**Dr Philip Smethurst**

## informing plantation, farm and landscape management

Dr Philip Smethurst is working to inform plantation, farm and landscape managers of the production, environmental and socio-economic consequences of ecosystem processes and management actions.

Updated 19th January 2018



## Current Activities

Dr Philip Smethurst works at plot, farm and catchment scales to understand and improve plantation and agricultural crop production, catchment water management, and codes of practice. Biophysical and socio-economic knowledge is captured in models that enable predictions of system behaviour at new locations. Real-time sensor technologies are used to provide situational awareness and forecasting for practice change.

Recent modelling experience includes:

* APSIM for crops (maize, wheat, pasture) and agroforestry (maize or wheat with gliricidia, grevillea, faidherbia or alnus; pasture with oil palm),
* 3-PG for eucalypt plantation forestry,
* 3PG-hydrology for linking plot-scale forestry and pasture production models to stream flows,
* Hydrus for hillslope water and nitrogen dynamics, and
* eWater Source for catchment water management.

Operationally focussed research and development experience in the forest plantation sector underpinned his leadership of a team that assessed codes of practice for plantation forestry in all Australian states and territories. His research on water quality and quantity in relation the management of trees in streamside management zones (buffers) is influencing revisions of these codes.

A current research-for-development project in Africa is focussed on improving livelihoods by including trees in the agricultural landscape. The key is to understand the conditions that add net value to small-holder farms and avoid those that have a net negative effect. Understandings are developed through on-ground experience at selected locations, and results are captured in models for extrapolation to other locations. Favourable technologies are now showing signs of self-generated adoption beyond direct project participants, including new small businesses associated with these agroforestry technologies.

## Background

Dr Philip Smethurst graduated from the University of Melbourne and University of Florida with expertise in soil, hydrology, agriculture, forestry, and plant nutrition. His experimentation and modelling research spans almost four decades, and currently leads or works on projects in Brazil, Rwanda, Ethiopia, and Australia. His current research links system-understanding, modelling, real-time data, plot scale food and wood production, catchment scale hydrology, and codes of practice.

Dr Smethurst first joined CSIRO in 1984 in Mount Gambier, South Australia, with the Division of Forestry. He focused on organic matter and nitrogen dynamics in pine plantations.

A major component of Dr Smethurst's research has aimed to improve the efficiency of fertiliser usage by matching nutrient supply and crop demand.

Between 1989 and 1992 he completed a Doctorate in soil and water science at the University of Florida, USA, during which his research focused on the mathematical modelling of phosphorus and potassium uptake by competing roots of grasses and pine seedlings.

In 1992 Dr Smethurst rejoined CSIRO in Hobart, Tasmania, Australia, to work on soil and nutrient management of eucalypt plantations.

In 2004, while in the same position, he started working with phosphorus fertiliser management in intensive dairy systems, and water issues associated with the placement of forest plantations in mixed rural landscapes.

Since 2012, Dr Smethurst has also been leading projects on agroforestry in East Africa, and the use of real-time sensor technologies in Australia for catchment water sharing for irrigation and environmental values.

## Achievements and Impacts

* Hosted CSIRO McMaster Fellow, Dr Daniel Neary, USDA Forest Service, Feb-Aug 2009, for collaborative research on water quality
* Supervised Honours (2), MSc (1), and PhD (14) postgraduate students, and annually led a course in undergraduate soil fertility
* Authored more than 77 journal papers, 85 reports, 91 conference presentations, and 1 provisional patent
* Soil and nutrition research which has underpinned changes to soil and fertiliser management in the plantation forestry industry
* Reduction in deep ripping, continued use of surface cultivation
* Increased use of N fertiliser at two to six years of age in temperate eucalypt plantations generally
* Increased use of K fertiliser in targeted radiata pine plantations
* Provision of soil and plant analysis tools to guide fertiliser management in plantation forests
* Water quality and stream flow research which is underpinning changes in regulations and investment practices
* An internationally unique project that evaluated and modelled fenced, streamside plantations as buffers for multiple objectives including cleaner water
* Tasmanian forest practices code is being revised in relation to the use of plantations in streamside management zones on cleared farmland
* Natural resource managers are using knowledge from our research to prioritise investments in streamside management zones.
* Catchment water managers including irrigators and regulators are developing novel means of adapting in real-time to changes in weather and stream flows
* Brazilian eucalypt plantation companies have improved knowledge of water behaviour in the landscapes in which they operate and understand the potential for management influence.
* Agencies and farmers in East Africa have improved confidence in adopting agroforestry for livelihood improvements.
* The APSIM modelling framework was expanded to include tree and agroforestry.

## Awards

2004 Gottstein Trust Fellowship to study riparian forestry.

1989 Maxwell Ralph Jacobs Award awarded by the Institute of Foresters of Australia for excellence in forest nutrition research.

1992 Soil and Water Science Graduate Student Excellence Award, University of Florida.

## Keynote and Speaker

2009 Potassium conference, India – Forest fertilization

2010 ForestTECH expo, Australia – cultivation practices for plantations

2011 Eucalypt workshop, New Zealand – genotype-site matching (3 Nov)

2014 Water quality forum, Scion, New Zealand - Forests and freshwater ecosystem services in Australia: streamside plantations on farmland. (20 May)

2015 Australian Water Association, Tasmania ‘Integration of Spatial Technologies in the Water Sector’ - ‘An Overview of the Sense-T Adaptive Water Management Project’ (26 Feb)

## Professional Memberships

* Australian Soil Science Society
* Soils Science Society of America
* Institute of Foresters of Australia.

