

PGP Steepland Harvesting – a collaborative research and development programme

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This paper is an overview of the collaborative forestry research and development (R&D) programme called Steepland Harvesting which started in 2010 and was completed in September last year. This overview was presented to the NZ Institute of Forestry conference in Nelson on 10 July 2018.

Introduction

Since 2007, the forest industry's R&D effort has been coordinated by an industry research company, Future Forests Research (FFR). In 2016 FFR changed its name to Forest Growers Research (FGR) to align more closely with the Forest Growers Levy Trust, the principal industry funder of forest growing and harvesting research since the commodity levy was introduced in 2014. In 2018, out of the \$8.8 million of levy funding, over 60% was allocated to research, science and technology programmes (totalling over \$5.4 million).

FGR's overall R&D aspirations are to improve profitability, create value and enhance sustainability. The aim is to improve forestry as a sustainable, profitable and internationally competitive sector for the economic and social benefit of New Zealand as a whole.

In addition to long-term programmes managed by Scion and funded by both the levy and Ministry of Business, Innovation and Employment (MBIE), there are two R&D partnerships at FGR: the Harvesting and Logistics Programme and the Specialty Wood Products Partnership. When it was formed in 2007, FFR created the Harvesting and Logistics Programme through a recognition by the industry of the need to address the main issues confronting forestry at the time – and to a large extent still face forestry today. The drivers for a major R&D effort in harvesting were the needs to address:

- Rising harvesting costs, especially in steep country
- Low productivity compared to other forestry countries, such as Canada and Sweden
- Improved safety.

Reducing supply chain costs for both ground-based and hauler operations is important to improve the profitability of harvesting our forests, especially the smaller and more isolated forests that are coming on stream in many regions. Safety was (and still is) an issue, especially felling and breaking-out roles in cable logging crews. In 2017, the New Zealand industry suffered seven fatalities and 75 serious harm incidents.

The industry at the time had no harvesting research organisation since the closure of the Logging Industry

Research Organisation in 2000. An industry Strategic Summit was held in July 2008 to provide a pathway to achieve these goals.

Programme goals

After two earlier attempts to secure MBIE funding, in 2010 FFR (as it was then) was successful in forging one of the first Primary Growth Partnerships (PGPs) called the Steepland Harvesting programme. Steepland Harvesting was an alliance between the New Zealand forestry sector, Scion and the University of Canterbury, with forest engineering and machinery companies and the Ministry of Agriculture and Forestry (later the Ministry for Primary Industries – MPI), through the PGP. At the start of the programme these goals were set:

- Improve productivity. This could be achieved by mechanising harvesting operations on steep country, especially in tree felling and extraction, to gain the benefits that had been achieved over the previous decades with mechanisation on easy country, and to create opportunities to attract the 'workforce of the future' into harvesting
- Reduce steepland harvesting costs by 25% (or \$8/m³ of wood produced). This was a 'big hairy goal', but one that was thought achievable
- Improve safety by eliminating hazardous manual roles in tree felling and breaking-out. Mechanisation of felling and extraction would put workers into machine cabs and take breaker-outs off the slope
- Grow the forestry machinery manufacturing sector by creating new felling and extraction technology for domestic and export sale. The industry needed to build technical capability in harvesting machinery development to future-proof the growth of the industry, given the closure at the time of most of the North American manufacturers of harvesting equipment that was used in New Zealand.

Programme partners

At the time the FFR Harvesting Theme had about 25 members, with most of the significant forest owners and forest management companies in New Zealand participating. Several forest machinery manufacturers, harvesting contractors, the key forestry educational and training organisations, forest industry consultants, and some regional councils and district councils that owned forests have also joined. The membership later grew to about 35 members as more companies came on board after seeing the benefits from productivity and safety improvements on steep terrain.

Later FGR continued to represent the many different groups from across the industry coming together for a common purpose. The benefits were not only the wide range of views and representation, but also a variety of skills on which to draw. Such extensive representation also assisted in the promotion of results and the uptake of the outputs of the programme.

Governance

Governance of the programme was via the Programme Steering Group (PSG) made up of representatives of FGR Ltd and MPI. Programme management was via a Technical Steering Group, which directed the projects and provided recommendations on funding and programme direction to the PSG.

Committed industry funding for the programme came from both cash and in-kind contributions from FFR industry members. Cash funding started at about \$350,000 p.a. in 2010/11. Significant in-kind support of approximately \$100,000 p.a. consisted of:

- Forest company staff time, data in the form of harvest plans, crew productivity and performance data, forest inventory and GIS information
- Individual manufacturers' time in engineering design
- Contractor assistance with plant and equipment for operational trials and evaluation.

