References

Abate, T., van Huis, A., Ampofo, J.K.O., 2000. Pest management strategies in traditional agriculture: An African perspective. Annual Review of Entomology 45, 631-659.

Abeyasekera, S., 2001. Analysis approaches in participatory work involving ranks or scores. Statistical Guides Series. Statistical Services Centre, University of Reading, Reading. Available online: https://www.reading.ac.uk/SSC/media/RUFORUM_DVD_2009-Aug/documents/Stats_Guides/ras.pdf (Accessed: 10/11/2012).

Admassu, B., Nega, S., Haile, T.A., Abera, B., Hussein, A., Catley, A., 2004. Impact assessment of a community-based animal health project in Dollo Ado and Dollo Bay districts, southern Ethiopia. Tropical Animal Health and Production 37, 33-48.

Altieri, M.A., Nicholls, C.I., 2004. Biodiversity and pest management in agroecosystems. Food Products Press, New York.

Amudavi, D., Khan, Z., Pickett, J., 2007. Enhancing the push-pull strategy. LEISA Magazine 23, 8-10.

Amudavi, D.M., Khan, Z.R., Wanyama, J.M., Midega, C.A.O., Pittchar, J., Hassanali, A., Pickett, J.A., 2009a. Evaluation of farmers' field days as a dissemination tool for push-pull technology in Western Kenya. Crop Protection 28, 225-235.

Amudavi, D.M., Khan, Z.R., Wanyama, J.M., Midega, C.A.O., Pittchar, J., Nyangau, I.M., Hassanali, A., Pickett, J.A., 2009b. Assessment of technical efficiency of farmer teachers in the uptake and dissemination of push-pull technology in Western Kenya. Crop Protection 28, 987-996.

Armitage, R.M., Hurly, K.M., Gillitt, C.G., 2009. Enhancing support measures to small scale growers and new freehold growers in the South African sugar industry. Proceedings of the South African Sugar Technologists' Association 82, 354-369.

Assefa, Y., Conlong, D.E., Mitchell, A., 2006. Status of *Eldana saccharina* (Lepidoptera: Pyralidae), its host plants and natural enemies in Ethiopia. Bulletin of Entomological Research 96, 497-504.

Assefa, Y., van den Berg, J., Conlong, D.E., 2008. Farmers' perceptions of sugarcane stem borers and farm management practices in the Amhara region of Ethiopia. International Journal of Pest Management 54, 219-226.

Assefa, Y., Van den Berg, J., Mitchell, A., Le Rü, B.P., Conlong, D.E., 2009. Record of *Eldana saccharina* Walker (Lep., Pyralidae) in inland South Africa and its genetic relationship with the coastal population. Journal of Applied Entomology 133, 449-455.

Assefa, Y., Conlong, D.E., van den Berg, J., Mitchell, A., 2010. Distribution of sugarcane stem borers and their natural enemies in small-scale farmers' fields, adjacent margins and wetlands of Ethiopia. International Journal of Pest Management 56, 233-241.

Assefa, Y., Conlong, D.E., Van den Berg, J., Le Ru, B.P., 2008. The wider distribution of *Eldana saccharina* (Lepidoptera: Pyralidae) in South Africa and its potential risk to maize production. Proceedings of the International Society of Sugar Cane Technologists 81, 290-297.

Atachi, P., Sekloka, E. T., Schulthess, F., 2005. Study on some bioecological aspects of *Eldana saccharina* Walker (Lep., Pyralidae) on *Zea mays* L. and alternative host plants. Journal of Applied Entomology 129, 447-455.

Atkinson, P.R., 1979. Distribution and natural hosts of *Eldana saccharina* Walker in Natal, its oviposition sites and feeding patterns. Proceedings of the South African Sugar Technologists' Association 53, 111-115.

Atkinson, P.R., 1980. On the biology, distribution and natural host-plants of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Journal of the Entomological Society of Southern Africa 43, 171-194.

Atkinson, P.R., Carnegie, A.J.M., Smaill, R.J., 1981. A history of the outbreaks of *Eldana saccharina* Walker, in Natal. Proceedings of the South African Sugar Technologists' Association 55, 111-115.

Atkinson, P.R., 1982. Phenology of *Eldana saccharina* Walker in Natal, and use of light traps to monitor distribution and abundance. Proceedings of the South African Sugar Technologists' Association 56, 90-94.

Babbie, E., 2010. The practice of social research. Wadsworth, Cengage Learning, Belmont.

Barker, A.L., Conlong, D.E., Byrne, M.J., 2006. Habitat management using *Melinis minutiflora* (Poaceae) to decrease the infestation of sugarcane by *Eldana saccharina* (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 80, 226-235.

Barker, A.L., 2008. Habitat management using stimulo-deterrent diversion techniques to decrease infestation of sugarcane by *Eldana saccharina* Walker (Lepidoptera: Pyralidae), Unpublished MSc Thesis. APES, University of the Witwatersrand, Johannesburg.

Bates, R., Sokhela, P., 2003. The development of small-scale sugarcane growers: a success story?, In: Niewoudt, L., Groenewald, J. (Eds.), The challenge of change: agriculture, land and the South African economy. University of Natal Press, Scottsville, pp. 105-118.

Baumgart-Getz, A., Prokopy, L.S., Floress, K., 2012. Why farmers adopt best management practice in the United States: A meta-analysis of the adoption literature. Journal of Environmental Management 96, 17-25.

Bazeley, P., 2003. Computerized data analysis for mixed methods research, In: Tashakkori, A., Teddlie, C. (Eds.), Handbook of mixed methods in social and behavioural research. Sage Publications, Inc., Thousand Oaks, pp. 385-422.

Bernays, E.A., Chapman, R.F., 1994. Host-plant selection by phytophagous insects. Chapman and Hall, New York.

Berry, S.D., Leslie, G.W., Spaull, V.W., Cadet, P., 2010. Within-field damage and distribution patterns of the stalk borer, *Eldana saccharina* (Lepidoptera: Pyralidae), in sugarcane and a comparison with nematode damage. Bulletin of Entomological Research 100, 373-385.

Bezuidenhout, C.N., Bodhanya, S., Sanjika, T., Sibomana, M., Boote, G.L.N., 2012. Network-analysis approaches to deal with causal complexity in a supply network. International Journal of Production Research 50, 1840-1849.

Bianchi, F.J.J.A., Booij, C.J.H., Tscharntke, T., 2006. Sustainable pest regulation in agricultural landscapes: a review on landscape composition, biodiversity and natural pest control. Proceedings of the Royal Society B: Biological Sciences 273, 1715-1727.

Björnsen Gurung, A., 2003. Insects – a mistake in God's creation? Tharu farmers' perception and knowledge of insects: A case study of Gobardiha Village Development Committee, Dang-Deukhuri, Nepal. Agriculture and Human Values 20, 337-370.

Blackwell, M.S.A., Pilgrim, E.S., 2011. Ecosystem services delivered by small-scale wetlands. Hydrological Sciences Journal 56, 1467-1484.

Bosque-Pérez, N.A., Mareck, J.H., 1991. Effect of the stem borer *Eldana saccharina* (Lepidoptera: Pyralidae) on the yield of maize. Bulletin of Entomological Research 81, 243-247.

Bosque-Pérez, N.A., Schulthess, F., 1998. Maize: West and Central Africa, In: Polaszek, A. (Ed.), African cereal stem borers: economic importance, taxonomy, natural enemies and control. CAB International, Wallingford, pp. 11-24.

Brauman, K.A., Daily, G.C., Duarte, T.K., Mooney, H.A., 2007. The nature and value of ecosystem services: an overview highlighting hydrologic services. Annual Review of Environment and Resources 32, 67-98.

Braun, A., Jiggins, J., Röling, N., van den Berg, H., Snijders, P., 2006. A Global survey and review of farmer field school experiences. International Livestock Research Institute (ILRI), Wageningen.

Brown, W.L., Eisner, T., Whittaker, R.H., 1970. Allomones and kairomones: transpecific chemical messengers. Bioscience 20, 21-22.

Bruce, T.J.A., Wadhams, L.J., Woodcock, C.M., 2005. Insect host location: a volatile situation. Trends in Plant Science 10, 269-274.

Campbell, P.L., Leslie, G.W., McFarlane, S.A., Berry, S.D., Rhodes, R., van Antwerpen, R., Rutherford, R.S., van Antwerpen, T., McElligott, D., Conlong, D.E., 2009. An investigation of IPM practices for pest control in sugarcane. Proceedings of the South African Sugar Technologists' Association 82, 618-622.

Campbell, P.L., Gillespie, W.A., Rhodes, R., Leslie, G.W., Phewa, F., Smit, M., 2010. Economic control of cynodon: a theoretical strategy for emerging sugarcane farmers. Proceedings of the South African Sugar Technologists' Association 83, 147-151.

Canegrowers, 2011. Report on the FIRCOP Survey Data Analysis: Canegrowers Internal Document G032. South African Canegrowers, Mount Edgecombe.

Carnegie, A.J.M., 1974. A recrudescence of the borer *Eldana saccharina* Walker (Lepidoptera: Pyralididae). Proceedings of the South African Sugar Technologists' Association 48, 107-110.

Carnegie, A.J.M., Leslie, G.W., Hindley, M.E.O., 1976. Incidence and spread of the borer *Eldana saccharina* Walker (Lepidoptera: Pyralididae). Proceedings of the South African Sugar Technologists' Association 50, 34-39.

Carnegie, A.J.M., Leslie, G.W., 1979. Attempts at the biological control of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 53, 116-119.

Carnegie, A.J.M., Smaill, R.J., 1980. The incidence of moth borers in South African sugarcane in the 1979/1980 season. Proceedings of the South African Sugar Technologists' Association 54, 154-157.

Carnegie, A.J.M., 1981. Combatting *Eldana saccharina* Walker: A progress report. Proceedings of the International Society of Sugar Cane Technologists 55, 116-119.

Carnegie, A.J.M., Leslie, G.W., 1990. *Eldana saccharina* (Lepidoptera: Pyralidae): ten years of light trapping. Proceedings of the South African Sugar Technologists' Association 64, 107-110.

Castillo, G.T., 1998. A social harvest reaped from a promise of springtime: user-responsive, participatory agricultural research in Asia, In: Röling, N.G., Wagemakers, M.A.E. (Eds.), Facilitating sustainable agriculture: participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press, Cambridge, pp. 191-214.

Chambers, R., Pacey, A., Thrupp, L., 1989. Farmer first: farmer innovation and agricultural research. Intermediate Technology Publications, London.

Chambers, R., 1994. The origins and practice of participatory rural appraisal. World Development 22, 953-969.

Chambers, R., 2002. Participatory workshops: a sourcebook of 21 sets of ideas and activities. Earthscan, London.

Chambers, R., 2008. Revolutions in development inquiry. Earthscan, London.

Chamier, J., Schachtschneider, K., Le Maitre, D.C., Ashton, P.J., Van Wilgen, B.W., 2012. Impacts of invasive alien plants on water quality, with particular emphasis on South Africa. Water SA 38, 346-356.

Clément, B., Proctor, M.C.F., 2009. Ecological dynamics I: Vegetation as bioindicator and dynamic community, In: Maltby, E., Barker, T. (Eds.), The wetlands handbook. Blackwell Publishing Ltd, Oxford.

Cochereau, P., 1982. Observations on the borer *Eldana saccharina* Walker (Lep.: Pyralidae) in maize and sugarcane in Ivory Coast. Proceedings of the South African Sugar Technologists' Association 56, 1-3.

Cockburn, J., Coetzee, H.C., Van den Berg, J., Conlong, D.E., 2012. Large-scale sugarcane farmers' knowledge and perceptions of *Eldana saccharina* Walker (Lepidoptera: Pyralidae) and push-pull. Proceedings of the South African Sugar Technologists' Association 85, 144-149.

Cohen, H., Yuval, B., 2000. Perimeter trapping strategy to reduce Mediterranean Fruit Fly (Diptera: Tephritidae) damage on different hosts species in Israel. Journal of Economic Entomology 93, 721-725.

Conlong, D.E., Hastings, H., 1984. Evaluation of egg parasitoids in the biological control of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 58, 168-172.

Conlong, D.E., 1990. A study of pest-parasitoid relationships in natural habitats: an aid towards the biological control of *Eldana saccharina* (Lepidoptera: Pyralidae) in sugarcane. Proceedings of the South African Sugar Technologists' Association 64, 111-115.

Conlong, D.E., 1994a. A review and perspectives for the biological control of the African sugarcane stalkborer *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Agriculture, Ecosystems & Environment 48, 9-17.

Conlong, D.E., 1994b. Host parasitoid interactions of *Eldana saccharina* (Lepidoptera: Pyralidae) in *Cyperus papyrus*, Unpublished PhD Thesis. Department of Zoology and Entomology, University of Natal, Pieternaritzburg.

Conlong, D.E., 1997a. Biological control of *Eldana saccharina* Walker in South African sugarcane: constraints identified from 15 years of research. Insect Science and its Application 17, 69-78.

Conlong, D.E., 1997b. *Eldana saccharina* (Lepidoptera: Pyralidae) in Africa: are there different biotypes? Proceedings of the South African Sugar Technologists' Association 71, 83.

Conlong, D.E., 2000. Indigenous African parasitoids of *Eldana saccharina* (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 74, 201-211.

Conlong, D.E., Kasl, B., 2000. Stimulo-deterrent diversion to decrease infestation in sugarcane by *Eldana saccharina* (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 74, 212-213.

Conlong, D.E., 2001. Biological control of indigenous African stemborers: what do we know? Insect Science and its Application 21, 267-274.

Conlong, D.E., Kasl, B., 2001. Stimulo-deterrent diversion of *Eldana saccharina* (Lep.: Pyralidae) and *Xanthopimpla stemmator* (Hymenoptera: Ichneumonidae) - preliminary results. Proceedings of the South African Sugar Technologists' Association 75, 180-182.

Conlong, D.E., Mugalula, A., 2001. *Eldana saccharina* (Lep: Pyralidae) and its parasitoids at Kinyara Sugar Works, Uganda. Proceedings of the South African Sugar Technologists Association 75, 183-185.

