

References

- Aigner, D.J., Lovell, C.A. and Schmidt, P. 1977, 'Formulation and estimation of stochastic frontier production function models', *Journal of Econometrics*, 6(1), 21-37.
- Alcock, B.S. 1979, *The Costs of Soil Erosion*, Miscellaneous Bulletin No. 11, Economic Services Branch, Department of Primary Industries, Toowoomba.
- Anderson, J.R. and Thampapillai, J. 1989, *Soil Conservation in Developing Countries: Project and Policy Intervention*, The World Bank, Washington D.C.
- Anonymous 1991, *Catchment Management Issues in the Namoi River Catchment*, Department of Water Resources, Sydney.
- Australian Bureau of Agricultural and Resource Economics 1993, *Farm Surveys Report 1993*, AGPS, Canberra.
- Australian Bureau of Statistics 1989, *Value of Agricultural Commodities Produced NSW, 1987-88*, AGPS, Sydney.
- Australian Bureau of Statistics 1990, *Value of Agricultural Commodities Produced NSW, 1988-89*, AGPS, Sydney.
- Australian Bureau of Statistics 1991, *Value of Agricultural Commodities Produced NSW, 1989-90*, AGPS, Sydney.

-
- Australian Bureau of Statistics 1992, *Australia's Environment: Issues and Facts*, AGPS, Sydney.
- Australian Soil Conservation Council 1989, *Third National Soil Conservation Program Report*, AGPS, Canberra.
- Barbier, E.B. 1993, 'Introduction; economics and ecology — the next frontier', in *Economics and Ecology: New Frontiers and Sustainable Development*, ed. E.B. Barbier, Chapman and Hall, London, pp. 1-10.
- Barlowe, R. 1986, *Land Resource Economics. The Economics of Real Estate*, Fourth Edition, Prentice-Hall, Englewood Cliffs, NJ.
- Barnett, H.J. and Morse, C. 1963, *Scarcity and Growth: The Economics of Natural Resource Availability*, Johns Hopkins Press, Baltimore.
- Barr, N. and Cary, J. 1992, *Greening a Brown Land: The Australian Search for Sustainable Land Use*, Macmillan, South Melbourne.
- Barrett, S. 1991, 'Optimal soil conservation and the reform of agricultural pricing policies', *Journal of Development Economics*, 36(2), 167-187.
- Barrett, S. 1994, 'Microeconomic responses to macroeconomic reforms: the optimal control of soil erosion, in *The Environment and Emerging Development Issues*, eds. P. Dasgupta and K.-G. Mäler, Clarendon Press, Oxford, pp. 1-26.
- Barrows, R. and Gardner, K. 1987, 'Do land markets account for soil conservation investment?', *Journal of Soil and Water Conservation*, 42(4), 232-236.
- Batie, S.S. 1989, 'Sustainable development; challenges to the profession of agricultural economics', *American Journal of Agricultural Economics*, 71(4), 1083-1101.
- Battese, G.E. 1992, 'Frontier production functions and technical efficiency: a survey of empirical applications in agricultural economics', *Agricultural Economics*, 7(2), 185-208.

- Best, R.G. and Westin, F.C. 1987, 'GIS for soils and rangeland management', in *Geographic Information Systems for Resource Management: A Compendium*, ed. W.J. Ripple, American Society for Photogrammetry and Remote Sensing, and American Congress on Surveying and Mapping, Falls Church, pp. 200-204.
- Bie, S. 1990, *Dryland Degradation Measurement Techniques*, Environment Working Paper No. 26, The World Bank, Washington DC.
- Binswanger, H.P. 1974, 'A cost function approach to the measurement of elasticities of factor demand and elasticities of substitution', *American Journal of Agricultural Economics*, 56(2), 377-386.
- Blyth, M. and McCallum, A. 1987, 'Onsite costs of land degradation in agriculture and forestry', in *Land Degradation: Problems and Policies*, eds. A. Chisholm and R. Dumsday, Cambridge University Press, Cambridge, pp. 79-98.
- Bojö, J. 1996, 'The costs of land degradation in Sub-Saharan Africa', *Ecological Economics*, 16(2), 161-173.
- Bojö, J. 1991, 'Economics and land degradation', *Ambio*, 20(2), 75-79.
- Bradsen, J. 1987, 'Land degradation ... current and proposed legal controls'. *Search*, 12(7), 205-210.
- Bradsen, J. 1988, *Soil Conservation Legislation in Australia*, University of Adelaide Printing Department, Adelaide.
- Brown, S., Schreier, H., Thompson, W.A. and Vertinsky, I. 1994, 'Linking multiple accounts with GIS as Decision Support System to resolve forestry/wildlife conflicts', *Journal of Environmental Management*, 42(4), 349-364.
- Burrough, P.A. 1986, *Principles of Geographic Information Systems for Land Resources Assessment*, Clarendon Press, Oxford.
- Burrough, P.A. 1989, 'Modelling land qualities in space and time: the role of geographical information systems', in *Land Qualities in Space and Time*:

-
- Proceedings of a Symposium of the International Society of Soil Science*, Wageningen, 22-26 August 1988, Pudoc, Wageningen, pp. 45-60.
- Cameron, J.I. and Elix, J. 1991, *Recovering Ground: A Case Study Approach to Ecologically Sustainable Rural Land Management*, Australian Conservation Foundation, Melbourne.
- Campbell, C.A. 1992, *Taking the Long View in Tough Times — Landcare in Australia*, National Landcare Facilitator Third Annual Report, National Landcare Program, Canberra.
- Campbell, C.A. 1994, *Landcare: Communities Shaping the Land and the Future*, Allen and Unwin, Sydney.
- Campbell, J.C., Radke, J., Gless, J.T. and Wirtshafter, R.M. 1992, 'An application of linear programming and geographic information systems: cropland allocation in Antigua', *Environment and Planning A*, 24(4), 535-549.
- Cary, J.W., Barr, N.F. and Wilkinson, R.L. 1993, 'Community attitudes to salinity control strategies: reconciling conflicting perceptions', in *National Conference on Land Management for Dryland Salinity Control*, Bendigo 28 September - 1 October 1993, La Trobe University, Bendigo, 169-230.
- Chambers, R. 1983, *Rural Development: Putting the Last First*, Longman Scientific and Technical, Harlow, UK.
- Chiang, A.C. 1992, *Elements of Dynamic Optimisation*, McGraw-Hill, New York.
- Chisholm, A.H. 1990, 'Population Growth, Agriculture and Land Degradation', in *Immigration, Population Growth and the Environment*, eds. H.R. Clarke, A.H. Chisholm, G.W. Edwards, and J.O.B. Kennedy, Bureau of Immigration Research, AGPS, Canberra pp. 107-123.
- Chisholm, A.H. 1992, 'Australian agriculture: a sustainability story', *Australian Journal of Agricultural Economics*, 36(1), 1-29.

