration rate (7.6). From a legal point of view, several normative grounds are mobilized to qualify these infringements. First, Article 27 of the Malagasy Constitution guarantees the right to training and the development of skills, a foundation directly contravened by the absence of local initiatives. Secondly, Article 243 of the Mining Code stipulates that local populations should have priority access to employment, a provision ignored in the current recruitment strategy. In addition, the MECIE decree imposes social inclusion as a fundamental axis of sustainability. Social inclusion is considered an essential element for sustainability, as it determines the social acceptability of the project and the reduction of negative impacts on local communities. These practices also violate several international instruments ratified by Madagascar. ILO Convention No.111 prohibits any (including indirect) form of discrimination in access to employment. The international Covenant on

Economic, Social and Cultural Rights (ICESCR) recognizes the right to earn a living through freely chosen work. Finally, Articles 19 and 23 of the Universal Declaration of Human Rights are also relevant: the first one guarantees access to information, which includes job offers, and the second one enshrines the right to fairly accessible work, under satisfactory conditions.
Thus, the average score of 7.33/10 is justified by the combination of a lasting economic impact, repeated indirect discrimination and systematic violations of fundamental rights at work.

B. Violations of Customs and Traditions by Chinese nationals

1. Findings

The most frequently reported violation was the slaughter of dogs in the river, mentioned by **85% of the people in the households surveyed in 2022**. This practice raises a double issue. On the one hand, it is a major health problem, since the river is a source of water used daily by local communities.
On the other hand, it has a highly sensitive cultural dimension, the killing of animals in a sacred or community space being perceived as a serious offense to local beliefs. This situation reflects a profound lack of awareness or respect of traditional practices. In addition, the attack on sacred sites, reported by 80% of respondents, concerns sacred spaces such as tombs and ancestral trees. These acts directly affect central spiritual elements in the local culture and cause a sense of desecration of places of collective memory.

Finally, the dumping of waste and wastewater on sacred grounds, although less frequently reported (65%), remains significant. It reveals not only a manifest incomprehension of local spiritual values, but also a lack of respect for them. This form of pollution also involves environmental risks and constitutes a desecration of places traditionally dedicated to contemplation or worship. Overall, these violations reflect a cultural mismatch between the practices imposed by external actors and the spiritual norms of local communities.

2. Evaluation

Box 2 Evaluation of customs and traditions violations

The survey reveals serious violations of local customs, perpetrated by some executives of the Chinese mining company. Among the documented facts is the slaughter of dogs in a river considered sacred, a practice perceived as deeply shocking in a context where the consumption of canine meat is culturally prohibited. This type of transgression was rated at 7.8 out of 10 due to its dual impact in terms of health and beliefs. Similarly, attacks on taboo places and sacred plants, scored at 8.0 out of 10, reflect a total lack of knowledge of the fundamental spiritual benchmarks for local communities. The dumping of substances on sacred sites, although slightly less frequent, remains a significant violation (7.2/10), compromising the respect due to the spaces of contemplation and collective memory.

These attacks are not only symbolic; they directly relate to elements of identity transmitted between generations, thus affecting social cohesion and community dignity. Their seriousness is reinforced by the almost total absence of recourse mechanisms (≤3/10), which prevents any redress or formal recognition. From a legal standpoint, these facts violate Article 8 of the Malagasy Constitution, guaranteeing human dignity, as well as Article 40, which protects cultural values and respect for beliefs. They also contravene the 2003 UNESCO Convention on the Safeguarding of the Intangible Cultural Heritage, to which Madagascar is a signatory. The scores awarded (cultural and social impact ≥8, frequency ≥8) highlight the recurrence of facts, the invisibility of local practices and an institutionalized contempt for community beliefs.

These violations reflect a profound ethical break in the conduct of the mining project, and call for a serious reconsideration of intercultural dialogue and respect for cultural rights at the operational and regulatory level.

C. Evictions of people from their land without their consent

1. Findings

As part of this survey, twelve people affected by the project (PAPs) were interviewed. It appears that the proofs of land rights held by these individuals are exclusively customary or totally non-existent. This legal vacuum makes PAPs particularly vulnerable to expropriations carried out in the context of the mining project. More than half of them have lost access to their land, although a few have managed to remain there despite the progress of the exploitation process. In addition, seven PAPs stated that they had neither the opportunity to negotiate the terms of departure nor the opportunity to give free and informed consent.

Five of these PAPs reported being pressured or threatened as part of the discussions. There is also a total absence of formal agreement : no written contract has been submitted to frame the terms of the land acquisition. The financial conditions, deadlines, reciprocal obligations and duration of the agreements have therefore remained unclear or non-existent from a legal point of view.

More specifically, two PAPs reported having received promises of compensation amounting to MGA 100,000 per month, which have never been honoured. While Gold Sand claims to have conducted negotiations and made compensations, the testimonies collected contradict this statement. Indeed, there is no evidence of a documented negotiation procedure. This lack of formal traceability reflects a clear violation of the transparency and protection principles of the land rights for local populations.

2. Evaluation

Box 3 Evaluation of people evictions from their land without their consent

The results of the survey reveal several forms of serious violations of the land and procedural rights of the communities affected by the mining project. First, forced displacement without compensation, scored at 8.0 out of 10, is a direct violation of the fundamental right to property and fair compensation. This situation is all the more worrying because it is part of a context marked by the failure of communication and formalization mechanisms.
The absence or inequality of prior communication, scored at 7.2, testifies to a lack of transparency, in contradiction with the obligations set out by the MECIE decree. In addition, the absence of a written agreement (7.8), the absence of any signed or submitted document (7.4), as well as the generalization of only verbal agreements (7.0), reflect a detrimental legal vacuum. This lack of formalization considerably weakens the position of households, depriving them of any contractual guarantee and legal proof that could support any claims.
In addition, the compensation promised but not paid (7.0) reflects a breach of explicit commitments, which compromises the communities' trust in the project actors.

Biased or non-existent negotiations (6.8), as well as cases of pressure or threat (7.0), highlight a worrying power asymmetry, especially in a rural context where communities are already vulnerable. These practices are incompatible with the requirements of free, prior and informed consent.
From a legal point of view, these facts constitute clear violations of Articles 34 and 8 of the Malagasy Constitution, relating respectively to property and human dignity. They also contravene Article 21 of Law No. 2021-016 on untitled private land ownership, which requires a prior written agreement between the permit holder and the landowner before any exploitation activity. In addition, Article 299 of the Mining Code stipulates that the holder of the mining permit and the landowner must enter into a written agreement defining their respective rights and obligations. In the absence of such agreements, any mining operation is legally contestable. Finally, these violations are in contradiction with Madagascar's international commitments, notably the Kampala Convention on Internal Displacement and the United Nations Guiding Principles on Business and Human Rights.
All of these elements highlight the frequency of abuse, the weakness of redress mechanisms, and the lack of a fair compensation framework. These practices permanently compromise the land tenure security of local communities and exacerbate their structural precariousness.

D. Barriers to access to information and public consultation

1. Findings

The survey conducted in Ambahita highlights a systemic deficit in public consultation and access to information in the context of the mining project. **First, 65% of respondents** reported having missed the consultations organized by Copax and Gold Sand. This figure

Is reinforced by the fact that 85% of households stated that public consultations were insufficient before and during the project. **Furthermore, 33.24% of respondents** expressed passive disinterest, resulting not from a refusal to participate, but from a lack of information or

means to engage. This phenomenon reveals a process of indirect exclusion that undermines the right to citizen participation. **Even more alarmingly, 95% of respondents** pointed out a lack of clear and transparent communication regarding the actual impact of the project, access to land, and opportunities for local employability. In the same proportion, they reported that the information provided was unclear or incomplete regarding the socio-economic and environmental impacts of the project. **Finally, 95% affirmed the total absence** of mechanisms allowing communities to ask questions, negotiate compensation, or assert their rights.

2. Evaluation

Box 4 Evaluation of barriers to public consultation and access to information

This survey highlights serious obstacles to public consultation and access to information in the context of the graphite mining project led by the company Gold Sand and COPAX. Indeed, the inadequacy of public consultations, noted by 85% of households, is estimated at 8.2 out of 10, reflecting a clear violation of national procedural standards. The lack of communication on the negative impacts of the project, denounced by 95% of respondents, reached a severity estimated at 9.2.

In addition, unclear information on socio-economic impacts, employment prospects and land acquisition, also reported by 95% of participants, is rated at 9.0. Finally, the absence of complaint or negotiation mechanisms, reported in the same proportions, receives a particularly high score of 9.4. These shortcomings constitute a violation of the MECIE decree, which requires free, prior and informed consultation for any project with an environmental impact. They also violate several provisions of the Malagasy Constitution, including Articles 8 (human dignity), 34 (right to information and property), and 40 (respect for beliefs and cultural values). At the international level, these practices run counter to Madagascar's commitments under the International Covenant on Economic, Social and Cultural Rights (ICESCR, art. 6), the International Covenant on Civil and Political Rights (ICCPR, art. 25), the Universal Declaration of Human Rights (UDHR, art. 8 and 19) and Principle 10 of the Rio Declaration. The scores awarded are based on an objective approach, crossing the criteria of legal seriousness, economic and social impact, frequency of violations and availability of remedies. The average score of 8.95 out of 10 reflects the convergence of a high level of normative severity, a systematic frequency of violations, a profound impact on the fundamental rights of populations, as well as an institutional vacuum in terms of redress and transparency mechanisms.

E. Discrimination against women in mining employment

1. Findings

The study conducted in the Gold Sand mining project areas of influence in Ambahita reveals the existence of systematic discrimination against women in terms of access to employment, distribution of positions, and professional recognition.

On the one hand, 90.24% of surveyed households stated that women are systematically excluded from technical and higher-paying positions. This professional exclusion reflects a structural limitation of their ability to access valued positions, thus perpetuating their economic dependence. On the other hand, 86.35% of the households surveyed reported the existence of prejudices suggesting that "female physiology" is not suited to the demands of mining work.

These gender stereotypes, although devoid of scientific basis, strongly influence recruitment

policies and explain unjustified segregation of women in the extractive sector. In addition, 95% of respondents confirmed that 75.45% of employed women are confined to precarious Jobs, such as cook assistants, cleaners or logistical assistants, with no prospects for development.

2. Evaluation

Box 5 Evaluation of discrimination against women in mining employment

The survey carried out as part of the mining project conducted by the company Gold Sand in Ambahita highlights several forms of discrimination against women. First, the gap between women in technical and higher-paid positions, mentioned by 90.24% of respondents, is noted at 7.6 out of 10. This practice constitutes a violation of the principle of equality before the law and the right to work, guaranteed by Articles 6 and 42 of the Malagasy Constitution. It also contravenes Articles 4, 8 and 111 of the Labour Code, as well as Articles 263 to 265 of the Mining Code revised in 2023, which expressly provide for the protection of human rights in the context of mining activities, with an emphasis on the responsibility of operators in terms of working conditions and respect for fundamental social standards.

Second, biases based on the alleged physiological maladjustment of women to mining work, mentioned by 86.35% of respondents, received a score of 7.2. This type of stereotype contributes to systemic discrimination, in contradiction with ILO Convention No. 111 on equal treatment in employment, and with the CEDAW Convention, which Madagascar has ratified. Finally, the assignment of women to precarious positions, with no prospects for development such as maids or cook assistants was reported by 75.45% of the respondents and evaluated at 6.8. It illustrates an inequality in working conditions and access to promotion, in defiance of the provisions of the Labour Code and Article 7 of the International Covenant on Economic, Social and Cultural Rights (ICESCR).

