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Harmful Impacts of Road Transport on the Environment in Commune VI of Bamako

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Abstract— *Road transport is a key driver of economic and social development; however, it also generates numerous negative environmental impacts, particularly in large African cities such as Bamako. This situation is characterized by increasing air and noise pollution, deterioration of air and water quality, and a decline in the living environment of local populations. Thus, this thesis examines the harmful impacts of road transport on the environment in Commune VI of Bamako. The primary objective of this work is to assess the adverse environmental impacts of road transport in commune VI of Bamako. The study employs a mixed-methodology approach, combining quantitative surveys of the population with qualitative interviews conducted with the hygiene and sanitation department of the town hall in commune VI. The results show that air pollution is perceived as the most worrying impact (90% of respondents), followed by noise pollution (70%), accidents (75%), and the degraded state of the roads (100%), which promotes congestion and the emission of pollutants. The primary pollutants identified are carbon dioxide (CO_2), fine particles, and nitrogen oxides, which degrade air quality and contribute to the onset of respiratory and cardiovascular diseases. This thesis highlights the urgency of promoting sustainable mobility management in the VI commune of Bamako. By contributing to a better understanding of the environmental issues associated with road transport, this work opens up new perspectives for more sustainable urban policies that respect public health.*

Keywords— *Road transport, Environment, Adverse impacts, Commune VI of Bamako.*

I. INTRODUCTION

Urban areas are also characterized by high population density and rapid economic development. This density places considerable pressure on air quality, mainly through pollutant emissions generated by road traffic. While in the past, air degradation was mainly attributed to industrial activities and domestic heating, today, transport is the dominant source of urban air pollution (Sturm et al., 1997).

Although vehicle emissions have been partially reduced through the use of cleaner fuels and technological innovation, urban areas continue to show increasing signs of environmental stress. These signs are manifested in the loss of green spaces, traffic congestion, noise pollution, and the ongoing deterioration of air quality (Fenget et al., 1998). Indeed, energy production for domestic and commercial uses, industrial activities, and transport are identified as the main sources of air pollution in major capital cities (EEA, 2000).

In Mali, the vehicle fleet, which is mostly composed of old vehicles, with more than 75% of them being over 15 years old (DNTTF, 2022), is poorly maintained. The fleet includes cars, utility vehicles, and two-wheelers, and is putting increasing pressure on often degraded road infrastructure. This situation causes chronic traffic jams, rapid deterioration of roads, high air pollution due to exhaust gas and fine particle emissions, as well as an increase in noise pollution.

Moreover, pollution is not limited to the air: oils and other residues spilled on roads are washed away by rainwater, contaminating surface and groundwater, particularly that of the Niger River, a vital source for local water supplies and fishing. Deforestation linked to the construction and expansion of road infrastructure also exacerbates the situation by destroying vegetation, which plays a crucial role in soil protection, groundwater recharge, and hydrological balance.

Commune VI of Bamako, the capital of Mali, is experiencing rapid urbanization and sustained population growth, resulting in a significant increase in mobility needs (Mairie de la commune VI, 2020).

This work aims to study the environmental impacts of road transport in commune VI of Bamako.

II. METHOD AND MATERIALS

The research methodology is employed in this chapter to better address our research questions, thereby confirming or refuting the hypotheses presented in the general introduction. The approach of our study is a mixed one; it involves both questioning and interviewing our subjects to address the research questions.

2.1 Presentation of the Study Area

Bamako, the capital of Mali, is a rapidly expanding city situated on the banks of the Niger River in the southwestern part of the country. According to the results of the fifth general population and housing census, Mali's population is expected to reach 22 million in 2022 (INSTAT, 2023). Divided into six communes, the city spans an area of 267 km² and has a population exceeding 3 million.

Commune VI is one of the six urban communes that make up the Malian capital, Bamako. Located on the left bank of the Niger River, in the southwest part of the city, it is the largest of the communes with an area of approximately 88.82 km². Its population is estimated at nearly 600,000 inhabitants, making it one of the most densely populated areas of Bamako. This commune is made up of about ten main districts, which are: Sogoniko, Magnambougou, Sokorodji, Missabougou, Faladié, Banankabougou, Sénou, Yirimadio, Djandjiguila, and Niamakoro (Mairie de la commune VI, 2020). It has a mixed

