Subconscious Biomimicking In An African Society: Aspects of Socio-Spatial Dimensions of Ant Nest and Human Built Environment

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Abstract
Modern man today faces the challenges of nature’s aggressive retaliation as a result of his mismanagement as well as destruction of natural resources, including the flora and fauna. Unprecedented climate change is one of the major consequences of this unfriendly and antagonistic attitude towards nature. Construction and designing of residences seem to be severely affected as most of the materials used in building a modern residence and its structure are less or even not eco-friendly. It is now realized that there is the need for man to turn to the same nature he once regarded as an enemy worth conquering for a solution to most of his problems which include living in harmony with the natural environment. Space management, using eco-friendly materials and designing a family-friendly residence that responds to climate and function are some of the architectural acumen which an ant is endowed with. This paper examines the apparent similarities between the structure of ant nest and that of the extended family-type of residence in Kano, Known as Gidan Gandu, as an example of subconscious Biomimicry in one of the oldest cities in West Africa. Relying on personal visits to some Gandu houses and a close examination of some ant nests the paper looks at the latter’s chambers, tunnels as road network that connects them, water traps, and using naturally available materials. An examination is made on the extent to which these resemble silo, spatial distribution of house members, chutes and spirit of brotherhood of the Gandu house. The paper discovered that there are similarities between ant nest and the Gandu

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residence. The paper found out that as ants are able to sustain, for ages, their skill, their brotherly spirit and their building architecture by engaging family members in the construction and maintenance of the house so also are family members in the Gandu house. The paper concludes that there is therefore the need to imitate the ant for a sustainable residence which is both environment-friendly and family-compliant as is evident on the Gandu type of residence in Kano.

Keywords: Biomimicking, Ant, Ant nest, Built Environment, Africa.

Introduction

And in no way is there a beast () in the earth or a bird flying with its two wings except that they are nations like you” (Q6:36).

From time immemorial humankind has been imitating nature in several ways consciously, unconsciously and moving subconsciously. Most of what we make or create is no more than a total or partial mimicry of either the world of flora or fauna. For instance, motorbikes are imitation of some insects, planes are of birds, trains and shuttles are of worms or larvae, etc. It is only now that man begins to realize that he can imitate nature to solve most of his problems which he earlier refused to as nature, then, was to him no more than an enemy worth subduing and conquering. This paper examines some socio-spatial dimensions of ant nest with a view to determining the extent to which it is subconsciously mimicked by man and integrated into his built environment, with particular reference to the Gandu type of residence in Kano. Gidan Buzu, a typical Gandu type of residence in ‘Yargaya’ ward, Kano State, is taken as a case study. With regards to existence of living things there are basically two schools: the evolutionists and the creationists. This paper stems from the creationist perspective and regards all beings as a creation of Allah, the Almighty. Similarly, as there are several species of ants with different behaviours the paper focuses on those common elements obtainable in every ant. Some peculiar habits are cited without referring to the affected specie so as to remain within the scope of the paper and avoid venturing into deep technical aspects. The paper does not intend to cover all aspects of ant’s life save those which have direct relevance to the human built environment. Emphasis is therefore laid on the nitty gritty of ant nest
and their mode of living together as a group with unique social organization.

**Defining biomimicry**

Literally, the term biomimicry is a combination of two words, i.e. *Bios* (meaning life) and *Mimesis* (meaning to imitate) (asknature: 2011). Technically, however, the term is given a variety of definitions all of which are almost similar (designboom: 2010; Richardson: 2010; Hills: 2008). While Biomimetics refers to the entire substances, equipments, mechanisms and systems produced with a view to imitating nature (Yahya: 2006) Biomimicry is defined as an innovation method (biomimicryguild: 2011) or a design discipline (asknature: 2011) that seeks sustainable solutions by imitating the time-tested patterns and strategies of nature. This is based on the idea that answers to many problems of man, such as food production, transportation, sustainable architecture, etc., have already been provided by nature millions of years ago.