-
- Chisholm, A.H. 1994, 'Land use choices in a changing world', *Land Degradation and Rehabilitation*, 5(2), 153-178.
- Chisholm, A.H. and Hone, P. 1996, 'Long lived resource quality and resource policy', in *Global Agricultural Science Policy for the Twenty-First Century*, Melbourne 26-28 August 1996, The Conference Secretariat of Global Agricultural Science Policy for the Twenty-First Century, 227-262.
- Clarke, H.R. 1992, 'The supply of non-degraded agricultural land', *Australian Journal of Agricultural Economics*, 36(1), 31-56.
- Cocks, K.D. 1992, *Use With Care: Managing Australia's Natural Resources in the Twenty-First Century*, New South Wales University Press, Kensington.
- Coelli, T.J. 1995, 'Recent developments in frontier modelling and efficiency measurement', *Australian Journal of Agricultural Economics*, 39(3), 219-245.
- Conacher, A. and Conacher, J. 1995, *Rural Land Degradation in Australia*, Oxford University Press, Melbourne.
- Conway, G.R. 1987, 'The properties of agroecosystems', *Agricultural Systems*, 24(2), 95-117.
- Crosson, P. 1993, 'Sustainable agriculture: a global perspective', *Choices*, Second Quarter, 38-42.
- Crosson, P. and Stout, A.T. 1983, *Productivity Effects of Cropland Erosion in the United States*, Resources for the Future, Washington D.C.
- Dalziell, I. and Poulter, D. 1992, The economics of land degradation: the case of acid soils, Paper presented to the 36th Annual Australian Agricultural Economics Society Conference, Canberra, February.
- Davidson, B. 1989, 'Some comments on the draft National Soil Conservation Strategy', *State Pollution Control Commission Paper*, May.

- Davidson, B. 1991, 'Australia's national soil conservation strategy: land use planning vs free markets', *Policy*, Autumn, 24-27.
- Dawson, P.J. and Lingard, J. 1982, 'Management bias and returns to scale in a Cobb-Douglas production function for agriculture', *European Review of Agricultural Economics*, 9(1), 7-24.
- Department of Environment, Housing and Community Development 1978, *A Basis for Soil Conservation Policy in Australia*, Commonwealth and State Government Collaborative Soil Conservation Study, Report No. 1, AGPS, Canberra.
- Department of Environment, Sport and Territories 1995, *A Profile*, Department of Environment, Sport and Territories, Canberra.
- Department of Finance 1991, *Handbook of Cost-Benefit Analysis*, AGPS, Canberra.
- Department of Primary Industries and Energy 1993, *Soil Conservation Advisory Committee Annual Report 1991-92*, AGPS, Canberra.
- Donaldson Planning and Management Services 1996, *Namoi Community Catchment Plan: Stage 1 Situation Statement*, Prepared for the North-West Catchment Management Committee, Gunnedah.
- Doran, H.E and Guise, J.W.B. 1984, *Single Equation Methods in Econometrics: Applied Regression Analysis*, University of New England Teaching Monograph Series 3, University of New England, Armidale.
- Dovers, S.R. 1995, 'Information, sustainability and policy', *Australian Journal of Environmental Management*, 2(3), 142-156.
- Dumsday, R.G. and Oram, D.A. 1990, 'Economics of dryland salinity control in the Murray River basin, Northern Victoria (Australia)', in *Dryland Management: Economic Case Studies*, eds. J.A. Dixon, D.E. James and P.B. Sherman, Earthscan Publications, London, pp. 215-240.
- Eckersley, R. 1989, *Regreening Australia: The Environmental, Economic and Social Benefits of Reafforestation*, Occasional Paper No. 3, CSIRO, Canberra.

-
- Ecologically Sustainable Development Working Group 1991, *Final Report — Agriculture*, AGPS, Canberra.
- Edgmand, M.R. 1979, *Macroeconomics: Theory and Policy*, Prentice-Hall, Englewood Cliffs, NJ.
- Edwards, G. 1990 'Regreening Australia: What rationale and what price?', *Agricultural Science*, March, 40-43.
- Edwards, G., Dumsday, R. and Chisholm, A. 1996a, 'Efficient use of Australia's land and water', *Search*, 27(6), 188-191.
- Edwards, G., Dumsday, R. and Chisholm, A. 1996b, 'Australia's land and water: policies that ensure they are used efficiently', *Search*, 27(7), 205-208.
- Edwards, K. 1988, 'How much soil loss is acceptable?' *Search*, 19(3), 136-140.
- Edwards, K. 1987, *Runoff and Soil Loss Studies in New South Wales*, Soil Conservation Service of NSW Technical Handbook No. 10, Sydney.
- Emery, G.C. 1991, Farm finance — new challenges, Paper presented to the South Queensland Rural Outlook Conference, Toowoomba, October.
- Environment Protection Authority of New South Wales 1993, *New South Wales State of the Environment 1993*, Environment Protection Authority of New South Wales, Sydney.
- Epps, W.R. and Crittenden, R. 1992, 'Appraisal of land degradation in Australia', *Land Use Policy*, July 9(3), 199-208.
- Ervin, D.E. and Mill, J.W. 1985, 'Agricultural land markets and soil erosion: policy relevance and conceptual issues' *American Journal of Agricultural Economics*, 67(3), 938-932.
- Ferdowsian, R., George, R., Lewis, F., McFarlane, D., Short, R. and Speed, R. 1996, 'The extent of dryland salinity in Western Australia', in *Proceedings of the 4th*
-

National Conference and Workshop on the Productive Use and Rehabilitation of Saline Lands, Albany, 25-30 March 1996, Promaco Conventions, Perth, 89-98.

Farley, R. 1994, 'President's message', *Australian Journal of Soil and Water Conservation*, 7(2), 2.

Ferrier, S. 1988, *Environmental Resource Mapping System (E-RMS): Users Manual for Version 1.2*, NSW National Parks and Wildlife Service, Sydney.

Fisher, P.F. 1991, 'Modelling soil map-unit inclusions by Monte Carlo simulation', *International Journal of Geographical Information Systems*, 5(3), 193-208.

Fisher, P.F. 1994, 'Visualisation of the reliability in classified remotely sensed images', *Photogrammetric Engineering and Remote Sensing*, 60(7), 905-910.

Fisher, P.F. and Langford, M. 1995, 'Modelling the errors in areal interpolation between zonal systems by Monte Carlo simulation', *Environment and Planning A*, 27(2), 211-224.

Fletcher, J.J. and Sietz, W.D. 1986, 'Information needs for conservation decisions', in *Conserving Soil: Insights from Socioeconomic Research*, eds. S.B. Lovejoy and T.L. Napier, SCS of America, Ankeny, Iowa, pp. 55-70.

Food and Agriculture Organisation 1976, *A Framework for Land Evaluation*, Soils Bulletin No. 32, FAO, Rome.

Food and Agriculture Organisation 1983, *Guidelines: Land Evaluation for Rainfed Agriculture*, Soils Bulletin No. 52 FAO, Rome.

Fox, G. and Dickson, E.J. 1988, *What's economic about the economic costs of soil erosion to Canadian farmers?*, Discussion Paper DP88/3, Department of Agricultural Economics and Business, University of Guelph, Guelph.

Freebairn, J. 1991, 'Land degradation', in *Markets, Resources and the Environment*, eds. A. Moran, A. Chisholm and M. Porter, Allen and Unwin, Melbourne, pp. 76-101.

-
- Fresco, L.O. and Kroonenberg, S.B. 1992, 'Time and spatial scales in ecological sustainability', *Land Use Policy*, 9(3), 155-168.
- Gardner, K. and Barrows, R. 1985, 'The impact of soil conservation investments on land prices', *American Journal of Agricultural Economics*, 67(3), 943-947.
- Goodchild, M.F. 1988, 'The issue of accuracy in global databases', in *Building Databases for Global Science*, ed. H. Mounsey and R. Tomlinson, Taylor and Francis, London, pp. 31-48.
- Graham, O.P. 1992, 'Survey of land degradation in New South Wales, Australia', *Environmental Management*, 16(2), 205-224.
- Graham, O.P. 1989, *Land Degradation Survey of New South Wales 1987-88: Methodology*, Soil Conservation Service Technical Report No. 7, Sydney.
- Greene, W.H. 1990, *Econometric Analysis*, Macmillan Publishing Company, New York.
- Gretton, P. and Salma, U. 1996, *Land Degradation and the Australian Agricultural Industry*, Industry Commission Staff Information Paper, AGPS, Canberra.
- Griffiths, W.E., Hill, R.C. and Judge, G.G. 1993, *Learning and Practicing Econometrics*, Wiley and Sons, New York.
- Hall, B. and Burgin, S. 1996, 'Potential problems associated with GIS for land resource assessment', *Australian Journal of Soil and Water Conservation*, 9(1), 4-9.
- Hall, N. and Hyberg, B. 1991, Effects of land degradation on farm output, Paper presented at the 35th Annual Agricultural Economics Society Conference, Armidale, February.
- Hamlett, J.M., Miller, D.A., Day, R.L., Peterson, G.W., Baumer, G.M. and Russo, J. 1992, 'Statewide GIS-based ranking of watersheds for agricultural pollution prevention', *Journal of Soil and Water Conservation*, 47(5), 399-404.