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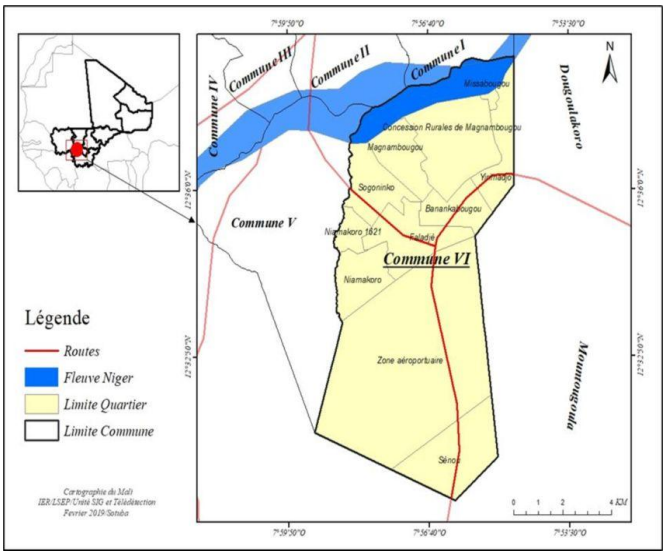
profile with residential districts, industrial and commercial zones, as well as a dense and varied road network.

The following map illustrates the location of commune VI in the Bamako metropolitan area.



Map 1: The occupation map of commune VI of Bamako.

Commune VI is experiencing rapid urbanization, a consequence of the rural exodus and population growth, which is leading to neighborhood expansion and an increase in road infrastructure. Its road network includes major axes connecting the city center to the outskirts, as well as numerous secondary roads, many of which are in poor condition. Due to its economic and demographic importance, Commune VI is a hub for road transport in Bamako, with heavy traffic consisting of private cars, taxis, sotramas, trucks, and motorcycles.

2.2 Documentary research

For any scientific work, consulting books and websites is essential for its success. For this review, we utilized research from the internet and school libraries, as well as dissertations and books related to our theme, to obtain scientific information. The information obtained contributed to the development of our survey questionnaire.

2.3 Collection, Processing, and Analysis of Data

Data collection employed two complementary approaches to understand the environmental impacts of road transport in commune VI of Bamako, utilizing both quantitative and qualitative methods.

2.3.1 Data collection

❖ Sampling

To carry out this work, we carried out a sampling. Purposive sampling was employed in the surveys for this thesis because respondents were selected based on the specified areas, such as the bus station and the volunteer criterion. The sample consists of 20 individuals with varying levels of knowledge.

❖ Data collection tools

Questionnaire: The research questionnaire collected the quantitative information needed for our study. It was administered face-to-face to a representative sample of 20 residents of Bamako's commune VI. The research questionnaire covers several key themes related to the environmental impacts of road transport. It is anonymous and is distributed to volunteers.

Interview guide: The interview guide was developed to collect qualitative data. Semi-structured interviews were conducted with managers of the hygiene and sanitation department of the town hall of commune VI. These interviews aimed to collect qualitative information on current initiatives, institutional constraints, as well as perceptions and strategies relating to the environmental management of road transport.

2.3.2 Data processing and analysis

The quantitative data were coded and then entered into statistical software (Excel), allowing the production of tables and graphs that illustrated the perceptions of residents according to their socio-economic profiles. This analysis enabled the identification of trends, including the prevalence of complaints related to noise or vehicle deterioration, as well as disparities between neighborhoods.

The interviews were fully recorded, transcribed, and then analyzed thematically. The coding of the responses followed the main axes of the interview guide, highlighting institutional and social issues, obstacles encountered, and the strategies envisioned by the town hall for the sustainable improvement of the situation.

The articulation of these two methodological approaches enabled a comprehensive and nuanced analysis of environmental issues related to road transport, thereby strengthening the validity of the results. This integrated approach provides a solid basis for formulating recommendations adapted to the local context.

III. RESULTS

3.1 Situation of road transport in commune VI of Bamako

The survey results highlight the direct impact of road infrastructure and traffic on the environment in Bamako's 6th district. 100% of respondents considered poor road conditions to be a major problem, highlighting the fact that the deterioration of the road network slows down traffic, increases fuel consumption, and intensifies pollutant emissions.

Furthermore, 90% of respondents identified traffic jams as a major problem, contributing to air pollution and noise. Finally, 10% of respondents mentioned the lack of public transport, a factor that encourages the increased use of private vehicles and increases environmental pressure.

These results indicate that poor road quality, congestion, and inadequate public transportation are interdependent factors that exacerbate air and noise pollution, as well as infrastructure wear. They confirm the urgent need for road maintenance, traffic regulation, and public transport development strategies to mitigate the environmental impact of road transport in commune VI.

The results in Figure 2 show that almost two-thirds of residents (45% poor, 20% very poor) perceive the roads in commune VI as seriously deteriorated, while only 5% consider them good and 30% average.