**Kano**

It is one of the thirty six states of the Federal Republic of Nigeria, lying between Latitude 130N in the North and 110N in the south and Longitude 80W in the west and 100E in the east. It is made up of 44 Local Government Areas. Its total land area is 20,760 Square Kilometres. Kano City is located on Latitude 12.000N and Longitude 8.300E. It became a state in 1964 (Kurawa: nd). Kano is attested to be the largest city in the western Sudan (McDonell: 1964). It is also described as 'excessively wealthy, most beautiful province and the garden of West Africa' (Barth: 1857 as quoted in McDonell: 1964). Metropolitan Kano stands on the 12th parallel within the Sudan savannah zone of West Africa. It is about three hundred miles south of the edge of the Sahara, four hundred miles north of the forest edge, three hundred miles west of Lake Chad, and five hundred miles east of the Niger River (McDonell: 1964). Kano has a population of 9,383,682 according to the 2006 National Census, the majority of whom are Muslim Hausa and Fulani. Islam came to Kano earlier than 1349 AD (Dawaki: 2008).

**The ant: A general overview**

Among the insect genus the ant (Fig.1) is attested to be one of the most social groups Because of their strong social organization their civilization is said to be similar to that of humans (Yahya: 2006). There are around eleven thousand known species of ants (articles
base: 2010) all of which live in a collective. One of the most interesting things about ants is that besides their peculiar building architecture they care for their young ones, protect their colonies, store their food and fight for the protection of their colonies. They are capable of living in places which condition is very harsh and unsuitable for other animals and plants. They are one of the most common creatures in the world. It is estimated that for every human being there are at least 1.5 million ants (Hadley: 2011).

Classes of Ants
An ant colony generally contains three classes of members. These are the workers, the soldiers and the queen (Fig.2). The queen’s duty is to reproduce after being mated by the few fertilizing males who die almost immediately after the nuptial flight. The soldiers set up the colony, procure a new living environment and hunt. The workers, all of whom are females, take care of the queen and her babies, clean and feed them. They also build new corridors and galleries for their nests, search for food and continuously clean the nest.

Types of ants
As already pointed out, there are about eleven thousand known species of ants. However, as at 2006 there are 11,880 known species (antsuff: 2011) while other scholars discovered that there are over 12,000 species (Hadley: 2011). Among the few studied types are the following:

a. Army ants.

b. Carpenter ants.

c. Weaver ants.
d. Slave-maker ants.
e. Jack jumper ants.
f. Fire ants.
g. Honey pot ants.
h. Leaf-cutter ants.
i. Bull dog ants.
j. Little black ants.
k. Yellow citronella ants.
l. Crazy ants.
m. Big-headed ants.
n. Pharaoh ants.
o. Bullet ants.
p. Gliding ants.
q. Lemon ants.
r. Atta laevigata.
s. Argentine ants.
t. Thief ants

1. The Ant Nest: a Socio-spatial Structure
Though there are many types of ants most of them make their shelter underground. This shelter is known as nest (Fig.3 and 4), which, as we shall see, consists of tunnels connecting many chambers each of which has a designated purpose (Rooney: nd). It is also important to note that although each ant specie has its peculiar and specie-typical nest there are elements that are common to all. All ant nests have tunnels which serve both as a passage and a linkage from one chamber to another, the only difference being in the number and size of the tunnels and the

Fig.3 Ant nest (Source: lineage.pmfun.com)  Fig.4 (Source: estatevaults.com)
chambers (Tschinkel: 2003). Another common element is that each chamber is reserved for a special purpose. Some scientists are of the view that ants live underground because of the following reasons:

1. Safety from predators most of which live above ground.
2. Easy access to food as greater portion of ant’s diet comprises of things on or underground.
3. Protection from heavy wind.
4. Food storage
5. Adaptability (ehow: nd).