- Hartwick, J.M. 1977, 'Intergenerational equity and the investing of rents from exhaustible resources', *American Economic Review*, 67(5), 972-974.
- Hartwick, J.M. 1978, 'Exploitation of many deposits of an exhaustible resource', *Econometrica*, 46(3), 201-217.
- Heady, E.O. 1952, *Economics of Agricultural Production and Resource Use*, Prentice-Hall, Englewood Cliffs, NJ.
- Heady, E.O. and Dillon, J.L. 1961, *Agricultural Production Functions*, Iowa State University Press, Ames, Iowa.
- Hession, W.C. and Shanholtz, V.O. 1988, 'A geographic information system for targeting nonpoint source agricultural pollution', *Journal of Soil and Water Conservation*, 43(3), 264-266.
- Hitzhusen, F.J. 1993, 'Land degradation and sustainability of agricultural growth: some economic concepts and evidence from selected developing countries', *Agriculture, Ecosystems and Environment*, 46(1), 69-79.
- Hurni, H. 1995, 'Watershed management and sustainable development', in *Proceedings of the 8th International Soil Conservation Organisation Conference*, New Delhi, India December 4-8 1994.
- Hyberg, B., Graham, O. and Thorne, P. 1993, 'A methodology for assessing the costs of land use in New South Wales', *Australian Journal of Soil and Water Conservation*, 6(1), 31-34.
- Johnson, L.B. 1990, 'Analyzing spatial and temporal phenomena using geographical information systems', *Landscape Ecology*, 4(1), 31-43.
- Johnson, A.K.L., Cramb, R.A. 1991, 'Development of a simulation based land evaluation system using crop modelling, expert systems and risk analysis', *Soil Use and Management*, 7(4), 239-246.
- Johnson, A.K.L., Cramb, R.A. 1992., *An Integrated Approach to Agricultural Land Evaluation. Volume 4: Development of an Integrated Land Evaluation System Using*

Crop Yield Prediction, Expert Systems and Risk Analysis, Department of Agriculture, University of Queensland, Brisbane.

- Johnson, A.K.L., Cramb, R.A. 1996, 'Integrated land evaluation to generate risk-efficient land-use options in a coastal catchment', *Agricultural Systems*, 50(3), 287-305.
- Johnson, A.K.L., Cramb, R.A. and McAlpine, J.R. 1994, 'Integrated land evaluation as an aid to land use planning in northern Australia', *Journal of Environmental Management*, 40(2), 139-154.
- Johnson, A.K.L., Cramb, R.A. and Wegener, M.K. 1994, 'The use of crop yield prediction as a tool for land evaluation studies in northern Australia', *Agricultural Systems*, 46(1), 93-111.
- Junor, R.S., Marston, D. and Donaldson, S.G. 1979, *A Situation Statement of Soil Erosion in the Lower Namoi Area*, Soil Conservation Service of New South Wales, Sydney.
- Just, R.E. 1993, 'Discovering production and supply relationships: present status and future opportunities', *Review of Marketing and Agricultural Economics*, 61(1), 11-40.
- Kessell, S.R. 1990, 'An Australian geographical information and modelling system for natural area management', *International Journal of Geographical Information Systems*, 4(3), 333-362.
- King, D.A. and Sinden, J.A. 1988, 'Influence of soil conservation on farm land values', *Land Economics*, 64(3), 242-254.
- King, D.A. and Sinden, J.A. 1994, 'Price formulation in farm land markets', *Land Economics*, 70(1), 38-52.
- Kirby, M.G. and Blyth, M.J. 1987, 'Economic aspects of land degradation in Australia', *Australian Journal of Agricultural Economics*, 31(2), 154-174.

-
- Laut, P., Firth, D. and Paine, T.A. 1980, *Provisional Environmental Regions of Australia*, CSIRO, Canberra.
- Lefroy, E.C., Salerian, J. and Hobbs, R.J. 1993, 'Integrating economic and ecological considerations: A theoretical framework', in *Reintegrating Fragmented Landscapes: Towards Sustainable Production and Nature Conservation*, eds. R.J. Hobbs and D.A. Saunders, Springer-Verlag, New York, pp. 209-244.
- Lewis, J.N. 1967, 'The changing importance of land use as a factor of production in farming', Mimeographed paper Department of Agricultural Economics, University of New England.
- Logan, T.J., Urban, D.R., Adams, J.R. and Yaksich, S.M. 1987, 'Erosion control potential with conservation tillage in the Lake Erie Basin: estimates using the universal soil loss equation and the Land Resource Information System (LRIS)', in *Geographic Information Systems for Resource Management: A Compendium*, ed. W.J. Ripple, American Society for Photogrammetry and Remote Sensing, and American Congress on Surveying and Mapping, Falls Church, pp. 194-199.
- Lowes, D. and Bellamy, J.A. 1994, 'Orientation in a Spatial Decision Support System for Grazing Land Management', *AI Applications*, 8(3), 55-66.
- MacCallum, D.E. 1967, Soil erosion control and resource allocation, Paper presented at the 10th Annual Australian Agricultural Economics Society Conference, Armidale, February.
- McConnell, K.E. 1983, 'An economic model of soil conservation', *American Journal of Agricultural Economics*, 65(1), 83-89.
- McDonald, G.T. and Hundloe, T.J. 1993, 'Policies for a sustainable future', in *Land Degradation Processes in Australia*, eds. G.H. McTanish and W.C. Boughton, Longman Cheshire, Melbourne, pp. 345-383.
- McTanish, G.H. and Boughton, W.C. (eds.) 1993, *Land Degradation Processes in Australia*, Longman Cheshire, Melbourne.

- Mallawaarachchi, T., Walker, P.A., Young, M.D., Smyth, R.E., Lynch, H.S. and Dudgeon, G. 1996, 'GIS-based integrated modelling systems for natural resource management', *Agricultural Systems*, 50(3), 169-189.
- Malthus, T.R. 1798, *An Essay on Population*, (reprint of 6th ed. Ward, Lock and Company, London, 1826).
- Marshall, A. 1890, *Principles of Economics*. English Language Book Society and Macmillan (1961 reprint), London.
- Martin, P. and Woodhill, J. 1995, ' "Landcare in the balance": Government roles and policy issues in sustaining rural environments', *Australian Journal of Environmental Management*, 2(3), 173-183.
- Meeusen, W. van den Broeck, J. 1977, 'Efficiency estimation of Cobb-Douglas production functions with composed error', *International Economic Review*, 18(2), 435-444.
- Mellerowicz, K.T., Rees, H.W., Chow, T.L. and Ghanem, I. 1994, 'Soil conservation planning at the watershed level using the USLE with GIS and microcomputer technologies: a case study', *Journal of Soil and Water Conservation*, 49(2), 194-200.
- Mill, J. S. 1848, *Principles of Political Economy*, Longmans Green, London (1929 Edition).
- Miranowski, J.A. and Hammes, B.D. 1984, 'Implicit prices of soil characteristics for farmland in Iowa', *American Journal of Agricultural Economics*, 66(5), 745-749.
- Molnar, I. 1955, 'Effects of soil erosion on land values and production', *Journal of the Australian Institute of Agricultural Science*, 21(3), 163-166.
- Molnar, I. 1965, 'Production in relation to rainfall, superphosphate and erosion', *Australian Journal of Agricultural Economics*, 9(2), 169-175.
- Moran, A. Chisholm, A. and Porter M. (eds.) 1991, *Markets, Resources and the Environment*, Allen and Unwin, North Sydney.

