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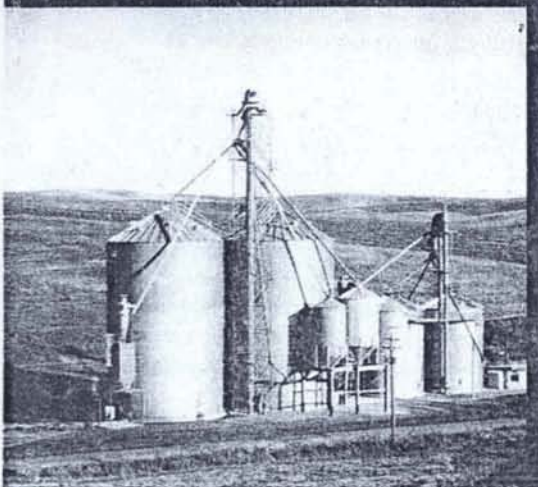
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Farm Structures and Environment: The Indispensable but Unappreciated Specialization of Agricultural Engineering in Nigeria

A Lead Paper in Farm Structures and Environment delivered at the 11th International Conference and 32nd Annual Conference of the Nigerian Institution of Agricultural Engineers (NIAE) held at Ilorin, October 17 – 20, 2011

Engr. Yahaya Mijinyawa
FNIAE, MNSE, R.Engr. (COREN)
(mijin1957@yahoo.com)

Abstract

Farm structures, a vital component of agricultural engineering is given very little recognition because of conflicts and ignorance. Neglected in terms of man power and facilities, its numerous potentials for agricultural development remain untapped. Climate change and noise from increasing farm mechanization activities are becoming threats to agricultural practice and a challenge to the farm structures experts. To appropriately respond to these challenges, due attention need to be given to the theory and practice of the profession while collaboration and information exchange among the experts need to be strengthened.

1. Introduction

Although this forum is not a classroom for rigorous academic discussion where basic definitions are presented, I am constrained to do that because over the years and despite previous efforts by many authors to provide an explanation, the general observation is that many people including those who claim to be practitioners are not exactly sure of what "farm structures" mean and what the boundaries are. From both within and without, it is viewed differently with some thinking that it is a profession for anybody irrespective of the skill. Conflicts have arisen especially in where environmental engineering is taught, with the farm structure researcher being accused of going out of his boundaries by researchers of other specializations.

Agricultural Engineering is traditionally recognized and referred to as the bedrock of agriculture because of its supportive role in all aspects of agricultural practice. In many cases, only three major areas of agricultural engineering are recognized and in order of application in agriculture, they are farm power and machinery, soil and water conservation engineering, and crop processing and storage. While farm structures is rarely recognized, farm electrification is still battling to be admitted into the fold at least in the Nigerian context. Despite this situation, many new areas are emerging such as computer application in agriculture and the need to have a name that reflects what the profession can do has been responsible for the change of name of virtually all the former departments of agricultural engineering in most Nigerian universities to names such as agricultural and environmental engineering or agricultural and bioresources engineering.

Farm structures and environment as a specialization in agricultural engineering has been grossly misunderstood. This should not be surprising because unlike the three popular specializations whose functions are easy to recognize and appreciate, not many people realize that those functions of the three specializations would almost be impossible if farm structures and environment did not provide the enabling support. Even those of us who are agricultural engineers and researchers of international repute do not realize that the success of our researches depends on farm structures and environment.

The question may therefore be asked as to what exactly is the misunderstood meaning and roles of farm structures in the agricultural practice.

There are not too many versions of the meaning but it could be viewed from two angles as a facility and as a discipline.

As a facility, farm structures refer to both shelter and non-shelter facilities, adjacent grounds and in some cases far remote areas from a farm whose function is germane to the success of such an agricultural enterprise. Farm structures could be originally designed to meet a specific function or a conversion or remodel of a facility

previously existing for other uses or considered of no use, but which has been converted for use within and occasionally outside a farm to meet the current need. The farm structures catalogue is unending and includes sheltered buildings which provide accommodation for human beings, livestock, farm produce and farm machinery, and non-sheltered structures such as roads, bridges, fences, towers and agricultural dams which allow access to the farm, provide security or are for multipurpose uses. The suitability and safety of the location of these structures (from the point of view of environmental impact assessment (EIA)); a conducive environment within and around these structures and an effective waste handling and controlling of all polluting elements are also very important.

