Socio-economic and environmental impacts: Production of burnt bricks of Sarh in southern chad

ADAMOU YERIMA

Assistant Master (CAMES)
University of Moundou (Chad)
adamou_yerima@yahoo.fr

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Abstract

The production and marketing of bricks meets housing needs. The several quarries of building materials are operational in the city of Sarh among which we note the production of baked bricks on the banks of the Barh-Koh River. The objective of this work is to analyze the socio-economic and environmental impacts of the production of fired bricks in Sarh. The method used consists of conducting documentary research followed by a survey of the main brick producers. It not only allows for family support but also enables certain achievements such as the purchase of land and equipment for those more invested, and also the development of a business.

Key words: production, socio-economic, brick, environment, Sarh

Impacts socio-economiques et environnementaux : Production de briques cuites à Sarh au sud du Tchad

Résumé

La production et la commercialisation de briques répond aux besoins de logement. Plusieurs carrières des matériaux de construction s'opérationnalisent dans la ville de Sarh parmi lesquelles nous notons la production de briques cuites aux abords du fleuve Barh-Koh. L'objectif de ce travail est d'analyser les incidences socio-économiques et environnementales de la production de briques cuites à Sarh. La méthode utilisée à consister à faire des recherches documentaires, suivi d'une enquête auprès des principaux acteurs producteurs de briques. Elle permet non seulement la prise en charge familiale mais elle permet aussi de faire certaines réalisations comme l'achat de terrain et des engins pour les plus investis, et aussi développer un fonds de commerce.

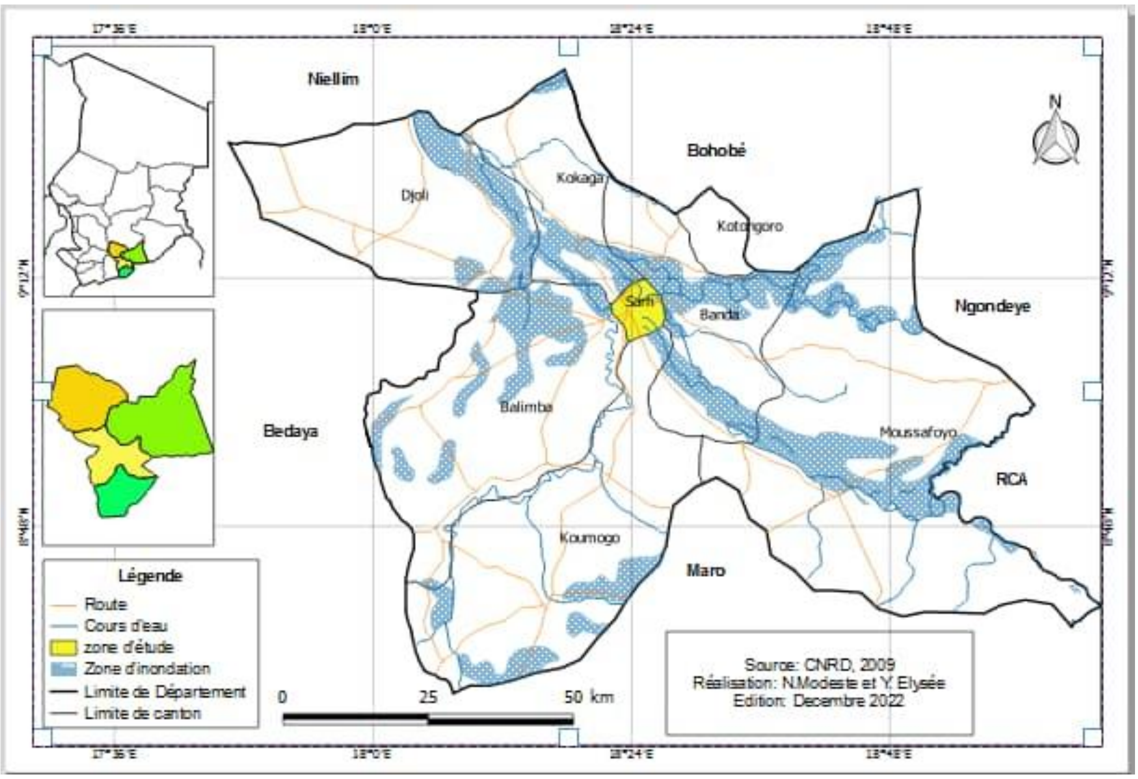
Mots-clés : production, socio-économique, brique, environnement, Sarh

