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Construction Techniques for Ensuring Stability of Agricultural Buildings: Implications for Agricultural Education Programmes in Nigerian Universities

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Abstract: This study focused on construction techniques for ensuring stability of agricultural buildings. The study was conducted in Enugu State, Nigeria. The study adopted survey research design. The population of the study was 113. There was no sampling, since, the number was small and manageable. A 39 items questionnaire titled Agricultural Buildings Construction Technique Questionnaire (ABCTQ) was used for data collection. Three experts validated the instrument. Cronbach alpha reliability formular was used to determine internal consistency of the instrument and a coefficient of 0.73 was obtained. Three research assistants were involved in data collection. Data was analyzed using mean and standard deviation for answering research questions while t-test was used to test the null hypothesis at 0.05 level of significance. Findings revealed no significant difference between mean ratings of agricultural engineers and extension agents on all the 15 items on knowledge of the respondents on construction techniques for ensuring stability of agricultural buildings, 13 items on responses on the role of regulatory bodies for ensuring stability of agricultural buildings and 11 items on strategies for ensuring stability of agricultural buildings. The study concluded that there was need for all stakeholders to adopt appropriate construction techniques because it would ensure stability of agricultural buildings. It was recommended that all stakeholders should collaborate in monitoring construction of all forms of building to forestall failures and eventual losses in farm assets.

Key words: Construction, techniques, agricultural buildings, stability, stakeholders, eventual losses

INTRODUCTION

The incidences of building collapse have attracted greater attention from stakeholders the world over. Building collapse had persisted to the extent that researchers have endeavoured to find out the real cause of the trend. This could be that appropriate techniques were not adopted during the construction process (Ede, 2013). The situation is not exceptional for other non-agricultural buildings because the same builders and technicians are engaged in design and construction of agricultural buildings. Every year, various cases of agricultural building failures are reported (Simpson, 2011; Bohnhoff, 2012). The report by ThinkReliability included a similar occurrence in New York State in 1999. These according to the researchers happened because such buildings were either not engineered or partially engineered. Accordingly, a total ignorance of applicable loads and load combinations is a hallmark of non-engineered building design (Bohnhoff, 2012).

Agricultural buildings are structures designed for farm use and other agricultural practices including but not limited to housing of crops and livestock products (Martinot, 2018). The researcher listed examples to include barns, green houses, storage buildings for farm implements, equipment and animal supplies, storage buildings for harvested and processed crops grown and raised on site and horticultural nurseries. Conceived to host biological production, the farm building constitutes indeed a unique example in the wide spectrum of building construction (Picuno, 2016). Generally, agricultural structures include both low and high cost temporary housing units and permanent structures which may demand long payback periods, thus, the quality of construction materials and other factors is a very essential indicator for the stability of the structures (Belie *et al*., 2000).

It has been reported that over the last two Winters over 4.000 agricultural buildings have collapsed under the weight of snow, costing the agricultural industry £millions of pounds as well as killing and injuring countless animals

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(Simpson, 2011). Elsewhere, another report indicated that in mid December, 2010, a snow event caused a swath of agricultural building failures in Southwest Wisconsin. The structures were a 2 years old free stall barn where members of the household were and their cattle were injured. Investigation on six of the cases by Bohnhoff (2012) revealed that the buildings were not fully engineered. Fortunately, there has been no loss of human life but there were some degrees of injury sustained by members of most of such affected farms. They collapsed because they were poorly designed. It is of great concern that farm-building constructions were not regulated in England and Wales while they are not affected by general building codes in the US (Simpson, 2011).

Several literatures has stipulated that a fully engineered building present calculations of all loads and load combinations to which the building will be subjected and determines how loads are distributed to each building element (i.e., performing structural analysis). It also identifies components and connections capable of handling the forces to which they will be subjected (Bazant, 1999; Mrema, 2011; Bohnhoff, 2012; Buelo, 2015). Bohnhoff added that a fully engineered building also accounts for the interaction of all structural components during analyses and size components based on those interactions. Taking a cue from above it could be concluded that a properly engineered building possess all the characteristics that would guarantee its stability.