-
- Morris, P., Wilks, L. and Wonder, B. (1992), 'Natural resource management: some economic and policy considerations', in *Natural Resource Management: An Economic Perspective*, ed. N. Wallace, Australian Bureau of Agricultural and Resource Economics, Canberra, pp. 3-31.
- Moxey, A.P. 1996, 'Geographical information systems and agricultural economics', *Journal of Agricultural Economics*, 47(1), 115-116.
- Moxey, A.P., White, B., Sanderson, J.A. and Rushton, S.P. 1995, 'An approach to linking an ecological vegetation model to an agricultural economic model', *Journal of Agricultural Economics*, 46(3), 381-397.
- Mues, C., Roper, H and Ockerby, J. 1994, *Survey of Landcare and Land Management Practices 1992-93*, ABARE Research Report 94.6, Canberra.
- Musgrave, W. and Pearse, R.A. 1985, 'Soil Management Policy in Australia: Institutions, Criteria and Socioeconomic Research', in *Soil Erosion Management*, eds. E.T. Craswell, J.V. Remeny and L.G. Nallana, proceedings of a workshop held at PCARRD, Los Banos Philippines 3-5 December 1984. ACIAR Proceedings Series No.6, pp 102- 14.
- Neff, D.L., Garcia, P. and Nelson, C.H. 1993, 'Technical efficiency: a comparison of production frontier methods', *Journal of Agricultural Economics*, 44(3), 479-489.
- Nelson, R.A. and Mues, C. 1993, *Survey of Landcare and Drought Management Practices 1991-92*, Land and Forestry Economics Section, ABARE, Canberra.
- Norton, B.G. 1995, 'Evaluating ecosystem states: two competing paradigms', *Ecological Economics*, 14(2), 113-127.
- Openshaw, S. 1989, 'Learning to live with errors in spatial databases', in *Accuracy of Spatial Databases*, eds. M.F. Goodchild and S. Gopal, Taylor and Francis, London, pp. 263-276.
- Oram, D. and Dumsday, R. 1994, 'Evaluating the benefits and costs of dryland salinity control at the farm level: a case study in the Campaspe Catchment', in *Procedures for*
-

-
- Economic Assessment of Management Options for Dryland Salinity: Report on a Workshop*, eds. A.A. Webb and R.J. Price, Land and Water Resources Research and Development Corporation Occasional Paper Series No. 6/94, Canberra.
- Palisade Corporation 1992, *@RISK Risk Analysis and Simulation Add-In for Microsoft Excel*, Palisade Corporation, New York.
- Palmquist, R.B. and Danielson, L.E. 1989, 'A hedonic study of the effects of erosion control and drainage on farmland values', *American Journal of Agricultural Economics*, 71(1), 55-62.
- Passmore, G. and Brown, C. 1991, 'Analysis of rangeland degradation using stochastic dynamic programming', *Australian Journal of Agricultural Economics*, 35(2), 131-157.
- Paterson, I. 1994, 'Storm clouds over landcare', *Australian Farm Journal*, August, 14-17.
- Pearce, D.W., Barbier, E. and Markandya, A. 1990, *Sustainable Development: Economics and Environment in the Third World*, Earthscan Publications, London.
- Peterson, D. 1996, 'Taxation and the landcare program', in *Taxation and the Environment*, Environmental Economics Seminar Series, Department of the Environment, Sport and Territories, AGPS, Canberra, pp. 23-30.
- Pickup, G. and Stafford-Smith, D.M. 1993, 'Problems, prospects and procedures for assessing the sustainability of pastoral land management in arid Australia', *Journal of Biogeography*, 20(5), 471-487.
- Pope III, C.A., Bhide, S. and Heady, E.O. 1983, 'The economics of soil conservation: an optimal control theory approach', *North Central Journal of Agricultural Economics*, 5(2), 83-89.
- Pressey, R.L. and Ferrier, S. 1994, 'Adapting a GIS for interactive conservation planning', *Tropical Forest Update*, 4(3), 3-5.

- Price, P. 1993, 'Resource base: the nation's vital asset', *Agricultural Science*, 6(6), 42-45.
- Prime Minister's Science and Engineering Council 1995, *Sustaining the Agricultural Resource Base*, Department of the Prime Minister and Cabinet, AGPS, Canberra.
- Quiggin, J. 1986, Failures and imperfections in policy analysis: the case of land degradation, Paper presented to the 30th Annual Australian Agricultural Economics Society Conference, Canberra, February.
- Quiggin, J. 1987, 'Land degradation: behavioural causes', in *Land Degradation: Problems and Policies*, eds. A.H. Chisholm and R.G. Dumsday, Cambridge University Press, Sydney, pp. 203-212.
- Randall, A. 1994, Making sense of sustainability, Paper presented at the 38th Annual Australian Agricultural Economics Society Conference, Wellington, February.
- Reeve, I. 1988, *A Squandered Land*, The Rural Development Centre, University of New England, Armidale.
- Reid, R.E. 1992, 'A review of agricultural land evaluation', in *Proceedings of the 5th Australian Soil Conservation Conference, Vol 2, Land Capability Assessment Workshop*, eds. G.J. Hamilton, K.M. Howes and R. Attwater, Department of Agriculture, Perth, pp. 63-66.
- Ricardo, D. 1817, *The Principles of Political Economy and Taxation*, (Everyman ed., London, 1926).
- Roberts, B.R. 1995, *The Quest for Sustainable Agriculture and Land Use*, UNSW Press, Sydney.
- Roberts, B.R. 1992, *Land Care Manual*, UNSW Press, Sydney.
- Rosewell, C.J. and Edwards, K. 1988, *Soilloss*, Technical Handbook No. 11, Soil Conservation Service of New South Wales, Sydney.

-
- Rossiter, D.G. 1990, 'ALES: a framework for land evaluation using a microcomputer', *Soil Use and Management*, 6(1), 7-20.
- Schapper, H. 1990, 'Challenge to national land conservation policy', *Australian Journal of Soil and Water Conservation*, 3(2), 4-8.
- Schultz, T.W. 1953, *The Economic Organisation of Agriculture*, McGraw-Hill, New York.
- Scott, D. 1991, *1991 State of the Environment Report. Agriculture and Victoria's Environment: Resource Report*, Office of the Commissioner for the Environment, Government of Victoria, Melbourne.
- Sefir-Younis, A. and Dragun, A. 1993, *Land and Soil Management: Technology, Economics and Institutions*, Westview Press, Boulder.
- Sengupta, J.K. 1989, *Efficiency Analysis by Production Functions: the Non-Parametric Approach*, Theory and Decision Library, Series B, Mathematical and Statistical Methods, Kluwer, Dordrecht.
- Simmons, P. 1992, 'Soil management: private versus public interest', in *Natural Resource Management: An Economic Perspective*, ed. N. Wallace, Australian Bureau of Agricultural and Resource Economics, Canberra, pp. 136-149.
- Sinden, J.A. and Thampapillai, D. 1995, *Introduction to Benefit-Cost Analysis*, Longman, Melbourne.
- Sinden, J.A. and King, D.A. 1990, 'Adoption of Soil Conservation Measures in Manilla Shire, New South Wales', *Review of Marketing and Agricultural Economics*, 58(2, 3), 179-192.
- Sinden, J.A. and T.P. Yapp 1987, 'The opportunity costs of land degradation in New South Wales: a case study', Paper presented to the 31st Annual Australian Agricultural Economics Society Conference, Adelaide, February.
- Sinden, J.A., Sutas, A.R. and Yapp, T.P. 1990, 'Damage costs of land degradation: an Australian perspective', in *Dryland Management: Economic Case Studies*, eds. J.A.
-