Structures which may not necessarily be located within the farm environment but the functions of which are closely related to agriculture are rightly grouped along with farm structures. Examples of such structures are warehouses for agricultural produce, green houses, facilities for farmers' co-operatives such as crop processing centers, fruits and vegetable storages, cotton gins, grain silos, and machinery repair sheds, which may not necessarily be located within a farm environment. Farm structures could either be natural or man-made. Some features in a farm which can be harnessed and improved upon to promote the farm activities and provide comfort for the farmer are also farm structures. Existing vegetation which can be harnessed to serve as shelter belts or wind breaks, in order to control soil erosion and improve land productivity, or protect structures against wind damage, thereby saving the scarce resources that would be required for repairs and replacement, are also farm structures.

The provisions of the facilities listed above goes beyond the artisan's job and require a lot of ingenuity. The individual must go the extra mile to acquire the special skill. The acquisition of this skill makes the individual a farm structures specialist. It is the art and science of providing these facilities that has been referred to as the farm structures discipline. In a nutshell, farm structures as a discipline, which can also be referred to as farm structures and environment or farm structures and conveniences, is that branch of agricultural engineering that deals with the provision and maintenance of built-up facilities and improvements on the natural environment within and outside the farm environment.

A farm structures engineer is a specialist in the fields of agricultural and civil engineering whose interests, education, training and experience have developed the knowledge of scientific principles, construction materials, construction procedures, and economics necessary to direct the design, construction, utilization and maintenance of farm houses, barns, sheds, silos and related structures and ensuring that the environment is conducive for working and living (Neubuer and Walker, 1961).

Farm structures form the nucleus of agriculture and contribute greatly to the efficiency of operation, the quality of products and the health and comfort of workers. Farm structures have made significant contributions to agricultural development. Some of these contributions include better farm houses and those for livestock, improved crop storage structures, improved road and communication network, use of modern conveniences and the provision of recreational facilities. All these have contributed to higher standard of living and working conditions of the farmer, reduction in postharvest losses through effective storage and timely evacuation of harvested farm produce from the farms to urban areas where the produce are most needed, and the enhancement of livestock production.

2. The Indispensable Roles of Farm Structures

Farm structures has been described as the indispensable specialization of agricultural engineering because of the supportive roles it plays to enable other specializations to adequately function. This is summarized in Table 1.

Despite the glaring functions from Table 1, the specialization is hardly accorded any recognition both in theory and practice. It is a marginalized unit in many agricultural engineering departments.

3. Farm Structures Training and Practice in Nigeria

Although farm structures practice has always been part of agriculture in Nigeria, the modern farm structures practice can be assumed to have commenced in the late 1950s. Precisely in 1957 when the first silo in Nigeria, a twenty ton capacity aluminum type was erected at Ilero in Oyo state, and in 1958, a similar one was erected at Ilaro in Ogun state. The introduction of those silos was in response to the problem of grain storage arising from the bumper harvests of the 1957/58 grain storage programme of Western Nigeria. In 1965, the first indigenous silo in Nigeria, a ventilated out-door concrete type was designed and erected at the Institute of Agricultural Research and Training, Moor plantation in Ibadan. Since then, many agencies of the Ministry of Agriculture have been involved in farm structures practice especially in developing crop storage structures (Osobu, 1971; Osobu, 1985).

The pioneers of farm structures practice in Nigeria were mainly civil engineers who using their ingenuity delved into the design and fabrication of some farm structures facilities. Even when the agricultural engineering discipline was introduced in some Nigerian universities, the theoretical emphasis was on farm machinery, soil and water, and crop processing. Very little attention was paid to farm structures even though its benefits were being enjoyed.

Indigenous training of farm structures actually commenced in the early 1980s with Professor Fola Lasisi playing a prominent role in the grooming of a few students including this author and at present, even if it is not accorded its right place, it is difficult to claim ignorance of the existence of farm structures as a unit of agricultural engineering.

4. The Professional Challenges

If there is any reason why I accepted the invitation to this conference, it was to enable me re-echo the issues which I raised in 2006 but which are yet to receive adequate attention. Those issues were the problems which appear to be militating against the development of the farm structures component of agricultural engineering. They were and still remain those of manpower, teaching, and research facilities.