Stability of buildings connotes the ability of abuilding to remain firm without experiencing any form of uneven settlement, partial or total failure whether in the construction process or when occupied or put to use (Bazant, 1999). According to Bazant (1999), the theory of stability is of crucial importance for structural engineering because of it important role in tackling problems of space structures, geotechnical structures, geophysical and materials science. The implication of the theory in this study lies on the fact that necessary factors has to be put in place for any intended agricultural building to be stable. Thus, the theory is expedient with reference to the construction techniques for enhancing stability of agricultural buildings which the present study focused on.

Consequently, building failure may involve total or part of its components and such buildings fail to perform its intended function of protection, safety or and in its stability. Stability represents a fundamental problem in solid mechanics which must be addressed to ensure the safety of structures against collapse during construction (Bazant, 1999) and beyond. Construction is a phase in the process of building which begins with the procurement and transportation to the site of materials, equipment, machinery and personnel as well as actual field erection (Mrema, 2011). During this phase, some redesigning may be required due to unforeseen circumstances such as unavailability of specified materials or foundation problems. Nonetheless, certain techniques must be adopted as obvious if buildings are to remain safe.

A technique refers to a way of carrying out a particular task, especially, the execution or performance of an artistic or a scientific procedure (Merriam, n.d.). In the context of this study, construction techniques are those technical procedures that are inevitable in the process of situating an agricultural building in any particular location for definite purposes. It includes those basic construction activities adopted based on certain known principles which begin from building design or drawings and involving other necessary onsite regulation and adjustments made as influenced by the features of the located site of an ongoing construction. This means first having an approved design/drawing, then, testing the soil for recommended qualities for the kind of building, digging the foundation to appropriate height, making a well fortified concrete blind on the foundation and properly filling and compacting the foundation after blinding (Emmitt and Gorse, 2014; Francis, 2014). Other techniques include fitting the rest of the procured and assembled building materials.

Under a normal set up, failures are not expected within the projected lifespan of constructed or built structures. However, due to the imperfection in the actions of human beings and the existence of so many other external factors that influence the safety of structures, failures do occur (Ede, 2013). Environmental factors, material and human factors are major causes of building failures. Human factors such as poor workmanship, lean mixes, absence of thorough site supervision and the use of obsolete equipment are responsible for poor structures in several regions of the world (Akande *et al*., 2016). Accordingly, poor quality materials and insufficient reinforcements were other factors reported as technical inefficiency (Mrema, 2011). Olagunju *et al*. noted poor quality building materials, insufficient filling of swampy areas and location of buildings along erosion prone areas and direction of wind are other major causes of building and structural failures. The case may not be exceptional about agricultural structures because similar building materials, technicians and workers are involved in the process. Failures in buildings and related construction works are direct opposites of stability. The importance of the present study is evident from the history of structural collapses caused by neglect or lack of understanding of the stability which begins from conception of the building design or plan.

Therefore, an effective planning includes a pictorial representation of a proposed building structure which shows all information about it such as various dimensions and other construction details. According to Busby *et al*. a good plan is expected to be well thought out before the actual building of the structure begins and could be accomplished by listing the desired facts about the structure to meet specific needs including size and material resource needs. It has been stated that buildings and the materials used must be evaluated for its sustainability (and stability) (Conti *et al*., 2016). In view of foregoing, a clear, accurate and easily interpretable drawing is touted to facilitate proper building construction. It is quite disheartening, however, that most agricultural buildings are located at the rural settings where non-specialist technicians are the most accessible and are to execute most of the construction operations.

