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Research of the Causes that Influence the Efficient Use of Agricultural Machinery Imported in Guinea

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Abstract : *Guinea is considered one of the largest importers of agricultural machinery in the sub-region, but it fails to achieve the main goal of food self-sufficiency, which will later lead to food security. Based on the development of cultivable land, harvests, in short the operations of agricultural production, we find that achieving objectives with agricultural machinery is difficult. In this article, we seek to understand the causes that influence the efficiency of different imported agricultural machinery. The research revealed the following: operators have little knowledge of upkeep and maintenance; studies around two different tractors revealed a common negative influence (tractors are imported without their original equipment); which plays a lot on them during construction. It also appears that the Chinese tractor FS704 adapts better to the operating conditions of Faranah than the American Massey Ferguson tractor with mechanical steering and after-sales service contracts do not exist and do not apply at any level in Guinea.*

Keywords: Agricultural Machinery, Tractors, Components, Breakdowns, Chinese FS704, Massey Ferguson

1. Introduction

The issue of food and nutritional security for populations has long been a major concern of the highest Guinean authorities. It is strongly linked to the poverty of the populations and results in particular in an insufficient availability of food in relation to the needs and difficulties of access of the populations to food products [1]. The Republic of Guinea is considered one of the largest importers of agricultural machinery in the sub-region, but it fails to achieve food self-sufficiency and the imported machinery has a short operating life. To try to solve this problem, we resolved to conduct research to elucidate the causes [2].

The first studies carried out on two tractors in 2019 led us to the following results:

- The two machines have made an average of thirty breakdowns in three months, which proves a priori that the operators have little notion of upkeep and maintenance, and the managers were not interested in the operating cost of the machines or did not know how to calculate it ;
- The breakdowns were related to the main components of the machines (the injection pump, the injectors, the oil and fuel pumps, the starter, etc.) in addition to the overheating of the engines. These failures do not allow a long operating life, in addition to operator mishandling. It therefore appears that the operators are not trained for the task ;
- Knowing that the operators were poorly trained and taking into account the condition of these tractors, we resolved to deepen the research by carrying out other studies, such as the comparative study of the influences on two different tractors and in good condition, to bring out other causes and also see which of the tractors best adapts to current operating conditions. For the work we have chosen Massey Ferguson tractors (American) and the Chinese tractor FS704.

2. MATERIALS AND METHOD

2.1 MATERIALS

2.1.1 Study zone

To carry out the research, we worked with the Agricultural Mechanization Center (AGRIMA) of Faranah, built by the North Korean company in 1976. In 2005, it became the Center for Agricultural Machinery (CMA) of Faranah. It is located not far from the national Faranah - Mamou, 1 km from the city center in the aviation district in front of the Professional Training Center (CFP) of Faranah [3].

Tools and equipment used

The tools and equipment used are as follows: two (2) watches, two stopwatches, pens and notebooks for monitoring, monitoring notebooks, wrenches (open-ended, adjustable, spark plug, pipe, joint, male Allen, etc.), the hoist, liquid soap, detergent for cleaning the parts, a grinding wheel, green papers, a wire brush and the various measuring instruments (caliper; micrometer; comparator; gauges, etc.).

The maintenance analysis tool was the 80/20 Pareto chart (the 20% of failures which explain the 80% loss of time) and the comparison of the availability coefficients Kd and the use coefficients Ku [4].

2.1.2 Types of tractors

The two types of tractors covered by this study are:

a) Massey Ferguson Tractor

This tractor is a utility vehicle that can be on a wheel or on a bug. It has a 60 horsepower four (4) cylinder engine, direct injection rotary pump, with mechanical steering. The model has a compact structure, its color is red, this brand can be recognized by the presence of three inverted triangles two at the bottom and one at the top. It is made in Great Britain with the association of the American company to DULUHT.

b) Chinese tractor SF704

It is also a wheeled utility vehicle and has a 70 horsepower four (4) cylinder engine, direct in-line injection pump. It is designed to be equipped just like the first with different work instruments (Seeder, harrow, plow, mower, etc.), the model has a compact structure in red color and equipped with power steering. The technical characteristics of these tractors are given in table 1.