## Academic Qualifications

* B.Agr.Sci: Bachelor of Agricultural Science from the University of Melbourne, Victoria, Australia, in 1976
* MSc (Botany): Masters of Science from the University of Melbourne in 1984. Thesis entitled ‘The Use of Legumes in early silviculture of *Pinus radiata* D.Don’
* PhD (Soil and Water Science): Doctor of Philosophy from the University of Florida, USA, in 1992. Dissertation entitled ‘Application of Solute-Transport Theory to Predict Uptake of K and P by Competing Slash Pine and Grass’

## Expertise

* soil fertility
* plant nutrition
* hydrology
* modelling
* forest plantations
* agroforestry
* sensor networks and forecasting

## Current Projects

* Water quality and stream flow in mixed landscapes
* Real-time catchment water sharing
* Agroforestry in East Africa

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## Location

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## Journal Articles

Smethurst PJ, Huth NI, Masikati P, Sileshi GW, Akinnifesi FK, Wilson J, Sinclair F (2017) Accurate crop yield predictions from modelling tree-crop interactions in gliricidia-maize agroforestry. Agricultural Systems 155:70–7. <http://www.sciencedirect.com/science/article/pii/S0308521X16303195>

Dilla A, Smethurst PJ, Parsons D, Barry K, Denboba M (2017) Potential of the APSIM model to simulate impacts of shading on maize productivity. Agroforestry Systems (in press) DOI : 10.1007/s10457-017-0119-0

### Almeida AC, Smethurst AS, Cavalcante RBL, Borges N (2016) Quantifying the effects of *Eucalyptus* plantations and management on water resources at plot and catchment scales. Hydrological Processes (in press). DOI: 10.1002/hyp.10992

Luedeling E, Smethurst PJ, Baudron F, Bayala J, Huth NI, van Noordwijk M, Ong CK, Mulia R, Lusiana B, Muthuri C, Sinclair FL (2016) Field-scale modeling of tree-crop interactions: challenges and development needs. Agricultural Systems 142: 51-69. <http://ac.els-cdn.com/S0308521X15300457/1-s2.0-S0308521X15300457-main.pdf?_tid=d70edde2-db78-11e5-a6de-00000aacb362&acdnat=1456374955_c1c62b9784b5b133cdb1b35eefafa36e>

Smethurst PJ, Gonçalves JLM, Pulito A, Gomes S, Paul K, Alvares CA, Filho JCA (2015) Appraisal of the SNAP model for predicting nitrogen mineralisation in tropical eucalypt plantation soils. Brazilian Journal of Soil Science 39:523-532.

Pulito AP, Gonçalves JLM, Smethurst PJ, Filho JCA, Alvares CA, Rocha JHT, Hübner A, Moraes LF, Miranda AC, Kamogawa MY, Gava JL, Chaves R, Silva CR (2015) Available nitrogen and responses to nitrogen fertilizer in Brazilian eucalypt plantations on soils of contrasting texture. Forests 6: 973-991.

Smethurst PJ, Almeida AC, Loos RA (2015) Stream flow unaffected by *Eucalyptus* plantation harvesting implicates water use by the native forest streamside reserve. Journal of Hydrology: Regional Studies 3:187-198, DOI: 10.1016/j.ejrh.2014.11.002

Smethurst PJ, Petrone KC, Langergraber G, Baillie CC, Worledge D, Nash D (2014) Nitrate dynamics in a rural headwater catchment: measurements and modelling. Hydrological Processes 28:1820–1834. DOI: 10.1002/hyp.9709 <http://onlinelibrary.wiley.com/doi/10.1002/hyp.9709/pdf>

Almeida AC,Dutta R, Franz TE, Terhorst A, Smethurst PJ, Baillie C, Worledge D (2014) Combining Cosmic-Ray Neutron and Capacitance Sensors and Fuzzy Inference to Spatially Quantify Soil Moisture Distribution. IEEE Sensors Journal 14(10), 3465-3472.

Smethurst PJ, Petrone KC, Langergraber G, Baillie CC, Worledge D, Nash D (2014) Nitrate dynamics in a rural headwater catchment: measurements and modelling. Hydrological Processes (in press). DOI: 10.1002/hyp.9709 <http://onlinelibrary.wiley.com/doi/10.1002/hyp.9709/pdf>

Almeida, A, Siggins A, Smethurst P., Silva C.V.J, Baillie C. (2010) Establishment of experimental catchments to quantify water use by different vegetation types. Ambiência - Revista do Setor de Ciências Agrárias e Ambientais 6: 137-150.

Burkitt, L.L., Donaghy, D.J., Smethurst, P.J. (2010) Low rates of phosphorus fertiliser applied strategically throughout the growing season under rain-fed conditions did not affect dry matter production of perennial ryegrass (*Lolium perenne* L.). Crop and Pasture Science 61:353-362.

Smethurst P (2010) Forest fertilization: trends in knowledge and practice compared to agriculture. Plant Soil 335:83-100. DOI: 10.1007/s11104-010-0316-3

Neary DG, Smethurst PJ, Baillie BR, Petrone KC, Cotching WE, Baillie CC (2010) Does tree harvesting in streamside management zones adversely affect stream turbidity? - Preliminary observations from an Australian case study. Journal of Soils and Sediments 10:652-670. [http://link.springer.com/article/10.1007%2Fs11368-010-0234-2?LI=true#page-1](http://link.springer.com/article/10.1007/s11368-010-0234-2?LI=true#page-1), DOI: 10.1007/s11368-010-0234-2

Miller AM, McArthur C, Smethurst PJ. 2009. Spatial scale and opportunities for choice influence browsing and associational refuges of focal plants. Journal of Animal Ecology (accepted).

Mitchell AD, Smethurst PJ. 2009. Magnesium and potassium deficiency induced in glasshouse-grown Eucalyptus globulus. Tasforests 18: (accepted).

Burkitt LL, Turner LR, Donaghy DJ, Fulkerson WJ, Smethurst PJ, Roche JR. 2009. Characterisation of phosphorus uptake by perennial ryegrass (Lolium perenne L.) during regrowth. New Zealand Journal of Agricultural Research. 52: 195-202.

Mitchell AD, Smethurst PJ. 2008. Base cation availability and leaching after nitrogen fertilisation of a eucalypt plantation. Australian Journal of Soil Research. 46: 445-454.

Miller AM, McArthur C, Smethurst PJ. 2007. Effects of within-patch characteristics on the vulnerability of a plant to herbivory. Oikos. 116: 41-52.

Smethurst PJ, Knowles A, Wilkinson A, Churchill K, Lyons A. 2007. Soil and foliar chemistry associated with potassium deficiency in Pinus radiata. Canadian Journal of Forest Research. 37: 1093-1105.

O’Hara CP, Bauhus J, Smethurst PJ. 2006. Role of light fraction soil organic matter in the phosphorus nutrition of Eucalyptus globulus seedlings. Plant and Soil. 280: 127-134.

Wiseman D, Smethurst P, Pinkard L, Wardlaw T, Beadle C, Hall M, Baillie C, Mohammed C. 2006. Pruning and fertiliser effects on branch size and decay in two Eucalyptus nitens plantations. Forest Ecology and Management. 225: 123-133.

