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Farm Structures: Roles And Challenges In Meeting The Needs of The Nigerian Farmer

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ABSTRACT

Although oil is the major source of Nigeria's revenue at present, agriculture is the single largest contributor to the well-being of the rural poor. Agriculture sustains 90% of the rural labour force, provides 60% of industrial raw materials, and contributes 30% to the GDP, with 90% of the output coming from the smallholder farmers. The Nigerian smallholder farmers face a lot of challenges. They are constrained from expanding their farm sizes due to limited labour supply. Poor farm transportation and severe post-harvest losses reduce their economic fortune while the productivity of the farmer and his livestock are reduced by inadequate housing. Farm structures' intervention in the provision of good access roads for farm machinery movement would enable farmers to expand their farm holdings, appropriate crop storage structures which reduce post-harvest losses, and cheap but comfortable housing will provide an enabling environment for increased productivity and income. The present Farm Structures curriculum as taught in many institutions needs to be beefed up while farm structures workshops and laboratories should be provided and well equipped. The establishment of a farm structures network is suggested.

INTRODUCTION

I like to begin this presentation by thanking the Zaria 2006 LOC and the NIAE EXCO for giving me a rare opportunity to present this paper. I call it a rare opportunity as it will provide a forum to share with others those ideas about farm structures which I have and believe should be x-rayed by others in order to advance the frontiers of knowledge in the least known specialization of agricultural engineering in Nigeria today.

Because of the role it plays in the existence of human, agriculture is the world's oldest and perhaps the largest industry. It is about the only industry in the world that caters for all living things. The role of the industry is better appreciated when it is realised that the three basic needs of man which are clothing, food and shelter are met through agriculture. Just as it caters for everybody, so also it is an area in which everybody shows some interest either directly by being a farmer and producer or indirectly as a consumer who through the purchase of agricultural products makes more money available to the farmer to increase his production capacity. The primary objective of any community or country is for her population to be well fed. The percentage of the population involved in active farming depends on the productivity per farmer. This is because if the production capacity per farmer is high enough to meet his family requirements and have excess to sell to others at a price which puts neither the farmer nor the consumer at a disadvantage, very few people can be involved in active farming while a larger percentage of the labour force is released to other sectors of the economy. However, where the production capacity is low such that the active farmer is only hardly able to produce to meet his family requirement or even less; almost everybody in such a community would be forced to be engaged in active farming. This explains why the percentage of the population actively involved in farming varies from one region of the world to the other. A higher percentage of the population is engaged in farming in underdeveloped and developing countries where the practice of agriculture is still predominantly dependent on manual labour, unlike in developed countries

where most of the farming activities have been mechanized and a lower percentage of the population are engaged in farming.

While awaiting the results of the 2006 national headcounts, Nigeria is estimated to have a population of 120 million people and occupies a land area of 924,000 km². Although oil is the major source of the country's revenue at present, as it accounts for 90% and 70 % of total exports and government revenue respectively, agriculture is the single largest contributor to the well-being of the rural poor. Agriculture sustains 90% and 70% of the rural and total labour force respectively and provides 60% of industrial inputs. The agricultural sector contributes 30% to the GDP, with 90% of the output coming from the smallholder farmers. (IFAD, 2001, Oni, 2004). That as much as 70% of the total labour force is engaged in agriculture, is a manifestation of the peasantry nature of the Nigerian farmer who has a small holding and hardly produces enough to meet his family requirements. On rare occasions, there are little surpluses for sale. In some instances, what is sold is not surplus but because of pressure for cash to meet domestic needs and in the absence of any other source of income, part of the family food is sold and to be replaced later through purchase. It is in an attempt to redeem this situation that every year we assemble to brainstorm on the way forward.

Despite the long years of agricultural practice with expected experiences, researches are still being undertaken aimed at reducing the drudgery and resource input in production in order to increase the output levels to meet the ever rising population. Agriculture is a multi-disciplinary industry involving a number of professionals all working as a team with the primary objective of making food and fiber available, and improving the economic situation of the principal actor – the farmer. Effective participation in a team work depends on a clear definition and understanding of individual's role. This is why I have chosen to examine some (not all) of the crucial roles that farm structures could play in meeting the needs of the Nigerian peasant farmer.

