From the Nile silt to the shale clay, from the valley to the desert : the material transformations of the red brick and its supply chain in Egypt and Sudan

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FROM THE SILT TO THE SHALE CLAY, FROM THE VALLEY TO THE DESERT: THE MATERIAL TRANSFORMATIONS OF THE RED BRICK AND ITS SUPPLY CHAIN IN EGYPT AND SUDAN

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INTRODUCTION

Red brick is one of the most used and most visible building materials in Egypt and Sudan, especially in urban areas. Its production process is roughly the same in both countries : an earthen raw material is mixed with an organic one or with sand, the mixture is then moulded in bricks, dried in the open air, fired in a kiln and then delivered to the construction sites. However, a big difference separates both processes : the type of clay.

The Egyptian and the Sudanese producers are indeed not relying on the same earthen raw material. The Nile silt (*ṭin* - طين), deposited each summer on the banks of the river, is still used by the Sudanese ones whereas, in Egypt, this material has been replaced by the shale clay (*ṭefla* - طفلة), extracted from quarries in the mountainous peripheries of the Nile valley. This difference implies a series of discrepancies in the red brick itself, in its production line and in its whole supply chain, as I will try to evidence in this article.

Most of studies on this building material in Egypt and Sudan have focused on technical and environmental aspects, serving different purposes : demonstrating the air pollution caused by the brick kilns (Alam and Starr, 2009) ; proposing alternatives to the use of Nile silt in Sudan, like the use of pouzzolane (Ali, 2008) ; or highlighting the need to replace the red brick by other building materials like the compressed earth block or a straw-cement one (Mansour *et al.*, 2007). Following on from other analyses on building materials, either be it in urban geography (Choplin, 2020) or in ethno-archeology (Choimet, 2020), I argue that these technical issues can be integrated in a more global approach, at the scale of the supply chain and linking it to economic, social and geopolitical dimensions.

Then, this paper relies on a ten months qualitative fieldwork in both countries, between February 2020 and June 2022, conducted in the context of a PhD thesis in urban geography. I led informal and guided interviews with many different actors who play a part in the red brick supply chain (producers, workers, architects, engineers…). For this article, I will specifically focus on visits to factories and on interviews with the producers around Cairo and Khartoum, in order to describe and explain their use and practice of earthen materials. Where are they buying it ? Are there different qualities of clays and of bricks? What are the differences between Nile silt and shale clay in the production process?

I do not aim to find an alternative to the red brick or enhance its production process. I am rather trying to understand the whole production context, the relationship between red brick producers and public actors and the access to raw materials. By analyzing the shift, or the absence of shift from Nile silt to shale clay in the red brick production process, I argue that technical aspects are to be linked with economic, political and urban ones.

Figure 1: The red brick kilns concentrated along the Blue Nile in Soba (Khartoum).
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After describing the composition of the red bricks and the geography of their supply chains, I will come back on this shift from Nile silt to shale clay, which did happen in the 1990s in Egypt but didn't in Sudan until now. Finally, the paper will deal with the rising difficulties in the access to clay for producers, linking it with methodological issues.

1. THE DIFFERENT CLAYS EXPLOITED ALONG THE NILE

The Sudanese red brick is made of Nile silt. It comes from the erosion of a basalt bedrock in Ethiopia and is deposited by the floods on the river banks each rainy season, after being transported by the Blue Nile. According to an interview with an engineer at the Geological Research Authority in Khartoum (March 30, 2022), the very rapid flow of the Blue Nile enables this deposit, contrary to the White Nile which is slower and carrying different types of rocks and sands.

The red brick producers are then concentrated along this Blue Nile, from al-Damazin to Khartoum, and then on the main course of the river until it reaches Egypt. The kilns (*kama'in* in colloquial Sudanese Arabic - كمائن) are located on the banks of the Nile, so the silt can be collected directly (Fig. 1). This dependence on the Nile floods implies a seasonal functioning, the kilns being active only from September to May, when the banks are not flooded.

More precisely, the red brick producers identify three main types of silt : the *guerara* one, the *zafout* one, which is more sandy, and the *balabati* one[1]. These three types have to be mixed with proper proportions in order to get a good brick. A producer in Omdurman explains : « If there is too much *zafout*, the brick will be weak. If there is too much *balabati*, the brick will be dry and will break. If there is too much *guerara*, the brick will crack. » (interview, April 16, 2022). These silt types are unequally distributed in Khartoum. According to a producer in al-Gereif Sharg (interview, March 6, 2020), the silt deposited in his area is particularly good, which explains the massive red brick production in this area.

