**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

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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

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## 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>)

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## 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.

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