Conlong, D.E., Kasl, B., Byrne, M., 2007. Independent kids - or motherly moms? implications for integrated pest management of *Eldana saccharina* Walker (Lepidoptera: Pyralidae). Proceedings of the International Society of Sugar Cane Technologists 26, 787-796.

Conlong, D.E., Rutherford, R.S., 2009. Conventional and new biological and habitat interventions for integrated pest management systems: Review and case studies using *Eldana saccharina* Walker (Lepidoptera: Pyralidae), In: Peshin, R., Dhawan, A.K. (Eds.), Integrated pest management: innovation-development process. Springer Science+Business Media B.V., Dordrecht, pp. 241-260.

Conlong, D.E., Campbell, P.L., 2010. Integrated weed management for sugarcane field verges: *Melinis minutiflora* and *Cynodon dactylo*n encroachment. Proceedings of the South African Sugar Technologists' Association 83, 276-279.

Cook, S.M., Khan, Z.R., Pickett, J.A., 2007. The use of push-pull strategies in integrated pest management. Annual Review of Entomology 52, 375-400.

Corning, P.A., 1998. "Complexity is just a word!". Technological Forecasting and Social Change 58, 1-4.

Creswell, J.W., 2009. Research design: qualitative, quantitative and mixed methods approaches. Sage Publications, Inc, Thousand Oaks.

Cumming, G.S., Spiesman, B.J., 2006. Regional problems need integrated solutions: pest management and conservation biology in agroecosystems. Biological Conservation 131, 533-543.

D'Emden, F.H., Llewellyn, R.S., Burton, M.P., 2006. Adoption of conservation tillage in Australian cropping regions: An application of duration analysis. Technological Forecasting and Social Change 73, 630-647.

Davis, K., Nkonya, E., Kato, E., Mekonnen, D.A., Odendo, M., Miiro, R., Nkuba, J., 2012. Impact of farmer field schools on agricultural productivity and poverty in East Africa. World Development 40, 402-413.

de Groot, R.S., Wilson, M.A., Boumans, R.M.J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41, 393-408.

de Nooy, W., Mrvar, A., Batagelj., V., 2005. Exploratory social network analysis with Pajek. Cambridge University Press, New York.

de Vos, A.S., Strydom, H., Fouché, C.B., Delport, C.S.L., 2011. Research at grass roots. Van Schaik Publishers, Pretoria.

Dent, D.R., 1995. Integrated pest management. Chapman & Hall London.

Dick, J., 1945. Some data on the biology of the sugarcane borer *Eldana saccharina* Walker. Proceedings of the South African Sugar Technologists' Association 19, 75-79.

Dini, J., Cowan, G., Goodman, P., 1998. Proposed wetland classification system for South Africa (1st Draft). South African National Wetland Inventory. Department of Environmental Affairs and Tourism, Pretoria. Available online: http://www.ngo.grida.no/soesa/nsoer/resource/wetland/inventory_classif.htm (Accessed: 10/11/2012).

Doke, C.M., Malcolm, D.M., Sikakana, J.M.A., Vilakazi, B.W., 2005. English-Zulu Zulu-English dictionary. Witwatersrand University Press, Johannesburg.

Draper, C., Conlong, D.E., 2000. *Eldana saccharina* Walker (Lepidoptera: Pyralidae) and the arthropod predator populations in small and commercial grower sugarcane fields. Proceedings of the South African Sugar Technologists' Association 74, 28.

Düvel, G.H., 2002. Needs assessments in extension: results and implications of different assessment methods. South African Journal of Agricultural Extension 31, 39-49.

Düvel, G.H., 2005. Principles, realities and challenges regarding institutional linkages for participatory extension and rural development in South Africa. South African Journal of Agricultural Extension 34, 188-200.

DWAF, 2005. A practical field procedure for identification and delineation of wetlands and riparian areas. Department of Water Affairs and Forestry, Pretoria. Available online: http://196.3.165.92/documents/WetlandZoneDelineationSep05.pdf (Accessed 31/10/2012).

Dytham, C., 2003. Choosing and using statistics: a biologist's guide. Blackwell Science Ltd, Oxford.

Ebenebe, A.A., Van den Berg, J., Van der Linde, T.C., 2001. Farm management practices and farmers' perceptions of stalk-borers of maize and sorghum in Lesotho. International Journal of Pest Management 47, 41-48.

Edwards, G., 2010. Mixed-method approaches to social network analysis, ESRC National Centre for Research Methods Review paper NCRM/015. National Centre for Research Methods, Southampton. Available online: http://eprints.ncrm.ac.uk/842/1/Social_Network_analysis_Edwards.pdf (Accessed: 03/09/2012).

Ehler, L.E., 1998. Conservation biological control: past, present, and future, In: Barbosa, P. (Ed.), Conservation biological control. Academic Press, San Diego, pp. 1-8.

Eilenberg, J., Hajek, A., Lomer, C., 2001. Suggestions for unifying the terminology in biological control. BioControl 46, 387-400.

Ellis, S.M., Steyn, H.S., 2003. Practical significance (effect sizes) versus or in combination with statistical significance (p-values). Management Dynamics 12, 51-53.

Elzinga, J., Turin, H., Damme, J., Biere, A., 2005. Plant population size and isolation affect herbivory of *Silene latifolia* by the specialist herbivore *Hadena bicruris* and parasitism of the herbivore by parasitoids. Oecologia 144, 416-426.

Eweg, M.J., 2005a. Changing fertiliser practices in the small-scale sector of the South African sugar industry: the role of extension. Proceedings of the South African Sugar Technologists' Association 78, 393-402.

Eweg, M.J., 2005b. The changing profile of small-scale 'sugarcane' farmers in South Africa, South African Sugar Industry Agronomists' Association AGM, Mount Edgecombe.

Eweg, M.J., Pillay, K.P., Travailleur, C., 2009. A survey of small-scale sugarcane farmers in South Africa and Mauritius: introducing project methodology, investigating new technology and presenting the data. Proceedings of the South African Sugar Technologists' Association 82, 370-383.

Fagbemissi, R., Price, L.L., 2008. HIV/AIDS orphans as farmers: uncovering pest knowledge differences through an ethnobiological approach in Benin. NJAS - Wageningen Journal of Life Sciences 56, 241-259.

Feder, G., Savastano, S., 2006. The role of opinion leaders in the diffusion of new knowledge: the case of integrated pest management. World Development 34, 1287-1300.

Fiedler, A.K., Landis, D.A., Wratten, S.D., 2008. Maximizing ecosystem services from conservation biological control: the role of habitat management. Biological Control 45, 254-271.

Fink, A., 2009. How to conduct surveys: a step-by-step guide
Sage Publications, Inc., Thousand Oaks.

Fisher, D.K., Norvell, J., Sonka, S., Nelson, M.J., 2000. Understanding technology adoption through system dynamics modeling: implications for agribusiness management. The International Food and Agribusiness Management Review 3, 281-296.

Gatsby Charitable Foundation, 2005. The quiet revolution: push-pull technology and the African farmer, Gatsby Occasional Paper. Gatsby Charitable Foundation, London.

Germishuizen, G., Meyer, N.L., 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14. National Botanical Institute, Pretoria.

Gillespie, D.Y., 1993. Development of mass-rearing methods for the sugarcane borer *Eldana saccharina* (Lepidoptera: Pyralidae) II: diet gelling agents. Proceedings of the South African Sugar Technologists' Association 67, 127-129.

Gillespie, W.A., Mitchell, F.J., 2006. A successful methodology for the establishment of an extension programme in a small grower area. Proceedings of the South African Sugar Technologists' Association 80, 188.

Gillespie, W.A., Mitchell, F.J., Way, M.J., Webster, T.M., 2009a. Demonstration plots double as seedcane nurseries for small-scale growers in the Noodsberg area. Proceedings of the South African Sugar Technologists' Association 82, 623-625.

Gillespie, W.A., Way, M.J., Webster, T.M., Mitchell, F.J., Ramay, D., Maher, G.W., 2009b. Technology transfer among small-scale sugarcane farmers in South Africa. Proceedings of the South African Sugar Technologists' Association 82, 626-628.

Gillespie, W.A., Mitchell, F.J., Way, M.J., Webster, T.M., Witthoft, J.H., 2012. Impact of new extension methodology on the performance of small growers. Proceedings of the South African Sugar Technologists' Association 85, 205.

Girling, D.J., 1972. *Eldana saccharina* Walker (Lepidoptera: Pyralidae), a pest of sugarcane in East Africa. Proceedings of the International Society of Sugar Cane Technologists 14, 429-434.

Girling, D.J., 1978. The distribution and biology of *Eldana saccharina* Walker (Lepidoptera Pyralidae) and its relationship to other stem-borers in Uganda. Bulletin of Entomological Research 68, 471-488.

Gliessman, S.R., 2007. Agroecology: the ecology of sustainable food systems. CRC Press, Taylor & Francis, New York.

Goebel, F.R., Way, M.J., 2003. Investigation of the impact of *Eldana saccharina* (Lepidoptera: Pyralidae) on sugarcane yield in field trials in Zululand. Proceedings of the South African Sugar Technologists' Association 77, 256-265.

Goebel, F.R., Way, M.J., Gossard, C., 2005. The status of *Eldana saccharina* (Lepidoptera: Pyralidae) in the South African sugar industry based on regular survey data. Proceedings of the South African Sugar Technologists' Association 79, 337-346.

Goebel, F.R., Way, M.J., 2007. Crop losses due to two sugarcane stem borers in Reunion and South Africa. Proceedings of the International Society of Sugar Cane Technologists 26, 805-814.

Goebel, F.R., Sallam, N., 2011. New pest threats for sugarcane in the new bioeconomy and how to manage them. Current Opinion in Environmental Sustainability 3, 81-89.

Google Inc., 2011. Google Earth 6.2.

Gounou, S., Schulthess, F., 2004. Spatial distribution of lepidopterous stem borers on indigenous host plants in West Africa and its implications for sampling schemes. Entomological Society of southern Africa, pp. 171-178.

Govender, N., Conlong, D.E., Smith, F.R., 2011. Biodiversity of lepidopteran stemborers and associated parasitoids in wild hosts surrounding sugarcane fields. Proceedings of the South African Sugar Technologists' Association 84, 301-305.

Graham, D.Y., Conlong, D.E., 1988. Improved laboratory rearing of *Eldana saccharina* (Lepidoptera: Pyralidae) and its indigenous parasitoid *Goniozus natalensis* (Hymenoptera: Bethylidae). Proceedings of the South African Sugar Technologists' Association 62, 116-119.

Gurr, G.M., Scarratt, S.L., Wratten, S.D., Berndt, L., Irvin, N., 2004a. Ecological engineering, habitat manipulation and pest management, In: Gurr, G.M., Wratten, S.D., Altieri, M.A. (Eds.), Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods. CSIRO Publishing, Collingwood, pp. 1-12.

Gurr, G.M., Wratten, S.D., Altieri, M.A., 2004b. Ecological engineering for pest management: advances in habitat manipulation for arthropods. CSIRO Publishing, Collingwood.

Gurr, G.M., Wratten, S.D., Snyder, W.E., 2012. Introduction, In: Gurr, G.M., Wratten, S.D., Snyder, W.E. (Eds.), Biodiversity and insect pests. John Wiley & Sons, Ltd, Chichester, pp. 1-20.

Hagmann, J., Chuma, E., Murwira, K., Connolly, M., 1999. Putting process into practice: operationalising participatory extension. Agren Network Paper No. 94, 1-18.

Hanneman, R.A., Riddle, M., 2011a. Concepts and measures for basic network analysis, In: Scott, J., Carrington, P.J. (Eds.), The SAGE handbook of social network analysis. Sage Publications Ltd, London, pp. 340-415.

Hanneman, R.A., Riddle, M., 2011b. A brief introduction to analyzing social network data In: Scott, J., Carrington, P.J. (Eds.), The SAGE handbook of social network analysis. Sage Publications Ltd, London, pp. 331-338.

Harraca, V., Du Pissanie, J., Rutherford, R.S., Conlong, D.E., 2011. Understanding the chemical ecology of stimulo-deterrent diversion as a basis for sugarcane pest control: *Eldana saccharina* vs *Melinis minutiflora*. Proceedings of the South African Sugar Technologists' Association 84, 275-280.

Hart, T., Aliber, M., 2010. The need for an engendered approach to agricultural technology. Agenda 24, 75-90.

Hassanali, A., Herren, H., Khan, Z.R., Pickett, J.A., Woodcock, C.M., 2008. Integrated pest management: the push-pull approach for controlling insect pests and weeds of cereals, and its

potential for other agricultural systems including animal husbandry. Philosophical Transactions of the Royal Society B 363, 611-621.

Hearne, J.W., van Coller, L.M., Conlong, D.E., 1994. Determining strategies for the biological control of a sugarcane stalk borer. Ecological Modelling 73, 117-133.

Heong, K.L., Escalada, M.M., 1999. Quantifying rice farmers' pest management decisions: beliefs and subjective norms in stem borer control. Crop Protection 18, 315-322.

Hokkanen, H.M.T., Pimentel, D., 1989. New associations in biological control: Theory and practice. Canadian Entomologist 121, 829-840.

Hollstein, B., 2011. Qualitative approaches, In: Scott, J., Carrington, P.J. (Eds.), The SAGE handbook of social network analysis. Sage Publications, Ltd., London, pp. 404-415.

ICIPE, 2007. Push-pull curriculum for farmer field schools. International Centre of Insect Physiology and Ecology, Nairobi.

Kabii, T., Horwitz, P., 2006. A review of landholder motivations and determinants for participation in conservation covenanting programmes. Environmental Conservation 33, 11-20.

Kaine, G., Bewsell, D., 2008. Adoption of integrated pest management by apple growers: the role of context. International Journal of Pest Management 54, 255-265.

Kamada, T., Kawai, S., 1989. An algorithm for drawing general undirected graphs. Information Processing Letters 31, 7-15.

Kasl, B., 2004. Stimulo-deterrent diversion approaches to decrease *Eldana saccharina* Walker (Lepidoptera: Pyralidae) infestation in sugarcane, Unpublished PhD Thesis. APES, University of the Witwatersrand, Johannesburg.

Keane, R.M., Crawley, M.J., 2002. Exotic plant invasions and the enemy release hypothesis. Trends in Ecology & Evolution 17, 164-170.

