References

Aggelides, S.M., and Londra, P.A. (1998) Comparison of empirical equations for temperature correction of gypsum sensors. *Agronomy Journal* **90**, 441-443.

Andrade, J.M.S., and Ocumpaugh, W.R. (1979) Transector: an inexpensive device to measure ground cover and botanical composition of swards. *Agronomy Journal* **71**, 369-370.

Anon. (1970) 'Water Resources of the Peel Valley'. Survey of Thirty Two N.S.W. River Valleys, Report No. 17. Water Conservation and Irrigation Commission NSW. (NSW Government Printers: Sydney)

Anon. (1980) 'Floods in the Namoi Valley'. Water Resources Commission (NSW Government Printers: Sydney)

APHA (1995) 'Standard methods for the examination of water and wastewater, 19th Edition'. (American Public Health Association: Washington, DC)

Bari, F., Wood, M.K., and Murray, L. (1995) Livestock grazing impacts on interrill erosion in Pakistan. *Journal of Range Management* **48**, 251-257.

Beale, G.T.H., Beecham, R., Harris, K., O'Neill, D., Schroo, H., Tuteja, N.K., and Williams, R.M. (2000) 'Salinity predictions for NSW rivers within the Murray-Darling Basin'. Centre for Natural Resource Publications CNR 99 048. (Department of Land and Water Conservation: Parramatta)

Beasely, D.B., and Huggins, L.F. (1981) 'ANSWERS – User Manual'. EPA 905/9-82-001 (US Environmental Protection Agency, Region V, Chicago IL) 54 p.

Begg, J.E. (1959) Annual pattern of soil moisture stress under sown and native pastures. *Australian Journal of Agricultural Research* **10**, 518-529.

Bell, A.K., and Allan, C.J. (2000) PROGRAZE – an extension package in grazing and pasture management. *Australian Journal of Experimental Agriculture* **40**, 325-330.

Beutner, E.L., and Anderson, D. (1943) The effect of surface mulches on water conservation and forage production in some semidesert grassland soils. *Journal of the American Society of Agronomy* **35**, 393-400.

Blake, G.R., and Hartge, K.H. (1986) Bulk density. In 'Methods of soil analysis, Part I, physical and mineralogical methods, Second Edition'. (Ed. A. Klute). (American Society of Agronomy, Soil Science Society of America: Wisconsin, USA)

Boast, C.W., and Robertson, T.M. (1982) A "micro-lysimeter" method for determining evaporation from bare soil: description and laboratory evaluation. *Soil Science Society of America Journal* **46**, 689-96.

Bond, J.J., and Willis, W.O. (1969) Soil water evaporation: Surface residue rate and placement effects. *Soil Science Society of America Proceedings* **33**, 445-448.

Boschma, S.P., and Scott, J.M. (2000) Measuring and predicting the consequences of drought for a range of perennial grasses on the Northern Tablelands of New South Wales. *Australian Journal of Experimental Agriculture* **40**, 285-297.

Bowen, I.S. (1926) The ratio of heat losses by conduction and by evaporation from any water surface. *Physical Reviews* **27**, 779-787.

Bradford, J.M., Ferris, J.E., and Remley, P.A. (1987*a*) Interrill soil erosion processes: I. Effect of surface sealing on infiltration, runoff and soil splash detachment. *Soil Science Society of America Journal* **51**, 1566-1571.

Bradford, J.M., Ferris, J.E., and Remley, P.A. (1987*b*) Interrill soil erosion processes: II. Relationships of splash detachment to soil properties. *Soil Science Society of America Journal* **51**, 1571-1575.

Brady, W.W., Mitchell, J.E., Bonham, C.D., and Cook, J.W. (1995). Assessing the power of the point-line transect to monitor changes in plant basal cover. *Journal of Range Management* **48**, 187-190.

Bristow, K.L. (1988) The role of mulch and its architecture in modifying soil temperature. *Australian Journal of Soil Research* **26**, 269-280.

Caldwell, M.M., Dean, T.J, Nowak, R.S., Dzurec, R.S., and Richards, J.H. (1993) Bunchgrass architecture, light interception, and water-use efficiency: assessment by fibre optic point quadrats and gas exchange. *Oecologia* **59**, 14-24.

Campbell, G.S. (1985) 'Soil physics with basic. Transport models for soil-plant systems'. (Elsevier: Amsterdam)

Chaieb, M., Henchi, B., and Boukhris, M. (1996) Impact of clipping on root systems of 3 grass species in Tunisia. *Journal of Range Management* **49**, 336-339.

Charman, P.E.V., and Roper, M.M. (1992) Soil organic matter. In 'Soils their Properties and Management: A soil conservation handbook for New South Wales'. (Eds. P.E.V. Charman, and B.W. Murphy) Ch. 14, pp. 206-214. (Sydney University Press: Sydney)

Charney, J., Stone, P.H., and Quirk, W.J. (1975) Drought in the Sahara: A biophysical feedback mechanism. *Science* **187**, 434-435.

Ciesiolka, C.A.A. (1987) Catchment management in the Nogoa Watershed. (Australian Water Research Council, Research Project 80/128)

Ciesiolka, C.A.A., and Rose, C.W. (1998) The measurement of soil erosion. In 'Soil erosion at multiple scales, principles and methods for assessing causes and impacts.' (Eds. F.W.T. Penning de Vries, F. Agus, J. Kerr) (CABI Publishing: Wallingford UK)

Clewett, J.F., Smith, P.G., Partridge, I.J., George, D.A., and Peacock, A. (1999) 'Australian Rainman Professional Version 3.3: An integrated software package of Rainfall Information for Better Management'. (Department of Primary Industries: Brisbane)

Connolly, R.D., Schirmer, J., and Dunn, P.K. (1998) A daily rainfall disaggregation model. *Agricultural and Forest Meteorology* **92**, 105-117.

Connolly, R.D., Silburn, D.M., and Ciesiolka, C.A.A. (1997) Distributed parameter hydrology model (ANSWERS) applied to a range of catchment scales using rainfall simulator data. III. Application to a spatially complex catchment. *Journal of Hydrology* **193**, 183-203.

Cornish, P. (1987) Root growth and function in temperate pastures. In 'Temperate Pastures: Their Production, Use and Management.' (Eds. J.L. Wheeler, C.J. Pearson, and G.E. Roberts) pp. 79-98. (Australian Wool Corporation/CSIRO: Melbourne)

Costin, A.B. (1980) Runoff and soil and nutrient losses from an improved pasture at Ginninderra, Southern Tablelands, New South Wales. *Australian Journal of Agricultural Research* **31**, 533-546.

Costin, A.B., and Gilmour, D.A. (1970) Portable rainfall simulator and plot unit for use in field studies of infiltration, runoff and erosion. *Journal of Applied Ecology* **7**, 193-200.

Crawford, M.C., and Macfarlane, M.R. (1995) Lucerne reduces soil moisture and increases livestock production in an area of high groundwater recharge potential. *Australian Journal of Experimental Agriculture* **35**, 171-180.

Cresswell, H.P., and Hamilton, G.J. (2002) Bulk density and pore space relations. In 'Soil physical measurement and interpretation for land evaluation.' (Eds., N.J. McKenzie, K.J. Coughlin, H.P. Cresswell) Ch. 3, pp. 35-58. (CSIRO Publishing: Melbourne)

Cunningham, G.M. (1975) Point quadrats to measure cover in rangelands. *The Journal of the Soil Conservation Service of New South Wales* **31,** 193-197.

Dadkhah, M., and Gifford, G.F. (1980) Influence of vegetation, rock cover and trampling on infiltration rates and sediment production. *Water Resources Bulletin* **16**, 979-986.

Doescher, P.S., Svejcar, T.J., and Jaindl, R.G. (1997) Gas exchange of Idaho fescue in response to defoliation and grazing history. *Journal of Range Management* **50**, 285-289.

Dolling, P.J. (2001) Water use and drainage under phalaris, annual pasture and crops on a duplex soil in Western Australia. *Australian Journal of Agricultural Research* **52**, 305-316.

Doorenbos, J., and Pruitt, W.O. (1975) Guidelines for predicting crop water requirements. Irrigation and Drainage Paper 24. (Food and Agriculture Organisation of the United Nations: Rome)

Dunin, F.X. (1969*a*) A model for rainfall routing during initial abstraction. *Journal of Hydrology* **9**, 57-72.

Dunin, F.X. (1969*b*) The evapotranspiration component of a pastoral experimental catchment. *Journal of Hydrology* **7**, 147-157.

Dunin, F.X., and Reyenga, W. (1978) Evaporation from a Themeda grassland 1. Controls imposed on the process in a sub-humid environment. *Journal of Applied Ecology* **15**, 317-325.

Dunkerley, D.L. (2000) Measuring interception loss and canopy storage in dryland vegetation: a brief review and evaluation of available research strategies. *Hydrological Processes* **14**, 669-678.

Dunkerley, D.L., and Booth, T.L. (1999) Plant canopy interception of rainfall and its significance in a banded landscape, arid western New South Wales, Australia. *Water Resources Research* **35**, 1581-1586.

Eldridge, D.J., and Robson, A.D. (1997) Bladeploughing and exclosure influence soil properties in a semi-arid Australian woodland. *Journal of Range Management* **50**, 191-198.

Eldridge, D.J., and Rothon, J. (1992) Runoff and sediment yield from a semi-arid woodland in eastern Australia. 1. The effect of pasture type. *The Rangeland Journal* **14**, 26-39.

Elwell, H.A., and Stocking, M.A. (1976) Vegetal cover to estimate soil erosion hazard in Rhodesia. *Water Resources Research* **11**, 601-605.

Emery, K.A. (1975) Survey of erosion and land use within the catchment area of Keepit dam. Part II-Topography, Land Use and Erosion. *The Journal of the Soil Conservation Service of New South Wales* **31**, 33-58.

Farahani, H.J., and Ahuja, L.R. (1996) Evapotranspiration modelling of partial canopy/residue-covered fields. *Transactions of the American Society of Agricultural Engineers* **39**, 2051-2064.