These violations, although rooted in local dynamics, reflect structural and institutionalized discrimination, accentuated by the absence of recourse mechanisms or internal mechanisms promoting professional equality. The rigorous evaluation was based on five criteria: legal severity, economic impact, social impact, frequency and possibilities of recourse. The average score obtained, 7.2 out of 10, reflects the persistence of a discriminatory system with marked economic and social consequences. This situation calls for urgent reform of gender inclusion policies in the Malagasy extractive sector, in line with Madagascar's national and international human rights commitments.

F. Barriers to access to justice for local communities in Ambahita

1. Findings

An almost generalised impossibility of access to justice was highlighted. Indeed, 98.4% of households surveyed and local authorities declare their inability to assert their rights against the mining company. This situation is mainly due to lack of financial means, fear of retaliation and very limited trust in local justice institutions.

In addition, 92.4% of respondents express a strong fear of retaliation in the event of a complaint. This fear contributes to a generalized silence in spite of the abuses suffered. Furthermore, 92.4% of respondents reported particularly serious incidents, including land-related abuse against landowners through land grabbing, and an alleged case of sexual assault and

desecration of a sacred river with the washing and slaughtering of dogs.
Despite the seriousness of the facts, none of these cases were brought to justice. All were settled amicably, often under pressure, revealing paralysed justice in a context of persistent impunity.

2. Evaluation

Box 6 Evaluation of access to justice for local communities in Ambahita

This survey highlights systemic and particularly serious obstacles to access to justice in the municipality of Ambahita. In the first place, the impossibility of initiating legal proceedings, mentioned by 98.4% of respondents and scored at 8.6, reflects a breach of the fundamental right to an effective remedy. At the same time, the fear of retaliation in the event of a complaint, mentioned by 92.4% of respondents and rated at 8.8 out of 10, highlights legal and psychological insecurity incompatible with the standards of a rule of law.

In addition, 92.4% of respondents report that serious cases – land grabbing, alleged sexual assaults, desecration of sacred sites – have been settled amicably under pressure, illustrating institutionalized impunity (note 8.4). Added to this is the almost total absence of independent or community-based redress mechanisms (99.4%, note 9.1), contrary to the UN Guiding Principles on Business and Human Rights.

These situations violate not only the Malagasy Constitution (art. 8, 19), but also the Code of Criminal Procedure, the revised Mining Code (art. 263-265), as well as international instruments such as the ICCPR (art. 2 and 14), CEDAW and local customary norms. The average score of 8.72 thus expresses the legal severity, the frequency of violations, their profound impact on people's safety and dignity, and the total absence of credible and effective remedies.

G. Violations of working conditions: contract, health, security, social protection

1. Findings

The survey reveals that 90% of households and 100% of employees surveyed report a total lack of working conditions that meet legal standards. First, no written employment contract is established between the company and its employees, which makes informal and legally unenforceable employment relationships. Secondly, no safety measures are put in place at the operating sites; workers do not have any personal protective equipment, exposing them to serious occupational risks.
Moreover, no form of social protection is provided, particularly in terms of health coverage or retirement, placing workers in a very precarious situation. These findings are corroborated by five heads of fokontany, a parliamentarian and municipal officials.

In addition, the company explicitly acknowledges not implementing these devices. Thus, workers operate in a framework totally devoid of legal protection, which is a clear violation of labour law and international conventions relating to the protection of workers.

2. Evaluation

Box 7 Evaluation of violations of working conditions

This survey reveals widespread violations of workers' rights in the Gold Sand mining project. Indeed, employees interviewed denounced the absence of a written employment contract (note 7.4), the absence of safety measures in the workplace, especially the absence of personal protective equipment (note 7.4), as well as the absence of any form of social protection (health, retirement), rated at 7.6. The average score of 7.5/10 reflects a situation of institutionalized precariousness, in which workers are exposed to serious occupational risks, without effective legal protection.

From a legal point of view, the absence of a written employment contract (note 7.4) violates the Malagasy Labour Code, which formally prohibits any work without a written contract. The absence of personal protective equipment (note 7.4) constitutes a violation of the right to security, guaranteed by the Constitution (art. 42), the Labour Code (art. 136 et seq.), and ILO Convention No. 155. The lack of social protection (note 7.6) violates Articles 207 to 212 of the Labour Code, which guarantee the right to health insurance, retirement and compensation, as well as Madagascar's international commitments, including ILO Convention No. 102. The Malagasy Constitution (art. 42 and 43) guarantees everyone the right to decent work and social security. These violations are massively observed (90 to 100% of cases), with a direct impact on the precariousness, insecurity and dignity of workers.

Thus, these practices compromise not only the physical safety of workers, but also their dignity and fundamental rights. They illustrate a systemic violation of the right to decent work, as guaranteed by national and international labour law standards.

H. Violations of Human Dignity: Sexual Harassment, and Moral Harassment

1. Findings

The survey reveals serious facts of sexual violence and discrimination against women and Malagasy employees at the mine site. Thus, 65.2% of households (people) and 91.12% of employees surveyed, supported by a parliamentarian and heads of fokontany, confirm the existence of a case of sexual touching on a stove, perpetrated by a Chinese executive. Repeated cases of sexual blackmail, including in the form of “sex for job”, targeting vulnerable women have also been reported. In addition, 70.23% of employees report offensive behaviour by Chinese nationals, including verbal abuse, frequent threats of dismissal and tasks imposed outside the contract. A particularly revealing incident concerns a financial penalty imposed on a cook for distributing food leftovers, resulting in a payroll reduction of MGA 100 000 and an unjustified salary cut. This deed was never confirmed or reversed by management. In addition, no listening unit or victim protection system has been set up on the site. As a result, victims find themselves isolated, exposed to reprisals, and unable to exercise their right to a remedy. The sexual touching case mentioned above was also settled amicably under pressure. The victim's family eventually gave up filing a complaint out of fear, reflecting a climate of enforced silence and lawlessness.

2. Evaluation

Box 8 Evaluation of violations of human dignity

The survey conducted in Ambahita highlights forms of attacks on human dignity in the context of the Gold Sand mining project and its partners. The facts include touching and sexual blackmail (score 7.6), threats and moral harassment (7.2), abusive sanctions on wages (7.6), as well as the imposition of tasks not provided for in the contracts (6.4).

These practices violate several Malagasy legal standards, including the Penal Code (Articles 330 et seq.), the Labour Code (Articles 4, 8, 121, 142), as well as the Constitution (Articles 6, 42, 43), which guarantee respect for human dignity, physical and moral integrity, and fair working conditions. Internationally, they contravene the Universal Declaration of Human Rights (Articles 1, 3, 5), the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW, Article 11), ILO Convention No. 190 on Violence and Harassment, as well as the ICESCR and ICCPR Covenants. The violations noted mainly affect women and the most precarious employees, exposed to a work environment marked by humiliation, fear and exploitation. The absence of institutional remedies such as a listening unit, a trade union or an internal mechanism aggravates the impact of this violence.

In sum, the average score of 7.2 reflects not only the seriousness of the facts, but also their tolerance by management, reflecting a systemic deficiency in the protection of fundamental rights at work.

I. Worst forms of child labour

1. Findings

The results of the survey conducted in the municipality of Ambahita reveal that no cases of child labour have been reported. Indeed, neither the households interviewed, nor the employees of the mine, nor the local authorities (heads of fokontany, municipal staff), nor even the managers of the Chinese company reported the presence of juveniles at the mining sites. All employees surveyed are over the age of 18, which seems to indicate apparent compliance with the legal prohibition of child labour.

However, it should be noted that the mining sector is classified as high risk of child exploitation by the International Labour Organization (ILO). This classification implies that, despite the current absence of reported cases, constant vigilance remains necessary. The establishment of prevention, regular monitoring and community awareness mechanisms is therefore essential to avoid any future drift and to guarantee lasting respect for children's rights.

2. Evaluation

Box 9 Evaluation of the worst forms of child labour

The scores awarded for the worst forms of child labour in the Gold Sand mining project in Ambahita are based on a rigorous and objective assessment. No cases were observed during the survey, which justifies a minimum score of 1/10 for the following criteria: legal severity, economic impact, social impact and frequency. This rating reflects not the lack of importance of the topic, but the lack of documented violation to date. However, a score of 5/10 is given to the latent risk, due to the historically sensitive nature of the mining sector, as highlighted by the ILO, UNICEF and various studies in sub-Saharan Africa.

The national legal framework – Malagasy Constitution (art. 23), Labour Code (art. 86-93) prohibits child labour, particularly in risk areas. These provisions are reinforced by ILO Conventions No.138 (minimum age) and No.182 (worst forms of child labour), all ratified by Madagascar. The average score of 1.8/10 therefore reflects a situation currently under control, but where prevention and vigilance mechanisms remain to be strengthened. The assessment is based on five objective criteria: legal severity, economic impact, social impact, frequency and existence of remedies or protective devices.

J. Discrimination against persons with disabilities in the Gold Sand mining project in Ambahita

1. Findings

The survey of 214 households in the municipality of Ambahita highlights a form of persistent exclusion of people with disabilities in the local mining sector. Indeed, among the 13 households that reported hosting a person with a disability, only one attempt to apply was made directly by the person concerned. This was not retained, without explicit justification. The other 12 households did not undertake an application process, citing a lack of information, fear of rejection or a feeling of inadequacy between their situation and the positions offered. 90% of households who reported hosting people with disabilities feel that there are no real job opportunities within the mining company. This perception, although it is based more on a feeling than on a direct experience of discrimination, justifies the need to establish a non-discrimination and proactive inclusion ploicy, in order to prevent any form of structural exclusion.

Box 10 Evaluation of discrimination against people with disabilities

The Ambahita survey highlights the worrying structural exclusion of people with disabilities from access to employment at the Gold Sand mining project. Out of a total of 214 households surveyed, 13 reported hosting a person with a disability. However, no employees with disabilities are counted among the workforce of the three mining sites operated. In fact, only one job application from a household concerned was filed, but it was rejected without justification, while the other households did not apply, citing a lack of information or fear of social exclusion.

In this context, 90% of households feel that the company does not offer any inclusive employment opportunities, reflecting a widely shared sense of exclusion and marginalization. In order to measure the extent of this situation, an evaluation was carried out according to five objective criteria: legal severity (8/10), economic impact (7/10), social impact (8/10), frequency (6/10) and prevention (7/10), for an overall average score of 7.2/10. This rating reflects indirect but persistent discrimination.
In legal terms, such practices violate the principles of equality enshrined in the Malagasy Constitution (Articles 6 and 42), Law No.97-044 on the integration of individuals with disabilities, as well as the Labour Code, which prohibits any form of discrimination in hiring. At the international level, they contravene several major instruments, including the United Nations Convention on the Rights of Persons with Disabilities (Article 27), the Universal Declaration of Human Rights. The absence of an inclusive recruitment policy, accessible communication, and specific support measures, reveals systemic discrimination.