Keeping, M., 1995. Coping with pests in the South African sugar industry. Proceedings of the South African Sugar Technologists' Association, 217-218.

Keeping, M.G., 2006. Screening of South African sugarcane cultivars for resistance to the stalk borer, *Eldana saccharina* Walker [Lepidoptera: Pyralidae]. African Entomology 14, 277-288.

Keeping, M.G., Rutherford, R.S., Conlong, D.E., 2007. Bt-maize as a potential trap crop for management of *Eldana saccharina* Walker (Lep., Pyralidae) in sugarcane. Journal of Applied Entomology 131, 241-250.

Keeping, M.G., Meyer, J.H., Sewpersad, C., 2012. Soil silicon amendments increase resistance of sugarcane to stalk borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae) under field conditions. Plant and Soil June 2012, 1-22.

Kfir, R., Overholt, W.A., Khan, Z.R., Polaszek, A., 2002. Biology and management of economically important lepidopteran cereal stem borers in Africa. Annual Review of Entomology 47, 701-731.

Khan, Z., Pickett, J., 2004. The ‘push–pull’ strategy for stemborer management: a case study in exploiting biodiversity and chemical ecology, In: Gurr, G.M., Wratten, S.D., Altieri, M.A. (Eds.),

Ecological Engineering for Pest Management: Advances in Habitat Manipulation for Arthropods. CSIRO Publishing, Collingwood, pp. 155-164.

Khan, Z., Midega, C., Pittchar, J., Pickett, J., Bruce, T., 2011. Push-pull technology: a conservation agriculture approach for integrated management of insect pests, weeds and soil health in Africa. International Journal of Agricultural Sustainability 9, 162-170.

Khan, Z.R., Ampong-Nyarko, K., Chiliswa, P., Hassanali, A., Kimani, S., Lwande, W., Overholt, W.A., Pickett, J.A., Smart, L.E., Woodcock, C.M., 1997a. Intercropping increases parasitism of pests. Nature 388, 631-632.

Khan, Z.R., Chiliswa, P., Ampong-Nyarko, K., Smart, L.E., Polaszek, A., Wandera, J., Mulaa, M.A., 1997b. Utilisation of wild gramineous plants for management of cereal stemborers in Africa. Insect Science and its Application 17, 143-150.

Khan, Z.R., Pickett, J.A., Wadhams, L., Muyekho, F., 2001. Habitat management strategies for the control of cereal stemborers and striga in maize in Kenya. Insect Science and its Application 21, 375-380.

Khan, Z.R., Midega, C.A.O., Hutter, N.J., Wilkins, R.M., Wadhams, L.J., 2006a. Assessment of the potential of Napier grass (*Pennisetum purpureum*) varieties as trap plants for management of *Chilo partellus*. Entomologia Experimentalis et Applicata 119, 15-22.

Khan, Z.R., Pickett, J.A., Wadhams, L.J., Hassanali, A., Midega, C.A.O., 2006b. Combined control of *Striga hermonthica* and stemborers by maize-*Desmodium spp*. intercrops. Crop Protection 25, 989-995.

Khan, Z.R., Amudavi, D.M., Midega, C.A.O., Wanyama, J.M., Pickett, J.A., 2008a. Farmers' perceptions of a 'push-pull' technology for control of cereal stemborers and Striga weed in western Kenya. Crop Protection 27, 976-987.

Khan, Z.R., Midega, C.A.O., Amudavi, D.M., Hassanali, A., Pickett, J.A., 2008b. On-farm evaluation of the 'push-pull' technology for the control of stemborers and striga weed on maize in western Kenya. Field Crops Research 106, 224-233.

Khan, Z.R., Midega, C.A.O., Njuguna, E.M., Amudavi, D.M., Wanyama, J.M., Pickett, J.A., 2008c. Economic performance of the 'push-pull' technology for stemborer and Striga control in smallholder farming systems in western Kenya. Crop Protection 27, 1084-1097.

Khan, Z.R., Midega, C.A.O., Bruce, T.J.A., Hooper, A.M., Pickett, J.A., 2010. Exploiting phytochemicals for developing a 'push-pull' crop protection strategy for cereal farmers in Africa. Journal of Experimental Botany 61, 4185-4196.

Kline, S.J., Rosenberg, N., 1986. An overview of innovation, In: Landau, R., Rosenberg, N. (Eds.), The positive sum strategy: harnessing technology for economic growth. National Academic Press, Washington, pp. 275-305.

Knowler, D., Bradshaw, B., 2007. Farmers' adoption of conservation agriculture: a review and synthesis of recent research. Food Policy 32, 25-48.

Kogan, M., 1998. Integrated pest management: historical perspectives and contemporary developments. Annual Review of Entomology 43, 243-270.

Kolb, D.A., 1984. Experiential learning: experience as the source of learning and development. Prentice-Hall, Englewood Cliffs.

Koopman, A., 2002. Zulu names. University of Natal Press, Scottsville.

Kotze, D.C., Breen, C.M., Quinn, N., 1995. Wetland losses in South Africa, In: Cowan, G.I. (Ed.), Wetlands of South Africa. Department of Environmental Affairs and Tourism, Pretoria, pp. 263-272.

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.S., Collins, N.B., 2007. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No TT 339/08. Water Research Commission, Pretoria.

Kotze, D.C., Ellery, W.N., Macfarlane, D.M., Jewitt, G.P.W., 2012. A rapid assessment method for coupling anthropogenic stressors and wetland ecological condition. Ecological Indicators 13, 284-293.

Kroon, D., 1999. Lepidoptera of southern Africa: host-plants & other associations. Lepidopterists' Society of Africa and D.M. Kroon, Jukskei Park and Sasolburg.

Krueger, R.A., 1998. Analyzing & reporting focus group results. Sage Publications, Inc., Thousand Oaks.

Landis, D.A., Wratten, S.D., Gurr, G.M., 2000. Habitat management to conserve natural enemies of arthropod pests in agriculture. Annual Review of Entomology 45, 175-201.

Le Maitre, D.C., Versfeld, D.B., Chapman, R.A., 2000. The impact of invading alien plants on surface water resources in South Africa: A preliminary assessment. Water SA 26, 397-408.

Le Rü, B.P., Ong'amo, G.O., Moyal, P., Muchugu, E., Ngala, L., Musyoka, B., Abdullah, Z., Matama-Kauma, T., Lada, V.Y., Pallangyo, B., Omwega, C.O., Schulthess, F., Calatayud, P.A., Silvain, J.F., 2006a. Geographic distribution and host plant ranges of East African noctuid stem borers. Annales de la Société Entomologique de France 42, 353-361.

Le Rü, B.P., Ong'amo, G.O., Moyal, P., Ngala, L., Musyoka, B., Abdullah, Z., Cugala, D., Defabachew, B., Haile, T.A., Matama, T.K., Lada, V.Y., Negassi, B., Pallangyo, K., Ravolonandrianina, J., Sidumo, A., Omwega, C.O., Schulthess, F., Calatayud, P.A., Silvain, J.F., 2006b. Diversity of lepidopteran stem borers on monocotyledonous plants in eastern Africa and the islands of Madagascar and Zanzibar revisited. Bulletin of Entomological Research 96, 555-563.

Leeuwis, C., 2004. Communication for rural innovation: rethinking agricultural extension. Blackwell Science Ltd., Oxford.

Leslie, G.W., 2004. Observations on crop damage and larval populations of the pyralid borer *Eldana saccharina* in sugarcane varieties NCO376 and N11. Proceedings of the South African Sugar Technologists' Association 68, 12-15.

Leslie, G.W., 2009. Estimating the economic injury level and the economic threshold for the use of alpha-cypermethrin against the sugarcane borer, *Eldana saccharina* Walker (Lepidoptera: Pyralidae). International Journal of Pest Management 55, 37-44.

Litsinger, J.A., Libetario, E.M., Canapi, B.L., 2009. Eliciting farmer knowledge, attitudes, and practices in the development of integrated pest management programs for rice in Asia, In: Peshin,

R., Dhawan, A.K. (Eds.), Integrated pest management: dissemination and impact. Springer Science+Business Media B.V., Dordrecht, pp. 119-273.

Llewellyn, R.S., Pannell, D.J., Lindner, R.K., Powles, S.B., 2006. Targeting key perceptions when planning and evaluating extension. Australian Journal of Experimental Agriculture 45, 1627-1633.

Llewellyn, R.S., 2007. Information quality and effectiveness for more rapid adoption decisions by farmers. Field Crops Research 104, 148-156.

Llewellyn, R.S., 2011. Identifying and targeting adoption drivers, In: Pannell, D.J., Vanclay, F. (Eds.), Changing land management: adoption of new practices by rural landholders. CSIRO Publishing, Collingwood, pp. 87-94.

MA, 2003. Ecosystems and human well being: a framework for assessment. Island Press, Washington DC.

Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P., Goge, C., 2007. WET-Health: a technique for rapidly assessing wetland health. WRC Report No TT 340/08. Water Research Commission, Pretoria.

Maes, K.V.N., 1998. Lepidoptera: introduction, In: Polaszek, A. (Ed.), African cereal stem borers: economic importance, taxonomy, natural enemies and control. CAB International, Wallingford, pp. 75-78.

Maher, G.W., Schulz, L., 2003. An environmental management system for sugarcane in the Noodsberg area of South Africa. Proceedings of the South African Sugar Technologists' Association 7, 189-195.

Maher, G.W., 2007. SuSFarMS environmental management system: an extension tool for implementing better management practices in sugarcane. Proceedings of the International Society of Sugar Cane Technologists 80, 498-503.

Mahlangu, I., Lewis, F., 2008. Social and institutional constraints to the production of sugarcane by small-scale growers in the Amatikulu catchment. Proceedings of the South African Sugar Technologists' Association 81, 128-132.

Mailafiya, D.M., 2011. Importance of wild host plants for stem borer parasitoid diversity and control of parasitism in cereal cropping ecosystems in Kenya. International Journal of Biodiversity Science, Ecosystem Services & Management 7, 12-19.

Mailafiya, D.M., Le Ru, B.P., Kairu, E.W., Dupas, S., Calatayud, P.-A., 2011. Parasitism of lepidopterous stem borers in cultivated and natural habitats. Journal of Insect Science 11, 1-19.

Marin, A., Wellman, B., 2011. Social network analysis: an introduction, In: Carrington, P., Scoot, J. (Eds.), The SAGE handbook of social network analysis. Sage Publications, Ltd., London, pp. 11-25.

Matama-Kauma, T., Schulthess, F., Le Rü, B.P., Mueke, J., Ogwang, J.A., Omwega, C.O., 2008. Abundance and diversity of lepidopteran stemborers and their parasitoids on selected wild grasses in Uganda. Crop Protection 27, 505-513.

Mathew, A.K., Fortmann, R.R., Tucker, A.B., 1990. The development and achievements of the Felixton LP&DC committee. Proceedings of the South African Sugar Technologists' Association 64, 40-44.

Matteson, P.C., 2000. Insect pest management in tropical Asian irrigated rice. Annual Review of Entomology 45, 549-574.

Maxwell, S., Bart, C., 1995. Beyond ranking: exploring relative preferences in P/RRA. PLA Notes 1995, 28-35.

Mayoux, L., Chambers, R., 2005. Reversing the paradigm: quantification, participatory methods and pro-poor impact assessment. Journal of International Development 17, 271-298.

Mazodze, R., Conlong, D.E., 2003. *Eldana saccharina* (Lepidoptera: Pyralidae) in sugarcane (*Saccharum* hybrids), sedge (*Cyperus digitatus*) and bulrush (*Typha latifolia*) in South-eastern Zimbabwe. Proceedings of the South African Sugar Technologists Association 77, 266-274.

McAlister, E.M.F., Russell, W.B., 1999. Construction and maintenance of contour banks, In: KwaZulu-Natal Department of Agriculture (Ed.), Conservation of Farmland in KwaZulu-Natal. KwaZulu-Natal Department of Agriculture and Environmental Affairs, Pietermaritzburg. Available online: http://agriculture.kzntl.gov.za/publications/production_guidelines/conservation_farmland/conservation_farmland_cover.htm (Accessed: 10/11/2012).

Meir, C., Williamson, S., 2005. Farmer decision-making for ecological pest management, In: Pretty, J.N. (Ed.), The pesticide detox: towards a more sustainable agriculture. Earthscan, London, pp. 83-96.

Midega, C.A.O., Nyang'au, I.M., Pittchar, J., Birkett, M.A., Pickett, J.A., Borges, M., Khan, Z.R., 2012. Farmers' perceptions of cotton pests and their management in western Kenya. Crop Protection 42, 193-201.

Miller, J.R., Cowles, R.S., 1990. Stimulo-deterrent diversion: a concept and its possible application to onion maggot control. Journal of Chemical Ecology 16, 3197-3212.

Mkize, N., 2003. A contribution to cabbage pest management by subsistence and small-scale farmers in the Eastern Cape, South Africa. Unpublished MSc Thesis. Department of Zoology & Entomology, Rhodes University, Grahamstown.

Molomo, T., 2012. Towards rural innovation extension delivery in Lesotho: the perceived benefit of a multi-stakeholders intervention approach. Unpublished MSc Thesis. Department of Agricultural Economics, Extension & Rural Development, University of Pretoria, Pretoria.

Moolman, H.J., 2011. Biodiversity of lepidopteran stem borers and their associated parasitoids in natural habitats in South Africa and Mozambique. Unpublished MSc thesis. School of Environmental Sciences and Development, North-West University, Potchefstroom.

Moolman, J.H., Van den Berg, J., Conlong, D., Cugala, D., Siebert, S., Le Ru, B., 2012. Diversity of stem borer parasitoids and their associated wild host plants in South Africa and Mozambique. Phytoparasitica, 1-16.

Morales, H., Perfecto, I., 2000. Traditional knowledge and pest management in the Guatemalan highlands. Agriculture and Human Values 17, 49-63.

Moyal, P., Le Rü, B., Conlong, D., Cugala, D., Defabachew, B., Matama-Kauma, T., Pallangyo, B., Van den Berg, J., 2010. Systematics and molecular phylogeny of two African stem borer genera, *Sciomesa* Tams & Bowden and *Carelis* Bowden (Lepidoptera: Noctuidae). Bulletin of Entomological Research 100, 641-659.

