# HARVESTING TECHNICAL NOTE

HTN14-06
2022

# Cost and Productivity Benchmarking Update: 2020-2021

**Summary**

The FGR harvesting cost and productivity benchmarking system was set up in 2008 to track cost and productivity as related to the stand and terrain conditions and the harvest system being used. New Zealand forestry companies have contributed annually to the database, and as of August 2021 the data set has a total of over 1800 unique harvest area entries. This data set provides the ability to track major new trends resulting from changes in harvesting operations such as higher levels of mechanisation, and the integration of new technology such as winch-assist. It also enables the changes implemented by contractors and forestry companies to be quantified and reflects the overall success of these collaborative research and development initiatives.

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## INTRODUCTION

The harvesting benchmarking system was set up by Future Forests Research Ltd (now Forest Growers Research), with strong support from industry, to track productivity and cost in harvesting operations. Logging rates are vital to sustaining a financially viable business, and the factors that drive logging costs, have been known for some time (Cubbage *et al.* 1988). The FGR system has been collecting and analysing harvesting data successfully since 2008 (Visser, 2009) and reporting results to the participating companies in the form of brief annual reports. A more comprehensive set of analyses was completed, based on a decade of data collection, and published as a technical report in 2020 (Visser and Obi 2020).

Other examples of benchmarking logging costs exist in other parts of the world. Baker *et al.* (2014) created a logging cost index for harvesting operations in the southern USA, while Bell *et al.* (2017) was able to validate a logging costing model using a sample of real data. In collaboration with the FGR system, a one-off comparison of cable logging rates across central European alpine countries was published based on smaller datasets (Spinelli *et al.* 2015), as well as one for smaller harvest systems in the southern Alpine region with data collected from loggers (Spinelli *et al.* 2017). With no comparable nationwide systems tracking logging cost or productivity anywhere overseas the success of the New Zealand forest industry in sustaining the benchmarking database with accurate data each year is commendable.

While previously the annual data capture period covered the calendar year, most of the 2020 data was collected from April 2020, and the 2021 data was collected until August 2021 to ensure a large enough sample to be representative of the NZ industry. As such the data is presented for the period 2020-21.

The Benchmarking data entry form has remained virtually the same since its inception, but there have been minor changes. Since 2018 information is now collected on the use of winch-assist harvesting systems, and for 2021 the Month parameter has been deleted as no meaningful cost or productivity information has been derived from seasonal effects over the last 10 years.

## GROUND BASED HARVESTING

For ground-based operations a total of 112 new entries were received (Table 1). Similar to the 2019 data, two-thirds of the entries were from grapple skidder operations, and 16% from forwarder operations. Almost 10% of operations were recorded as shovel logging and this may suggest an increased level of adoption of this system that has been widely used in the Pacific Northwest for many years.



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# HARVESTING TECHNICAL NOTE

***Table 1: Summary of ground-based data over time (total n=939)***

| Attribute | 2008-10 | 2011-12 | 2013-14 | 2015-16 | 2017-18 | 2019 | 2020-21 |
|---|---|---|---|---|---|---|---|
| Scheduled Hours/day | 8.35 | 8.45 | 8.45 | 8.40 | 8.25 | 8.80 | 8.70 |
| Piece Size (t) | 2.1 | 1.8 | 2.0 | 2.1 | 1.9 | 1.9 | 1.9 |
| Extraction Dist. (m) | 205 | 206 | 205 | 221 | 250 | 230 | 195 |
| Slope (%) | 14.5 | 19.5 | 15 | 15.1 | 16.7 | 15.6 | 14.9 |
| # Machines | 3.6 | 4.3 | 4.6 | 5.0 | 4.7 | 4.7 | 5.4 |
| # Workers | 7.9 | 7.1 | 6.7 | 6.8 | 6.3 | 5.7 | 6.0 |
| # Log Sorts | 11.2 | 10.8 | 11.2 | 10.2 | 11.5 | 9.5 | 10.4 |
| Harvest Area (ha) | 13.8 | 14.2 | 12.1 | 11.9 | 13.7 | 12.1 | 12.6 |
| Stand Vol. (t/ha) | 511 | 505 | 546 | 572 | 559 | 590 | 600 |
| Productivity (t/hour) | 30.5 | 28.2 | 31.6 | 34.1 | 34.4 | 34.4 | 35.3 |
| Logging Rate ($/t) | 22.70 | 24.70 | 25.60 | 23.90 | 27.60 | 28.70 | 27.90 |

*Note: data from 2008 through to 2018 have been averaged over 2-yearly period.

Shovelling works particularly well on sloping terrain, but also reduces the requirement for skid trails. Hence the drivers for this change could be increasing the operating range of ground-based systems with extraction on steeper terrain, or a greater reluctance to create higher levels of soil disturbance from use of skid trails.

These latest data show a slight increase of 3% in harvesting productivity (to 35.3 tonnes per scheduled hour), and while not significantly different from the previous year, it does continue a longer-term trend of increasing ground-based productivity. The ground-based logging rate declined by a corresponding 3% (down by $0.80/tonne to $27.90/tonne) compared to 2019 data.

Including the increase in the Consumer Price Index of 2.3% (Stats NZ, 2018), this is effectively a drop of $1.50/tonne in logging rate. This might be related to the variable market conditions in 2020 and 2021 (COVID restricted periods) putting price pressure on all aspects of the supply chain. However, it may also reflect the start of a real improvement in cost-effectiveness – due to consolidation of gains from on-going mechanisation of ground-based operations. This is evidenced by the notable increase in the number of machines per crew, increasing to 5.4 from 4.7.

