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Survey on public health risks at artisanal brick kilns in Kananga City (Central Kasaï Region), Democratic Republic of the Congo

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ABSTRACT

Introduction

In developing countries, diseases related to unsafe water, a lack of sanitation, and poor hygiene are important (famous) public health challenges.

Purpose

This study aimed to survey the public health risks at artisanal brickworks in the city of Kananga, Democratic Republic of the Congo.

Methods

A prospective survey was carried out among artisanal brickmakers and brickworks using questionnaires and free observation.

Results

The study revealed that 58% of brickyards used river water, 35% used marsh water, and 8% used pond water to shape bricks, so there was no safe water source at brick yards. Of these water sources, 84% drink unsanitary water from rivers and lakes, 23% store water in an open container, 25% drink from the source at any time when they are thirsty, 90% drink only once a day after eating or washing, 71.5% wash only once a day after working, and 5% rarely wash; 100% of people do not clean the clothes they use at work regularly; 83% of people do not have appropriate clothing for their work. They don't have boots or gloves and work with their hands and naked feet. 95.5% of bricklayers sleep in the surrounding bush.

Conclusion

These observations sufficiently prove that in brick factories, sanitation and hygiene measures are defective or even inadequate, and brick manufacturers are prone to various environmental diseases, of which lack of sanitation and hygiene are the main causes. This study thus highlights practices that are related to brick manufacturing, endangering public health through the contamination of drinking water and contributing to environmental problems such as deforestation. Material support, supervision of contractors for sanitation and hygiene, and health education in brick yards are recommended for promoting environmental sanitation and hygiene.

INTRODUCTION

Context and definition of the problem

In developing countries, diseases related to unsafe water, a lack of sanitation, and poor hygiene are important (famous) public health challenges; it is estimated that 88% of diarrheal diseases are caused by unsafe water, a lack of sanitation, and a lack of hygiene; safe water, sanitation, and hygiene are essential to health, survival, growth, and development, but these basic needs are still luxury for many of the world's poor (Adams, 2019). Neglected tropical diseases flourish when poor populations live in poverty, where hygiene is still the most important contributor. Geohelminthiasis is estimated to affect more than 2 billion people worldwide and is widespread in tropical and subtropical regions due to local environmental conditions and the presence of water (Johnson, 2018). The environment contains four components: the abiotic factors of the environment: the climate, the soil; the biotic factors: the vegetation, the animals; the population; the culture and the technology sphere (Binzangi, 2019). We will focus on humans, one component of biofactors, by studying their hygiene in the context of the construction of bricks in Kananga.

Problem

Like other cities in the great Kasai region, Kananga is facing serious shortages of building materials, particularly cement. Cement is a very expensive product, and most social classes find it hard to find in the region, where it is relatively high. Lack and high cost of cement, unemployment, and urban expansion have encouraged the emergence of small-scale bricks. Today, fired bricks occupy a prominent place in the construction materials group and is of socio-economic importance in the region. As a result, many people of various ages participate in the construction of bricks and spend days and nights in the construction to meet their different needs. In this regard, workers, visitors, and buyers face various issues related to sanitation and hygiene. To avoid various diseases associated with the lack of sanitation and hygiene in their work environments and urbanization, it is essential to evaluate the implementation of sanitation and hygiene measures in brick factories and to ensure that these workers practice good hygiene, have clean water, food, appropriate clothing, and proper defecation avenues to ensure their well-being. The following questions must be asked:

- Do the artisanal brick-makers in the town of Kananga practice sanitation and hygiene measures at their work sites?
- Are their water supplies safe?
- How can brickmakers be encouraged to internalise, appropriate, and practise good hygiene and sanitation measures in their workplaces?

Hypothesis

Artisanal brickwork may not meet the recommended health and hygiene standards fully. Deficiencies in the implementation of these standards may have adverse effects on the health of workers.

