HARVESTING TECHNOLOGY WATCH

HTW-10
June 2012

Summary

TECHNOLOGY WATCH is a biannual report outlining research and technology developments that are occurring outside the FFR Harvesting Theme, frequently overseas. The section on new logging technology highlights the Highlander harvester from Konrad in Austria, and the Alpine Shovel Yarder from South Africa. In Technology Outside Forestry the All-Terrain Platform (ATP) developed in Katikati for the horticultural industry may have application in forestry. Ex-FFR Files presents a project in the environment and social theme to value ecosystem services, and the Global View looks at forestry research at the Centre of Forest Business at the University of Georgia, USA.

Dzhamal Amishev, Scion

NEW LOGGING TECHNOLOGY

Highlander Harvester from Austria

The Austrian company Konrad Forsttechnik GmbH has manufactured an innovative high-performance harvester for mid- to large-sized timber: the 20-tonne Highlander. It can be described as a clambunk skidder-harvester because of the flexible operation possibilities it provides on moderately steep terrain (up to 55% ground slope).

It is equipped with a grapple on a clamping bench (plus optional winch for load accumulation and skidding) and a harvester head for felling and processing trees up to 75 cm in diameter.

Due to its high tractive force, the “crab steering” of its wheels and the synchronised step-and-drive movement, it has good manoeuvrability on steep and difficult terrain. This is because all four wheels are separately controlled and driven. Using only the front-axle drive, the Highlander can move on the road at speeds up to 25 km/h, thus reducing transporter requirements.

Its flexibility can be employed in operations with reduced labour and capital requirements by using the same machine and operator for felling, extracting and processing trees into different log sorts (Figure 1).

Powered by a 230 horsepower engine the crane has a reach of more than 10 m, and along with the cab is on a tiltable rotating platform providing high versatility during the felling and extraction phases. All hydraulic hoses are located inside the crane boom, thus minimising the possibility of damage and mechanical delays, resulting in high utilisation.

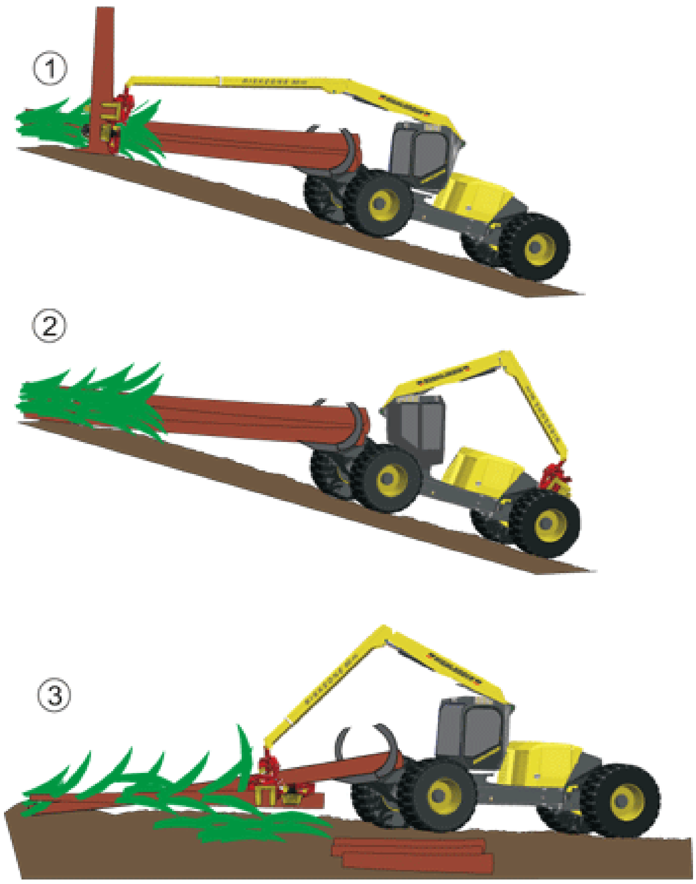

Figure 1: Three different functions of the Highlander.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