Thus, if a proposed agricultural building structure is in accordance with recommended specifications, it may save time and money and resources, thus, help to avoid the difficulties associated with lack of careful forethought. Some factors to be considered when planning and designing a farmstead were identified and this include the climate, topography and soil type (Erebor, 2003). Meanwhile, construction materials for use in construction that make buildings, generally, stable may comprise of concrete molded bricks or mud blocks or even iron rods or sheets among others (Ede, 2013). One very important technique in construction of structures such as livestock building that could ensure high stability is the foundation because very good and properly laid foundations confer high stability on the building (Buelo, 2015).

Foundation is a fundamental portion which has direct contact with and transmits loads to the ground (Ede, 2013; Emmitt and Gorse, 2014; Francis, 2014). Emmitt *et al*. (2014) the primary functional requirement of the foundation is strength and stability. The obvious role the foundation is to anchor the superstructure against wind-induced-sliding withstand any sudden ground movement and resist any pressure imposed by the surrounding soil mass and ground water on the basement walls (Emmitt *et al*., 2014). The researchers further state that, the foundation aids safe transmission of loads against the building without causing deflection or deformation to the building. It is then, the building is adjudged to stable.

In accordance with the aforementioned, a good foundation, not only for agricultural buildings must consider the geophysical characteristics of the location which include among others, the soil type and the soil profile (Erebor, 2003). This is because those characteristics jointly determine how stable a structure to be built should be. In the same vein, Buelo (2015) asserts that effort must be made to ensure that agricultural buildings are properly engineered. The author outlined five tips for making an agricultural building with durable. These include proper preparation of the building site; using high-quality materials (e.g., lumber, windows and doors) and hiring or recruiting a good crew. Accordingly, Buelo notes that a good crew has a better grip of the engineering behind the design of a building. The remaining tip was inclusion of durability features such as ventilation because installing a good ventilation system is smart for any structure, yet is vital in agricultural buildings.

Moreover, if the soil in the located site for the structure is characterized by shrinkable clay soil, sandy and pliable soil and is near deep-rooted vegetations, a formidable foundation is recommended. Emmitt and Gorse (2014) stated that this is because shrinkable clays suffer vertical and horizontal shrinkage on drying and expansion on wetting due to seasonal change. Secondly, proximity to vegetation could have considerable effect on the stability of the building. Therefore, a major construction technique to adopt at the foundation level is to lay the foundation that is not collapsible but has higher carrying capacity (Francis, 2014). Francis reiterated that a good foundation prevents differential movement by ensuring that the soil is excavated down to the harder strata which confers higher bearing capacity. Another technique is the use of sufficient reinforcement. Reinforcement in building construction refers to the concrete aspect of the building, they are a composition of steel irons used in combination with cement and gravels to guide against tensile and compressive forces, thus, provides tensile strength to the concretes (Ede, 2013; Francis, 2014; Emmitt and Gorse, 2014). Ede (2013) states that reinforcement is the product of a mixture of stones and sand particles bound together which the adhesive component being water enhances the mixture.

From the foregoing, it shows that a good concrete work confers higher stability on any building structure. Most often, stakeholders in the construction industry and systems seem to undermine most of those criteria to the extent that obvious considerations and guiding principles are always relegated (Ede, 2013; Akande *et al*., 2016). Perhaps if stakeholders at the helm of affairs avoid factors responsible for building failures, it the ugly trend may be prevented, thus, ensuring stable agricultural buildings. Buildings and other construction works in agriculture could take the forms of livestock houses, irrigation channels and systems, access roads and bridges among others. Thus, the location, materials and layout determines its stability after construction (Mrema, 2011). Therefore, when constructing or reconstructing an agricultural structure, conceptualizing and developing a simple drawing then complying with structural details during construction are inevitable to avoid failures (Akande *et al*., 2016).