Mueller-Dombois, D., Ellenberg, H., 1974. Aims and methods of vegetation ecology. John Wiley and Sons, Inc. , New York.

Murage, A.W., Amudavi, D.M., Obare, G., Chianu, J., Midega, C.A.O., Pickett, J.A., Khan, Z.R., 2011a. Determining smallholder farmers' preferences for technology dissemination pathways: the case of 'push-pull' technology in the control of stemborer and Striga weeds in Kenya. International Journal of Pest Management 57, 133-145.

Murage, A.W., Obare, G., Chianu, J., Amudavi, D.M., Pickett, J., Khan, Z.R., 2011b. Duration analysis of technology adoption effects of dissemination pathways: A case of 'push-pull' technology for control of Striga weeds and stemborers in Western Kenya. Crop Protection 30, 531-538.

Murlis, J., Elkinton, J.S., Cardé, R.T., 1992. Odor plumes and how insects use them. Annual Review of Entomology 37, 505-532.

Mwangi, E.N., Essuman, S., Kaaya, G.P., Nyandat, E., Munyinyi, D., Kimondo, M.G., 1995. Repellence of the tick *Rhipicephalus appendiculatus* by the grass *Melinis minutiflora*. Tropical Animal Health and Production 27, 211-216.

Nederlof, E.S., Tossou, R., Sakyi-Dawson, O., Kossou, D.K., 2004. Grounding agricultural research in resource-poor farmers' needs: a comparative analysis of diagnostic studies in Ghana and Benin. NJAS - Wageningen Journal of Life Sciences 52, 421-442.

Nederlof, E.S., Röling, N., van Huis, A., 2007. Pathway for agricultural science impact in West Africa: lessons from the Convergence of Sciences programme. International Journal of Agricultural Sustainability 5, 247-264.

New, T.R., 2005. Invertebrate conservation and agricultural ecosystems. Cambridge University Press, Cambridge.

Newman, M.E.J., 2003. The structure and function of complex networks. SIAM Review 45, 167-256.

Norton, G.A., Adamson, D., Aitken, L.G., Bilston, L.J., Foster, J., Frank, B., Harper, J.K., 1999. Facilitating IPM: the role of participatory workshops. International Journal of Pest Management 45, 85-90.

Obopile, M., Munthali, D.C., Matilo, B., 2008. Farmers' knowledge, perceptions and management of vegetable pests and diseases in Botswana. Crop Protection 27, 1220-1224.

Olsen, C.H., 2003. Review of the use of statistics in *Infection and Immunity*. Infection and Immunity 71, 6689-6692.

Ong'amo, G.O., Le Rü, B.P., Dupas, S., Moyal, P., Muchugu, E., Calatayud, P.A., Silvain, J.F., 2006. The role of wild host plants in the abundance of lepidopteran stem borers along altitudinal gradient in Kenya. Annales de la Société Entomologique de France 42, 363-370.

Ong'amo, G.O., Le Rü, B., Dupas, S., Moyal, P., Calatayud, P.A., Silvain, J.F., 2006. Distribution, pest status and agroclimatic preferences of lepidopteran stemborers of maize and sorghum in Kenya. Annales de la Société Entomologique de France 42, 171-177.

Onwuegbuzie, A.J., Dickinson, W.B., Leech, N.L., Zoran, A.G., 2009. A qualitative framework for collecting and analyzing data in focus group research. International Journal of Qualitative Methods 8, 1-21.

Onyango, F.O., Ochieng-Odero, J.P.R., 1994. Continuous rearing of *Busseola fusca* (Lepidoptera: Noctuidae) on an artificial diet. Entomologia Experimentalis et Applicata 73, 139-144.

Ooi, P.A.C., Praneetvatakul, S., Waibel, H., Walter-Echols, G., 2005. The Impact of the FAO-EU IPM Programme for Cotton in Asia. Universitat Hannover, Hannover.

Orr, A., 2003. Integrated pest management for resource-poor African farmers: is the emperor naked? World Development 31, 831-845.

Osborn, R.F., 1964. Valiant harvest. South African Sugar Association, Mount Edgecombe.

Owens, M.E., Eweg, M.J., 2003. Extension delivery for small-scale sugarcane growers in South Africa: a public/private joint venture, Proceedings of the 19th Annual Conference of the Association for International Agricultural and Extension Education, Raleigh, North Carolina, USA, pp. 496-508.

Pahl-Wostl, C., 2007. The implications of complexity for integrated resources management. Environmental Modelling & Software 22, 561-569.

Parsons, M.J., 2003. Successful intercropping of sugarcane. Proceedings of the South African Sugar Technologists' Association 77, 77-98.

Peshin, R., Dhawan, A.K., 2009. Integrated pest management: dissemination and impact. Springer Science+Business Media B.V., Dordrecht.

Peshin, R., Jayaratne, K.S.U., Singh, G., 2009a. Evaluation research: methodologies for evaluation of IPM programs, In: Peshin, R., Dhawan, A.K. (Eds.), Integrated pest management: dissemination and impact. Springer Science+Business Media B.V., Dordrecht, pp. 31-78.

Peshin, R., Vasanthakumar, J., Kalra, R., 2009b. Diffusion of innovation theory and integrated pest management, In: Peshin, R., Dhawan, A.K. (Eds.), Integrated pest management: dissemination and impact. Springer Science+Business Media B.V., Dordrecht, pp. 1-30.

Piepho, H.P., Büchse, A., Emrich, K., 2003. A hitchhiker's guide to mixed models for randomized experiments. Journal of Agronomy and Crop Science 189, 310-322.

Polaszek, A., 1997. An overview of parasitoids of African lepidopteran cereal stemborers (Hymenoptera: Chrysidoidea, Ceraphronoidea, Chalcidoidea, Ichneumonoidea, Platygastroidea). International Journal of Tropical Insect Science 17, 13-18.

Polaszek, A., 1998. African cereal stem borers: economic importance, taxonomy, natural enemies and control. CAB International, Wallingford.

Polaszek, A., Khan, Z., 1998. Host plants, In: Polaszek, A. (Ed.), African cereal stem borers: economic importance, taxonomy, natural enemies and control. CAB International, Wallingford, pp. 3-10.

Pretty, J.N., 1995. Participatory learning for sustainable agriculture. World Development 23, 1247-1263.

Pretty, J.N., Gujit, I., Scoones, I., Thompson, J., 1995. A trainer's guide for participatory learning and action. International Institute for Environment and Development, London.

Pretty, J.N., 2003. Reducing food poverty by increasing agricultural sustainability in developing countries. Agriculture, Ecosystems & Environment 95, 217-234.

Pretty, J.N., 2005. The pesticide detox: towards a more sustainable agriculture. Earthscan, London.

Quinlan, M., 2005. Considerations for collecting freelists in the field: examples from ethnobotany. Field Methods 17, 219-234.

Randlkofer, B., Obermaier, E., Hilker, M., Meiners, T., 2010. Vegetation complexity - the influence of plant species diversity and plant structures on plant chemical complexity and arthropods. Basic and Applied Ecology 11, 383-395.

Ratnadass, A., Fernandes, P., Avelino, J., Habib, R., 2011. Plant species diversity for sustainable management of crop pests and diseases in agroecosystems: a review. Agronomy for Sustainable Development 32, 273-303.

Reimer, A.P., Weinkauf, D.K., Prokopy, L.S., 2012. The influence of perceptions of practice characteristics: an examination of agricultural best management practice adoption in two Indiana watersheds. Journal of Rural Studies 28, 118-128.

Rogers, E.M., 1983. Diffusion of innovations, 3rd Edition ed. Free Press, New York.

Röling, N., van de Fliert, E., 1994. Transforming extension for sustainable agriculture: the case of integrated pest management in rice in Indonesia. Agriculture and Human Values 11, 96-108.

RÖling, N.G., de Jong, F., 1998. Learning: shifting paradigms in education and extension studies. Journal of Agricultural Education and Extension 5, 143-161.

Röling, N.G., Jiggins, J., 1998. The ecological knowledge system, In: Röling, N.G., Wagemakers, M.A.E. (Eds.), Facilitating sustainable agriculture: participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press, Cambridge, pp. 283-311.

Röling, N.G., van de Fliert, E., 1998. Introducing integrated pest management in rice in Indonesia: a pioneering attempt to facilitate large-scale change, In: Röling, N.G., Wagemakers, M.A.E. (Eds.), Facilitating sustainable agriculture: participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press, Cambridge, pp. 153-171.

Röling, N.G., Wagemakers, M.A.E., 1998. Facilitating sustainable agriculture: participatory learning and adaptive management in times of environmental uncertainty. Cambridge University Press, Cambridge.

Röling, N.G., 2004. Thematic paper 2: Communication for development in research, extension and Education, FAO Communication Roundtable, Rome, Italy.

Röling, N.G., Hounkonnou, D., Offei, S.K., Tossou, R., Van Huis, A., 2004. Linking science and farmers' innovative capacity: diagnostic studies from Ghana and Benin. NJAS - Wageningen Journal of Life Sciences 52, 211-235.

Rutherford, R.S., Conlong, D.E., 2010. Combating sugarcane pests in South Africa: from researching biotic interactions to bio-intensive Integrated pest management in the field. Proceedings of the International Society of Sugar Cane Technologists 27, 1-17.

Sanjika, T., Bezuidenhout, C.N., Bodhanya, S., Lyne, P.W.L., 2012. A network analysis approach to identify problems in integrated sugarcane production and processing systems. Proceedings of the South African Sugar Technologists' Association 85, 50-53.

SASA, 2011. Sugar Industry Directory 2011-2012. South African Sugar Association, Mount Edgecombe.

SASRI, 2005. Guidelines and recommendations for eldana control in the South African sugar industry. South African Sugarcane Research Institute, Mount Edgecombe.

SASRI, 2006. Information Sheet 8.1: Stalk borers. South African Sugarcane Research Institute, Mount Edgecombe.

SASRI, 2010. SASRI Herbicide Guide. South African Sugarcane Research Institute, Mount Edgecombe.

SASRI, 2011. South African Sugarcane Research Institute visitors' guide. South African Sugarcane Research Institute, Mount Edgecombe.

SASRI, 2012. Annual progress report 2011/2012. South African Sugarcane Research Institute, Mount Edgecombe.

Schulthess, F., Bosque-Pérez, N.A., Chabi-Olaye, A., Gounou, S., Ndemah, R., Goergen, G., 1997. Exchange of natural enemies of lepidopteran cereal stemborers between African regions. International Journal of Tropical Insect Science 17, 97-108.

Scoones, I., Thompson, J., 2009. Farmer first revisited. Practical Action Publishing, Rugby.

Sgrillo, R., 2011. Google Earth Path v 1.4.5.

Shelton, A.M., Badenes-Perez, F.R., 2006. Concepts and applications of trap cropping in pest management. Annual Review of Entomology 51, 285-308.

Shepard, B.M., Hammig, M.D., Carner, G.R., Ooi, P.A.C., Smith, R., Dilts, R., Rauf, A., 2009. Implementing integrated pest management in developing and developed countries, In: Peshin, R., Dhawan, A.K. (Eds.), Integrated pest management: dissemination and impact. Springer Scince+Business Media B.V., Dordrecht, pp. 275-305.

Sibiya, T.G., Hurly, K.M., 2011. Sustaining small-scale sugarcane cooperatives in South Africa through clustering, collaboration, goal alignment and record-keeping, 4th IAPSIT International Sugar Conference, New Delhi, India, pp. 1-8.

Singels, A., Ferrer, S., Leslie, G.W., McFarlane, S.A., Sithole, P., Van der Laan, M., 2011. Review of South African sugarcane production in the 2010/2011 season from an agricultural perspective. Proceedings of the South African Sugar Technologists' Association 84, 66-83.

Singels, S.A., Leslie, G.W., McFarlane, S.A., Sithole, P., Ferrer, S., Maher, G.W., 2012. Review of South African sugarcane production in the 2011/2012 season from an agricultural perspective. Proceedings of the South African Sugar Technologists' Association 85, 30-46.

Sinzogan, A.A.C., Van Huis, A., Kossou, D.K., Jiggins, J., Vodouhè, S., 2004. Farmers' knowledge and perception of cotton pests and pest control practices in Benin: results of a diagnostic study. NJAS - Wageningen Journal of Life Sciences 52, 285-303.

Smith, J.J., 1993. Using ANTHROPAC 3.5 and a spreadsheet to compute a free-list salience index. Cultural Anthropology Methods 5, 1-3.

Smith, J.M., Conlong, D.E., Byrne, M., Frerot, B., 2006. Response of *Goniozus indicus* (Hymenoptera: Bethylidae) to sugarcane and *Cyperus papyrus* volatiles. Proceedings of the South African Sugar Technologists' Association 80, 250-255.

Snapp, S.S., Blackie, M.J., Donovan, C., 2003. Realigning research and extension to focus on farmers' constraints and opportunities. Food Policy 28, 349-363.

Soule, M.J., Tegene, A., Wiebe, K.D., 2000. Land tenure and the adoption of conservation practices. American Journal of Agricultural Economics 82, 993-1005.

South Africa, 1978. Sugar Act 9 of 1978.

Spector, J.M., Christensen, D.L., Sioutine, A.V., McCormack, D., 2001. Models and simulations for learning in complex domains: using causal loop diagrams for assessment and evaluation. Computers in Human Behavior 17, 517-545.

Steyn, H.S., 2002. Practically significant relationships between two variables. SA Journal of Industrial Psychology 28, 10-15.

Tamiru, A., Bruce, T.J.A., Woodcock, C.M., Caulfield, J.C., Midega, C.A.O., Ogol, C.K.P.O., Mayon, P., Birkett, M.A., Pickett, J.A., Khan, Z.R., 2011. Maize landraces recruit egg and larval parasitoids in response to egg deposition by a herbivore. Ecology Letters 14, 1075-1083.

Thompson, J., Scoones, I., 1994. Challenging the populist perspective: rural people's knowledge, agricultural research, and extension practice. Agriculture and Human Values 11, 58-76.

Thomson, D.N., 2010. Enhancing small-scale grower sustainability through institutional change. Proceedings of the South African Sugar Technologists' Association 83, 122-135.