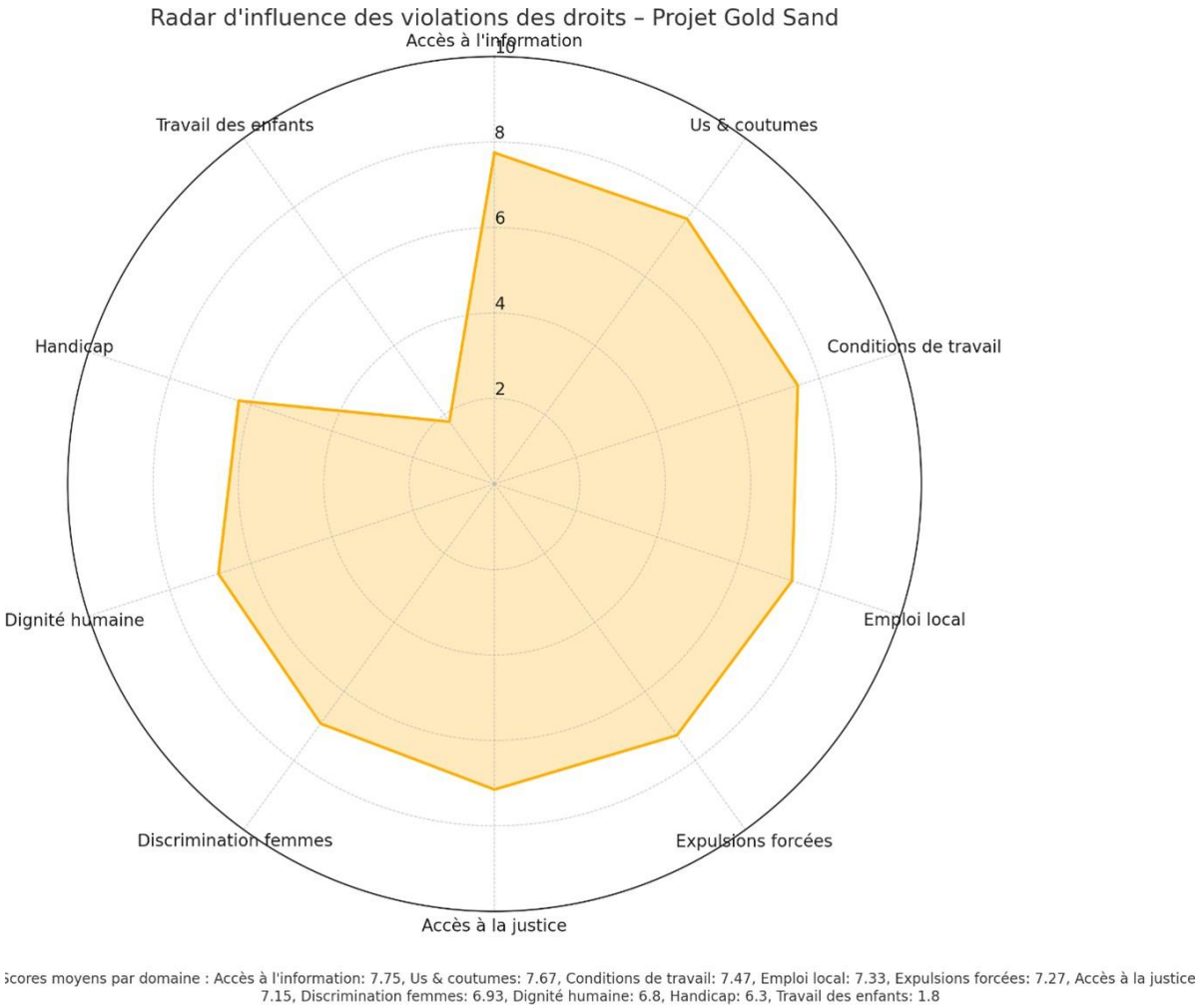
3.3.2 Summary of the evaluation and prioritization of human rights violations committed

The cross prioritization of violations identified in the Gold Sand mining project is based on an approach combining the score awarded during the survey, the legal severity of the norm violated (constitutional, legal or international) and the level of infringement on human dignity (physical, moral, social or economic). This scientific and legal approach makes it possible to prioritize violations according to their normative severity, their impact on fundamental rights and the frequency or extent revealed by field statistics.

Table 2 Prioritization of human rights violations

Cross-prioritization (Score /Normative Severity/Human Dignity)			
Ranking	Breach typology	Score	Ranking grounds
1	**Obstruction of public information and consultation**	7.75	Systemic violations of the **decree MECIE**, **ICESCR** and **UDHR art. 19 → affects the exercise of all other rights.**
2	**Violation of customs by Chinese nationals**	7.67	Violation of **cultural rights** (ICESCR Art. 15, Malagasy Constitution), **which can cause a social and identity divide.**
3	**Violation of normal working conditions**	7.47	Violations of **the Labour Code, Constitution Art. 42, ILO Conventions**, direct impact on **safety and dignity at work**.
4	**Obstacle to employment and local recruitment**	7.33	Violation of **economic and social rights** (ICESCR Art. 6, 7; Constitution), strong community resonance.
5	**Forced evictions without consent or compensation**	7.27	Violations of **property, land sovereignty**; very serious but more localized.
6	**Serious violations of human dignity (sexual harassment, moral harassment)**	7.2	Although the score is moderate, **direct harm to moral and physical integrity** is **extremely serious** under the law.
7	**Obstacles of the access to justice**	7.15	Violation of **the fundamental right to an effective remedy** (ICCPR art. 14), prevents other violations from being corrected.
8	**Discrimination against women in mining employment**	6.93	Violation of the **principle of equality** (Constitution, CEDAW), impact on autonomy and access to resources.
9	**Discrimination against people with disabilities**	6.3	Ongoing indirect discrimination, violation of **CRPD art. 27**, but no cases of physical or outright violence.
10	**Worst forms of child labour (latent risk, no cases identified)**	1.8	Justified low score: **no proven violation** but **sectoral structural risk** (ILO C182, C138).
OVERALL SCORE/10			**6.68**

3.3.3 RADAR diagram of violation typologies



This radar diagram highlights the categories of human rights most affected by the Gold Sand mining project in Ambahita. The highest scores relate to access to information (7.75), customs and traditions (7.67), working conditions (7.47) and local employment (7.33), reporting perceived serious and recurrent violations in these areas. Forced evictions (7.27) and access to justice (7.15) follow closely. In contrast, child labour scores low (1.8), confirming the absence of reported cases. Human dignity (6.8), discrimination against women (6.93) and disability (6.3) show intermediate scores, reflecting less visible but persistent forms of exclusion. This analysis prioritizes areas of intervention to strengthen respect for rights in the extractive context.

Areas	Average score
Access to information	7.75
Customs & Traditions	7.67
Working conditions	7.47
Local Employment	7.33
Forced removals	7.27
Access to Justice	7.15
Discrimination Against Women	6.93
Human dignity	6.8
Disability	6.3
Child Labour	1.8

3.3.4 Kruskal-Wallis test

- **Test to compare perceived severity between different categories of human rights**

This first test was carried out to determine whether the categories of violations observed had an equivalent severity or not according to the scores assigned to each. These scores were obtained from the cross-analysis of five objective criteria: legal severity, economic impact, social impact, frequency and possibilities of recourse.

The null hypothesis H_0 posited that all categories of human rights had been violated in a uniform way ($X_a = X_\beta = Xc = \ldots = Xn$). The alternative hypothesis H_1 argued that some categories had been violated more severely than others, thus revealing statistically significant differences in the distribution of violations. The results of the Kruskal-Wallis test gave a statistic H = 27.10 and a p-value = 0.0013. As this value is below the significance level of 5% ($p < 0.05$), the null hypothesis is rejected. There is therefore a significant difference in the way rights have been affected from one category to another. This result confirms that certain violations such as access to information, violations of customs or working conditions are statistically more worrying than others, such as child labour (unobserved but at latent risk). This highlights the importance of a prioritized and contextualized response to different forms of violations, depending on their intensity, frequency and legal and human severity.

- **Comparison between profiles of respondents**

This second Kruskal-Wallis test was used to assess whether perceptions of the severity of human rights violations varied significantly by respondent profile. Three main categories were analyzed: riparian households (affected population), employees of the mining company Gold Sand, and institutional representatives (local authorities, municipal staff, and parliament).

The objective was to test the hypothesis that the degree of affiliation or institutional position could influence how violations were perceived, which would potentially call into question the objectivity or comparability of responses.

The hypotheses made were as follows:
- H_0 (null hypothesis): there is no significant difference in the severity scores assigned between the different categories of respondents.
- H_1 (alternative hypothesis): at least one group differs significantly in how they perceive the severity of violations.

The statistical results (H = 3.42; p-value = 0.181) indicate that the observed differences are not statistically significant ($p > 0.05$). In other words, the reported perceptions are broadly homogeneous, regardless of the institutional or social profile of the respondent.
This absence of statistically significant bias between groups reinforces the credibility of the data collected. It suggests that the results obtained reflect a shared and consistent perception of violations, and not judgments influenced by particular positions or affiliations. This gives additional robustness to the overall analysis of human rights abuses in the Ambahita mining project

- **Influence of affiliation to the mining company on the perception of violations**

This third study was conducted to assess if respondents' level of affiliation to the Gold Sand mining company, whether they were direct employees, contractors/subcontractors, or unaffiliated, influenced their view of the severity of human rights violations. The objective of this analysis is to determine whether people with a direct or indirect connection to the company express perceptions significantly different from those who have no relationship with the company.

This makes allows to test the existence of potential biases related to loyalty, economic dependence or institutional distance.

The assumptions made are as follows:
•H_0 (null hypothesis): there is no significant difference in the severity scores attributed to violations according to the level of affiliation to the mining company.
•H_1 (alternative hypothesis): at least one group (employees, subcontractors, non-affiliates) perceives violations in a significantly different way. The statistical results obtained indicate a statistic H = 6.87 and a p-value = 0.170.

Since the p-value is above the significance level of 5% ($p > 0.05$), we do not have enough evidence to reject the null hypothesis. In other words, the differences observed in perceptions of the severity of violations by level of affiliation are not statistically significant. This result suggests that, overall, perceptions of human rights violations are relatively homogeneous, regardless of respondents' connection to the mining company.

3.3.5 Confirmation of Hypothesis 1

The hypothesis that "the graphite mining project by Gold Sand and its partners in Ambahita involves proven violations of the fundamental and procedural rights of local communities" has been confirmed following a triangulated methodological protocol using legal, empirical, and statistical approaches.

From a regulatory standpoint, the violations identified infringe upon high-level legal texts. These include the international treaties ratified by Madagascar (ICESCR, ICCPR, CEDAW, CRPD, ILO Conventions No.111, No.138 and No.182, UDHR), the Malagasy Constitution (Articles 6, 8, 19, 22, 23, 34 and 42), as well as relevant national laws such as the Labour Code (Articles 4, 8, 86 to 93), the Penal Code, the revised Mining Code (Articles 263 to 265), Law 97-044 on disability, and Decree MECIE (revised in 2025). These violations affect physical integrity (harassment, violence), economic stability (discrimination in hiring, lack of social protection), civic participation (lack of consultation, cultural violations), and meaningful recourse (fear of reprisals, lack of legal recourse).

Empirically, the study is based on data collected from 330 respondents. These people are broken down as follows: 214 households living in the area surveyed via structured surveys,
95 employees of the mining company who participated in semi-structured interviews, as well as a set of institutional or representative profiles. Among these, we have 08 local

authorities (heads of wards a,d sub-wards, municipal staff), 4 company executives, 04 interpreters, a parliamentarian, and 04 representatives of decentralized technical services. For these categories, the method chosen was that of semi-structured interviews, even institutional interviews for technical services. It should be noted that the latter were mobilised not only to report on the overall implementation of the project, but also to verify the perceptions expressed by the communities and to inform any corrective measures undertaken.

Statistically, three Kruskal-Wallis tests were conducted. The first one revealed a statistically significant difference in the perceived severity of violations by categories of rights ($H = 27.10$; p-value = 0.0013), highlighting the need for prioritization of intervention. The second test confirmed the homogeneity of perceptions among the respondent profiles (households, employees, authorities), with a p-value > 0.05 ($H = 3.42$; $p = 0.181$), which reinforces the credibility and objectivity of the results.

