R&D WORKS – SEPTEMBER 2012

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Welcome to this September edition of the FWPA R&D newsletter.

This month our stories include research into a lignin-solvent process to harvest high energy/density biofuel from plant cellulose; a new model that uses harvest machine data to monitor thinning and make economic calculations about remaining forest stands; and an important FWPA-sponsored study that found biodiversity in production forests is maintained when there are close by conservation reserves.

I hope you enjoy reading about the these, and other, research stories that could be part of the successful future of our industry.

Ric Sinclair
Managing Director, FWPA

MAIN NEWS

Focus on wood innovation – an Australasian first

FWPA are pleased to support Wood Innovations 2012, a new FIEA program that has been set up for Australasian forestry and wood products companies this year in mid-October. The focus is on new products that have been commercialised and could be adopted by local companies – from solid wood through to panel products.

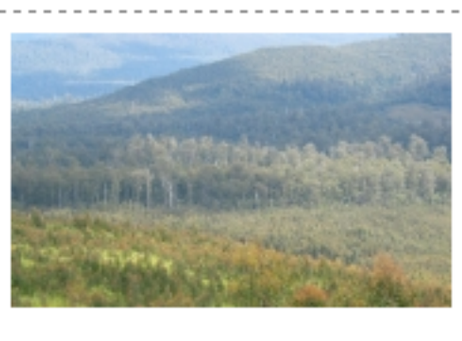
'In the current economic environment, local companies are recognising that, to remain competitive, they need to think outside the square' says Forest Industry Engineering Association (FIEA) director, Brent Apthorp. 'To stay in the game, new wood product innovations that can be adopted to diversify current manufacturing operations, product mix and markets, need to be evaluated.'

FIEA has been working closely with FWPA, leading technology providers and R&D organisations from around the world to bring new and relevant wood technology innovations to the Australian and New Zealand industries.

Full details on the event can be viewed on www.woodinnovationsevents.com

FOREST GROWING

Contribution of CAR reserves to mature-forest biodiversity in production forest landscapes



A recent report has found that the network of CAR (comprehensive, adequate and representative) reserves that underpin Australia's National Forest Policy is effective in maintaining biodiversity in production forests. In addition, the network means the biodiversity of mature eucalypt forest is not affected by forestry in the surrounding landscape.

This FWPA-supported research studied the biodiversity of birds, beetles and vascular plants in a 900 km^2 landscape of wet eucalypt forest. It compared the biodiversity in 27–49 year-old silvicultural regeneration forest plots with the biodiversity in nearby mature eucalypt forest plots. In each forest type plots were located in one of four levels of landscape-disturbance intensity – termed a context-class, where a lower context-class number indicates a greater level of disturbance in the surrounding landscape.

Although the species richness and abundance of birds and plants were significantly lower in older silvicultural regeneration plots compared to mature eucalypt forest plots, differences decreased as context-class increased (i.e. forests were less disturbed). Silvicultural regeneration forest can recover to have a biodiversity similar to mature forest within 50 years of harvest when surrounded by landscapes with high context-class, and the closer a regeneration forests plot is to a patch of mature forest the more abundant and/or species rich it becomes.

Project Ref: PNC142-0809

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Weathering the economic impacts of storm damage

Damage to trees caused by storms is a major source of economic loss in production forests worldwide. Knowing how long wind-thrown logs will remain in good condition can reduce losses by maximising the retrieval of salvageable timber. Wood is affected by sapstain as it dries out so every salvage operation is a race against time. Scion researchers and their collaborators have found some answers by simulating storm damage to planted *Pinus radiata* forests at various New Zealand locations.

Results showed that less time is available for log recovery after storms during spring and summer than in autumn and winter. Also, the available salvage period is shorter in warmer regions such as the northern region of the North Island, especially during summer.

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New model for monitoring thinning

Skogforsk has launched a new model for monitoring thinning. It can facilitate monitoring and reduce costs when thinning large areas of forest and is a long-awaited development.

Researchers have developed a calculation model using the forest machine data about the felled forest to make calculations about the remaining standing forest. Johan J Möller of Skogforsk explains: 'Naturally, the felled trees and the remaining trees differ in some ways, for example the diameters of the trees that are left are somewhat larger. But statistical calculations and practical tests have enabled us to build a model that works for most thinning projects.'

Researchers believe that the majority of thinning projects will be monitored automatically using harvester data. Other types of thinning, primarily special practices such as uneven aged thinning in forests close to urban areas or high thinning of mixed stands will continue to require manual measures in the future.

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NEW PRODUCT INNOVATIONS

New lignin-solvent process harvests biofuel, paper and chemicals from plant material

In order to improve the sustainability credentials of biofuels, experts have been trying to figure out ways to produce them from non-food sources, such as cellulose – the material that makes up the cell walls of plants. The Wisconsin Institute for Sustainable Technology (WIST) has developed an aqueous solvent that separates cellulosic material into pure cellulose and lignin, the substance that gives woody biomass its rigidity. The lignin-solvent mixture can then be separated from the water and becomes a high-energy-density fuel that can be used independently or in combination with biodiesel.