Scope of the study

The study is part of the field of environment and health in the workplace. It is both an approach to combating poor sanitation and sanitation practices and the need to restore good sanitation and sanitation practices in brickworks through material support and health education. This promotes the health of brick manufacturers. This makes it of theoretical and practical interest. It is also noteworthy that our study is current and deals with current environmental issues. The study was chosen based on observations made during our visits to various craftsmen's brickworks in Kananga City over time. This study was devoted to 2023 when we became aware of the scope of the problem. We chose Kananga as our living environment because the production of burned bricks was a response to improvements in housing and various socio-economic subsidies since the return of the Kasais who were expelled from Katanga, and there were many brickworks and brick manufacturers in the area.

Research objectives

Global objective

The general aim of this project was to assess hygiene and sanitation practices in the handicraft brick factories in Kananga City.

Specific objectives

To promote sustainable sanitary conditions and sanitation, this work is an instrument for a qualitative change in

attitudes and behaviours of brick manufacturers and general citizens. It therefore aimed to:

i. demonstrate if craftsmen in Kananga do carry out hygiene and hygiene measures at their workplace;
ii. determine whether craftsmen use clean water supplies;
iii. propose strategies to promote hygiene and hygiene measures in craftsmen in Kananga.
iv. inform and raise the awareness on the problems of sanitation in brick factories, especially by helping the relevant authorities and the local population understand how inadequate sanitation promotes disease.

State of the question

Hygiene and sanitation in the work environment have already been the subject of several studies such as INEPES (2020) and Ngbolua. (2019), Castellan (2018), Ngambi (2017), CHAN (2016), Nzonikoua and Eugene (2015), Diawara (2010), BotianI and so on. (2008), (2007), and (2007) reveal the irregularities and consequences of hygiene and hygiene practices in various cities around the world. However, the study conducted direct and indirect observation of the sanitation and hygiene conditions of artisans at the workplaces (brick factories) in Kananga City to raise public and private stakeholders, residents and brick manufacturers' awareness and attention to the need for hygienic and good hygienic conditions at the workplaces and to provide health education and support to reduce the risks to health.

METHODS

Study area

The research was conducted in Kananga City, the capital of the central province of Kasai, in the centre of the Democratic Republic of the Congo. The survey included 383 brickworkers and 28 brickworks in the three municipalities of Kananga: Kananga, Katoka, and Lukonga **(Figure 1)**.

Materials

The use of registers, pencils, questionnaire papers, and cameras allowed us to collect information about brick manufacturers' habits.

Methods

A prospective survey was carried out among artisanal brickmakers and brickworks using questionnaires and free observation.

RESULTS

Tables 1 and **2** respectively present the number of brickmakers by municipality, site, and brickworks and Brickmakers by source of water supply.

Table 1:
Number of brickmakers by municipality, site, and brickworks

Communes	Sites	Brickworks	Brickmakers
KANANGA	BENAKAZADI	2	30
	MOBUTU	1	18
	TUBULUKU	9	102
	20_MAI	1	14
KATOKA	KATOKA II	1	39
	KATOKA III	1	29
	TSHILUMBA	3	46
LUKONGA	BEL AIR	2	24
	ORTHODOX	1	30
	TSHIBASHI	3	18
	TSHINGESHA	2	12
	ZAIRE	2	21
TOTAL	12	28	383

Table 1 shows that the study covered 383 brickmakers sampled at 12 sites and 28 brickworks in the city of Kananga.

Table 2:
Brickmakers by source of water supply

Sites	Number of brickmakers by source of water				
	Water from rivers	Water from marshes	Water from marshes	Total	%
BENAKAZADI	16	9	5	30	8
MOBUTU	12	6	0	18	5
TUBULUKU	80	16	6	102	27
20 MAI	9	5	0	14	4
KATOKA II	19	12	8	39	10
KATOKA III	15	8	6	29	8
TSHILUMBA	22	12	12	46	12
BEL AIR	16	8	0	24	6
ORTHODOXE	21	9	0	30	8
TSHIBASHI	11	7	0	18	5
TSHINGESHA	9	3	0	12	3
ZAIRE	14	7	0	21	5
TOTAL	244	102	37	383	100
Percent (%)	64	26	10	100	

Table 2 shows that of the 383 subjects surveyed, 64% use river water, 26% use marsh water and 10% use pond water.