Thus, the quality of the red brick depends on the general quality of the silt, but also on the experience and the skills of the kiln owner who will recognize the different types of silt, its characteristics and use a proper mix for his production. The whole silt is then mixed by workers with water and an organic material, generally cow dung, in order to enhance the adherence of the mixture. The production process in Sudan is handmade, the bricks being manually moulded and fired in

1. According to Omer Ali Mohamed Ali (2008), the *balabati* is a « very plastic clay with a fraction of clay varies between 20% - 25% » (p. 26), the *zafout* is « containing 10% clay, 15% sand and the rest is silt » (p. 27) and the *guerara* shows very low plasticity as it is a « sandy silt with the sand portion varying from 20% to 40% and the rest is silt » (p. 27).

ephemeral kilns (Fig. 2) which are dismantled after each firing. The final product is a roughly 19 cm long and plain brick. The quality of the burnt bricks is also different inside the kiln and bricks are classified in three categories, according to their level of firing (Fig. 3).

Figure 2: A burning kiln in al-Gereif Sharg (Khartoum).
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The Egyptian red brick producers also rely on a clay material (*ṭefla*), but it is extracted from mountainous quarries. These quarries are located on the margins of the Nile valley because the river bed has moved across the geological eras, which has created alluvial plains at its fringes (Shata, 1988). The shale clay areas are mainly concentrated between Cairo and Beni Suef, but some can be also found on the Western part of the Delta, close to Wadi Natrun lake, or on its Southern-Eastern part, close to Bilbeis (بلبيس). The main production areas are in Arab Abu Said and al-Saf, south of Cairo (Fig. 4).

Figure 3: The different red brick qualities inside a kiln in Hillat Koko (Khartoum).
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As for the Nile silt in Khartoum, there are different types of shale clay and the quality can vary from quarry to quarry. Red bricks are made from a mixture of a « yellow clay » (*ṭefla safra*), a « brown » one (*ṭefla samra*), which is more viscous, and sand (interview with a producer in al-Rihawi, March 9, 2022). If sand can be extracted in many different parts of Egypt, shale clay can only be found in the aforementioned quarries. The proportions between these three main components depend on the experience of the producer, its ability to identify the shale clay characteristics and to supply his factory with high quality clay.

Figure 4: Arab Abu Said, the main red brick production area in Egypt.
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According to interviews with some producers in 2022, the quarries of Dahchour and Girza are providing the best quality of clay in Egypt. But the general shift to these quarries, on the Western banks of the Nile, approximately 50 km south to Cairo, is recent. Based on what a producer in al-Qalyubya governorate told me (May 10, 2022), this shift depended on two main factors : the poor quality of other quarries, like the ones in 10th Ramadan and Bilbeis, and the running out of Arab Abu Said quarries which provided the best quality.

The distribution of red brick factories is highly dependent on the localization of these quarries, as the producers try to save money on transportation costs. A fully functioning factory may need the supply of three trucks a day, which highlights the importance of the localization of the factory and of the quarry in a context of rising fuel prices in Egypt. The process is much more industrialized and mechanized than in Sudan, which results in an alveolar red brick (Fig. 5).

Figure 5: The classic alveolar bricks in al-Qaliubya governorate (Egypt)
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These two opening descriptions of the red brick supply chains in Egypt and Sudan and of the earthen materials which are used are a necessary prerequisite for a better understanding of the transformations of this building material. Then, one has to keep in mind that the Sudanese producers rely on a renewable clay, which they collect directly on the banks of the river, while the Egyptian ones depend on the extraction of another type of clay, which can be found in some quarries only and which seems to become scarce. These two very different contexts regarding the access to the main raw material are determinant for the functioning of the whole supply chain, as I will show it in the next part about the consequences of the shift from Nile silt to shale clay in Egypt.

2. CHANGING THE CLAY, INDUSTRIALIZING THE PRODUCTION ?

Until the 1980s, red brick production in Egypt was mainly manual and the producers were using the Nile silt, as it is still the case nowadays in Sudan. What caused this discrepancy ? Why is the Nile silt still used in Khartoum whereas it has been replaced by shale clay in Egypt, despite the proximity between these two countries ?