Introduction

The relationship between humans and nature dates back to the creation of the world. Since the beginning of time, the relationship between humans and nature has been interdependent. Living for humanity means developing a system of adaptation to the laws imposed by nature (C. Seignobos 1981, p 279). This system of adaptation or survival includes the transformation of the resources provided by nature. Humans have evolved from being simple predators at the beginning of their history to the formidable predators of today (L. Courard 2017, p 11). This predation, supported by the transformation of resources, provides better insight into the impacts of human activities on the environment that are observable in the era of industrialization.

The case of baked bricks in the city of Sarh (Figure 1) is an illustration. They fuel the housing industry. The objective of this work is to analyze the socioeconomic and environmental impacts of baked brick production in Sarh. Thus, for the socio-economic and environmental impacts of the production of fired bricks, the following question will be of great use to us: how can the production of bricks have impacts at the socio-economic and environmental level? The answers to this question will allow us to understand the phenomenon.

Figure 1: The town of Sarh in the province of Moyen-Chari



Source: CNRD, 2009. Conception: Adamou Y et realization: Nmodeste Elysée

Figure 1 shows the geographical location of our study area, which is the city of Sarh, the capital of the Barh-Koh department. As we can see, Sarh is located in the middle of flood zones. These areas could be essential for agriculture.

Sarh is the capital of the province of Moyen-Chari and the Barh-Koh department. The city of Sarh is located between 9°13' North latitude and 18°23' East longitude. It covers an area of 3,000 hectares according to the 2018 Communal Development Plan (PCD). Its average altitude is 370 m. Its population is estimated at 180,000 inhabitants (PCD). Located on the interfluve of two rivers, the Chari and Bar-Koh, where the brick quarries are located.

1. Methodology

Regarding sampling, we interviewed one hundred (100) brick producers, fifty (50) buyers and ten (10) officials of the Ministry of the Environment (Delegation). For our methodology, we used observation through field visits, followed by documentary research in various libraries across the country, and finally, field surveys. These different surveys allowed us to interview the main stakeholders in brick production. We were sometimes required to build and assemble the kilns with the people involved in order to obtain the information we needed.

2. Results

2.1. Environmental impacts of fired brick production in the city of Sarh

Baked brick constructions are gaining momentum in the town of Sarh, this painting illustrates the impact of the use of this material.

Table 1. Situation of buildings according to the types of bricks in the city districts

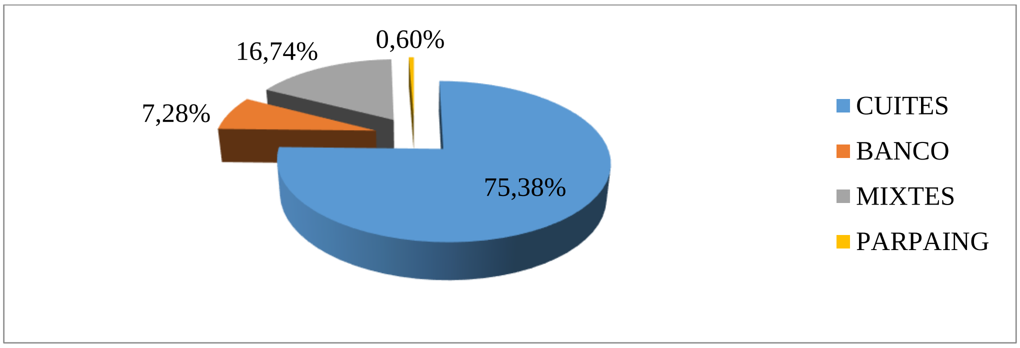
Neighborhood	Cooked	Banco	Mixed	Concrete blocks	Total
Tatala 1	591	88	189	10	878
Maingara residentiel	424	27	68	0	519
Badi	381	20	53	1	455
Total	1396	135	310	11	1852

Source: Field survey, february 2024

These statistics are the result of a building census in Tatala 1 and Badi in the 5th arrondissement and Maingara Residential in the 6th arrondissement. The objective is to determine the proportion of houses built with different types of bricks.

