



Performance evaluation of indigenous earth dwelling in rural area of Nigeria

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ABSTRACT

According to 2006 census the vast majority of household live in the rural area of Nigeria, inhabits indigenous earth dwelling of various typologies. These accounted for thirty five percent of total national housing stock. They are characterized with deterioration and dilapidation. Ensuring an adequate performance level of well built earth dwelling, it requires high level of maintenance. Furthermore, many of these structures are built in ignorance of rules and regulations of good building practice. The focus group of professional especially architect and builder were organized to coordinate the study process, ensuring adequate evaluations of issues that can facilitate improved performances of earth as a building materials. The attitude of lack of maintenance was also considered and observed. Their recommendations are evaluated and classified according to issues and strategies: Seven prevailing factors facilitating fast deterioration of earth dwelling were identified. The study recommended fundamental strategies that could help to: Upgrade traditional building, Improve the performance and durability of earth dwelling, Reduce the amount of maintenance cost required by ensuring adequate building precautions and to create a practical and affordable construction based on local practice.

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Introduction

Housing has been universally accepted as the second most important essential human need after food. Rural housing in all its totality is more than mere shelter since it embraces all the social services and utilities that make a neighborhood habitable environment. In all the earlier studies by Arayela (1999), it became obvious that the past 50 years there are massive migrations of rural dwellers to urban areas. This is as a result of poor state of rural housing, which vast majority of household lives in rural areas and in recent census conducted it was reported that 70% of Nigeria population still lives in the rural areas.

In view of the finding in surveying analysis conducted by the Department of Architectural technology, Osun State College of Technology Esa – Oke. The rural housings are characterized with dilapidations, deterioration and chaotic situations, which are unsafe for human living. It has been generally observed that 96% of the indigenous earth dwelling had failed in form of multiple cracks, collapse and leaking roofs (field work unpublished).

Rural areas are remotely located to barest civilization which is a pointer to the grievous and terrible living condition. The upgrading of rural housing for the ultimate goal of lifting the standard and quality of living condition of rural dwellers is basically essential. This will enhance social-economic situation and overall development of rural dwellers.

Most rural dwellers are only responsible for mainly the provisions of earth structure without giving adequate attention to effective management of such structures. With the extensive damage this attitude has done, shift and orientation emphases are very necessary. If a satisfactory service is to be provided for the rural housing in comparism with the important role housing play in the lives of the rural area, maintenance practice must be given a top priority. Although, large programme of new house

building may continued for many years with the adequate knowledge of earth as building material. It should still be appreciated if good maintenance measures in the existing housing stock are administered. Available housing should be utilized in the best possible manner to achieve the greatest possible satisfaction of the various housing needs. Furthermore, in order to achieve the objective of improving the performance of indigenous earth dwellings, education and re-orientation of rural dwellers in the most efficient manner on the adequate of holistic knowledge about earth and maintenance culture must be embraced. Urban centers do not actually hold the promise of a good life because, infrastructures are overstrained and housing conditions are of poor qualities due to over crowding, Illiteracy, ignorance, and lack of proper construction process (Onokerhoraye, 1776, Jagun, Wahab, 1990). Rural housing stands an outstanding priority in the development of rural area. The rural areas of Nigeria suffer a high magnitude of housing inadequacy which manifests in qualitative terms rather than quantitative. There are monumental deficiencies in the quality of the buildings which in most cases are unsafe for human habitation. The buildings are usually built with poor quality materials by inexperienced builders, in violation against good-building practice and standard, such as inappropriate-building orientation, lack of effective foundation and unreliable building material place the building technical performance under contention (Olotuah, 2001).

Structural failures in earth structure are common and of great concern in rural area of Nigeria. It is an open fact that every rainy season leaves a trail of wall collapses and more roof leaking points, putting functional and behavioral elements of building performance into question.

