The Effects of Mechanised Log Skidding on some Components of Farm Tractors in Ondo State, Nigeria

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Abstract

An investigation was made into the effects of mechanised logging and log skidding on some components of farm tractors used under the Tractor Hiring Units (THU) of the Ministry of Agriculture in Ondo State, Nigeria. Thirty tractors of various makes and models were examined after a period under logging operations based on a template of eight key criteria and thirty four sub criteria related to vital tractor systems and components. Data collected were analysed to determine the percentage of the components that are good, damaged but repairable or damaged or missing parts. The results show that the highest occurrence of failure are with worn out tyres (80%), followed by broken rear work lights, headlamps and road warning lights (60%) and broken lateral stabilizers (53.3%). Similarly, the least damaged components of tractors under the study were the tyre rims (66.7% good), wheel hubs and axle arms (56.7%) and hydraulic linkage arms and forks as well as brake pedal travel and release (46.7%).

Keywords: tractors, damage, serviceable, faults, forestry

1. Introduction

Sustaining the natural productivity of forests during harvesting operations is a major concern for policy makers in the forest zone of Nigeria and across the world. Apart from the known contributions of deforestation to global warming and climate change, this will guarantee that remaining trees, wildlife and soil nutrients are retained in their original position and proportion. With the advent of modernisation, forestry extraction activities have adopted mechanisation to remove the drudgery associated with the process. The adverse effects of machines on the forest eco system and residual stand have been documented by several researchers including Ezebilo (2004), Adekunle and Olagoke (2010) and FAO (2011), however challenges of the failure of tractors that are primarily designed and used for arable crop farming and now converted to use in forestry mechanisation without necessary adaptation have not been adequately studied. As an alternative, horse logging is generally considered more expensive and less productive than tractor logging (McNamara and Kaufman 1985).

A major incentive for tractor use in log extraction is that hiring rates for forestry activities are higher than for crop husbandry purposes. The cost of acquiring a medium range agricultural 4 WD tractor with forestry specifications and protection is quite high. In addition, tractor owners take decision to deploy their tractors for log extraction to cure the perennial problem of underutilisation during the dry season to shore up the annual use of tractors, which have been found to be at a deplorable range of 678.92 to 534.4 hours by Oluka (2000).

The consequence of this is that failures may occur more frequently, more intensly and in unusual places on these tractors. Upon more investigation, it is suspected that the increased cost of hiring may not account for the repair costs and reduction in service years.

According to FAO (2011) estimates, Nigeria has 693,000 ha of forest plantations. Ondo state has a total of 3076.16 square kilometres of forest reserves, of which 92.2% are high forests, and 6.3% is savannah, while 1.5% is mangrove swamp. About 1391.63 (45.3%)

Table 1 Template for survey of tractor conditions

Make/model of tractor				Registration No	
Engine No				Chasis/serial No	
Location		Criteria		Subcriteria	Score
1	Transmission system	1	Gear	Gear noisy in neutral and in gear	
		2		Oil leak from gearbox	
		3		Difficulty in engaging/disengaging gear	
		4	Clutch	Worn clutch pressure plate	
		5		Clutch slip	
		6		Damaged release bearings	
2	Steering and alignment	7	Steering	Loss of power assistance	
		8		Connection loose or damaged	
		9		Low oil level	
		10	Alignment	Damaged steering shaft assembly, drag links and tie rod assembly	
		11		Oil leak from steering ram	
3	Brakes and final drive	12	Brakes	Excessive brake pedal travel	
		13		Brake grab and drag	
		14		Braking is unbalanced	
		15		Brakes fail to release	
		16		Brakes inefficient	
4	Hydraulic system	17	Linkages	Damaged a) Top link	
		18		b) Lifting arm (L&R)	
		19		c) Lifting forks (L&R)	
		20		d) Lower links (L&R)	
		21		e) Broken lateral stabilizers	
		22		Lift fails to operate/erratic during lowering/raising	
5	Drawbar	23	Drawbar	Broken drawbar bracket	
		24		Missing hooks and pins	
6	Rims/tyres	25	Traction Devices	Broken rim	
		26		Worn out tyres	
		27		Incorrect tyre pressure	
		28		Damaged wheel hubs and axle arms	
7	General/ physical condition	29	General	Damaged front grille, hood or side panels	
		30		Damaged instruments panel	
		31		ROPS and FOPS*	
		32	Lighting Equipment	Broken rear work lights	
		33		Broken headlamps and road warning lights	
8	Accessories	34		Wheel spanner, jack and repair tools	