The three neighborhoods were chosen based on the city's sprawl: Tatala 1 is considered an intermediate neighborhood between the central neighborhoods and the newer outlying neighborhoods (Badi and Maingara Residential). Of the 878 plots recorded in the Tatala 1 neighborhoods, 591 are made of fired bricks, 88 of mud bricks, 189 of mixed bricks (fired and mud bricks), and 10 of concrete blocks. If we look at the outlying neighborhoods of Maingara Residential and Badi, the number of houses built with mud bricks tends to decrease, and concrete block houses are almost rare (Figure 2).

Figure 2: Proportion of houses built according to the types of bricks in three districts of the city



Source: Field survey, 2024

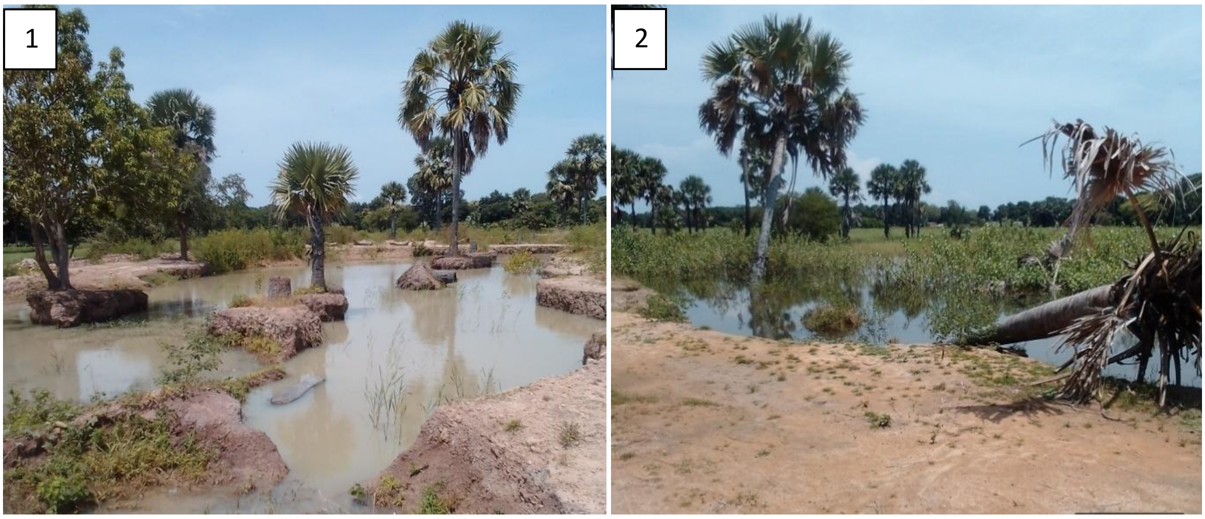
This figure shows the proportion of houses built according to the type of brick in the three sample neighborhoods.

Based on this data, 75.38% of houses in the city of Sarh are built of fired bricks. If we can establish parity between houses including fired and mud bricks, they will be 84%, compared to 15.40% of mud brick houses, which were once dominant. Cinder block brick houses are very rare. This rarity of cinder block brick houses reflects the limited access to sustainable building materials such as cement in Chad and in the city of Sarh in particular, where price is a factor of exclusion. A cinder block brick in Sarh costs 350 francs, which makes it seven (7) times more expensive than a fired brick or fourteen (14) times more expensive than an adobe brick. This preference for baked bricks by the population of the city of Sarh reflects the role of this material in improving semi-hard buildings in the city. However, the excessive use of baked bricks reflects the degree of impact their implementation has on the environment in the city.

2.1.1. Impacts on vegetation cover

The production of fired bricks is one of the human activities practiced in Chad in general and in the city of Sarh in particular. These activities seriously damage the environment. This sector is considered a consumer of wood energy. Apart from this consumption, it destroys the vegetation cover (Plate 1) in its implementation phases, thus a gradual deforestation.