The main reason is infrastructural. The completion of the High Aswan Dam in the late 1960s by the Egyptian president, Gamal Abdel Nasser, completely disrupted the red brick sector. This water control and electricity production infrastructure led to the interruption of the seasonal floods in Egypt which affected directly the producers (McKenzie, 1985). They had to turn from the renewable Nile silt to the agricultural soils in the valley, which have approximately the same properties. Nevertheless, the government quickly forbade this process of digging agricultural soils, called *tagrif*, through a series of legal texts, from the 1966 Agricultural Law to decrees promulgated by Hosni Mubarak in 1985 (*Ibid.*). This legal framework forbids completely the use of Nile silt or agricultural soil for another purpose than agriculture. Progressively, the red brick producers were then incited to use another raw material, namely the shale clay.

This shift led to a series of material transformations in the supply chain. Firstly, regarding the localization. Although most of the production units were located on the banks of the Nile and in the Delta, some producers started to abandon these factories to settle in areas close to shale clay quarries. Industrial concentrations were informally and progressively established in these areas, such as in Arab Abu Said and in al-Saf which gather approximately 500 factories among the 1200 scattered in the whole country.

The other major consequence of this shift in the earthen material used is the industrialization of the supply chain. Shale clay is indeed more rocky and less viscous and malleable than the Nile silt (Figs. 6 and 7). These properties make it very difficult to be mixed and moulded manually, even if the Egyptian producers started to use it in their lowly industrialized production units in the 1990s. But they had to invest in machines, especially for the compression of the brick, as this producer says : « Before the machines, the *ṭefla* brick used to break easily. This *ṭefla* is not adapted to a manual production and the machines improved the quality of the product and the efficiency of the factory » (May 10, 2022).

Figure 6: The « brown » and the « yellow » shale clays in Arab Abu Said (Egypt)
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Figure 7: The two types of shale clays mixed in a factory in al-Rihawi (Egypt)
© C. Pérez-Houis, March 2022

Finally, this use of *ṭefla* led to change the structure of the brick, from plain to alveolar. As McKenzie (1985) explains, this new clay material is denser than the Nile silt. Its use makes the brick heavier than the previous one and it became almost mandatory to perforate it in order to lighten it. This transformation was also only possible through an industrialization of the production process, as machines are needed to get an alveolar brick (Fig. 8). It also led to a needed adaptation of the Egyptian producers' *savoir-faire*.

All of these transformations, resulting from a replacement of the initial earthen material, happened in the 1990s in Egypt but didn't concern the Sudanese supply chain. The latter is not industrialized and mechanized, the bricks produced are plain and less standardized and, of course, Nile silt is still used. One could argue that Sudanese producers, in accordance with the

Figure 8: An interrupted production line in Fayoum oasis (Egypt).
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general economic situation and the low level of industrialization in the country, are just late or less advanced than the Egyptians.

On the contrary, I would like to show that the permanency of a manual production in Sudan is linked with both structural and circumstantial factors. The absence of a High Dam and the continuing floods are a first fact that explains this situation. The red brick producers can still rely on the seasonally deposited Nile silt, a renewable and cheap resource. Another argument against the economically centered and aforementioned analysis is the actual attempt, in the 1980s, of Sudanese public actors to move the producers from the river banks to peripheral areas. Some areas were identified, such as Aid Babiker and Sheikh al-Amin, on the Eastern fringes of Khartoum, as proper areas to extract clay from alluvial plains and establish red brick factories. However, this plan wasn't implemented. The resistance of producers to be relocated far away from the urban areas and the high costs of the operation made it fail, according to an engineer in the Geological Research Authority in Khartoum : « It failed because of the transport costs and the lack of water resources. They had to dig a well, which is very costly » (interview, March 30, 2022). The political context, namely the military coup in 1989 by Omar al-Bashir and the apparent lack of interest of the new rulers for these red brick producers, is also to be taken into account in order to explain the current situation of the sector.

The analysis of the progressive shift from Nile silt to shale clay in Egypt and of the discrepancy with the Sudanese case show the entanglement of technical, engineering, geopolitical and economic issues. It seems all the more important to understand these progressive material changes of the supply chains as the conditions of access to the raw materials are more recently evolving.

3. A GROWING DISTANCE BETWEEN CLAY RESOURCES AND RED BRICK PRODUCERS

Even if contexts are different between both countries, access to the clay resources, either be it the shale clay or the Nile silt, seems to be more and more difficult for both Sudanese and Egyptian red brick producers.