Tscharntke, T., 1992. Fragmentation of Phragmites habitats, minimum viable population size, habitat suitability, and local extinction of moths, midges, flies, aphids, and birds. Conservation Biology 6, 530-536.

Tscharntke, T., Steffan-Dewenter, I., Kruess, A., Thies, C., 2002. Contribution of small habitat fragments to conservation of insect communities of grassland–cropland landscapes. Ecological Applications 12, 354-363.

Tscharntke, T., Bommarco, R., Clough, Y., Crist, T.O., Kleijn, D., Rand, T.A., Tylianakis, J.M., Nouhuys, S.v., Vidal, S., 2007. Conservation biological control and enemy diversity on a landscape scale. Biological Control 43, 294-309.

Tscharntke, T., Clough, Y., Wanger, T.C., Jackson, L., Motzke, I., Perfecto, I., Vandermeer, J., Whitbread, A., 2012. Global food security, biodiversity conservation and the future of agricultural intensification. Biological Conservation 151, 53-59.

Turlings, T.C.J., Tumlinson, J.H., Lewis, W.J., 1990. Exploitation of herbivore-induced plant odors by host-seeking parasitic wasps. Science 250, 1251-1253.

Turpie, J.K., 2004. The role of resource economics in the control of invasive alien plants in South Africa. South African Journal of Science 100, 87-93.

Turpie, J.K., Marais, C., Blignaut, J.N., 2008. The working for water programme: evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. Ecological Economics 65, 788-798.

Urquhart, P., 1999. IPM and the citrus industry in South Africa, Gatekeeper Series no. 86. International Institute for Environment and Development, Sustainable Agriculture and Rural Livelihoods Programme, London.

van de Fliert, E., 1993. Integrated pest management. farmer field schools generate sustainable practices: A case study in central java evaluating IPM training, WU Papers. Wageningen Agricultural University, Wageningen.

van den Berg, H., Jiggins, J., 2007. Investing in farmers - the impacts of farmer field schools in relation to integrated pest management. World Development 35, 663-686.

Van den Berg, J., 1997. Economic control of sorghum stem borers. Crop Protection Series, Number 3. ARC-Grain Crops Institute, Potchefstroom.

Van den Berg, J., Nur, A.F., Polaszek, A., 1998. Cultural control, In: Polaszek, A. (Ed.), African cereal stem borers: economic importance, taxonomy, natural enemies and control. CAB International, Wallingford, pp. 333-348.

Van den Berg, J., van der Walt, A., 2010. Crop pests, cropping strategies and use of Napier grass as pest management tool in the Limpopo Province of South Africa, Unpublished manuscript. School of Environmental Sciences and Development, North-West University, Potchefstroom.

Van den Berg, J., 2012. Prohibitive nature of socio-economic factors, Unpublished manuscript. School of Environmental Sciences and Development, North-West University, Potchefstroom.

van Emden, H.F., Williams, G.F., 1974. Insect stability and diversity in agroecosystems. Annual Review of Entomology 19, 455-475.

van Ginkel, C.E., Glen, R.P., Gordon-Gray, K.D., Cilliers, C.J., Muasya, M., van Deventer, P.P., 2011. Easy identification of some South African wetland plants. WRC Report No TT 479/10. Water Research Commission, Pretoria.

van Huis, A., Meerman, F., 1997. Can we make IPM work for resource-poor farmers in sub-Saharan Africa? International Journal of Pest Management 43, 313-320.

van Huis, A., 2009. Challenges of integrated pest management in sub-Saharan Africa, In: Peshin, R., Dhawan, A.K. (Eds.), Integrated pest management: dissemination and impact. Springer Science+Business Media B.V. , Dordrecht, pp. 395-417.

van Veldhuizen, L., Waters-Bayer, A., De Zeeuw, H., 1997. Developing technology with farmers: a trainers guide for participatory learning. Zed Books, London.

van Wilgen, B.W., Richardson, D.M., le Maitre, D.C., Marais, C., Magadlela, D., 2001. The economic consequences of alien plant invasions: examples of impacts and approaches to sustainable management in South Africa. Environment, Development, and Sustainability 3, 145-168.

Vanclay, F., 2004. Social principles for agricultural extension to assist in the promotion of natural resource management. Australian Journal of Experimental Agriculture 44, 213-222.

Vanlauwe, B., Kanampiu, F., Odhiambo, G.D., De Groote, H., Wadhams, L.J., Khan, Z.R., 2008. Integrated management of *Striga hermonthica*, stemborers, and declining soil fertility in western Kenya. Field Crops Research 107, 102-115.

Vreysen, M.J.B., A. S. Robinson, A.S., Hendrichs, J., 2007. Area-wide control of insect pests: from research to field implementation. Springer Science+Business Media B.V, Dordrecht.

Waller, B.E., W. Hoy, C., Henderson, J.L., Stinner, B., Welty, C., 1998. Matching innovations with potential users, a case study of potato IPM practices. Agriculture, Ecosystems & Environment 70, 203-215.

Warner, K.D., 2008. Extending agroecology: grower participation in partnerships is key to social learning. Renewable Agriculture and Food Systems 21, 84-94.

Way, M., 2004. Annual local pest and disease and variety control committee pest report. South African Sugarcane Research Institute, Mount Edgecombe.

Way, M.J., 2001. Characteristics of sugarcane bored by *Eldana saccharina* (Lepidoptera: Pyralidae). Proceedings of the South African Sugar Technologists' Association 75, 257.

Way, M.J., Goebel, F.R., 2003. Patterns of damage from *Eldana saccharina* (Lepidoptera: Pyralidae) in the South African sugar industry. Proceedings of the South African Sugar Technologists' Association 77, 239-240.

Way, M.J., Goebel, F.R., Gillespie, W.A., 2003. Surveying *Eldana saccharina* (Lepidoptera: Pyralidae) in a small-scale grower sector of the South African sugar industry. Proceedings of the South African Sugar Technologists' Association 77, 275-277.

Way, M.J., 2012. Thysanoptera diversity in the South African sugar industry. Proceedings of the South African Sugar Technologists' Association 85, 171.

Webster, T.M., Maher, G.W., Conlong, D.E., 2005. An integrated pest management system for *Eldana saccharina* in the Midlands North region of KwaZulu-Natal. Proceedings of the South African Sugar Technologists' Association 79, 347-358.

Webster, T.M., Brenchley, P.G., Conlong, D.E., 2009. Progress of the area wide integrated pest management plan for *Eldana saccharina* Walker (Lepidoptera: Pyralidae) in the Midlands North region of KwaZulu-Natal. Proceedings of the South African Sugar Technologists' Association 82, 471-485.

Westmacott, C.E., 2002. Comparison of *Eldana saccharina* arthropod predator assemblages in sugarcane grown under different cultural conditions. Unpublished MSc Thesis. Department of Zoology and Entomology, University of KwaZulu-Natal, Pietermaritzburg.

Wezel, A., Bellon, S., Doré, T., Francis, C., Vallod, D., David, C., 2009. Agroecology as a science, a movement and a practice: a review. Agronomy for Sustainable Development 29, 503-515.

Williamson, M., 1996. Biological invasions. Chapman & Hall, London.

Wuensch, K.L., 2009. Standardised effect size estimation: why and how? Available online: http://core.ecu.edu/psyc/wuenschk/statslessons.htm (Accessed: 24/06/2012).

Wyatt, J., 1997. Wetland Fix 6: Alien plant control guide. Mondi Wetlands Programme, Irene. Available online: http://www.wetland.org.za/ckfinder/userfiles/files/3_5_6-%20Wetland%20Fix%20-%20Part%206.pdf (Accessed 07/11/2012).

Zhang, W., Ricketts, T.H., Kremen, C., Carney, K., Swinton, S.M., 2007. Ecosystem services and dis-services to agriculture. Ecological Economics 64, 253-260.

Appendices

Appendix A: Questionnaire used for large-scale growers' survey (Chapter 1)

Farm Name & GPS:	*Farmer name:*		*Date:*		*No.:*
Eldana habitat management project: Pre-introduction survey with large-scale/commercial farmers					
PART 1: Demographic/Personal Profile Questions:					
1	Gender:	1. Male	2. Female		
2	Age:	1. 18-30 years	2. 31-40 years	3. 41-50 years	4. 51-60 years	5. 60+ years
3	How long have you been farming sugarcane?	1. less than 5 years	2. 5-10 years	3. 11-20 years	4. 21-31 years	5. more than 30 years
4	Do you have tertiary education?	1. yes	2. no			
	4.a. If yes, where did you study, and what course did you study?					
5	Have you ever had additional training on farming?	1. yes	2. no			
	5.a If yes, what topics were you trained in?	1. sugarcane farming	2. pest management	3. other crops	4. livestock farming	5. other: _____
6	What is your relationship to this farm/land?	1. owner	2. manager	3. shareholder	4. owner and manager	5. other: _____
7	Which other crops or livestock do you farm on this land?	1. none	2. maize	3. timber	4. livestock	5. other: _____
PART 2: General insect pest management questions:						
8	Which is the biggest problem affecting sugarcane yield on your farm? Please rank the following options from 1 to 6: 1 is the worst problem, 6 is the least problem.	1. soil				
		2. rainfall				
		3. insect pests				
		4. disease				
		5. frost				
		6. variety choice				
9	Which pest and/or disease problems are the worst on your farm?					
10	Which sugarcane insect pest is the biggest problem on your farm? Please rank the following options from 1 to 5: 1 is the worst problem, 5 is the least problem.	1. Eldana				
		2. white grub				
		3. Sesamia				
		4. thrips				
		5. aphids				
11	Have you ever used insecticides on your sugarcane?	1. yes	2. no			
12	If you have used insecticides before, please describe which product you used, and which insects were causing the problem.					
13	Please select which of these methods you use for insect pest control: rank the options from 1 to 5: 1 is the most used, 5 is the least used.	1. spraying				
		2. habitat management/pp				
		3. monitoring				
		4. cutting&hygiene managmt				
		5. variety choice				

	PART 3: Eldana pest management questions:					
14	Have you heard of Eldana?	1. yes	2. no			
15	Please identify Eldana and Eldana damage from these photos/specimens:	1	2	3	4	5
16	Has Eldana ever been found on your farm?	1. yes	2. no			
17	Do you know that the range of Eldana is spreading from the coast inland?	1. yes	2. no			
18	Please choose your response to this statement: Eldana is currently a threat to sugarcane production in the Midlands North area.	1. strongly agree	2. agree	3. neutral	4. disagree	5. strongly disagree
19	Please choose your response to this statement: Eldana will be a threat to sugarcane production in the Midlands North area in the near future.	1. strongly agree	2. agree	3. neutral	4. disagree	5. strongly disagree
20	Are you worried about Eldana possibly affecting your sugarcane production in the future?	1. yes	2. no			
21	How serious a problem is Eldana in sugarcane production on your farm at the moment? Please choose a number from 1 to 5: 1 is the most serious, 5 is the least serious.	1	2	3	4	5
22	Why did you choose this option in the question above:					
23	What do you do to control Eldana? Please rank these 5 control measures from 1 to 5: 1 is the one you use the most, 5 is the one you use the least.	1. spray				
		2.monitor				
		3. hygiene & cutting				
		4. push-pull				
		5. variety choice				
24	Have you heard of Integrated Pest Management as a method for controlling Eldana?	1. yes	2. no			
25	Have you heard of 'habitat management' or 'push-pull' as a method for controlling Eldana?	1. yes	2. no			

26	Have you been involved in more positive or more negative discussions about habitat management/push-pull/ IPM?	1. positive	2. negative	3.positive and negative	4. none	
27	Where did you first hear about IPM/habitat management/push-pull for Eldana control?	1. general reading	2. other farmers	3. MNP&D or Ecozone days	4. SASRI information packs/pamphlets	5. other: _____
28	Do you know these plants (used for push-pull)? Please say yes/no/maybe for each one:	1. Melinis minutiflora/Molasses grass	2. Bt maize	3. sedges	4. *Cyperus papyrus*	5. *Cyperus dives*
29	Do you know how Bt maize works? If so, please explain:					
30	Do you know where you could get Bt maize seed?					
31	Do you know where you could Molasses grass seed/seedlings?					
32	Do you know where you could get sedges/Cyperus sp. ?					
33	Do you read the SASRI pamphlets and information packs that are sent to you?	1. yes, always	2. yes, mostly	3. sometimes	4. no, not much	5. no, never
34	Do you think push-pull/habitat management as part of an IPM approach is a good method for controlling Eldana?	1. yes	2. no	3. maybe	4. I don't know habitat management	5. other: _____
35	Do you know how to implement habitat management on your farm?	1. yes	2. no			
36	Do you think that you understand the practical and cost implications of habitat management?	1. yes	2. no			

	PART 4: Questions about extension work/intervention:					
37	Is the information you receive about pest management from SASRI/the local Pest & Disease office useful to you?	1. yes	2. no			
38	Are you interested in receiving more information on pest management than you currently receive?	1. yes	2. no			
39	Would you like to learn more about push-pull/habitat management for controlling Eldana?	1. yes	2. no			
40	How would you like to learn more about push pull and other methods for controlling Eldana? Please rank these options from 1 to 5: 1 is the one you would be most interested in, 5 is the one you would be least interested in.	1. Eco-zone/farmers info days				
		2. Visiting model farms which show the method				
		3. Pamphlets/info by email or post				
		4. Interactive workshops				
		5. Personal contact with P&D/SASRI officers				
41	How often would you like to receive information via workshop/pamphlet about pest management from SASRI/P&D office:	Workshops	1. Once a year	2. 2-3 times a year	3. Once a month	4. Other:
		Pamphlets	1. Once a year	2. 2-3 times a year	3. Once a month	4. Other:
42	Are you willing to be involved in future research toward introducing push-pull for control of Eldana in this area?	1. yes	2. no			
43	How would you suggest we go about introducing a new method like push-pull for control of Eldana in the Midlands North area?					
44	What do you see as the biggest barrier to us introducing a new method like push-pull for Eldana amongst farmers?					