- Dixon, D.E. James and P.B. Sherman, Earthscan Publications, London, pp 282-294.
- Soil Conservation Service of New South Wales 1989, *Land Degradation Survey New South Wales 1987-88*, Soil Conservation Service, Sydney.
- Solow, R.M. 1974, 'Intergenerational equity and exhaustible resources', *Review of Economic Studies: Symposium on the Economics of Exhaustible Resources*, 41, 29-45.
- Solow, R.M. 1986, 'On the intertemporal allocation of natural resources', *Scandinavian Journal of Economics*, 88(1), 141-149.
- Solow, R.M. 1993, 'Sustainability: an economist's perspective', in *Economics of the Environment: Selected Readings*, eds. R. Dorfman and N. Dorfman, W.W. Norton and Company, New York, pp 354-370.
- Sonter, R.O. 1991, 'Soils and land use', in *Soils: Their Properties and Management*, eds. P.E.V. Charman and B.W. Murphy, Sydney University Press, Soil Conservation Service, Sydney, pp. 217-226.
- Standing Committee on Agriculture 1991, *Sustainable Agriculture*, Report of the Working Group on Sustainable Agriculture, SCA Technical Report Series - No. 36, CSIRO, East Melbourne.
- Standing Committee on Agriculture and Resource Management 1993, *Sustainable Agriculture: Tracking the Indicators for Australia and New Zealand*, SCARM Report No. 51, CSIRO, East Melbourne.
- Stocking, M. 1993, 'The rapid appraisal of physical properties affecting land degradation', in *Environment Users Scholars: Exploring Interfaces*, eds. C. Christinasson, A. Dahlberg, V-M. Loiske, and W. Östberg, Environment and Development Studies Unit, Stockholm University, Stockholm, pp. 20-23.
- Stone, E., Andriotis, A. and Chamley W. 1994, *Commonwealth Grants Allocation to the States for Resource Conservation Programs 1977-78 to 1993-94*, Department of Conservation and Natural Resources Strategic Planning and Research Division,

- Discussion Paper No. 1, Department of Conservation and Natural Resources, Melbourne.
- Thackway, R. and Cresswell, I.E. (eds.) 1995, *An Interim Biogeographic Regionalisation for Australia: a Framework for Establishing the National System of Reserves*, Australian Nature Conservation Agency, Canberra.
- Thampapillai, D.J. and Anderson, J.R. 1994, 'A review of the socio-economic analysis of soil degradation problems for developed and developing countries', *Review of Marketing and Agricultural Economics*, 62(2), 291-315.
- Turner, B. 1994, 'What is a geographic information system?' *Tropical Forest Update*, 4(3), 2.
- Turner, G.W. and Ruffio, R.M.C. 1993, 'Environmental auditing for nonpoint source pollution control in a region of New South Wales (Australia)', *Water Science Technology*, 28(3-5), 301-309.
- Turner, R.K. and Pearce, D.W. 1993, 'Sustainable economic development: economic and ethical principles', in *Economics and Ecology: New Frontiers and Sustainable Development*, ed. E.B. Barbier, Chapman and Hall, London, pp. 177-194.
- Turvey, C.G. and Lowenberg-DeBoer J. 1988, 'Farm-to-farm productivity differences and whole-farm production functions', *Canadian Journal of Agricultural Economics*, 36(2), 295-312.
- Upstill, G. and Yapp, T. 1988, 'Offsite cost of land degradation', in *Land Degradation: Problems and Policies*, eds. A.H. Chisholm and R.G. Dumsday, Cambridge University Press, Sydney, pp. 99-116.
- Upton, M. 1976, *Agricultural Production Economics and Resource Use*, Oxford University Press, London.
- Upton, M. 1979, 'The unproductive production function', *Journal of Agricultural Economics*, 30(2), 179-191.
- Uren, N. 1992, 'Sense and nonsense about soil degradation', *Policy*, Winter 27-30.

-
- van de Graaff, R.H.M. 1988, 'Land evaluation', in *Australian Soil and Land Survey Handbook: Guidelines for Conducting Surveys*, eds. R.H. Gunn, J.A. Beattie, R.E. Reid and R.H.M. van de Graaff, Inkata Press, Melbourne, pp. 258-281.
- van Vuuren, W. and Fox, G. 1989, 'Estimating the costs of soil erosion: a comment', *Canadian Journal of Agricultural Economics*, 37(3), 549-553.
- Walpole, S.C. 1994, 'Estimation of regional, local and site-specific profitability of soil conservation for the wheat-sheep zone of New South Wales, Australia', *Journal of Environmental Management*, 41(4), 349-364.
- Walpole, S.C. 1995, 'Integration of economic and bio-physical information to assess the site-specific profitability of land management programs using a geographical information system', in *Proceedings of the 8th International Soil Conservation Organisation Conference*, New Delhi, India December 4-8 1994.
- Walpole, S.C. and Sinden, J.A. 'ECA and GIS: Integration of economic and environmental indicators to aid land management decisions', *Ecological Economics* (in press).
- Walpole, S.C., Sinden, J.A. and Yapp, T.P. 1992, *The Opportunity Cost of Land Degradation on Agriculture in New South Wales*, Department of Agricultural and Resource Economics, University of New England, Armidale.
- Walpole, S.C., Sinden, J.A. and Yapp, T.P. 1994, 'The Opportunity Cost of Land Degradation on Agriculture in New South Wales', in *Procedures for Economic Assessment of Management Options for Dryland Salinity*, eds. A. A. Webb and R.J. Price, Occasional Paper 06/94, National Dryland Salinity R, D & E Program, LWRRDC, Canberra, pp 12-13.
- Walpole, S.C., Sinden, J.A. and Yapp, T.P. 1996, 'Land quality as an input to production: the case of land degradation and agricultural output', *Economic Analysis and Policy*, 26(2), 185-207.
- Watt, L.A. 1990, 'Effect of soil erosion on productivity — a review of experimental results', *Australian Journal of Soil and Water Conservation*, 3(2), 50-52.
-

-
- White, K.J. 1993, *SHAZAM Users Reference Manual Version 7.0*, McGraw-Hill, Vancouver.
- Woods, L.E. 1984, *Land Degradation in Australia*, Australian Government Printing Service, Canberra.
- World Commission on Environment and Development 1987, *Our Common Future*, Australian Edition, Oxford University Press, Melbourne.
- Yapp, T.P. and J.A. Sinden 1992, 'The economic impact of land degradation — issues, estimates and policy implications', in *Proceedings of the Seventh International Soil Conservation Organisation Conference, Volume 2*, International Soil Conservation Organisation, Sydney, pp. 509-517.
- Yapp, T.P., Sinden, J.A. and Walpole, S.C. 1992, 'Soil conservation and land degradation - finding the balance' *Search*, 23 (10),308-10.
- Young, M.D. 1992, *Sustainable Investment and Resource Use*, Man and the Biosphere Series, Volume 9, UNESCO, Paris., and The Parthenon Publishing Group.
- Young, M.D. 1993, *For Our Children's Children: Some Practical Implications of Inter-Generational Equity, the Precautionary Principle, Maintenance of Natural Capital, and the Discount Rate*, Working Document 93/5, CSIRO, Canberra.
- Young, M.D., Walker, P. Mallawaarachchi, T. and Smyth, R. 1995. 'National and GIS-based regional resource accounting in Australia', in *Integrating Economic and Ecological Indicators: Practical Methods for Environmental Policy Analysis*, eds. J.W. Milton and J.F. Shogren, Praeger, Westport, pp. 169-179.
- Zhao, F., Hitzhusen, F. and Chern, W.S. 1991, 'Impact and implication of price policy and land degradation on agricultural growth in developing countries', *Agricultural Economics*, 5(3), 311-324.