Rural housing upgrading is thus essential in order to effectively improve technical, functional and behavioral elements of building performance. Those that is absolutely

unsafe for human habitation must be completely redeveloped. Detail report from focus group shows that rural dwellers built with available materials at their disposal not find out soil suitability and without appreciable measures of maintenance on regular basis. This attitude has a damaging effect on the earth structure. The development of rural housing offers the opportunity of meeting national objectives, providing standard rural housing procedures of international standard. Stemming rural-urban drifts as a result of lack of employment opportunity in rural area, this will enhance job creation through development of cottage industries, markets, and schools. (Wu, 1979). This is the reason why rural housing deserves necessary attention to make them habitable socially and economically. This study is intended to be exploratory, the goal of which is to gather information from rural dwellers especially the local housing developers that have been involving in construction process of indigenous earth structure in the rural areas of Nigeria. A preliminary analysis of the rural dwellers is very necessary to elucidate their building plans, knowledge and to provide various suggestions for optimum building performance. Furthermore, three important questions are asked about the feasibility of each suggestion: is it expensive? would it be effective? and does it align culturally?. It has been observed by focus group that some of the ideas are ambiguous, while others deserved serious considerations. These rural suggestions are presented in two parts; the first part is an initial exploration of the feasibility of the focus group which includes a list of most general applicable ideas. The second part of the analysis is a presentation of suggestion by focus groups. It is offered to guide the planning process of improving the performance of indigenous earth dwelling. It has been suggested by focus group that there are seven fundamental issues associated with earth as a building materials and seven types of strategies for addressing them. The paper then concludes with recommendation for practical guide lines that will enhance improved performance of indigenous earth dwelling.

The Study Approach

The study used focus group to engaged rural dwellers in guided interview and discussion at the rural suburbs of Nigeria (Krueger, 1994). The participants are experienced local house developers from rural dwellers, the focus groups were led by research fellows, who are aided by a discussion guide developed through prior interview with earth consultants, experts in building local houses with indigenous material especially earth. The focus groups are a form quantitative researches in which purposely-selected participants in the field of study are interviewed in a group setting. Such setting increases the efficiency of interviewing and interaction among the group members, it leads to more insightful response than attained through individual interviews. Such a pattern suggests the probability of a generalized view within the population being studied. Focus group also carried out structural failure investigation, by collecting soil samples used for earth construction by local builders to determine the relative quantities of soil fractions in the soil samples.

Housing Situation at the rural areas of Nigeria

Having carried out detailed studies in six states that span through Northern, Southern, Western and Eastern parts of Nigeria with the aid of effective professionalism in focus group. The prevailing housing situations in rural area are characterized with lack of good quality control measures in the material process. This resulted in several multiple cracks failures and wall collapse. The performance evaluation of earth dweller is very low due to unsuitability of soil for construction,

incompetent builder and unacceptable low standard of workmanship, among others.

From the study, higher percentages of those building about seventy two percent have been existed for over thirty years without any maintenance measure administered over time. Majority of the rural housing stocks have been cracked, partly collapsed, dilapidated and unsafe for human habitation while those built in recent years constitute 18%, however there exists a correlation between relative habitation and age of the building. Fadamiro (1995) strengthens further that technical, functional and behavioral element of those building falls basically as traditional process, thus presenting an organic composition to maintenance and adaptability. These findings therefore emphasize the need for a comprehensive programme of effective rehabilitation for the improvement of technical, functional and behavioral performance of the existing rural indigenous dwelling.

Construction materials and technology

Clay form the commonest material upon which wall constructions are based as ninety nine percent of all the buildings are constructed of earthen material. However the use of earth as a building material does not in itself build substandard and poor quality housing, but inability to strict adhering to adequate measure with regard to constructional detail and constant routine maintenance (Norton, 1997). Earth of different typology exhibits different characteristics that may or may not be suitable for construction. The constructional processes that will enable high quality outcome depend apparently on the properties of earth material used. Minke (2000) identified the following properties:

(a) Strength

Earth employed in building has an appreciable strength in compression, but it is weak in tensile strength especially when damp. When earth is used as a load bearing material, forces must be transmit within the thickness of the earth structure to the ground. Therefore the recommended thickness for monolithic load bearing earth wall is between (450mm and 900 mm). However, it is possible to construct slender wall, such as arches and vaults if the slender structure is being supported while drying out. Furthermore the compressive strength can be increased by compaction, which of course raises the density of the structure.

(b) Durability

The durable nature of the earth materials for building construction is obvious from ever durable traditional earth buildings that have survived centuries of continual use.