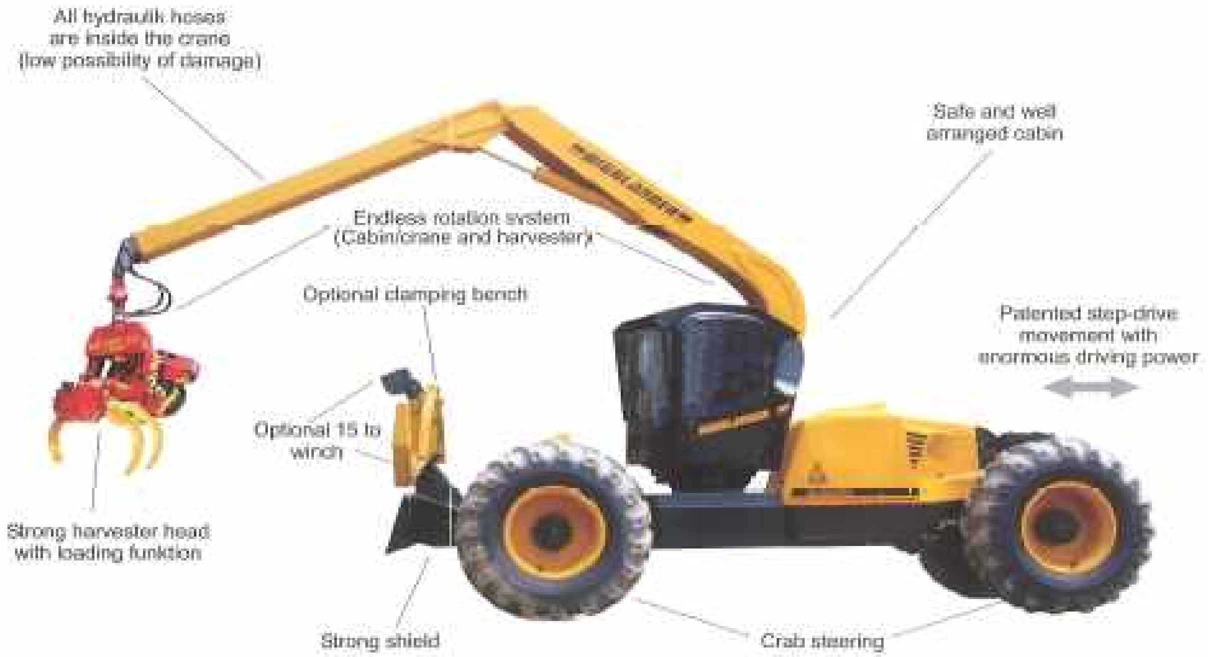

Figure 2: The Highlander steep terrain harvester.

It has an air-conditioned, low-vibration cab with ergonomic operational controls. It also offers a levelled work position due to its tiltable seat and cab. These features provide high ergonomic comfort for fully-mechanised felling, processing and sorting (Figure 2).

Because of these features this machine has potential for a range of applications in New Zealand. One such application is in commercial thinning. Another opportunity is for small woodlot harvesting with poor or non-existent infrastructure where the use of conventional commercial cable logging systems would be costly and economically infeasible.

This machine would provide the opportunity to directionally fell trees for reduced breakage and better positioning for subsequent extraction. Hence it can be used for harvesting/extracting of difficult or environmentally sensitive sections of a commercial forest stand where expensive road and landing construction and upgrades would be required. The manufacturer has even suggested it can be used in a “hot deck” yarding operation by felling and presenting the felled trees directly on to the carriage/grapple of the yarder (Figure 3).

