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TECHNICAL RELEASE

15-R-23

FUEL CONSUMPTION ON LOGGING OPERATIONS

Studies/Surveys: consumables *November 2015*

INTRODUCTION: Over much of the past decade, fluctuating oil prices have increased the importance of fuel consumption estimates for cost control as well as cost forecasting in logging. Fuel costs are a significant component of variable cost and are directly linked to a number of other costs (tires, lubricants, etc). While a number of fuel consumption rules of thumb are available, changing equipment technology and highly variable production rates create considerable doubt about the accuracy of current estimates.

The purpose of this study was to estimate fuel consumption rates and determine if we could detect differences in fuel consumption due to tract characteristics. The study was funded by the National Council for Air and Stream Improvement (NCASI) and the Wood Supply Research Institute (WSRI).

METHODS: Requests for fuel consumption data were made to loggers in a variety of ways (education meetings, equipment exhibitions and regional logger meetings) over a period from January 2012 to October 2014. We solicited fuel consumption data that presented fuel use and production by tract or by week. For both sources of data, participants were asked to identify harvest type (thinning or clearcut) and tract characteristics, with estimates for slope, soil moisture, and tree size. Fuel consumption was reported in gallons and production in tons. Data were sometimes available by machine and sometimes only for the whole harvesting system. Averages were developed and weighted by production (tons).

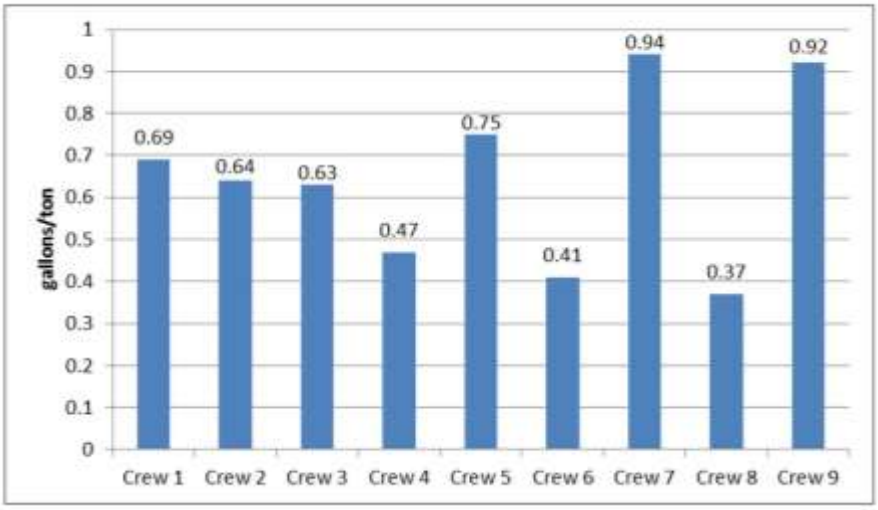

Fig. 1: *Average fuel consumption from individual tract data (ground-based systems).*

RESULTS: Data were accumulated for a period which started January 2012 and ended March 2015. Although we made hundreds of contacts during the outreach portion of this effort, only nine crews reported data for tract fuel consumption, and most of the weekly fuel consumption data were reported by six crews. The limited response by contractors reduced the geographic and harvesting system variability within the data.

Tract Data

The nine crews that reported tract data harvested over 48,000 tons, and the average fuel consumption was 0.65 gal/ton with a range from 0.37 to 0.94 gal/ton. In the tract data, machine model years ranged from 1992 to 2013. Crews submitting data worked in AL, GA, LA, NC, and OH. There was only one crew with manual felling, and it had average fuel consumption that was roughly half the mean, at 0.37 gal/ton. The only crew that reported more than one tract had a mean fuel consumption of 0.69 gal/ton, with a standard deviation of 0.12. The standard deviation of all tract data was 0.16. ***Fig. 1*** presents the tract data for crews producing treelength products and delimbing at the landing (full-tree systems). There were too few data points to analyze tract characteristics.

