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Review

Testing and evaluation of farm machines: an essential step for developing mechanization in Nigeria

***Faleye T., Farounbi A.J., Ogundipe O.S., and J.A. Adebija**

National Centre for Agricultural Mechanization (NCAM) PMB 1525, Ilorin, Kwara State, Nigeria.

*Corresponding authors e-mail: topeleye99@gmail.com

Abstract

The need for mechanization of Nigerian Agricultural production cannot be over emphasized. Greater understanding of equipment characteristics that enhance operation in the specific conditions of each region in Nigeria is also pertinent. Standards for testing agricultural equipment have to be adapted and adopted based on this understanding. The results generated from standard testing have to be used to guide concerned agricultural equipment industry in the country, assist in improving the quality of locally produced equipment, the selective importation of equipment, and in farmers' purchase and use of agricultural equipment. Nigerian agricultural productivity can be significantly enhanced with mechanization specifically designed to perform in local agro-ecological conditions. This would require modern testing equipment, efficient organizational structures and research-based knowledge to ensure efficiency and impact in improving agricultural mechanization in the country.

Keywords: Testing, Agricultural Machinery and Mechanization.

INTRODUCTION

In order to meet the food demand of the ever-increasing world population, one of the approaches being adopted is the substitution of human power with mechanical power in agricultural production. Different terms in different situations have been used to connote this mechanical power substitution. These include appropriate technology, Tractorization, Selective Mechanization or simply, Mechanization (FAO 1980). The major operation carried out in the field with mechanical power is tillage (Ahaneku et. al., 2011).

Agricultural tillage involves soil cutting, soil turning, and soil pulverization and thus demands high energy, not just due to the large amount of soil mass that must be moved, but also due to inefficient methods of energy transfer to the soil. The most widely used energy-transfer method is to pull the tillage tool through the soil. This is mainly realized with the use of tractors.

The primary purpose of agricultural tractors is to provide drawbar work since drawbar is the most commonly used power outlet of a tractor (Ahaneku et. al., 2011). According to Kathirvel et al. (2001), the ability to provide draft to pull various types of implements is a primary measure of the effectiveness of a tractor. Drawbar work is achieved through the drive wheel to move the tractor and or implements through the soil. Drawbar work can be expressed as the product of pull and travel speed. Therefore, the ideal tractor converts all the energy from the fuel into useful work at the drawbar. In practice, most of the potential energy is lost in the conversion of chemical energy to mechanical energy, along with losses from the engine through the drive train and finally through the tractive device (Zoz and Grisso, 2003). Reports from literature indicate that about 20% to 55% of the available tractor energy is wasted wears at the tractive device-soil interface. This energy wears the tires and compacts the soil to a degree that may cause detrimental crop production (Burr et al. 1982; Baloch, et al. 1991; Zoz and Grisso 2003). Ownership of a tractor and associated items of equipment can involve a substantial investment. Improper choice of size of tractor can be costly because a very small tractor can result in long hours of field work, excessive delays and premature

replacement, while a too large tractor can result in excessive operating and overhead costs (Summer and Williams, 2007). The ideal tractor with matching equipment should get the work completed on time at the lowest possible cost.

The performance of tractor depends on the performance of a combination of traction devices and the performance of the tractor drive train. While the efficiency of a traction device is defined as tractive efficiency, the efficiency of a complete tractor is defined as power delivery (Zoz et al., 2002).

Ahaneku et al., (2011) reported that farm size, availability of labour and custom services, crop selection, and cultural practices, such as choice of tillage system, all affect the selection of optimum equipment and, ultimately, the number of tractors necessary to carry out farming operation. Although demand for tractor power generally increases with farm size, excess labour requirements may permit owners of one tractor to allow several operators to keep the machine running for extended periods of the day during high demand times. This means that tractors to be used for these strenuous activities should undergo extensive test to avoid incessant break down. To select and match tractors with implements, information is needed about the capacity of both the tractor and implement as well as the likely load to be imposed on the tractor (Ahaneku et. al., 2011). Accordingly, draft requirements will vary with implement size, soil type, speed of operation and depth of operation. Therefore, for effective tractor-implement matching, there is the need to ascertain actual field efficiencies and draft requirements along with other indices of attractive performance. It has been advocated that the determination of tractor performance under field conditions involves a rather complex apparatus. Therefore, a few methods were developed for various agricultural scopes by utilizing tractor test results and considering tractor mechanics in order to predict tractor performance (Ozarslan and Erdogan, 1996). Low rate of adoption of new four wheel drive tractors has been adduced to lack of information of the real field performance of these machines (Ortiz-Laurel et al., 2006). It is only through the results of field tests of the available tractors that farmers can make informed decisions as to the model of tractor to purchase based on their performance. Under agricultural mechanization, field machines such as tractors constitute a major portion of the total cost of crop production. The proper operation of these machines is essential for profitable agricultural production. Therefore, performance data for tractors and implements under different soil conditions are important for farmers, machinery operators and tractor manufacturers alike (Al-Suhaibani et al., 2010). Accordingly, Grisso et al. (2008) enumerated actions that are necessary for efficient operation of farm tractors to include:

(a) Maximizing fuel efficiency of the engine and mechanical efficiency of the drive train,

(b) Maximizing attractive advantage of traction devices and

(c) Selecting an optimum travel speed for a given tractor-implement system.