This in-kind support was essential as small business enterprises could not afford to put cash into the programme. Later in the programme the Forest Grower Levy Trust contributed funding to it from 2015.

Outcomes of the programme

The major outcomes of the programme (and other sector-wide activities) over the period 2010 to 2017 have been:

- A major increase in the level of mechanisation of harvesting operations
- Sector-wide cable harvesting productivity increases
- Safety benefits
- Forest engineering developments.

Rise of mechanisation

The New Zealand forest industry has seen a massive increase in the mechanisation of harvesting since 2013. The sector-wide benefits from the adoption of new mechanised felling technology is highlighted in Figure 1. From the FGR benchmarking database, mechanised felling is now used in over 80% of ground-based harvesting and almost 30% of hauler operations. Of course not all of these developments are attributable to the Steepland Harvesting programme, but it has acted as a catalyst to encourage, support and adopt new felling and extraction technology.

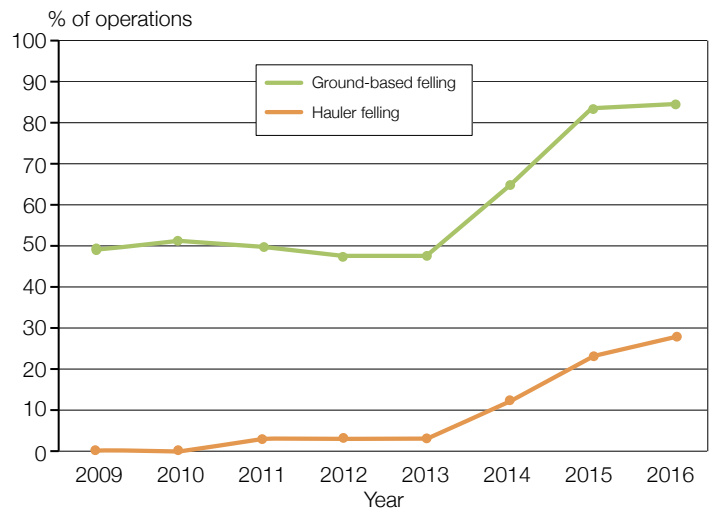


Figure 1: Increase in mechanisation of harvesting in New Zealand, 2009–2016

Sector-wide increase in productivity

The widespread uptake of mechanisation has seen a 25% improvement in operational productivity in steep country operations (Figure 2). Cable harvesting productivity has increased from 23.4 tonnes/scheduled machine hour (SMH) in 2013, when winch-assist machines were first introduced, to 29.4 tonnes/SMH in 2016 (Source: FGR Benchmarking).

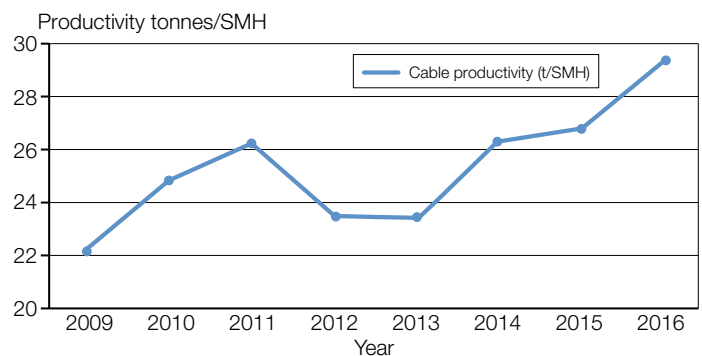


Figure 2: Increase in cable logging productivity (tonnes produced per scheduled machine hour), 2009–2016

Safety benefits

There have been many safety initiatives undertaken across the industry as a result of the Independent Forestry Safety Review in 2014 and the Health and Safety at Work Act 2015 (HSWA) such as:

- Establishment of the Forest Industry Safety Council, including worker participation
- Setting clear and common standards, especially for safety-critical roles
- Increased WorkSafe inspections
- A focus on improved safety culture
- Certification for harvesting workers and contractors
- Improved information sharing through the Safetree website.

Since 2013, we have also seen a major uptake in new technology such as winch-assist feller bunchers, hydraulic grapple carriages and camera systems that has had a safety benefit. Data from WorkSafe NZ shows that as a result of all these initiatives there has been a 60% reduction in serious harm injuries (SHIs) from 188 incidents in 2012 to 75 incidents in 2017.