A third application of the Kruskal-Wallis test was conducted to assess whether the level of affiliation of respondents to the Gold Sand mining company whether they are direct employees, contractors/subcontractors or non-affiliated, influences their perception of the severity of human rights violations ($H = 6.87$ and a p-value = 0.170). This result suggests that, overall, perceptions of human rights violations are relatively homogeneous, regardless of respondents' connection to the mining company. Finally, the cross-analyses, including the prioritization table and the radar diagram, confirm that the most critical violations relate to access to information, cultural rights, working conditions, local recruitment, and access to justice. Although no cases of child labour have been observed, vigilance is still required in this sector classified as at risk.

In short, this convergence between normative corpus, field evidence, and validated data allows to assert in a robust and scientific manner that the mining project in question causes multifaceted violations of the fundamental rights of local communities.

3.4 Result of the environmental impact analysis relating to the graphite mining project in Ambahita

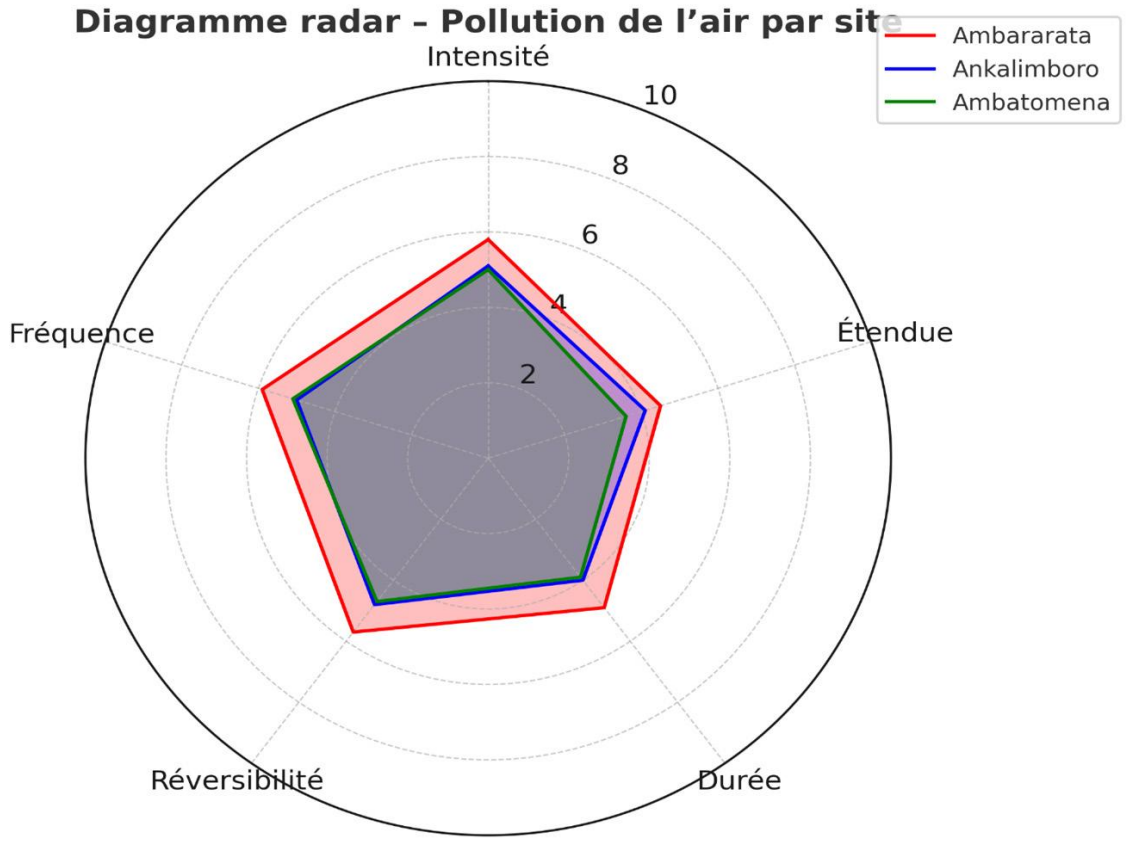
3.4.1 Air pollution related to graphite mining

This analysis focuses on the assessment of air pollution generated by mining activities in the Ambararata (stand-by), Ankalimboro and Ambatomena (under construction) sites. The data collected from 214 households help characterize the impacts through five fundamental criteria: intensity, geographical extent, duration, reversibility and frequency.

Firstly, when it comes to intensity, the data reveals an average of 5.3 out of 10.
This rating is the result of a majority of responses taking air pollution into account as ranging from moderate to high. This situation is mainly explained by crushing activities, the frequent circulation of machinery and the absence of dust removal devices in several critical areas. These elements contribute to a significant concentration of fine particles and dust in the local atmosphere.
Then, with regard to the geographical extent, in the majority of cases, pollution remains localized to the areas directly affected, but it tends to extend to peripheral areas, or even to the whole municipality in certain circumstances. The score of 4.04 out of 10 reflects this spatial enlargement, which can be amplified by seasonal winds facilitating the dispersion of pollutants beyond the perimeters of immediate intervention. Additionally, the duration criterion obtains an average score of 4.28 out of 10. This assessment indicates that while some polluting episodes are one-off, a significant proportion of cases show medium to long-term impacts. This reflects the persistence of pollutants in the atmosphere, even after the cessation of mining operations.
Regarding reversibility, the average score of 5.12 suggests that the effects of air pollution are difficult to correct without specific intervention. The perceptions collected indicate that in the absence of corrective measures, such as reforestation, revegetation or dust removal from tracks and mining sites, natural recovery is slow or even compromised.
Finally, in terms of frequency, air pollution is considered moderate to frequent with a score of 5.36. It is recurrent, especially during the site preparation phases and during material transport operations, accentuating the continuous exposure of inhabitants to atmospheric pollution.

Box 11 Evaluation of air pollution impact

The overall air pollution impact score is 4.82 out of 10. Although it remains below the critical threshold of 6, the threshold at which an impact is considered to be of environmental or health concern according to the standards of the impact scale used in this study, this level remains of concern. It reflects a combination of direct and indirect effects on public health (respiratory disorders, inhalation of particles), on the natural environment (deposits on plants) and on living conditions (reduced visibility, dust in homes). Therefore, it is imperative to strengthen measures to prevent and manage air emissions in the three sites concerned.



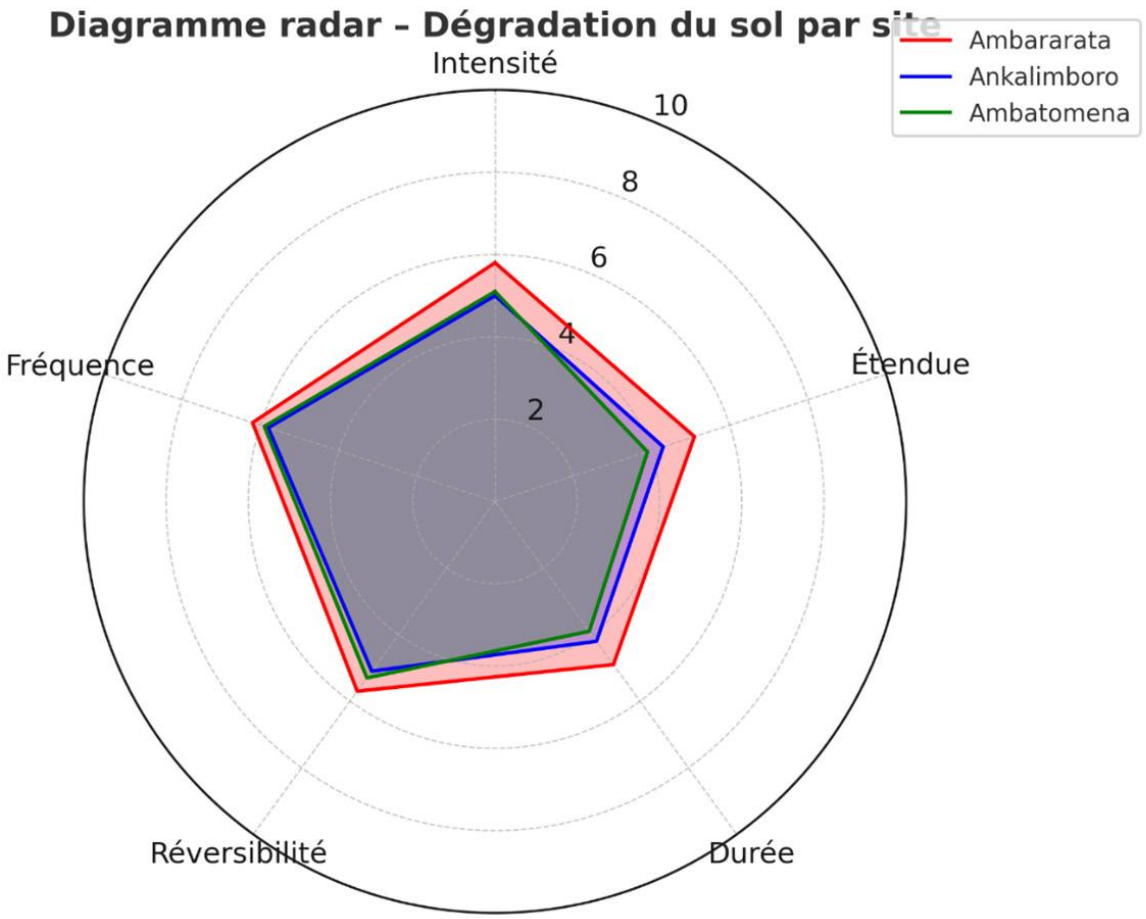
3.4.2 Soil degradation related to graphite mining activities

This study evaluates soil degradation related to graphite mining activities based on field observations analysed according to a multi-criteria grid. This takes into account five essential dimensions: intensity, extent, duration, reversibility and frequency, in accordance with the previously defined methodology.

The intensity criterion reveals an average score of 5.31 out of 10, reflecting moderate to strong soil degradation. This phenomenon is mainly related to clearing activities, earthworks and repeated passage of heavy machinery. In some fragile areas, the loss of soil structure is particularly marked, lastingly affecting its productivity. Analysis of the spatial extent of the impact gives a score of 4.43. This means that degradation not only remains around the circumscribed extraction areas, but tends to spread to peripheral agricultural areas. This observation is particularly observed in Ambararata, near the retention dam, where disturbances extend to adjacent cropland. Regarding the duration of impacts, the average score of 4.38 indicates a prevalence of perceived short-term effects. However, a significant number of observations report more lasting sequelae, especially on rice-growing lands, which struggle to restore their fertility without technical intervention or assisted regeneration.
When it comes to reversibility, the score is 5.36 out of 10. This reflects a low capacity of the soil to recover its original ecological and agricultural functions. This observation is explained by compaction phenomena, loss of humus, nutrient depletion by leaching, and even accelerated water erosion. The absence of rehabilitation measures contributes to the worsening of these deteriorations.
In terms of frequency, soil degradation occurs repeatedly, with an average score of 5.95. This situation is the result of recurrent site preparation work, stripping of surface layers and poorly controlled drainage. These practices promote erosion, runoff and loss of soil fertility.

Box 12 Evaluation of soil degradation

The average overall environmental impact score related to soil degradation is 5.09 out of 10. This level is considered moderate to worrying, in particular because of the often-irreversible nature of the violations observed. The risks are particularly high for arable areas near mining sites, where infrastructure such as retention ponds alter water flows and compromise access to water for irrigated crops.



This radar diagram shows that the Ambararata site has the highest levels of soil degradation on the five dimensions analysed (intensity, extent, duration, reversibility, frequency). This indicates increased vulnerability of this site, requiring urgent stabilization and rehabilitation measures. Ankalimboro and Ambatomena show lower but not negligible impacts, calling for continuous monitoring.