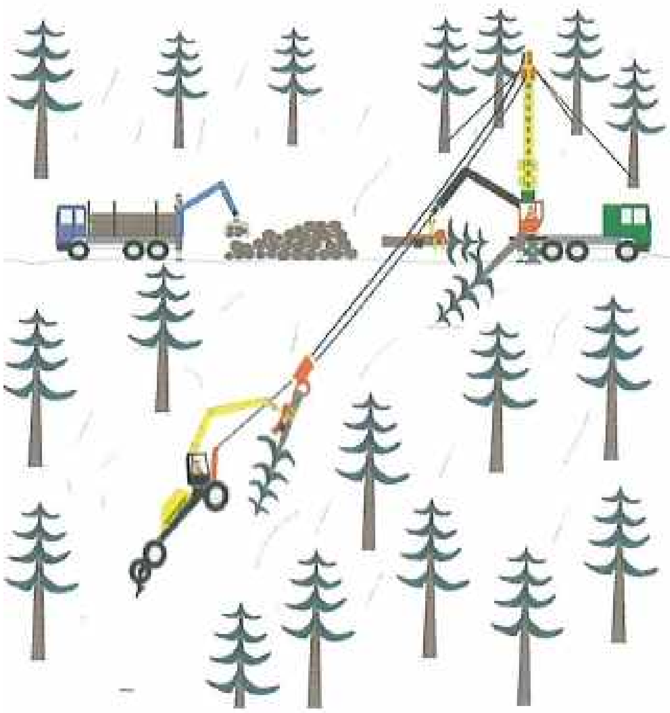

Figure 3: A hot-deck yarding operation using the Highlander.

Reference:
http://www.forsttechnik.at

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

Alpine Shovel Yarder from South Africa

A South African company, 'Alpine Logging' has been producing the Alpine Shovel Yarder, the South African version of the New Zealand 'Harvestline', as well as other cable harvesting accessory equipment for many years. With the local market in South Africa exhausted, Alpine Logging has been expanding its horizons.

In 2010, Alpine Logging supplied twelve Alpine Shovel Yarder winch kits and logging grapples to Malaysia, nine of which have been fitted to 30-tonne excavator bases to date. The machines were used in small piece size (0.25 to 0.5 tonne) *Acacia mangium* plantation in Sarawak. A number of cable systems were tried, but a newly developed grapple system was the most cost effective and by far the safest – with the total elimination of breaker outs (Figure 4).

Figure 4: High power double drum shovel yarder with extended tower from Alpine Logging.

The grapple system included: manual felling, bunching using a 20-tonne excavator to place trees into bunches on pre-planned extraction routes, a 20-tonne excavator for feeding the grapple, and a mobile tail hold. The average cycle time for the grapple system was around 2.5 minutes with an average volume per cycle of approximately 1.4 tonnes (3 - 5 pieces per cycle). This resulted in daily production of approximately 220 tonnes.

Alpine Logging also produces a single drum unit (Figure 5), which is a very cost-effective extraction unit on its own. It is especially useful on steep slopes up to 80 m long near roads, where the timber can be pulled directly to roadside, picked up and heeled onto the road.

Figure 5: A single drum winch/grab combination prebunching for the Alpine Shovel Yarder.

The grapple system would be very applicable here and provide an alternative to the New Zealand-built Harvestline at a competitive cost.

The system has applicability in New Zealand for:

- supporting larger tower operations picking up the slower or awkward areas;
- stand-alone operations where the piece size is small (1 – 1.6 t);
- small woodlot type operation;
- support of ground-based operations picking up the steeper or wet areas; and
- double hauler two-staging operations to avoid road construction to small areas.

Alpine Logging has plans to enter the New Zealand and Australian market and deliver cost effective and simple logging equipment. According to the manufacturer any 30 tonne or larger excavator can be converted to an Alpine Shovel Yarder in a couple of weeks at a very competitive price.

Reference:
http://www.alpinelogging.co.za/

TECHNOLOGY OUTSIDE FORESTRY

All-Terrain Platform (ATP) from MTEL

The Katikati-based Mural Town Engineering Ltd (MTEL) has developed an innovative All-Terrain Platform (ATP). It was initially developed for avocado growers who needed a more versatile platform for increased productivity and safer access to orchards on difficult terrain.