Finlayson, J.D., Cacho, O.J., and Bywater, A.C. (1995) A simulation model of grazing sheep: I. Animal growth and intake. *Agricultural Systems* **48**,1-25.

Fowler, W.B., and Lopushinsky, W. (1989) An economical, digital meter for gypsum soil moisture blocks. *Soil Science Society of America Journal* **53**, 302-305.

Freebairn, D.M., and Boughton, W.C. (1981) Surface runoff experiments on the Eastern Darling Downs. *Australian Journal of Soil Research* **19**, 133-146.

Freudenberger, D., Hodgkinson, K., and Noble, J. (1997) Causes and consequences of landscape dysfunction in rangelands. In 'Landscape ecology, function and management: principles from Australia's rangelands'. (Eds. J. Ludwig, D. Tongway, D. Freudenberger, J. Noble, and K. Hodgkinson) pp 63-77. (CSIRO: Australia)

Garden, D.L., and Dowling, P.M. (1997) Native grass-based pastures. In 'Grazing management of temperate pastures: literature reviews and grazing guidelines for major species'. (Eds. R.D. Fitzgerald, and G.M. Lodge) Technical Bulletin No. 47. pp. 14-16. (NSW Agriculture: Orange)

Garden, D.L., Lodge, G.M., Friend, D.A., Dowling, P.M., and Orchard, B.A. (2000) Effects of grazing management on botanical composition of native grass-based pastures in temperate south-east Australia. *Australian Journal of Experimental Agriculture* **40**, 225-245.

Gerlach, T. (1967) Hillslope troughs for measuring sediment movement. *Révue de Gémorphologie Dynamique* **4**, 173.

Giancoli, D.C. (1985) 'Physics. Principles with applications.' 2nd Ed. (Prentice-Hall International Inc.: London)

Gifford, G.F. (1985) Cover allocation in rangeland watershed management (a review). In 'Watershed management in the eighties'. (Eds. E.B. Jones, and T.J. Ward.) pp. 23-31. (American Society of Civil Engineers: New York)

Gifford, G.F., and Hawkins, R.H. (1978) Hydrologic impact of grazing on infiltration: a critical review. *Water Resources Research* **14**, 305-313.

Gill, S.I., Naeth, M.A., Chanasyk, D.S., and Baron, V.S. (1998) Runoff and sediment yield from snowmelt and rainfall as influenced by forage type and grazing intensity. *Canadian Journal of Soil Science* **78**, 699-706.

Gonzalez-Sosa, E., Braud, I., Thony, J.L., Vauclin, M., and Calvet, J.C. (2001) Heat and water exchanges of fallow land covered with a plant residue mulch layer: a modelling study using the three year MUREX data set. *Journal of Hydrology* **244**, 119-136.

Gonzalez-Sosa, E., Isabelle, B., Thony, J.L., Vauclin, M., Bessemoulin, P., and Calvet, J.C. (1999) Modelling heat and water exchanges of fallow land covered with plant-residue mulch. *Agricultural and Forest Meteorology* **97**, 151-169.

Goodall, D.W. (1952) Some considerations in the use of point quadrats for the analysis of vegetation. *Australian Journal of Scientific Research* **5**, 1-41.

Greacen, E.L., and Hignett, C.T. (1979) Sources of bias in the field calibration of a neutron meter. *Australian Journal of Soil Research* **17**. 405-415.

Greacen, E.L., and Schrale, G. (1976) The effect of bulk density on neutron meter calibration. *Australian Journal of Soil Research* **14**. 159-169.

Greacen, E.L., Correll, R.L., Cunningham, R.B.. Johns, G.G., and Nicolls, K.D. (1981) Calibration. In 'Soil Water Assessment by the Neutron Method.' (Ed. E.L. Greacen) pp.50-81 (CSIRO: Melbourne)

Greenwood, K.L. (1996) Soil physical properties under pasture after long-term grazing by sheep. PhD thesis, University of New England Armidale NSW.

Greenwood, K.L., and Hutchinson, K.J. (1998) Root characteristics of temperate pasture in New South Wales after grazing at three stocking rates for 30 years. *Grass and Forage Science* **53**, 120-128.

Greenwood, K.L., and McKenzie, B.M. (2001) Grazing effects on soil physical properties and the consequences for pastures: a review. *Australian Journal of Experimental Agriculture* **41**, 1231-1250.

Greenwood, K.L., MacLeod, D.A., and Hutchinson, K.J. (1997) Long-term stocking rate effects on soil physical properties. *Australian Journal of Experimental Agriculture* **37**. 413-419.

Greenwood, K.L., MacLeod, D.A., Scott, J.M., and Hutchinson, K.J. (1998) Changes to soil physical properties after grazing exclusion. *Soil Use and Management* **14**, 19-24.

Gutierrez, J., and Hernandez, I.I. (1996) Runoff and interrill erosion as affected by grass cover in a semi-arid rangeland of northern Mexico. *Journal of Arid Environments* **34**. 287-295.

Hanson, B., Orloff, S., and Peters, D. (2000*a*) Monitoring soil moisture helps refine irrigation management. *California Agriculture* **54**. 38-42.

Hanson, B., Peters, D., and Orloff, S. (2000*b*) Effectiveness of tensiometers and electrical resistance sensors varies with soil conditions. *California Agriculture* **54**, 47-50.

Harte, A.J. (1992) Soils and farming practice. In 'Soils their Properties and Management: A soil conservation handbook for New South Wales'. (Eds. P.E.V. Charman, and B.W. Murphy) Ch. 16, pp. 227-241. (Sydney University Press: Sydney)

Hatton, T.J., West, N.E., and Johnson, P.S. (1986) Relationships of the error associated with ocular estimation and actual total cover. *Journal of Range Management* **39**, 91-92.

Haydock, K.P., and Shaw, N.H. (1975) The comparative yield method for estimating dry matter yield of pasture. *Australian Journal of Experimental Agriculture and Animal Husbandry* **15**, 663-670.

Heilman, J.L., Brittin, C.L., and Neale, C.M.U. (1989) Fetch requirements for Bowen ratio measurements of latent and sensible heat fluxes. *Agricultural and Forest Meteorology* **44**, 261-273.

Heng, L.K., White, R.E., Chen, D., Helyar, K.R., and Fisher, R. (2001) Seasonal differences in the soil water balance under perennial and annual pastures on an acid Sodosol in southeastern Australia. *European Journal of Soil Science* **52**, 227-236.

Hodgkinson, K.C., and Baas Becking, H.G. (1977) Effect of defoliation on root growth of some arid zone perennial plants. *Australian Journal of Agricultural Research* **29**, 31-42.

Hormay, A.L. (1970) 'Principles of rest-rotation grazing and multiple-use land management'. U.S. Department of Agriculture, Training Text No. 4 (2200) (U.S. Government Printer)

Horton, R.E. (1933) The role of infiltration in the hydrological cycle. *Transactions of the American Geographical Union* **14**, 446-460.

Hosomi, M., and Sudo, R. (1986) Simultaneous determination of total nitrogen and total phosphorus in freshwater samples using persulphate digestion. *International Journal of Environmental Studies* **27**, 267-275.

Houghton, P.D., and Charman, P.E.V. (1986) 'Glossary of Terms used in Soil Conservation'. (Soil Conservation Service of NSW: Sydney)

Humphries, A.W., and Auricht, G.C. (2001) Breeding lucerne for Australia's southern dryland cropping environments. *Australian Journal of Agricultural Research* **52**, 153-169.

Hutchinson, K.J., and King, K.L. (1980) The effects of sheep stocking level on invertebrate abundance, biomass and energy utilisation in a temperate, sown grassland. *Journal of Applied Ecology* **17**, 369-387.

Hutchinson, K.J., and King, K.L. (1982) Microbial respiration in a temperate sown grassland grazed by sheep. *Journal of Applied Ecology* **19**, 821-833.

Isbell, R.F. (1996) 'The Australian soil classification, Australian soil and land survey handbook'. (CSIRO Australia: Canberra)

Jayawardane, N.S., Meyer, W.S., and Barrs, H.D. (1983) Moisture measurement in a swelling clay soil using a neutron moisture meter. *Australian Journal of Soil Research* **22**, 109-117.

Jeffrey, S.J., Carter, J.O., Moodie, K.B., and Beswick, A.R. (2001) Using spatial interpolation to construct a comprehensive archive of Australian climate data. *Environmental Modelling and Software* **16**, 309-330.

Ji, S., and Unger, P.W. (2001) Soil water accumulation under different precipitation, potential evaporation, and straw mulch conditions. *Soil Science Society of America Journal* **65**, 442-448.

Johns, G.G., and Lazenby, A. (1973*a*) Defoliation, leaf area index and the water use of four temperate pasture species under irrigated and dryland conditions. *Australian Journal of Agricultural Research* **24**, 783-795.

Johns, G.G., and Lazenby, A. (1973*b*) Effect of irrigation and defoliation on the herbage production and water use efficiency of four temperate pasture species. *Australian Journal of Agricultural Research* **24**, 797-808.

Johns, G.G., Tongway, D.J., and Pickup, G. (1984) Land and water processes. In 'Management of Australia's Rangelands'. (Eds. G.N. Harrington, A.D. Wilson, and M.D. Young) Ch. 3, pp. 25-40. (CSIRO: Australia)

Johnson, I.R. (1996) WaterMod 2: Soil water dynamics in agricultural and environmental systems. Greenhat Software, Armidale, Australia (http://www.greenhat.com.au)

Johnson, I.R. (2001) SGS Pasture Model Background to the model and preliminary site simulations. 67 p. (IMJ Consultants Pty Ltd: Armidale NSW)

Johnson, I.R. (2002) SGS Pasture Model. Greenhat Software, Armidale. Australia (http://www.imj.com.au/sgs/)

Johnson, I.R., and Parsons, A.J. (1985) A theoretical analysis of grass growth under grazing. *Journal of Theoretical Biology* **112**, 345-367.

Johnson, I.R., and Thornley, J.H.M. (1983) Vegetative crop growth model incorporating leaf area expansion and senescence, and applied to grass. *Plant, Cell and Environment* **6**, 721-729.