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Tables 3, 4, and 5 give respectively brick makers and drinking water, Brickmakers' method of storage of drinking water, and Brickmakers and hand hygiene.

Table 3:
Brick makers and drinking water

Sites	Number of brickmakers by drinking water					
	Undisinfected river water	Undisinfected marsh water	River water disinfected	Disinfected marsh waters	Total	%
BENAKAZADI	20	5	5	0	30	8
MOBUTU	14	4	0	0	18	5
TUBULUKU	90	6	3	3	102	27
20_MAI	9	5	0	0	14	4
KATOKA II	24	9	6	0	39	10
KATOKA III	17	5	7	0	29	8
TSHILUMBA	36	10	0	0	46	12
BEL AIR	14	4	6	0	24	6
ORTHODOXE	20	4	6	0	30	8
TSHIBASHI	14	4	0	0	18	5
TSHINGESHA	9	3	0	0	12	3
ZAIRE	17	4	0	0	21	5
TOTAL	284	63	33	3	383	100
Percent (%)	74	16	9	1	100	

Table 3 shows that of the total number of brickmakers registered, 74% drink non-disinfected river water, 16% drink non-disinfected swamp water, and 10% drink disinfected river or swamp water.

Table 4:
Brickmakers' method of storing drinking water

Sites	Frequency of brickmakers by drinking water storage method				
	Open containers	Enclosed containers	Drinking from the source	Total	%
BENAKAZADI	8	10	12	30	8
MOBUTU	4	6	8	18	5
TUBULUKU	48	32	22	102	27
20 MAI	6	6	2	14	4
KATOKA II	14	12	13	39	10
KATOKA III	10	9	10	29	8
TSHILUMBA	14	16	16	46	12
BEL AIR	6	6	12	24	6
ORTHODOXE	10	9	11	30	8
TSHIBASHI	6	6	6	18	5
TSHINGESHA	3	4	5	12	3
ZAIRE	6	8	7	21	5
TOTAL	135	124	124	383	100
Percent (%)	35.2	32.4	32.4	100	

The data in Table 4 show that 35.2% of the subjects keep their water in open containers, 32.4% keep it in closed containers, and 32.4% drink from the source of supply because they do not have a storage container.

Table 5:
Brickmakers and hand hygiene

Sites	Number of bricklayers by hand hygiene				
	Using soap or SHA before meals	Use of soap or SHA after toilet	No use	Total	%
BENAKAZADI	5	0	25	30	8
MOBUTU	4	0	14	18	5
TUBULUKU	6	0	96	102	27
20 MAI	3	0	11	14	4
KATOKA II	6	0	33	39	10
KATOKA III	5	0	24	29	8
TSHILUMBA	9	0	37	46	12
BEL AIR	6	0	18	24	6
ORTHODOXE	5	0	25	30	8
TSHIBASHI	2	0	16	18	5
TSHINGESHA	0	0	12	12	3
ZAIRE	3	0	18	21	5
TOTAL	54	0	329	383	100
Percent (%)	14	0	86	100	

These data show that 86% of brickmakers do not use soap or hydroalcoholic solution before meals or after washing (Table 5).

Tables 6, 7, 8, and 9 give brickmakers and clothing hygiene, bricklayers by personal hygiene, brickmakers and faecal hygiene, and brickmakers and the wearing of appropriate trade dress, respectively.

Table 6:
Brickmakers and clothing hygiene

Sites	Number of brickmakers per laundry					
	Once per week	Once per 2 weeks	Once a Month	Rarely	Total	%
BENAKAZADI	8	3	12	7	30	8
MOBUTU	6	2	7	3	18	5
TUBULUKU	30	13	29	30	102	27
20_MAI	4	2	4	4	14	4
KATOKA II	12	9	11	7	39	10
KATOKA III	10	6	6	7	29	8
TSHILUMBA	19	12	6	9	46	12
BEL AIR	9	6	4	5	24	6
ORTHODOXE	10	8	5	7	30	8
TSHIBASHI	4	4	5	5	18	5
TSHINGESHA	4	3	3	2	12	3
ZAIRE	8	4	5	4	21	5
TOTAL	124	72	97	90	383	100
Percent (%)	32.3	19	25.3	23.4	100	

Table 6 shows that 32.3% clean their clothes once a week, 19% once every fortnight, 25.3% once a month, and 23.4% rarely.