The ATP machine comes out with dual oscillating axle hydraulic suspension for difficult terrain (Figure 6). Each axle acts independently to stabilise the main chassis, and includes sideways levelling and terrain slope monitoring display on the screen. It can also be offered with a forward/aft levelling option to 20°. It is built to comply with AS NZS 1418.10-2011 Standards for Cranes Hoists & winches - Mobile Elevating Work Platforms.

The standard package includes:

- 3 speed modes
- Dual oscillating axles
- All driven wheels are braked
- Chassis side levelling to 20 degrees (manual)
- On screen terrain slope readout
- Continuous 360 degree slew
- Proportional controls (as opposed to on/off)
- Operator friendly control layout
- Controlled from cage or from ground
- Variable load sensing hydraulics
- Rated cage load 220 kg
- Good gradeability (climbs until traction runs out)
- Diesel engine auto throttle up on load
- Hour meter
- Tool tray
- Cage entry gate for ease of access
- Cage with front and rear protection
- Manual emergency descent
- Axle-to-chassis auto lock when not travelling to maximise stability
- Free-fall lockout on booms and suspension
- Manual safety decent
- Articulated booms for comprehensive reach
- All-steel surround panel protection
- Multi failsafe

Figure 6 The All Terrain Platform (ATP) from MTEL.

Optionally, the ATP machine can be featured with:

- On screen chassis angle readout
- Auto-level function
- Auxiliary hydraulics to the cage
- Picking bin, including self-choking bag
- Implement holders/tool trays
- Tow hitch one/or both ends
- Low chassis/high chassis models
- 2WD or 4WD
- 7-metre and 9-metre platform heights.

It has a maximum working height of up to 11 m and a maximum horizontal reach of up to 7.4 m (for the 9-metre platform option). When stowed, it is 6.2 m long, 2.3 m high and 2.7 m wide for easy transportation from site to site.

This mobile platform could provide some solutions to problems we face in steep terrain forestry operations. As it is, the ATP machine can be used in pruning operations to provide a more ergonomically efficient and safe working experience, as well as possibly enhancing productivity. It is, in effect, a remote-controlled steep terrain machine and could be used as a remote controlled tree felling machine with some appropriate modifications/additions.

References:
Don Rust (don@mtelco.co.nz)
http://youtu.be/ei-Ge5lWQSA

EX-FFR FILES

A Framework for Valuing Avoided Soil Erosion in New Zealand's Future Forests

A project in the Environment and Social theme has focused on economic evaluation of forestry ecosystem services, and more specifically of "avoided soil erosion". The rationale for the project is the fact that soil provides a range of cultural, regulating, provisioning and supporting ecosystem services. Afforestation is an important means of protecting soil. Hence avoided soil erosion is one ecosystem service provided by forestry.

The aim of this project was to provide an economic value for the tangible and intangible services from forestry ecosystem services such as avoided soil erosion. Accounting for forestry ecosystem services provides a more realistic value of forestry which enables more effective environmental planning and policy.

This project used the three future forest scenarios developed by Scion, ranging from slight to extreme erosion severity (Watt *et al.* 2010), as a template for valuing avoided soil erosion.

These scenarios targeted non-arable land classes for afforestation that have limitations for sustainable land use under perennial vegetation. The erosion rate under existing non-forest vegetation was compared with the erosion rate under afforestation, using the New Zealand Empirical Erosion Model (NZEEM).

In light of all the recent extreme weather events and the aftermath of damage caused by landslides and debris flows, this research provides some relevant results. Benefits from soil conservation are received at private (on-site) and at public levels (off-site) (Table 1).

Table 1: Public and private benefits and costs from avoided soil erosion from afforestation.