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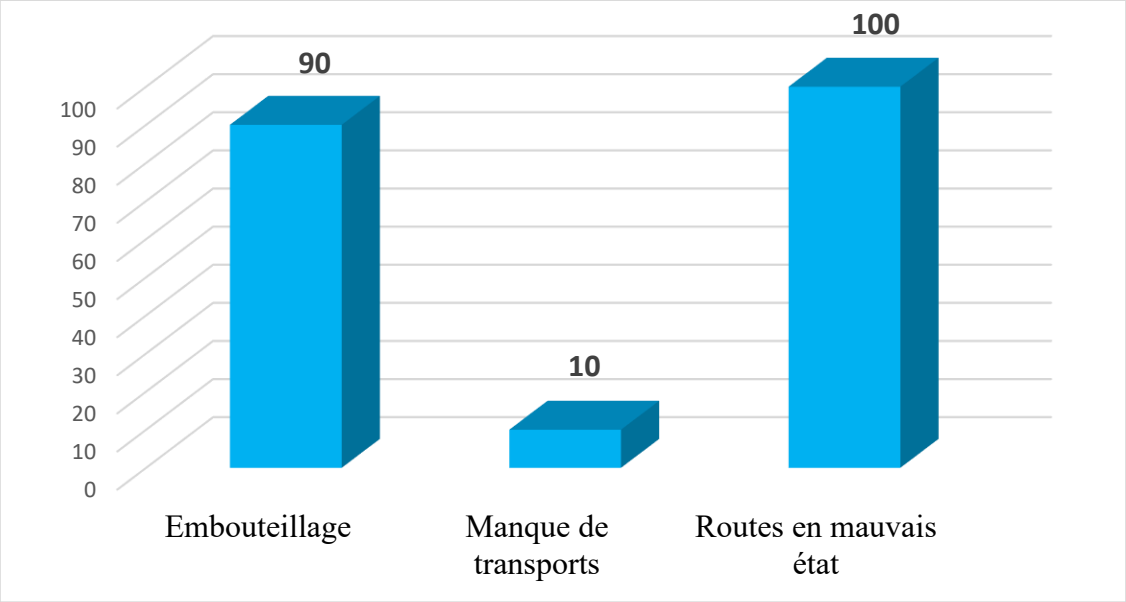

Figure 1: Characteristics of road transport in Commune VI

Source: personal surveys, December 2024

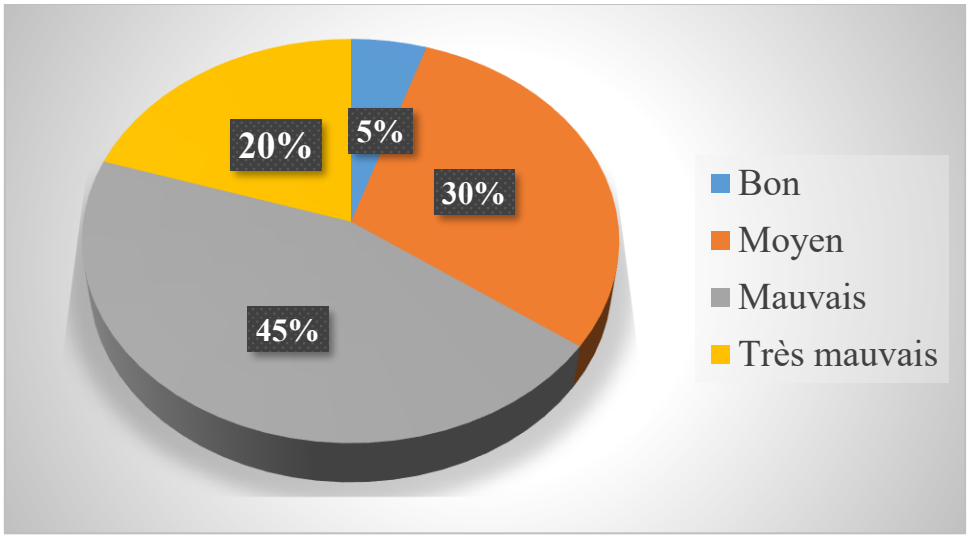

Figure 2: Opinions of respondents on the state of the roads in commune VI
Source: Personal surveys, December 2024.

3.2 Problems related to road transport in municipality VI

The results of the graph indicate that road transport in Commune VI is perceived as a significant contributor to environmental and social nuisances. The majority of respondents (90%) consider air pollution to be the main problem, reflecting the direct impact of vehicle emissions on public health and the environment. Noise pollution, reported by 70% of respondents, reflects an urban environment disrupted by traffic noise, while traffic congestion (50%) exacerbates these nuisances by increasing fuel consumption and pollutant emissions. Road accidents, mentioned by 75% of respondents, also lead to indirect environmental effects such as fuel leaks and infrastructure deterioration.