Table 6 shows that 32.3% clean their clothes once a week, 19% once every fortnight, 25.3% once a month, and 23.4% rarely.

Sites	**Brickmakers by number of baths**				
	Once after work	Twice before and after labour	Sometimes no bath	Total	%
BENAKAZADI	16	3	11	30	8
MOBUTU	12	2	4	18	5
TUBULUKU	69	11	22	102	27
20 MAI	8	0	6	14	4
KATOKA II	10	6	8	24	6
KATOKA III	14	6	10	30	8
TSHILUMBA	9	4	5	18	5
BEL AIR	6	1	5	12	3
ORTHODOXE	12	4	5	21	5
TSHIBASHI	23	8	8	39	10
TSHINGESHA	19	4	6	29	8
ZAIRE	30	6	10	46	12
TOTAL	228	55	100	383	100
Percent (%)	60	14	26	100	

These data show that 60% of brickmakers wash once a day, 14% wash twice and 26% may or may not wash (Table 7).

Table 8:
Brickmakers and faecal hygiene

Sites	**Number of brick makers by faecal hygiene**			
	Latrine use	Using the surrounding bush	Total	%
BENAKAZADI	0	30	30	8
MOBUTU	6	12	18	5
TUBULUKU	0	102	102	27
20 MAI	4	10	14	4
KATOKA II	4	35	39	10
KATOKA III	6	23	29	8
TSHILUMBA	0	46	46	12
BEL AIR	0	24	24	6
ORTHODOXE	0	30	30	8
TSHIBASHI	0	18	18	5
TSHINGESHA	0	12	12	3
ZAIRE	0	21	21	5
TOTAL	20	363	383	100
Percent (%)	5	95	100	

These data reveal that 95% of brickmakers defecate in the open air in the bush surrounding brickworks for lack of latrines (Table 8).

Table 9:
Brickmakers and the wearing of appropriate trade dress

Sites	**Number of brickmakers wearing appropriate uniforms**					
	Use of gloves	Wearing booties	Wear gloves and boots	No gloves or booties	Total	%
BENAKAZADI	4	2	0	24	30	8
MOBUTU	0	4	0	14	18	5
TUBULUKU	2	6	3	91	102	27
20 MAI	2	2	0	10	14	4
KATOKA II	4	4	0	31	39	10
KATOKA III	4	3	0	22	29	8
TSHILUMBA	6	5	0	35	46	12
BEL AIR	2	2	0	20	24	6
ORTHODOXE	4	3	2	21	30	8
TSHIBASHI	0	2	0	16	18	5
TSHINGESHA	0	0	0	12	12	3
ZAIRE	2	2	0	17	21	5
TOTAL	30	35	5	313	383	100
Percent (%)	8	9	1	82	100	

These data show that 82% of workers do not have appropriate clothing for their trade as bricklayers (Table 9).

DISCUSSION

Number of brickmakers

The information presented in the initial table indicates the participation of three municipalities, 12 locations, 28 brick

kilns, and 383 brickmakers in our investigations. This robust data provides compelling evidence that the artisanal production of fired bricks is a significant issue and represents a strategic initiative to enhance housing quality in Kananga (Mputu, 2007). The crafting of bricks and other construction items utilizing moist clay soil ranks as the second most crucial aspect of artisanal production. Proposing the industrialization of the brick sector in Kananga emerges as a recommended solution for its development (Tshilembi, 2019).