PRIVATE BENEFITS	PRIVATE COSTS	PUBLIC BENEFITS	PUBLIC COSTS
Timber revenue	Forestry regime costs (e.g. planting, thinning, pruning, harvesting)	Avoided damage to public infrastructure	Lost soil carbon from conversion to forestry
Carbon revenue	Road construction	Avoided flood damage	Increased erosion damage during forest harvest
Avoided private property damage	Transport	Avoided damage to consumptive water quality	
Avoided infrastructure damage	Opportunity cost of land use change	Avoided cost of sedimentation	
Avoided lost productivity from land use change			

This creates different incentives for private individuals (e.g., landowners) and the public (e.g., neighbouring residents) to effect land use change. The differences in incentives are important for selecting an effective policy to encourage the provision of avoided soil erosion.

Monetary estimates for a decrease in erosion rate (e.g., cost reduction in sediment removal from waterways) may then be used to indicate the value of avoided erosion from afforestation. These estimates are categorised into net public and private benefits for the selection of a policy mechanism.

A possible increase in erosion during forest harvesting and re-establishment must also be accounted for as the contribution of roots to site stability is related to the rate at which roots grow and occupy the soil.

As an example, the erosion rates for the Gisborne region were calculated using the model (Figure 7). Results showed that in the northern half of this region, the Waiapu River has some of the highest sediment loads in the world. Some of the future forest scenarios indicated a very high level of erosion; this would be reduced as a result of afforestation.

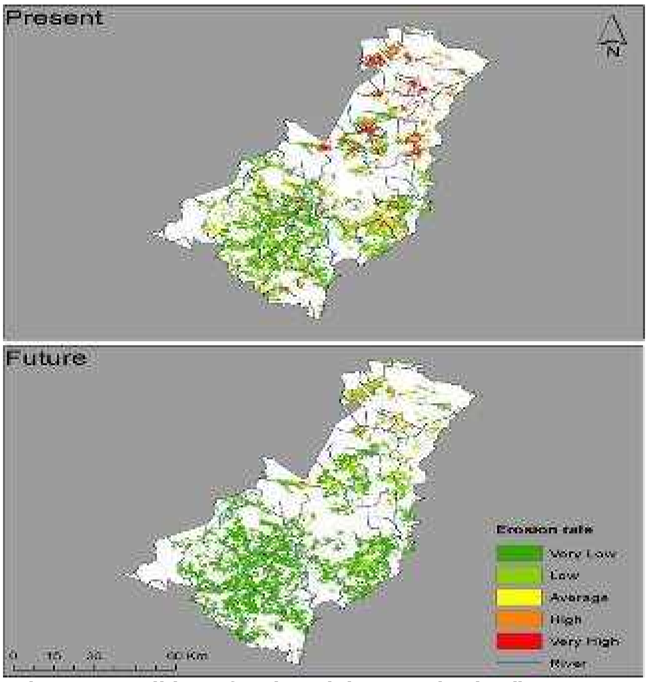

Figure 7: Soil loss for the Gisborne District (in tonnes of sediment/km^2/year) under present land use and under future woody vegetation using NZEEM modelling.

To ensure that land use is more sustainable and does not incur external costs to the public, such as reduced water quality or flooding, different policy options should be carefully assessed considering the relative magnitude of net private and public benefits.

For example, if avoided soil erosion provides strong positive net benefits publicly and privately then "Extension" (such as education, communication, technology transfer) may be necessary to encourage the land use change.

If the net public benefit outweighed the net private cost, then "Positive incentives" (such as financial or regulatory instruments to encourage behaviour) may be necessary to encourage land use change.

Furthermore, if the net private cost outweighed the net private benefit then new technologies may be needed to reduce private costs; otherwise no action is appropriate.

References:

L. Barry, R. Yao, U. Paragahawewa, J. Turner, D. Harrison, 2012. Scion, Rotorua.

Watt, M. S., Kirschbaum, M. U. F., Paul, T. S. H., Tait, A., Pearce, H. G., Brockerhoff, E. G., Moore, J. R., Bulman, L. S., & Kriticos, D. J. (2008). The effect of climate change on New Zealand's planted forests: Impacts risks and opportunities. Rotorua, New Zealand: Scion.

