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(RESEARCH ARTICLE)

ENVIRONMENTAL IMPACTS OF BORROW PITS AND CONSTRUCTION MATERIAL STORAGE AREAS DURING THE CONSTRUCTION OF THE MAMINI SECONDARY SCHOOL, BOUAKÉ, CÔTE D'IVOIRE

Lydie Marcelle THIEBLESSON [1,*], Assoumou Joseph YOMANFO [2] and Agré Séraphin DJOMO [1]

[1] Jean LOROUGNON GUEDE University in DALOA, Ivory Coast, Laboratory of Environmental Science and Technology.
[2] University of BONDOUKOU, Ivory Coast, National School of Architecture and Urban Planning (ENSAU).
* Corresponding Author

ORCID Details
Lydie Marcelle THIEBLESSON: https://orcid.org/0009-0001-4021-5319
Assoumou Joseph YOMANFO: https://orcid.org/0000-0002-5526-7904
Agré Séraphin DJOMO: https://orcid.org/0009-0006-0555-5955

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ABSTRACT

This study focuses on the environmental impact of material storage and extraction sites for the construction activities generated environmental impacts during and after project implementation affecting vegetation, soil, water resources, air quality, wildlife, and nearby communities. Dust and exhaust emissions degraded air quality and affected local population/nearby residents. Noise emissions and vibrations affect the local population, wildlife, and soil. Fuel spills associated with rubble removal contaminated surface water and degrade soil and vegetation. The felling of trees to make way for construction work destroys vegetation and wildlife. The borrow pits are not adequately rehabilitated after exploitation and are instead used/but are used… but are instead used as storage areas for remaining materials and waste equipment.

Keywords: Environmental impacts, Storage area, Borrow pit, Construction project.

1 INTRODUCTION

Climate change has become one of the most significant environmental challenges worldwide). It is reflected in the continuous increase in global surface temperatures. [1] In parallel, planetary boundaries are being progressively exceeded. Consequently, exceeding these limits threatens environmental sustainability [2]. Environmental impact, according to ISO 14001 (v. 2004), is defined as "any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services." These consequences can be direct or indirect, short-, medium-, or long-term [3]. Since the 1972 Stockholm Declaration on the Human Environment, environmental governance and awareness have expanded considerably [4]. However, environmental protection measures apply across all sectors of society, from simple to complex activities, thereby highlighting externalities linked to all human activities. Among activities that can bring negative externalities to the environment is recognized as a major source of environmental degradation [5]. In Côte d'Ivoire, the BTP sector is expanding rapidly. The country is

experiencing rapid urbanization, leading to increased demand for infrastructure. Massive investments in infrastructure construction such as roads, bridges, residential and commercial buildings, airports, ports, hospitals, and schools have contributed to the growth of this sector. The rapid and poorly controlled infrastructure development has led to dramatic degradation of living conditions for populations and serious damage to the peri-urban environment [6]. Today, it is no longer just about building infrastructure but also ensuring the protection of people and the environment.

2 MATERIALS

2.1 Materials used for environmental data collection

Environmental data collection materials are listed in Table 1.

Table 1: Data collection materials

Designation	Rôle
Camera	To capture field photographs
Notebook	To record field observations
PPE	To protect against potential accidents; includes: helmets, safety shoes, vests, protective gloves, goggles, etc.
Pens	For labeling collected samples
	to be placed in plastic bags and sample bags

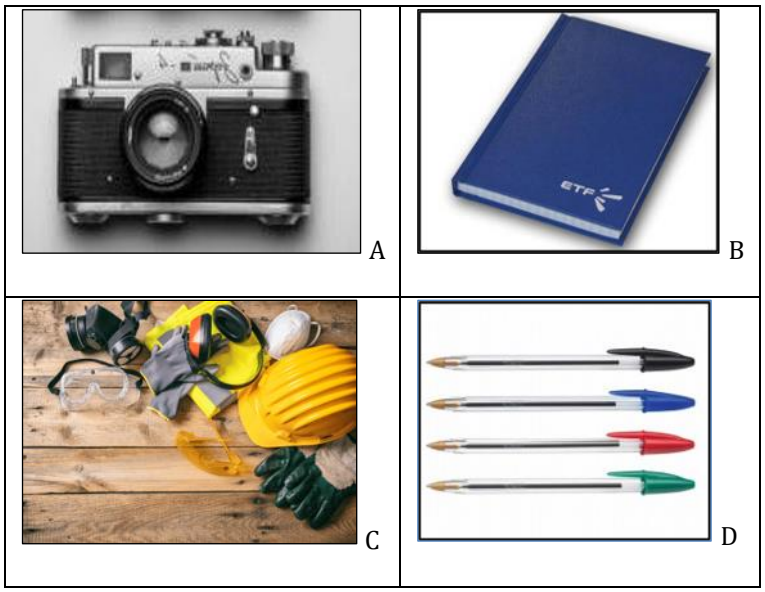

Figure 1: Data collection materials: (A) Camera; (B) Notebook; (C) PPE; (D) Pens

3 METHOD

3.1 Method for studying environmental impacts

The methodology for studying environmental impacts consists of (2) parts:

- Identify impacts of construction work on the environment;
- Evaluate impacts of construction work on the environment.

3.1.1 Identification of environmental impacts of work

Identification of environmental impacts focused on identifying significant environmental impacts. These are impacts that are both likely in the context of the Mamini CDP construction work and its study area. These impacts must be

significant in terms of their effects on the biophysical and human environments due to their intensity, extent, and duration. Construction-related impacts were identified by relating impact factors on the one hand, and environmental components likely to be affected on the other.

3.1.1.1 Evaluation of impacts of work on the environment

Environmental impacts were evaluated using already known criteria.