Bricklayers and water sources

Table 2 illustrates the water sources employed at the twelve surveyed brickwork sites among the 383 listed brickmakers. It reveals that 39 brickmakers (10%) utilize pond water, 244 (64%) use water from rivers or streams, and 102 (26%) rely on marsh water for brick production. These findings strongly indicate that brickmakers lack access to a reliable water source in their workplaces, exposing them to potentially contaminated water during their operations. These outcomes align with findings in the Nganza commune (Kabombo, 2022), supporting observations by Ignacio et al. (2012), who highlighted that 900 million people worldwide lack access to clean water. Additionally, these results echo UNICEF's assertion that over 40% of individuals globally without access to drinking water reside in sub-Saharan Africa.

Each day, millions suffer or succumb to illness due to inadequate access to drinking water and sanitation. In impoverished nations, the prevalence of poverty hinders the development of improved water points and sanitation facilities, leading to limited access to clean drinking water and sanitation (UNICEF, 2014).

Data from **Table 3** indicate that concerning the quality of drinking water across all sites, out of the 383 brickmakers surveyed at the 28 brickworks in 12 locations, 33 (9%) consume disinfected river water, 3 (1%) opt for disinfected marsh water (a total of 36 brickmakers or 10% consume disinfected water from any source). Meanwhile, 284 brickmakers (74%) and 63 (16%) consume river water and non-disinfected marsh water, demonstrating that 90% of brickmakers consume unhealthy water.

This quantitative analysis serves as compelling evidence that brickmakers lack access to a reliable water source in their work environment and often consume unhealthy water, making them susceptible to waterborne and water-supported diseases. This aligns with the findings in UNICEF's (2012) literature, emphasizing that in developing countries, the construction of improved water points and sanitation facilities is hindered by poverty, leading to limited access to clean drinking water and sanitation for everyone.

The information presented in **Table 4** highlights an additional concern alongside the previously observed unhealthy springs and drinking water. Specifically, 124 brickmakers (32.4%) do not possess containers for storing drinking water and instead drink directly from the spring (river or marsh) when thirsty. Furthermore, 135 brickmakers (35.2%) store their drinking water, whether disinfected or not, in open containers, while 124 brickmakers (32.2%) store their drinking water, regardless of its source and treatment, in closed containers.

These figures underscore that more than half of the brickmakers fail to store their drinking water properly, leaving uncovered water vulnerable to contamination by various parasites. This practice predisposes consumers to various illnesses, as evidenced by observations in the Nganza commune (Kabombo, 2022).

Figure 1:
Source of water supply at the Tubuluku brickworks

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Figure 2:
Pond water used in the Tshilumba brickworks

Hygiene and sanitation at Brickworks

Table 5 data reveal that, concerning hand hygiene across the 28 brickworks at 12 sites and the 383 surveyed brickmakers, only 54 individuals (14%) use soap or a hydro-alcoholic solution to disinfect their hands before eating. None of the brickmakers employ a disinfectant to wash their hands after work. A significant majority, comprising 329 brickmakers (86% of the workforce), do not use soap or hydro-alcoholic solution either before eating or after washing. This data points to a lack of adherence to proper hand hygiene practices among brickmakers.

In **Table 6**, it is evident that when it comes to clothing hygiene on the sites, 124 bricklayers (32.3%) clean their work clothes once a week, 97 (25.3%) do so once a month, 72 (19%) clean their work clothes once every fortnight and 90 (23.4%) rarely clean their work clothes. This highlights inadequate personal hygiene practices in the brickworks at all the sites, echoing findings from Omoze's (2011) survey, which indicated that in developing countries, populations face challenges due to a lack of information on water, hygiene, and sanitation.

Table 7 showcases results related to the body hygiene of brickmakers at their workplace. Out of the 383 brickmakers surveyed, 228 (60%) bath once a day after work, 55 (14%) wash twice a day (before and after work), and 100 (26%) rarely bath before or after work. Deficient body hygiene practices among brickmakers could predispose them to dermatitis and other diseases. Castellan's (2018) observations on neglecting body hygiene in workplaces align with these results, emphasizing the need for individual and collective protection measures.