Unfortunately, despite all effort by relevant agencies, a major cause of instability or failure of not only agricultural buildings is the design and construction phases which some researchers expressed concern that most structures lack proper engineering and construction techniques (Ede, 2013; Mrema, 2011). The major reason is negligence, greed, deficient foundations, inadequate and faulty steel reinforcements, hasty construction, no soil test, poor supervision and non-adherence to recommended building techniques (Ede, 2013). It is of great concern that most clients, for instance in Nigeria choose not employing qualified personnel to acquire appropriate construction documents (Madu, 2005). Madu (2005) maintained that poor supervision of the building while under construction is another worrisome aspect as effort is on spending minimum amount of money on the construction. Many farm owners try to minimize cost with the expectation to earn higher turnover especially under the widely existing smallholder farmer population. Incidentally, even where a structural design is not deficient, absence of proper supervision on the site by qualified personnel probably facilitated by inferior quality materials may preclude failure (Akande *et al*., 2016). Therefore, the stability or otherwise of every construction work in the agricultural industry really depends on the techniques and principles adopted by the designers, site supervisors, masons and carpenters. The challenges identified above could partly be tackled by ensuring well-planned designs (Simpson, 2011; Emmitt and Gorse, 2014; Francis, 2014). Beginning from the planning phase, up to the general layout, all dimensions of the intended structure are expected to be checked properly (Mrema, 2011). Accordingly, Akande *et al*. (2016) noted a well structurally and architecturally designed agricultural building with appropriate specifications, especially in relation to the type of agricultural entreprise could prevent failure.

The researchers are of the opinion that failures in agricultural buildings could be avoided by adhering to recommended techniques. This study sought to find out the opinions of agricultural engineers and livestock experts on the effect of construction techniques on stability of livestock buildings in Nigeria. Specifically, the study determined construction techniques for ensuring stability of agricultural buildings, roles of construction regulatory agencies on stability of agricultural buildings and determined administrative strategies that could be adopted to ensure stability of agricultural buildings in Nigeria. Recommendation were made based on findings of the study which if adopted would go a long way in helping to prevent failure of agricultural building in Nigeria.

Research questions: The following research questions would guide the study:

- What are the construction techniques that would ensure stability of agricultural buildings?
- What role can regulatory agencies play in ensuring stability of agricultural buildings?
- What are the administrative strategies that could be adopted to ensure stability of buildings in the agricultural industry?

Research hypothesis: There is no significant difference in the mean ratings of agricultural engineers and extension agents on the construction techniques that would ensure stability of agricultural buildings in Nigeria. There is no significant difference in the mean ratings of agricultural engineers and extension agents on role of regulatory agencies play in ensuring stability of agricultural buildings in Nigeria. There is no significant difference in the mean ratings of agricultural engineers and extension agents on the administrative strategies that could be adopted to ensure stability of agricultural buildings in Nigeria.

MATERIALS AND METHODS

The study adopted survey design. The study was carried out in Enugu State, Nigeria with a target population of 113 comprising 65 agricultural engineers and 48 agricultural extension experts (Enugu State Ministry of Agriculture, 2017). There was no sampling, thus, the whole population served as respondents for the study. The instrument used for data collection was a 39 items structured questionnaire titled Agricultural Building Construction Techniques Questionnaire (ABTQ). The questionnaire had four point response options of Strongly Agreed (SA), Agreed (A), Disagree (D) and Strongly Disagree (SA) with a corresponding nominal value of 1-4, respectively. Three experts validated the instrument. Two were from Department of Agricultural and Bio-resources Engineering and Department of Agricultural Extension, respectively) and one from Industrial Technical Education (Building), all in the University of Nigeria, Nsukka. Their corrections and suggestions were used to improve the contents of the questionnaire. Cronbach alpha reliability method was used to determine the internal consistency of the questionnaire items. A reliability coefficient of 0.73 was obtained. The 113 copies of the questionnaire were distributed with the help of three research assistants. All copies of the questionnaire were retrieved and analyzed. Weighted mean was used to answer the research questions while t-test was used to test the hypothesis at 0.05 level of significance. Items with mean values of <2.50 were regarded as not agreed while any item with 2.50 and above was regarded as agreed. The null hypothesis were upheld because t-calculated was greater than the t-critical value. This implies that there was of no significance in the mean scores of the respondents.

