

## Editorial

### **Environmental change and sustainability issues in the Kalahari region**

The collection of papers in this special edition of the Journal of Arid Environments is a sequel to a Workshop held in Maun, Botswana, in October 2000, on the theme *Climate Change, Biodiversity and Multi-species Production Systems in the Kalahari Region*. Constituting only about one-third of the workshop papers delivered, this set of articles survived a rigorous peer-review process and are being published as one of the planned outputs of the Maun meeting. Except for the keynote paper by Darkoh which is a review article with a continental purview, the collection is based on research conducted by natural and social scientists within the Southern African Kalahari region either as part of the Southern African Science Initiative (SAFARI 2000) co-ordinated from the University of Virginia in the U.S.A. or of the Kalahari Transect project based at the University of Botswana.

The distinguishing characteristics of the Kalahari region are the deep aeolian Kalahari sands and the 150–1500 mm, south-to-north, rainfall gradient (Scholes & Parsons, 1997; Ringrose & Chanda, 2000). The region is renowned for its rich wildlife resources and hosts a diversity of agricultural and non-agricultural livelihood systems. However, mounting pressure from various human activities and the threat of climate desiccation due to global (climate) change pose serious challenges to environmental and livelihood sustainability in the region. Finding effective responses to these challenges are hampered by a host of constraints among which is a general dearth of adequate scientific databases on critical socio-economic and biophysical environmental issues. It is within this context that the papers presented in this volume should be viewed: they represent a small contribution towards building a knowledge base for the sustainable management and development of the Kalahari region, complementing earlier, often diffuse, efforts in this direction (e.g. Skarpe, 1986, 1990, 1992; Thomas & Shaw, 1991; Perkins & Thomas, 1993*a,b*; Ringrose *et al.*, 1996; Dube, 1998; Dougill *et al.*, 1998*a,b*; Darkoh, 1999; Ringrose & Chanda, 2000).

The volume opens with the keynote paper by Michael Darkoh addressing the important question of the intricate relationship between agriculture and biodiversity on the African continent. The next three papers, authored by Caylor *et al.*, Ringrose *et al.* and Hipondoka *et al.* address land-use/-cover change issues. Some highlights from this set include the finding by Ringrose *et al.* of a negative association between rainfall and woody vegetation cover, suggesting the phenomenon of bush encroachment increasing towards the drier parts of Botswana. Although at present this trend could be due to overgrazing (Moleele, 1999), recent studies on the potential impact of climate change on woody vegetation in Botswana have indicated the expansion of the area under shrubs and bush encroachment species (Ringrose *et al.*, 2002). The finding reported in the paper by Hipondoka *et al.* that both grasses and trees in the Kalahari commit the bulk of their roots to tapping moisture within surface soil horizons challenges the conventional wisdom that trees in the Kalahari environment are mostly deep rooting. The next set of papers (Feral *et al.*, Aranibar *et al.* and Mubyana *et al.*) deal with issues of soil nutrient status and microbial activity, highlighting the influence of land use and rainfall (Feral *et al.*) and nitrogen-fixing microbes (Aranibar *et al.*). The study by Mubyana *et al.* demonstrates the low nutrient status of the soils of the Okavango Delta, much in line with the findings reported in Chanda *et al.* in this volume about the soils of the Matsheng in the drier southern region of Botswana.

Aerosol and trace gas pollution in the Southern African region has become a significant issue of concern among scientists since the discovery by Peter Tyson and co-workers of persistent aerosol layers in the troposphere controlled by the ambient subtropical high-pressure region (e.g. Tyson, 1997). The set of articles by Stein *et al.*, Hely *et al.* and Korontzi *et al.* address this issue, with major focus on the contribution of biomass burning (Hely *et al.* and Korontzi *et al.*). The final set of papers in the volume deal with issues of resource management (Moleele and Maina; Mbaiwa; Sekhwela) and livelihoods (Chanda *et al.*, 1998), highlighting aspects that need to be addressed if sustainability is to be attained.