Appendix 1

Publications arising from research work that was undertaken during the candidature of the degree, and percentage contribution by the senior author, where a co-authorship occurs.

- Walpole, S.C. 1994, 'Estimation of regional, local and site-specific profitability of soil conservation for the wheat-sheep zone of New South Wales, Australia', *Journal of Environmental Management*, 41(4), 349-364.
- Walpole, S.C. 1995, 'Integration of economic and bio-physical information to assess the site-specific profitability of land management programs using a geographical information system', in *Proceedings of the 8th International Soil Conservation Organisation Conference*, New Delhi, India December 4-8 1994.
- Walpole, S.C. and Sinden, J.A. 'BCA and GIS: Integration of economic and environmental indicators to aid land management decisions', *Ecological Economics* (in press). (90%)
- Walpole, S.C., Sinden, J.A. and Yap, T.P. 1996, 'Land quality as an input to production: the case of land degradation and agricultural output', *Economic Analysis and Policy*, 26(2), 185-207. (80%).

Appendix 2

Local Government Areas in rural New South Wales

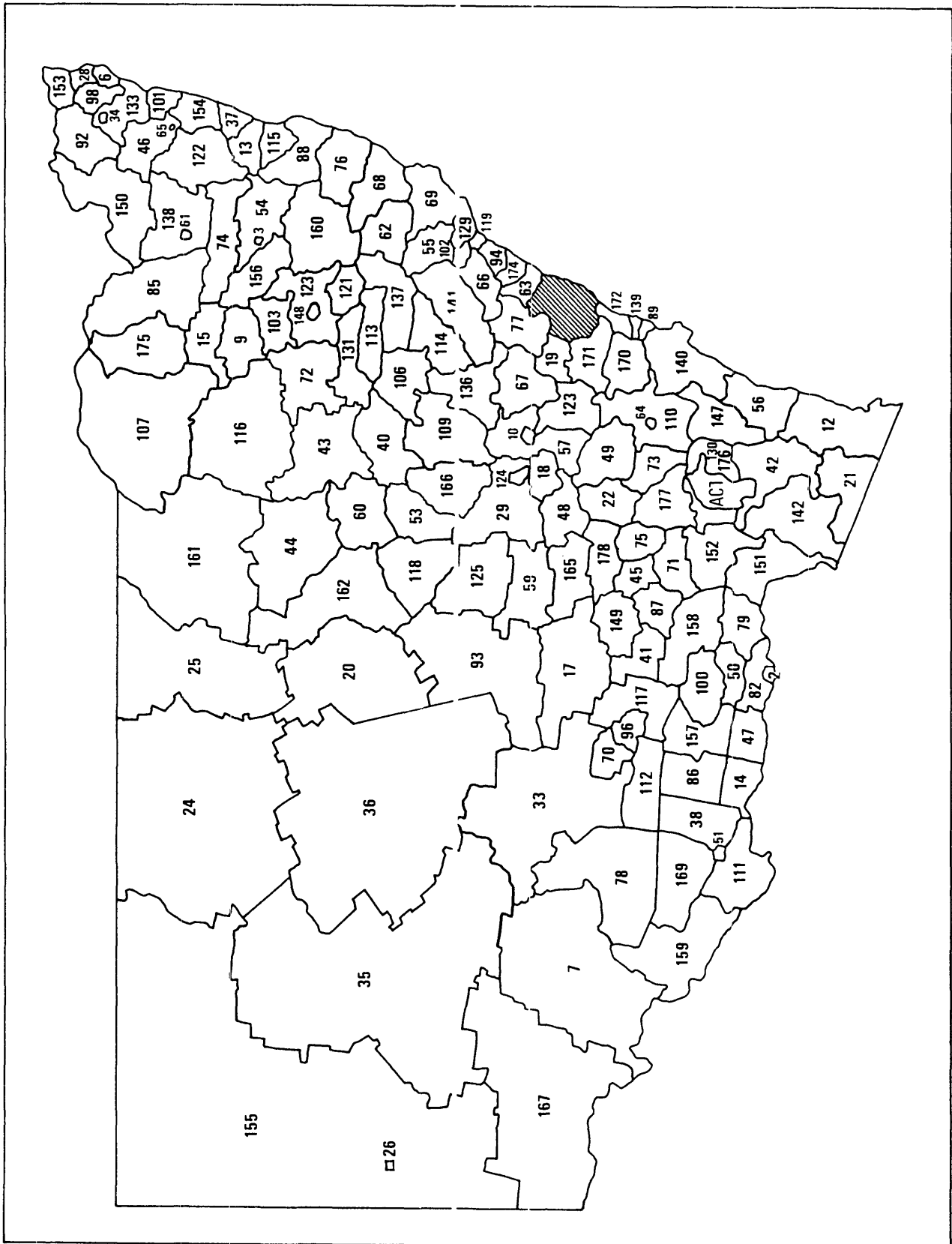


Figure A 2.1
Local Government Areas in rural New South Wales

Key for Local Government Areas shown in Figure A2.1

2	Albury (C)	48	Cowra (S)
3	Armidale (C)	49	Crookwell (S)
6	Ballina (S)	50	Culcairn (S)
7	Balranald (S)	51	Deniliquin (M)
9	Barraba (S)	53	Dubbo (C)
10	Bathurst (C)	54	Dumaresq (S)
12	Bega Valley (S)	55	Dungog (S)
13	Bellingen (S)	56	Eurobodalla (S)
14	Berrigan (S)	57	Evans (S)
15	Bingara (S)	59	Forbes (S)
17	Bland (S)	60	Gilgandra (S)
18	Blayney (S)	61	Glenn Innes (M)
20	Bogan (S)	62	Gloucester (S)
21	Bombala (S)	63	Gosford (C)
22	Boorowa (S)	64	Goulburn (C)
24	Bourke (S)	65	Grafton (C)
25	Brewarrina (S)	66	Greater Cessnock (C)
26	Broken Hill (C)	67	Greater Lithgow (C)
28	Byron (S)	68	Greater Taree (C)
29	Cabbone (S)	69	Great Lakes (S)
33	Carrathool (S)	70	Griffith (S)
34	Casino (M)	71	Gundagai (S)
35	Central Darling (S)	72	Gunnedah (S)
36	Cobar (S)	73	Gunning (S)
37	Coff's Harbour (C)	74	Guyra (S)
38	Conargo (S)	75	Harden (S)
40	Coolah (S)	76	Hastings (M)
41	Coolamon (S)	78	Hay (S)
42	Cooma-Monaro (S)	79	Holbrook (S)
43	Coonabarabran (S)	82	Hume (S)
44	Coonamble (S)	85	Inverell (S)
45	Cootamundra (S)	86	Jerilderie (S)
46	Copmanhurst (S)	87	Junee (S)
47	Corowa (S)	88	Kempsey (S)

