An ecosystem modelling approach to rehabilitating semi-desert rangelands of North Horr, Kenya

G.A. Olukoye[1], W.N. Wamicha[1] and J.I. Kinyamario[2]
[1] Department of Environmental Sciences, Kenyatta University, P.O. Box 43844, 00100 GPO, Nairobi, Kenya, E-Mail: golukoye@hotmail.com and [2] Department of Botany, University of Nairobi, P.O Box 30197, Kenya

Keywords: ecosytem, modelling, rangelands, sand dune, *Suaeda monoica*

Introduction Decreased rainfall, recurrent droughts and increased anthropogenic activities have led to a dramatic increase in wind erosion on pastoral lands of North Horr resulting in the reactivation of the once-stable sand dunes. This has degraded the vegetation and impoverished the local community. Mobile sand has a severe impact on dry season grazing areas (Omar & Abdal, 1994) and, therefore, affects pastoral livestock production. In North Horr, *Suaeda monoica* is important in camel production and for stabilising sand dunes but it has been over-utilized over the years. The objective of this study was to use ecosystem modelling approaches to examine the issue of land rehabilitation in North Horr taking cognisance of emerging perspectives on interactions among climate, plants and herbivory in such rangelands.

Materials and methods The study site is situated in North Horr Division on the north-western edge of the Chalbi Desert in northern Kenya. It falls under agro-climatic zone VI and receives an annual mean rainfall of 157 mm (Schwartz *et al*., 1991). A Range Utilization Model (RUM) that relates potential forage production to herbivory energy demand was used to derive the herbivory pressure index for the camels in utilizing *S. monoica* in the years 1999 and 2000. The PRY (Prying livestock productivity) model (Baptist, 1990) was used to model the *S. monoica* subsystem in terms of economic and ecological functioning, using 56 of the 70 households that own camels.

Results Monthly camel herbivory pressure status indices for the years 1999 and 2000 were all less than 10%. In 1999 and 2000, camel herbivory pressure and corresponding vegetation degradation in the *S. monoica* complex was highest in February (1%) and April (3%) respectively. The difference between years in vegetative degradation may not have been attributable to an imbalance between energy demand and *S.monoica* forage production associated with a high camel population since the 1999 and 2000 monthly average camel numbers of 265±79 and 292±21 were not statistically different (P>0.05). Modelling showed that within the traditional management system (no culling and female age limit at 300 months) camel productivity was least efficient with total output value per animal per year of US$ 58 and a dry matter intake of 989 kg per animal per year resulting in an efficiency level of 72%. This was 33% less efficient compared to the optimal culling practice given by setting a breeding-female age limit at 274 months. In terms of pastoral management, the traditional camel management translated to a productivity index of US$ 59 per ton of dry matter intake. This value was less than that which could be obtained at an optimal culling practice of US$ 86 per ton of dry matter intake.

Conclusions The PRY model confirmed the results of the RUM model in that the observed imbalance between camel herbivory demand and supply could be related more to climate-induced vegetation degradation than herbivory demand. It may be concluded that *S. monoica* can perform the dual ecological and economic functions of dune stabilization and camel browsing respectively, if flexible camel stocking rates are applied within the *S. monoica* vegetation complex. This would require either an adjustment in the camel management system with respect to culling strategies to increase offtake or alternatively increase in the *S.monoica* cover. *S. monoica* cover could be increased through natural regeneration, which should take advantage of the symbiotic relationship between camels and this shrub. It is therefore, important to integrate both the biophysical and socio-economic aspects in sustainable *nebkha* –dune stabilization and hence land rehabilitation in North Horr.

Acknowledgement The financial support of the German Ministry of Economic Cooperation and Development through Deutsche Gesellschaft für Technische Zusammenarbeit is appreciated.

References

Baptist, R. (1990) Simulated livestock dynamics-effects of pastoral offtake practice and drift on cattle wealth. Proceedings of the 8th Scientific Workshop of the Small Ruminant Collaborative Research Support Program, Nairobi, Kenya, pp. 207-215.

Omar, S.A.S. & M.Abdal (1994). Sustainable agricultural development and halting desertification in Kuwait. *Desertification Control Bulletin,* 24, 23-26.

Schwartz, H.J., S.Shaabani & D.Walther (eds) (1991). Range Management. Handbook of Kenya. Vol.II, 1. Republic of Kenya, Ministry of Livestock Development, Range Management Division, Nairobi.