Pinkard EA, Baillie CC, Patel V, Paterson S, Battaglia M, Smethurst PJ, Mohammed CL, Wardlaw T, Stone C. 2006. Growth responses of Eucalyptus globulus Labill. To nitrogen application and severity, pattern and frequency of artificial defoliation. Forest Ecology and Management. 229: 378-387.

Miller AM, McArthur C, Smethurst PJ. 2006. Preferences of two mammalian herbivores for potential cover crops in plantation forestry. Australian Forestry. 69: 114-121.

Miller AM, McArthur C, Smethurst PJ. 2006. Characteristics of tree seedlings and neighbouring vegetation have an additive influence on browsing by generalist herbivores. Forest Ecology and Management. 228: 197-205.

Comerford NB, Cropper Jr WP, Li H, Smethurst PJ, Van Rees KCJ, Jokela EJ, Adégbidi H, Barros NF. 2006. Soil supply and nutrient demand (SSAND): A general nutrient uptake model and an example of its application to forest management. Canadian Journal of Soil Research. 86: 665-673.

Paul KI, Polglase PJ, O’Connell AM, Carlyle JC, Smethurst PJ, Khanna PK, Worledge D. 2004. Soil water under forests (SWUF): a model of water flow and soil water content under a range of forest types. Forest Ecology and Management. 182: 195-211.

Williams DR, Potts BM, Smethurst PJ. 2004. Phosphorus fertilizer can induce earlier vegetative phase change in Eucalyptus nitens. Australian Journal of Botany. 52: 281-284.

Smethurst P, Holz H, Moroni M, Baillie C. 2004. Nitrogen management in Eucalyptus nitens plantations. Forest Ecology and Management. 193: 63-80.

Mitchell AD, Smethurst PJ. 2004. Surface soil changes in base cation concentrations in fertilized hardwood and softwood plantations in Australia. Forest Ecology and Management. 191: 253-265.

Gonçalves JLM, Stape JL, Laclau J-P, Smethurst P, Gava JL. 2004. Silvicultural effects on the productivity and wood quality of eucalypt plantations. For. Ecol. Manage. 193: 45-61.

Paul KI, Polglase PJ, Smethurst PJ, O’Connell AM, Carlyle JC, Khanna PK. 2004. Soil temperature under forests: a simple model for predicting soil temperature under a range of forest types. Agricultural and Forest Meteorology 121: 167-182.

Moroni MT, Smethurst PJ, Holz PJ. 2004. Indices of soil nitrogen availability in five Tasmanian Eucalyptus nitens plantations. Australian Journal of Soil Research. 42: 719-725.

Garnett TP, Shabala SN, Smethurst PJ, Newman IA. 2003. Kinetics of ammonium and nitrate uptake by eucalypt roots and associated proton fluxes measured using ion selective microelectrodes. Functional Plant Biology. 30: 1165-1176.

Smethurst PJ, Baillie C, Cherry M, Holz G. 2003. Fertilizer effects on LAI and growth of four Eucalyptus nitens plantations. Forest Ecology and Management. 176: 531-42.

Williams DR, Potts BM, Smethurst PJ. 2003. Promotion of flowering in Eucalyptus nitens by paclobutrazol was enhanced by nitrogen fertilizer. Canadian Journal of Forest Research. 33: 74-81.

Paul KI, Polglase PJ, O’Connell AM, Carlyle JC, Smethurst PJ, Khanna PK. 2003. Defining the relation between soil water content and net nitrogen mineralization. European Journal of Soil Science. 54: 39-48.

Adams PR, Beadle CL, Mendham NJ, Smethurst PJ. 2003. The impact of timing and duration of grass control on growth of a young Eucalyptus globulus Labill. plantation. New Forests. 26: 147-65.

Letey J, Sojka RE, Upchurch DR, Cassel DK, Olson K, Payne B, Petrie S, Price G, Reginato RJ, Scott HD, Smethurst P, Triplett G. 2003. Deficiencies in the soil quality concept and its application. Invited Editorial. Journal of Soil and Water Conservation. 58: 180-187.

Moroni MT, Smethurst PJ. 2003. Litterfall nitrogen and phosphorus fluxes in two Tasmanian Eucalyptus nitens plantations. Tasforests. 145: 53-64.

Moroni MT, Smethurst PJ, Holz GK. 2002. Nitrogen fluxes in surface soils of young Eucalyptus nitens plantations in Tasmania. Australian Journal of Soil Research. 40: 543-553.

Mendham D, Smethurst P, Holz G, Menary R, Grove T, Weston C, Baker T. 2002. Soil analyses as indicators of P status in young Eucalyptus nitens and E. globulus plantations. Soil Science Society of America Journal. 66: 959-968.

Paul KI, Polglase PJ, O’Connell AM, Carlyle JC, Smethurst PJ, Khanna PK. 2002. Soil nitrogen availability predictor (SNAP): A simple model for predicting mineralisation of nitrogen in forest soils. Australian Journal of Soil Research. 40:1011-1026.

Cromer RN, Turnbull CRA, LaSala AV, Smethurst PJ, Mitchell AD. 2002. Eucalyptus growth in relation to combined nitrogen and phosphorus fertilization and soil chemistry in Tasmania. Australian Forestry. 65: 256-264.

Garnett TP, Shabala SN, Smethurst PJ, Newman IA. 2001. Simultaneous measurement of ammonium, nitrate and proton fluxes along the length of eucalypt roots. Plant and Soil. 236: 55-62

Smethurst PJ, Herbert AM and Ballard LM. 2001. Fertilization effects on soil solution chemistry in three eucalypt plantations. Soil Sci. Soc. Am. J. 65: 795-804.

Smethurst PJ, Jennings S, Matysek A. 2001. Economics of nitrogen fertilization of eucalypts for pulpwood. Australian Forestry. 64: 96-101.

Smethurst PJ. 2000. Soil solution and other soil analyses as indicators of nutrient supply: a review. Forest Ecology and Management. 138: 397-411.

Smethurst PJ, Matschonat G, Ballard LM, Dingle JK. 1999. Phase partitioning of ammonium in Australian and European forest soils. Communications in Soil Science and Plant Analysis. 30(13&14): 2023-2034.