Table 1: Technical characteristics of the tractors

Characteristics	Tractors		Units
	Chinese Fs704	Massey Ferguson	
Direction	Assistance	Mechanical	-
Manufacturer	China	Britain	-
Power	51.52	44.16	kW
Tank capacity	78	70	litre
Wheelbase	3.57	3.2	m
Maximum revs	2200	2000	tr/min
Length	3.57m	3.2	m
Width	2.3	2.8	m
Weight	2.7	2.2	t
Coupling points	3	3	
Plow	4	4	Corps
Driving wheels	4	2	-
Hydraulic pump flow	40	17	l/mn
Generator	30	25	A
Drums	12	12	V

2.2 METHOD

The methodology adopted for this study consists of: drawing up monitoring tables, monitoring the tractors in the different fields, studying the different parameters of the two tractors (coefficients of availability, use and dispersions), comparing the coefficients of availability (K_d) and utilization coefficients (K_u) [5, 6].

2.2.1 Tractor availability and use coefficients

The determination of the coefficients of availability and use of tractors is carried out as follows [7, 8].

a) Coefficient of availability

The availability coefficient (K_d in %) is calculated by formula 1.

$$K_d = \frac{t_d}{t_p}.100 \quad (1)$$

With: ($t_d = t_{pl} - t_a$) is the available time; (t_{pl}) is the planned time and (t_a) is the downtime.

b) Coefficient of use

The duty cycle (K_u in %) is calculated by formula 2.

$$K_d = \frac{t_u}{t_d}.100 \quad (2)$$

With: ($t_u = t_d - t_{pt}$) is the useful working time; (tp) and is the waste of time

2.2.2 Statistical analysis of the coefficients of availability and use of tractors

a) Massey Ferguson Tractor

- The average availability coefficient Kdm is calculated by formula 3.

$$K_{dm} = \frac{\sum_{i=1}^{k} K_{di}}{n} = 89{,}93\ \% \quad (3)$$

- The variance is calculated by formula 4.

$$\sigma^2 = \frac{\sum_{i=1}^{k} (K_{di} - K_{dm})^2}{n} = 266.77 \quad (4)$$

- The standard deviation becomes:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{k} (K_{di} - K_{dm})^2}{n}} = 16.33\ \%$$

This value (16.33%) is above the allowable (15%) in technique.

- The average duty cycle by formula 5.

$$K_{um} = \frac{\sum_{i=1}^{k} K_{ui}}{n} = 64.48\ \% \quad (5)$$

- The variance σ2 by formula 6.

$$\sigma^2 = \frac{\sum_{i=1}^{k} (K_{ui} - K_{um})^2}{n} = 425.46\ \% \quad (6)$$

- The standard deviation becomes

$$\sigma = \sqrt{\frac{\sum_{i=1}^{k} (K_{ui} - K_{um})^2}{n}} = 20.62\ \%$$

This result (20.62%) clearly exceeds the allowable (15%) in technique [9]. The dispersion around the mean is quite large.

b) Chinese tractor FS 704

By applying the previous formulas from (3 to 6) we find the values of the coefficients of the Chinese Tractor FS 704.

- The average availability coefficient is: Kdm = 93.96%.
- The variance is: σ2 = 11.91 and the standard deviation becomes: σ = 3.42%. This value is below the allowable limit of (15%). So the dispersion around the mean is very low.
- The average duty cycle is: Kum = 78.87%
- The variance is: σ2 = 43.84% and the standard deviation becomes: σ = 6.66%.

The dispersion of the duty cycle around the average is also small. As a result, there was little loss of time, so fewer breakdowns than the Massey Ferguson tractor.

3. RESULTS AND DISCUSSIONS

3.1 RESULTS

3.1.1 Availability coefficients

The results of the comparison of the availability and use coefficients of the two tractors are given in Table 2.