* ROPS – Roll Over Protection Structure; FOPS – Falling Object Protection Structure

of these forest reserves have been encroached (DAS 2009). Similarly, 86,082 and 87,370 trees were harvested in 2007 and 2008, respectively.

Tree harvesting methods are often classified either as »Low Level« that is chainsaw felling and tree processing–line skidding, »Medium Level« that is chainsaw felling, line skidding and tree processing at landing or »High Level« which involves harvester felling and tree processing – forwarding logs to landing. Logging of timber in Nigeria is often done selectively, first selecting the mature trees. During the harvesting, the trees are felled, delimbed and topped, then skidded to the landing with tractors fitted with a winch (optional), cable or chains. In certain cases, after buckling, trees may be sawn in situ, loaded into modified tractor trailers for haulage.

Although no research has been carried out in the area of study on the failure rate of these tractor components and systems, this paper seeks to highlight the location of common failures and repair costs.

2. Material and methods

A small sample of 30 tractors was studied to collect data on tractor failures after the tractor has been in use for skidding for a period of three months. Physical inspection of tractor condition was conducted and documented by experienced agricultural mechanics in a conditional survey. Data was elicited on vital tractor systems using a template of eight key criteria and thirty four sub criteria shown in Table 1. Selected tractors have previously been used for similar operation and they were reported to be in good condition before commencement.

Results were scored in code of Good (1), Faulty and Serviceable (2), Defective or missing (3) for easy analysis. Analysis was done with SPSS statistical package.

3. Results and discussion

The distribution of tractors by location in Table 2 shows that the highest percentage (36.7%) of the sampled tractors were from Owo zone, 30% of the tractors were from Ikare zone, 16.7% were from Okitipupa and Akure zones.

Fig. 1 shows the distribution of tractors by their model. TAK Tractor with 13 units forms the majority of the sampled tractors. 6 of the tractors were Massey Ferguson model, while 5 were Swaraj model. 2, 3, and 1% were Mahindra, New Holland and Steyr Ursus models, respectively.

Table 2 Distribution of respondents by location

Zones	Frequency	Percent
Akure	5	16.7
Ikare	9	30.0
Okitipupa	5	16.7
Owo	11	36.7
Total	30	100.0

Source: Field Survey 2014

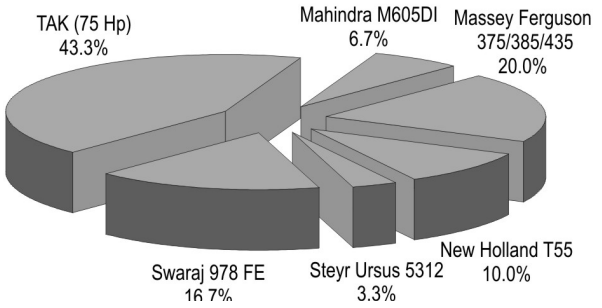

Fig. 1 Distribution of tractors by models

3.1 Brake condition

Table 3 shows that half of the sampled tractors had serviceable problems pertaining to excessive brake pedal travel, 46.7% of them were in good condition not having this problem, whereas the status of only few tractors (3.3%), as regards the challenge, was not provided. Results further show that majority (53.3%) of the tractors had service problems related to brake grab