4.1. The manpower challenge:

A religion is spread by apostles and the quality of apostles to a large extent determines how well it is accepted. The biggest challenge facing this discipline is the paucity of farm structures experts. Today in many institutions, the subject is substantially handled by individuals whose major area of interest is not farm structures. It is hard to blame such strangers because in most cases they are even doing the departments a favour, for if they were to refuse, the students would graduate without any knowledge of the subject of farm structures. I teach farm structures courses to non-major students at the postgraduate level and from their performances, many of them have little or no exposure at the undergraduate level in farm structures.

a) The facility problem:

There is no doubt that there are a crop of farm structures experts in some Nigerian universities both trained abroad and locally but the point must be noted that irrespective of their intelligence, they need facilities to teach and enable students execute their projects and researches. Whenever one visits a university, the visitor does not need anybody to introduce the Department of agricultural engineering to him because he is most likely going to see a tractor parked in front of the department and perhaps at the back, a plot with crops and irrigation pipes may be seen. It is not likely that a silo will be seen. In addition, there may be no laboratory or experimental site that is dedicated to farm structures.

What the students see every day, is what they develop interest in and at the final year, they would naturally want to execute projects that are not farm structures related. Leaving the university after five years with limited knowledge about farm structures, it will be strange to expect that when returning for masters, they would want to go for farm structures. I have had bitter experiences in that the few I have tried to encourage at the undergraduate level return for postgraduate to specialize in other options.

5. The Immediate Task before the Farm Structures Expert

More than ever before, the farm structures experts are faced with a number of challenges arising from both natural and human effects. Two of these are the climate and noise

5.1 Climate change

Nigeria and many other tropical countries were known to have stable climate for the production of various crops, which accounted for why the agricultural system was mainly rainfed. Not only that the farmers depended solely on the natural climate for agricultural practice but they used to have a workable farming calendar. Irrigation schemes were only of relevance in the northern parts of the country. Times have however changed with the advent of climate change, a situation whereby it has become impossible to predict when the rains which are major requirements for crop production would commence and cease, and what quantity can be expected. The experts are faced with the challenges of proffering solutions on how the environment can be modified to ensure sustainable agricultural practice. Creation of micro-climate through the use of greenhouses is gradually becoming imperative in Nigeria especially for precious crops. Greenhouses must be appropriately designed and

material selected taking into account the location. The experts must come up with what is appropriate for each ecological zone, identify appropriate glazing materials and arrange for the development of the relevant manpower to construct and manage the greenhouses.

5.2 Noise control

Agricultural mechanization was introduced to boost food production and at the outset, no one suspected that a price too heavy may have to be paid. Quietness which was a characteristics and an asset to the farm environment was lost due to noise emanating from equipment operation. As the population rises with dwindling human labour on the farm, more of mechanization and use of equipment will be noticed on the farm. There is a daily increasing noise generation in the farm environment which has a catalogue of negative effects. The farm structures experts has the responsibility to monitor the noise exposure level of farm workers and device ways of arresting the situation.

6. What is on in University of Ibadan

In the past five years, the University of Ibadan has attempted to establish a formidable farm structures unit and the research focus is in three major areas.

6.1 Postharvest technology

In the area of postharvest technology, the provision of appropriate storage structures is the main focus of the unit. For bulk storage of grains which are the predominant food crops cultivated and demanded, the silo has remained the storage structure irrespective of the numerous disadvantages. Since the construction material, notably steel, has long been identified as the major problem, attention is now devoted towards sourcing for alternative and appropriate construction material.

Considering the cool environment within a termitarium, the unit commenced investigations into the potentials of termite mound clay as a material for silo construction. Initial results demonstrated good potential by way of reduced indoor temperature fluctuations and recommended elongated study period and studies into the engineering properties of termite mound clay (Adegunloye, 2007). The unit is presently working on these recommendations through the establishment of a silo site (Plate 1), and comparing the conditions within silos constructed from steel, concrete and termite mound clay. Temperatures and relative humidity profile are expected to be established for final conclusions to be drawn.

6.2 Noise in farm environment

This unit has directed her energies towards the monitoring of the level of noise generated in farm environment and activities as a first stage. These are aimed at establishing the threat or otherwise to which workers are exposed. The ultimate goal is to ensure that noise threat is eliminated through appropriate measures. One of such studies is shown in Plate 2. Preliminary results from activities such as land preparation, feed mills and from piggery units reveal that as much as 90 dB, 116 dB and 103 dB are respectively generated. These levels of noise far exceed the safe workplace noise level of about 85dB recommended by various codes (WHO, 2001; CCOHS, 2004; Akinyemi, 2010; Ogbue, 2010; Alege, 2011). As an interim measure, the use of personal protective devices such as ear muffs and plugs are being recommended while the reduction in working period which is easier to implement than reducing the noise level is also advocated.