Johnson, I.R., Lodge, G.M., Kinghorn, B.P., Meszaros, S.A., and Murphy, S.R. (2002) Estimating soil physical parameters using simulation and differential evolution. In 'Proceedings of the IASTED International Conference APPLIED SIMULATION AND MODELLING June 25-28, 2002, Crete, Greece'. pp. 274-279.

Johnston, A., Dormaar, J.F., and Smoliak, S. (1971) Long-term grazing effects on fescue grassland soils. *Journal of Range Management* **24**. 185-188.

Johnston, W.H. (2000) Calibration of gypsum blocks and data loggers and their evaluation for monitoring soil water status. *Australian Journal of Experimental Agriculture* **40**. 1131-1136.

Johnston, W.H., Clifton, C.A., Cole, I.C., Koen. T.B., Mitchell, M.L., and Waterhouse, D.B. (1999) Low input grasses useful in limiting environments (LIGULE). *Australian Journal of Agricultural Research* **50**, 29-53.

Jones, R.M., and Hargreaves, J.G.N. (1979) Improvements to the dry-weight-rank method for measuring botanical composition. *Grass and Forage Science* **34**, 181-189.

Jovanovic, N.Z., and Annandale, J.G. (1997) A laboratory evaluation of Watermark electrical resistance and Campbell Scientific 229 heat dissipation matric potential sensors. *Water SA* **23**, 227-232.

Kelliher, F.M., Leuning, R., and Schulze, E.D. (1993) Evaporation and canopy characteristics of coniferous forest and grasslands. *Oecologia* **95**, 153-163.

Kemp, D.R., and Dowling, P.M. (2000) Towards sustainable temperate perennial pastures. *Australian Journal of Experimental Agriculture* **40**, 125-132.

Kemp, D.R., Michalk, D.L., and Dowling, P.M. (2000) Towards more sustainable pastures: lessons learnt. *Australian Journal of Experimental Agriculture* **40**, 343-356.

King, K.L. (1997) Soil organisms and soil fertility. In 'Proceedings of the Seventh Annual Conference of the Tasmanian Branch of the Grassland Society of Victoria (Inc.)'. pp. 34-44.

King, K.L., and Hutchinson, K.J. (1976) The effects of sheep stocking intensity on the abundance and distribution of mesofauna in pastures. *Journal of Applied Ecology* **13**, 41-55.

King, K.L., and Hutchinson, K.J. (1983) The effects of sheep grazing on invertebrate numbers and biomass in unfertilised natural pastures of the New England Tablelands (NSW). *Australian Journal of Ecology* **8**, 245-255.

Kirchhof, G., and Pender, C. (1993) 'Delta-T Scan User Manual'. (Delta-T Services: Cambridge, England)

Lang, R.D. (1979) The effect of ground cover on surface runoff from experimental plots. *The Journal of the Soil Conservation Service of New South Wales* **35**, 108-114.

Lang, R.D. (1990) The effect of ground cover on runoff and erosion from plots at Scone, New South Wales. Master of Science (Hons.) thesis, Macquarie University, Sydney NSW.

Lang, R.D. (1998) Pasture management for both production and stability. In 'Proceedings of the 9th Australian Agronomy Conference, Wagga Wagga'. pp. 349-350.

Lang, R.D., and McCaffrey, L.A.H. (1984) Ground cover - its affects on soil loss from grazed runoff plots, Gunnedah. *The Journal of the Soil Conservation Service of New South Wales* **40**, 56-61.

Langlands, J.P., and Bennett, I.L. (1973) Stocking intensity and pastoral production. I. Changes in the soil and vegetation of a sown pasture grazed by sheep at different stocking rates. *Journal of Agricultural Science* **81**, 193-204.

Lawson, M.A. (1998) Water infiltration on bare and grassed pasture soils and the effect of aggregate stability, soil carbon and particle size. B Rur. Sci. (Honours) thesis, University of New England, Armidale NSW.

Lea, D.A.M. (1977) 'An atlas of New England'. (Eds. D.A.M. Lea, J.J.J. Pigram, and L. Greenwood). (Department of Geography: University of New England, Armidale)

Linsley, R.K., Kohler, M.A., and Paulhus, J.L.H. (1988) 'Hydrology for Engineers, SI Metric Edition'. (McGraw Hill Book Company: Singapore)

Lodge, G.M. (1979) Effect of fertility level on the yield of some native perennial grasses on the north-west slopes, New South Wales. *Australian Rangeland Journal* **1**, 327-333.

Lodge, G.M. (1983) Grazing management of native pasture species on the North-West Slopes of New South Wales. PhD thesis, University of New England, Armidale NSW.

Lodge, G.M. (1993) The domestication of the native grasses *Danthonia richardsonii* Cashmore and *Danthonia linkii* Kunth for agricultural use. I. Selecting for inflorescence seed yield. *Australian Journal of Agricultural Research* **44**, 59-77.

Lodge, G.M., and Murphy, S.R. (2002*a*) Ground cover in temperate native perennial grass pastures 2. Relationships with litter and herbage mass. *The Rangeland Journal,* **24,** 301-312.

Lodge, G.M., and Murphy, S.R. (2002*b*) Root depths of sown and native pastures on the North-West Slopes of New South Wales. In 'Proceedings of the 17th annual conference of the grassland society of NSW, July 2002'. pp. 65-66. (Ed. A. Bowman) (Grassland Society of NSW Inc.: Orange)

Lodge, G.M., and Roberts, E.A. (1979) The effects of phosphorus, sulphur and stocking rate on the yield, chemical and botanical composition of natural pastures, North-West Slopes, New South Wales. *Australian Journal of Experimental Agriculture and Animal Husbandry* **19**, 698-705.

Lodge, G.M., and Whalley, R.D.B. (1983) Seasonal variations in the herbage mass, crude protein and *in-vitro* digestibility of native perennial grasses on the north-west slopes of New South Wales. *Australian Rangeland Journal* **5**, 20-27.

Lodge, G.M., and Whalley, R.D.B. (1985) The manipulation of species composition of natural pastures by grazing management on the northern slopes of New South Wales. *Australian Rangeland Journal* **7**, 6-16.

Lodge, G.M., McCormick, L.H., Dadd, C.P., and Burger, A.E. (1991) A survey of graziers and pasture management practices on the Northern Slopes of New South Wales. Technical Bulletin No. 43 (NSW Agriculture and Fisheries: Sydney)

Lodge, G.M., Murphy, S.R., and Harden, S. (2003*a*) Effects of continuous and seasonal grazing strategies on the herbage mass, persistence, animal productivity and soil water content of a Sirosa phalaris – subterranean clover pasture, North-West Slopes, New South Wales. *Australian Journal of Experimental Agriculture* **43**, 539-552.

Lodge, G.M., Murphy, S.R., and Harden, S. (2003*b*) Effects of grazing and management on herbage mass, persistence, animal production and soil water content of native pastures. 1. A redgrass-wallaby grass pasture, Barraba, North-West Slopes, New South Wales. *Australian Journal of Experimental Agriculture* **43**, In press.

Lodge, G.M., Murphy, S.R., and Harden, S. (2003*c*) Effects of grazing and management on herbage mass, persistence, animal production and soil water content of native pastures. 2. A mixed native pasture, Manilla, North-West Slopes, New South Wales. *Australian Journal of Experimental Agriculture* **43**, In press.

Lodge, G.M., Murphy, S.R. and Johnson, I.R. (2001) Soil water balance modelling highlights limitations for pasture production in northern NSW. In 'Proceedings of the 10th Australian Agronomy Conference, Hobart.' http://www.regional.org.au/au/asa/2001/

Lodge, G.M., Murphy, S.R., and Johnson, I.R. (2002) Seasonal variation in long term estimates of soil water balance predicted by the SGS Pasture Model for a native pasture in northern New South Wales. In 'Proceedings of the 17th annual conference of the grassland society of NSW, July 2002'. pp. 60-62. (Ed. A. Bowman) (Grassland Society of NSW Inc.: Orange)

Lodge, G.M., Whalley, R.D.B., and Robinson, G.G. (1984) Temperate Rangelands. In 'Grazing management an ecological perspective.' (Eds. G.N. Harrington, A.D. Wilson, and M.D. Young) Ch. 21, pp. 317-329. (CSIRO: Australia)

Logan, J.M. (1965) Rainfall intensities on the north west slopes and plains. *The Journal of the Soil Conservation Service of New South Wales* **21**, 210-223.

Lolicato, S.J. (2000) Soil water dynamics and growth of perennial pasture species for dryland salinity control. *Australian Journal of Experimental Agriculture* **40**, 37-45.

Lull, H.W. (1959) Soil compaction on forest and range lands. Forest Service Miscellaneous Publication No. 768. (United States Department of Agriculture: Washington DC)

Malek, E. (1992) Night-time evapotranspiration vs. daytime and 24 h evapotranspiration. *Journal of Hydrology* **138,** 119-129.

Mannetje, Lt', and Haydock, K.P. (1963) The dry-weight-rank method for the botanical analysis of pasture. *Journal of the British Grassland Society* **18**, 268-275.

Mason, W., and Andrew, M. (1998) Sustainable Grazing Systems (SGS) - developing a national experiment. In 'Proceedings of the 9th Australian Agronomy Conference. Wagga Wagga'. pp. 314-317.

Mason, W.K., and Kay, G. (2000) Temperate Pasture Sustainability Key Program: an overview. *Australian Journal of Experimental Agriculture* **40**, 121-123.

MathSoft (1999) 'S-PLUS 2000 user guide'. (Data Analysis Products Division, MathSoft: Seattle WA)

Mau, T.F. (1946) Erosion control in the Tamworth District. *The Journal of the Soil Conservation Service of New South Wales* **2**, 142-149

McCann, I.R., Kincaid, D.C., and Wang, D. (1992) Operational characteristics of the watermark model 200 soil water potential sensor for irrigation management. *Applied Engineering in Agriculture* **8**, 603-609.

McCaskill, M.R., Ridley A.M., Okom, A., White, R.E., Michalk, D.L., Melland, A., Johnston, W.H., Murphy, S.R., and Andrew, M.H., (2003) SGS Nutrient Theme: environmental assessment of nutrient application to extensive pastures in the high rainfall zone of southern Australia. *Australian Journal of Experimental Agriculture* **43**, In press.