Table 3 Percentage of occurrence of tractor faults

Criteria		Good, %	Serviceable, %	Bad, %	No response, %
Brakes	Excessive brake pedal travel	46.7	50.0	–	3.3
	Brake grab and drag	43.3	53.3	–	3.3
	Braking is unbalanced	30.0	63.3	–	6.7
	Brakes fail to release	46.7	36.7	–	16.7
	Brakes inefficient	26.7	63.3	–	10.0
Linkages	Damaged a) Toplink	33.3	13.3	46.7	6.7
	b) Lifting arm (L&R)	46.7	40.0	13.3	–
	c) Lifting forks (L&R)	46.7	26.7	26.7	–
	d) Lower links (L&R)	40.0	13.3	40.0	6.7
	e) Broken lateral stabilizers	16.7	30	53.3	–
	Lift fails to operate/erratic during lowering/raising	26.7	20.0	13.3	40.0
Drawbar	Broken drawbar bracket	43.3	13.3	40.0	3.3
	Missing hooks and pins	13.3	36.7	46.7	3.3
Traction devices	Broken rim	66.7	13.3	16.7	3.3
	Worn out tyres	3.3	13.3	80.0	3.3
	Incorrect tyre pressure	16.7	43.3	16.7	23.3
	Damaged wheel hubs and axle arms	56.7	20.0	16.7	6.7
Lighting equipment	Broken rear work lights	3.3	30.0	60.0	6.7
	Broken headlamps and road warning lights	6.7	46.7	40.0	6.7
General	Damaged front grille, hood or side panels	30.0	50.0	10.0	10.0
	Damaged instruments panel	20	43.3	10	26.7
	ROPS and FOPS	6.7	50	10	33.3
Accessories	Wheel spanner, jack and repair tools	–	30	3.3	66.7
Steering	Loss of power assistance	26.7	46.7	6.7	3.3
	Connection loose or damaged	43.3	43.3	6.7	6.7
	Low oil level	26.7	56.7	3.3	13.3

and drag, 43.3% of them were in good condition, while there was no response for 3.3%. Most (63.3%) of the tractors had problems of unbalanced braking, some (30%) of them were in good condition, while the status of few (6.7%) of the tractors was not known. Pertaining to the sub criteria of brakes failing to release, it is obvious from Table 3 that majority (46.7%) of the tractors do not encounter the problem. 36.7% of them had this problem, while the status of some (16.7%) of them was not known. With respect to inefficient brakes, 26.7% were in good condition, 63.3% had problems, while the status of 10% of them concerning this challenge was not known. Summarily, the brake system of most tractors sampled with respect to all signs of brake performance, were high in percentage with respect to faulty but serviceable status. From this, it could be said that brake system of most tractors used in the study is in poor condition.

3.2 Hydraulic linkage

Results show that Top-link of 46.7% of the tractors was damaged or missing, 33.3% were in good condition, 13.3% were faulty but serviceable. However, the status of Top-link of 6.7% of the tractors was not known. 46.7% of the tractors had their lifting arm (Left or Right) in good condition, though 40% of the lifting arms (L&R) were faulty but serviceable. 13.3% of the lifting arms (L&R) were critically damaged. Similarly, the lifting forks (L&R) of 46.7% of the tractors were in good condition. The status of 26.7% of them was faulty but repairable, with another 26.7% critically bad. Results further show that 40% of the tractors had their lowering link (L&R) in good and bad condition, respectively, 13.3% of the lowering links were faulty but serviceable, while there was no response to indicate the status of 6.7% of them. Analysis also reveals that broken lateral stabilizers are common with a majority (53.3%) of the tractors, 30% were faulty but serviceable, while few (16.7%) were in good condition. As to whether lift fails to operate/erratic during lowering/raising, most (40%) of the respondents gave no comment. This might probably be because tractors were not examined with mounted implement during data collection. However, 20% of response indicated faulty but serviceable conditions, while 13.3% were in critical condition and only 26.7% of them in good condition. Based on this analysis, it is apparent that linkages conditions of most tractors in the study area are moderately functional.

3.3 Drawbars

Analysis of the condition of tractor drawbars shows that the drawbar bracket of 43.3% of the tractors was in good condition, 40% of those brackets were critically bad (Fig. 2), while 13.3% were faulty but serviceable. The status of few (3.3%) of them were not known. This result might be the outcome of improvisation of winches, converting drawbar brackets to hitch point as commonly practised by operators during log skidding. With respect to missing hooks and pins, majority (46.7%) of the tractors reported them missing, 36.7% were partly missing, while few (13.3%) were in good condition. The status of only 3.3% of them was not known. Thus, the drawbar status of most tractors is averagely poor.