6.3 Climate change remediation

As a starting point, the unit is establishing the present status of greenhouse utilization in the southwestern zone through baseline surveys. This is in realization of the fact that for over a long time, greenhouses have been used in Nigeria but mainly for research and the experiences from the use of the existing greenhouses would provide a useful guide in introducing commercial greenhouses (Mijinyawa and Osiade, 2011). Shortly after the commencement of this study, it was observed that the method of cleaning the roof is problematic. Studies have also commenced on the development of a simple cleaner for the greenhouse roof. The preliminary design has been tested and it has the potential of reducing the time and labour requirements by the existing cleaning methods (Akpenpuun, 2010). A demonstration of the equipment is shown in Plate 3. The performance of the various glazing materials is being examined with a view to recommending appropriate types for the environment.

7. Strategies for Advancement

7.1 Formation of network on farm structures

One of the areas that is likely to promote the teaching and practice of this discipline is the availability of information to all and sundry to whom the discipline may be beneficial. There is no doubt that the few experts in the area are involved in relevant researches and have quite a lot of information at their local level but there is very little interaction among them. A network to include information exchange and development of strategies appears to be a potential way of addressing the problem.

7.2 Laboratory and workshop development

In many instances, the farm structure unit does not extend beyond the office of the individual teaching the course. This shows that the unit has neither a laboratory nor workshop. This situation does not encourage the undergraduate students to look forward to coming back for a course in farm structures. The various departments should make it a point of duty to establish laboratories and well equipped workshop.

8. Conclusion

Farm structures, a vital component of agricultural engineering is given very little or no attention. It is important that due attention is paid towards its development both in training and facilities so that its numerous potentials for agricultural development can be harnessed.

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Table 1: Farm structures intervention in agricultural engineering practice

Specialization	Primary Function	Farm Structure Indispensable Support
1 Farm Power and Machinery	Land preparation	The various farm machinery and equipment are prone to wear and tear if unprotected from inclement weather. They can also be vandalized or pilfered if not properly secured. They must be transported to the farms where they are most needed many which may not be accessible. The provision of farm workshops, implement sheds, and access routes are the responsibilities of the farm structures experts.
2 Soil and Water Conservation	Water and nutrient regulation to meet plant needs	The dams for irrigation water, canals and channels are farm structures. If farm structures refuse to provide the dam and canals, it will be difficult to transport and store the water required.
3 Crop Processing and Storage	To add value to harvested crops and ensure it can be found when needed.	People engaged in processing agricultural products, must be protected against inclement weather. There are the issues of conducive working environment, security of persons and goods which are provided by farm structures. Processed produce must be adequately stored and the storage structures are farm structures.
4 Research	Breaking new grounds for agricultural development	Experimental sites must be protected against pilferage while it is quite often necessary to regulate climate. These are activities of the farm structure experts.



Plate 1a. A group of termite mound clay silos



Plate 1b. Concrete and metal silos

Plate 1. Silo experimental research site, University of Ibadan, Ibadan

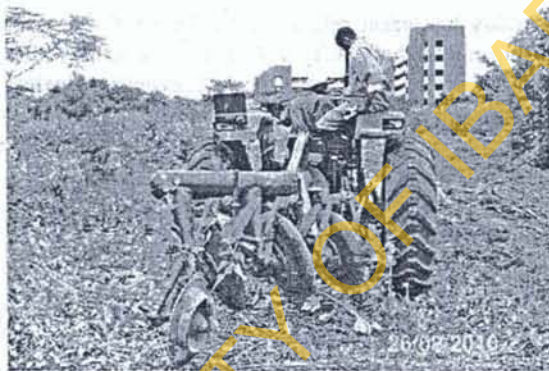


Plate 2. Noise level measurement during land preparation

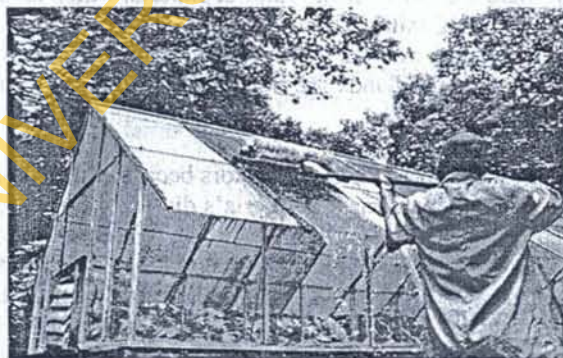


Plate 3. Demonstration of greenhouse roof cleaning equipment