In Sudan, the producers access to the Nile silt directly on the land they work on. This resource seems to be abundant enough to supply for the surrounding kilns for a whole production season. However, these kilns are highly criticized by a series of institutional actors, such as local governments, international institutions and academics (Abu Shura, 2000 ; Alam and Starr, 2009 ; Abdallah, 2013). These actors highlight the air and water pollution provoked by the production and burning of these bricks, but also the fact that the digging of the silt is creating holes in the banks of the river and that producers overexploit this naturally renewable resource (Fig. 9). On this basis, these criticizing actors argue that red brick producers need to be removed from the banks of the Nile and relocated to the margins of the Sudanese capital. A series of decrees, relying on environmental and sanitary arguments, forbid the production of this building material on the banks of the Nile inside Khartoum area (Pérez-Houis, 2022). Producers would be moved away from the source of the earthen material they use for their activity, which, as mentioned before, didn't really happen for economic and political reasons.

Figure 9: Holes dug in the Nile banks by red brick producers in Soba (Khartoum).
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Egyptian producers were concerned by the same issues in the 1980s and the 1990s, with the mandatory replacement of the Nile silt by the shale clay. Until recently, the shale clay quarries were controlled by local operators to whom red brick producers bought directly the material, before delivering it to the factory by trucks. The factories located close to these shale clay quarries obtain a relative advantage compared to the producers who are still on the banks of the Nile or in the Delta region. For example, some red brick factories used to be located in al-Warraq area, on the banks of the river inside Cairo. One of the former producers, according to an interview I led with him, turned from Nile silt to shale clay in the late 1980s. But, quickly, in 1992, he had to interrupt his activity because of the rising price of the shale clay, the cost of transport and his lack of competitiveness compared to all the factories located in Arab Abu Said, close to the quarries (interview, May 31, 2022). This example shows the high dependance of red brick producers to the price and localization of the earthen resources.

Besides, the conditions of access were recently tightened as the military took control of the quarries. The army is a very powerful economic actor in Egypt, being present in almost all sectors (Abul-Magd, 2018 ; Amar, 2018 ; Sayigh, 2019). However, they were not directly involved in the red brick production but rather in the cement one, until a recent modification of the Law 198/2014 on the mineral resources. The Law 145, promulgated in 2019, made mandatory the approval of the Ministry of Defense to obtain an exploitation permit in the quarries. Practically, the military actors recovered administrative and judiciary control on most of the shale clay quarries, which led to a higher formalized system of exploitation and to a quick price increase. According to a contractor in Fayoum oasis, who is buying red bricks on a daily basis for his construction sites, this reorganization of the shale clay quarries was indeed directly visible in the price hike of red bricks (interview, May 14, 2022). A sales manager in a red brick company confirmed this fact : « The increase in the prices of the shale clay is linked to the taking of control of the quarries by the army. The exploitation was informal until then, but now it is controlled, the quantities are precisely counted » (interview, June 19, 2022). The military control of the quarries is not only an economic issue, but also political as the functioning of these institutions is often very opaque.

Finally, these different conditions of access is reflected in my own opportunities of access to these clay sources. In Sudan, it has been easier of course, as the Nile silt is directly located next to the kilns. But in Egypt, even if I could observe the different types of shale clays used in the factories, I have never been able to visit a quarry. The producers I met never proposed it to me, even though I asked many questions on this clay and its characteristics. In a context of high tensions about qualitative research and security issues in Egypt, I didn't insist too much and these quarries stayed inaccessible for the whole length of my fieldwork. This reflects the potential suspicion raised by my questions and my presence, the high number of controls on the roads and maybe also the recent military takeover on these quarries.

CONCLUSION

This paper dealt with the clay resources in Egypt and Sudan through their use in the red brick production. This focus on the earthen materials enables the articulation of technical and geological issues with economic and geopolitical ones. The economic and geographic conditions of access to these clay resources should be analyzed deeper in further research. The different criteria identified by the producers to choose one quarry over another (quality of the clay, localization, distance to the factory, price of the gasoline…) are still to be more clarified. However, as shown in the last part, the Egyptian quarries are now under the supervision of the Ministry of Defense, which impedes a qualitative research about it, and the current war in Sudan makes it all the more difficult to investigate the red brick production units.

Besides, I argued in this paper that the discrepancies between both supply chains, in terms of level of industrialization and mechanization, cannot be understood as a development or underdevelopment matter. There is not a chronological linearity of development, that would go from unburnt bricks to burnt bricks handmade with Nile silt to industrialized ones made of shale clay. The transformations of the red brick production depend on a high variety of factors, including the properties of the clay, the localization of the factories and the accessibility of these earthen resources.

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