89	Kiama (S)	139	Shellharbour (M)
92	Kyogle (S)	140	Shoalhaven (C)
93	Lachlan (S)	141	Singleton (S)
94	Lake Macquarie (C)	142	Snowy River (S)
96	Leeton (S)	147	Tallaganda (S)
98	Lismore (M)	148	Tamworth (C)
100	Lockhart (S)	149	Temora (S)
101	Macleay (S)	150	Tenterfield (S)
102	Maitland (C)	151	Tumbarumba (S)
103	Manilla (S)	152	Tumut (S)
106	Merriwa (S)	153	Tweed (S)
107	Moree Plains (S)	154	Ulmarra (S)
109	Mudgee (S)	155	Unincorp Far West (U)
110	Mulwaree (S)	156	Uralla (S)
111	Murray (S)	157	Urana (S)
112	Murrumbidgee (S)	158	Wagga (C)
113	Murrurundi (S)	159	Wakool (S)
114	Muswellbrook (S)	160	Walcha (S)
115	Nambucca (S)	161	Walgett (S)
116	Narrabri (S)	162	Warren (S)
117	Narrandera (S)	165	Weddin (S)
118	Narromine (S)	166	Wellington (S)
119	Newcastle (C)	167	Wentworth (S)
121	Nundle (S)	169	Windouran (S)
122	Nyaboidia (S)	170	Wingecarribee (S)
123	Oberon (S)	172	Wollongong (C)
124	Orange (C)	175	Yallaroi (S)
125	Parkes (S)	176	Yarrowlumla (S)
127	Parry (S)	177	Yass (S)
129	Port Stevens (S)	178	Young (S)
130	Queanbeyan (C)		
131	Quirindi (S)		S - Shire
133	Richmond River (S)		M - Municipality
136	Rylstone (S)		C - City
137	Scone (S)		U - Unincorporated
138	Severn (S)		

Appendix 3

Descriptions of Agro-ecological zones specified for the regional analysis

Zone ^a	Description
Temperate semi-arid slopes and plains (Zone 1)	This is a diverse region which encompasses the heartland of Australian agriculture. It is the southern wheat/sheep/cattle belt which extends from the eastern highlands onto the riverina plainlands of the Murray-Darling across the Mallee to the Eyre Peninsula and to the south-west of Western Australia. The climate is dry with hot summers, cool winters and a winter dominant rainfall. The natural vegetation of eucalypt, casuarina and acacia woodland and forest along with chenopod mixed and acacia shrubland has been widely cleared for cereal cultivation and temperate pastures. Throughout the eastern region, irrigation farming and horticulture is very important, particularly in the Murray, Murrumbidgee and Goulburn Rivers.
Temperate highlands (Zone 2)	This region encompasses the high rainfall mountainous areas of NSW and Victoria. Much of the region is about 1500 metres with peaks rising above 2000 metres. It is one of the better watered regions of Australia and on the lower country eucalypt forest cover the rugged terrain. On the alpine country, which is snow covered in winter, the eucalypt forest gives way to woodland with an understorey of tussock grasses. The region also contains a narrow area of rolling land bordering the coast. Considerable areas of forest have been modified by forestry and fire. The rolling lands and tablelands have been largely cleared of the eucalypt woodland and forest replaced with temperate pasture species. The coastal environments feature low beach ridges backed by shallow swampland, small estuaries and in some instances large estuarine lakes as in Gippsland. The climate is wet and cold in winter and hot and dry in summer. The large variation in altitude and proximity to coastal influences, generates a considerable diversity in this region. The grazing of sheep and cattle on developed temperate pastures for wool, lamb, beef and dairy products dominate the agriculture. Forestry, water resources and tourism are very important land uses in the region.
Sub-tropical highlands (Zone 3)	This region consists of rolling, undulating and hilly country between the coastal ranges and the inland slopes and plains of northern NSW and southern Queensland. The climate is moist and cool with a generally uniform rainfall distribution in the south which becomes summer dominant in the north. The southern and eastern margins are strongly dissected with significant wilderness areas. Elsewhere the eucalypt forests and woodlands have been cleared and replaced with exotic pasture species for intensive livestock grazing of both sheep and cattle. In the Hunter and Peel River valleys irrigated agriculture and horticulture are important although the mining of coal is a significant competing land use.

^aEach of these zones overlaps with adjoining states

Source: Ecologically Sustainable Development Working Group (1991).

Appendix 4

Landholder survey

**CONFIDENTIAL
LANDHOLDER SURVEY**

This survey is being undertaken by Sandra Walpole of the Department of Agricultural and Resource Economics and the Department of Ecosystem Management, University of New England, as part of her PhD project. The purpose of the survey is to obtain land management data at the paddock or farm level. This information will then be used to determine the effect of soil erosion on agricultural output, and the likely profitability of conservation projects. The survey is completely anonymous.

1. Please indicate (tick) the overall level of sheet and rill erosion on your property:

cropping pasture

- a) no appreciable erosion _____
- b) minor _____
- c) moderate _____
- d) severe _____
- e) very severe _____

2. Have you undertaken any of the following management practices in the past year? If so, please describe the land management practices carried out.

Management type	Brief description of management practices	Cost (\$)	Privately funded (%)	Agency or landcare funded (%)
Whole farm planning				
Soil conservation works				
Tree planting				
Pasture management/ improvement				
Cropping/tillage practices				
Fencing				
Total expenditure				

3. What prompted you to undertake the land management practices?(tick)

- a) losses in productivity _____
- b) erosion problems _____
- c) landcare group initiative _____
- d) tax deductions _____
- e) government grant _____
- f) other (please specify) _____

4. Were you aware whether the projects would be profitable or unprofitable before they were undertaken?

Yes/No/Partly _____

5. Would information on the profitability of site-specific land management projects have influenced your decision to undertake such projects?

Yes/No/Maybe _____

6. What conservation works are still required on your property?

7. Farm inputs and outputs in 1992/93

- a) Area of property (ha) _____
- b) Tonnes of grain produced _____

- d) Gross value of grain produced _____

- c) Number of head of stock _____

- e) Gross value of stock sold _____

- f) Carrying capacity (d.s.e.) _____

- g) Fertiliser applied (T or \$) _____

- h) Chemicals applied (L or \$) _____

i) Labour (no.) _____

j) other important inputs _____

8. What proportion of the land was used for

a) cropping _____

b) pasture _____

c) trees/woodland _____

9. Have you perceived any changes in overall farm output due to soil erosion and subsequent soil conservation measures? _____

10. Has the property/paddock recently been purchased? Year _____

11. Is the property/paddock likely to be sold in the near future? Y/N _____

12. Have there been any significant changes in land use on your property in the past five years? If yes, please describe them _____

13. Are you a member of a landcare group? If so, please name the group

Thank-you for your time and co-operation.