McCormick, L.H. and Lodge, G.M. (2001) A field kit for producers to assess pasture health in the paddock. In 'Proceedings of the 10th Australian Agronomy Conference, Hobart'. www.regional.org.au/au/asa/2001//3/d/mccormick.htm

McCown, R.L., Hammer, G.L., Hargreaves, J.N.G., Holzworth, D.P., and Freebairn, D.M. (1996) APSIM: A novel software system for model development, model testing and simulation in agricultural systems research. *Agricultural Systems* **50**, 255-271.

McGowan, M., and Williams, J.B. (1980) The water balance of an agricultural catchment I. Estimation of evaporation from soil water records. *Journal of Soil Science* **31**, 217-230.

McIvor, J.G., Williams, J., and Gardener, C.J. (1995) Pasture management influences runoff and soil movement in the semi-arid tropics. *Australian Journal of Experimental Agriculture* **35**, 55-65.

McJannet, D.L., Vertessy, R.A., Tapper, N.J., O'Sullivan, S.K., Beringer, J., and Cleugh, H. (1996) Soil and litter evaporation beneath re-growth and old-growth mountain ash forest. Report 96/1. (Cooperative Research Centre for Catchment Hydrology: Melbourne, Victoria)

McLeod, M.K. (2002) Soil water dynamics under grazed pastures in the Northern Tablelands of New South Wales Australia. PhD thesis, University of New England, Armidale NSW.

McLeod, M.K., Cresswell, H.P., MacLeod, D.A , Faulkner, R.D., and Daniel, H. (1998) Measurement of evapotranspiration from different pasture types using the rapid chamber method. In 'Proceedings of the 9th Australian Agronomy Conference, Wagga Wagga'. pp. 231-234.

Meeuwig, R.O. (1970) Infiltration and soil erosion as influenced by vegetation and soil in northern Utah. *Journal of Range Management* **23**, 185-188.

Meyer, W.S., Smith, D.J., and Shell, G. (1999) Estimating reference evaporation and crop evapotranspiration from weather data and crop coefficients. An addendum of AWRAC Research Project 84/162 Quantifying components of water balance under irrigated crops. Technical Report 34/98, 60 p. (CSIRO Land and Water: Canberra)

Milchunas, D.G., and Lauenroth, W.K. (1993) Quantitative effects of grazing on vegetation and soils over a global range of environments. *Ecological Monographs* **63**, 327-366.

Mitchell, A.R., and Shock, C.C. (1996) A watermark datalogging system for ET measurement. In 'Evaporation and irrigation scheduling. Proceedings of the International Conference. San Antonio, Texas'. pp. 468-473.

Molinar, F., Galt, D., and Holechek, J. (2001) Managing for mulch. *Rangelands* **23**, 3-7.

Monteith, J.L. (1965) Evaporation and the environment. In 'The State and Movement of Water in Living Organisms.' *Proceedings of the Symposium of the Society for Experimental Biology* **19**, 205-234.

Monteith, J.L. (1981) Evaporation and surface temperature. *Quarterly Journal Royal Meteorological Society* **107**, 1-27.

Moore, T.R., Thomas, D.B., and Barber, R.G. (1979) The influence of grass cover on runoff and soil erosion from soils in the Machakos area, Kenya. *Tropical Agriculture* **56**, 339-344.

Munsell (1994) 'Munsell soil color charts.' (rev. ed.) (Macbeth Division of Kollmorgan Instruments Corp.; New Windsor, N.Y.)

Murphy, S.R. (1993) Land management options to reduce recharge in far southwest NSW. In 'A national conference on: Land management for dryland salinity control.' pp. 50-53. (La Trobe University: Bendigo)

Murphy, S.R., and Lodge, G.M. (2001*a*) Plant density, litter and bare soil effects on actual evaporation and transpiration in autumn. In 'Proceedings of the 10th Australian Agronomy Conference, Hobart' www.regional.org.au/au/asa/2001/2/b/murphy2.htm

Murphy, S.R., and Lodge, G.M. (2001*b*) Real time analysis of rainfall, soil water content and runoff on the North-West Slopes, NSW. In 'Proceedings of the 10th Australian Agronomy Conference, Hobart' www.regional.org.au/au/asa/2001/5/b/murphys.htm

Murphy, S.R., and Lodge, G.M. (2002) Ground cover in temperate native perennial grass pastures I. A comparison of four estimation methods. *The Rangeland Journal* **24**, 288-300.

Murphy, S.R., and Lodge, G.M. (2003) Surface soil water dynamics in pastures in northern New South Wales. 1. Use of electrical resistance sensors. *Australian Journal of Experimental Agriculture* **43**, In press.

Murphy, S.R., Lodge, G.M., and Harden. S. (2003) Surface soil water dynamics in pastures in northern New South Wales. 2. Surface runoff. *Australian Journal of Experimental Agriculture*. **43**, In press.

Mwendera, E.J., Mohamed Saleem, M.A., and Dibabe, A. (1997) The effect of livestock grazing on surface runoff and soil erosion from sloping pasture lands in the Ethiopian Highlands. *Australian Journal of Experimental Agriculture* **37**, 421-430.

Naeth, M.A., Bailey, A.W., Chanasyk, D.S., and Pluth, D.J. (1991*a*) Water holding capacity of litter and soil organic matter in mixed prairie and fescue grassland ecosystems of Alberta. *Journal of Range Management* **44**, 13-17.

Naeth, M.A., Bailey, A.W., Pluth, D.J., Chanasyk, D.S., and Hardin, R.T. (1991*b*) Grazing impacts on litter and soil organic matter in mixed prairie and fescue grassland ecosystems of Alberta. *Journal of Range Management* **44**, 7-12.

Northcote, K.H. (1974) 'A factual key for the recognition of Australian soils'. (CSIRO Australia: Adelaide)

O'Leary, G.J., and Incerti, M. (1993) A field comparison of three neutron moisture meters. *Australian Journal of Experimental Agriculture* **33**, 59-69.

Orchard, B.A., Cullis, B.R., Coombes, N.E., Virgona, J.M., and Klein, T. (2000) Grazing management studies within the Temperate Pasture Sustainability Key Program: experimental design and statistical analysis. *Australian Journal of Experimental Agriculture* **40**, 143-154.

Otterman, J. (1977) Anthropogenic impact on the albedo of the earth. *Climatic Change* **1**, 137-155.

Payne, R.W., Lane, P.W., Ainsley, A.E., Bicknell, K.E., Digby, P.G.N.. Harding, S.A., Leech, L.K., Simpson, H.R., Todd, A.D., Verrier, P.J., and White, R.P. (1988) 'GENSTAT 5 Reference Manual'. (Oxford University Press: Oxford)

Penman, H.L. (1948) Natural evaporation from open water, bare soil and grass. *Proceedings of the Royal Society of London.* **A193**, 120-146.

Priestly, C.H.B., and Taylor, R.J. (1972) On the assessment of surface heat flux and evaporation using large-scale parameters. *Monthly Weather Review* **100**, 81-92.

Proulx, S., Sri Ranjan, R., and Klassen, G. (1999) 'Laboratory evaluation of soil moisture sensors'. Presented at the July 18-21 ASAE/CSAE-SCGR Annual International Meeting, Paper No. 992169. (ASAE: St. Joseph, MI)

Puckridge, D.W. (1978) A comparison of evapotranspiration measurements of crop communities using lysimeters and assimilation chambers. *Australian Journal of Soil Research* **16**, 229-236.

Qiu, G.Y., Ben-Asher, J., Yano, T., and Momii. K. (1999) Estimation of soil evaporation using the differential temperature method. *Soil Science Society of America Journal* **63**, 1608-1614.

Rafique, S.M. (1994) Effect of grazing management and fertilizer application on vegetation and soil properties of a moist temperate forest range in Siran Valley (Mansehra), NWFP. *Pakistan Journal of Forestry* **44**, 20-29.

Reicosky, D.C. (1983) Comparison of alfalfa evapotranspiration measured by a weighing lysimeter and a portable chamber. *Agricultural Meteorology* **28**, 205-211.

Reicosky, D.C., and Peters, D.B. (1977) A portable chamber for rapid evapotranspiration measurements on field plots. *Agronomy Journal* **69**, 729-732.

Ridley, A.M., Christy, B., Dunin, F.X., Haines, P.J., Wilson, K.F., and Ellington, A. (2001) Lucerne in crop rotations on the Riverine Plains 1. The soil water balance. *Australian Journal of Agricultural Research* **52**, 263-277.

Ridley, A.M., White, R.E., Simpson, R.J., and Callinan, L. (1997) Water use dynamics and drainage under phalaris, cocksfoot, and annual ryegrass pastures. *Australian Journal of Agricultural Research* **48**, 1011-1023.

Ritchie, J.T., Godwin, D.C., and Otter-Nacke, S. (1988) 'CERES-Wheat: a Simulation Model of Wheat Growth and Development'. (Texas A and M University Press: College Station, Texas)

Roe, R., Southcott, W.H., and Turner, H.N. (1959) Grazing management of native pastures in the New England Region of New South Wales. 1. Pasture and sheep production with special reference to systems of grazing and internal parasites. *Australian Journal of Agricultural Research* **10**, 530-554.

Rosewell, C.J., Crouch, R.J., Morse, R.J., Leys, J.F., Hicks, R.W., and Stanley, R.J. (1992) Forms of erosion. In 'Soils their Properties and Management: A soil conservation handbook for New South Wales'. (Eds. P.E.V. Charman, and B.W. Murphy) Ch. 2, pp. 12-35. (Sydney University Press: Sydney)

Ross, P.J. (1990*a*) 'SWIM: A simulation model for soil water infiltration and movement. Reference manual'. (Division of Soils CSIRO Australia: Townsville)

Ross, P.J. (1990*b*) Efficient numerical methods for infiltration using Richard's equation. *Water Resources Research* **26**, 279-290.

Rosset, M., Riedo, M., Grub, A., Geissmann, M., and Fuhrer, J. (1997) Seasonal variation in radiation and energy balances of permanent pastures at different altitudes. *Agricultural and Forest Meteorology* **86**, 245-258.