Garnett TP, Smethurst PJ. 1999. Ammonium and nitrate uptake by Eucalyptus nitens: effects of pH and temperature. Plant and Soil. 214(1-2): 133-140.

Wang XJ, Smethurst PJ, Holz GK. 1998. Nitrogen fluxes in surface soils of 1-2-year-old eucalypt plantations in Tasmania. Australian Journal of Soil Research. 36: 17-29.

Smethurst PJ, Line MA, Moroni MT. 1998. Soil microbial biomass and activity in two eucalypt plantation soils after fertilisation. Tasforests. 10: 69-73.

Smethurst PJ, Wang BP. 1998. Soil solution phosphorus and Eucalyptus nitens roots in NP-treated microsites in highly phosphorus-fixing soil. New Zealand Journal of Forestry Science. 28: 140-51.

Mendham DS, Smethurst PJ, Moody PJ, Aitken RL. 1997. Modelling nutrient uptake - a possible indicator of phosphorus deficiency. Australian Journal of Soil Research. 35: 313-25.

Smethurst PJ, Herbert AM, Ballard LM. 1997. A paste method for estimating concentrations of ammonium, nitrate and phosphate in soil solution. Australian Journal of Soil Research. 35: 209-25.

Wang XJ, Smethurst PJ, Herbert AM. 1996. Relationships between three measures of organic matter or carbon in soil of eucalypt plantations in Tasmania. Australian Journal of Soil Research. 34: 545-53.

Wang XJ, Smethurst PJ, Holz GK. 1996. Nitrogen mineralization indices in Ferrosols under eucalypt plantations of north-western Tasmania: association with previous land use. Australian Journal of Soil Research. 34: 925-35.

Smethurst PJ, Nambiar EKS. 1995. Changes in soil carbon and nitrogen during the establishment of a second crop of Pinus radiata. Forest Ecology and Management. 73: 145-155.

Sands PJ, Smethurst PJ. 1995. Modelling nutrient uptake and plant growth in Ingestad units using Michaelis-Menten-like nutrient-uptake kinetics. Australian Journal of Plant Physiology. 22: 823-831.

Turvey ND, Smethurst PJ. 1994. Soil types as classes for managing the nutrient status of planted Pinus radiata in Victoria, Australia. Australian Forestry. 57: 148-156.

Turvey ND, Smethurst PJ. 1994. Nutrient concentrations in foliage, litter and soil in relation to wood production of 7- to 15-year-old Pinus radiata in Victoria, Australia. Australian Forestry. 57: 157-164.

Comerford NB, Smethurst PJ, Escamilla J. 1994. Nutrient uptake by absorbing surfaces of root systems of trees. New Zealand Journal of Forestry Science. 24: 195-212.

Smethurst PJ, Comerford NB. 1993. Simulating nutrient uptake by single or competing and contrasting root systems.  Soil Science Society of America Journal. 57: 1361-1367.

Comerford NB, Smethurst PJ. 1993. Potential for leaching of potassium and phosphorus from pine and grass roots.  Communications in Soil Science and Plant Analysis. 24: 1577-1581.

Smethurst PJ, Comerford NB. 1993. Potassium and phosphorus uptake by competing pine and grass: observations and model predictions. Soil Science Society of America Journal. 57: 1602-1610.

Smethurst PJ, Comerford NB, Neary DG. 1993. Weed effects on early K and P nutrition, and growth, of slash pine on a Spodosol. Forest Ecology and Management. 60: 15-26.

Smethurst PJ, Comerford NB, Neary DG. 1993. Predicting the effects of weeds on K and P uptake by young slash pine on a Spodosol. Forest Ecology Management. 60: 27-39.

Woods PV, Nambiar EKS, Smethurst PJ. 1992. Effect of annual weeds on water and nitrogen availability to Pinus radiata trees in a young plantation. Forest Ecology and Management. 48: 145-163.

Smethurst PJ, Nambiar EKS. 1990. Distribution of carbon and nutrients and fluxes of mineral nitrogen after clear-felling a Pinus radiata plantation. Canadian Journal of Forest Research. 20: 1490-1497.

Smethurst PJ, Nambiar EKS. 1990. Effects of slash and litter management on fluxes of nitrogen and tree growth in a young Pinus radiata plantation. Canadian Journal of Forest Research. 20: 1498-1507.

Lowther JR, Smethurst PJ, Carlyle JC, Nambiar EKS. 1990. Methods for determining organic carbon in podzolic sands. Communications in Soil Science and Plant Analysis. 21: 457-470.

Bekunda MA, Smethurst PJ, Khanna PK and Willett IR. 1990. Effects of post-harvest residue management on labile soil phosphorus in a Pinus radiata plantation. Forest Ecology Management. 38: 13-25.

Carlyle JC, Lowther JR, Smethurst PJ, Nambiar EKS. 1990. Influence of chemical properties on nitrogen mineralization and nitrification in podzolized sands: implications for forest management. Australian Journal of Soil Research. 28: 981-1000.

Smethurst PJ, Nambiar EKS. 1989. An appraisal of the in situ soil core technique for measuring nitrogen uptake by a young Pinus radiata plantation. Soil Biology and Biochemistry. 7: 939-942.

Smethurst PJ, Nambiar EKS. 1989. Role of weeds in the management of nitrogen in a young Pinus radiata plantation. New Forest. 3: 203-224.

Smethurst PJ, Turvey ND, Attiwill PM. 1986. Effect of Lupinus spp. on soil nutrient availability and the growth of Pinus radiata D.Don seedlings on a sandy podzol in Victoria, Australia. Plant and Soil. 95: 183 190.

Turvey ND, Smethurst PJ. 1984. Variations in wood density of Pinus radiata D.Don across soil types. Australian Forest Research. 15: 43 49.

Turvey ND, Attiwill PM, Cameron JN, Smethurst PJ. 1983. The growth of planted pine trees in response to variations in the densities of naturally regenerated acacias. Forest Ecology and Management. 7: 103 117.

## Books and Book Chapters

Smethurst P, Petrone K, Neary D (2012) Understanding the effectiveness of vegetated streamside management zones for protecting water quality. *In* Lefroy T, Curtis A, Jakeman T, McKee J (eds*)* Landscape Logic: Pattern, People and Process in Landscape Management. CSIRO, Collingwood, Australia, pp. 51-67 (<http://www.publish.csiro.au/pid/6769.htm>)

Smethurst P (2011) Genotype-site matching and management for abiotic constraints: dryland eucalypts for the south island. *In* Developing a Eucalypt Resource: learning from Australia and Elsewhere. Workshop Proceedings 3-4 Nov. 2011, Wood Technology Research Centre, University of Canterbury, New Zealand, pp. 93-104.