These data highlight that road transport in commune VI simultaneously contributes to the deterioration of air quality, increased noise and congestion, forming a vicious circle that affects the quality of life and increases pressure on the environment.

3.3 Types of pollution caused by road transport in municipality VI

The results of this graph reveal that road transport in commune VI has a multiple environmental impact, with a predominance on air quality (85% of respondents), mainly due to exhaust gases, fine particles, and unburned hydrocarbons. Soil pollution and noise pollution, reported by 60% of respondents, reflect respectively the effects of oil and fuel leaks, the abandonment of mechanical parts, and the noise generated by traffic and old engines. Finally, water pollution, although less cited (30%), remains significant due to polluted runoff into waterways (Figure 4).

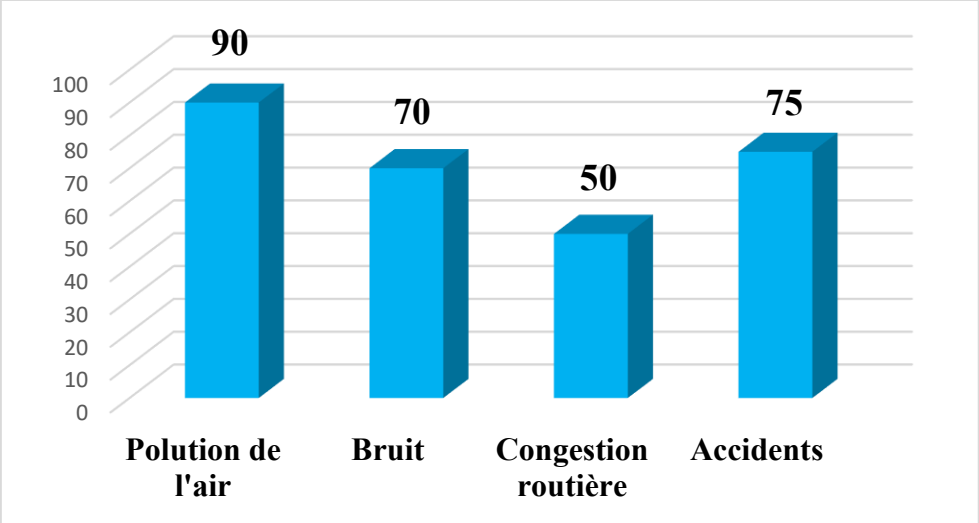

Figure 3: Problems related to road transport in commune VI
Source: personal surveys, December 2024.

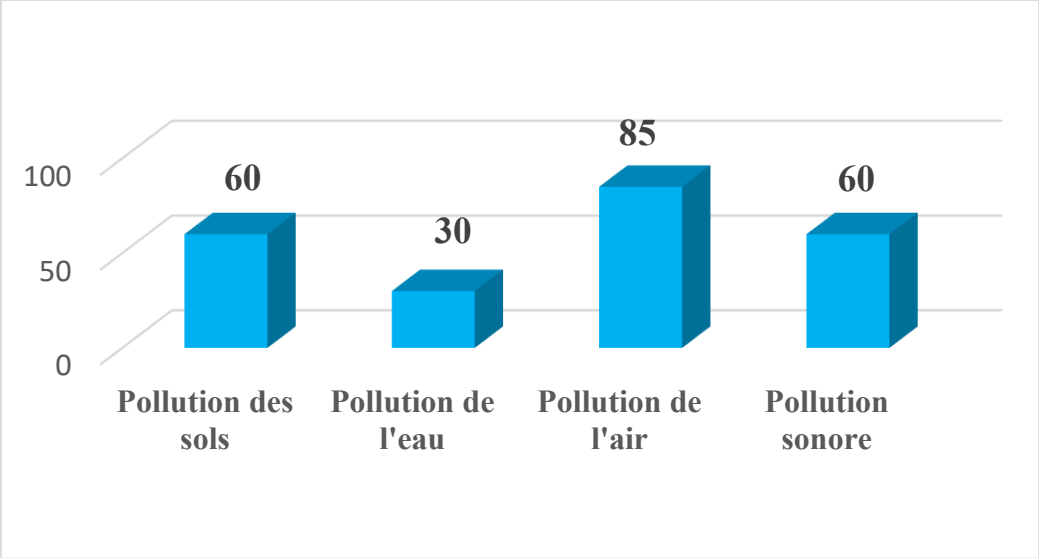

Figure 4: Types of pollution associated with road transport

Source: Personal surveys, December 2024

According to MS, the main pollutants emitted by road transport are exhaust gases (CO, NOx, SO2, and fine particles), greenhouse gas emissions (CO_2, CH_4, and N_2O), as well as noise emissions. The age of vehicles contributes to higher pollution.