Salve, R., and Tokunaga, T.K. (2000) Flow processes in a rangeland catchment in California. *Journal of Range Management* **53**, 489-498.

Sanchez, C.E., and Wood, M.K. (1987) The relationship of soil surface roughness with hydrologic variables on natural and reclaimed range land in New Mexico. *Journal of Hydrology* **94**, 345-354.

Sauer, T.J., Moore, P.A., Ham, J.M., Bland, W.L., Prueger, J.H., and West, C.P. (2002) Seasonal water balance of an Ozark hillslope. *Agricultural Water Management.* **55**, 71-82.

Scanlan, J.C., Pressland, A.J., and Myles, D.J. (1996) Run-off and soil movement on mid-slopes in north-east Queensland [Australia] grazed woodlands. *The Rangeland Journal* **18**, 33-46.

Schuman, G.E., Morgan, J.A., Reeder, J.D., LeCain, D.R., Hart, R.H., and Manley, J.T. (1996) Response of soil carbon and nitrogen to grazing on a mixed-grass prairie in Wyoming, USA. In 'Proceedings of the Australian and New Zealand National Soils Conference, Melbourne.' Vol. 2 pp. 235-256.

Scott, P.R., and Sudmeyer, R.A. (1993) Evapotranspiration from agricultural plant communities in the high rainfall zone of the southwest of Western Australia. *Journal of Hydrology* **146**, 301-319.

Scotter, D.R., Clothier, B.E., and Turner. M.A. (1979) The soil water balance in a fragiaqualf and its effect on pasture growth in Central New Zealand. *Australian Journal of Soil Research* **17**, 455-465.

Semple, W.S., and Leys, J.F. (1987) 'The measurement of two factors affecting the soils susceptibility to wind erosion in far south-west New South Wales: soil roughness and proportion of non-erodible aggregates'. Western Region Technical Bulletin 28. (Soil Conservation Service NSW: Sydney)

Sharma, M.L. (1976) Contribution of dew in the hydrologic balance of a semi-arid grassland. *Agricultural Meteorology* **17**, 321-332.

Sharpley, A.N. (1980) The enrichment of soil phosphorus in runoff sediments. *Journal of Environmental Quality* **9**, 521-526.

Simpson, R.J., Bond, W.J., Cresswell, H.P.. Paydar, Z., Clark, S.G., Moore, A.D., Alcock, D.J., Donnelly, J.R., Freer, M., Keating, B.A , Huth, N.I., and Snow, V.O. (1998) A strategic assessment of sustainability of grazed pasture systems in terms of their water balance. In 'Proceedings of the 9th Australian Agronomy Conference, Wagga Wagga'. pp. 239-242.

Simunek, J., Sejna, M., and van Genuchten. M.Th. (1999) 'HYDRUS-2D/MESHGEN-2D, Simulating Water Flow and Solute Transport in Two-Dimensional Variably Saturated Media'. (IGWMC-TPS 53c) (Colorado School of Mines: Colorado USA)

Sinclair, D.F., and Williams, J. (1979) Components of variance involved in estimating soil water content and water content change using a neutron moisture meter. *Australian Journal of Soil Research* **17**, 237-247.

Smith, M. (1992) 'Report on the expert consultation on revision of FAO methodologies for crop water requirements'. (Land and Water Development Division, Food and Agriculture Organisation of the United Nations: Rome)

Smith, M., Allen, R., and Pereira, L. (1996) Revised FAO methodology for crop water requirements. In 'International Conference on Evapotranspiration and Irrigation Scheduling in San Antonio USA, November 1996'. (FAO: Rome)

Snaydon, R.W. (1971) Soil water content beneath summer dormant and summer active swards in a seasonally semi-arid environment. *Agricultural Meteorology* **8**, 349-363.

Snyman, H.A. (1994) Evapotranspiration, water-use efficiency and quality of six dryland planted pasture species and natural vegetation, in a semi-arid rangeland. *African Journal of Range and Forage Science* **11**, 82-88.

Snyman, H.A., and Fouche, H.J. (1991) Production and water-use efficiency of semi-arid grasslands of South Africa as affected by veld condition and rainfall. *Water SA* **17**, 263-268.

Song, J. (1998) Diurnal asymmetry in surface albedo. *Agricultural and Forest Meteorology* **92**, 181-189.

Spaans, E.J.A., and Baker, J.M. (1992) Calibration of watermark soil moisture sensors for soil matric potential and temperature. *Plant and Soil* **143**, 213-217.

Srinivasan, M.S., Gburek, W.J., and Hamlett, J.M. (2002) Dynamics of stormflow generation - a hillslope-scale field study in east-central Pennsylvania, USA. *Hydrological Processes* **16**, 649-665.

Stirzaker, R., Vertessy, R., and Sarre, A. (2002) (Eds.) 'Trees, water and salt. An Australian guide to using trees for healthy catchments and productive farms'. (Joint Venture Agroforestry Program: Canberra)

Stout, W.L. (1992) Water-use efficiency of grasses as affected by soil, nitrogen, and temperature. *Soil Science Society of America Journal* **56**, 897-902.

Symons, G.J. (1967) Evaporators and evaporation. *British Rainfall* **8**.

Thomson, S.J., Younos, T., and Wood, K. (1996) Evaluation of calibration equations and application methods for the watermark® granular matrix soil moisture sensor. *Applied Engineering in Agriculture* **12**, 99-103.

Thornley, J.H.M., and Johnson, I.R. (2000) 'Pasture and Crop Modelling'. (The Blackburn Press: New Jersey)

Thurow, T.L. (1991) Hydrology and erosion. In 'Grazing management an ecological perspective.' (Eds. R.K. Heitschmidt, and J.W. Stuth) Ch. 6, pp. 141-254. (Timber Press: Portland Oregon)

Tisdall, J.M. (1994) Possible role of soil microorganisms in aggregation in soils. *Plant and Soil* **159**, 115-121.

Tothill, J.C., Hargreaves, J.N.G., Jones, R.M., and McDonald, C.K. (1992) 'BOTANAL – a comprehensive sampling and computer procedure for estimating pasture yield and composition. I. Field sampling. Division of Tropical Crops and Pastures'. Tropical Agronomy Technical Memorandum No. 78. (CSIRO: Australia)

Trewin, D. (2002) 'Year Book Australia 2002'. (Australian Bureau of Statistics: Canberra)

van Bavel, C.H. (1962) Accuracy and source strength in soil moisture neutron probes. *Soil Science* **26**, 405.

van Doren Jr., D.M., and Allmaras, R.R. (1978) Effect of Residue Management Practices on the Soil Physical Environment, Microclimate and Plant Growth. In 'Crop Residue Management Systems'. ASA Special Publication No. 31. pp. 49-83. (American Society of Agronomy, Crop Science Society of America, Soil Science Society of America: Madison, Wisconsin)

van Genuchten, M.Th. (1980) A closed-form equation for predicting the hydraulic conductivity of unsaturated soils. *Soil Science Society of America Journal* **44**, 892-898.

Vanha-Majamaa, I., Salemaa, M., Tuominen, S., and Mikkola, K. (2000). Digitised photographs in vegetation analysis – a comparison of cover estimates. *Applied Vegetation Science* **3**, 89-94.

van Rees, H., and Boston, R.C. (1986) Evaluation of factors affecting surface runoff on alpine rangelands in Victoria. *Australian Rangeland Journal* **8**, 97-102.

Walker, G., Gilfedder, M., and Williams, J. (1999) 'Effectiveness of current farming systems in the control of dryland salinity'. (CSIRO Land and Water: Canberra)

Ward, R.C. (1971) Measuring evapotranspiration: a review. *Journal of Hydrology* **13**, 1-21.

Warren, S.D., Thurow, T.L., Blackburn, W.H., and Garza, N.E. (1986) The influence of livestock trampling under intensive rotation grazing on soil hydrologic characteristics. *Journal of Range Management* **39,** 491-495.

Weltz, M.A., and Blackburn, W.H. (1995) Water budget for south Texas rangelands. *Journal of Range Management* **48**, 42-52.

Weltz, M.A., Wood, M.K., and Parker, E.E. (1989) Flash grazing and trampling: effects on infiltration rates and sediment yield on a selected New Mexico range site. *Journal of Arid Environments* **16**, 95-100.

White, H.F. (1946) Prevention of soil erosion in New England. *The Journal of the Soil Conservation Service of New South Wales* **2**, 84-86.

Wilcox, B.P., and Wood, M.K. (1988) Hydrologic impacts of sheep grazing on steep semiarid rangelands. *Journal of Range Management* **41**, 303-306.

Wilcox, B.P., Wood, M.K., and Tromble, J.M. (1988) Factors influencing infiltrability of semiarid mountain slopes. *Journal of Range Management* **41**, 197-206.

Willms, W.D., McGinn, S.M., and Dormaar, J.F. (1993) Influence of litter on herbage production in the mixed prairie. *Journal of Range Management* **46**, 320-324.

Wilson, A.D., Harrington, G.N., and Beale, I.F. (1984) Grazing Management. In 'Management of Australia's Rangelands'. (Eds. G.N. Harrington, A.D. Wilson, and M.D. Young) Ch. 9, pp. 129-140. (CSIRO: Australia)

Wood, M.K., Donart, G.B., and Weltz, M. (1986) Comparative infiltration rates and sediment production on fertilised and grazed blue grama rangeland. *Journal of Range Management* **39**, 371-374.

Wright, H.A., Churchill, F.M., and Stevens, W.C. (1982) Soil loss, runoff, and water quality of seeded and unseeded steep watersheds following prescribed burning. *Journal of Range Management* **34**, 331-335.

Yoder, R.E., Johnson, D.L., Wilkerson, J.B., and Yoder, D.C. (1998) Soil water sensor performance. *Applied Engineering in Agriculture* **14**, 121-133.

Yu, B., Ciesiolka, C.A.A., Rose, C.W., and Coughlan, K.J. (1997) A note on sampling errors in the rainfall and runoff data collected using tipping bucket technology. *Transactions of the American Society of Agricultural Engineers* **40**, 1305-1309.