Most farm machines are imported and these are not specially designed to operate in the various Africa regions' specific agro-ecological conditions. In general, they are imported without any standardized testing and evaluation. In addition, it is realized that many of locally manufactured agricultural implements in Nigeria are of substandard quality. This low quality machinery leads to financial losses and at times is also unsafe for operation in the fields.

Federal Government of Nigeria has established National Centre for Agricultural Mechanization, (NCAM) Ilorin to increased agricultural mechanization through training and research. The centre has been in existence for a number of years but had limited impact on agricultural mechanization development. The reasons for the limited impact can be linked to several issues, including:

- Lack of sound national agricultural mechanization strategies;
- Insufficient performance data and information on different agricultural tractor and machines available in the country;
- Inadequate and trained manpower for costing agricultural equipment;
- Lack of standardized equipment for conducting tests
- Poor quality of locally manufactured equipment; and
- Insufficient management system for repair, maintenance and replacement parts.

This paper argues the need for local testing and evaluation of agricultural machines in Nigeria as a mean to promote mechanization. Many of the constraining environmental conditions, such as high temperatures, low humidity, soil types, and small field size have been identified. However, there is a need for greater understanding of equipment characteristics that enhance operation in the specific conditions of each region of the country. The results generated from standard testing will be used to guide concerned agricultural equipment industry in the country, assist in improving the quality of locally produced equipment, the selective importation of equipment, and in farmers purchase and use of agricultural equipment.

Testing and Evaluation of Agricultural Machines in Nigeria

Some of the challenges facing agricultural mechanization in Nigeria

- Farming system is characterized by predominantly small scale farmers with their low crop production and productivity due to heavy dependence on the hand tools as the private manufacturing sector is ill

equipped and underdeveloped agribusiness industry lacks entrepreneurial skills, technical knowledge, and capital to develop businesses. The supply of agricultural machinery and implements is very poor.

- Government had not successfully encouraged agricultural mechanization by not developing a local manufacturing industry. There is need to improve the private and public sector partnership in main areas like manufacturing of agricultural machinery and implements and their parts, agricultural processing industries and food technology systems, Institutional capacity building, and strengthening of infrastructure.
- Selection of appropriate technologies for mechanization of different operations in crop production have to be done based on techno-economic considerations.
- Another key issue and challenges is the poor funding of agricultural research and development institutions and expensive repairs and maintenance, poor machinery management techniques and inadequate enabling environment.

Role of National Centre for Agricultural Mechanization

In this paper, testing of agricultural machine referred to systematic determination of the functional performance, structural strength, durability, power requirements, capacity and forces acting upon it by carrying out the work under wider range of conditions. NCAM is expected to, as a matter of high priority in its programme of activities, pay special attention to land clearing and land development, erosion control, weeding, harvesting, crop processing, irrigation, use of small-scale tools and equipment.

In respect with the above, the Centre's testing programme can make a significant contribution to the evolving mechanization process, providing its services to local agricultural machinery manufacturers, importers and dealers through conducting standard scientific tests to identify the most appropriate machinery and equipment to match specific needs of different region of the country.

Evaluating the performance and suitability of locally manufactured and imported agricultural equipment requires an understanding of:

(i) The environmental conditions that dictate agricultural equipment specifications;
(ii) The characteristics and components of equipment that lead to efficient operation under local conditions; and
(iii) The types of testing that measure, reliability, suitability and performance of each identified component.

Reasons for performing these tests

The reasons for performing tests on agricultural machinery may include several views which are summarized below:

(i) Evaluating the products, both for improvement and capability assessment
(ii) Generating a reliable data on the efficient performance of farm machinery being manufactured.
(iii) Creating user unbiased awareness and decisions making concerning machinery selection.
(iv) Publishing technical literature, service manual, performance data sheet for marketing and R&D.
(v) Agencies dealing with promotion of farm mechanization find it convenient and profitable to make recommendations on the basis of test reports. Also, the test reports can help financial institutions and credit lending agencies in their decision-making process.

Need for promoting test stations

Nigerian Agriculture requires between 1, 500, 000 to 2, 000, 000 tractors with its associated implements for it to be fully tractorized. This is no doubt is a massive investment from all tiers of governments and private sectors.

In order to guard the country from sub-standard tractors, there is the need for NCAM, saddled with the responsibility of testing and evaluation of all agricultural equipment, to step up its testing facilities such that same yard sticks is being used to evaluate tractors and equipment. It was along this line of discussion that the Centre came up with a Tractor Test Track which is virtually first in Africa and patterned along the Nebraska Tractor Test Track, Lincoln, USA. Government is urged to provide more fund for the Centre so that more other facilities for testing and evaluation would be acquired.

CONCLUSION AND RECOMMENDATIONS

Agricultural mechanization has not been very successful in Nigeria, but there is a renewed interest by the present government through the policy called "Agricultural Transformation Agenda". There is also a risk that the absence of sound mechanization strategies and policies may lead to a repetition of earlier mistakes, such as investing in expensive machines not suitable to local conditions. The proper funding of agricultural machinery testing stations can help overcome these mistakes and promote R&D targeting the needs of Nigerian farmers.

Collaborations with testing stations in developed countries in terms of staff training and equipment acquisition will help in a long way to improve the quality of test and in Research and Development

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