RESULTS AND DISCUSION

Table 1 reveals that all the 13 items had mean ratings that range from 2.53-3.81 for the agricultural engineers while the mean for livestock experts ranges from 2.55-3.71 which are above the benchmark of 2.50. The standard deviation of agricultural engineers ranged from 0.57-1.37 and that of extension agents ranged from 0.55-1.22. This indicates that the responses of the respondents were not far from one another in their opinions. The result shows that agricultural engineers accepted that the thirteen items were good strategies for ensuring stable buildings. The hypothesis tested in Table 1 revealed that eight items (strategies) had their calculated t-values ranging from 0.18-1.43 which is greater than alpha-value, p>0.05. This showed that there is no significant difference in the mean ratings of the two groups of respondents on the fifteen items. The null hypothesis was not rejected for the thirteen strategy items that could ensure stability of the agricultural structure because the t-cal were greater than t-critical.

Table 2 reveals that all the thirteen items had mean ratings that range from 2.53-3.81 for the agricultural engineers while the mean for livestock experts ranges from 2.55-3.83 which are above the benchmark of 2.50. The standard deviation of agricultural engineers ranged from 0.52-1.37 and that of extension agents ranged from 0.35-1.22. This indicates that the responses of the respondents were not far from one another in their opinions. The result shows that agricultural engineers accepted that the thirteen items were good strategies for ensuring stable buildings. The hypothesis tested in Table 1 revealed that eight items (strategies) had their calculated t-values ranging from 0.18-1.02 which is greater than alpha-value, p>0.05. This showed that there is no significant difference in the mean ratings of the two groups of respondents on the twelve items. The null hypothesis was not rejected for the13 strategy items that could ensure stability of the agricultural structure.

Table 3 reveals that all the thirteen items had mean ratings that range from 2.33-3.83 for the agricultural engineers while the mean for extension agents from 2.51-3.70 which are above the benchmark of 2.50. The standard deviation of agricultural engineers ranged from 0.57-1.37 and that of extension agents ranged from 0.55-1.23. This indicates that the responses of the respondents were not far from one another in their

Table 1: Mean ratings, standard deviation and t-test analysis of the responses of agricultural engineers and extension agents on knowledge of construction techniques that ensures stability of agricultural buildings (N_1 = 65; N_2 = 48)

Items	X_1	SD_1	X_2	SD_2	Remark	t-cal	H_o
Proper site location	3.06	0.93	3.14	1.14	Agreed	0.68	NS
Site survey	3.11	1.06	2.85	0.84	Agreed	0.56	NS
Testing and analyzing soil design	2.97	0.57	3.02	1.12	Agreed	1.43	NS
Proper architectural designs and drawings	2.93	0.68	2.55	1.09	Agreed	0.75	NS
Approval of drawings by accredited regulatory agencies (e.g., development control board)	2.76	1.20	2.83	0.66	Agreed	1.04	NS
Adequate and well prepared bill of quantities	2.53	1.30	2.95	1.22	Agreed	0.62	NS
Appropriate tools and equipment	3.06	0.83	3.56	0.72	Agreed	0.31	NS
Excavate foundation to strata	3.81	0.63	3.16	0.55	Agreed	0.86	NS
Compliance with specifications on the design from foundation	3.50	0.87	3.67	0.73	Agreed	0.82	NS
Employing time-tested craftsmen	2.70	1.37	2.80	1.21	Agreed	0.60	NS
Testing and proper use of quality materials	2.55	0.59	2.67	0.83	Agreed	0.18	NS
Proper concreting with good tensile strength	3.67	0.91	3.00	0.80	Agreed	0.36	NS
Ensure sufficient reinforcements with steel rods	3.42	1.21	2.33	1.80	Agreed	1.16	NS
Provision of good and effective drainage	3.00	0.80	3.67	0.91	Agreed	0.36	NS
Considering the existence of wind and other natural and opposing forces	3.16	0.63	3.71	0.55	Agreed	0.86	NS