Zhang, L., and Dawes, W. (1998) 'WAVES - an integrated water and energy balance model'. CSIRO Land and Water Technical Report No. 31/98. (CSIRO Land and Water: Canberra)

Zhang, L., Hume, I.H., O'Connell, M.G , Mitchell, D.C., Millthorpe, P.L., Yew, M., Dawes, W.R., and Hatton, T.J. (1999) Estimating episodic recharge under different crop/pasture rotations in the Mallee region. Part 1. Experiments and calibration. *Agricultural Water Management* **42**, 219-235.

Zhou, Q., Robson, M., and Pilesjo, P. (1998). On the ground estimation of vegetation cover in Australian rangelands. *International Journal of Remote Sensing* **19**, 1815-1820.

Appendix 1. Daily evapotranspiration data

Table 1. Daily evapotranspiration (mm/d) for plots with a dry soil surface at Tamworth Centre for Crop Improvement.

Plot	Plant density (plants/m^2)	Litter mass (kg DM/ha)	6 February 2001	3 April 2000	9 May 2001	3 July 2000	6 November 2000
1	12	0	3.8	3.9	1.8	1.6	3.6
2	4	500	3.7	3.1	1.6	1.1	4.1
3	12	1500	3.3	4.4	1.6	1.3	4.2
4	25	3000	4.1	4.0	1.8	1.4	4.2
5	0	1500	1.7	2.2	1.2	0.8	2.0
6	25	500	3.6	4.5	1.2	1.5	4.9
7	4	3000	3.0	3.0	1.6	0.9	3.8
8	0	0	1.5	1.0	1.2	0.8	1.5
9	25	0	3.1	3.6	1.6	1.3	5.2
10	4	0	2.9	2.3	1.6	1.1	3.7
11	0	3000	1.7	1.9	1.0	0.8	2.0
12	0	500	1.4	1.4	1.4	1.0	1.7
		Mean (mm/d)	2.8	2.9	1.5	1.1	3.4

Table 2. Daily evapotranspiration (mm/d) for plots with a wet soil surface at Tamworth Centre for Crop Improvement.

Plot	Plant density (plants/m^2)	Litter mass (kg DM/ha)	7 February 2001	4 April 2000	8 May 2001	7 July 2000	7 November 2000
1	12	0	5.1	4.4	1.7	1.3	3.4
2	4	500	5.1	3.7	1.5	1.1	3.4
3	12	1500	5.0	4.1	1.6	1.2	3.7
4	25	3000	5.6	3.7	1.8	1.5	4.0
5	0	1500	3.4	2.7	1.1	0.6	2.4
6	25	500	4.8	3.7	1.3	1.3	2.7
7	4	3000	5.0	2.4	1.3	0.7	3.5
8	0	0	3.9	3.2	1.1	1.0	2.7
9	25	0	4.9	4.0	1.6	1.4	2.8
10	4	0	4.9	3.6	1.4	1.1	3.6
11	0	3000	2.5	2.3	1.0	0.6	2.3
12	0	500	3.2	3.5	1.5	0.8	2.6
		Mean (mm/d)	4.5	3.4	1.4	1.1	3.1

Table 3. Daily evapotranspiration (mm/d) for plots at Springmount.

Plot	Treatment	9 February 2001	10 May 2001	5 July 2000	9 November 2000
			Dry soil surface		
1	Bare soil	1.2	0.6	0.2	0.7
3	Low cover and herbage mass	6.7	1.9	0.4	3.0
5	Medium cover and herbage mass	5.3	1.6	0.4	2.0
7	High cover and herbage mass	3.6	1.4	0.6	4.0
	Mean (mm/d)	4.2	1.4	0.4	2.4
			Wet soil surface		
2	Bare soil	4.5	2.2	1.8	3.9
4	Low cover and herbage mass	7.5	1.7	1.8	4.4
6	Medium cover and herbage mass	7.6	2.0	1.0	4.0
8	High cover and herbage mass	3.3	1.3	1.3	4.1
	Mean (mm/d)	5.7	1.8	1.5	4.1

Appendix 2. Analyses of individual layer stored soil water

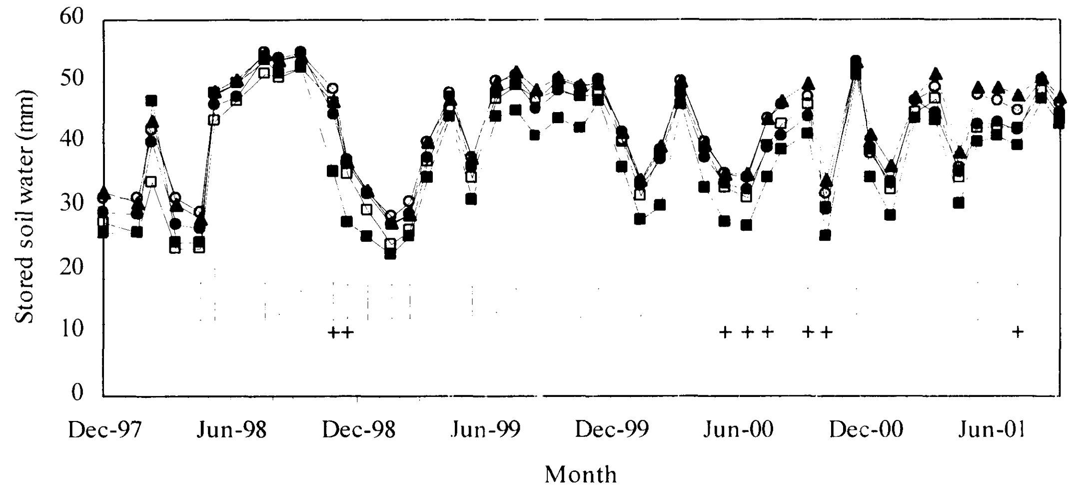

Figure 1. Monthly stored soil water (mm) for the 10-30 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

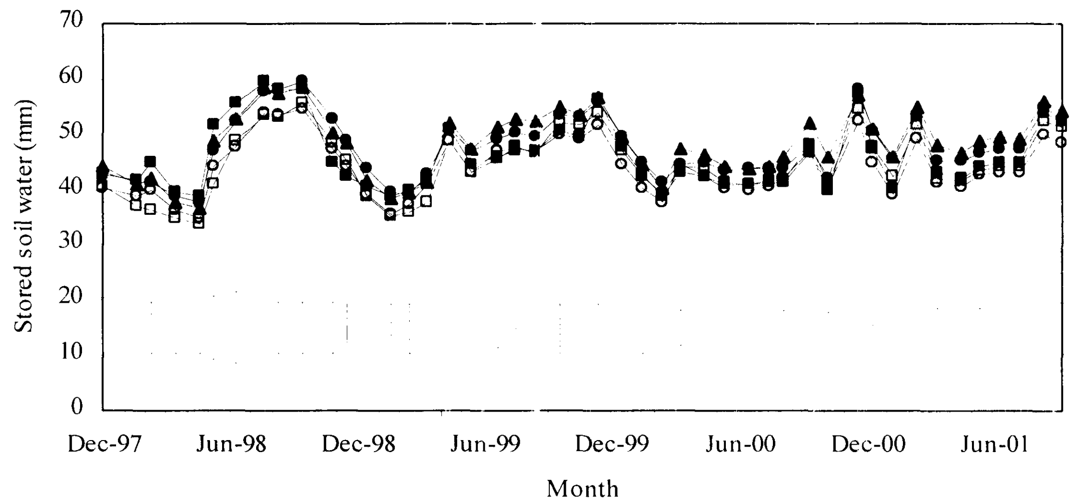

Figure 2. Monthly stored soil water (mm) for the 30-50 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

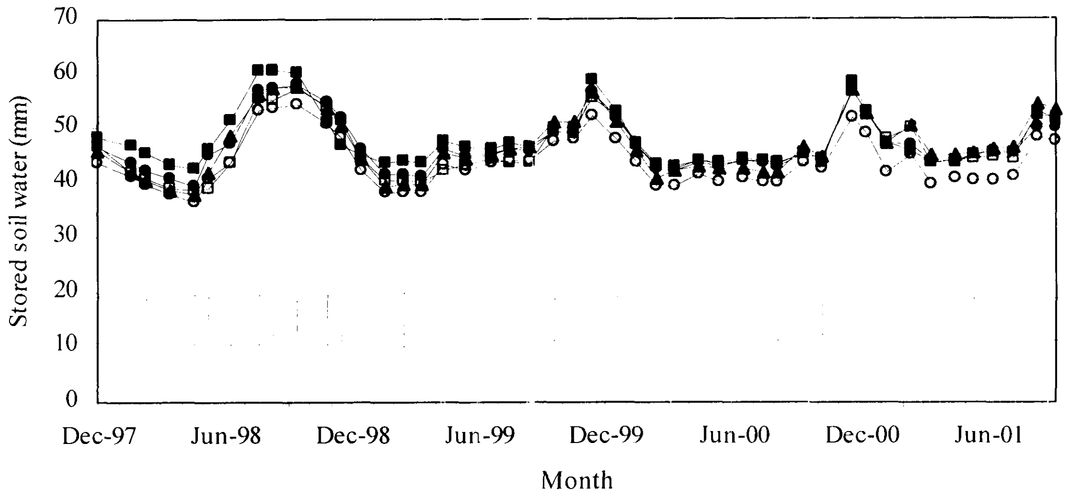

Figure 3. Monthly stored soil water (mm) for the 50-70 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