Compaction, additives and surface coating improve the durability of earthen material reducing the effect of tendencies of abrasion. Earth building in a local damp environment need to be protected from prolonged water contact. This can be achieved by placing the walls out of reach of ground water and splashing by protecting the wall from rain splashing with an adequate roof overhang and by protecting the exposed surfaces with breathable surface coating. Impermeable surface coating to earth wall should be avoided, because it traps water within the earth wall therefore encouraging rising dampness and it shrinks as drying out this can be improved by addition of straw.

(c) Thermal Properties

Dense form of earth construction have high thermal mass and are able to store heat and thereby releases it slowly to balance indoor climate. Furthermore the light non-load bearing form of earth construction are resistant to heat flow and provide good insulation. It has been proven to alter the thickness and

weight of earth material to achieve different thermal effect to satisfy particular needs in different context.

(d) Humidity Regulation

Earth is able to absorb and release humidity which thereby balance indoor climate. The humidity is absorbed by the walls and slowly released to the atmosphere thus reducing condensation, which prevents fungal growth.

(e) Fire Resistance

Earth building materials are fire resistant unless they contain significant amount of fibre. It has also been proven according to German building standards, that earth with a high straw content is not combustible if the density is higher than 1700kg/m^3 . Light earth fibre mixes are fire resistant and can be enhanced with the use of earth (G. Minke, 2001).

Identified Problems Associated With Indigenous Earth Dwelling.

The specific issues generated by the rural dwellers are being developed into categories that could help to identify prevailing problems affecting the adequate performance of earth dwelling. The following issues were generated on the field carrying out this study.

(a) Inadequate strength attainment in the present of dampness

It has been established during the interview with local housing developers that excess moisture added to the earth when building or to the earth structure, causes shrinkage. According to focus group report, it has been reported that water has tendency of re-mix with earth to affect the strength. Furthermore the materials composition of earth allows the absorptions of moisture by capillary actions. The structure deteriorates gradually as it absorbs moisture, which weakened the structure and leads to total collapse.

(b) Building site posed another greatest threat:

Focus group participants reported that earth structure vulnerable to cracks and decay in a location that always flooded, wet or in a terrain that encourage erosive effect of driving rain. Earth building exposes to decay which lead to crack, as the building site experiences differential settlement, cracks form the weakened point for moisture attack in earth structures. This study showed that the degree of compaction of the building site determined its load bearing capacity, instability of the site give rise to uneven settlement resulting in cracks. A similar experience happened when a firm soil strata has not been reached before construction of the foundation.

(c) Attack of low level and high level erosion:

The rural dwellers frequently emphasize the base of the wall just above the foundation level as highly vulnerable to low level erosion. This is as a result of rain water dripping from roof levels to ground surface and splashing into the lower part of the earth structure, thus weakens the earth. This resulted in decay and deterioration of the affected lower part(s), it often leads to partial or total collapse of the building. The rural dwellers comments on the increase of erosion of the surface of the wall at higher level showed that it is usually cause by inadequate roof eaves overhang or dripping of rain water splashing on the surface of the wall at higher level. Thus weaken the earth, resulting in decay and deterioration of the building fabric

(d) Inappropriate roof covering and inadequate foundation detail:

The reports from focus group showed that some of the roof coverings are inappropriate while others have been won out over time due to weathering. They are ineffective, causing ineffective covering to the earth structure; therefore moisture from rain remains a threat to earth structure. In all the rural areas surveyed 99% of earth the structure lacks basic foundation because rural

housing developers start construction of foundation on shallow escalated top soil that lack bearing capacity. This resulted in multiples cracks due to differential soil settlement as a result of pressure of earth wall on compressible top soil. Also because of lack of proper maintenance practice of local dwellers such cracks lead to absolute collapse.

(e) Cracks defect in earth structure

The report from focus group shows the complaint of rural dwellers of low tensile strength of the earth building materials as the commonest problem with earth dwelling. Cracks are found at corners where tensile stresses are greatest, such as in window and door opening. It was also reported that once cracks occur each adjacent wall is free to move, so differential movement will resulted in falling apart of the wall.