Appendix B: Summary of data analysis methods (Chapter 2)

Results Section	Data presentation & analysis	Statistical tests reported	Tables and Figures
2.3.1 Respondents' profiles	• Frequencies and percentages (descriptive statistics)	• No statistical tests	Table 2.1
2.3.2 General sugarcane and insect pest management & perceptions	• Ranking data (median rank scores) • Contingency tables • Frequencies and percentages (descriptive statistics, pie charts and bar graphs)	• Wilcoxon signed ranks test (*p*-value, *Z* statistic) • Chi squared (χ^2, *p*-value, df) • effect sizes (*w* statistic)	Appendix 3 Figure 2.2, 2.4 Figure 2.3
2.3.3 Knowledge, perceptions and practices of *E. saccharina*	• Ranking data (median rank scores) • Contingency tables • Frequencies and percentages (descriptive statistics, bar graphs)	• Wilcoxon signed ranks test (*p*-value, *Z* statistic) • Chi squared (χ^2, *p*-value, df) • effect sizes (*w* statistic)	Appendix 3 Figure 2.5 Figure 2.6
2.3.4 Knowledge and perceptions of push-pull and IPM	• Contingency tables • Frequencies and percentages (descriptive statistics, bar graphs)	• Chi squared (χ^2, *p*-value, df) • effect sizes (*w* statistic)	Table 2.2 Figure 2.7 Figure 2.8
2.3.5 Dissemination of pest management information	• Ranking data (median rank scores) • Frequencies and percentages (descriptive statistics, pie charts and bar graphs)	• Wilcoxon signed ranks test (*p*-value, *Z* statistic)	Appendix 3 Figure 2.9 Figure 2.10 Figure 2.11

Appendix C: Details of Wilcoxon signed rank tests for ranking questions (Chapter 2)

Pairs of variables compared	*p*-value	Bonferroni corrected *p*-value	*Z* statistic
A. Sugarcane production constraints			
soil and rainfall	0.137	2.055	1.486
soil and insect pests**	0.000	0.000	5.182
soil and disease**	0.000	0.000	4.481
soil and frost	0.945	14.175	0.070
soil and varieties**	0.000	0.003	3.725
rainfall and insects**	0.000	0.000	5.386
rainfall and disease**	0.000	0.000	4.219
rainfall and frost	0.149	2.235	1.443
rainfall and varieties**	0.000	0.002	3.852
insect pests and disease	0.010	0.153	2.570
insect pests and frost**	0.000	0.000	4.873
insect pests and varieties**	0.000	0.004	3.629
disease and frost**	0.000	0.003	3.713
disease and varieties	0.075	1.124	1.781
frost and varieties**	0.001	0.015	3.283
B. Worst insect pests			
eldana and white grub	0.069	0.691	1.817
eldana and sesamia	0.444	4.440	0.765
eldana and thrips	0.575	5.754	0.560
eldana and aphids	0.499	4.990	0.676
white grub and sesamia	0.335	3.345	0.965
white grub and thrips	0.148	1.475	1.448
white grubs and aphids	0.059	0.592	1.887
sesamia and thrips	0.125	1.250	1.533
sesamia and aphids	0.124	1.235	1.540
thrips and aphids	0.529	5.290	0.629
C. Eldana pest management activities			
insecticides and monitoring*	0.008	0.077	2.666
insecticides and cultural control*	0.008	0.077	2.666
insecticides and push-pull	0.012	0.117	2.521
insecticides and varieties	0.018	0.178	2.369
monitoring and cultural control	0.058	0.585	1.892
monitoring and push-pull	0.455	4.550	0.747
monitoring and varieties	0.889	8.889	0.140
varieties and cultural control	0.026	0.263	2.221
varieties and push-pull	0.313	3.130	1.010
push-pull and cultural control	0.022	0.217	2.296

D. Favoured extension methods			
farm days and model farms	0.988	9.880	0.015
farm days and pamphlets**	0.000	0.001	4.031
farm days and workshops**	0.000	0.000	4.098
farm days and personal visit	0.046	0.461	1.994
model farms and pamphlets**	0.000	0.002	3.751
model farms and workshops**	0.000	0.000	4.412
model farms and personal visits	0.017	0.165	2.397
pamphlets and workshops	0.606	6.055	0.516
pamphlets and personal visits*	0.005	0.047	2.828
workshops and personal visits**	0.001	0.014	2.467

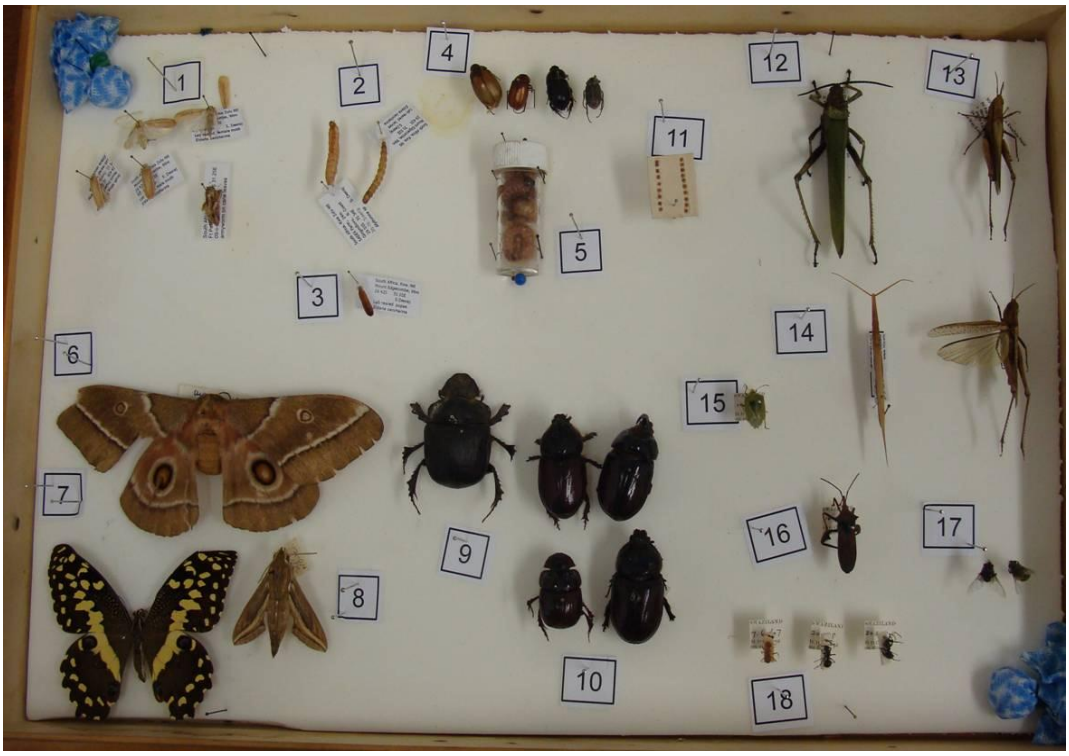
Appendix D: Questionnaire used by Reunion island students (Chapter 3)

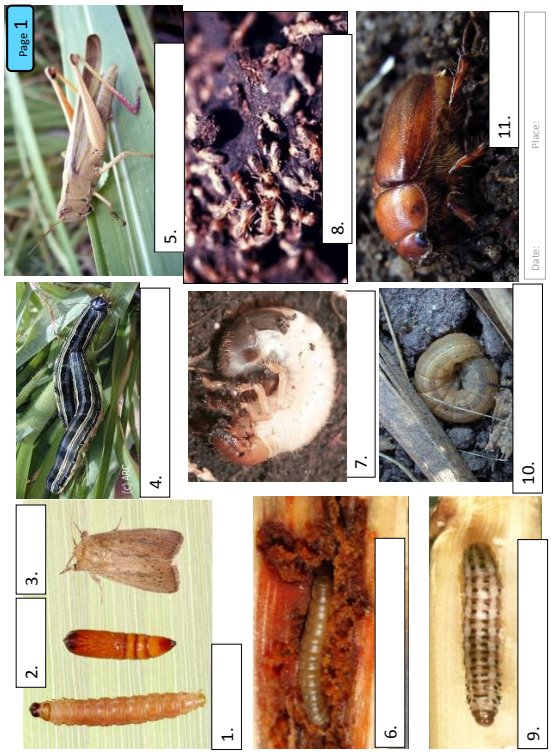
SHORT SURVEY FOR SMALL SCALE GROWERS – SCORES

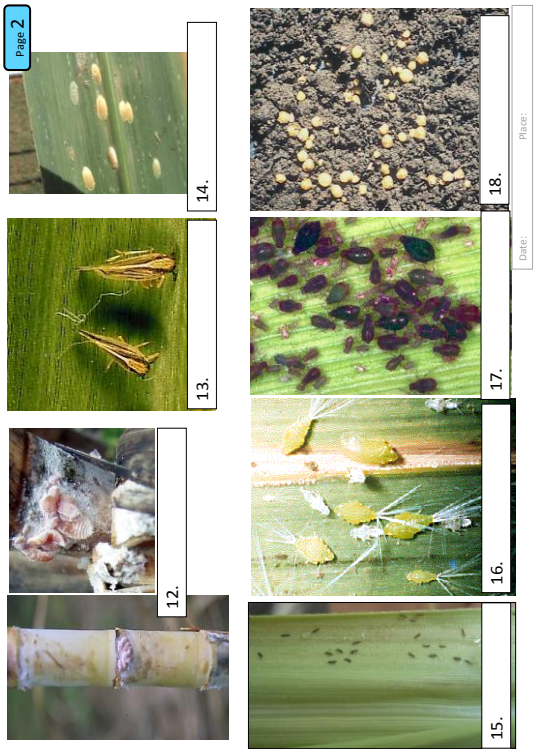
0	Don't know what the topic is about
1	It's a wrong or incomplete answer at the question
2	It's a right answer at the question

VARIETIES	What variety do you grow ?	N 12, N 16, N 37, N 48 …
SOILS	Are your fields soil sampled ? Why ?	"No" -> 0 "Yes, EO Advice" -> 1 "Yes / explain" -> 2
REPLANTING	Have you ever replanted your sugarcane ? (double check with date of first plantation)	"Don't' know or No" -> 0 "No but I know" -> 1 "Yes/explain" -> 2
FERTILISER	Do you apply fertiliser ? Why ?	"Don't' know or No" -> 0 "No but I know" -> 1 "Yes/explain" -> 2
PESTS	Do you know what are the main pests in the area ? (2 names)	2 listed among : Eldana / Leaf eaters / soil pests / sap feeders
	Have you seen eldana in your sugarcane ? How do we control it ?	2 listed among : Use healthy seedcane, use insecticide, survey method
DISEASES	Do you know what are the main diseases in the area ? (2 names)	2 listed among : RSD, Smut, Mosaïc, Rust
	Give us 2 means to control disease.	2 listed among : Varieties, replant, chemical, healthy seedcane
WEEDS	Do you know what are the main weeds in the area ? (2 names)	2 listed among : Tufted & creeping grasses / sedges / broard leaf
	Give us 2 means to control weeds	2 listed among : Weedice / Hand hoeing / Trashing
HARVEST	How many months after planting do you harvest ? (check with EO)	"Don't' know" -> 0 "Wrong" -> 1 "Right" -> 2
ADVICES	How many times do you get extension officiers visits (numbers / year) ?	"0 à 1" -> 0 "2 à 3" -> 1 "3 et + " -> 2
	Do you get other advice except from EO's ? Who from ?	"Don't' know" -> 0 "No" -> 1 "Yes" -> 2
ECONOMIC RESULTS	Do you know what is your SC income ? Explain us	"Don't' know" -> 0 "I know/don't explain" -> 1 "I know/explain" -> 2
PROSPECT	What are your plans for SC and other production in the future ?	"No plan" -> 0 "Plan without details" -> 1 "Plan and details" -> 2

Appendix E: Insect specimens and photographs used during focus group discussions about insect pests (Chapter 3)







Appendix F: Questionnaire used for push-pull adoption telephone survey (Chapter 4)

Questionnaire: LSG follow-up survey on push-pull implementation

1. Have you had eldana on your farm?

2. What do you think of push-pull?

3. Please rate how effective you think push-pull, as part of IPM, is for controlling eldana:

0=not effective, 10=very effective

4. Please rate your knowledge of how to implement push-pull:

0=no knowledge, 10=excellent knowledge

5. Have you implemented push-pull on your farm?

6. Why/why not?

If yes: 7. Please explain how you did this:

8. Do you have suggestions for other farmers starting to implement push-pull?

9. Have you had any problems with implementing push-pull?

10. How much of a hassle is implementing push-pull, please rate from 0-10: 0= no hassles

10=a lot of hassle

If no: 11. What would have to happen for you to start implementing push-pull next week?