There is generally a single entrance to the underground nest. What comes next is a simple vertical tunnel which connects to horizontal chambers in a ladder-like fashion. The hill with which these chambers are interlaced is in most cases an entrance to these underground warrens as well as the result of the incessant digging of the ants (Hinckley: nd). It is simple piles of fine soil, sand or clay and with pine needles sometimes. The chambers serve different functions (Fig.5). Some are reserved as store for keeping food, others serve as a garden, and others as refuse dumping areas while others are brooding spots. Some chambers serve as nursery while others are areas where larvae of other species are tended (Hadley: 2011). The queen lives and is fed in special chambers (Hinckley: nd) wherein she continues to produce thousands of eggs. Ant larvae and eggs are stored in other chambers. The underneath tunnel can go straight down for up to fifteen feet (Fig.6) (Sanders: 2000). Most of the time workers, brood and queen are concentrated in the intermediate and lower pats of the nest while the upper sections contain a number of empty chambers, sometimes filled with refuse (Buhl, et al: 2005). While vertical
tunnels are for transportation and movement horizontal chambers are for work, storage and brood housing. Simply put, ant architecture is generally a single cave which is excavated underground which eventually grows into enlarged chambers with vestibules and connecting galleries. Eventually, these develop into vast and deep-storied rooms and avenues downward (antcolonies: 2010). Nest starts when a newly mated queen digs a tunnel and rears her first few larvae. By age the adult workers sort themselves. The oldest does the upper part while younger ones perform the deeper work. They dispose of any garbage which they found in this way and carry tiny bits of dirt and garbage in their mandibles and drop them outside (Sander: 2000). The queen goes to the nether nest and starts laying eggs as chambers and corridors are added. Young workers start out low in the nest engaging in general nest maintenance, food preparation and seed storage until they become guards, trash collectors and foragers (McClintock: 2003). The queen’s duty is to ensure the continuity of the specie by laying eggs. Male ants are assigned the duty of mating while most females work. Some of the responsibilities of the worker ants are nest building, patrolling, colony defense, brood tending, foraging (Holldobler et al: 1990 in Scwander et al: 2005), enslaving, fungus culturing, refuse disposal, etc. While foraging is done by older workers brood is taken care of by the younger ones (Robinson et al: 2009). Though responsibilities are distributed accordingly ants shift duty in times of emergency. For instance, worker ants transform into feeder ants when there is dearth of food. They feed others with the food particles contained in their reserve stomach (Yahya: 2006). After carefully studying the ants and their behaviour scientists discovered that ants possess a spirit of unselfish unity, sharing spirit, strong sense of discipline, action in time and spirit of saving (Vpaulose: 2010). Ants are a nation as we are and their building architecture is older than that of human beings (Al-Kaheel: nd).

Structure of the Gandu type of residence

Gandu is a term used to refer to a residence that houses an extended family. Gidan Gandu technically refers to residence in which generations reside. It begins when a man builds a house and resides in it. Eventually, whenever one of his male children gets married he is given a piece of plot within the compound to build his own residence. The number of residences within that compound progresses with increase in the number of married male children. Gradually the house comes to contain a large number of people and, in many instances,
generations. *Gandu* house can be paternal (married sons living with their father) or fraternal (married brothers continuing to live together after the death of their father) (Goddard: 1947).

The fence surrounding the house may be built of baked earthen bricks which is thereafter mortared and plastered with earth-dung-straw mixture. The wall could also be of cornstalks (*Darni*) (Fig.7) or of a straw mat (*Zana*) (Fig.8) (Barkow: 1973).