We hope that the reader finds this special edition informative and illuminating. We are thankful to the International START Secretariat in Washington and our institution, the University of Botswana, for funding the scientific meeting at which the papers in the volume were presented. Funding from START was derived from a grant to START from the Norwegian Agency, NORAD. We are also grateful to the Head of Environmental Science, Prof. M.B.K. Darkoh, for his constant encouragement and wise counsel as we set about processing these papers for the JAE.

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### References

- Chanda, R., Ringrose, S. & Magole, L. (Eds) (1998). *Towards Sustainable Natural Resource Management in the Kalahari Region: Abstracts and Report from the Kalahari Transect regional Scientific Workshop*. Start Report No. 2, Gaborone, Botswana. 68 pp.
- Darkoh, M.B.K. (1999). Desertification and environmental management in Botswana. In: Salih, M.A. & Tedla, S. (Eds), *Environmental Planning, policies and Politics in Eastern and Southern Africa*, pp. 181–200. London: MacMillan, New York: St. Martin's Press.
- Dougill, A.J., Heathwaite, A.L. & Thomas D.S.G. (1998a). Soil water movement and nutrient cycling in semi-arid rangeland: vegetation change and system resilience. *Hydrological Processes*, 12: 443–459.
- Dougill, A.J., Trodd, N.M. & Shaw, M.J. (1998b). Spatial patterns of grass biomass in a grazed semiarid savanna: ecological implications. *The North West Geographer*, 2: 21–32.
- Dube, O.P. (1998). Monitoring vegetation cover over diverse landscape types in semi-arid southeastern Botswana. *Geocarto International*, 13: 43–51.
- Moleele, N.M. (1999). *Bush encroachment and the role of browse in cattle production: an ecological perspective from a bush encroached grazing system, Olifants Drift, Kgatleng District, Southeast Botswana*. Dissertation No.13, Stockholm University Dissertation Series. 93 pp.
- Perkins, J.S. & Thomas, D.S.G. (1993a). Environmental response and sensitivity to permanent cattle ranching, semiarid Western central Botswana. In: Thomas, D.S.G. & Allison, R.J. (Eds), *Landscape Sensitivity*, Chichester: Wiley and Sons. 273–286.
- Perkins, J.S. and Thomas, D.S.G. (1993b). Spreading deserts or spatially confined environmental impacts? Land degradation and cattle ranching in the Kalahari Desert of Botswana. *Land Degradation and Rehabilitation*, 4: 179–194.
- Ringrose, S. & Chanda, R. (Eds) (2000). *Towards Sustainable Management in the Kalahari Region: Some Essential and Critical Issues*. Directorate of Research and Development, University of Botswana, Gaborone and START, Washington. 304 pp.
- Ringrose, S., Chanda, R., Nkambwe, M. & Sefe, F. (1996). Environmental change in the mid-Boteti area of north-central Botswana: biophysical processes and human perceptions. *Environmental Management*, 20: 397–410.

- Ringrose, S., Chipanshi, A.C., Matheson, W., Chanda, R., Motoma, L. & Magole, I. (2002). An attempt to differentiate between climatically and direct human induced changes to the woody vegetation cover of Botswana. *Environmental Management*, **30**: 98–109.
- Scholes, R.J. & Parsons, D.A.B. (1997). *The Kalahari Transect: Research on Global Change and Sustainable Development in Southern Africa*. IGBP Report 42. 64 pp.
- Skarpe, C. (1986). Plant community structure in relation to grazing and environmental changes along a north–south transect in the western Kalahari. *Végétatio*, **68**: 3–18.
- Skarpe, C. (1990). Shrub layer dynamics under different herbivore densities in an arid savanna, Botswana. *Journal of Applied Ecology*, **27**: 873–885.
- Skarpe, C. (1992). Dynamics of savanna ecosystems. *Journal of Vegetation Science*, **3**: 293–300.
- Thomas, D.S.G. & Shaw, P.A. (1991). *The Kalahari Environment*. Cambridge: Cambridge University Press. 284 pp.
- Tyson, P.D. (1997). Atmospheric transport of aerosols and trace gases over Southern Africa. *Progress in Physical Geography: Special Issue on Physical Geography in South Africa*, **21**, 79–101.