THE ROLES OF FARM STRUCTURES IN MEETING THE FARMERS' NEEDS

Although I am not here to bore you down with classroom lectures, I think it is important we have a definition of what constitutes farm structures and what the needs of the Nigerian farmers are. It is only then that we can effectively know what farm structures both as a discipline and facilities are capable of offering and should offer in meeting the farmers' requirements.

As a facility, a farm structure refers to an item or building which is either originally designed and fabricated or previously existing for other uses, but which has been converted for use within and occasionally outside an agricultural establishment. Although structures and buildings are used interchangeably, they are not exactly the same. Lindley and Whitaker (1996), defined a building as a roofed and walled structure built for permanent use while a structure is something constructed or made up of interdependent parts in a definite pattern of organization. Buildings refer to shelters, which provide accommodation for man, livestock, farm produce and farm machinery while structures include both buildings and non-sheltered structures such as roads, bridges and fences which either allow access to the farm or provide security. The distinction between a structure and a building is therefore the presence or absence of a wall and roof which provides a shelter. Structures is a broader group inclusive of both sheltered and non-sheltered facilities

As a discipline, farm structures which is also 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 buildings and other facilities within and occasionally, 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, materials, construction procedures, and economics necessary to direct the design and construction of farm houses, barns, sheds, bins, silos, and related structures (Neubuer and Walker , 1961)

Some of the needs of the Nigerian farmers and possible areas of intervention by farm structures are presented in Table 1.

Farm transportation

Although the point is often emphasized that accessibility should be a priority in the choice of agricultural enterprise location, in many cases, the farmer has no choice as to where his farm is located. Nearness to the place of abode and perhaps ownership of the plot to be used are more often the determining factors in the choice of where an individual farms. For the obvious reasons of land availability and lack of other salaried jobs, the rural areas are the centres of agricultural activities in general and especially in developing countries, Nigeria inclusive. The large portion of Nigeria's agricultural practice is carried out in areas with poor transportation system. Adequate farm transportation is needed for the ease of movement of inputs into and outputs out of the farms. Poor transportation system has many side effects on the agricultural practice in Nigeria.

There is a popular saying in the northern part of Edo state which goes thus: *In farming, the initial land clearing and land preparations are not the problems but rather the bottleneck arises when the farm has been established and it is time to weed.* People who have invested their money in establishing farms abandon them because they suddenly discover that they cannot cope with the labour demand for weeding. This quotation underscores the role of labour or farm power and machinery in determining the size of farm holdings. The lack of access routes as a major barrier to increasing farm holdings in Nigeria has been reported by a number of researchers.

The three-prong approach to the implementation of an agrarian programme is the use of improved seeds, agro-chemicals and increased areas under cultivation. Despite the vast areas of land available in the rural areas, the Nigerian small holder farmer has not significantly increased his farmholding. It is not by choice but due to circumstances beyond his control. He must cultivate a size that he can adequately manage with the human labour at his disposal. Farm machinery are alien to him because the lack of access route would not permit the movement of farm machinery to his farm location.

Although Oni (2003) attributed the toilage and drudgery nature of the Nigeria agriculture to the dependence on imported machinery and equipment, which in some cases are not suitable for our environment, the situation is worsened by lack of access routes to the core farming areas where the locally developed ones can be tested and perfected. The local efforts are therefore confined to the experimental fields of the research institutions while their beautiful reports dot the shelves of their libraries

Makanjuola (2004) reported that the government and private tractor hiring services were established to address the problem of labour experienced by the small scale farmers, but the benefits of the scheme have not been fully exploited because most of the farms are located far away from the service centre and there are no access routes to reach such farms

In their study of the performance of the Edo state tractor hiring services, Mijinyawa and Kisaku (2006) observed that transportation was one of the factors that have reduced the impact of the unit. There were a few individual farmers who desired and could afford the cost of renting farm machinery to expand their holdings but there were no access routes through which the relevant

farm machinery could be delivered to their farms. Such farmers had no option than to remain contented with their small holdings.