Criteria	Ambararata	Ankalimboro	Ambatomena
Intensity	6.5	5.5	5.2
Scope	5.0	4.5	4.3
Duration	4.8	4.1	3.9
Reversibility	5.3	4.9	4.7
Frequency	6.0	5.6	5.4

3.4.3 Water pollution related to graphite mining

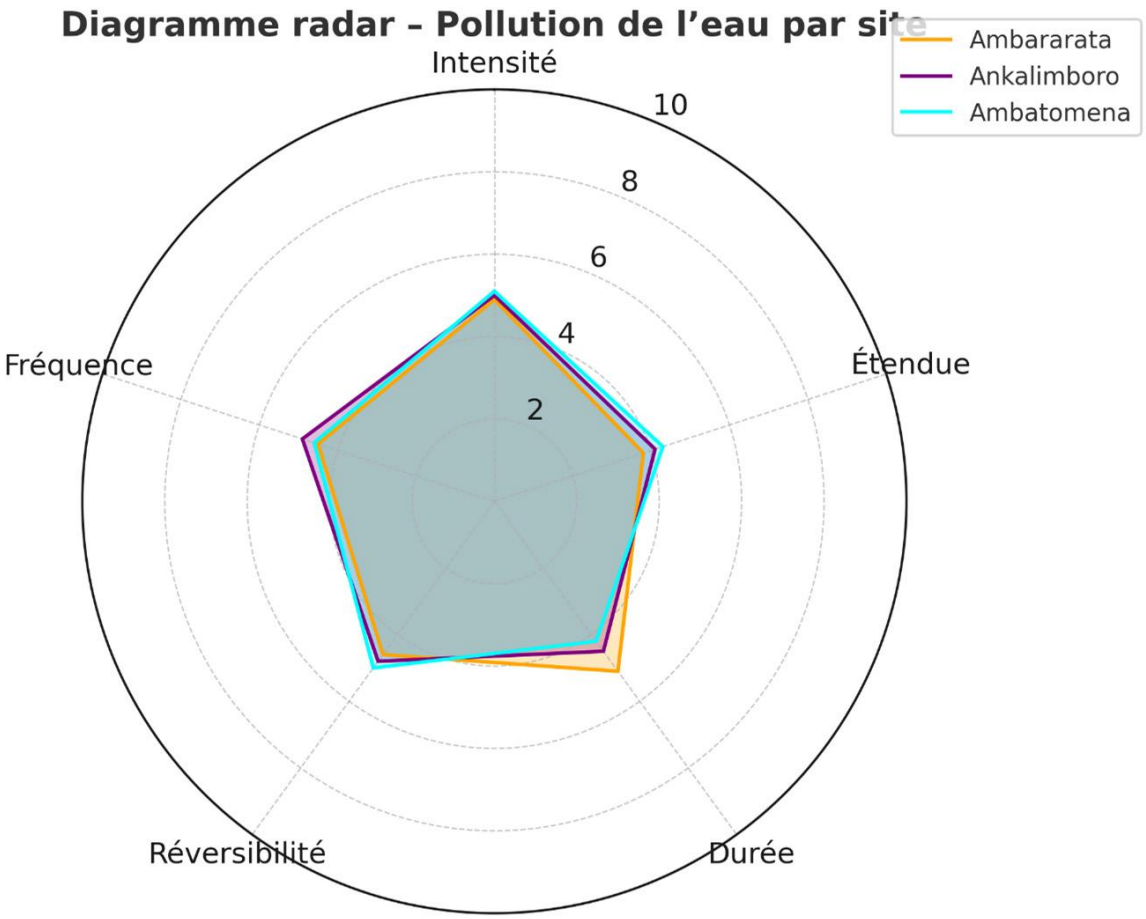
Water pollution was observed at the three Ambararata, Ankalimboro and Ambatomena mining sites. The evaluation is based on five fundamental criteria: intensity, geographical extent, duration, reversibility and frequency. Each of these parameters was rated on a scale of 1 to 10 in accordance with the multi-criteria evaluation grid.

For the Ambararata site, the average pollution intensity is estimated at 4.9 out of 10. This score reflects moderate pollution, linked to residual flows dating from the operating period that come from the extraction site and the base camp. In addition, the duration of effects is estimated at 5.1, indicating a persistence of impacts, even after the cessation of mining activities. The geographical extent of the pollution is relatively contained with a score of 3.8, reflecting spatial containment. However, reversibility is rated at 4.6, suggesting long-lasting effects that are difficult to correct without sanitation intervention. The Ankalimboro site, currently under construction, has a similar pollution intensity of 5.0. The frequency reaches 4.9, a sign of repetitive episodes of runoff or muddy water discharge during the work. The extent of the effects is slightly more pronounced (4.1), which could indicate a partial spread of pollution. Finally, reversibility is rated at 4.8, confirming a low resilience capacity of the aquatic environment.
As for Ambatomena, the level of intensity is slightly higher (5.1), and the extent
is also more significant (4.3), which reflects a wider spatial impact, especially around drainage infrastructure. On the other hand, the duration is rather shorter (4.2), probably in connection with specific prevention measures. Despite this, reversibility is rated at 5.0, indicating long-term environmental vulnerability without targeted corrective actions.

Box 13 Evaluation of water pollution

The overall consolidated average score for water pollution from graphite mining is 4.63 out of 10. This level reflects pollution that is considered moderate but worrying, particularly during the construction phase when control mechanisms are still poorly developed. It emerges from this analysis that the three sites present persistent risks of water quality degradation, requiring the strengthening of collection, treatment and hydrological monitoring systems.

This radar diagram shows that the Ambararata site has the highest levels of soil degradation on the five dimensions analysed (intensity, extent, duration, reversibility, frequency). This indicates increased vulnerability of this site, requiring urgent stabilization and rehabilitation measures. Ankalimboro and Ambatomena show lower but not negligible impacts, calling for continuous monitoring.



Criteria	Ambararata	Ankalimboro	Ambatomena
Intensity	5.5	5.3	5.4
Scope	3.9	3.8	4.0
Duration	5.2	4.5	4.3
Reversibility	5.1	4.8	4.7
Frequency	4.7	5.0	4.8

3.4.4 Deforestation in the Ambararata, Ankalimboro and Ambatomena mining sites

With regard to deforestation associated with mining in the graphite sites of Ambararata, Ankalimboro and Ambatomena, the analysis is based on a corpus of 214 field observations, evaluated according to five fundamental environmental criteria: intensity, extent, duration, reversibility and frequency. Each of these criteria is scored on a scale of 1 to 10, in accordance with Facteau's multi-criteria grid (1999).

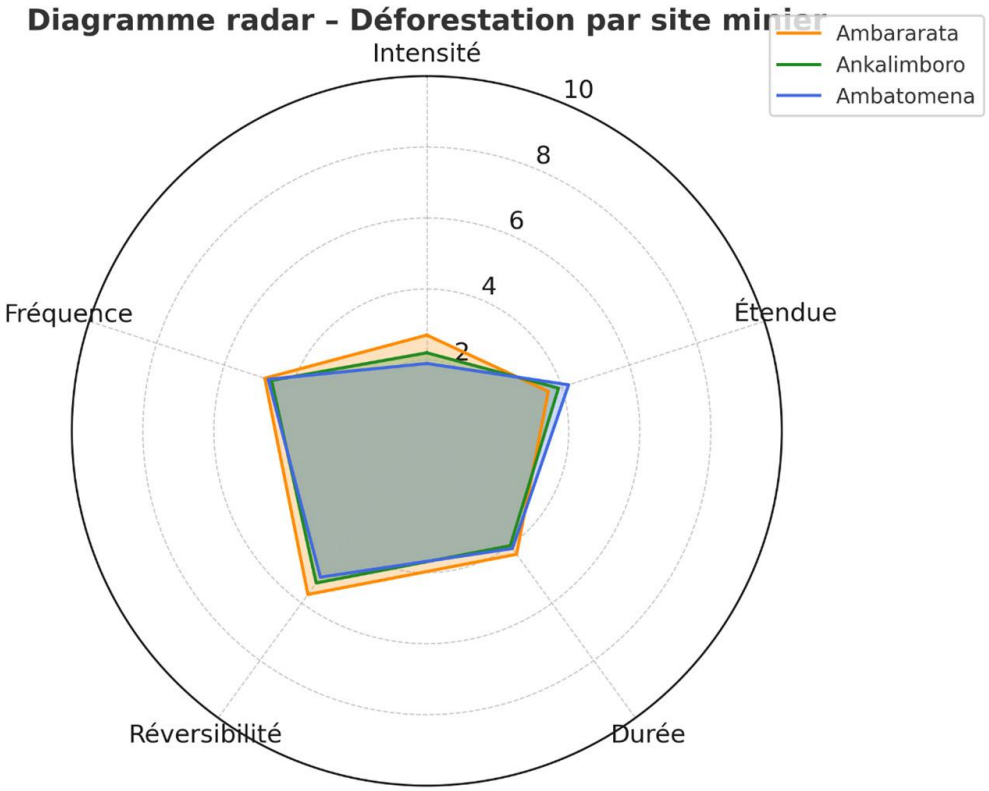
The average intensity of deforestation is generally low, with an average score of 2.26 out of 10. This score reflects reduced forest pressure, especially in Ankalimboro and Ambatomena where land is often already anthropized. In Ambararata, some cases of high intensity have been observed in the areas of access tracks or initial developments. The overall low intensity is explained by the predominance of savannah or cultivated environments in the mining area. Then, in terms of extent, the average of 3.91 indicates a generally localized impact. At the three sites, the effects are mainly concentrated around the areas of direct intervention. However, in Ambatomena and Ankalimboro, an extension of deforestation is observed in the areas of basic construction and widening of tracks.
Regarding duration, the observed average is 4.1. At all three sites, the majority of impacts are considered temporary. However, a dozen respondents attributed higher scores to the "duration" dimension of the impacts in Ambararata, particularly due to the lack of reforestation observed after the cessation of mining activities. This underscores the need for a long-term ecological restoration strategy.

Regarding reversibility, the average score is 5.36. This reflects a low natural regenerative capacity, particularly visible in Ankalimboro where the soil is compacted by construction activities. In Ambatomena, spontaneous plant regeneration is sometimes observed, but it remains insufficient without active reforestation measures. The situation in Ambararata remains of concern due to the lack of post-exploitation initiatives.

Finally, the average frequency of deforestation is 4.7. Pressure is moderate to frequent, especially in Ankalimboro where development work is still ongoing. In Ambatomena, ad hoc interventions on natural vegetation also contribute to an increased frequency of forest losses. At Ambararata, although the site is paused, residual effects remain visible in previously mined areas.

Box 14 Evaluation of deforestation associated with mining in the sites

The average overall deforestation score for all sites is 4.07 out of 10.
This level suggests moderate, but not negligible, deforestation. It is worth noting that the initial low forest density in the areas studied helps to mitigate the perceived severity of the impact. However, the cumulative effects on local biodiversity, habitat fragmentation and soil erosion call for more stringent management measures. It is essential that mining operators implement environmental monitoring and reforestation programs tailored to each site in order to restore the affected ecological balances.



The radar diagram on deforestation reveals generally low to moderate levels on all the sites studied. The intensity of deforestation is slightly more pronounced in Ambararata, which could be explained by cuts prior to the stand-by phase. The extent and duration of the impacts are relatively uniform across the three sites, suggesting diffuse but constant forest pressure. Reversibility remains moderate, indicating a need for targeted reforestation, especially in the most exposed areas. The frequency of attacks remains comparable, indicating an uneven but persistent deforestation.

Criteria	Ambararata	Ankalimboro	Ambatomena
Intensity	2.8	2.2	2.5
Scope	3.5	3.6	3.9
Duration	3.9	3.8	3.7
Reversibility	5.0	4.7	4.6
Frequency	4.6	4.5	4.4

3.4.5 Summary of environmental impacts

A. Rating on a scale of 1-10

This summaary presents an assessment of the main environmental impacts related to mining activities in the Ambararata, Ankalimboro and Ambatomena sites.