12. Please tell me how you would score eldana management in your management priorities,

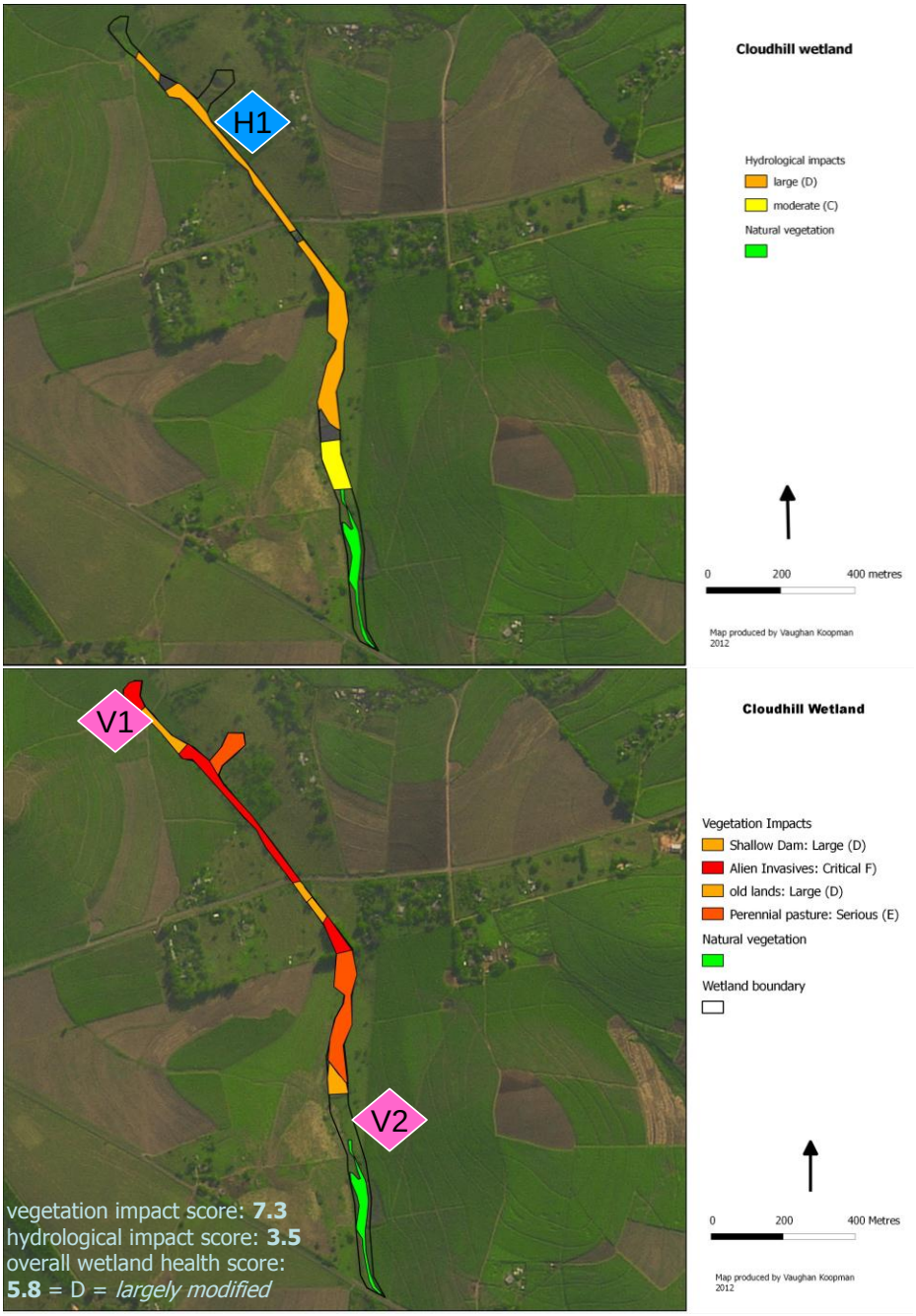
from 0 – 10 i.e. 0=no priority, 10=top priority:

13. Please indicate how important environmental matters are in your farm decision-making:

0=not important at all, 10=very important

Appendix G: Maps and summaries of WET-Health assessments (Chapter 6)

CLOUDHILL: Wetland assessment and recommended action for eldana push-pull

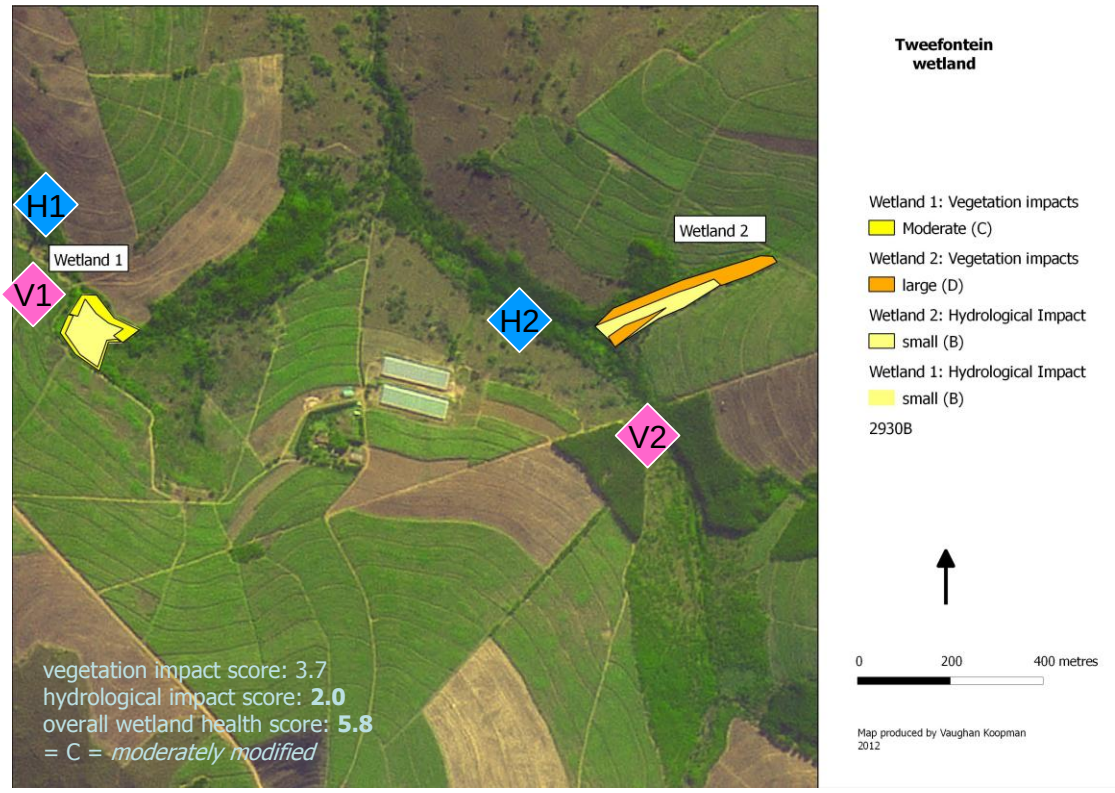


Assessment: The wetland at Cloudhill is a palustrine wetland with a channel. Large sections are overgrown with alien invasive plants or converted to pasture/small dams. Large woody invasive alien plants (IAPs) cause the channel to become more incised and erosion to increase (H1). The lower portion has a healthy patch of natural vegetation. Action: Immediate recommended action is to clear IAPs from accessible, priority areas (e.g. stream crossings) and establish *Cyperus papyrus* and *Cyperus dives* (V1&V2). These may need to be protected from grazing cattle. Long-term recommended action is to remove large woody IAPs from the channel (H1) and maintain the entire system free of IAPs.

WATERFALL: Wetland assessment and recommended action for eldana push-pull

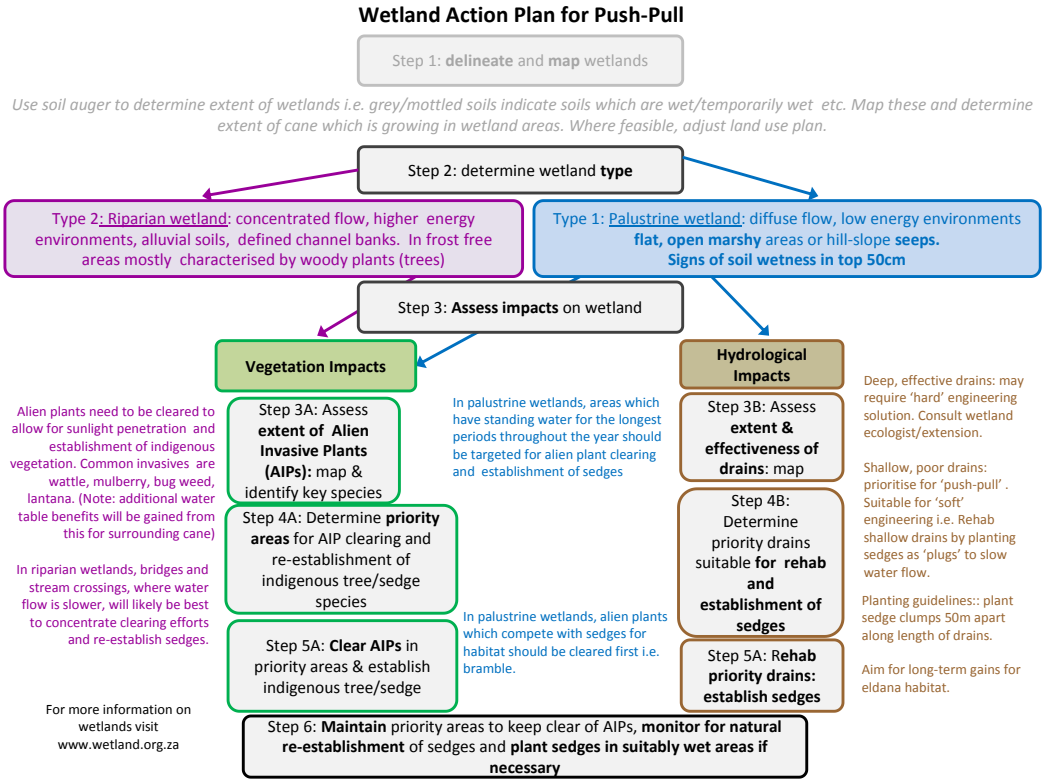
Assessment: The wetlands at Waterfall are unchanelled palustrine wetlands. Due to extensive drains for crop lands, there are large hydrological impacts on this wetland. One large and two small dams have caused large vegetation impacts as well. Overall the size of the wetland is much reduced form its natural state. However, good control of invasive alien plants (IAPs) in the wetland means that there are areas with healthy natural vegetation, including sedges. Action: continue with IAP management, slow flow in least used/functioning drains by planting *Cyperus dives* and *Cyperus papyrus* (H1). In the long-term, consider blocking other drains and taking one field entirely out of production, as it is within the wetland zone (H2).

TWEEFONTEIN Wetland assessment and recommended action for eldana push-pull



Assessment: The two wetlands assessed at Tweefontein are hill slope seeps which are part of a larger stream channel which was not assessed. The vegetation in the two hill seeps is not modified much, although there is quite a bit of black wattle (*Acacia mearnsii*) encroaching on Wetland 2, and some *Lantana camara* encroaching on Wetland 1. There are hardly any hydrological impacts on these two wetlands, however invasive alien plants (IAPs) are having impacts on the larger stream channel. Action: IAPs should be cleared from the stream channel at crossings to allow establishment of *Cyperus papyrus* and *Cyperus dives* in accessible areas (V1, V2). IAPs must be kept out of the hill slope seeps. In the long-term, large woody IAPs should be removed from the stream channel (e.g. H1 H2) which will allow natural re-establishment of sedges in places.

Appendix H: "Push-pull wetland action plan": A tool for farmers to assess wetlands and maximize efficacy as *E. saccharina* habitat (Chapter 6)



Background and motivation for managing wetlands for push-pull: Why optimise wetlands for eldana control?

Research has shown that eldana prefers wetland sedges (*Cyperus dives* & *Cyperus papyrus*) to sugarcane. Eldana is most effectively controlled naturally in sedges by its natural enemies (parasitoids). Field trials and farmers' experiences have shown that well-managed cane adjacent to sedges growing in wetlands has lower infestations of eldana than cane which is not adjacent to sedges. Because they provide habitat and natural control for eldana (=a population 'sink'), well-managed wetlands can be a valuable resource to farmers. 'Habitat management' means managing plant habitats to maximise their efficacy in controlling crop pests. In the push-pull system, which is recommended by SASRI as part of IPM for eldana control, wetland sedges can serve as a strong 'pull' for eldana.

Wetland management to maximise the beneficial ecosystem services which wetlands provide is becoming more and more important. Using push-pull as a motivation to approach wetland restoration and management can help to focus farmers' efforts in rehabilitating their wetlands. Clearing alien plants can be costly but long term yield benefits will outweigh short term clearing costs.

The benefits of wetlands can be shared across farm boundaries. Farmers are encouraged to work together on area-wide IPM programmes when restoring their wetlands .

Broad recommendations for managing wetlands to optimise them as habitat for eldana

- Sedges grow in moist soils – prioritise these areas for alien invasive plant (AIP) clearing and establishment of sedges.
- Key sedge species to establish for eldana habitat: *Cyperus dives* (giant sedge) & *Cyperus papyrus* (papyrus). *Cyperus latifolius* can provide habitat as well, but is a lot less favoured than the other two.
- Use source material from natural sedge populations on the farm/neighbouring farms.
- Sedges can be transplanted : dig up rhizomes, split them, trim growth (leave ~30cm) and re-plant in wet areas. Transplanted sedges take 2-3 years to establish. They are fire and frost tolerant.
- Prioritise most natural areas for establishment of sedges and start with less infested areas to maximise effort.
- Look out for 'wet spots' in fields where a stand of sedge (e.g. papyrus) can be established.
- Establish a 1-2m buffer zone of natural vegetation alongside drains/riparian wetland areas. Ideally maintain indigenous vegetation in these buffer zones.
- Burning: reduce burning frequency and intensity. i.e. try to burn once every 2-3 years, when burning try to do a cool and/or patchy burn in wetland areas. **Remember: frequent burning favours AIPs.**
- The ideal is that all wetland areas be restored to their natural state, however this is often not economically viable. By managing wetlands with an emphasis on eldana habitat, one can take small achievable steps towards improving wetland management on a farm.