Fig. 2 Damaged drawbar bracket of Massey Ferguson 375 tractor

3.4 Traction devices

The results show that 66.7% of the tractors did not have problems of broken rim, but 13.3% of them had a minor problem in this area, while 16.7% had critically bad rims. The status of 3.3% of them was not known. Results also revealed that most (80%) of the tractors in the study encountered problems of bad, worn out tyres. 13.3% of them had partly worn out tyres, while only 3.3% of them had their tyres in good condition. There was no response to indicate the status of 3.3% of them. It was found that most (43.3%) of the sampled tractors suffer from incorrect tyre pressure of 30 psi. This might be attributable to the fact that most of the tractors were not serviceable during data collection. Only a few (16.7%) of the tractors in the study were in good condition and free from this challenge, some (23.3%) of the respondents did not unveil the status of this component probably because this problem can easily be remedied. In the same vein, the wheel, hub and axles arms of majority (56.7%) of the tractors were found to be in good condition, while 20% were faulty but serviceable. However, 16.7% of them were critically bad. The status of about 6.7% was not known.

3.5 General physical condition and accessories

The results further show that front grille, hood or side panels of majority (50%) of the tractors were faulty but repairable, 30% of the tractors had these components in good condition, while about 10% of them had the component in critically bad condition. There was no response for the remaining 10% regarding the condition of this component. Also, the instrument panels of 43.3% of the sampled tractors were faulty but serviceable, 20% of them had the component in good condition, while the remaining 10% had it in bad condition. The status of this component in some 26.7% of the tractors was unknown. Furthermore, Roll Over Protection Structure (ROPS) and Falling Object Protection Structures (FOPS) in half of the tractors were not available. 10% of them had the components in bad condition and only 6.7% of the tractors had it in good condition when available. There was no response to indicate the status of the components in about 23.3% of the tractors. Here, the inadequacy of response might indicate the lack of comprehension of what constitutes ROPS and FOPS by respondents or the general lack of ROPS on many tractors in the state. Wheel spanner, jack and repair tools of about 30% of the tractors were faulty but serviceable, none of them had the components in good condition, while only 3.3% of them had it in critically bad condition. The majority (66.7%) of the respondents did not indicate the status of these components. Summarily, with respect to all components, it could be said that most of the tractors' accessories are faulty but repairable.

Furthermore, the analysis of lightning equipment in Table 3 shows that the rear work light of most (60%) of the tractors was broken and in bad condition, 30% of them had faulty but repairable rear work light, while only 3.3% of them had good rear work lights. 6.7% of the respondents did not indicate the status of their tractors rear work light. Considering the status of headlamps and road warning lights, majority (46.7%) of the tractors had faulty but repairable headlamps and road warning lights, 40% of them had bad headlamps and road warning lights, while few (6.7%) of them had good headlamps and road warning lights. The status of headlamps and road warning was unknown in about 6.7% of the tractors. Based on this result, it could be said that lightning status of most of the tractors in the study area is poor, which is understandable in view of the high possibility of frequent contacts with trees, shrubs and other vegetal disturbance in the work environment.

Assessment of the steering condition with respect to loss of power assistance indicated that 26.7% of the tractors were in good condition, 46.7% of the tractors had minor and rectifiable faults. Few (6.7%) of them were in bad condition, while 3.3% of the respondents did not indicate whether their tractors had challenges with power assistance or not. Results further show that majority (43.3%) of the tractors had no loose or damaged connection, the same percentage were