Fig.7 *Darni* (Source: Author)  
Fig.8 *Zana* (Source: Author)

Rooms are arranged within or around an open courtyard (Fig.9) with adequate provision for segregation of the sexes (Moughtin: 1964). House entrance is through the general entrance hall (*Zaure*) after which passage rooms (*Soraye* sing. *Soro*) follow with entrances posited at different points. The number of these passage rooms largely depends on the socio-economic status of the house owner. Circulation from the entrance room into the private realm of the house is, in some cases, through a courtyard which normally house the huts of male guests and unmarried male youths. Around this courtyard are entrance halls of the various quarters in which the individual families that constitute the extended family reside. In some cases both personal farm plots (*Gayauna*) and the family farm are within the compound but in other cases these are outside of the compound. Besides the general granary, thrashing and winnowing yard (Fig.10), each part has its own courtyard. General granary is in most cases situated near the compound head’s hut (Greenberg: 1947).
The compound head has his well-defined privileges and obligations. Besides assigning farm plots he sees to it that every adult male works on the communal farm from Monday to Thursday each week. He also provides farm equipments and seeds (Greenberg: 1947). Adult males are assigned the responsibility of feeding the entire family through cultivation of the family land, though they sometimes engage in livestock, craftwork and trading. Women thresh, winnow, grind and sift the cereals. They are also charged with the responsibility of cooking and sweeping of the compound. Unmarried women gather firewood and fetch water. All members have a share in the common harvest (Solivetti: 1994). A portion is given out as Zakat and the remainder is sold so as to meet the domestic expenses. Consumption of the harvested cereals is delayed as long as possible into the dry season or even through the next harvest (Greenberg: 1947).

**The Gidan Buzu**

A typical Gandu residence which is taken as a case study in this paper is the Gidan Buzu (Fig.11) in ‘Yargaya’ ward, Dawakin Kudu Local Government, Kano State, Nigeria. The house was built by a man whose name was Buzu around 1904. After his death his five male children continued to live in the house and each has his own family. The eldest son is now the compound head. It is therefore a fraternal Gandu. The five sons are Alhaji Alhassan, Mallam Mu’azu, Mallam Sule, Alhaji Musa and Mallam Ado. Presently, this house contains more than ten different families.
The house has a main entrance through a main entrance hall. Next is the compound mosque for the five daily prayers. Adjacent to it is a way that leads to different parts and sections of the house. There are about five main loosely partitioned parts (Fig.12) each of which contains different sections. Each part belongs to a son who also lives along with his married sons. There are the main linkages to the main parts of the house and within each part there are minor linkages that connect the different sections contained in each part. All house members therefore interact with one another on daily basis. Each part
and section has its own open courtyard. The courtyard (Fig. 13) comprises of the cooking area, dish-washing spot, granary, animal stands, well, pounding and grinding area and thrashing and winnowing spot. Rooms are of flat roofs with chutes posited at the edges for draining away rain water. Each part and section contains at least two rooms and a bathroom. Both the communal and personal farm plots are outside of but not far away from the house. Older parents no longer cook as they are served with breakfast, lunch and dinner by their married sons on daily basis. Son’s wives cook for the entire house, turn by turn and the husband of each wife whose turn is due pays for all the expenses. Thrashing and winnowing are done daily and turn by turn by a segment of the son’s wives. Grinding is done by another segment while others sip the grinded cereals. The actual cooking is then done by the wife whose turn is due.

![Fig. 12 A loosely partitioned part (Author)](image1)
![Fig. 13 Some items in the courtyard (Author)](image2)

**The subconsciously mimicked aspects**
The following are some of the aspects of ant’s socio-spatial life which are subconsciously imitated in the *Gandu* type of residence:

1. **Spatial organization**
The ant nest, as was earlier pointed out, contains chambers with assigned functions. The queen and her guards reside in some while other chambers shelter soldiers, foragers, workers, patrollers, fungus garden, etc. Every space in ant nest therefore has a designated use and purpose and none is wasted. This aspect of spatial organization is subconsciously imitated in the *Gandu* residence. For instance, in the *Gidan Buzu*, besides the public realm which contains the house...
façade, large entrance hall and the mosque, the private realm of the house contains parts and sections. There is the granary section, the compound head section which contains his own personal and private area (Turaka), wife’s room, room for unmarried children and the parts where his married sons reside. The other four major parts of the house contain his brothers and their children. There are also major and minor links which serve both as passages and linkages. The major links connect the five loosely partitioned parts of the house while the minor ones link the different sections within each part. The parts and sections are fenced either with earthen bricks, cornstalks or straw mats. There are some mini gardens in some parts which, as I learned, belong to some wives. As ant nest contain chambers where larvae are tended the Gidan Buzu also contains spots where sheep and goats, chickens, guinea fowls and ducks are reared. Some of these are reserved for the general use of the house while some are personal. Chambers in ant nest serve specified functions. Whenever a chamber is added there is a purpose which it should serve and the number of chambers is in accordance with the need of the colony as the population increases. In the Gandu house number of rooms is increased when needed. Similarly, parts and sections expand as the number of married sons increases.