Smethurst P. 2006. Fertilisers. In: Davidson N. Ed. Farm Forestry: A Technical and Business Handbook. Private Forests Tasmania. Pp. 220-227.

Smethurst P. 2004. Nutritional Physiology of Trees. In: Burley J, Evans J, Youngquist JA (ed). Encyclopedia of Forest Sciences. Elsevier Ltd. Oxford. Pp. 1616-1622.

Cherry ML, MacFarlane C, Smethurst P, Beadle C. 2002. Visual Guide to Leaf Area Index of Eucalypt Plantations. Cooperative Research Centre for Sustainable Production Forestry. Hobart, Australia. 22 p.

Smethurst PJ. 2001. Soil solution and other soil analyses as indicators of nutrient supply: a review. In: Boyle JR, Powers RF. (eds). Forest Soils and Ecosystem Sustainability. Elsevier, Amsterdam. Pp. 397-411.

Smethurst PJ, Baillie CC, Cherry ML. 2001. Nutritional effects on leaf area index and growth of a young Eucalyptus nitens plantation. In 'Plant Nutrition - Food Security and Sustainability of Agro-Ecosystems Through Basic and Applied Research'. WJ Horst. Ed. Kluwer Academic: Dordrecht, Holland. Pp. 928-929.

Ellis RC, Smethurst PJ. (eds). 1999. Practising Forestry Today. Proceedings, 18th Biennial Conference of the Institute of Foresters of Australia. Hobart, Tasmania. 3-8 October 1999.

Turvey ND, Smethurst PJ. 1983. Nitrogen fixing plants in forest plantation management. In: Gordon JC, Wheeler CT. (eds). Biological Nitrogen Fixation in Forest Ecosystems: Foundations and Applications. Martinus Nijhof, The Hague. Pp. 233-260.

## Conference Proceedings (since 2008)

Smethurst PJ, Huth NI (2017) Two-dimensional tree-crop simulation complexities and progress in APSIM. Oral presentation, Modsim2017, Hobart 4-8 Dec. 2018.

Valadares RV, Smethurst PJ, Peternelli LA, Silva IR, Cantarutti R, Costa MD and Neves JCL (2017) Modeling rhizosphere carbon and nitrogen cycling in Eucalyptus plantation soil. Oral presentation, Modsim2017, Hobart 4-8 Dec. 2018.

Dilla A, Smethurst P, Parsons D, Barry K (2016) Agricultural productivity impacts of multipurpose trees in the parkland agroforestry system of Ethiopia’s East Shoa region. Poster, Graduate Research Conference, University of Tasmania, 2nd September 2016.

Mhammedi Z, Hellicar A, Ashfaqur R, Kasfi K, Smethurst P (2016) Recurrent Neural Networks for One Day Ahead Prediction of Stream Flow. In Hellicar A, Rahman A, and Koch F. (eds) ‘Proceedings of the Workshop on Time Series Analytics and Applications, Hobart, Australia. Pp. 25-31, ISBN: 978-1-4503-4820-1, DOI [10.1145/3014340.3014345](http://dx.doi.org/10.1145/3014340.3014345)

Smethurst P, Huth N, Almeida A, Morrison B (2016) Production and Water Outcomes:
New Technologies for Plantation Systems. 3rd Smart Plantation Management Conference, Kuala Lumpur, Malaysia, 7-8 December 2016. Invited speaker

Runcie, P (2016) Real-time water resources information used for water sharing in a Tasmanian irrigation community. Contribution to Panel Session 7: Digital water management improving utilities efficiency, Water Industry Innovation Forum (<https://www.awa.asn.au/Documents/Innovation_Forum_and_Expo_Program_Final.pdf>), Royal Randwick, Sydney, Australia.

Dilla A, Smethurst P, Parsons D, Barry K (2016) Agricultural productivity impacts of multipurpose trees in the parkland agroforestry system of Ethiopia’s East Shoa region. Poster, Graduate Research Conference, University of Tasmania, 2nd September 2016.

Mhammedi Z, Hellicar A, Ashfaqur R, Kasfi K, Smethurst P (2016) Recurrent Neural Networks for One Day Ahead Prediction of Stream Flow. Proceedings TSAA 2016 Hobart, Australia

Smethurst PJ, Morrison B, Almeida A, Carins J, Davenport A, Edeson G, Ellison J, Keast D, Lemon D, Penton DJ, Bai Q, Taylor P, Worledge D (2015) Real-time water resources information used for water sharing in a Tasmanian irrigation community. Paper prepared for 36th Hydrology and Water Resources Symposium, Hobart, Tasmania, 7-10 December 2015. In: 36th Hydrology and Water Resources Symposium: The art and science of water. Barton, ACT: Engineers Australia, 2015: 932-939. Availability:<http://search.informit.com.au/documentSummary;dn=825127996176940;res=IELENG> ISBN: 9781922107497.

Henry D, Smethurst P (2015) Public-Private Examples of Sensor Networks in Australian Agriculture. Invited presentation prepared for ‘American Society of Agronomy Symposium - Going from Big Data to Agronomic Decisions’. Minneapolis, USA, 15-18 Nov. 2015. Abstract: <https://scisoc.confex.com/scisoc/2015am/webprogram/Paper93009.html>

Smethurst P (2014) Forests and freshwater ecosystem services in Australia: streamside plantations on farmland. Scion, 3rd Forest Ecosystem Sciences Forum - Protecting and Enhancing New Zealand’s Freshwater Resources Through Forestry. 20th May 2014, Wellington, New Zealand.

Smethurst and Langergraber (2013) Hillslope Application of the HYDRUS-Wetland wetland module. Poster paper, 4th International Conference "HYDRUS Software Applications to Subsurface Flow and Contaminant Transport Problems, Prague, 2013.