The focus group participants reported that unsuitability of earthen materials and poor workmanship could be responsible for weakness at the corners. They also reported that algae, lichens and other micro organisms grow colonize outside the surface of the earth structure. Their presence also causes surface erosion and micro-cracking on the building.

(f) Common problem of wattle and daub

Wattle and daub are vulnerable to structural rottenness, they are common to Southerners and Easterners. It could be attacked by damp causing damp rotting of wattle skeleton; also it could be attacked by termite and insect feeding on them. This creates a situation of no structural support which leads to collapse of the earth structure.

(g) Lack of Routine Maintenance Practice

With the general observation of focus group, majority of the rural dwellers just build and inhabit the house until total collapse of the structure. No adequate planned programme of maintenance practice from time to time on earth dwelling, this lead to absolute dilapidation of indigenous earth dwellings in rural areas.

Findings and Discussions

In the content of this study, focus group was engaged with local housing developer in interview and discussions. Comments from the discussion are categorized into the following performance indicators.

(i) Suitability of building site for earth structure.

(ii) Selection of preferred earth building technique and suitability of workmanship that matched with standard.

(iii) Consideration of suitability of soil for construction work.

(iv) Designing an-earth building that will enhance structural strength and durability.

(v) Detailing precautions.

(vi) Effective external Fabric protection.

(vii) Frequent repairs and maintenance measures.

Understanding Earth as a Building Material

The focus group report suggested that adequate understanding of earth as a building material will enhance performance evaluation of indigenous earth dwellings as its passionate advocates but not just to build with earth because of its availability but must understand the nature and behavioral pattern of earth under different conditions.

Earth is vulnerable to weakness according to rural dwellers, in the presence of damp it loses much of its comprehensive strength. Earth dwellings has tendency of re-mix with water to reduce its strength, it extremely susceptible to heavy rainfall, splash-back erosion, seasonal and non-seasonal flooding. This will either cause shrinkage or decay to earth structure (John Norton, 1997). It is important to note that adequate draining of water away from earth dwelling will eliminate the threat posed by the presence of water. Furthermore, according to focus group

reports, it was established that earth is weak in tension but has appreciable compressive strength. The critical constraint in using load bearing earth is the slenderness of the structure, since the lack of resistance to bending has to be compensated for by greater width in the structure to maintain stability. Their reports corroborate further that soil composition of the earth construction is paramount important; majority of rural housing developers have no adequate knowledge about the right earth composition for the earth walling. They use earth in wrong context that will not guarantee strength, durability and quality control of earth dwelling. In effect, there are soil which are extremely sensitive to the effect of water, expanding greatly when wet and shrinking when drying out. This is destructive in earth dwelling with a great deal of multiple cracking. Observations of existing rural earth dwelling provide best information about the local soils. Rain and wind had destructive effects on these local buildings with multiple cracks and absolute collapse. This is as a result of inappropriate soil composition, poor workmanship, poor roof cover, inadequate roof eaves overhang and lack of maintenance.

A great variety of construction techniques have been identified by focus group in response to local soils and weathering actions. In accordance to this study, inappropriate construction techniques resulted in poor quality earth structure associated with cracking and structural defect dwelling. The prevailing construction process adopted in different part of Nigeria includes:

- (a) Direct moulding in western area with the form of multiple cracking and dilapidation due to inability to compact very well.
- (b) Wattle and daub and direct moulding in Eastern and Southern area which reflect the problem of structural defect due to rottenness of skeletal element of wattle and daub.
- (c) Unfired brick in form of adobe in Northern part of the country which attains relative compaction enhancing adequate comprehensive strength but problem of flooding causes multiple cracking.

Constructional detail of earth building

According to focus report, structural failures in the earth structures are common and of great concern to this study. Raining season leaves evidence of collapse of earth structure and multiple cracks often observed. The following limitations were raised by the participants of focus group.

- Complete absence of adequate constructional knowledge from design to construction.
- Lack of building professional impute in supervision
- Incompetent builder and the use of poor materials
- Low standard of workmanship and lack of quality control in the construction process.