Besides the lignin-solvent process, WIST hopes to develop a biorefinery that could be fitted to existing paper mills or to revive idle ones. They have performed the process in the lab and now are looking to develop it into a demonstration-scale plant.

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Higher value veneer products from fibre managed plantation eucalypts

Hardlam, a high-quality LVL (laminated veneer lumber) product made from rotary peeled, pulp-grade hardwood logs, is being launched this month by Forestry Tasmania.

Developed from research by Forestry Tasmania, with funding from FWPA, Hardlam is set to become a potential winner for Tasmanian timber producers. It is made from small-diameter or low-grade eucalypt logs that previously would be turned into woodchips, producing a range of structural end-sections and appearance-grade products such as flooring, furniture and framing.

Researchers sandwiched different combinations of regrowth hardwood timbers and plantation grown hardwoods such as shining gum and blue gum. The regrowth forest timbers ensure maximum strength and stiffness while the plantation timbers help give the LVL a lighter colour that makes it look very like a premium Tasmanian Oak product.

A number of respected Tasmanian designers have used Hardlam to make a range of furniture pieces. They found the it was very stabile, easy to glue and took stains and varnishes well, creating beautiful products.

Hardlam is available in two grades: Standard which may contain knots, gum veins and patches (without compromising structural performance), and Premium which is very suitable for appearance-grade products.

Project Ref: PNB139-0809

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TIMBER CONSTRUCTION AND DESIGN

Emerging technologies in residential timber construction

Many new building products and systems are developed every year; but which ones are best for building in timber?

A recent FWPA funded project reviewed and rated over 40 emerging technologies relevant to timber residential construction from North America, the United Kingdom, Europe, Japan, New Zealand and Australia.

The new technologies that scored highest include: structural floor/wall/roof timber systems; improved wood that is dimensionally stable with improved durability in terms of weather, fungal and termite resistance; and building information modelling (BIM) systems where 3D designs are linked to building costs and production information, as well as strategically setting out the site during construction.

The report recommends high-scoring new technologies be given special consideration for future research and development, dependent on industry support. In addition, the report advises Australian industry to build active liaisons with timber related institutions and companies overseas, finding state-of-the-art timber construction technologies more quickly and reducing overlap and waste in the research and development process.

Project Ref: PRA245-1112

WOOD HARVESTING, TRANSPORT AND LOGISTICS

Volume losses of eight clearfell logging systems

Research by Stellenbosch University quantified volume losses during the felling and conversion of pine sawtimber trees, and determined the usable timber left infield.

The different types of volume losses investigated were high stumps, felling and crosscut saw kerf, log allowances, excessive removal of merchantable wood, incorrect log trimming allocation and usable wood left infield. Different aspects compared included merchandising at roadside landing and merchandising yards, motor-manual or mechanised felling, and tree size. Systems consisted of felling with chainsaws or drive-to-tree feller bunchers, extraction was with cable or grapple skidders, and all crosscutting was done with chainsaws.

The results showed that total wood use across all systems were 92%. Motor-manual felling systems caused greater losses than mechanised felling systems for most of the volume loss classes.

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Optimised harvesting system for energy wood

The primary aim of this University of Eastern Finland study was to develop a methodology for estimating the procurement cost of forest chips from early thinnings. The most common logging systems and supply chains of forest chips used in early thinnings in Finland were compared at stand and regional level using productivity models and cost parameters obtained mainly from the substudies of this thesis. Furthermore, a decision tree was constructed for selecting the harvesting method for energy wood originating from early thinnings.

Based on the availability analysis, delimbing reduced regional cutting recovery by 42% compared to whole tree harvesting, when the minimum concentration of energy wood was set at 25 m^3 ha^{-1}. Delimbing reduced the recovery rate of biomass thereby also reducing the number of potential harvesting sites with adequate removal rates.

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Effects of whole-tree harvesting on site productivity

The increased removal of biomass from the forest sites with whole-tree harvesting has raised concern over the sustainability of site productivity. This Finnish Research Institute study reviewed results from 86 studies quantifying the short-term effects of whole-tree harvesting compared to stem-only harvesting on site productivity using soil and tree-based indicators. The aim was to estimate the risks of both negative and positive impacts on site productivity.

Results showed that, following clear-cutting with whole-tree harvesting, the potential impacts on site productivity might be high enough to justify a need for addtional risk mitigation measures. Following thinning with whole-tree harvesting, the level of risks were lower and the probability of negative impacts to site productivity were better in comparison to clear-cutting. Therefore, mitigation measures at thinning may not be needed.