X_1 = Mean of agricultural engineers; X_2 = Mean of extension experts; SD_1 = Standard Deviation of agricultural engineers; SD_2 = Standard of Deviation of extension experts; H_o = Null Hypothesis; t-cal = t-calculated; NS = Not Significant

Table 2: Mean ratings, standard deviation and t-test analysis of the responses of agricultural engineers and extension agents on the role of regulatory agencies in ensuring stability of agricultural buildings ($N_1 = 65$; $N_2 = 48$)

Items	X_1	SD_1	X_2	SD_2	Remark	t-cal	H_o
Contractors complying with deigns and specifications	2.85	0.74	2.82	0.44	Agreed	0.68	NS
Reporting any inevitable alterations made during construction	2.60	1.07	2.55	0.81	Agreed	0.18	NS
Ensuring adequate and clear structural designs	2.67	0.52	2.57	1.12	Agreed	1.43	NS
Ensuring drawings in No.3 pass through COREN for approval	3.10	0.68	2.55	0.83	Agreed	0.72	NS
Ensuring proper testing and analyzing soil before making design	2.76	0.78	3.83	0.76	Agreed	1.04	NS
Ensuring compliance with specifications for foundation	2.53	1.30	2.95	1.22	Agreed	0.62	NS
Ensuring excavation of foundation to starter	3.81	0.63	3.16	0.55	Agreed	0.86	NS
Ensuring testing and proper use of quality materials	3.58	0.53	3.50	0.83	Agreed	0.53	NS
Ensuring employing time-tested craftsmen	2.70	1.37	2.80	1.21	Agreed	0.60	NS
Ensuring proper concreting and reinforcements	3.30	0.82	3.00	0.66	Agreed	0.72	NS
Ensuring provision of good and effective drainage	2.90	1.32	2.81	0.79	Agreed	1.02	NS
Ensure consideration for the existence of other natural and opposing forces	2.60	1.07	2.65	0.81	Agreed	0.87	NS

X_1 = Mean of agricultural engineers; X_2= Mean of extension experts; SD_1= Standard Deviation of agricultural engineers; SD_2= Standard of Deviation of extension experts; H_o = Null Hypothesis; t-cal = t-calculated; NS = Not Significant; COREN Conference of Registered Engineers of Nigeria

Table 3: Mean ratings, standard deviation and t-test analysis of the responses of agricultural engineers and extension agents on strategies for ensuring stable agricultural buildings ($N_1 = 65$; $N_2 = 48$)

Items	X_1	SD_1	X_2	SD_2	Remark	t-cal	H_o
Approval of structural designs/drawings before commencement of work	3.02	1.06	3.67	1.23	Agreed	0.68	NS
Certified engineers/time-tested agents must be on site to represent clients	3.11	0.57	3.63	1.20	Agreed	0.58	NS
Regular supervision by resident agricultural engineers	3.83	0.93	3.58	0.84	Agreed	1.43	NS
Every stage beginning from building layout, foundation etc be certified/approved	2.33	1.30	3.70	1.12	Agreed	0.75	NS
Regular supervision by government representative	3.58	1.37	1.33	1.09	Agreed	1.04	NS
Regular payment of site workers	2.53	1.30	2.95	1.22	Agreed	0.62	NS
Effective collaboration between all parties as partners in the project	3.81	0.63	3.16	0.55	Agreed	0.86	NS
Agro specialists be consulted during feasibility for the intended purpose	3.10	1.70	3.25	1.22	Agreed	0.58	NS
Environmental specialists be consulted to avoid climate-bound risk factors	2.70	1.37	2.80	1.21	Agreed	0.60	NS
Buildings for large/heavy stationary farm equipment/machines be properly reinforced	2.67	0.63	2.51	0.55	Agreed	1.13	NS
Buildings for large animals be well spaced according to stocking	3.00	1.41	3.50	1.21	Agreed	0.43	NS