Causes of crack and failure are briefly explained thus:

Hydrometer test at the laboratory reveal that there is a relatively high sand fraction above the recommended limits in the soil sample collected from Western and Northern parts of Nigeria. The average sand fraction content of 78.5 percent is higher than the acceptable and recommended limits on the other hand soils sample from Eastern part of the country reflect high clay content which shows outright cracking as the structure is drying out. This must have affected bonding properties of the earth structure.

Furthermore many of the earth structure have no proper foundations design in structural detail they were constructed on bare earth after shallow excavations. Then due to settlement of the applied load, cracking resulted because of no foundation to transfer the load to the ground. This eventually leads to absolute wall collapse.

Importance of Quality Housing in Rural Development

Rural housing offer opportunity of meeting national objectives of the developmental process of the rural areas and improve the general living condition of the rural areas (Wu, 1979). Also among many other reasons, the fact that rural housing aid development of small-scale cottage industries within the rural setting which include local textile weaving, tailoring, cassava processing, dyeing among others. In the light of this, rural housing enhances economic productivity of the rural dwellers in the recent work of Arayela, (1999) frustration of economic activities are traceable to housing problem.

Housing should not therefore be seen as a service function but an instrument that contribute to economic development. It gives an appropriate shape to the physical environmental development thereby motivating people towards greater productivity. Rural housing have direct effect on the social stability, employment, physical, rural health and education. It also affects the efficiency and ultimate development of rural dwellers. Therefore, performance evaluation of rural indigenous dwelling must recognize the role and significant of housing since no development can be achieved without standard housing plan.

Supporting strategies for improving the performance of indigenous earth dwelling

It would be useful to translate issue and finding obtained by focus group into issue of improving the performance of indigenous earth dwelling in the developing economics, simply because provision of infrastructure facilities is in favor of the urban center. These have led to substandard and dilapidated housing stock, poor living condition, economic breakdown and overall environmental degradation in the rural areas.

To put the record straight according to Mabogunje (1980), improving the performances of indigenous earth is concerned with the improvement of standard of living of the low income rural population through transforming the social-economic structures of their productivity activities.

The ways to measure the practicality of focus group participants is in term of effectiveness of proposed supportive actions include efficient, equity and acceptability.

While several suggestions could be hard to implement, some are rather inexpensive, effective and should not come into conflict with other issues. They include the following;

- (a) Adoption of improvement of performance will eliminate chaotic rural environmental development.
- (b) It will enhance equal distribution of wealth and development between urban centre and rural area, which discourages rural-urban drift.
- (c) It will raise economic production of rural population.

Performance Evaluation Proposal

In view of the circumstances outlined, it seems important to examine ways in which.

- (a) Improving the performance of the existing indigenous earth dwelling.

This study shows that majority of earth dwellings have been damaged over time due to weathering effect and lack of maintenance. Rehabilitation work must be carried out on those that are within the safe limit of structural stability, durability and weather proofness of earth dwelling, the rehabilitation includes:

Roof repairs

Roof covering and inadequate roof members that have been damages should be replaced promptly to disallow rain water soaking in to the earth structure.

Repairs of low-level and high level erosion

Damage causes by rain splash into the external wall fabrics must be repaired using earth mix to fill back the eroded parts. It is important to note from focus group report that cement mix will not be effective because it will separate over short period.

Repairs of cracks defects

Cracks that are obvious to eye must be repairs by studying what are the likely causes, if it is a result of poor workmanship it should be filled with earth mix but if the causes requires experts knowledge, their effort be promptly called for, for effective solution.

Protect the external wall fabric

External wall should be protected because of prolong exposure to weathering effect. Mud plaster can be used to protect it against weathering effect, this is effective because it conform to behavioral pattern of the earth allowing earth structure to breathe and maintaining a fairly constant moisture level.

Ensure that ground level are below floor level and the surface water is drained away from the building

(b) Construction of new earth structure.

New earth dwelling can be constructed using indigenous materials and building techniques that will have improved performance with regard to weather proofness, durability, structural strength and stability. This will reduce the maintenance burden to appreciate level for rural populace. The construction process must conform to national building regulations, meeting the necessary requirement of local housing authority for appropriate recommendation for practical steps.

(c) Policy issue on improving the performance of rural housing.