Box 15 Summary of environmental impacts

Ambararata (stand-by): 15
This site currently paused, has an average overall score of 4.69 out of 10. The most pronounced impact concerns soil degradation (5.09), followed by air pollution (4.82). Deforestation remains contained (4.28) due to pre-existing anthropization. Despite the temporary cessation of activities, residual effects remain, particularly in connection with old earthworks and hydraulic infrastructure.

Ankalimboro / construction phase
The Ankalimboro site has an overall score of 4.66, revealing a level of impact comparable to Ambararata. Air pollution (4.88) and water pollution (4.66) are particularly notable, linked to ongoing construction work. The frequency of disturbances on the ground (4.88) and the moderate pressure on vegetation (4.20) confirm the need for monitoring devices during this critical phase of the project.

Ambatomena construction phase
The Ambatomena site scores slightly lower overall, rated 4.55 out of 10. The intensity of the impacts is rather homogeneous between air pollution (4.76), water (4.64) and soil degradation (4.82). However, deforestation is lower (399), which is explained by the partially denuded nature of the affected land and more diffuse pressure on forest ecosystems. This profile reflects a moderate but extensive disruption of the physical environment.

B. Kruskal-Wallis statistical test: diversity of impact levels

The non-parametric Kruskal-Wallis test applied to the environmental scores from the three mining sites (Ambararata, Ankalimboro and Ambatomena). The purpose of this test is to verify whether the different categories of impacts (air pollution, water pollution, soil degradation and deforestation) are affected in a similar way or not by the mining activities observed.

$H_0 : X_a = X_\beta = X_c = X_d = X_e = X_f = X_g$
All mining activities at the three sites have similar impacts on environmental aspects.

$H_1 : \exists\ i, j / X_i \neq X_j$
At least one of the mining activities results in a significantly different impact than the others. Kruskal-Wallis (H) statistic: 9.73, p-value: 0.021. With a p-value of less than 0.05, the test rejects the null hypothesis at the 5% threshold.

Box 16 Results of the Kruskal-Wallis statistical test on the diversity of impact levels

This result indicates that there are statistically significant differences between the average environmental impact scores for the dimensions studied. In other words, mining activities in Ambahita do not produce the same levels of impact on the different physical environmental factors.

Statistical analysis confirms that mining activities generate more pronounced effects than others on certain components of the environment.

C. *Kruskal-Wallis Test – Objectivity by Gold Sand Affiliation Level (Employees, Service Providers, Non-Affiliates)*

In order to assess the objectivity of the perceptions collected as part of this environmental study, a Kruskal-Wallis statistical test was applied. This test aimed to verify whether or not respondents' proximity to the mining company Gold Sand and its partners influenced the assessment of the severity of environmental impacts. Three groups were analysed: company employees (direct proximity), local households (community proximity) and institutional representatives (regulatory proximity).

Box 17 result of the Kruskal-Wallis test on the objectivity of respondents' responses

The Kruskal-Wallis test confirms the objectivity of the data collected during the survey. The results demonstrate that judgments about environmental impacts are not biased by respondents' institutional or professional relationship with the mining company. This methodological robustness reinforces the credibility of the analysis.

Hypotheses

H_0 : The scores assigned are identical regardless of the status of the respondent H_1 :
The scores assigned vary according to the status of the respondent Kruskal-Wallis
Statistics (H): 1.65, p-value: 0.437

The p-value obtained (0.437) is above the critical threshold of 0.05, which means that the null hypothesis cannot be rejected. The data does not allow to distinguish significant differences between the scores assigned by the different categories of respondents. In other words, from a statistical point of view, a difference in perception between employees, residents and institutional representatives on environmental impacts is not confirmed.

3.4.6 Conclusion of hypothesis 2

The environmental impact analysis conducted at the Ambahita, Ambararata and Ankalimboro sites is based on an integrated methodology combining empirical observations, assessment scale from 1 to 10 and statistical tests. The impacts identified mainly concern air quality, soil condition, water pollution and noise pollution. The average scores are as follows
: air pollution (4.82), soil degradation (5.12), water pollution (5.47) and noise pollution (4.23). These levels, ranging from moderate to worrying, are particularly marked in Ambararata, where cases of erosion, water stagnation and dust emissions are frequently reported. Noise pollution related to earthworks and mining traffic complements this observation in the two sites in the construction phase.

Two Kruskal-Wallis tests were used to strengthen methodological rigour. The first one assessed the dispersion of impact levels between sites, revealing statistically significant differences and confirming that environmental pressures vary according to the geographical context. The second test focused on the objectivity of perceptions, measuring whether respondents' level of affiliation with Gold Sand and its partners influenced their assessments. The results ($p > 0.05$) did not reject the null hypothesis, suggesting that the responses are generally homogeneous and objective.
Based on this triangulation, score analysis, statistical tests, and qualitative feedback, the study confirms the hypothesis that the mining activities of Gold Sand and its partners generate real, localized and worrying environmental impacts. The urgency of strengthening environmental management measures, including soil restoration, air emission control and water quality monitoring, appears to be a strategic priority. For the verification of this hypothesis, only 214 riparian households were respondents of a structured survey directly focusing on their exposure to the effects of mining and their perception of environmental impacts. For the other categories of respondents (mine employees, local authorities, technical services, company executives), the questions asked focused mainly on the overall aspects of compliance with environmental commitments, the application of environmental specifications, and conformity with impact studies.
In short, this integrated approach allows to document the environmental dynamics at work and to guide founded operational recommendations for the attention of operators.

3.5 Result of the analysis of the impact of graphite mining on the well-being of riparian populations

3.5.1 Statistical significance of the effects of explanatory variables on perceived well-being

This section presents the results of the analysis of the impact of graphite mining on the well-being of local communities, according to the predefined variables. Well-being, as defined by the United Nations, includes meeting basic needs, health, education, a healthy environment and social participation. The study uses a regression model to identify the main determinants of perceived well-being, based on an econometric equation integrating several explanatory variables.

Perceived well-being = $\beta_0 + \beta_1$ (increased income) + β_2 (access to health) + β_3* (access to education) + β_4* (access to infrastructure) + β_5* (access to employment) + β_6* (gender) + β_7* (age) + β_8* (education) + β_9* (marital status) + ε**

Table 2 Prioritization of human rights violations

Variable	Coefficient	p-value	Interpretation
Intercept or reference value	**0.2290**	0.7158	Is not statistically significant and therefore does not allow for direct interpretation on perceived well-being.
Increase in income	**0.3177**	0.4787	Positive effect but **not significant**. The link between increased income and perceived well-being is not established with certainty.
Health access	**0.2502**	0.4790	Positive effect but **not significant**. Suggests a possible but statistically weak link.
Access to education	**0.2157**	0.3682	**Non-significant** positive effect. May reflect that access to education does not guarantee an immediate improvement in perceived well-being.
Access to infrastructures	**0.3241**	0.3296	Positive but **not significant** coefficient ($p > 0.05$). While access to infrastructure improves quality of life, it does not automatically result in improved perception of well-being.
Access to employment	**0.3490**	0.2295	Moderate positive effect but **not significant**. This indicates a favourable pattern but not robust evidence.
Gender	**0.1604**	0.5752	No significant influence of gender on the likelihood of perceived well-being.
Age	**0.0097**	0.2916	**Insignificant** effect and extremely minor effect. Age is not a discriminating factor here.
Education	**0.4095**	0.3111	Although the coefficient is high, the **too high** p value indicates statistical **non-significance**.
Marital status	**0.0200**	0.9076	Completely negligible and insignificant effect.

Box 18 Result of the analysis of the impact of graphite mining on the well-being of riparian populations

Analysis of the logit model applied to survey data from 214 riparian households reveals an absence of a statistically significant relationship between the explanatory parameters tested (increase in income, access to health, access to education, access to employment, infrastructure, level of education, gender, age, marital status) and the improvement in perceived well-being. None of these factors meet the usual threshold of significance ($p < 0.05$), as indicated by the p-value associated with the intercept ($p = 0.7158$), confirming that the overall model is not strong.
In other words, the overall test of the logit model does not reject the null hypothesis that all the variables considered do not improve the predictive capacity of perceived well-being. Although some variables such as educational level (coef. = 0.41), access to employment (coef. = 0.35) or increase in income (coef. = 0.31) have coefficients going in the expected direction, their influence remains insufficient to conclude a statistically valid effect.
These results suggest that the benefits of the graphite mining project in Ambahita, although identifiable through certain trends, do not yet translate into a perceptible and significant improvement in the well-being of the populations concerned. This indicates that the benefits of the mining project remain fragmented, unconsolidated, and insufficiently integrated into a sustainable local development dynamic.

3.5.2 Testing the predictive power of the logit model

Box 19 Result of the model's predictive power assessment

The correct classification rate of the logit model is 70.8%. This means that the model is able to correctly predict the level of well-being of 71 out of 100 households. This performance, although moderate, indicates that the model is reasonably capable of distinguishing households according to the status of their perceived well-being. This means that, out of 100 respondents, about 71 were well ranked according to their perceived level of well-being. The model is a little better at recognizing households that declare themselves to be in a state of well-being: it correctly identifies 3 out of 4 households in this case. On the other hand, it is a little less efficient in identifying those who are not well, with correct detection in about 2 out of 3 cases.

3.5.3 Collinearity Test and Variance Inflation Factor (VIF)

Box 20 Collinearity test and Variance inflation factor

In statistical analysis, the VIF (Variance Inflation Factor) is an indicator allowing to check whether the explanatory variables used in the model are too similar to each other. If so, this can be problematic, as these variables may convey the same information and skew the model results.
In our logit model applied to the assessment of household well-being, we calculated the VIF for each variable. All results are below the critical threshold of 5, indicating low collinearity. This means that each variable provides different information and that the model is stable. The coefficients linked with these variables in the logit model can therefore be interpreted with confidence, as they are not skewed by internal redundancies.

In summary, there is no problematic redundancy between the variables. However, due to the overall non-significance of the model, the results should be interpreted with caution. Each factor analysed may have an individual contribution in explaining the perceived well-being of households, although these contributions are not statistically confirmed.

3.5.4 McFadden's Pseudo R^2 test

Box 21 McFadden's Pseudo R^2 test

McFadden's Pseudo R^2 is an indicator of whether a logit model fits the data well. In this study, it was used to measure the extent to which the chosen explanatory variables (income, employment, education, etc.) explain the variability in the level of well-being of households bordering a mining project.

The result obtained is 0.502, which means that the model explains about 50.2% of the observed variations. This is a very good score in logistic analysis, as it is generally considered that a Pseudo R^2 greater than 0.3 indicates a satisfactory adjustment.

In other words, this logit model is well calibrated: it is able to explain a significant part of the differences in well-being between the households studied. This shows that the factors selected are relevant, and that the results obtained can be used to guide decisions related to the impact of the project on the local population.

In summary, the Pseudo R^2 of 0.502 validates the overall quality of the model, and reinforces the credibility of the econometric analysis conducted in this study.

3.5.5 Conclusion of Hypothesis 3

The econometric study carried out as part of the graphite mining project in Ambahita aimed to assess the measurable effect of this project on the vulnerability of local populations. The main hypothesis was as follows: "The Ambahita graphite mining project does not always influence the vulnerability of local populations." To test its veracity, a double methodological approach was adopted, combining statistical data and qualitative data from the field survey.

Statistically, a logit model has been built to estimate the probability that a household declares itself to be in a state of well-being, considered here as an inverse indicator of vulnerability. The model incorporated explanatory variables directly related to the project (income, employment, access to health, infrastructure, education), as well as control variables (age, gender, marital status, education).