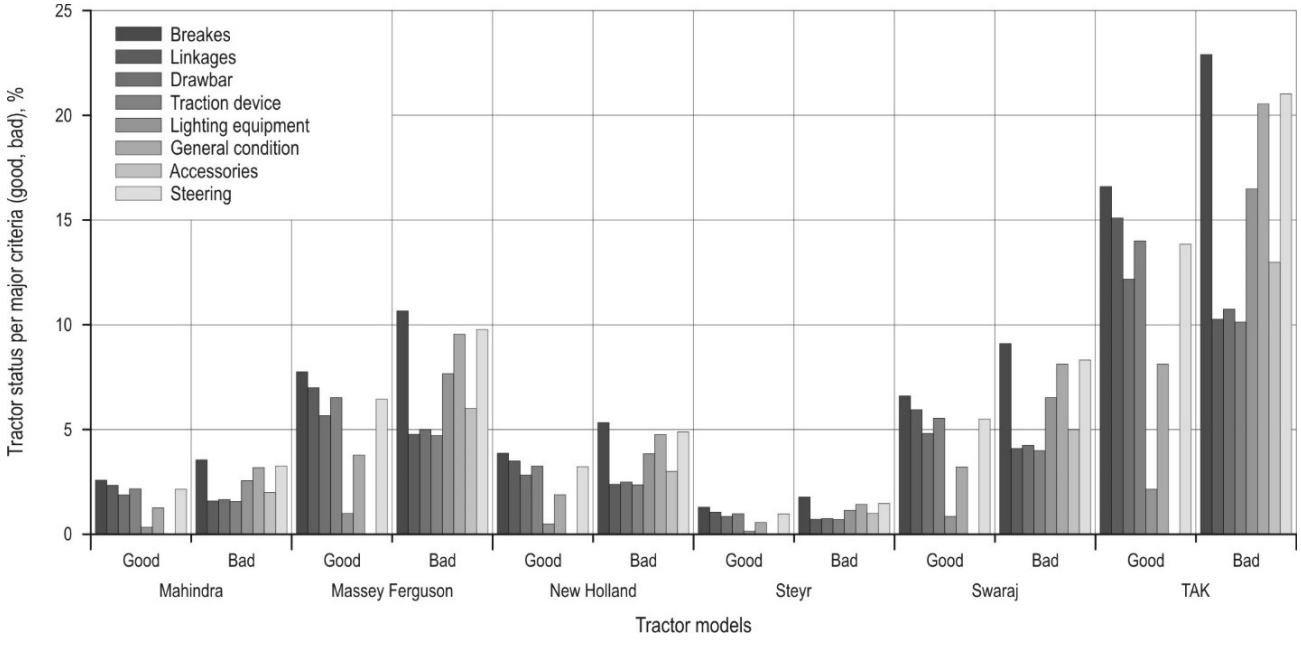

Fig. 3 Analysis of tractor component failure on good/bad basis

faulty but serviceable, while 6.7% had steering hoses that needed replacement. There was no assessment for 6.7%. 56.7% of the tractors had serviceable problems of low steering oil level, 26.7% were in good condition, while very few (3.3%) were in bad condition meaning that they had critical low oil level. There was no response for 13.3% of them. Analysis also revealed that 40% of the sampled tractors had repairable faults of shaft assembly, drag link and tie rod. 26.7% of them were in good condition, while 10% needed a replacement of these components. There was no response for 23.3% of tractors examined. Also, 43.3% of the tractors had oil leaking from steering ram, 23.3% of them were without this problem, while the status of 33.3% of the tractors was unknown. Based on these results and with respect to all the components related to steering system, it could be said that the status of majority of tractors in the study area is slightly below the average.

Analysing on the basis of mean percentages of major criteria (components and symptoms) and aggregating to strictly good and bad scores on tractor basis and ignoring undisclosed responses, the results (Fig. 3) indicated that the braking unit had a good/bad ratio of 0.72, the linkages 1.47, drawbar 1.13, traction devices 1.38, while the good/bad ratio of the lighting, general physical condition and steering was 0.13, 0.40 and 0.66, respectively.

4. Conclusion

The key to sustainable forest harvesting is to apply the best knowledge available in six critical areas: harvest planning, forest roads, felling, extraction, long distance transport and post-harvest assessment. Most of these operations include the use of tractors and other machines to enhance productivity. The current study has indicated that the use of conventional tractors without adaptation to forestry use is largely harmful to the machine, although the examiners could be subjective, and the quantity and uniformity of the assessment during the study were not always sufficient. Further study on the cost of these failures might be required to assure tractor owners that using tractors this way is not the case of being »penny wise and pound foolish«.

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