Plate N°1: The consequences of brick production on the plant cover during the rainy season in Sarh



Source: Adamou photos 10/10/2024 (X: 9.12452°, Y: 18.374012°)

This plate highlights the damage observed in brick quarries during the rainy season. In image (1), we see vegetation in the background, and in the foreground of the image, some specific plant species composed of palmyra palm (Borassus aethiopum) and cashew (Anacardium occidentale) are found in the middle of the brick quarry containing water that helps to level the palmyra palms, as illustrated in image (2).

The use of dome nuts in brick firing poses a threat of extinction for the species in the long term. As Robert Madjigoto points out, to fire 40,000 bricks, 40 bags of dome palm nuts are required. This means that at least 4,000 bags of nuts will be needed to fire 100,000 bricks. If one dome palm tree provides an average of 100 domes, 40 palm trees will be needed to achieve the desired goal. Excessive use will indeed harm the species' sustainability.

2.1.2. Increased air pollution

Bricks are fired with different energy sources including firewood, charcoal and dome palm nuts; all these energy sources emit carbon during combustion. This emission of carbon dioxide during the firing phase contributes to air pollution around the production areas. It is true that in Sarh bricks are not fired with cow dung as in some cities in Chad such as N'Djamena, Abéché and many other urban centers. These energies sources based on animal dung are used in firing bricks, having a destructive impact on air quality due to the presence of methane.

Lately, cow dung is used to bake bricks. It should be noted that livestock farming produces methane, the main greenhouse gas through animal feces; air pollution from smoke and heat released during the baking of bricks (Photo 1) constitutes a danger for the natural environment and also for living beings living in this environment "the combustion of waste in the baking of bricks is a source of greenhouse gases and is harmful to the health of manufacturers. Through this burning of waste, the gas produced pollutes the air and causes acute respiratory infections.

Photo N°1: The contribution of brick firing to air pollution

Source: Adamou 04/25/2024 (X: 9.180565°, Y: 18.366224°)

This photo highlights the contribution of the firing phase to air pollution. In the foreground of the photo, vegetation is visible, consisting largely of grasses. In the background, we see a column of brick kilns and a belt of vegetation made up of trees and shrubs. We can obviously see a wave of smoke coming out of an active kiln. This smoke pollutes the ambient air in the production areas, thus causing discontent among the population of the said area.

2.1.3. Pressure on bank erosion

The raw material that determines the implementation of fired bricks in the city remains clay. Its extraction modifies the relief, translated by gigantic quarries extending hundreds of meters in the various production sites. These quarries have room for maneuver in the constantly decreasing level of the Barh-Koh River. This extraction has room for maneuver in the erosion of the Barh-Koh River, the main bastion of fired brick production. This erosion subsequently leads to the deposit in the river bottom and contributes to its embankment. As emphasized by the Water and Forestry Service.

2.2. Pressure on road degradation

The availability of fired bricks in the city certainly creates jobs among which transport occupies an important place. Transport is operated thanks to the availability of roads which serve the places of production to the places of use. According to the officials of the 5th Arrondissement, out of ten (10) roads in certain districts of the said Arrondissement used in the transport of bricks, nine (9) are in poor condition, sometimes impassable during the rainy seasons and making it difficult for users to move around. This deterioration of roads is due to the overweight of the means of transport, generally four-wheeled vehicles. These vehicles carry on average 3,000 bricks or three (3) tons per trip, which gives a considerable weight, but the type of soil in the city is dominated by sandy soil, almost all of these roads are not well maintained.