Almeida A,Dutta R, Terhorst A, Baillie C, Worledge D, Smethurst P (2013) Temporal and spatial calibration CosmOz site at Tullochgoram, Tas. 3rd CosmOz workshop, Brisbane, Australia, 22-23 May 2013. https://wiki.csiro.au/display/cosmoz/2013+-+3rd+CosmOz+Workshop

Castray A, Timms G, Rawnsley R, Smethurst P(2013) An economy-wide sensor network: how Sense-T is building the knowledge infrastructure for the future. Digital Rural Futures Conference, 26-28 June 2013, University of New England, Armidale, NSW, Australia.

Almeida A,Dutta R, Franz T, Terhorst A, Baillie C, Worledge D, Smethurst P, (2013) Quantifying spatial distribution of soil moisture using a cosmic ray and capacitance sensor network. IEEE Sensors Conference 4-6 Nov. 2013, Baltimore, Maryland, USA. <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6688468>

Almeida AC, Siggins A., Baillie C. , Smethurst PJ, Worledge D, 2013.  Quantifying the effect of vegetation and soils on streamflow at catchment scale. 20th International Congress on Modelling and Simulation (MODSIM2013), 1-6 December 2013, Adelaide, SA, Australia.

Smethurst (2012) Streamside Management Zones for Multiple Benefits: Water Quality and Stream Flow. Invited speaker to NRM North forum 5th Sept 2012, Inveresk.

Smethurst P (2011) Genotype-Site Matching and Managing for Abiotic Constraints: Dryland Eucalypts for the South Island. Proceedings of Eucalypt Workshop, Blenheim, New Zealand, 3-4 Nov. 2011. Wood Technology Research Centre, University of Canterbury. ISBN 978-0-473-19896-1

Almeida A,Dutta R, Franz T, Terhorst A, Baillie C, Worledge D, Smethurst P, (2013) Quantifying spatial distribution of soil moisture using a cosmic ray and capacitance sensor network. IEEE Sensors Conference 4-6 Nov. 2013, Baltimore, Maryland, USA.

Smethurst PJ, Langergraber G, Petrone KC, Holz GK. 2009. [Hillslope and stream connectivity: simulation of concentration-discharge patterns using the HYDRUS model](http://www.mssanz.org.au/modsim09/I14/smethurst_I14.pdf) *[external link]*. Modsim09 Abstract. July 2009. Cairns, Australia.

Smethurst PJ, Petrone KC, Langergraber G, Baillie C. 2009. [Plantation buffers for streams in agricultural catchments: developing the knowledge base for natural resource managers and farm-foresters](http://www.mssanz.org.au/modsim09/F12/smethurst_F12.pdf) *[external link]*. Modsim09 Abstract. July 2009. Cairns, Australia.

## Reports

Mukuralinda A, Abayneh D, Okia C, Buyinza J, Hadgu K, Nkurunziza C, Kinuthia R, Smethurst P, Baudron F, Kiptot E, Masikati P, Iiyama M, Kuria A, Tanui J, Tenge N, Bernard M, Mowo J, Sinclair F (2017) Improving sustainable productivity in farming systems and enhanced livelihoods through adoption of evergreen agriculture in eastern Africa shortened as ‘Trees for food security’ project (T4FS; FSC/2012/014), Final Report, ACIAR FR2017/21, ISBN 978-1-86320-090-5, 100p. <http://aciar.gov.au/files/final_report_fsc-2012-014.pdf>; <http://aciar.gov.au/publication/fr2017/21>

Smethurst PJ, Morrison B, Edeson G, Taylor P, Almeida AC, Worledge D, Bai Q, Rahman A, Penton D, Keast D, Lemon D, Ellison J, Coombe M (2017) Sense-T Project ‘Adaptive Water Resources Management’ Final Report. CSIRO Client Report.

Smethurst P, Huth N, Masikati P, Fainges J, Muthuri C, and Sinclair F (2016) Trees now part of a global crop modeling framework (APSIM) <http://www.worldagroforestry.org/sites/default/files/outputs/Trees%20for%20food%20security_CSIRO%20modeling%20factsheet.pdf>

Smethurst PJ, Huth NI, and Luedeling E (2014) Tree-Crop Modelling Strategy for the ICRAF-ACIAR Project Trees-for-Food-Security, East Africa. CSIRO, Australia. 18p.

Smethurst PJ et al. (2012) Assessments of Code of Practice for Plantation Forestry. CSIRO, Australia. [separate reports for each of eight Australian States and Territories]

<http://www.daff.gov.au/forestry/australias-forests/plantation-farm-forestry/principles>

Smethurst PJ, Petrone KC, Baillie CC, Worledge D, Langergraber G (2011) Streamside Management Zones for Buffering Streams on Farms: Observations and Nitrate Modelling. Landscape Logic Commonwealth Environmental Research Facility Technical Report No. 28, 31p. (<http://www.landscapelogicproducts.org.au/site/system/files/57/original/Tech_report_28_Streamside_management_zones.pdf?1300224477>)

Neary DG, Smethurst PJ, Baillie B, Petrone C (2011) Water Quality, Biodiversity and Codes of Practice in Relation to Harvesting Forest Plantations in Streamside Management Zones. CSIRO Report, 99p. (<http://www.csiro.au/Organisation-Structure/Flagships/Sustainable-Agriculture-Flagship/~/media/CSIROau/Flagships/Sustainable%20Agriculture%20Flagship/SMZ-technical-report.pdf>)

Smethurst P, Petrone K (2010) Streamside management zones for protection of water quality. Fact sheet for managers and policy-makers #13 Landscape Logic Commonwealth Environmental Research Facilities Hub, University of Tasmania, Sandy Bay, Tasmania, Australia (<http://www.landscapelogicproducts.org.au/site/products/51-streamsode-management-zones-for-water-quality-protection>)

Smethurst P, Neary D (2010) Farm-scale sediment sources: tree harvesting, cattle and roads. Fact sheet for managers and policy-makers #4, Landscape Logic Commonwealth Environmental Research Facilities Hub, University of Tasmania, Sandy Bay, Tasmania, Australia (<http://www.landscapelogicproducts.org.au/site/products/50-farm-scale-sediment-sources-tree-harvesting-cattle-and-roads>)

May B, Smethurst P, Carlyle C, Mendham D, Bruce J, Baillie C. 2009. [Review of Fertiliser Use in Australian Forestry](http://www.fwpa.com.au/latestreports.aspx?s=4&pn=PRC072-0708) *[external link]*. Forest and Wood Products Australia report No. PRC072-0708. 97p.