In **Table 8,** data indicates that out of the 383 surveyed brickmakers, only 20 individuals (5%) had access to a latrine for defecation, while the majority, 363 (95%), used the surrounding bush instead of latrines. The absence of sanitation facilities in the brickworks leads to open-air defecation, attracting flies and parasites that can spread diseases. Run-off water may carry these contaminants to water sources, contributing to pollution. These findings support the assertion by Cluster (2007) that hygiene and sanitation are often defective globally, with more than 2.6 billion people lacking access to basic sanitation facilities, as confirmed by WHO (2004), Kouser (2007), and WHO/UNICEF (2010).

Bricklayers and appropriate clothing

The findings presented in **Table 9** indicate that across the 12 survey sites, out of the 383 brickmakers who were surveyed while engaged in their trade, 313 individuals (82%) did not wear any clothing suitable for their profession, such as boots or gloves. Only 5 brickmakers (1%) were observed wearing appropriate work attire, 30 individuals (8%) wore only hand gloves, and 35 brickmakers (9%) wore only boots suitable for their trade. Gaufaux (1991) highlighted the prevalence of worms in the clayey and damp soils used by brickmakers, which could expose them to contamination by worms, amoebae, typhoid bacilli, and other parasites.

These results strongly indicate the irregularity, if not the absence, of sanitation and hygiene practices in the artisanal brickworks in the city of Kananga. This situation puts brickmakers at a heightened risk of various parasitic diseases that have the potential to become urbanized hazards.

Figure 3:
Brickmakers at work in the Bena Kazadi Brickworks

This study demonstrates that for brick manufacturing, brickmakers use either river water, swamp water, or pond water. Additionally, no hygiene is guaranteed, posing a

significant risk to the health of the population in the surrounding areas. Risks include the transmission of geo-helminthiases due to the lack of toilets, and the high risk of waterborne diseases (such as schistosomiasis, amoebiasis, etc.) due to a lack of clean water. While economically profitable for households, this activity constitutes a major public health problem since human waste can be carried by runoff into rivers used for drinking water. In a similar study in Gbado-Lite, in the North Ubangi province of the Democratic Republic of the Congo (Ngbolua et al., 2019), the same risks exist along with environmental disasters caused by tree felling for use as biofuels. Deforestation is a key factor in climate change and the proliferation of tropical diseases. This study thus highlights practices related to brick manufacturing, endangering public health through the contamination of drinking water and contributing to environmental problems such as deforestation. Indeed, deforestation can have significant impacts on public health. The loss of forests can result in the release of fine particles and air pollutants, contributing to respiratory problems. Furthermore, deforestation can facilitate the spread of infectious diseases by disrupting natural ecosystems and bringing humans closer to wildlife, thereby increasing the risk of zoonoses. The loss of biodiversity associated with deforestation can also compromise potential medicinal resources derived from plants and animals, impacting pharmaceutical research and traditional medicine.

CONCLUSION AND SUGGESTIONS

This study is a prospective survey of the hand-made brickworks of Kananga City in 2023. Our research aimed to demonstrate how brickmakers live and behave in terms of sanitation and hygiene in their workplaces. At the end of our survey, we found that brickmakers did not take sanitation or hygiene measures in brickworks seriously because:

- Bricklayers did not have drinking water sources in the work environment; they used unsafe water sources for work and drinking. This water is consumed without prior treatment and is insufficiently stored;
- Brickworkers do not practice hand washing; most people wash their hands before meals without soap or hydro-alcoholic solution; all of them wash after washing; none of them wash after washing, so there is no hand washing;
- Brickworkers use the surrounding bushes instead of the bathrooms, so there is no sanitation or fecal hygiene;
- few Brickworkers wash regularly before and after work, most only once, some only occasionally bathe, at their own

Almost all Bricksmen do not have the right clothing for their work; they work barefoot and without gloves, so there is no appropriate clothing in the place. All these observations confirm our hypothesis and provide ample evidence that brick manufacturers are exposed to various diseases associated with a lack of sanitation and hygiene. To promote sanitation and hygiene at Kananga's artisanal brickworks, to prevent various diseases and reduce the transmission and risk of urbanization, material support and health education are recommended.

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