Vital to improving the performance of indigenous earth dwelling is to develop maintenance inspection scheme, that will monitor effective performance of indigenous dwelling, determine when those structures need maintenance, type of maintenance to be administered and to determine when those structures are reaching the end of their life cycle.

The maintenance inspection would need to be established through synthesis of National and local policies and programmes. This will includes investigation of the history of earth dwelling, category of failure. The result of investigation would verify design parameters, the conditions of those structures to develop maintenance priorities and frequencies needed to monitor the performance of indigenous earth dwelling.

Recommendations

The information obtained from this research comes from vintage point of highly professional involvement in delivery effective housing system for rural areas in Nigeria. The challenge is to reflect how this information might be used to develop guidelines for improving indigenous earth dwellings. It is also to foster the co-existence of functional environmental development. The following recommendations have been put forward, to act as guidelines in enhancing the ability to safely and effectively improve indigenous earth dwelling.

In order to be effective and to avoid aggregation of existing problems, the following practical guide will help for site selection, through construction and maintenance that enable true professionalism in design and construction.

Choosing suitable site for earth building and appropriate soil composition for earth building

According to focus group report, earth building requires stable site which do not flooded and providing some weather protection from erosive effect of driving rain. Knowledge of earth as a building material by rural dwellers is important for

excellent performance of earth dwelling from selection of soil through construction and maintenance processes. Moisture must be perpetually drained away from the earth structure, its external fabrics must be protected against moisture, it must render impervious to moisture and preventing the clay from losing its binding capacity. Choose suitable soil for earth construction is vital to overall durability of the earth dwelling. Adequate knowledge that guards balancing the acceptable level of clay, sand, silt and water is essential in construction of earth structure. The crucial features of the appropriate soil composition must be understood, it must contain at least five to fifty percent clay to achieve bonding. This must enhance effective cohesion and waterproof ness that will enhance durability of earth structure. In building with earth, necessary modification can be carried out in an unsuitable soil by adding necessary composition that will affect adequate cohesion and waterproofing.

Choosing suitable earth building technique

There are different earth-building techniques requirement for different soil mixes. This study showed that most of rural area visited used direct earth mouldling, which are not frequently effective because of inability to compact well and is usually accompany with shrinkage and cracking, the known technique has been identified suitable. Rammed earth, poured earth, adobe, pressed brick, wattle and daub each of these techniques has different mixes that must be abided with.

Design of earth Building

Good design take account of the limitation of the earth to be useful as building material, it must be used as thick wall built of limited height. It must be designed in such a way that all forces must pass down within the thickness of the structure to the ground. The structure to maintain stability, also openings and joinery must not pose a threat to the stability of adjoining walls. Opening should be kept out at least 50 CM away from corners of walls. Joining should not be positioned in the thickness of the wall in such a way that when the door or window is opened it will pivot on the corner edge of the openings. An experienced earth designer can assist with design that works for structure and durability.

Detailing Precisions

There are rules to be strictly abided with if the earth structure is to be improved for effective performance. Indigenous earth structure requires good foundation that will discourage moisture absorption and protection from foundation. It must be effective in preventing rain splash that causes lower erosion, also must discourage any rising damp that weakens the lower part of the structure. Roof eaves overhang must be adequate to discourage upper level erosion. Structure orientation in which majority of rural dwellers are ignorant of causing majority of weathering effect on earth structure. It must be positioned to minimize exposure to prevailing rain bearing winds as this will protect external wall that are in direction of rain. (John Norton 1997). The choice of protection must be done carefully, within the most effective limits the best protection to be used is earth itself, difficult with many other protections is that it will not adhere well to earth structure especially unstabilized indigenous earth walls. In particular cement does not achieve a chemical bond with earth because of seasonal changes. In this condition, difference of rates of expansion of different materials lead to cracking of earth building materials.

Developing Maintenance Culture

Regular inspection of the earth dwelling is always worth while for improved performance of the earth dwelling. Majority of rural dwellers lack maintenance culture they built without regular maintenance practice. The rural dwellers must be

educated for the need for regular maintenance lack of which will result in deterioration of earth structure. This leads to decay, cracking and total collapse. Proper and adequate maintenance will restore the building to effective state of improved performance. On the other hand, it is important to note that better protection cannot replace regular maintenance practice once the protection is affected the wall is exposed. Regular maintenance must prevent absolute dilapidation, whereas lack of maintenance will result in total collapse of earth structure and returning to soil.