Smethurst P. 2008. [Summary of Australian Codes of Forest Practice As They Pertain to Managing Commercial Plantations in Stream-Side Buffers on Cleared Agricultural Land](http://www.crcforestry.com.au/publications/downloads/TR178-Smethurst-FORPRINT.pdf) *[848KB PDF, external link]*. CRC Forestry Technical Report No. 178.

Smethurst P, Petrone K, Baillie C. 2008. Novel approaches to rehabilitating streamside reserves.1. The overseas experience and experimental catchments in Tasmania. Invited presentation to Seminars on ‘Managing Streams in the Forest Estate for Minimum Environmental Impacts’. Forest Practices Authority and Forestry CRC, 24 July 2008.

Smethurst PJ. 2008. [Plantation management in riparian zones](http://www.crcforestry.com.au/view/index.aspx?id=40633)*[external link]*. CRC for Forestry, Water Project Newsletter ‘Uptake’ November 2008.

Smethurst PJ. 2008. [Early results from riparian forestry and buffering research](http://www.landscapelogic.org.au/publications/newsletters/2008/Dec_08_LL_newsletter.pdf) *[1.9MB PDF, external link]*. Landscape Logic CERF Hub, Newsletter December 2008, pp. 6-7.

Smethurst PJ. 2008. Can he do that? Riparian buffers and the state codes of forest practice. Australian Agroforestry 62:20.

Smethurst P, Harwood C, Hawkins C, Paul K, Almeida A, Churchill K, Bruce J. 2007. Prefeasibility Scoping Study of Commercial Forestry at Murrayfield. Ensis Client Report no. 1737. 51p.

Smethurst PJ. 2007. Nitrogen Cycling in Forests with Inter-Specific Competition: Models and Knowledge in Relation to Temperate Eucalypt and Pine Plantations. Ensis Client Report No. 1766. Co-released as Cooperative Research Centre for Forestry Technical Report No. 172. 31p.

Pinkard EA, Mohammed CL, Battaglia M, Wardlaw T, Stone C, Smethurst P, Baillie C, Patel V. 2006. Fertilisation and forest health: preventing or offsetting biotic leaf loss in eucalypt plantations. In ‘Final Report to the Forest and Wood Products Research and Development Corporation. Project PN04-4003’ p.170 #.

Smethurst P, Churchill K. 2006. Preliminary Economic Analyses Comparing Use of 1080 or Alternatives. Confidential Report to Forest and Forest Industry Council of Tasmania. 7p.

Smethurst PJ. 2006. Options for managing nitrogen fertilisers in temperate eucalypt plantations. Cooperative Research Centre for Forestry. Technical Report No. 162. 18p.

Baillie CC, Smethurst PJ. 2005. Timbercorp Treefarms Eucalyptus globulus First-Season-by-Second-Season Fertiliser Experiments: Progress Report on 2002 and 2003 Tree Measurements. CSIRO Forestry and Forest Products. Client Report No. 1512. 91p.

Smethurst P, Holz G, Baillie C. 2004. Nitrogen fertilizer research in Eucalyptus nitens plantations. Cooperative Research Centre for Sustainable Production Forestry, Technical Report No. 137, 35p.

Smethurst P. 2004. [Production Forestry in Riparian Zones: Examples From Brazil, USA, Germany and Australia](http://www.gottsteintrust.org/html/reports/catalog.htm#psmethurst)*[external link]*. Gottstein Fellowship Report, 36p.

Smethurst P, Churchill K, Lyons A, Clarke G, Bower D, Campbell G. 2003. Pinus radiata response to ripping, weed control and fertilization at four ex-pasture sites. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 130. 34p.

Baillie C, Smethurst P, Appleton R. 2003. Weed control and fertiliser release treatments in eucalypt plantations in Gippsland, Victoria. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 127, 48p.

Ottenschlaeger M, MacFarlane C, Smethurst P, Beadle C. 2003. Test results for the ‘Visual Guide to Leaf Area Index’. Cooperative Research Centre for Sustainable Production Forestry, Beyond the Black Stump #34.

Baillie CC, Smethurst PJ. 2002. Climate in the Florentine Valley. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 72. 28p.

Pietrzykowski E, McArthur C, Smethurst PJ, Barnes C. 2002. Effectiveness of lupins as a cover crop for reducing damage by browsing mammals. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 72, 28p.

Cherry ML, Macfarlane C, Smethurst PJ, Beadle CL. 2002. Rags to riches: Estimating leaf area index (LAI). Beyond the Black Stump 29.

Paul K, Polglase P, Coops N, O'Connell T, Grove T, Mendham D, Carlyle C, May B, Smethurst P, Baillie C. 2002.  Modelling Change in Soil Cabon Following Afforestation or Reforestation: Preliminary Simulations using GRC3 and Sensitivity Analyses. National Carbon Accounting System Technical Report No. 29, 106pp. Australian Greenhouse Office. Canberra, Australia.

Potts BM, Dutkowski G, Smethurst P, Vaillancourt R. 2001. Report to ACACA (AFFA) funded 2001 Eucalypt Mission to China.

Osborne R, Smethurst P, Wilkinson A. 2001. Further Evaluation of the ‘Nova’ quick-test meter. Cooperative Research Centre for Sustainable Production Forestry, Technical Report No. 60. 26p.

Osborne R, Smethurst P, Wilkinson A. 2001. Soil Fertility Assessment: Survey and Training Using a Quick-Test meter. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 61. 65p.

Smethurst P. 2001. Potassium can boost young pines. Onwood No. 32.

Smethurst P. 2001. Potassium can boost young pines. Southern Tablelands Farm Forestry Network. Pp. 4-5.

Smethurst PJ, Lyons A, Churchill K. 2001. [Yellow pines signal potassium deficiency in reforested old pasture land in Tasmania](http://www.ppi-ppic.org/ppiweb/bcropint.nsf/%24webindex/6AB376DBF27036EC85256B08003BCFCC/%24file/Yellow%2BPines.pdf) *[142KB PDF, external link]*. Better Crops International 15(2):11-13.

Baillie C, Appleton R, Smethurst P, McGennisken B. 2001. Report to Australian Paper Plantations: Results of Follow-Up Spot Spraying Trial in E. nitens (VRW082) at 8 Months Post-Planting. Cooperative Research Centre for Sustainable Production Forestry. Confidential Client Report. 16p.