While the rural areas are the centres of production, the major markets for farm produce are the urban and peri-urban centres and an effective transportation system between the two is the only guarantee for adequate compensation for the farmers' effort. Inability to convey produce to points of sale especially the perishables, results in financial losses to the farmer. Raghavan (2003) reported that as much as 20 - 45 % losses are incurred in the handling and transportation of horticultural crops from the rural to the urban markets. Road conditions accounts mostly for this situation. Mijinyawa and Abayomi (2005) observed that most farmers in Osun and Oyo states have incurred losses especially with cassava due to failures of pre-arranged transport to arrive at the appointed time.

In a study carried out in Enugu state, Ugwu (2001), observed that farmers who were beneficiaries of the feeder roads constructed by the Agricultural Development Programme recorded higher yield per hectare and expectedly made more profits than those who did not. This was because they had access to farm machinery which enabled them to increase their farm sizes and farm inputs were also delivered on time. Harvested produce were timely evacuated and there were minimal losses before delivery to the points of sale.

The need for good road networks, bridges and culverts linking the farm and the market cannot be overemphasized and this is within the domain of the Farm Structures experts. Tijjani (1989) suggested that in as much as the on- and off- farm road networks are desirable, their provision must be well planned and executed in such a way as not to cause damage to the soil through aiding erosion and flooding. Provided with the necessary tools, resources and material, the design and construction of simple road network inclusive of bridges and culverts that are cheap and easy to maintain, and which take into account the present and future needs of the beneficiaries will provide good access to the farming communities. With such developments, farmers can have access to farm machinery and expand their farm holdings. Produce could be conveyed on time and in good condition commanding higher returns and improving the economy of the farmer.

Post-harvest Technology

Post-harvest technology include any activity that is carried out on an agricultural produce right from when it is matured and harvested from the field until when ready for consumption. Such activities include cleaning (threshing, shelling, sorting), size reduction, moisture reduction (drying) and storage to maintain the quality of agricultural products. The ultimate aim of postharvest technology is to ensure adequate compensation for the farmer's efforts through minimizing the reduction in quality and quantity of the produce between harvest and the table. It is a multi-disciplinary work involving different professionals as shown by the Bourne food pipeline (Fig.1). The food pipeline identifies five points at which post harvest losses are encountered. These are at the level of primary processing, transportation, storage, secondary processing and packaging, and marketing. Of these five stages, transportation and storage are areas of intervention by the farm structures experts.

It is the desire of the farmer to keep his produce over a period of time without loss in either quality or quantity but studies have shown that such a situation is not usually attained in practice. Reduction in quality and quantity appear inevitable between the time of harvest and when delivered to the consumer. This has a negative effect on food security and self sufficiency.

Igbeka (2003) reported that the various agrarian policies in Nigeria in recent years coupled with favorable weather conditions have resulted in notable increases in the production of food in

general and in grains such as maize, sorghum and millet in particular. Despite the increase in food production however, the benefits of the increase in food production have not been very evident partly because of food losses which occur due to lack of reliable and adequate food handling and storage systems for marketable surpluses. Post harvest losses have been variously estimated to be about 10 – 30 percent for grains and up to 50 percent for fruits and vegetables. He further reported that from the impact of the 1985 and 1986 bumper harvest, it is strongly believed that the major problem militating against food security in Nigeria is not the production per se but post-harvest operations such as storage, marketing and distribution.

Even without statistics, many of us would attest to this claim because we are directly or indirectly linked with the peasant farmers and we know some who even with the retention of their farm holdings have in recent years harvested more produce than they hitherto harvested. Yet the economic situations of such people have remained unchanged even in the face of increasing food prices. We cannot but ask the question, what happened to the excess and perhaps that is the answer Igbeka (2003) has provided. Other workers such as Raghavan (2003), Oni (2003) and Odigboh (2004) have expressed similar concern about postharvest losses. If the post-harvest losses cannot be completely eliminated, the magnitude should at least be reduced. This was the objective of the 1975 FAO programme on reduction of postharvest losses. (De Lima, 1982).