Table 2: Comparison of the coefficients of availability and use of the two tractors

Tractors	Coefficient of availability		Coefficient of use	
Massey Ferguson	89,93		64,48	
	Variance	Standard deviation	Variance	Standard deviation
	266,77	16,33	425,46	20,62
Chinois FS704	93,96		78,84	
	Variance	Standard deviation	Variance	Standard deviation
	11,91	3,42	43,84	6,62

From Table 2, it can be seen that the availability and use coefficients of the Chinese tractor FS704 are higher than those of the American Massey Ferguson tractor. So the Chinese FS704 tractor is better suited to our present operating conditions in Faranah. In either case, the duty cycle does not reach 90%, nor around 90%. So one is weak and the other slightly weaker, this is mainly due to the use of adopted equipment (not suitable for tractors), especially plows in our research.

3.1.2 Failure analysis of the two tractors

a) Massey Ferguson Tractor

Massey Ferguson tractor failure analyzes are given in Table 3.

Table 3: Frequency of failures

Organs		Frequency	Frequency (%)	Cumulative
Plow	Coupling point	13	50	50
	Disc bearing			
	Tensioner Tire			
Other tractor components	Tire	3	11.53	61.53
	Oil pump	3	11.53	73.04
	Mono block	2	7.69	80.73
	Executive brain	1	3.84	84.57
	Gearbox Air filter	1	3.84	88.41
	Air filter	1	3.84	92.25
	Gasoil filter	1	3.84	96.09
	Quiet	1	3.84	99.93
	Total	**26**		-

These results are illustrated by the Pareto chart (Figure 1).

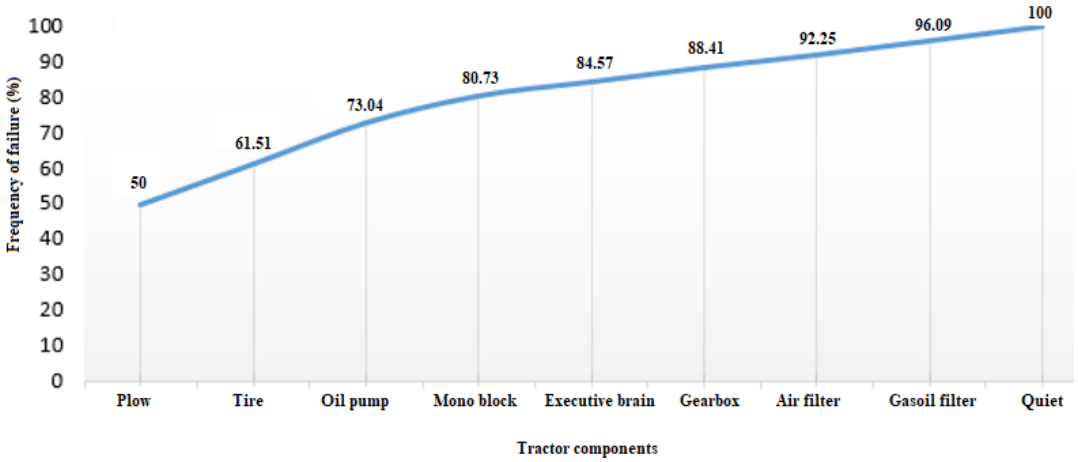

Figure 1: Pareto chart of the Massey Ferguson tractor

After analyzing the diagram, 80.73% of breakdowns belong to the following components: the plow; the tire, the pump, the monobloc. Of the 80.73% ; 50% belong to the plow, which is why it is adopted, so it is not an original plow.

b) Chinese tractor FS704

The failure analyzes of the Chinese tractor FS704 are given in table 5.

Table 4: Frequency of failures

Organs		Frequency	Frequency (%)	Cumulative
Plow	Disc bearing	9	50	50.00
	Suspension arm	3	16.66	66.66
	Coupling point	3	16.66	83.32
	Tensioner	2	11.11	94.43
Support	Body support	1	5.55	99.98
	Total	**18**		

These results are illustrated by the Pareto chart (Figure 2).