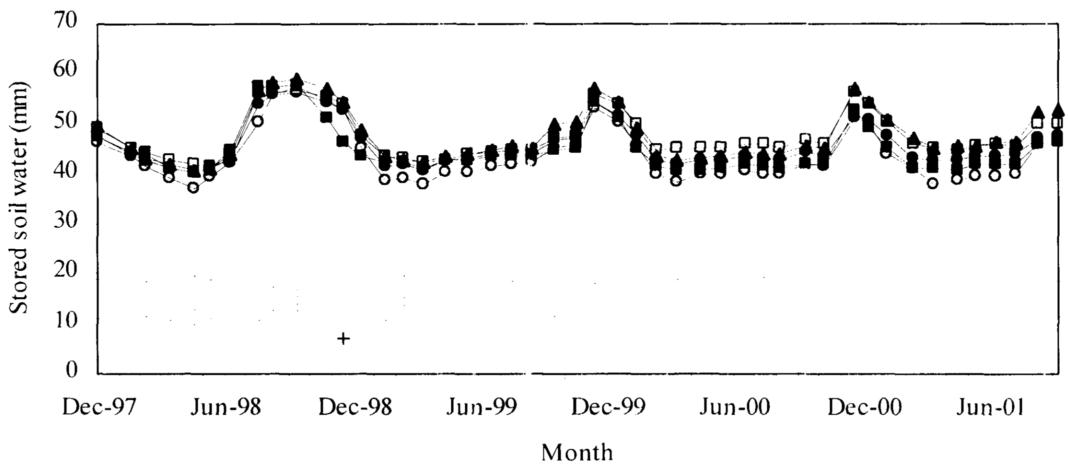

Figure 4. Monthly stored soil water (mm) for the 70-90 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

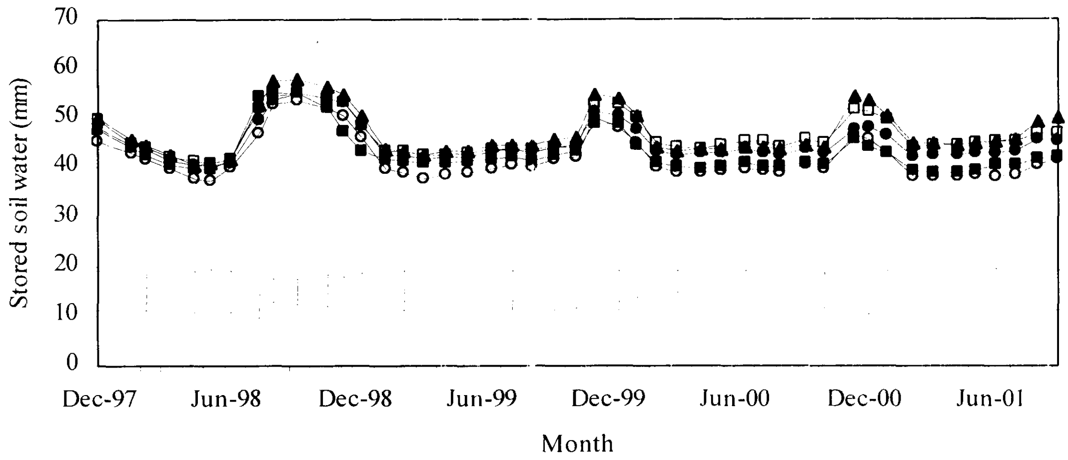

Figure 5. Monthly stored soil water (mm) for the 90-110 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (P<0.05).

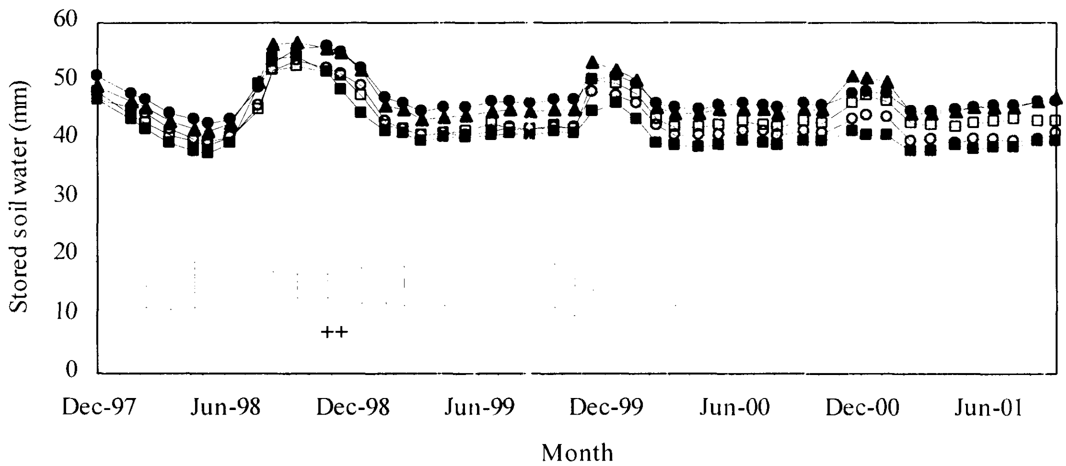

Figure 6. Monthly stored soil water (mm) for the 110-130 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (P<0.05).

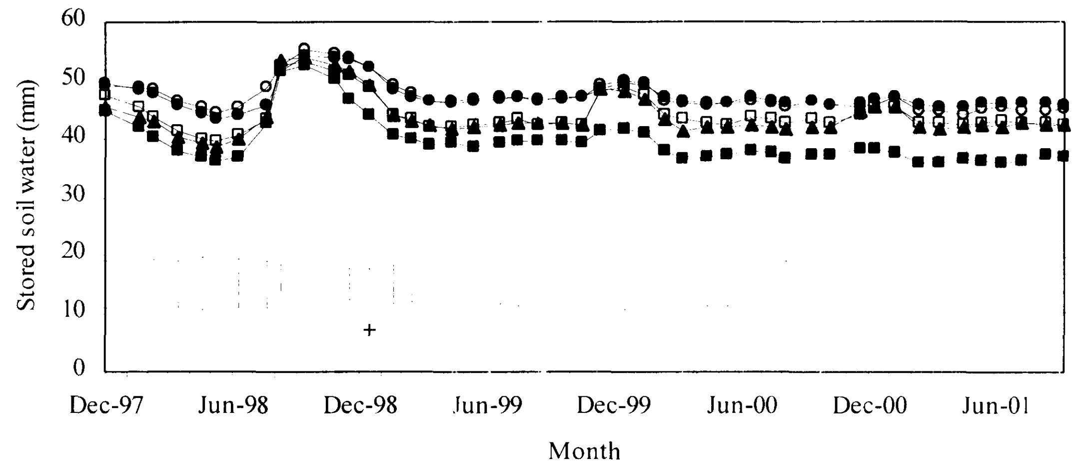

Figure 7. Monthly stored soil water (mm) for the 130-150 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

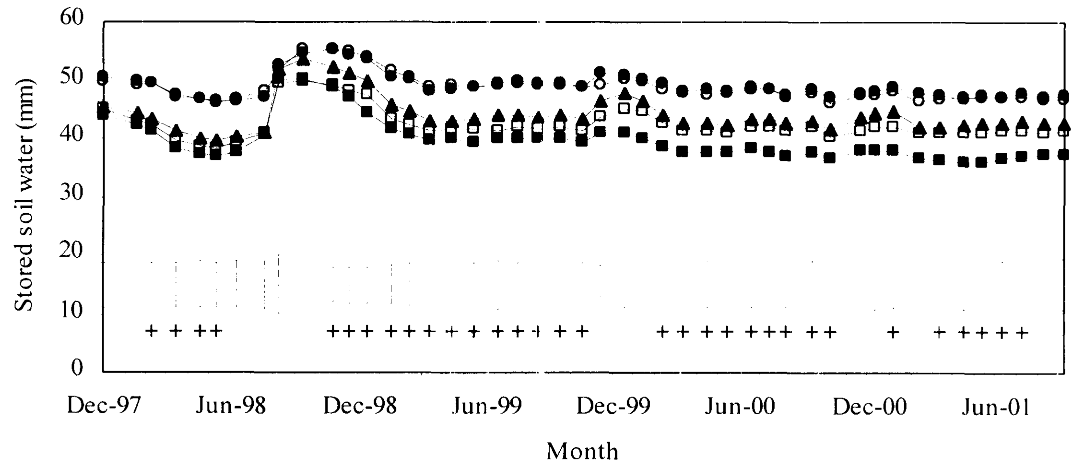

Figure 8. Monthly stored soil water (mm) for the layer 150-170 cm for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (*P*<0.05).

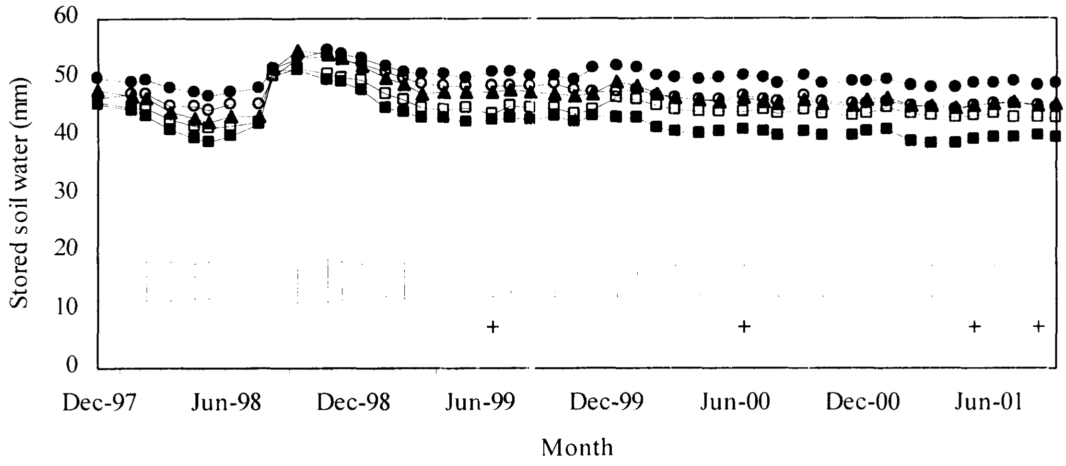

Figure 9. Monthly stored soil water (mm) for the 170-190 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (P<0.05).