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Determining biomass in residues following harvest

In NSW there are significant volumes of biomass currently being left on site after harvesting public and private plantations, resulting in high site preparation and re-establishment costs. Use for heat, electricity or liquid fuel production could partially, or completely, offset these costs.

This NSW DPI and Forest NSW research, through pilot projects in the Macquarie region of NSW, aimed to determine quantities of the different biomass fractions in the residues, and a preliminary cost benefit analysis from extracting that resource.

The results suggest that there is potential for removal of additional biomass from the Macquarie region pine forests, however the current market values for bioenergy production makes this uneconomical. If the demand for bioenergy and biofuels grow into the future as expected, and should more economical ways of extracting the biomass be developed, it may become economically viable to do so.

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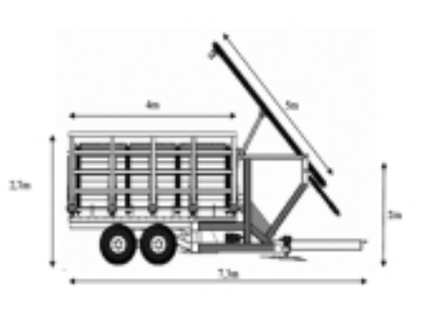
Harvesting of short rotation coppice



Short rotation coppice (SRC) harvesting techniques are available, but broad experience and knowledge about machine performance and the related effective costs of harvesting operations are still missing. This information is crucial, as harvesting costs strongly influence the economic performance of the overall supply chain. Therefore, this University of Freiburg study aimed to collect and analyse productivity data of different harvesting systems for SRC.

The combined cut and chip system and the cut and storage system were studied by literature review. Time studies were also carried out on harvesting operations using the cut and storage system. Five trials were performed with the harvesting machine 'Stemster MK III', with resulted in the share of productive working time being 85% and the average productivity at 21 green tons per scheduled machine hour (gt smh^{-1}).

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Cut-to-length logging of pine in Tasmania

The CRC for Forestry has released a new bulletin examining the productivity, fuel consumption and logging residues of a cut-to-length (CTL) harvesting system. The research examined a CTL logging system consisting of a tracked feller buncher, processor and a forwarder operating in 1.8 m^3 *Pinus radiata* in southern Tasmania.

The results showed that the feller buncher achieved productivity of 122 m^3 per productive machine hour (PMH), the processor 62 m^3 per PMH and the forwarder 80.9 m^3 per PMH (average extraction distance of 134 m). An interesting result was the large difference in productivity between the two processor operators when processing trees greater than approximately 1.5 m^3.

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WOOD PROCESSING AND MANUFACTURING

Putting the good oil on wood

Scientists at Rotorua's Crown Research Institute, Scion, have been testing ways to prevent the growth of mould in homes and preserve timber using natural treatments. 'We started by testing more than 100 compounds that showed promise as potential wood preservatives', says bio-preservation scientist Dr Tripti Singh. 'Our laboratory work paid off with a handful of essential oils identified as lead candidates for further testing'.

The study tested exposed pine wood blocks to rot fungi and tested several essential plant oils as potential preservatives. 'These essential oils preserved the wood spectacularly well compared with untreated samples,' says Tripti.

However, when these treated samples were exposed to water for several days, the oils were leached out of the wood. Tripti and her team, together with an industry partner, are evaluating ways to overcome the leaching issue.

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Wood-based panels: effect of laminate type on emissions

It is important for the industry to gain a better understanding of the influence of wood-based panels on indoor air quality of a building. This study from the Korea Forest Research Institute examined the effects of laminate type on the emission of volatile organic compounds (VOCs) from particle board (PB) and medium density fibreboard (MDF) panels, using a 20-L small chamber method.

Five different types of surface laminates and two types of surfaces coatings were applied to the veneer bonded to a surface of PB and MDF panels that were of different grades with respect to formaldehyde emission (FE) such as E0, E1, and E2 before surface lamination.

The results suggest that a proper selection of the surface laminate for wood panels has a significant impact on indoor air quality of a building.

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OTHER INFORMATION

3D printer can build a house in 20 hours

We've seen 3D printers used for everything from iPhone cases to makeshift weapons, but if you think bigger, what can these new printers really be used for? Could you really make your own house with a 3D printer in less than 20 hours? Turns out you can, and the technology is now set to be used by NASA for a future Moon colony.

Professor Behrokh Khoshnevis from the University of Southern California Researchers has developed a process called Contour Crafting, which adapts automated and technology-assisted manufacturing techniques to house building. A CAD design is sent to a large-scale 3D printer that is mounted to a block of land. The printer lays out the concrete-like foundation of the home through a nozzle that can move anywhere on the property. Like any 3D print-out, the house is made layer-by-layer and reinforced with various materials – like electrical, plumbing and communication infrastructure – as the build progresses.

This new building concept, while still at an early research stage, has the potential to completely change the timber construction industry in the future. This is one technology that the industry should keep an eye on.

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