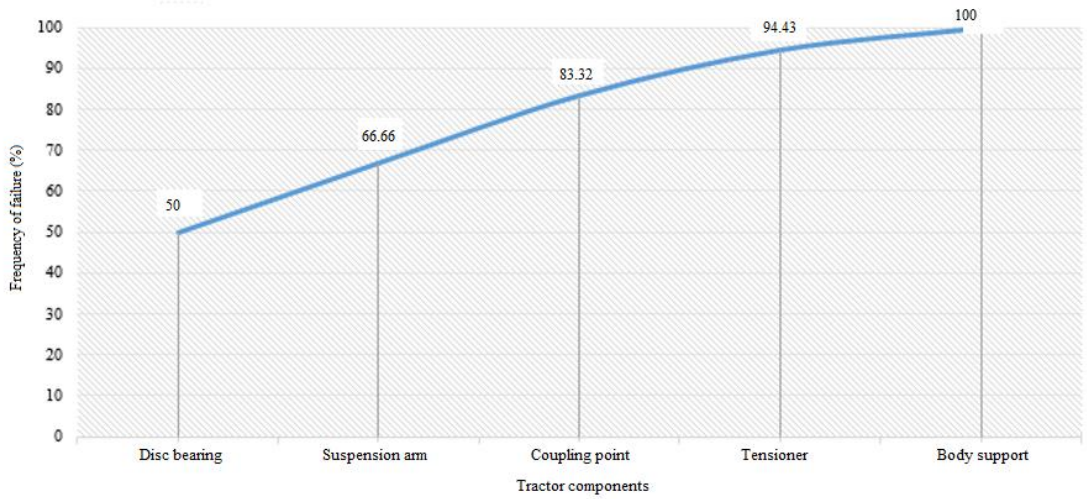

Figure 2: Pareto chart of the Chinese tractor FS704

Following the analysis of the Pareto chart, 83.32% of failures were recorded on the following components: disc bearing, suspension arm, coupling point all belonging to the plow and even 94.43% belong to the plow. This time again the plow is not an original plow from the SF704 tractor. From these two cases we find that the plows are adopted to the tractors, therefore are not the original plows.

3.2 DISCUSSION

The follow-up of tractors in 2019 revealed the very poor training of operators working on agricultural machinery, and the lack of concept of upkeep and maintenance, accompanied by their incorrect maneuvers, affect the efficiency and the service life of the machinery.

From Table 2, comparison of the availability (Kd) and use (Ku) coefficients, it can be seen that the availability and use coefficients of the Chinese tractor FS704 (Kd = 93.96%; Ku = 78.84%) are superior to those of the American Massey Ferguson tractor (Kd = 89.93%; Ku = 64.48%). This explains why the Chinese tractor FS704 adapts better to current operating conditions. In both cases, the utilization coefficients do not reach 90%, this is mainly due to the use of the equipment adopted (not suitable for tractors), especially plows in the context of our research. From the analysis by the diagram according to Tables 3 and 4 of the frequency of breakdowns, the 80.73% of the breakdowns of the Massey Ferguson tractor belong to the following components: the plow; the tire, the pump, the monobloc. Of the 80.73%, 50% belong to the plow, which is why it is adopted, so it is not an original plow.

Similarly, following the same analysis for the SF704 tractor, 94.43% of breakdowns belong to the plow. Once again the plow is not the original plow. Breakdown frequency tables 3 and 4 also show that the American Massey Ferguson tractor had more breakdowns than the Chinese FS704 tractor. It is also very important to point out the total lack of spare parts to construction sites during the various works, as well as in stores and on the market. Some authors in their research, have analyzed the process of mechanization of agriculture in Guinea during the following three periods: from 1958 - 1984, from 1984 - 2010 and from 2010. The main objective was to understand the factors failure and success of the mechanization of agricultural production with a view to proposing local strategies. But the work focused on the analysis of documents and various agricultural mechanization programs without ever going to the construction sites [10, 11].