2. Building Materials
The chief materials which ants use in making their nest are earth, pebbles, sand, clay and leaves. Tunnels which connect chambers are carved out of earth and partitions between chambers are made from it. Most ants build their nests underground (Tscinkel: 2003). Even the hill contains no more than piles of fine soil, sand or clay. The Gidan Buzu is built of earth, which was dug from burrow pits, mixed with straw, weed, animal dung and seeds of locust bean tree, all mixed together., soaked and trampled by foot for several weeks and used in brick-making and plastering. Some roofs are of trunks of palm tree, straw mats, gravels and soft dry earth while others are of jute, cornstalks, weeds and straw mats. The former are flat while the latter are conical. Partitions between rooms are of earth while those between house parts and sections are loose. Some are of earth and some are of straw mats (A.Adamu ‘Yargaya). It can be inferred from this that both humans and ants use environment-friendly, non-radiative and naturally available materials which can easily be recycled. When the ant uses sand, earth, clay and leaves humans in the Gandu house use earth, straw, weeds and seeds all of which pose no danger to the environment.
3. Communal Spirit and Cohesion

Of all the insects so far studied ants are discovered to be the most social and the most successful. It is believed that their success is underpinned by their social organization and the commitment of each individual to the survival of the colony (Di Caro: 2004). They do everything together which includes nest building and maintenance, foraging and patrolling, brood tending as well as protecting the social and territorial integrity of the colony. They succeed in doing all this through a beautiful distribution of responsibility. For instance the small ant has limited tasks in accordance with its size but the youth and the strong defend the colony, process food and accomplish other onerous tasks (Al-kaheel: nd). The ant share everything, including a drop of water. Whenever one finds food it spreads pheromone all along its way back home and informs others about it. They follow the pheromone and carry the food home. Though the ant world is highly populated this spirit of sharing serves a lot in preventing chaos and destitution. Their self-sacrifice is therefore very advanced. Ant has the humility to follow the leader (Pavlina: 2009). In the Gidan Buzu seniority prevails as the compound head commands respects among all house members. Some elder and close neighbours of Gidan Buzu with whom I discussed (M.Haladu and Alh. Tata) informed me that the following are what obtain in the house:

i. Seniority

The compound head is consulted over every issue. He advises, admonishes and calls to order. He organizes and oversees the family’s participation in neigbour’s or relative’s event. He is also responsible for circumcising all the male children in the compound when their time is due.

ii. Co-operation and mutual assistance

There exist mutual love and concern for one another in the family. The three daily meals are taken in groups; elders, married children, unmarried children, wives and mothers. Each group eats separately. All participate in building a new residence for a married son and all partake in general house maintenance. When one is absent for a long time or dies his dependants are adequately catered for under the general supervision of the compound head. Food grains are given to a newly-married son to allow him to settle before he starts harvesting his own.
iii. Respect for elders
Every child in the House considers all elders as his own parents. In fact one caters for someone’s children while his own are catered by someone else. There is therefore no room for a child to give regard only to his biological parents.

Thus as sustainability of the ant’s architecture and brotherly spirit is ensured through their communal spirit so also do cultural and architectural sustainability in the Gandu house becomes realistic and easy by their communal living. Skills, culture, etc., are easily passed on to the younger members.