3.1.1.1.1 Criteria for evaluating impacts of work on the environment

The evaluation of environmental impacts of the Mamini CDP construction work is based on the use of five (5) criteria:

- Value of the affected component;
- Nature of the impact;
- Intensity of the disturbance;
- Extent of the impact;
- Duration of the impact;
- Importance of the impact.

3.1.1.1.2 Value of the component affected by the impact

Each component of the receiving environment has its own value, resulting from an intrinsic value and an extrinsic value that contribute to the overall value. Intrinsic value is established based on inherent characteristics of the environmental component, referring to its rarity, uniqueness, and sensitivity.

3.1.1.1.2.1 Nature of the impact
The nature of an impact can be positive, negative, or undetermined. A positive impact leads to an improvement of the affected environmental component due to the work.

3.1.1.1.2.2 Intensity of the disturbance
The intensity of the disturbance depends on the magnitude of the modifications observed on the environmental component affected by a work activity or resulting disturbances.

3.1.1.1.2.3 Extent of the impact
The extent of the impact refers to the radius of action, i.e., the spatial distribution of the repercussion. An impact can be point-specific, local, or regional in extent.

3.1.1.1.2.4 Duration of the impact
An impact can be qualified as temporary or permanent:

- A temporary impact can last a few days, weeks, or months, but must be associated with the notion of reversibility;
- A permanent impact has an irreversible character and is observed in a definitive or very long-term manner.

3.1.1.1.2.5 Importance of the impact
The importance of an impact, whether positive or negative, is determined based on the evaluation made using the previously stated criteria. Thus, the importance of the impact depends on the value assigned to the affected component, its intensity, its extent, and also its duration. It will be qualified as low, medium, or high.

4 RESULTS AND DISCUSSION

4.1 Results of environmental impact studies

4.1.1 Environmental impacts

Environmental impacts are presented in Table 2. Environmental components components that were affected by the work directly or indirectly, negatively or positively, to varying degrees during and/or after the construction of the Mamini CDP are: vegetation, soil, water, air, fauna, and the population.

Table 2: Matrix for identifying impacts of work on the environment

	Air	Water	Soil	Populations	Vegetation	Fauna
Dust emissions	X			X		
Gas emissions	X			X		X
Noise emissions				X		X
Vibrations			X	X		X
Fuel spills		X	X		X	
Tree felling					X	X
Soil destruction			X		X	

According to Table 2, dust and gas emissions affect air quality nearby communities. Noise emissions impact the population and fauna, while vibrations impact soil, the population, and fauna. Fuel spills during site clearance and rubble collection affect water, soil, and vegetation. Tree felling for the work impacts vegetation and fauna. Soil destruction causes damage to the soil itself and vegetation.

4.1.2 Damage caused by the work

The figures below present the results of the exploitation of borrow and storage areas for materials for the work. Figure 2 shows views before and after exploitation of borrow areas, while Figure 3 shows remains of used materials stored in the storage area.



Figure 2: Presentation of damage caused by exploitation of borrow areas (A) Borrow area before exploitation; (B and C) Borrow area after exploitation



Figure 3: Remains of stored materials

4.1.3 Evaluation of impacts of work on the environment

Table 3 presents the impact analysis matrix of the work on the environment.

Table 3: Analysis of impacts of work on the environment

	Value of component	Nature of impact	Intensity of disturbance	Extent of impact	Duration of impact	Importance of impact
Dust emissions	Medium	Negative	Low	Local	Temporary	Low
Gas emissions	Medium	Negative	High	Local	Temporary	Medium
Noise emissions	Medium	Negative	High	Local	Temporary	Medium
Vibrations	Medium	Negative	High	Local	Temporary	Medium
Fuel spills	High	Negative	Low	Point-specific	Permanent	Low
Tree felling	High	Negative	High	Point-specific	Permanent	Medium
Soil destruction	High	Negative	High	Point-specific	Permanent	Medium

The analysis of results presented in Table III shows that environmental impacts linked to the construction work of the Mamini CDP can be classified into two groups according to the importance of their impacts on the environment: environmental impacts of low importance and environmental impacts of medium importance.

5 DISCUSSION

The Mamini CDP construction work is a project aimed at facilitating education, even in remote areas. Locally available construction materials were extracted, as suggested by [7]; [8]. The natural environment provides local communities with resources necessary for daily life. However, different resource exploitation works can lead to disruptions in activities or the lives of populations. The borrow areas stripped for raw materials needed for building construction have left large excavated pits that can store water during rainy seasons. This can cause unpleasant odors and become breeding grounds for mosquitoes vectors of malaria. The lives and health of populations living nearby may therefore be affected by these environmental modifications. These results are consistent with those of [9] in the case of their work on the Djibo Bakary bridge in Niger. There, the lives of the population were disrupted by the modification of a wetland due to earthworks and deforestation. Air and water pollution, soil degradation, disappearance of small terrestrial fauna, and destruction of vegetation cover following tree felling during construction work observed here corroborate the study of [10]. In their work, Fressignac states that environmental degradation contributes to fragment ecological habitats, limits species movement, and can ultimately reduce biodiversity. The disappearance of animal and plant species due to poor resource management and abusive exploitation of these resources is also in line with the work of several authors such as [11]; [7]; [12], who found that in sub-Saharan regions, local populations perceive a current decline in plant species.

6 CONCLUSION

The findings indicate that the level of degradation in the context of the Mamini CDP (Local Middle-school Construction) work varies from low to moderately low. However, regardless of the level of degradation observed, site restoration work on exploited sites must be considered by any project to preserve existing biodiversity.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare no conflicts of interest regarding this manuscript.

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