Of the five stages in the Bourne Food pipeline, the storage stage is where the produce spends the longest time and expectedly the highest percentage of the losses are likely to occur. The development and improvement of appropriate crop storage structures tailored towards the need of the individual farmer provides a solution to postharvest losses and enhance the farmer income.

The recognition of post harvest losses as a bottleneck to the attainment of food sufficiency and security is not new in Nigeria as Lasisi(1988), observed that improvement in agricultural production without the solution of the associated problems of safe storage and preservation of the grains and other produce so harvested for short and long periods of time will have little or no effect in increasing the quantity as well as the quality of produce available for human consumption and livestock feeding. This opinion of Lasisi (1988) was not entirely new as the need to reduce post harvest losses and ensure adequate food supply led to the establishment of the Nigerian Stored Produce Research Institute (NSPRI) in 1948. Between then and now, a number of implementation agencies on postharvest technology have been established while there are extensive reports of breakthroughs in postharvest technologies in our universities and research institutes. Reports are available for us to read that research efforts in postharvest technology have resulted in the development of a number of crop storage structures such as the ventilated cribs, ventilated yam barn, improved mud rhumbu, evaporative cooling structure, vegetable sheds, diffuse light stores, humidity chambers, crates filled with sawdust for cassava storage, wooden and plastic crates for the transportation of fruits (Balogun and Mijinyawa, 1995). Recognizing the usefulness and bottlenecks with the silos especially the problem of moisture condensation under a warm humid climate typical of Nigeria, research efforts are on in Ibadan, Ilorin and Minna towards sourcing for alternative materials of construction. Research efforts are also considering the design of small scale silos to meet the storage requirements of the small scale farmer. It is expected that when these researches are perfected, the problem of moisture condensation associated with the metal silos will be eliminated. The evaporative cooler pioneered by NSPRI using pot-in –pot, metal in bricks and other versions have worked at small scale level but need to be expanded for possible commercial utilization.

What is worrisome and which one cannot but ask is the question

'if we can celebrate our successes as modifiers, adapters and innovators of storage facilities especially in the past two decades, why have we not

succeeded in reducing the level of postharvest losses. Why are the figures being presently quoted not different from those of the 1970s?'

Balogun and Mijinyawa,(1995), observed that there is a missing link between the researchers and the farmers who are the expected beneficiaries of their research outputs and hence the impact of recent development in postharvest technology has not been well felt. This is probably the basis of the challenge by Wushishi (1989), when he said *'the agricultural universities, the agricultural engineering departments of other universities and other research establishments in the country have a duty to embark on extensive research into the development of storage and processing devices suitable for our local environment. They can achieve this by either improving on the existing ones or adapting foreign developed ones to our local needs. As a corollary, the private investors also have a duty to acquire the research findings of these institutions and translate them into mass production. Such private investors should also assist the research efforts of the institutions e.g. through research grants or contribution to research funds if any exists in the institution'*.

My fellow colleagues, no matter the amount of research we conduct or number of research papers we present, our task will remain undone not until we have developed storage structures that practically reduce the level of postharvest losses and put at the disposal of the farmer. It is a challenge that we must face.

Farm housing and livestock structures

Environment plays a crucial role in the productivity of the farmer and his livestock, storability of his farm produce, and the wear and tear of his farm machinery. Most farms would perform better as residential and save the farmers the burden of daily commuting between home and farm and loss of time, were it not for where to spend the night. A number of farmers would equally desire to put up farm houses even for temporary stay but are discouraged by cost. Materials of construction has been reported to constitute over 50% of the cost of buildings. Farm structures experts should look inward for appropriate and cheap materials that could be used for farm structures construction. The studies on stabilization of mud as low cost materials for farm structures construction (Ndububa, 2001), and properties of oil palm trunk and other similar ongoing works in various institutions are directed at developing alternative materials that could be used for farm houses construction. These need to be perfected and put to appropriate use.