Appendix 5

Maps of bio-physical and land management data produced from the GIS data

Scale 1:91064

- red earths/red brown earths
- black earths
- skeletal soils
- disturbed soils
- gravelly solodics
- gravelly red earths
- euchrozems
- no suitable group
- Farm boundaries

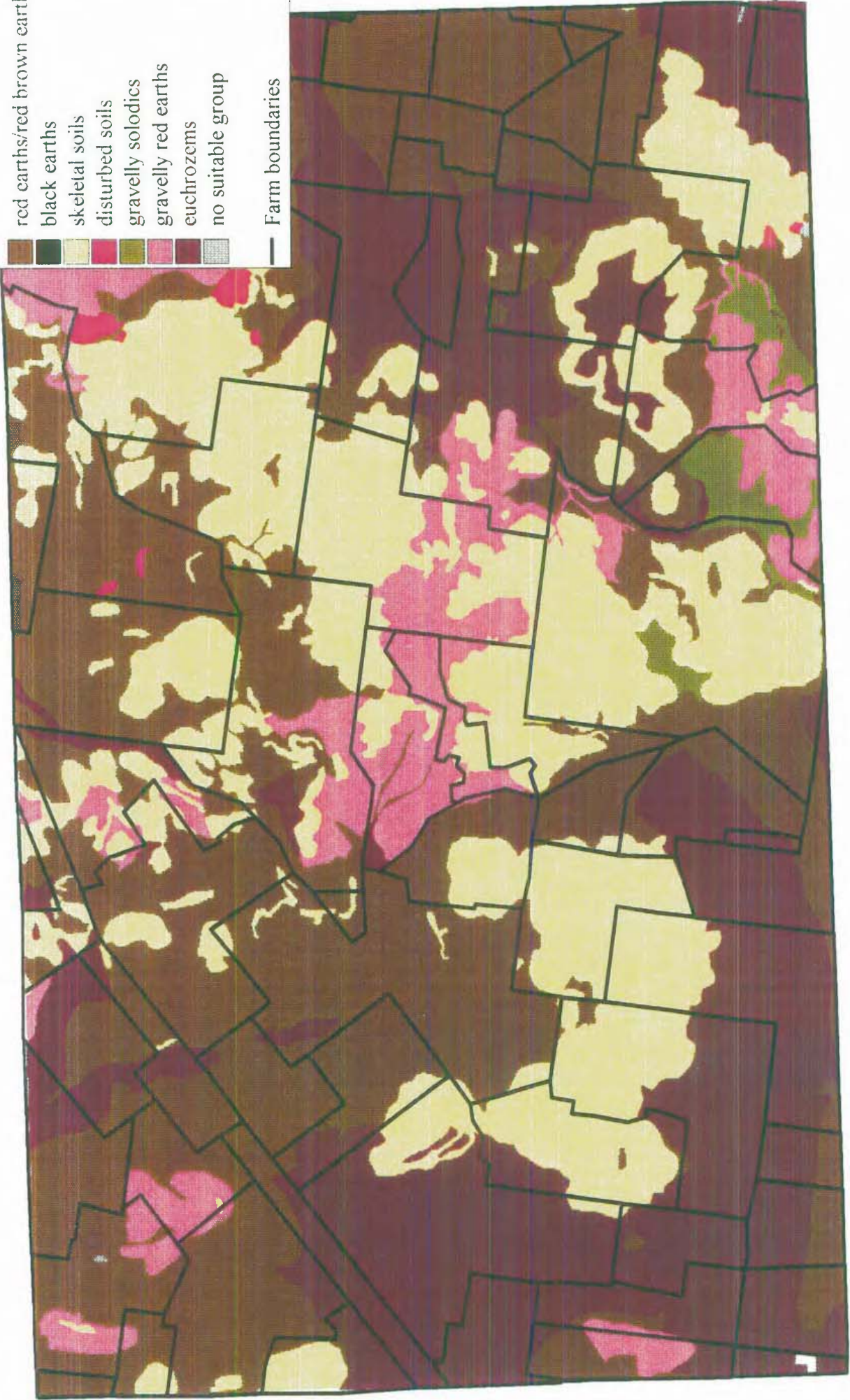


Figure A 5.1

Soil types in the farm survey area

Scale 1:91064

- no soil cons
- soil cons no additional
- soil cons additional
- Farm boundaries



Figure A 5.2
Soil conservation status classification in the farm survey area

Scale 1:91064

- level to very gently inclined
- gently undulating
- undulating
- rolling
- hilly
- mountainous
- precipitous
- Farm boundaries

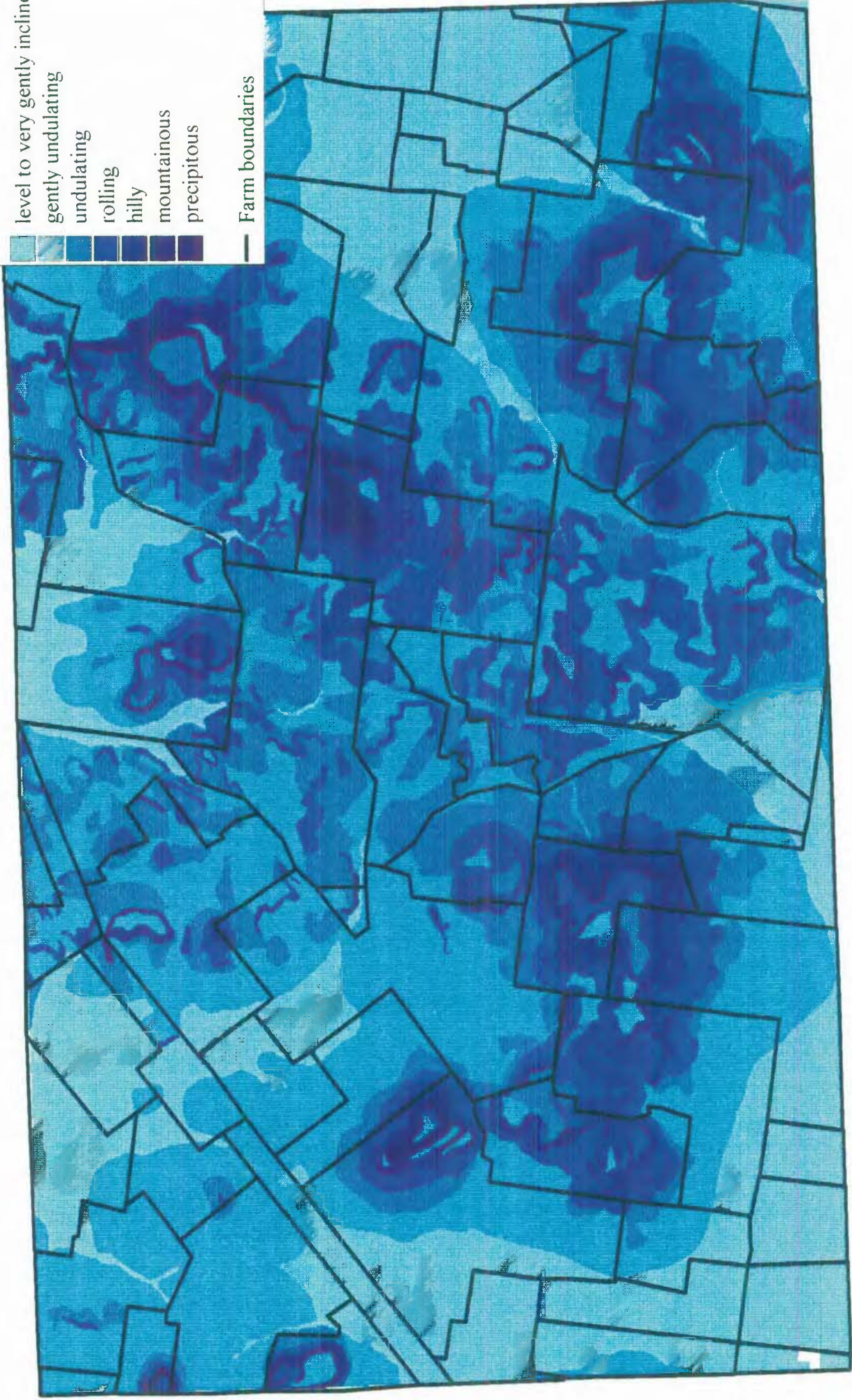


Figure A 5.3

Slope classes in the farm survey area

Scale 1:91064

- dry scl or wland und noreg
- native pine und noreg
- road reserves noreg
- native scat timber noreg
- native mat trees clumps noreg
- no mature trees noreg
- dry scl or wland und reg
- native pine und reg
- road reserves reg
- native scattered timber reg
- native mat trees clumps reg
- no mature trees reg
- Farm boundaries



Figure A 5.4
Timber classes in the farm survey area