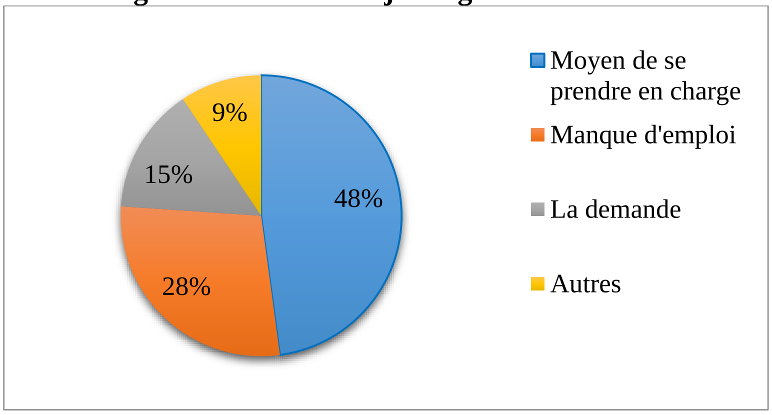
2. Socio-economic impacts of baked brick production in the city of Sarh

Beyond its environmental impact, the baked brick activities in the town of Sarh contribute to improving the socio-economic conditions of the main stakeholders.

2.2.1. An activity that mobilizes young people

The fired brick industry is a direct or indirect consumer of labor, consisting largely of young people, especially students, unemployed graduates and non-graduates who try to escape the prisms of poverty by joining the production chain or activities related to the availability of this material: transport, construction. After the large local industries that absorb a good number of young people, the brick industry also plays an important role in job creation in the city of Sarh. Young people find refuge in this activity in order to meet their vital needs (Figure 3).

Figure 3: Reasons for joining brick activities



Source: Field survey, May 2024

Figure 3 highlights several reasons for joining the activities of fired brick production in the city of Sarh. As this graph illustrates, 48% of manufacturers consider that this activity is considered a source of solutions allowing them to support themselves. 28% of producers believe that it is the lack of employment in the city that pushes them to do this activity compared to 15% of brickmakers who explain their joining this activity by demand. This sector affects different age groups (Table 2).

Table 2: Age class in the production of fired bricks in Sarh

Age group	Workforce	Percentage
15-24 years	24	24
25-34 years	35	35
35-44 years	32	32
45-54 years	9	9
Total	100	100

Source: Field survey, May 2024

Different age groups are interested in the production of baked bricks in Sarh. 35% of producers are in the 25-34 age group, considered the dominant age group, followed by those aged 35-44, or 32%. The last group is that of producers aged 45-54, representing 9% of producers.

2.2.2. Significant income

Burnt brick production is a function of income. This income determines the size or quantity of bricks produced. Income is considered as an index of categorization of producers. The 50,000-150,000-franc bracket is considered the lowest income and allows for the production of an average of 3,000 to 7,000 bricks. The second bracket is between 200,000-400,000 francs; it allows for the production of an average of 15,000 to 20,000 bricks and the last bracket is between 500,000-1,000,000 francs considered as the high production class. Their production varies between 25,000 to 60,000 bricks or more (Table 3).

Table 3. Quantity of bricks produced by producers

Quantity of bricks	Workforce	Percentage
1000-14000	12	16.44
15000-29000	31	42.47
30000-44000	13	17.81
45000-59000	8	10.96
60000 et plus	9	12.32
Total	73	100

Source: Field survey, May 2024

The data in Table 3 shows the different quantities produced by brick manufacturers. It should be noted that most manufacturers produce an average of 15,000 to 29,000 bricks; this category determines the financial capacity of producers. The 45,000 to 60,000 category is that of producers with substantial financial means.

2.3.1. Production and transportation costs of fired bricks

All production has a cost, particularly for baked bricks from the town of Sarh. This cost is assessed from the very first stages of production. This is divided into two phases: the production phase for unbaked bricks and those including baking. Regarding the first phase, the cost of producing 1,000 unbaked bricks is around 12,000 francs, including restoration. On some (very rare) sites, it can cost less than 10,000 francs.

Regarding baked bricks, the baking phase begins with:

- kiln assembly;
- purchasing energy sources;
- restoration.

The baking of 10,000 bricks requires an average budget of 250,000 francs. The transportation of this material is handled by various means, the cost of which remains the same everywhere. The cost of transporting 1,000 bricks remains the same for all vehicles (Table 4), i.e.: 10,000 francs per 1,000 bricks. However, this rate can vary depending on the distance, up to 12,500 francs per 1,000 bricks and to 15,000 francs during the rainy season.