Quite similar to crop production in which the bulk comes from the aggregation of the production by the peasant farmers, a significant number of livestock and poultry are kept by peasant farmers and rural households. These are kept mainly under free range system which exposes them to various hazards such as vehicular accidents, pilferage and predators. Recent works have resulted in simple cages and hutches that can be used for poultry and rabbitry providing conducive environment and easily managed.

Other areas

There are many other areas of agricultural development where the expertise of farm structures is highly desired. In the past few months, the menace of soil erosion has been reported in many parts of the country. The problem of soil erosion be it by wind or water is not new in Nigeria. What was new or strange in the recent event was the rate and extent of devastation. That was essentially a fall out of accumulated poor planning and bad land use and management over a number of years. Although the reports focused more on houses and roads, farm lands on which the survival of many Nigerian peasant farmers depends were no less affected. The problem is now here with us and we must face the challenge and provide erosion control structures in order to

assist the peasant farmer preserve his little farmland. Flooding is also another problem that has caused serious damage to farmland which Tijjani (1988) traced to poor planning of the farmstead. He rightly pointed out that such hazards are preventable if expert opinion which the farm structures experts have can be sought in the establishment of new farmsteads, road network and even dams.

PROFESSIONAL DEVELOPMENT

According to one school of thought, an individual can only either refuse to give or give what he or she owns and has control over. If we as farm structures experts must be able to meet the farmers' needs, we must be adequately equipped to render such services. It is only through competence that we can offer such services. The major challenge before the farm structures personnel therefore is how to attain the relevant professional competence and excellence. Three of the ways to go about this are curriculum development, functional workshops and laboratories, and human resource development.

Curriculum development

In many universities in Nigeria, farm structures is sparingly covered in the agricultural engineering curriculum. In many institutions, there is only one course taught in the specialization during the five - year undergraduate programme. Even the NUC minimum standards specify only one course in the specialization. It is therefore necessary to properly re-examine the curriculum taking into account the practical needs of the Nigerian farm environment. Farm structures courses should be taught at more than one level in the undergraduate agricultural engineering programme.

Laboratories and workshops

Although the NUC minimum standards outlines what a farm structures laboratory or workshop should have, not many of the universities have a place designated for farm structures talk less of being adequately equipped. Where some of the practicals are done, the department of civil engineering comes to the rescue. It is important that laboratories and workshops are established and adequately equipped. Technicians and technologists should equally be employed to man the laboratories and workshops.

Human resources development

While preparing this paper, I attempted some comparison between the papers presented under the various traditional agricultural engineering specializations in our conferences for the past five years. The summary of this I have presented in Table 2. You will recall that at the beginning of this paper, I referred to farm structures as the least known specialization of agricultural engineering. If the presentations at our conferences are indices to measure what is on-going in our universities, the farm structures option needs to buck up. The blame is neither here nor there but the message is that those of us in the area need to team up and develop ourselves and the option. It is for this reason that I will suggest that we consider the idea of a network at this conference.

CONCLUSION

In order to enhance agricultural production and improve the economy and environment of the Nigerian farmer, Farm Structures interventions are required in the areas of farm transportation development, appropriate storage structures and housing to meet the needs of the farmer, his livestock and general protection. Recognising the role of competence in service delivery, there is need to review the existing Farm Structures curriculum as taught in Nigerian higher institutions taking into account the needs of the Nigerian farmer and his environment. Functional laboratories and workshops should be provided while technical staff should be recruited. Existing academic staff need to search for opportunities for short visits and staff exchange to appropriate institutions

outside the country to widen their scope. It is suggested that a network be formed to facilitate information exchange among researchers in the area.