These data confirm the multidimensional nature of the nuisances generated by road transport and the need for coordinated actions to limit their effects.

3.4 Level of impact of road transport on the environment in municipality VI

Analysis of respondents' perceptions reveals that 60% of them consider road transport to have a high or very high impact on the environment, thereby highlighting the population's recognition of the pressure exerted on environmental components, including air quality, noise, and soil integrity. This perception can be attributed to traffic intensity, the obsolescence of the vehicle fleet, recurring congestion, and the inadequacy of nuisance reduction measures.

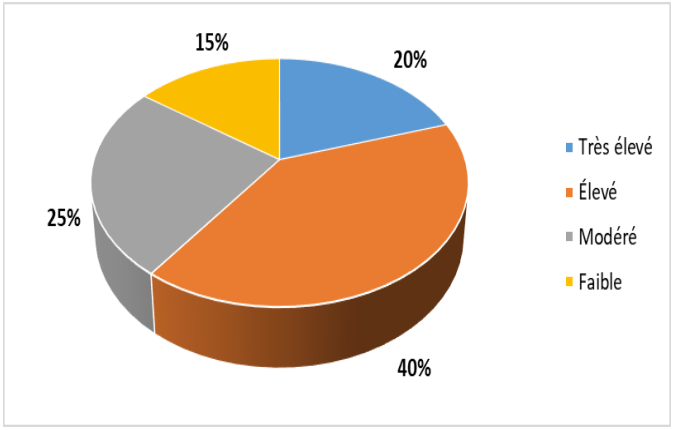

Figure 5: Level of impact of road transport on the environment in municipality VI
Source: personal surveys, December 2024

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Conversely, 40% of respondents considered the impact to be moderate or low, which may reflect either limited exposure to nuisances or a less sensitive perception of their effects. These results confirm that road transport is a major factor in environmental degradation in Bamako's commune VI, while highlighting the variability of perceptions depending on individual sensitivity and proximity to high-traffic areas (Figure 5).

IV. Discussion

The results of our survey reveal that 90% of respondents perceive air pollution as the main environmental problem caused by road transport in Bamako's commune VI. This perception is consistent with findings from other urban contexts in West Africa. For example, a study conducted in Ouagadougou by Zongo et al. (2021) also highlights that air pollution is the primary environmental concern for residents exposed to heavy road traffic, particularly in poorly urbanized peripheral neighborhoods.

Noise pollution, mentioned by 70% of our respondents, is also a notable environmental problem. This result confirms the findings of Faye (2020) in a study on Dakar, who notes that noise pollution linked to traffic jams, poor vehicle condition, and excessive horn use significantly affects the quality of urban life. It should also be noted that these nuisances are not only perceived as annoying but are also associated with sleep disorders and chronic stress, as demonstrated by Koné (2019) in the district of Abidjan.

Furthermore, 75% of respondents in our survey cite traffic accidents as a major challenge. This high rate illustrates a reality shared in several major cities in the sub-region. In this regard, Diallo (2022) shows, in his study on traffic in Conakry, that road insecurity is perceived as one of the greatest risks to urban transport, exacerbated by driver indiscipline, non-compliance with traffic laws, and the poor condition of road infrastructure.

Finally, road congestion, mentioned by 50% of respondents, is an increasingly worrying phenomenon in Bamako, as in other West African capitals. In Cotonou, for example, Toko's (2020) study highlights the economic losses and environmental inconveniences caused by recurring traffic jams, including increased emissions of pollutants due to frequent stops and excessive fuel consumption.

In Bamako, these effects are amplified by unplanned urban growth and high levels of individual motorization.

V. Conclusion

This study aims to analyze the harmful impact of road transport on the environment in the VI commune of Bamako. To address this issue, a mixed-methodology approach was adopted, combining quantitative and qualitative methods.

The results show that 90% of respondents identify air pollution as the main environmental problem, directly linked to emissions of fine particles, carbon monoxide (CO), and nitrogen oxides (NO_x); 70% of those surveyed denounce noise pollution as a daily nuisance. In addition, 75% of respondents perceive accidents as a major risk, reinforced by the degraded state of the road network, considered poor by 100% of respondents.

This study makes significant contributions at various levels, encompassing practical, theoretical, and methodological dimensions.

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