Table 4. Transport cost for 1000 fired bricks in Sarh

Costs in francs	Workforce	Percentage
5000-9000	1	1.37
10000-14000	72	98.63
Total	73	100

Source: Field survey, May 2024

In Sarh, transporting bricks comes at a cost. This table explains the transport costs for 1,000 fired bricks. It shows that the average cost for transporting 1,000 bricks ranges from 10,000 to 14,000 francs.

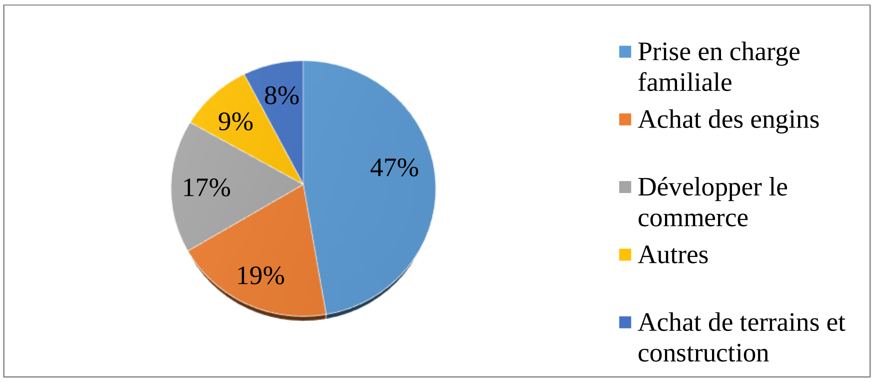
2.3.2. Workers' pay scales

The fired brick industry operates on the basis of a pay scale. It should be noted that the daily production of raw bricks, i.e. unfired, is in the range of 500 to 600 bricks per day. A production line made up of an average of six (6) people. In 1992, the grid reserved for production was established as follows: the machine manager (molding press) received 800 francs; his deputy also, the rest of the members were satisfied with 400 francs each. This treatment has been improved recently, the entire team shares the production of one thousand one hundred (1,100) bricks, a sum of eight thousand (8,000) francs excluding the food ration of one thousand (1,000) francs. According to the testimony collected from the workers, this activity is very exhausting but the remuneration does not allow them to make ends meet.

2.3.3. Promoters' profit margins

Most brick producers do not have accounting records. Therefore, it is difficult to determine profit margins. This negligence probably stems from the fact that some manufacturers gradually use the proceeds from brick sales for other purposes. And not all bricks are paid for in cash; a large portion is taken as debt and sometimes not repaid. This results in accumulated debt, hence the deficit. However, some brick producers earn an income ranging from 350,000 to 1 million francs, sometimes more, to carry out the brick firing project and generate the income necessary to support the family (Figure 4).

Figure 4: Positive contribution of fired brick production



Source: Field survey, May 2024

The fired brick industry impacts the lives of producers. For most, this activity allows them to support themselves. Not only does it allow them to support their families, but it also allows them to undertake certain projects, such as purchasing land and machinery for the most invested, and also to develop a business.

2.4.1. An activity subject to taxes

Like any other income-generating activity, the brick industry is subject to a tax that benefits various government departments in the city of Sarh. This is the mining and geology department, which levies an average tax of 25,000 francs annually per production unit (Field Survey, 2024). The forestry department benefits from an average tax of 20,000 francs (Field Survey, 2024). Traditional chiefs are not spared; in the Balimba canton, each production unit pays an annual tax of 45,000 francs. The town hall does not benefit enough from this activity in terms of tax. This gives rise to disagreement between the mining and geology departments.

Table N°5: Beneficiaries of production taxes

Tax beneficiaries	Workforce	Percentage
Mining and Geology Department	54	43.2
District leaders	28	22.4
City hall	19	15.2
Forest Service	18	14.4
Head of canton	6	4.8
Total	125	100

Source: Field survey, May 2024

This table presents the main beneficiaries of the brick production tax. It appears that the mining service is in first place, which is explained by the strictness of the agents towards the manufacturers. The category of district chiefs also consists of certain customary chiefs who collect the tax on the plots exploited in their district. The position of the Town Hall in this table is explained by the laxity of the agents as well as the competition from the mining service. It should be noted that the quarries located in the Balimba district pay tax to the canton chief. It should also be noted that the producers pay the tax to the Town Hall (Table 6).