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Table 1. Farmers' needs and possible areas of Farm Structures' intervention

Area	Farmers' desire	Intervention
Farm transportation	Effective delivery of input to farm and evacuation of output to urban and peri-urban areas	Design and construction of adequate road network inclusive of bridges and culverts that are cheap and easy to maintain and containers for produce handling
Post harvest technology	Keep produce for as long as desired	Provide appropriate storage structures capable of retaining quality and quantity of produce.
Housing	Safe and conducive accommodation for the farmer to carry out various activities	Appropriate and affordable buildings with emphasis on local materials for the purpose of cost reduction
Production of special crops	Certain crops require environmental conditions different from ambient	This is accomplished through the use of screenhouses , greenhouses and similar special buildings capable of regulating the conditions within the growth chamber
Livestock protection	Keep livestock safe from both natural and man-made hazards such as pilferage	Livestock structures offer protection against inclement weather and against predators.
Farmland Protection	General security and protection of entire farmstead and equipment.	Fencing primarily secures the farm from all form of external attack and intrusion while sheds offer protection against wear and tear of farm machinery.

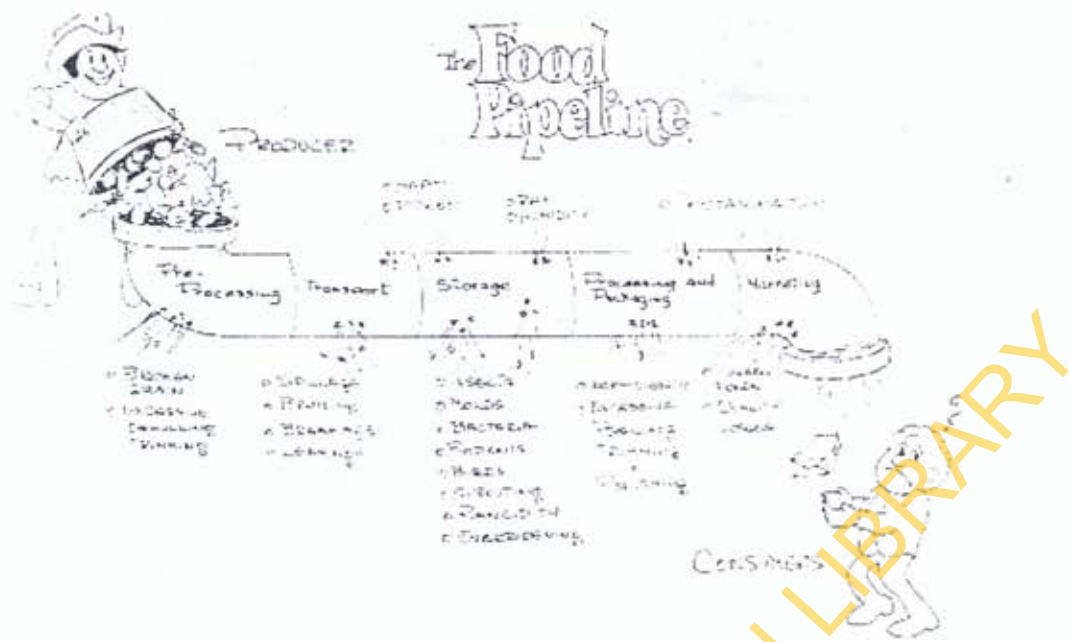


Fig.1. The Bourne Food Pipeline
(Source: FAO, 2006)

Table 2. Summary of papers presented at NIAE conferences in the past five years

Area		2000		2001		2002		2003		2004	
		No	%	No	%	No	%	No	%	No	%
Farm and Machinery	Power	9	21.9	14	23.0	11	33.3	8	22.9	19	23.2
Soil and Water	Engineering	9	21.9	19	31.1	6	18.2	9	25.7	22	26.8
Crop Processing and Storage		17	41.5	12	19.7	10	30.3	14	40.0	26	31.7
Farm Structure and Environment.		2	4.9	4	6.5	3	9.1	4	11.4	6	7.3
Others		4	9.8	12	19.7	3	9.1	0	0.0	9	11.0
Total		41	100.0	61	100.0	33	100.00	35	100.0	82	100.0