The results show that the model has a good overall fit: McFadden's Pseudo R^2 reaches 0.502, indicating that more than 50% of the variations in the level of well-being are explained by the variables chosen. In addition, the correct classification rate of the model is 70.8%, which means that it correctly predicts the welfare status of nearly 7 out of 10 households.

However, analysis of the individual significance of the variables reveals that some, such as education, access to employment and increased income, have positive but not systematically

significant effects. This lack of statistical robustness is reinforced by qualitative data: some households report one-off benefits, while others perceive no tangible change.

The VIF collinearity tests confirm the acceptable statistical independence of the variables, which allows for a valid interpretation. Nevertheless, the lack of global and individual significance of the effects implies that the benefits of the project are real but unevenly distributed and difficult to generalize.

These results may also reflect structural limitations of the model: key explanatory factors may be missing, such as public policies, social conflicts, mining profit redistribution practices, or unmodelled interaction effects. It is also possible that nonlinear relationships or combined effects between variables have not been captured.

Finally, the low level of implementing corporate social responsibility (CSR) commitments as part of the environmental and social specifications reduces the perceived impact of the project, which fuels frustrations in local communities.

In conclusion, quantitative and qualitative data converge to confirm that the project's influence on vulnerability is partial, unevenly distributed and still largely insufficient to produce a structuring effect. These elements underline the need to review the social and economic inclusion mechanisms of the mining project in order to ensure more equitable and sustainable development.

MAIN RECOMMENDATIONS

4.1 Human rights violations in graphite mining

Following the thorough study of the human rights violations committed in the context of the graphite mining project in the Ambahita, Ambararata and Ankalimboro sites, the following recommendations are made in order to strengthen the protection of fundamental rights at all levels:

FOR CIVIL SOCIETY:

- Establish and ensure the continuity of community monitoring networks on human rights, particularly in the areas of labour, public consultation, and non-discrimination.
- Organise legal awareness campaigns accessible to communities on available recourse options.
- Systematically document cases of harassment, expulsions, or discrimination in order to provide evidence for national and international complaint mechanisms.

FOR THE COMPANY (Gold Sand and its partners):

- Establish a code of conduct aligned with international human rights standards and enforce it at all levels.
- Establish an internal complaint mechanism that is secure, anonymous and accessible to employees and residents.
- Regularly train staff (including expatriates) on Malagasy legal obligations and respect for local customs.
- Ensure equitable access to employment without discrimination based on gender, age, disability or community of origin.

FOR LOCAL AUTHORITIES:

- Actively monitor community complaints and mediate between the mining company and local populations.
- Ensure the effective participation of communities in public consultations, this making sure that they are informed.

FOR THE CENTRAL ADMINISTRATION:

- The Ministry of Labour should increase the frequency of social inspections at mine sites and publish the results.
- The Ministry of Mines must condition the granting or renewal of permits based on the evaluation of human rights practices.
- The Ministry of Justice must promote effective access to legal recourse for victims of violations (legal aid, witness protection).

FOR THE ONE (National Environment Regulatory Authority):

- Systematically integrate a human rights assessment grid into environmental monitoring processes (MECIE).
- Cooperate with local NGOs to ensure participatory and inclusive monitoring of the social effects of the mining project.

FOR LOCAL COMMUNITIES:

- Organise into local committees to express grievances in a collective and coordinated manner.
- Claim reparation measures where fundamental rights have been violated, relying on legal or associative partners.
- Actively participate in consultations and demand transparency in mining projects affecting their territory.

4.2 Environmental impacts of graphite mining

In light of the results of the study on the environmental impacts of graphite mining in the three sites (Ambahita, Ambararata, Ankalimboro), the following recommendations are proposed, divided by key actor in order to ensure an effective, preventive and sustainable response to the observed degradations:

FOR CIVIL SOCIETY:

- Raise the awareness of communities on the environmental rights recognized by the Constitution and international texts.
- Monitor and document water and air pollution, deforestation or biodiversity damage through community vigilance networks.
- Engage in advocacy efforts to strengthen sanctions for non-compliance with environmental standards.

FOR THE COMPANY (Gold Sand and its partners):

- Develop and implement a strengthened and transparent environmental management plan including: soil restoration, wastewater treatment, and dust and emissions control.
- Establish a system for continuous monitoring of air, water, and soil quality, and publicly display results.
- Work with local experts to adapt mitigation measures to the specific ecological realities of each site.

FOR LOCAL AUTHORITIES:

- Participate in the validation of environmental impact reports (EIAs) and ensure their public accessibility. (acquire information through documentation, learn about the content)
- Coordinate field monitoring actions with communities and the ONE to verify the effective implementation of mitigation plans.

FOR THE CENTRAL ADMINISTRATION:

- The Ministry of the Environment should review and strengthen the requirements of the MECIE decree, in particular on community participation and independent audits.
- The Ministry of Mines should integrate a binding environmental component into mining conventions and monitor its application.
- The Ministry of Labour can intervene on environmental occupational risks (dust, poisoning) affecting workers.

FOR THE ONE:

- Carry out unannounced inspections at mine sites and publish the results in the interests of transparency.
- Set up an early warning system in case of water contamination, deforestation or abnormal erosion.
- Systematically involve local populations in the development, monitoring and evaluation of Environmental Management Plans (EMPs)

FOR LOCAL COMMUNITIES:

- Identify representatives trained on environmental issues to ensure community monitoring.
- Claim access to environmental data, as well as ecological compensation in case of harm (e.g. reforestation, drinking water supply).
- Participate in policy dialogue mechanisms on land use planning and the protection of sensitive areas.

4.3 Fallouts on the well-being of populations

Following the study on the benefits of the graphite mining project in the Ambahita, Ambararata and Ankalimboro sites, and given the absence of statistically significant links between the project and a measurable improvement in household well-being, the following recommendations are made in order to maximise the social, economic and institutional benefits for local populations:

FOR CIVIL SOCIETY:

- Provide a mediation role between communities and the company for the negotiation of concrete local benefits (infrastructure, social services).
- Strengthen the capacities of local actors to monitor the execution of the company's commitments in terms of social responsibility.
- Require traceability of social expenses made by the company under its local obligations.

FOR THE COMPANY (Gold Sand and its partners):

- Develop a local development plan in rapport to communities, with targeted actions on health, education and access to water.
- Prioritise local recruitment and strengthen vocational training programs accessible to youth and women.
- Support income-generating projects for local populations (micro-enterprises, agricultural or artisanal cooperatives).

FOR LOCAL AUTHORITIES:

- Require monitoring of the company's commitments and report to the population on projects funded or in progress.
- Facilitate people's access to administrative procedures to benefit from social benefits (e.g. land, civil status, public aid).

FOR THE CENTRAL ADMINISTRATION:

- The Ministry of Labour should establish mechanisms to monitor effective job creation and compliance with social commitments entered into by mining companies.
- The Ministry of Mines should include mandatory and verifiable local development clauses in mining agreements.
- The various sectoral ministries (health, education, water) should coordinate their actions to amplify the leverage effect of mining projects on local well-being.

FOR THE NOE:

- Expand the criteria for evaluating mining projects to explicitly include socio-economic benefits for riparian populations.
- Participate in the development of community well-being indicators to be included in environmental and social audits.

FOR LOCAL COMMUNITIES:

- Identify collectively the priorities in terms of social and economic needs, and formalise them with the company.
- Actively participate in the implementation and monitoring of social projects undertaken as part of corporate social responsibility.
- Ensure equitable distribution of benefits within communities, especially to vulnerable groups (women, youth, people with disabilities).

CONCLUSION

This cross-sectional research, conducted at the three graphite mining sites in Ambahita, Ambararata and Ankalimboro, aimed to rigorously, integratively and empirically assess the effects of the Gold Sand mining project on human rights, the environment and the socio-economic benefits of the riparian communities. The methodology adopted is based on an analytical triangulation combining field survey, legal and environmental analysis, as well as statistical modelling. This multidisciplinary approach made it possible to cross the normative, perceptual and quantitative dimensions in order to produce a robust and hierarchical impact assessment. A total of 330 people were interviewed, including 214 heads of riparian households (representing the main sample), 95 mine employees, as well as institutional actors (local authorities, parliamentarians, technical services) and representatives of the mining company. The data collected was analysed using several methodological instruments: a graduated impact assessment scale (rated out of 10), three non-parametric Kruskal-Wallis tests applied respectively to human rights categories, respondents' institutional profiles, and their level of affiliation with the company, as well as a logit model to test the relationship between project outcomes and perceived well-being. The results confirm several major hypotheses:

In terms of human rights, the analyses demonstrate the existence of systemic violations, affecting critical areas such as access to information, public consultation, working conditions and respect for customs and customs. The first Kruskal-Wallis test ($H = 27.10$; $p = 0.0013$) confirms that some categories of rights are statistically more affected than others, thus validating a hierarchy of infringements. Regarding environmental impacts, impact scores and cross-analyses by site confirm moderate to worrying effects, including on water quality, air pollution and soil degradation. The inter-site comparison and the variation of scores according to the level of affiliation of the respondents (test $H = 5.24$; $p = 0.073$) reveal a significant tendency to differentiate perceptions, reinforcing the interest of localized environmental management. On the socio-economic side, the results of the logistic regression model do not indicate a statistically significant link between project involvement and the improvement in perceived well-being. This reveals a clear gap between the benefits promised and the benefits actually felt by the communities.

Finally, the results of the third Kruskal-Wallis test ($H = 3.42$; $p = 0.181$) attest to the overall objectivity of the responses collected, perceptions being relatively homogeneous regardless of the status of the respondents (households, employees, institutional representatives). This absence of significant bias reinforces the reliability of the empirical data.

Ultimately, the relevance of this study lies in the complementarity of the approaches used and the solidity of its methodological foundations. It provides a reliable basis for guiding remediation measures, improving social and environmental governance, and ensuring effective alignment of the project with fundamental rights. It also offers a transferable model for the evaluation of other extractive projects in similar contexts, based on a rigorous scientific approach, participatory and focused on international standards.

LIMITATIONS OF THE STUDY

Despite the methodological rigor applied and the triangulation of approaches (legal, statistical and participatory), the study has some limitations that it is important to recognise for a nuanced interpretation of the results and to guide future research or follow-up actions.

Methodological limitations:

-Sampling, although diverse, does not cover all potentially affected populations, especially highly marginalised groups or undeclared seasonal workers.

-The survey is based on declarative perceptions that can be influenced by cognitive biases (fear, mistrust, expectations) or contextual factors (rumours, local tensions).

-The timing of the study does not make it possible to assess the delayed effects of the mining project, notably those that appear in the medium or long term (chronic pollution, sustainable displacement).

Data limitations and results:

-Some dimensions of well-being or human dignity are difficult to quantify by conventional indicators, which limits their consideration in statistical analysis.

-The scores assigned to violations or impacts, although derived from goal-oriented grids, retain a degree of subjectivity inherent in the respondents' experience.

-The results on the benefits of the project do not allow set causal conclusions to be drawn, due to a possible confusing effect between other social or economic factors.

Limitations of statistical modelling:

-The Kruskal-Wallis test, although suitable for non-parametric data, does not allow the measurement of the precise intensity of deviations or the identification of all sources of intra-group variation.

-Modelling does not take into account some unobserved structural variables (effective legal framework, relationships of power, quality of local governance).

In summary, although the results provide solid and substantiated insights, they should be considered as strong but not exhaustive indications. These limitations call for this analysis to be complemented by longitudinal, participatory and even ethnographic approaches, and for multisectoral monitoring mechanisms to be strengthened to ensure a more comprehensive and dynamic understanding of the effects of the mining project.