The rate of SHIs/million m³ of wood production has dropped from 7.2 in 2012 when New Zealand was harvesting just over 25 million m³, down to just 2.4 SHI/million m³ in 2017 when the harvest increased to over 30 million m³ (Figure 3). Also, over 200 workers have been removed from hazardous manual felling and breaking-out roles.

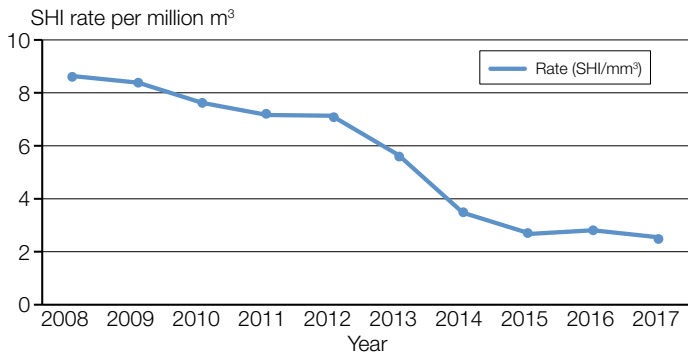


Figure 3: Reduction in serious harm incidents per million m³ production

Forest engineering developments

Focusing on forest engineering developments, the latest to occur from the industry over the last five years or so have been in these areas:

Winch-assisted felling

Improved mechanised tree felling using feller bunchers with winch-assist (see first photo). It is estimated that over 90 of these types of machines, from at least six different manufacturers, are now operating in New Zealand.



Winch-assisted felling with the ClimbMAX steep slope harvester

Teleoperated felling

The potential for improved safety with remote control and teleoperation was explored with the full teleoperation of a John Deere 909 feller buncher-controlled from a remote operator console.



Operator console for teleoperation of the feller buncher

Grapple carriages

Improved grapple yarding with remote-controlled hydraulic grapple carriages. There are now three manufacturers selling grapple carriages, ranging from the non-motorised Alpine grapple carriage to the fully motorised carriages, such as the Falcon Claw and the Hawkeye. About 75 grapple carriages are now operating in New Zealand.



Alpine grapple carriage

In-cab vision systems

Hauler vision, navigation and tension monitoring systems are designed to give the machine operator a better view of operations and range from the HarvestNav on-board navigation system, to the Falcon tension monitoring 'app' and the CutoverCam hauler vision system.



CutoverCam hauler vision system

Skyline shifting

Improved skyline shifting developments ranged from remote-controlling a mobile tail-hold machine to the Skyshifter, an innovative tail-hold carriage.



Skyshifter remote-controlled tail-hold carriage

Processing and loading

Multi-function processing and loading using a quick coupler. The final product from the Steepland Harvesting programme is the Doherty automatic quick coupler (Figure 4). This attachment to the stick of a knuckle



Figure 4: Doherty automatic quick coupler

boom loader enables the operator to rapidly switch from a grapple processor to a loader grapple at the flick of a switch without leaving the cab.

Sector-wide commercial outcomes

Overall, the commercial outcomes over the whole sector have been very successful. There are now many new mechanised felling and extraction operations that did not exist five years ago.

These innovations include many new winch-assisted felling machines, grapple carriages with cameras, and on-board vision systems.

There are now four major machinery manufacturers exporting winch-assist products to North America (EMS Ltd, DC Equipment Ltd, ClimbMAX Equipment Ltd and Rosewarne & May Ltd). Over 180 new winch-assist felling units have been sold, including over 90 machine exports to North and South America. About 75 new grapple carriages have been sold, including Falcon Claw, Hawkeye and Alpine.

Over 100 new camera systems have also been sold and more than 20 HarvestNav navigation systems are in use. Sales of new harvesting machinery and equipment since 2012 have totalled over \$110 million. Contractors who have adopted this new technology have seen operational cost savings. The sector-wide net harvesting cost benefits to date are estimated at over \$115 million.

Conclusion

The results of the forest engineering developments across the sector over the last five years include 20 new products developed that are suited to New Zealand conditions. Sixteen of these products have been commercialised and four are still in the prototype stage.

The collaboration of forestry companies, contractors, machinery manufacturers and the government through the PGP has improved the way innovations are commercialised and has de-risked this investment by contractors. This has seen significant growth of New Zealand machinery manufacturers and technology developers, which future-proofs the growth of the forest industry and continues to catalyse new innovations in harvesting operations.

This collaboration has also speeded up the uptake of products and the delivery of significant productivity and safety benefits. The PGP Steepland Harvesting programme has therefore been an excellent example of the power of collaboration in the New Zealand forest industry.

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