Solutions drawn from ant mimicking
After carefully examining the above-mentioned aspects of ants life and the extent to which it ia subconsciously mimicked in the Gandu residence, particularly the Gidan Buzu as a case study, It is discovered that solutions to some of the problems of man which he faces today can be drawn. This includes the following:

i. Enhancing vernacular architecture
This type of architecture is proved to be environment-friendly and responds better to the climate and local culture (Marwa: 2009)18. Besides energy conservation and application of materials that are eco-friendly vernacular architecture also preserves cultural heritage through sustaining tradition, craftsmanship, culture, etc. Vernacular architecture is not only 'green', environmental and economic but also social and cultural (Slavica: 2002)19. Using local building material to construct housing that makes such good use of passive energy that almost no extra energy is required to maintain it is one of the remarkable features of vernacular architecture. It combines the dual benefit of providing comfortable living environment and having minimum impact on the natural environment (Mukarami and Toshiharu: 2008).

ii. Space management
The ant builds its nest according to the various functions which the nest is expected to serve. For instance, besides being a shelter, ant nest is also a farm a store a culturing spot, and a manufactory. The Gandu house is also a school, a place of worship, a court for settling disputes, a farm, a family cohesion centre and a manufactory as local crafts are practiced. No space is left idle and unused without a designated function. Space is reserved for sheep and/or goats. Similarly, there are spots for ceramic pots containing drinking water.
There is also an area for chickens, guinea fowls, etc. It is due to space management that both ant nest and Gandu house are able to cater for large population. Dearth of shelter is therefore substantially avoided if space is properly managed.

iii. Family cohesion
This is particularly important in a world devoured by naked individualism in which the term family is gradually disappearing from its vocabulary. The Qur’an calls on the entire human race to respect the ‘wombs’ which is an indication that the family should not be left to weaken or collapse. In the ant nest and the Gandu residence not only the nuclear family but the entire extended family is preserved and protected from weakening. About four generations now reside in the Gidan Buzu in spite of which dispute is very minimal. Wedding and naming ceremonies as well as mourning are considered a collective concern. The family is therefore safeguarded.

iv. Promoting sustainability
From mimicking the ant’s socio-spatial structure sustainability is promoted. This is largely because:

- The architecture responds to function, climate, natural forces, local resources and culture. This is a vital pre-requisite for a sustainable house development.
- There is therefore a direct relationship between the builder and the building and its environment.
- This architecture entails maximum utilization of naturally available energy to its own benefit.
- All building materials are grown and available on the land. A palm tree, for instance, serves as a wind breaker, fruit bearer, a food, a seasoning condiment and fuel. When needed as a building material it is also available (Sa'ad as quoted in Barkindo: 1989)
- It is designed to be reused or recycled as a whole or in part at the end of its (long) life. This is because if such a house were to be demolished the bricks, the earth, the palm trunks, etc., can be reused in building another house.
- It is artistic; because it satisfies aesthetic standards and sensibilities.
- It is also functionally effective.
- It is a low-cost architecture. This is because it requires no drawn pre-building plan or expensive quantity surveying.
• It is low-tech as it carries simple solutions. For instance, roof leaking requires only scratching of the earth roof and some little refills.
• It is equitable as it allows architecture to be accessible to everybody now and in the future and not just to the wealthy. (Primer and Diprose 1994-2010).

It therefore sustains, to a larger extent, human life and culture, the human-ecosystem, the built environment and individual architectural artifacts.

Conclusion
After examining ant nest and the Gandu type of residence in Kano, taking Gidan Buzu as a case study, the paper discovered that there are great similarities between the ant and humans in terms of social organization and building architecture. The paper also discovered that there are some socio-spatial aspects of ant nest which are subconsciously mimicked and integrated into the human built environment as is reflected on the Gidan Buzu residence in Kano. The paper also found out that though there are many species of ant they all share some common elements which humans can easily mimic and solve some of their socio-spatial problems. The paper therefore concludes that there is the need to imitate the ant for the realization of sustainable residences which are both eco and family-friendly as is evident on the Gandu type of residence.

References


**Discussants**