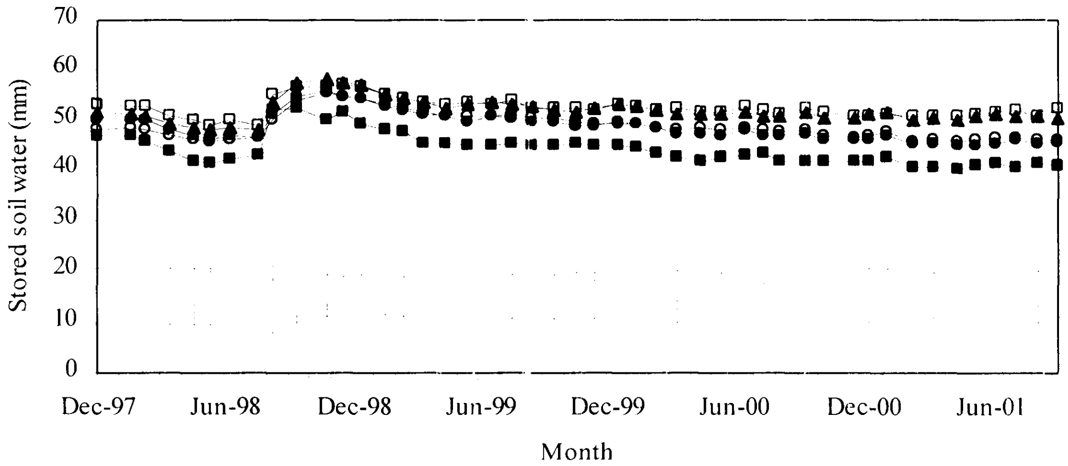

Figure 10. Monthly stored soil water (mm) for the 190-210 cm layer for each grazing treatment at Springmount, T1C4 (●), T2C6 (○), T3FERT8 (■), T4GR4 (□), and T5GR12 (▲). Vertical bars indicate least significant difference between treatments for stored soil water. Significant differences are indicated by + (P<0.05).

Appendix 3. Pasture Model parameter set

Table 1. Full listing of parameters used for calibrating the Pasture Model for grazing treatments at Springmount. Units and descriptions are those that are used on the interface of the Pasture Model.

PARAMETER	T5GR12				T2C6				T3FERT8			
Soil water parameters												
Soil physical properties												
	S	A	B1	B2	S	A	B1	B2	S	A	B1	B2
Saturated water content (%v):	43	43	38	35	43	43	38	35	43	43	38	35
Ksat (cm/d):	4	15	5	5	5	15	19	19	4	15	10	7
Drainage point (%v):	29	28	23	20	29	28	23	20	29	28	23	20
Wilting point (%v):	10	10	13	14	10	10	13	14	10	10	13	14
Air dry water content (%v):	4	4	4	4	4	4	4	4	4	4	4	4
Hydraulic flux coefficient:	3	3	3	3	3	3	3	3	3	3	3	3
Canopy and litter												
Maximum LAI water storage capacity (mm water / LAI):	1				1				1			
Litter water storage capacity, mm / (t / ha)	2				0.2				2			
Litter d.wt. (t/ha) for 50% reduction in evaporation	2				3				3			
Adjust Ksat in response to litter cover	TRUE				TRUE				TRUE			
Runoff and lateral flow												
Profile length (m)	100				100				100			
Profile inclination (%)	5				5				5			
Maximum ground surface water storage capacity (mm):	10				10				10			
Minimum ground surface water storage capacity (mm):	2				2				2			
Curvature parameter for ground surface water storage	0.5				0.9				0.5			
Lateral flow flux (m/d)	0.1				0.1				0.1			
Soil nutrient parameters												
Initial organic status												
Surface (% mass)	4				4				4			

PARAMETER	**T5GR12**					**T2C6**					**T3FERT8**				
Inert C (% mass)	0.5					0.5					0.5				
Depth for 50% decline, cm	5					5					5				
Curvature	2					2					2				
Initial inorganic status	NO3	NH4	P	K	S	NO3	NH4	P	K	S	NO3	NH4	P	K	S
Surface (mg / kg)	0	10	30	100	5	0	10	30	100	5	0	10	30	100	5
Depth for 50% decline, cm	20	20	5	20	20	20	20	5	20	20	20	20	5	20	20
Curvature	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Bulge (mg / kg)	3	0	0	0	2	3	0	0	0	2	3	0	0	0	2
Bulge depth (cm)	30	100	100	100	100	30	100	100	100	100	30	100	100	100	100
Spread	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Model parameters															
Fast decay, rate constant (/day)	0.02					0.02					0.02				
Fast decay, efficiency	0.6					0.6					0.6				
Slow decay, rate constant (/day)	0.0005					0.0005					0.0005				
Slolw decay, efficiency	0.1					0.1					0.1				
Nutrient composition of organic matter at start of simulation	C/N	C/P	C/S			C/N	C/P	C/S			C/N	C/P	C/S		
	13	130	110			13	130	110			13	130	110		
Temperature effect for OM turnover															
Minimum temperature, C	0					0					0				
Optimum temperature, C	20					20					20				
Maximum temperature, C	30					30					30				
Minimum temperature, C	0.5					0.5					0.5				
Nitrogen transformations															
Rate constant for NH4 nitrification	0.01					0.01					0.01				
Rate constant for NO3 denitrification	0.05					0.05					0.05				
Rate constant for urea volatilization	0.05					0.05					0.05				
Critical rainfall for volatilization	5					5					5				
Nutrient adsorption	NH4	P	K	S		NH4	P	K	S		NH4	P	K	S	
Reference nutrient in solution (mg/kg)	1	0.1	1	1		1	0.1	1	1		1	0.1	1	1	
Reference sorbed nutrient (mg/kg)	50	100	50	5		50	100	50	5		50	100	50	5	
Freundlich coefficient	0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	

PARAMETER	T5GR12			T2C6			T3FERT8		
Plant inputs									
Initial litter dry wt (t/ha)	0.4			0.4			0.4		
Initial litter composition	C/N	C/P	C/S	C/N	C/P	C/S	C/N	C/P	C/S
	40	400	400	40	400	400	40	400	400
Rate constant for incorporation of litter in the soil (%/day)	2			2			2		
Depth to which litter is incorporated (cm)	5			5			5		
Animal inputs									
Initial dung dry wt (t/ha)	0.1			0.1			0.1		
Initial dung composition	C/N	C/P	C/S	C/N	C/P	C/S	C/N	C/P	C/S
	10	100	100	10	100	100	10	100	100
Rate constant for incorporation of dung in the soil (%/day)	2			2			2		
Depth to which dung is incorporated (cm)	5			5			5		
% urine N to volatilization:	25			25			25		
Pasture Parameters	**PC4**	**PC3**		**PC4**	**PC3**		**PC4**	**PC3**	**AC3**
General									
Height : LAI (cm / LAI):	10	10		10	10		10	10	5
Initial shoot dry weight (t/ha)	1.5	1		1.5	1		1.5	1	0.01
Initial green % d.wt.	30	50		10	20		30	50	1/04/00
Initial root dry weight (t/ha)	1.6	0.5		1.6	0.5		1	0.5	1/11/00
									20
Growth									
Leaf Pmax at opt temp (mg CO2 / (m2.s))	0.5	0.5		0.5	0.4		0.6	0.5	0.6
Minimum temp for Pm (C)	10	2		15	5		15	5	2
Optimum temp for Pm (C)	25	14		28	20		30	20	18
Maximum temp for Pm (C)	32	35		32	30		37	30	28
Curvature for Pm (T)	0.2	0.2		0.2	0.2		0.2	0.2	0.2
Leaf appearance interval at the Pmax opt temp (day)	10	10		40	30		20	20	40
Live leaves per tiller	3	3		4	4		4	4	4
Light extinction coefficient (0-1)	0.5	0.5		0.5	0.5		0.5	0.5	0.5
Dead to litter (%/day)	1	1		1	1		1	1	2

PARAMETER	T5GR12		T2C6		T3FERT8		
Roots							
Sigmoidal root distribution							
Root depth (cm)	50	40	50	40	50	40	40
Depth for 50% root distribution:	20	15	20	15	20	15	15
Scale factor	4	3.5	2	2	2	2	3
Root senescence rate, % live / day	1	1	2	2	2	2	1
Transpiration							
Include compensation	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Water content between WP and FC for no water stress (%)	50	50	50	50	50	50	50
GLF at saturation:	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Animal parameters							
% trampling of standing dead per 100 animals / ha	5	2	5	5	3	3	2
Cell wall digestibility of live plant material (%)	60	60	60	60	60	60	70
Cell wall digestibility of dead plant material (%)	30	30	30	30	30	30	20
Pasture Parameters: P C3							
Stock parameters							
Animal type:	Wether		Wether		Wether		
Number of animals	160		240		320		
Intake parameters							
Max intake per animal, 80% digestible (kg/d)	1.3		1.3		1.3		
Max intake per animal, 30% digestible (kg/d)	0.5		0.5		0.5		
Curvature parameter	1		1		1		
Intake in relation to d.wt. on offer							
Unavailable d.wt. (t/ha)	0		0		0		
Min d.wt. on offer for max intake (t/ha)	1		1		1		
Curvature parameter	1		1		1		
Metabolism							
Normal mature body weight (kg)	50		50		50		
Normal mature maintenance requirement (MJ/day)	1		1		1		
Initial body weight (kg)	25		25		25		

PARAMETER	T5GR12					T2C6					T3FERT8				
Nutrient distribution between dung and urine	N	P	K	S		N	P	K	S		N	P	K	S	
% excreted nutrient in dung (remainder is in urine)	50	80	0	50		50	80	0	50		50	80	0	50	
Supplementary feeding															
Feed options															
Critical % of ME requirement at which to feed	40	Implemented				40	Implemented				40	Implemented			
Target intake as % of ME requirement through supplement	70	Implemented				70	Implemented				70	Implemented			
Maximum daily supplement ME intake (MJ/day)	15	Implemented				15	Implemented				15	Implemented			
Minimum daily supplement ME intake (MJ/day)	0	Not implemented				0	Not implemented				0	Not implemented			
Supplement composition	ME (MJ/kg)	N(%)	P(%)	K(%)	S(%)	ME (MJ/kg)	N(%)	P(%)	K(%)	S(%)	ME (MJ/kg)	N(%)	P(%)	K(%)	S(%)
	12	4	0.4	1	0.5	12	4	0.4	1	0.5	12	4	0.4	1	0.5

Appendix 4. Publications arising from this research

This appendix provides copies of journal articles, conference papers and abstracts of articles that have been submitted for publication.