X_1 = Mean of agricultural engineers; X_2 = Mean of extension experts; SD_1 = Standard Deviation of agricultural engineers; SD_2 = Standard of Deviation of extension experts; H_o = Null Hypothesis; t-cal = t-calculated; NS = Not Significant

opinions. The result shows that agricultural engineers accepted that the thirteen items were good strategies for ensuring stable buildings. The hypothesis tested in Table 1 revealed that eight items (strategies) had their calculated t-values ranging from 0.41-1.43 which is greater than alpha-value, $p>0.05$. This showed that there is no significant difference in the mean ratings of the two groups of respondents on the thirteen items. The null hypothesis was not rejected for the eleven strategy items that could ensure stability of the agricultural structure.

In Table 1, all mean ratings of the agricultural engineers and extension experts on 15 construction techniques that ensure stability were above the 2.50 benchmark and were accepted. Thus, it showed that those techniques were necessary in ensuring stability of agricultural buildings. This concurred with the opinions of Emmitt and Gorse (2014) and Francis (2014) who all stipulated that to have a stable building requires a structural drawing, soil test, proper digging and reinforcements of the foundation and fitting the entire structure with quality materials. The finding was also in agreement with Akande *et al.* (2016) who studied causes, effects and remedies to the incessant building collapse in Lagos State. The authors identified building plan approval, soil testing, quality materials and involvement of construction professionals among others as valid approaches that could ensure stability of the buildings in general.

Similarly, findings in Table 2 showed that all the thirteen items had means above benchmark of 2.50 and were therefore, accepted. This indicated that both the agricultural engineers and extension experts were very closer in their opinions with no marked difference. This indicated that the respondents were in agreement with the items on effects of the roles played by regulatory agencies on the stability of agricultural buildings. The finding is in accordance with the views of Francis (2014) and Akande *et al.* (2016). The researchers stipulate that compliance with building regulations including the building plan and appropriate sanctions meted by regulatory agencies serve as correction measures considered very necessary to ensure stability of buildings.

Then, in Table 3, the respondents agree to all the twelve item statements on the administrative strategies that could be adopted to ensure the stability buildings. The mean ratings for all the items were above the benchmark and indicated no significant difference in the mean scores. This finding is in tandem with the views of Ede (2013), Okechukwu (2010) and Akande *et al*. (2016). The finding was also in line with Madu (2005) who revealed the need for proper supervision by qualified building personnel. Therefore, all the researchers revealed that approval of structural building plans, supervision of ongoing construction by certified agents including government, regular and prompt payment of site workers are among other inevitable strategies that could guarantee stability of buildings in general.

CONCLUSION

There is need for proper adherence to recommended construction techniques to ensure befitting buildings for various operational purposes in production of crops, livestock and allied products in agriculture. Agricultural buildings are useful for the purposes of storage, processing and husbandry of livestock as the case may be. It could be concluded that effective monitoring by accredited building construction and regulatory agencies remains the only sure way to attaining stability of agricultural buildings.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made: government should ensure the inclusion and proper adherence to building codes and regulations by all intended agricultural buildings and structural constructions. All stakeholders in the agriculture and building construction industries should effectively collaborate and be involved in processing and sitting of agricultural buildings until the end of the project. This would ensure proper articulation of all elements and components that confers resilience on the building. Site engineers and technicians must ensure adequate adherence to specifications made in the structural design and notify appropriate quota on inevitable alterations made in accordance with building regulations. Government officials from appropriate and agro-related industries should visit construction sites regularly to ensure that buildings meet stated agricultural production purposes and requirements.

Land and soil surveyors must be engaged to identify the properties of any proposed and located site before the actual construction to guarantee the stability of the building. The agriculturists, farm owners or company intending to erect production structures must procure quality materials to guarantee resistance against forces of the environment, especially, heavy storms and floods that may cause failures.

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