Some of the improved productivity and lower logging rates may also be explained by the slightly more favourable average harvesting stand conditions. Stand volume was slightly higher at 600 tonnes/ha and extraction distance was shorter (at just under 200m) than in previous periods – the highest stand volume and shortest average extraction distance to date.

This year's data show the average number of crew members at 6 (retaining the longer-term downward trend from 8 a decade ago).

The ratio of machines (5.4) to workers (6.0), shows there is a 90% level of mechanisation – suggesting that approximately 9 out of every 10 workers is now operating in the cab of a machine.



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There continues to be a good range of machine types in the data; for example, there were 7 grapple skidder entries (out of 112) with logging rates of less than $20/tonne, but also 11 entries with rates higher than $30/tonne. For all the ground-based data, there were five entries with rates over $40/tonne, three were associated with shovel logging, and two of those used motor-manual felling, indicating that this system is being used in the more challenging settings. Only five ground-based operations reported using winch-assist, and only four operations used two-staging (which is similar to last year).

## CABLE LOGGING OPERATIONS

There were 95 yarder entries in 2020-21 (Table 2), with only 28 operations using tower yarders (30%), and 70% of the data coming from swing yarder operations. The more extensive use of swing yarders over time has been a clear trend, increasing from less than a third a decade ago. The 2018 yarder survey indicated that most of the yarders were tower yarders, and the 2019 data showed an even split between the two systems. This highlights that the results of each annual Benchmarking survey depend on the sample of operations received from participating companies and can fluctuate year-on-year depending on the companies and regions that submit the most entries.

***Table 2: Summary of cable yarding data (total n=920)***

| Attribute | 2008-10 | 2011-12 | 2013-14 | 2015-16 | 2017-18 | 2019 | 2020-21 |
|---|---|---|---|---|---|---|---|
| Scheduled Hours/day | 8.6 | 8.6 | 8.7 | 8.6 | 8.6 | 8.6 | 8.5 |
| Piece Size (t) | 2.2 | 1.9 | 2.2 | 2.3 | 2.1 | 2.1 | 1.9 |
| Extraction Dist. (m) | 204 | 202 | 110 | 216 | 238 | 206 | 196 |
| Slope (%) | 48 | 39 | 49 | 45 | 43 | 42 | 45 |
| No. of Machines | 4.0 | 4.6 | 4.7 | 4.9 | 5.6 | 6.1 | 7.0 |
| No. of Workers | 9.3 | 8.2 | 8.9 | 7.9 | 7.8 | 7.9 | 8.2 |
| No. of Log Sorts | 10.6 | 10.8 | 9.9 | 9.6 | 10.4 | 8.1 | 10.3 |
| Harvest Area (ha) | 13.5 | 14.2 | 11.2 | 12.8 | 13.9 | 13.8 | 10.4 |
| Stand Vol. (t/ha) | 510 | 504 | 517 | 553 | 590 | 605 | 596 |
| Productivity (t/hour) | 23.5 | 24.9 | 24.8 | 28.1 | 28.0 | 31.1 | 32.7 |
| Logging Rate ($/tonne) | 32.50 | 33.20 | 36.30 | 37.40 | 40.30 | 42.20 | 40.30 |

*Note: data from 2008 through to 2018 have been averaged over 2-yearly period.



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# HARVESTING TECHNICAL NOTE

The increase in the average number of machines per crew from 4-5 about 10 years to seven machines per crew in 2020-21 establishes an increasing machine trend that has been more pronounced in yarding operations than in ground-based operations.

The increase in the level of mechanisation (both felling and processing) from around 2013 is clearly evident with a corresponding steady increase in logging productivity over the years from around 24 tonnes per hour to 32.7 tonnes per hour in 2020-21. The number of workers per crew has maintained at around 8 workers over the last six years since 2015, down from an average of nine a decade ago. The ratio of machines (7.0) to workers (8.2) indicates an average mechanisation level of 85%, the highest recorded to date. Some of these machines in yarder operations however are mobile tail holds and winch-assist machines (without operators), so it would be more correct to state that about 60-65% of yarder crew members operate machines. There are still some manual operations undertaken in cable operations today.

Mechanised felling is present in 73% of cable operations, a large increase over the last three years. This is being supported by 65% of cable crews using winch-assist. Two-staging remains far more prevalent in yarder operations compared to ground-based operations, with about 20% of cable operations reported as using two-staging for the majority of the setting. Only four of those two-staging operations operated at distances greater than 200m between the yarder pad and the processing landing.

## SUMMARY

A total of 207 new harvest area entries were received during the period April 2020 to August 2021 (112 ground-based entries and 95 yarder operations). Mechanised processing on landings now occurs in over 97% of New Zealand operations, meaning that fewer than 1 in 30 crews are now relying on chainsaws for bucking stems and log making. However, the crews still relying on motor-manual processing are mainly smaller 'woodlot' type production crews. By volume harvested almost 99% of operations are mechanised.

The proportion of mechanised felling for ground-based operations is similar to that of processing (94% by number, but over 97% by volume). Mechanised felling ahead of yarder extraction is now up to 73% of cable operations, with 65% of cable harvesting operations using winch-assist to support their mechanised felling on steep slopes.

There has been a decline in the average number of crew members in operations over the past decade, and productivity has continued to increase for both ground-based and yarder operations. Ground-based operations productivity now averages 35.4 tonnes per hour and yarder productivity is 31.9 tonnes per hour.

While over the past decade the logging rate has increased slightly above the consumer price index, the period 2020-2021 recorded a slight drop in logging rates, compared to 2019. Ground-based operations averaged $27.90/tonne and cable logging rates averaged $40.30/tonne. If this reduction holds true over time, it suggests a real gain in cost-effectiveness through the implementation of mechanisation.

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