GLOBAL VIEW

Centre for Forest Business at the University of Georgia, USA

The Centre for Forest Business at the University of Georgia was established in 1997 to provide national leadership in education, research and service to the forest industry, private landowners, and the general community in Georgia. The main research focus is in the following areas:

- The integration of sound forest business principles and practices with contemporary biological and quantitative methods to achieve sustainable forest production.
- The investigation of forest resources and forest industry alternatives that are economically competitive in the global marketplace.
- The proposal of market-based solutions to forest resource problems and opportunities.

The Centre has eleven participating faculty members and a number of staff and students to help fulfil its mission. Some research results from recently published work include:

- Greene *et al.* [1] found biomass harvesting to be most developed in regions where pulpwood markets have historically been

somewhat limited. In these regions, biomass markets have developed over the years to exploit this supply of unused or residual material economically. Expanding biomass harvesting in regions with stronger pulpwood markets (South Central and Southeast) would involve more competition with pulpwood and attempts to collect smaller residual material. They found that using larger-size material that is typically piled by loaders or delimbers rarely had ash content problems. For that reason, grinding was often as acceptable as chipping in these regions.

- Greene *et al.* [2] found that better sorting of stems increased revenue by ensuring that stems were assigned to the highest value product class. When a stem must be cut to produce a product, the value of the two logs produced must be compared against the value of the original single stem plus the cost of the processing and sorting.

- McNeil *et al.* [3] reported that tree-length systems were more fuel efficient than cut-to-length systems (0.49 gal/ton vs. 0.78 gal/ton). Fuel efficiency in clearfell was better than in thinning or partial cuts (0.45 gal/ton vs. 0.67 gal/ton). The most fuel-efficient systems in the study were tree-length systems in clearfell.

- Baker *et al.* [4] investigated the addition of a small chipper to mechanised tree-length harvesting systems to produce biomass chips from tops, limbs, and underbrush in planted southern pine stands. Chipping the limbs and tops of merchantable stems did not reduce the production of roundwood, but produced only 7–11 t/ha of biomass. Harvesting understory biomass in addition to chipping limbs and tops worked well with clearcut harvests, but reduced roundwood production by 50% in thinnings. Small chippers added to roundwood operations appear to have limited potential in current market conditions, but should become a viable option as stronger markets for biomass chips develop.

- Lang *et al.* [5] compared value recovery of a modified tree-length (MTL) logging system that measured product diameter and length using a Waratah 626 harvester to that of a tree-length (TL) system that estimated stem dimensions. Analysis of individual stems showed significant differences between TL and MTL, with TL recovering 80.3% and MTL recovering 73.7% of total value after downgrades.

References:

http://www.ugacfb.com/

1. Greene, D., S. Baker, J. Cutshall, and A. Enrich. 2011. Regional approaches for harvesting forest biomass: A report on field studies to the Wood Supply Research Institute. Forest Operations Review 13(1): 14-25.

2. Greene, W.D., S.A. Baker and R.D. Cass. 2010. Product sorting impacts on logger productivity and costs. Technical Release 10-R-8. Forest Resources Association. Rockville, MD. 2p.

3. McNeill, J., W.D. Greene, and S.A. Baker. 2010. Off-road diesel fuel consumption for logging operations. Technical Release 10-R-9. Forest Resources Association. Rockville, MD. 2p.

4. Baker, S.A., M.D. Westbrook, and W.D. Greene. 2010. Evaluation of integrated harvesting systems in pine stands of the southern United States. Biomass and Bioenergy 34(5): 720-727.

5. Lang, A.H., S.A. Baker, W.D. Greene, and G.E. Murphy. 2010. Individual stem value recovery of modified and conventional tree-length systems in the southeastern United States. International Journal of Forest Engineering 21(1): 7-11.