The fact of seeking answers to the causes of failures of agricultural development programs in the work sites brings us closer to reality, and allows us to quickly correct the shortcomings linked to the work sites and to the development programs. Recently Guinea has imported more than two hundred and eighty (280) tractors of small power, having a working width of 1.2 to 1.5m and also more than two hundred and eighty (280) harvesters [11]. Is it favorable for Guinea or for an entrepreneur to have small machines or large machines that can replace four to five small ones?

Technically it would be favorable to choose a large tractor of greater power, having a working width of five to six meters which would replace four to five small tractors. This would encourage the use of a single operator instead of four to five others for small machines. It would greatly reduce the time it takes to complete the work, as well as fuel and lubricant consumption. It would also make it easier to service, maintain machinery, obtain spare parts and only have to pay one operator instead of 4 to 5 operators for the same job.

4. CONCLUSION

The causes influencing the efficient operation of agricultural machinery imported into Guinea are the following: the lack of good training of operators working on the machinery, which greatly affects the yield and the

life of agricultural machinery; the difficulty of choosing agricultural machinery that best suits our operating conditions, or that would facilitate the execution of the work; the purchase of small power machines which entails the use of a large number of operators, a multiplication of wages, upkeep and maintenance; the purchase of machinery without their appropriate equipment; lack of after-sales service contract with suppliers. The after-sales service promotes (the training of operators and mechanics for the upkeep and maintenance of the machine, hydraulic, electrical and electronic systems, analysis of engine wear and a plan for the supply of spare parts. spare.

References

[1] Kolado Bocoum, Rapport final, Programme Accéléré de Sécurité Alimentaire et Nutritionnelle et de Développement Agricole Durable de la Guinée, 2016-2020, Ministere du Plan et de la Coopération Internationale, République de Guinée, Janvier, 2017, 119p.

[2] Programme mondial du recensement de l'agriculture, Programme, concepts et définitions, Organisation des Nations Unies pour l'Alimentation et l'Agriculture, Rome, 2016, 228 p.

[3] Ibrahima Barry, Ansoumane Sakouvogui, Mamby Keita, Renjie Dong, Sara Bailo Diallo, Evaluation of the Potential of Biogas and Methane a Party of the Cow Dung, International Journal of Academic Multidisciplinary Research, Vol. 5 Issue 1, January - 2021, Pages: 151-154.

[4] Silas O. Nkakini and Francis O. Etenero, Agricultural tractor and machinery performance and serviceability in Delta State, Nigeria, Journal of Engineering and Technology Research, Vol. 11(5), pp. 47-57, october 2019.

[5] Ricco Rakotomalala, Analyse de corrélation, Étude des dépendances - Variables quantitatives Version 1.1, Université Lumière Lyon 2, 27-Dec-2017, 105p.

[6] S. C. Kim, K. U. Kim, D. C. Kim, Prediction of fuel consumption of agricultural tractors, Applied Engineering in Agriculture, Vol. 27(5): 705-709, 2011.

[7] B. K. L. ZOKPODO, N. M. DAHOU & E. D. DAYOU, Analyse des déterminants liés au fonctionnement des Centres d'Exploitation des Machines Agricoles (CEMA) au Bénin, Annales des sciences agronomiques, 21(2), 181-202, 2017.

[8] D.W. Smith, B.G. Sims and D.H. O'Neill, Testing and evaluation of agricult machinery and equipment, Principles and practices, FAO Agricultural Engineering Service 1994, 288p.

[9] Firas Salim Al-Aani, Mathew J. Darr, Benjamin Ross Covington and Levi John Powell, The performance of farm tractors as reported by CAN-BUS measures, ASABE Annual International Meeting, 2016, 21p.

[10] Idrissa Magassouba, Réflexion sur le processus de la mécanisation agricole dans un contextede changement en Guinée, Revue scientifique RESUK N°14, Guinée, Kankan 2014.

[10] Idrissa Magassouba, Réflexion sur le processus de la mécanisation agricole dans un contextede changement en Guinée, Revue scientifique RESUK N°14, Guinée, Kankan 2014.