

## Adobe, dwellings and malaria – A challenge in sub-Saharan Africa

Sub-Saharan Africa will need to build hundreds of millions of houses in the coming decades to cope with explosive population growth. The aim of this article is to show how improving housing contributes to controlling malaria and at the same time to highlight the central role that adobe can play. The sources of information to respond to this approach correspond to the Pubmed, Plos and BMC bibliographic bases. The key words used were "Malaria", "Housing" and "Africa". The World Health Organization (WHO) and United Nations (UN) websites were also reviewed.

### Findings

*Malaria is a disease prevalent in sub-Saharan Africa. Its importance is reflected in the World Health Organization (WHO) data, which states that each year some 219 million people are infected and 435,000 die. 90% of deaths are concentrated in sub-Saharan Africa. The disease is transmitted to humans by the Anopheles mosquito (MA) that bites at night inside houses and rests on its walls and ceilings during the day.*

### Adobe

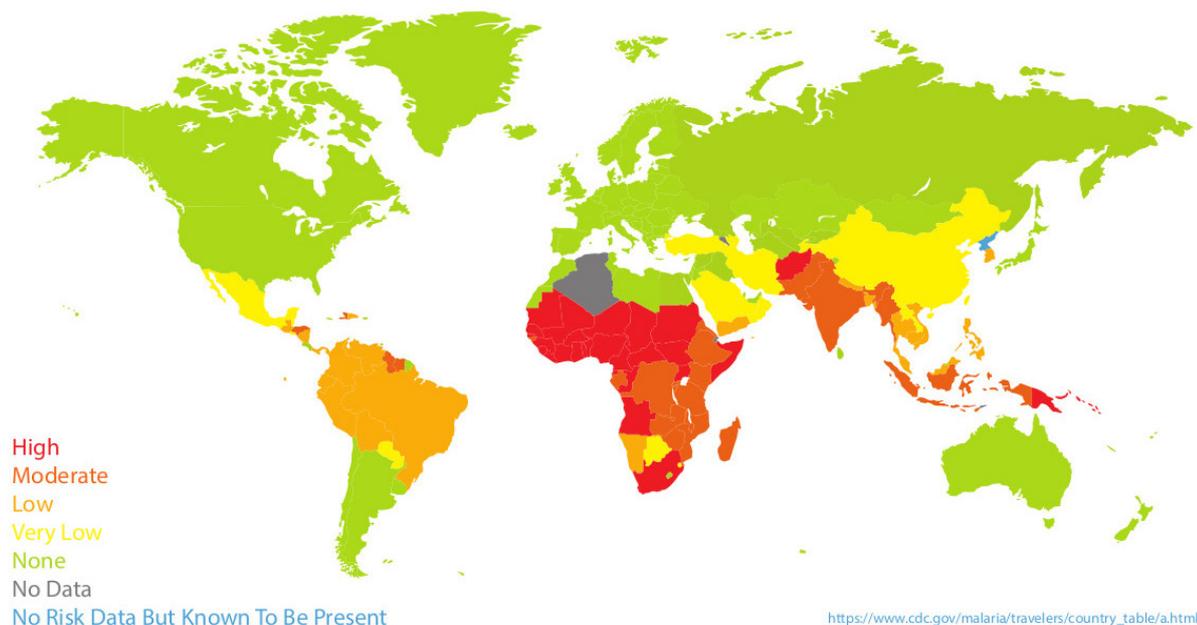
Adobe bricks and blocks are the most well-known and one of the most versatile ways of using earth for construction. For centuries, they have been used to build almost every type of domestic and public building in almost every region of the world. Mud-brick buildings include fortresses, palaces, tombs and temples. Some of these are several thousand years old and are a testament to how excellent this building material can be in varied climates.

In production, an advantage of mud bricks or blocks is that they can be made at the source of the raw materials, and then moved to the building site more economically than moving mounds of earth and water. In many cases the production site and the building site are on virtually the same spot.

Other advantages are that a good building material can be produced with a minimum of equipment. One can test and select acceptable bricks before they are used in building, and the use of a small-sized building component permits greater flexibility in the size and shape of the walls.