Appendix I: Accession numbers of stem borer and parasitoid specimens identified at the ARC-PPRI Biosystematics Division in Pretoria (Chapter 6)

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BIOSYSTEMATICS DIVISION

IDENTIFICATION JOB SHEET

Material received from:

Ms Jessica Cockburn
SASRI
Entomology Department

Date: 2012/11/05

Identification Job Number: **2012/159 2nd report**

Date received: 2012/10/19

Receipt acknowledged: Yes

Sender's Accession Number	Our Accession Number	Family Name	Species Name	Determiner & Date
S.Ex 2219	AcP 9526	BRACONIDAE	*Stenobracon* sp.	G.L. Prinsloo, 2012
S.Ex 2220	AcP 9527	BRACONIDAE	*Dolichogenidea* sp.	G.L. Prinsloo, 2012
S.Ex2221	AcP 9528	BRACONIDAE	*Cotesia* sp. probably *sesamiae* (Cameron)	G.L. Prinsoo, 2012
S.Ex 2222	AcP 9529	BRACONIDAE	*Cotesia* sp. probably *sesamiae* (Cameron)	G.L. Prinsoo, 2012
S.Ex 2223	AcP 9530	BRACONIDAE	Undet. male specimens Probably *Cotesia* sp.	G.L. Prinsoo, 2012
S.Ex 2224	AcP 9531	BRACONIDAE	*Cotesia* sp.	G.L. Prinsoo, 2012
S.Ex 2122	AcP 9511	PYRALIDAE	*Eldana saccharina* Walker Female	VM Uys, 2012
S.Ex 2127	AcP 9512	CRAMBIDAE	Prob. *Chilo partellus* (Swinhoe) (Genitalia damaged on slide)	VM Uys, 2012
S.Ex 2226	AcP 9513	PYRALIDAE	*Eldana saccharina* Walker Female	VM Uys, 2012
S.Ex 2227	AcP 9514	PYRALIDAE	*Eldana saccharina* Walker Female	VM Uys, 2012

Sender's Accession Number	Our Accession Number	Family Name	Species Name	Determiner & Date
S.Ex 2233	AcP 9515	CRAMBIDAE	*Chilo partellus* (Swinhoe) male	VM Uys, 2012
S.Ex 2234	AcP 9516	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2235	AcP 9517	CRAMBIDAE	*Chilo partellus* (Swinhoe) male	VM Uys, 2012
S.Ex 2236	AcP 9518	CRAMBIDAE	*Chilo partellus* (Swinhoe) male	VM Uys, 2012
S.Ex 2237	AcP 9519	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2238	AcP 9520	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2239	AcP 9521	CRAMBIDAE	*Chilo partellus* (Swinhoe) male	VM Uys, 2012
S.Ex 2240	AcP 9522	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2241	AcP 9523	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2242	AcP 9524	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012
S.Ex 2243	AcP 9525	CRAMBIDAE	*Chilo partellus* (Swinhoe) female	VM Uys, 2012

Appendix J:

PHOTOGRAPHIC ESSAY

Sending Eldana Home

Moving eldana out of sugarcane
back into its natural wetland habitat

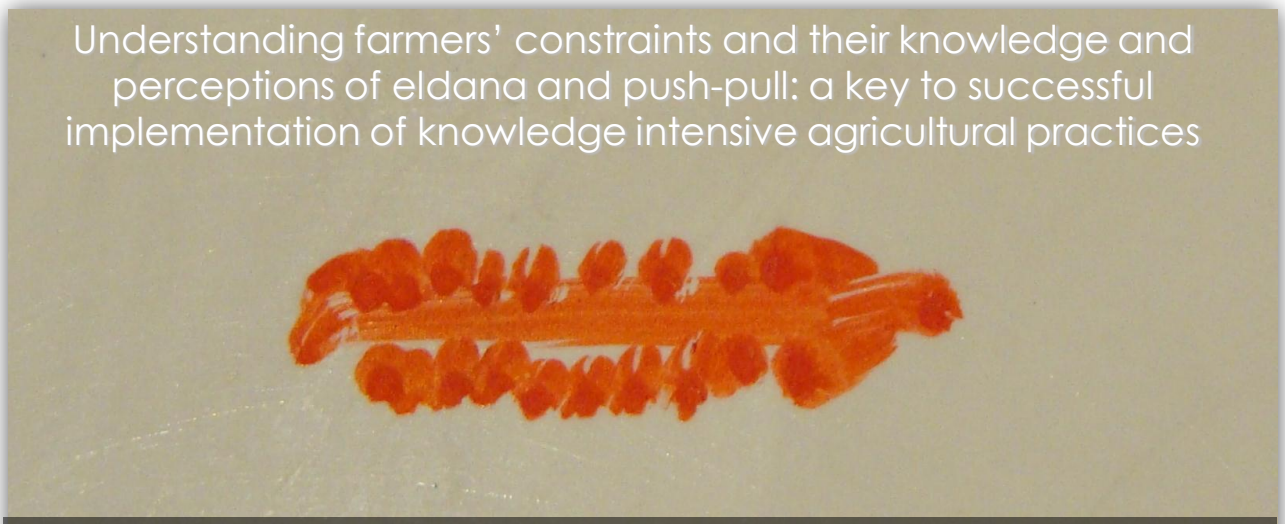
Jessica Cockburn

Eldana saccharina is the most damaging pest of sugarcane in South Africa. It is estimated to cause up to R150 million in revenue loss to the industry annually

Eldana is an indigenous insect of wetlands. Destruction of wetland habitats to plant sugarcane is thought to have caused the insect to shift onto sugarcane as a new host. It reaches much higher populations in sugarcane than in its wild host plants and its natural enemies have not followed it into its new habitat. Worldwide, vast monocrops are recognised as unstable ecosystems prone to intensive pest infestations which are difficult to control.


Push-pull plants
Research has shown that eldana prefers its indigenous host plants, the sedges *Cyperus dives* and *Cyperus papyrus*, to sugarcane. Thus they are recommended as 'pull plants' to attract eldana away from sugarcane back into its natural habitat. They grow naturally in wetlands in KwaZulu-Natal

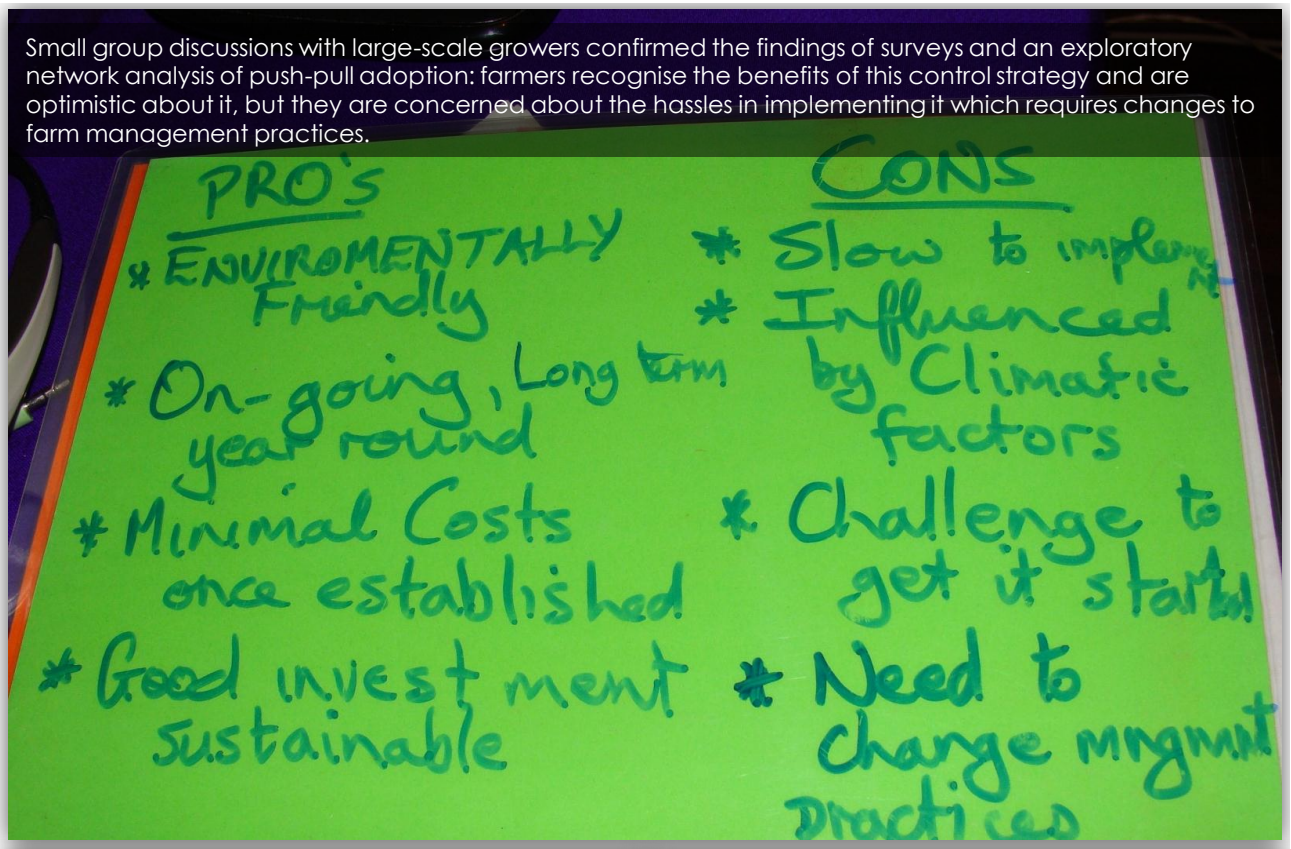

Molasses grass (*Melinis minutiflora*) has been used as a repellent 'push plant' against maize stem borers and has shown to effectively repel eldana from sugarcane and reduce damage.
Genetically modified Bt maize can be used as a 'dead end trap crop' or a 'pull plant' for eldana: maturing maize has been shown to be more attractive to egg-laying eldana moths than sugarcane.



A field visit to small-scale growers on the south coast to implement push-pull revealed that they did not know anything about eldana or how to manage it. We took a few steps back and discussed stem borers in maize, which the farmers were familiar with – this is a drawing of a stem borer by one of the participants.

Participatory research tools, including sketch maps and matrix scoring, allowed farmers to explain what sugarcane means to them. This showed that sugarcane makes a large contribution to household food security and education costs. Many small-scale growers are women who are responsible not only for sugarcane farming but also for the well-being of their children on a daily basis.

Focus group discussions about insects elicited much interest and knowledge from farmers about insects. They know a lot of pests of food crops and have many innovative control measures for these. In contrast, they know little about sugarcane pests and their control. They don't perceive sugarcane pests as a major constraint.



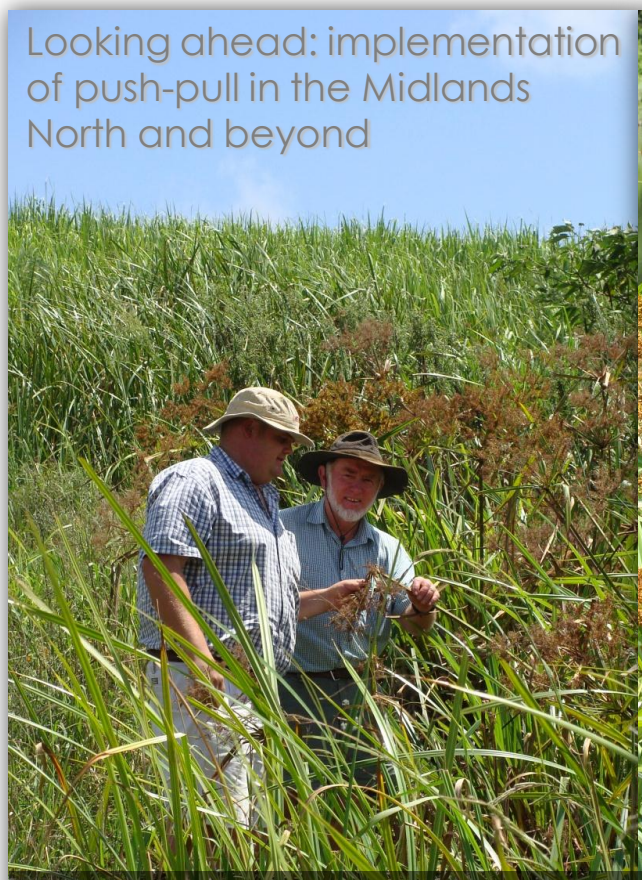
Small group discussions with large-scale growers confirmed the findings of surveys and an exploratory network analysis of push-pull adoption: farmers recognise the benefits of this control strategy and are optimistic about it, but they are concerned about the hassles in implementing it which requires changes to farm management practices.

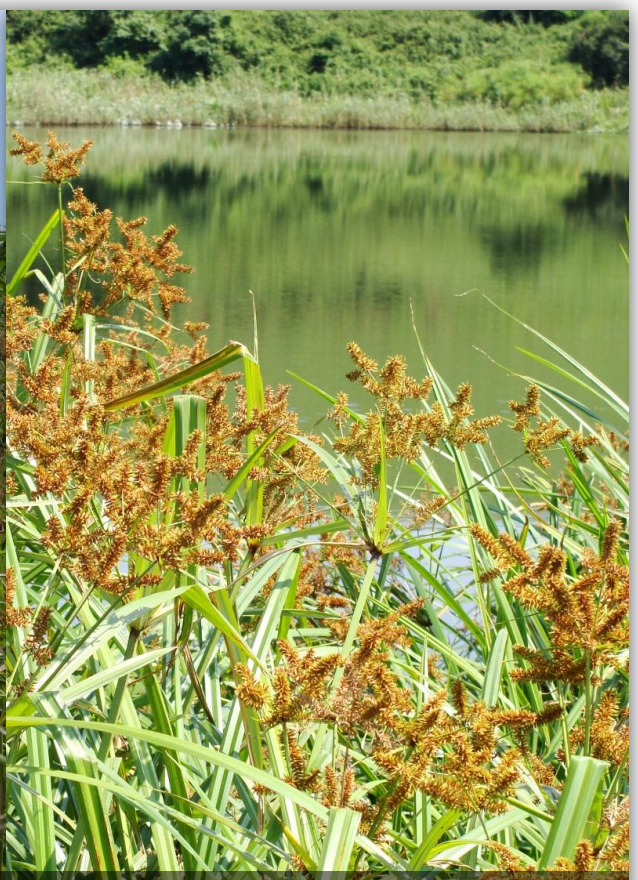
Model farms on which push-pull field trials were conducted doubled as sites for field days. Host farmers became push-pull experts and the strategy was adapted to suit their farming practices. 'Learning by doing' reduced farmers perceptions of push-pull as a hassle, and they could share advice on how best to implement it with visiting farmers.

Model farms provided opportunities for farmers, extension staff and researchers to work together on implementing push-pull for control of eldana, promoting participatory research and extension.

Experiential learning: planting push and pull plants together with farmers helps them to realise the value of biodiversity in agricultural systems. Push-pull is an inexpensive, low input strategy which can reduce the impact of eldana on sugarcane.

Looking ahead: implementation of push-pull in the Midlands North and beyond





Where farmers have planted sedges to pull eldana away from the cane, in combination with molasses grass as a push, they are noticing reductions in eldana damage. This only works in conjunction with good crop management in an integrated pest management (IPM) framework. Good wetland management is also crucial, and a tool has been developed to aid farmers in this.

Implementation of push-pull in the Midlands North is on track. Most farmers are enthusiastic about push-pull and IPM and realise the long-term benefits of such sustainable agricultural practices. Participatory approaches to research and extension, in which farmers' constraints, perceptions and knowledge were investigated, have been a vital component of this success. Push-pull can help to reduce damage to crops from eldana and send it home!