Comerford NB, Li H, Jokela EJ, Barros NF, Adegbidi H, Smethurst P. 2001.  A nutrient uptake model and its usefulness for southern pine management. Soil Science Society of America Annual Meeting. Charlotte, North Carolina. October 2001.

Smethurst PJ, Jennings S, Matysek A. 2000. Economics of Nitrogen Fertilizing Eucalypts for Pulpwood. Cooperative Research Centre for Sustainable Production Forestry, Technical Report No. 28, 18p.

Smethurst P, Baillie C. 2000. Report to Australian Paper Plantations: Statistical Analysis of Data from VRW075 and VRW076. Cooperative Research Centre for Sustainable Production Forestry, Confidential Client Report.

Osborne R, Smethurst P, Wilkinson A. 2000. Evaluation of a Quick-Test Meter for Measuring Nutrient Concentrations in Soil and Plant Waters. Cooperative Research Centre for Sustainable Production Forestry. Technical Report No. 33. 15p.

Williams DR, Potts BM, Smethurst PJ. 2000. The performance and reliability of paclobutrazol in promoting the flowering of Eucalyptus nitens can be enhanced by nitrogen fertilisation. Cooperative Research Centre for Sustainable Production Forestry. Hot Off The Seedbed No. 24.

Baillie C, Smethurst P. 2000. Report to Australian Paper Plantations: Statistical Analysis of Data from VRM040, VRM041, and VRM042. Cooperative Research Centre for Sustainable Production Forestry, Confidential Client Report, 11p.

Smethurst PJ, Baillie C. 2000. Appraisal of soils at Cambridge: Report to SBTA. 8 pp.

Smethurst P, Spurr D, Baillie C, Osborne R. 2000. Stem volume equation for Eucalyptus nitens. Cooperative Research Centre for Sustainable Production Forestry, Beyond the Black Stump #19.

Smethurst P, Lyons A, Churchill K. 2000. Yellow, potassium deficient pines. Cooperative Research Centre for Sustainable Production Forestry, Beyond the Black Stump #21.

Smethurst P, Lyons A, Churchill K. 2000. What’s wrong with yellow pines. Private Forest Tasmania Newsletter No. 58, pp. 8-9.

Smethurst PJ, Baillie CC. 2000. Report to Australian Paper Plantations: Statistical Analysis of Data from VRW075 and VRW076. Cooperative Research Centre for Sustainable Production Forestry. Confidential Client Report. 8p.

Smethurst PJ, Baillie CC. 2000. Report to Australian Paper Plantations: Statistical Analysis of Data from VRW077 and VRW078. Cooperative Research Centre for Sustainable Production Forestry, Confidential Client Report, 5p.

Smethurst PJ. 1998. Slash management in temperate eucalypt plantations: a mini-review. CRC for Sustainable Production Forestry, Technical Report No. 1.

Smethurst PJ. 1998. Fertilisers. Farm Forestry Technical Information Sheet No. 17. Private Forests Tasmania.

Smethurst PJ. 1998. Post-canopy-closure nutrient management in temperate eucalypt plantations: mini-review and research strategy. CRC for Sustainable Production Forestry. Technical Report No. 2.

Smethurst PJ. 1998. Revised fertiliser prescriptions for Australian Paper Plantations pine and eucalypt plantations. CRC for Sustainable Production Forestry, Confidential Client Report.

Shedley C, Battaglia M, Baillie C, Smethurst P. 1998. A productivity prediction system for drought-prone regions of south-western Australia. CRC for Sustainable Production Forestry, Technical Report No. 7.

Smethurst PJ. 1997. Which plantations need nitrogen fertiliser and when? Beyond the Black Stump #7.

Smethurst PJ. 1996. Timber Certification and Labelling. Bark 356: 1-2.

Smethurst PJ. 1996. Book Review. Bacon, P.E. (ed.) Nitrogen Fertilization in the Environment. Soil. Biol. Biochem. 28: 121.

Smethurst PJ. 1996. A simple indicator of carbon for some of our soils. Beyond the Black Stump #2.

Fife DN, Nambiar EKS, Smethurst PJ. 1991. Managing the nitrogen fertilization of Pinus radiata from planting to age 10 years. User Series Report No. 4, CSIRO Division of Forestry.

Smethurst PJ, Nambiar EKS. 1986. Dynamics of organic matter and nitrogen between crop cycles of radiata pine: a progress report. CSIRO Division of Forest Research, Mount Gambier, South Australia, 34 pp.

Smethurst PJ. 1984. The likely economic consequences of using lupins in Pinus radiata plantations of Gippsland. A.P.M. Forests Pty. Ltd. Research Report 84/1.

Smethurst PJ. 1984. Nutrient status of soils and Pinus radiata plantations in Gippsland. A.P.M. Forests Pty. Ltd. Research  Report 84/3.

Smethurst PJ. 1984. Wood density of Pinus radiata: state of  knowledge and research priorities. A.P.M. Forests Pty. Ltd.  Research Report 84/4.

Smethurst PJ. 1984. Growth plot requirements for Pinus radiata plantation establishment with the medium regime of establishment. A.P.M. Forests Pty. Ltd. Research Report 84/5.

Smethurst PJ. 1983. Comparison of the effects of low and high intensities of establishment on pine growth. A.P.M. Forests  Research Report 83/1.

Smethurst PJ. 1983. Review of existing trials and the need for new "Fertilizer at Thinning Trials" in Gippsland. A.P.M. Forests Pty. Ltd. Research Report 83/2.

Smethurst PJ. 1980. Forest nutrition research and forestry production in Sweden and West Germany. A.P.M. Forests Pty. Ltd. Overseas Visit Report.

Smethurst PJ. 1982. Economic comparison of winged ripping and current cultivation techniques. A.P.M. Forests Pty. Ltd. Research Note.

Turvey ND, Smethurst PJ, Salmon G. 1982. A Survey of the Soils in Parts of the Yarram and Maffra Districts of the Forests Commission Victoria. A.P.M. Forests Miscellaneous Report 39 pp.

Turvey ND, Smethurst PJ. 1982. Soil type yield curves for Pinus radiata in Gippsland, and the effect of rotation length and intensive silviculture on the cost and quality of wood pulp. A.P.M. Forests Pty. Ltd. Research Report 1/82.