Weekly Data

The weekly data were provided by six logging crews operating in South Alabama and Northeast Florida. Data for the crews covered the period August 2012 to March 2015. The six crews reported fuel consumption data for the harvest of just less than 0.5 million tons. The majority (94%) of the data were reported for slopes less than 15%. We received data for a range of average tree size (5-18 inches DBH) and from both thinnings and clearcuts. Only 22% of the weekly estimates included soil moisture estimates. Logging crews that submitted weekly data produced treelength products and delimbed at the landing (full-tree systems). All systems utilized wheeled feller-bunchers, skidders and knuckleboom loaders. Other machines with fuel consumption reported included bulldozers, in-woods trucks, chain flail delimbers, and excavator-based processors.

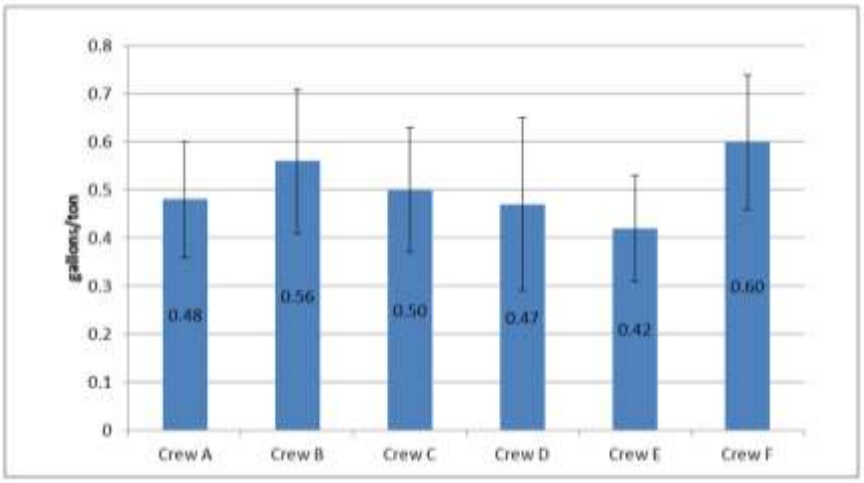

Fig. 2: *Average fuel consumption from weekly data for the harvest of mostly treelength products processed at the landing. Error bars represent the 90% confidence interval for each crew.*

The average fuel consumption was 0.51 gal/ton with a standard deviation of 0.15 and a 90% confidence interval of ±0.026 gal/ton for 346 weeks of data. The average fuel consumption ranged from 0.42 (Crew E) to 0.60 ((Crew F) (***Fig. 2***).

DISCUSSION: An analysis was completed to determine the impact from slope, soil moisture and tree size, but it was inconclusive. The distribution of data points was inadequate to determine fuel consumption differences due to major tract characteristics or harvest type (thinning vs. clearcut). The crew data indicate that within-crew variability was substantial, but we were unable to attribute that variability to the tract or harvest characteristics. The most significant measurement issue is whether the machine activity that consumes the fuel is reflected in weekly production. Examining both the within-crew and between-crew variability, it seems likely that only a proportion of the variability is related to that estimation error. Variability of 0.1

to 0.2 gal/ton may be related to a number of factors, including tree characteristics, product sorting, landing spacing, and terrain, as well as machine age and size, operating habits, and system efficiency.

Average fuel consumption (0.51 gal/ton) could be used as a starting estimate for similar conditions in the lower coastal plain. Fuel consumption variability would be related to conditions that change production (e.g. volume per tree or thinning) or that change the machine work per tree (e.g. skid distance, sorting, processing). These estimates represent in-woods consumption only and do not include use for over-the-road vehicles such as crew cabs or service trucks.

CONCLUSION: Fuel consumption data only highlight the need for maintaining activity and cost records summed by time or tract. The specification of a level of performance on a particular area is best addressed by records of past performance in similar conditions. Records of fuel purchases are adequate for system consumption, but for machine consumption fuel meters are required. Fuel meters can be purchased from various venders, and costs vary from $100 to $300, depending on size and accuracy. Methods to collect fuel consumption data are presented in FRA Technical Release 15-R-20, *Keeping Fuel Consumption Data on a Logging Operation*.

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