Public Education

Environmental education is the process of educating rural dwellers about matters and issues that affect indigenous earth dwelling, such as the nature of earth use, the strength and weakness of the earth, physical attributes that affect the strength and what enhance it. Also the effect of soil, construction technique, site location, roof coverings external fabric affect the structural stability of earth dwelling. Moving concise to the urgent need of environmental education among rural populace is imperative. The government at various levels and non-governmental organization should set up educative programmes, of formal and informal education within the rural communities on indigenous earth structure.

The following educative strategies could be adopted.

- (a) Aggressive enlightenment campaign using local dialect through extension service agent. This involve taking information and learning material to rural areas on regular basis
- (b) Adult education programme, this becomes potential tool in improving standard of living by educating the adult mind about how to take precautions to improve indigenous earth structure.
- (c) The use of conventional materials like poster and bulleting boards.
- (d) The Role of Government and Non-Governmental Organization

Government intervention at various levels is important, organizing programme that will aid improvement of indigenous earth structure. The programmes include emergency rehabilitation of earth structure, such as roof covering, external wall and general environmental development. Also setting up awareness programme that will educate rural populace on importance of maintenance of earth structure. Effort of NGO can be sort fostering strategic support in upgrading the dilapidated rural housing and sponsoring programme that will enlighten the rural populace.

Conclusion

Improved indigenous rural housing performance play an important role in quality of living and socio-economic activities of rural dwellers. Focus group finding support that substandard housing situated at the rural area encourages rural urban drift and discourages local industrial developments, this generated

unemployment problem. Interaction with rural dweller reveal that the quality of life developments is affected because of appreciable rural development need, such as quality housing system that will enhance quality of living education system, health system and industrial development. This research focuses on how indigenous earth building can be adopted and improved to provide adequate and appropriate building performance for a variety of purpose that will enhance rural development. Furthermore to achieve improved rural housing performances a practical improved rural implementation of the above listed recommendations is required for the opportunity of spreading rural development. This becomes tools to enhance socio-economic characteristic of rural dwellers which contribute to overall national economy.

References

- Arayela, O. (1999). Framework for Acceleratory and Sustaining Rural Development in Nigeria. *International Journal of urban and Regional Affairs*, 3(2): 31-37.
- Chup, C. D. (1999). "Complementary Strategies for Sustainable Environmental and Development in Nigeria". *The Nigerian Geographical Teachers Journal* volume No. 1.
- Fadamiro, J. A. (1995). Prevention of Windstorm on building as favour in the production and maintenance of a safe at AARCHES. 6th AGM/Workshop at ATBU Bauchi.
- Gordon, T. Pearson (1992). *Conservation of clay and chalk Building*. London Don Heal Publication.
- Jagun, A. (1983). Urban Housing need estimate in Nigeria Government capacity in its provision. *Journal of business and Social Studies* 4(2).
- Krueger, R. A. (1994). *Forms group: A practical guide for applied research*. Fond on sage publications.
- Mabogunje, L. Akin (1980). *The Development process A special perspective* (2nd Ed). Unwins Hyman Limited London.
- Minke, G. (2000). *Earth construction handbook: The Building Material Earth In Modern Architecture*. W/P press ISBN; 1-85312-805-2.
- Norton, J (1997). *Handbook on Building with Earth*. Intermediate Technology publication Ltd. London.
- Olotuah, A. O. (2000). "Earth architecture palpable option for the Nigerian Building Industry". *African Journal of Environmental Studies*, 1(1&2) 161-166
- Onokerhoraye, A. (1976). The pattern of Housing Benin. *Nigeria in elastic* vol. 41 No 242.
- Peter, S. N. (1995). *Rationale Nature and seeped of Environmental Education*. Macmillan Nigeria Publishers Ltd.
- Wu, Chung-Tung (1979). *National and Regional Development Strategies Implication for Housing Policies in Housing in Third World Countries*. Perspectives on policies of cut pp 36-42.