01 Adobe blocks (photo: author)



02 Malaria heat map (source: cdc.gov)

Mud bricks or blocks are made from damp earth which is pushed or thrown into a mould, which is then removed to allow the brick to dry. After a few days, the brick can be stacked for immediate use or stored for later use.

### Malaria

Malaria is a potentially fatal disease caused by parasites of the genus *Plasmodium*, which are transmitted to people through the bite of an infected vector, the female *Anopheles* mosquito. Of the five parasite species that cause malaria in humans, the deadliest is *Plasmodium falciparum*. The first symptoms (fever, headache, and chills) usually appear 10 to 15 days after the mosquito's infectious bite. If left untreated, *P. falciparum* malaria can cause severe symptoms and even death.

Malaria remains a major cause of illness and death in children and adults around the world. In 2017, 87 countries reported one or more cases of the disease. Malaria control requires an integrated approach covering prevention (with emphasis on vector control plus chemoprevention), early diagnosis and prompt and effective treatment. The guidelines for the treatment of malaria were first published in 2006 and have been revised periodically, most recently in 2015. To date, however, there has been no equivalent policy document on malaria vector control.

Although malaria is preventable and treatable, it continues to have devastating effects on the health and way of life of people all over the world. In 2013, approximately 3.2 billion people were at risk of the disease in 97 countries, territories and areas, with an estimated 198 million cases (range: 124 million to 283 million). In the same year, some 584,000 people (range: 367,000 to 755,000) died of this disease. In most of the countries where it is endemic, the disease disproportionately affects the poor and marginalised, who have limited access to health facilities and cannot pay for the recommended treatment.

The group most vulnerable to malaria infection is children under five. In 2017, an estimated 266,000 children died of malaria before their fifth birthday, representing 61% of global malaria deaths. That equates to one every two minutes. More than 200 million new cases are reported each year. While in some countries the number of cases and deaths has reduced dramatically since 2000, recent years have seen stagnation and, worryingly, malaria is advancing in some countries.

### Dwellings

Growth expectations from now to the year 2050 forecast that more than 7000 million people will live in the cities of the future. To house these new inhabitants, many constructions still need to be built [1].



03 Dwellings in Cameroon (photo: author)

A further layer of complexity is the fact that about 75% of dwellings around the world have been and are built without any engineer or architect. To best address this, affordable buildings are needed that are easy to build for widespread use and are of good aesthetic and technical quality [2].

The building sector is a major contributor to ongoing ecological collapse, mainly because:

- the most common construction materials, cement, concrete, and steel have a high environmental impact to produce.
- Building materials are used inefficiently
- Existing buildings as well as new buildings waste a lot of energy

To mitigate this effect, it is of utmost importance to build with local low carbon materials, not just in developed countries but also all over the world.

With the demographic explosion in sub-Saharan Africa, hundreds of thousands of new houses will be needed in the coming years. Making sensible material choices can make a significant contribution to reducing emissions. For populations with low economic power, adobe has potential to serve as the backbone of the construction of new housing due to its affordability. It is ecological, with minimal environmental impact, and is abundantly available throughout Africa, and consequently does not require transporting over

significant distances. This material is resistant, durable and the population knows how to handle it.

#### **Adobe, dwellings and malaria**

The shift from environmentally costly building materials to low-impact alternatives is not only an important strategy to counteract climate change but also a unique opportunity to move forward in controlling the largest pandemic in sub-Saharan Africa: Malaria.

Studies have shown that exposure to mosquito bites still mostly occurs indoors as people are generally indoors during the dark hours when mosquitoes are active.

Some simple modifications to typical rural house design can be an effective and relatively inexpensive method of reducing indoor mosquito vector densities and consequently decreasing malaria transmission.

What sense does it make to build sustainably on the continent with the highest projected population growth when people, and especially children, continue to die of malaria as a result of poor house design.

Observational studies have demonstrated a strong association between house improvements – such as insulated roofs, closed eaves, eaves tubes, insecticide-treated curtains, and window and door screens – and reduced malaria transmission. However, these incremental improvements do not address the fun-



04 Traditional Tanzanian dwellings (photo: pixabay/mariamichelle)



05 Tanzanian houses with open eaves (photo: pixabay/mariamichelle)

damental problems of traditional rural African house design; that structures are poorly ventilated structures and built at ground level. Elevating buildings insulates the living space from heat radiating from the ground and improves airflow, essential for healthy air quality and a comfortable indoor environment, particularly in hot, humid climates.