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NATIONAL AND INTERNATIONAL LEGAL REFERENCES

1. National Legal References

• Constitution of the Republic of Madagascar:
- Article 6: Principle of equality before the law
- Article 8: Protection of human dignity
- Article 19: Right to information
- Article 22: Right to political and social participation
- Article 34: Right to property, to fair compensation
- Article 40: Respect for cultural beliefs and values
- Article 42: Right to work and vocational training
- Article 43: Right to social protection

• Malagasy Labour Code (Law No. 2024-014):
- Article 6: Equal treatment and prohibition of discrimination based on sex or origin
- Article 8: Written contract obligation and compliance with working conditions
- Articles 92 to 95: Equal pay and non-discrimination at work
- Articles 152 to 159: Safety, health and hygiene at work
- Articles 250 to 258: Right to social protection, health insurance, retirement

• Revised Malagasy Mining Code 2023:
- Articles 263 to 265: Human rights obligations
- Article 299: Written agreement between the licensee and the landowner

• Decree No.2025-080 setting the rules and procedures for the Environmental and Social Assessment:
- Obligation of prior, free and informed public consultation
- Specific requirements for environmental and social impact assessments
- Transparency and information for affected populations
- Increased responsibilities of mining operators and environmental authorities

• Law No.2021-016 on untitled private land ownership:
- Article 21: Obligation to obtain a written agreement from the owner before any economic activity

• Malagasy Penal Code:
- Article 309: Offences against human dignity, applicable penalties
- Articles 320-328: Offences against property, including infringements of cultural heritage
- Articles 345 to 352: Offences against public peace (collective violence, threats)
- Article 395: Endangering the lives of others (including serious pollution)
- Sections 330-333: Sexual offences (Rape, Sexual Harassment, Sexual Exploitation)
- Article 222: Deliberate violence with aggravating circumstances (repetition, authority, closed place)

2. International Legal References Ratified by Madagascar
- Universal Declaration of Human Rights
- International Covenant on Civil and Political Rights (ICCPR)
- The International Covenant on Economic, Social and Cultural Rights (ICESCR)
- Convention on the elimination of all forms of discrimination against women (CEDAW)
- Convention on the Rights of the Child (CRC) and its first two Protocols optional
- Convention of Rights for People with Disabilities (CRPD)
- International Convention on the Protection of the Rights of All Migrant Workers CMW
- Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT)

- ILO fundamental conventions:
- Convention No.29 on Forced Labour
- Convention No. 87 on Freedom of Association
- Convention No. 98 on the right to organize and collective negotiation
- Convention No. 100 on equal pay
- Convention No. 105 on the abolition of forced labour
- Convention No. 111 on workplace discrimination
- Convention No. 138 on minimum age
- Convention No.169 on indigenous people
- Convention No. 182 on the worst forms of child labour
- Convention No.190 on Violence and Harassment at Work
- Rio Declaration on Environment and Development (Principle 10)
- Convention for the Safeguarding of the Intangible Cultural Heritage (UNESCO 2003)
- United Nations Guiding Principles on Business and Human Rights
- EITI Standard (Extractive Industries Transparency Initiative)
- Sustainable Development Goals (SDG) – UN 2030 Agenda
- OECD Principles for Responsible Business Conduct (2023)

APPENDIX

1. Photos

EPP in Ambahita (left), Ambahita Town Hall (right)





EPP in Ampisopiso, built by GOLDSAND





Ankalimboro village (left), Ambararata village (right)





Training of surveyors-Household survey using the KoboCollect tool









Employees at the Ambatomena site testifying to their working conditions





Employees in the Ankalimboro site testifying their working conditions







2. Downloadable documents



Complaint from local communities (employees, PAPs, local communities)



Attendance sheet

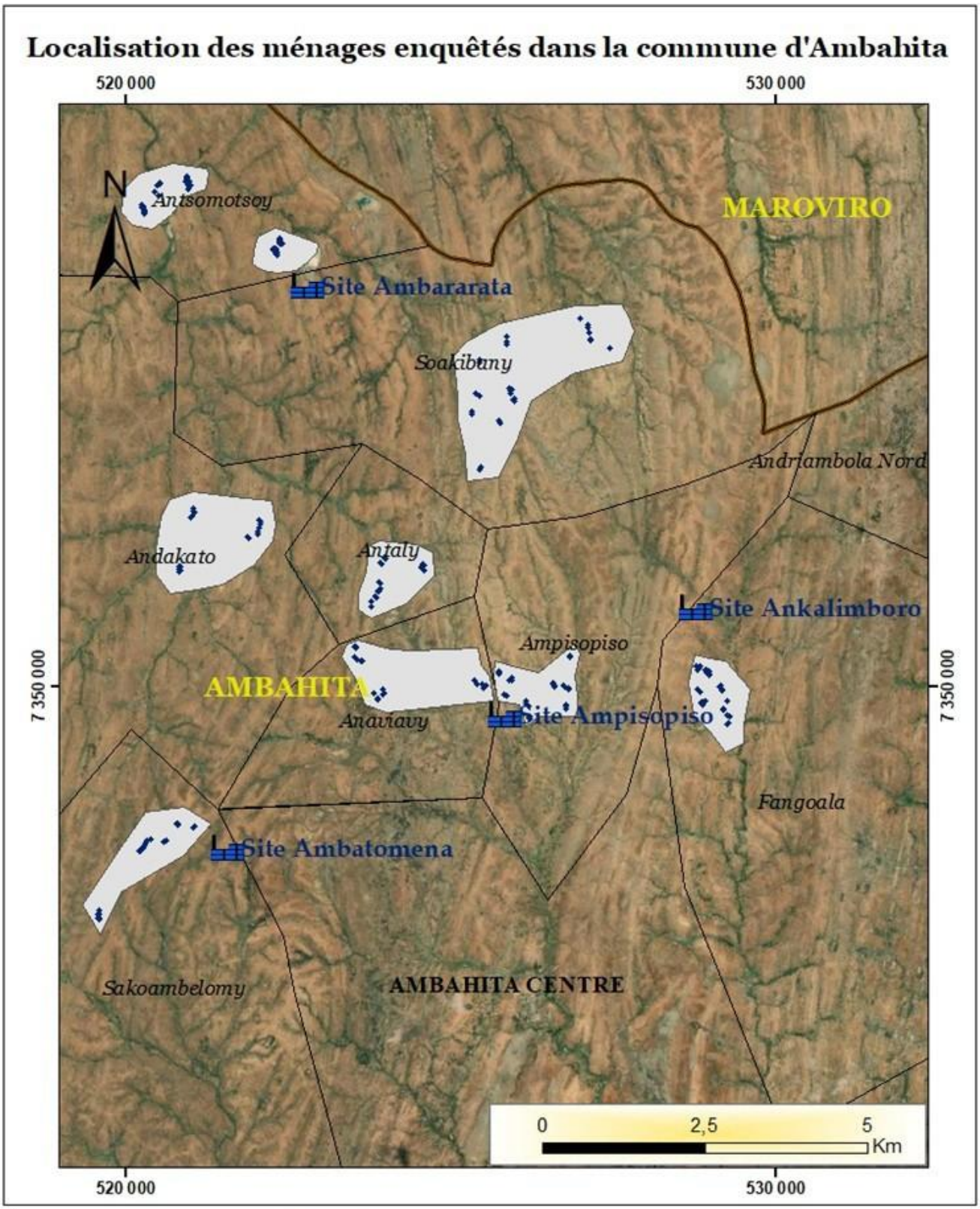


Survey questionnaires and interview forms



Gold Sand Recovery Plan 08 May

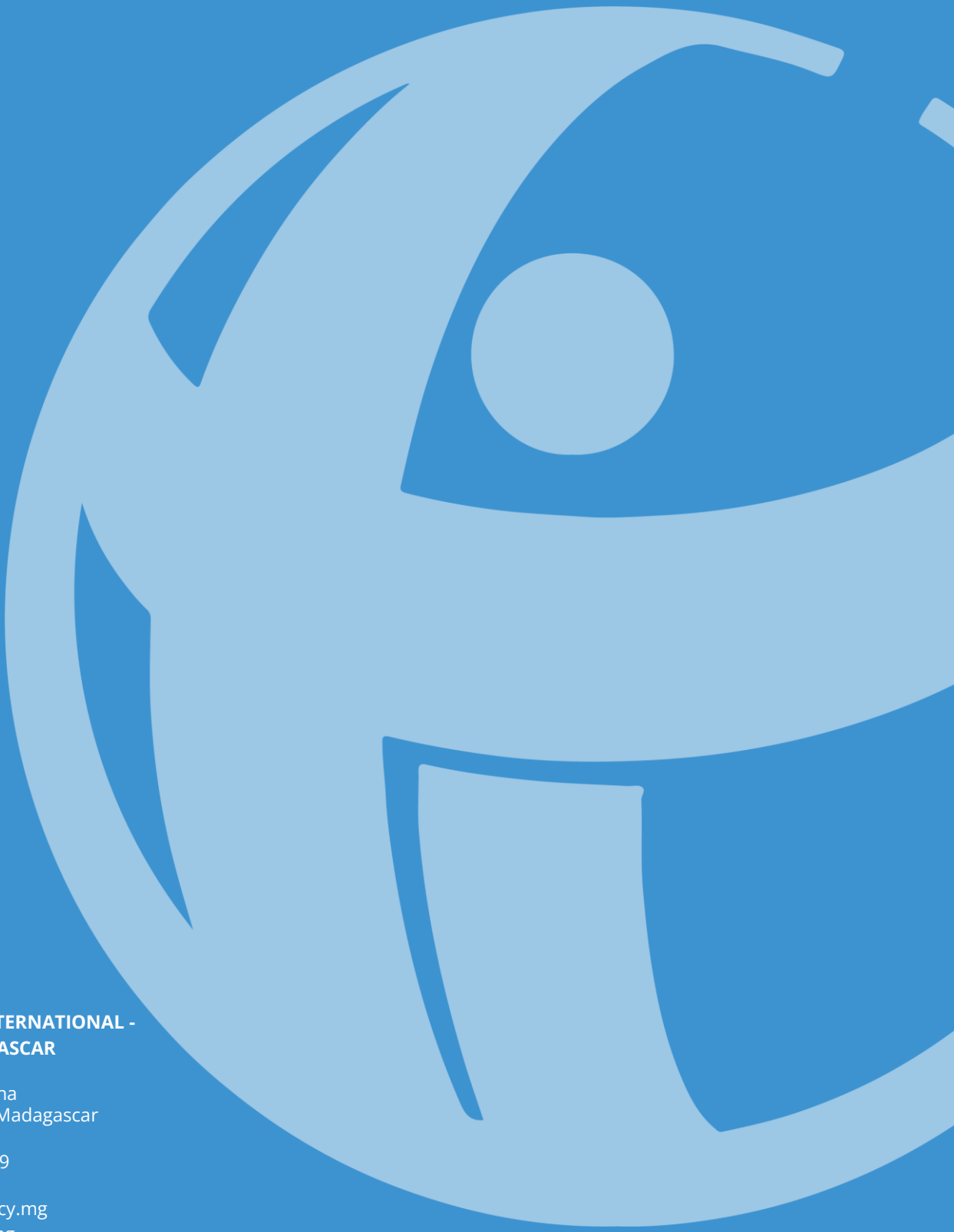
3. *Location of households surveyed in the Ambahita Commune*



Légendes

- Ambahita Centre
- Commune Ambahita
- Commune de Maroviro
- District de Bekily
- 214 ménages enquêtés
- Quatre sites (Gold Sand et Copax)

Système de projection de données :
WGS 1984 UTM Zone 38S
Avril 2025



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