Table N°6: Tax paid to Sarh Town Hall

Value in francs	Workforce	Percentage
5000-14000	6	31.58
15000-24000	13	68.42
Total	19	100

Source: Field survey, May 2024

Table 6 highlights the tax scale that baked brick manufacturers in Sarh pay to the municipality of the said city. This table shows that the average tax paid by most producers is between 15,000 and 24,000 francs. However, there are financial arrangements between the municipal officials responsible for tax collection for the sector and the manufacturers.

The mining department, like some other relevant departments involved in the brick industry, levies a tax on this activity. This tax is not standard, as can be seen in Table 7.

Table N°7. Tax paid to the mining service

Value in francs	Workforce	Percentage
15000--24000	27	50
25000--34000	25	46.3
35000--44000	2	3.7
Total	54	100

Source: Field survey, May 2024

The tax paid to the mining department ranges from 15,000 to 34,000 CFA francs. Sometimes the two parties reach an agreement, as some manufacturers report (Field Survey). Producers pay the tax to neighborhood chiefs and traditional leaders (Table 8).

Table N°8. Tax paid to district chiefs and customary chiefs

Value in francs	Workforce	Percentage
5000—9000	7	25
10000-14000	7	25
15000 et plus	14	50
Total	28	100

Source: Field survey, May 2024

Like some services, some traditional figures and local authorities (neighborhood chiefs) also levy taxes on brick production activities within their jurisdiction. This tax, which exceeds 15,000 francs, is the result of a simple arrangement. In light of all these impacts, it is important to emphasize the importance of using fired bricks, which has significantly reduced the number of house collapses, often causing material damage and loss of life.

3. Discussion

The presentation focused on the socio-economic and environmental impacts of fired brick production in the city of Sarh in southern Chad. It also demonstrated the significant socio-economic and environmental impacts in Sarh. These findings confirm the work of (C. Seignobos 1981, p. 265), (J-P Guengant 2013, p. 122), (A. P. TALLA 2010, p. 55) and (M. Lansiart 2008, p. 32). These authors studied fired bricks from the Chari region, the evolution of the environmental impacts of quarries, and the history of brick and its uses. The economic impacts were also discussed by (L. Courard 2017, p 22), (A. Traoré, 2003; p. 89), and (E. Sipila Kahozi 2014, p. 110).

The impact of brick production is visible at the social, economic, and environmental levels in the city of Sarh. The production of fired bricks has been an important factor in the fight against unemployment in Sarh.

Regarding environmental impacts, these activities seriously damage the environment. This sector is considered a consumer of fuelwood. Beyond this consumption, it destroys vegetation cover.

The use of dome nuts in brick firing poses a long-term threat to the species. Beyond environmental impacts, fired bricks consume labor directly and indirectly, largely composed of young people, especially students, unemployed graduates, and those without qualifications who are trying to escape the cycle of poverty.

Conclusion

This study focuses on an analysis of fired brick production and its socioeconomic and environmental influences in Sarh, in the Moyen-Chari province. As part of this work, several documents were reviewed to demonstrate their relevance. We applied a field method based on observations and data collection from our research unit, which is the group of site managers or their representatives. We also interviewed various key informants. The analysis focuses more on production procedures, access methods, and shared socioeconomic and environmental impacts, as well as the various strategies for sustainable production and access to fired bricks in the city of Sarh. Firing is 100% dependent on firewood and dome nuts, reflecting the contribution of fired brick production to environmental degradation.

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Adamou YERIMA est Maître Assistant CAMES en Géographie économique. Il est membre de l'équipe de recherche de Laboratoire de Géographie de l'Université de Moundou (TCHAD). Il est Vice-Président Chargé de la Recherche et de la Coopération de l'Université de Moundou. Il concentre ses recherches et publications sur les économies transfrontalières en Afrique et sur le développement des Territoires.

Adamou YERIMA
Université de Moundou (UDM)
BP 206 Moundou adamou
yerimaa@yahoo.fr