These findings suggest it may be possible to decrease malaria transmission and improve comfort by modifying the design of houses in the hot humid climate zones of sub-Saharan Africa. Furthermore, improved ventilation may facilitate the use of bed nets and reduce the transmission of respiratory tract infections. Additional water harvesting and effective latrines may also reduce the risk of enteric infections. Large-scale randomised clinical trials are now needed to assess the clinical benefits and cost-effectiveness of modified house designs on malaria transmission and respiratory tract and enteric infections.

Malaria control in the tropics is currently based largely on treatment of people with clinical illness and personal protection against malarial mosquito vectors. Vector control campaigns emphasize environmental sanitation and suitable environmental management, implementation of educational programmes and the use of insecticides, either in impregnated fabrics (e.g., mosquito nets and curtains) or sprays (indoors and outdoors). The use of pesticides, which needs to be regulated and is subject to strict controls, must adhere to the recommendations of the WHO [1,2]. Scant consideration has been given to housing design and construction as an environmental strategy for controlling malaria [3].

### The characteristics of sub-Saharan housing

Housing across the sub-Saharan region shares typical characteristics. These include walls made of adobe blocks or packed mud rarely taller than one storey, or the height of a one person. Roofs are made of bundles of branches or straw or reed sheaves that extend to provide an overhanging eaves. The eaves between the walls and roof are generally open. The houses are generally built at ground level with floors of dirt or rammed earth and single room for the entire family. Windows and doors are elementary, and, in most cases, there is no chimney, no running water and no latrine.

### House improvements

The main objective of improvements is to prevent mosquitoes from entering the house. There are two main strategies:

- **Placing screens over apertures**  
Mosquito nets and screens for window and door openings are an obvious strategy. However, the eaves must also be protected. The traditional open eaves of African style houses serve as important mosquito house entry points because they funnel odours outwards that attract night-active anophelines. So-called eaves tubes should be added to block host-seeking mosquitos from entering the dwelling.
- **Raise the building off the ground**  
The ancient Egyptians were right. People in houses raised on stilts suffer fewer mosquito attacks than people living on the ground. The vast majority of mosquitoes do not fly higher than 1 m until they encounter a vertical obstacle such as a wall. Consequently, the anophelines feed on the animals kept under the houses and avoid the people.

The combination of these two strategies has the potential to reduce mosquito entry into the interior by up to 95%. Even where doors and windows are simple, mosquito netting can be applied.

### Comfort

The solutions presented above also have implications for comfort within the interior. While sheet metal roofs may seem an advancement over grass roofs, they provide little insulation, and the space overheats quickly. The oppressive heat within cause people to dispense with the bed net.

Raising the house off the ground with pillars in combination with mosquito netting over wall openings improves thermal comfort without compromising privacy.

Similarly, cooking within the house without proper smoke extraction is not only a respiratory hazard but also attracts mosquitoes. Instead, the kitchen should be separated from the single room that most African houses have.

Finally, a false ceiling made of papyrus mats also helps to prevent mosquitos entering and can additionally bring down room temperatures by up to 3°C in some cases.

### Conclusions

Redesigning African housing to prevent mosquitoes from entering could potentially be a turning point in the fight to eradicate malaria in sub-Saharan Africa. At the same time, the use of adobe remains an excellent option for building new sub-Saharan houses.

The strategies outlined above can be implemented in adobe constructions to block the mosquitoes from getting into the interior of houses.

Making changes to the design of houses that are part of the traditional culture of sub-Saharan populations can only be achieved with their co-operation. They need to be included in the design considerations so that they can see the advantages that they bring and the greater comfort that they provide.

Given the high volume of housing that will be needed on the African continent in the coming years and the limited resources available to large parts of the population, adobe houses represent an important option:

They are affordable, have a low environmental impact, can build upon existing traditions and, with appropriate design changes, can provide the necessary comfort and safety to significantly reduce the incidence of malaria.

### Reference literature

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