GLOBAL LIVESTOCK CRSP

Livestock Production Systems and Environmental Interactions: Producer Response to Climate and Market Changes in the River Njoro Watershed, Kenya

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In developing countries, the past two decades have witnessed changes in market structure, climate and demographic characteristics resulting in fast growth in the demand for livestock products and increasing dependence on livestock for sustainable livelihood systems. In response, there have been rapid land use and land cover changes, characterized by expansion of agricultural systems and a decline in farm sizes. As markets change, producers respond through different adaptive capacities. Producers endowed with more livelihood assets: financial, natural, social and physical, are more capable of responding to and benefiting from these changes. This study consisted of two components: characterizing livestock producers in the River Njoro watershed in order to determine the factors that influence the selection of livestock production systems; and assessing the socioeconomic status of producers in the study area, with the objective of monitoring adaptation based on the following key attributes: livestock stocking rates, feeding systems, herd structure and farm size. Study results identified three primary production systems: Intensive highly diversified and commercial systems; Semi-intensive subsistence systems; and Extensive semi-commercial systems, with an overall trend towards more intensive systems. From the socio-economic surveys it was found that 30% of producers adapted production systems to increase productivity due to a shortage of pasture, and 15% due to increasing demand for livestock products, while 22% cited changes in land tenure as the critical factor to production system change, drawing attention to land tenure issues in the watershed. When producers gain greater property rights through allocation of title deeds, they are more inclined to invest in long-term livestock structures and engage in more intensive systems, a potentially positive feedback loop for improving livelihoods in the region, given proper management and governance and/or community oversight of production systems.

Background

The River Njoro watershed is about 300 square kilometers, located within Nakuru District, Kenya. Livestock production is an important economic activity to approximately 80% of the watershed population through its contribution to livelihoods, agricultural production and ecological services. Many farmers in the watershed integrate crop and livestock production on farms averaging 7.8 hectares in size. There are, however, many landless livestock producers within the Njoro region, and most of the livestock production in the watershed depends on communal resources such as water and grazing land.

Despite their contributions to food production, livestock are (directly and indirectly) responsible for causing negative ecological impacts, such as water pollution and soil erosion. The River Njoro watershed has experienced rapid land use and land cover changes in the past two decades (Baldyga, 2007). These changes correspond with rapid changes in consumption patterns and rates of urbanization, leading to increased demand for livestock products. In response to these changes, which include a decline in farm sizes caused by population pressure, producers have adjusted their agricultural systems over time. These systems determine the influence of livestock on watershed resources. Overall degradation of communal land resources is a matter of serious concern in the River Njoro watershed. In the study area, farm animals graze openly along the road reserves, the riparian zones, and other public fields without any controls on resource use or consideration of permissible stocking rates. This phenomenon has led to increased land degradation and pressure on natural resources. Livestock grazing along riparian zones leads to soil compaction, which in turn results in reduced infiltration, increased runoff and erosion, and increased deposition of sediments and nutrients to water bodies.

The lack of oversight on livestock grazing in rural areas like the River Njoro watershed threatens to undermine communal ecological resources and requires intervention, whether public or communal, to enforce more sustainable livestock management practices. This brief presents the results of a study designed to identify the major livestock production systems and changes taking place in these systems in the River Njoro watershed, in order to better understand the constraints and opportunities of each system, and to identify interventions targeting production and management improvements along with ecological safeguards.

Preliminary Findings

A baseline survey conducted by the Sustainable Management of Rural Watersheds (SUMAWA) project in 2004 was repeated in 2007 to identify different production systems and to assess the socioeconomic status of producers and farming practices within the study area, with the objective of monitoring changes in households based on the following key attributes: livestock stocking rates, feeding systems, herd structure and farm sizes. The study identified three major livestock production systems: 1) Intensive highly diversified commercial systems; 2) Intensive subsistence systems; and 3) Extensive semi-commercial systems.

Production System Characterization. Intensive-highly diversified commercial systems constituted 34.7% of the sample. Producers in this cluster were spread over three zones in the watershed with Njoro, Nessuit and Ngata having 50.0%, 21.4% and 28.6% of the households respectively. Producers in this system are generally older and displayed the highest level of risk management through involvement in several enterprises (diversification), self-production of farm fodder, and use of purchased concentrates. The zero grazing and semi-zero grazing units in this system are considered more efficient as these farms had the highest milk output per head. In addition, these producers had a higher commercialization index (measured by proxy: the proportion of marketed milk output). On average, they have a higher level of education and greater access to credit. Due to the higher degree of commercialization, these producers had the highest household incomes. On average, they are located closer to markets, good roads and water sources.

The second cluster is comprised of semi-intensive subsistence systems. Producers in this cluster are found mainly in the lower watershed (Ngata and part of Njoro) and constitute the lowest number of households, 19.0%. It is characterized by younger farmers with a higher level of education that enables them to be more involved in off-farm activities (e.g. salaried employment). Producers in this category have greater access to credit and extension services, mainly due to greater social status and influence. However, producers within this system have the lowest number of livestock holdings on semi-zero grazing units, and have little experience in livestock keeping. Their commercialization index is low, indicating that most of their production is for home consumption. Their degree of diversification is also very low and they do not produce fodder on their farms. They therefore depend on grazing their own pastures, and cut and curry fodder from communal areas such as riparian zones and roadsides.

The final cluster, extensive semi-commercial systems, contains the highest number of households (46.3%) spread evenly over the entire watershed. The majority of producers in this category are found in Ngata (41.1%) while the rest are distributed between Njoro (39.3%) and Nessuit (19.6 %). In general, these producers have a relatively higher number of livestock holdings, but a moderate level of market orientation. They keep a mixture of cross breeds and local cattle breeds. Only a few produce fodder, and they have several production constraints, including access to credit and extension services. These producers have been keeping livestock for the longest period of time, and are ranked lowest in the utilization of concentrates.

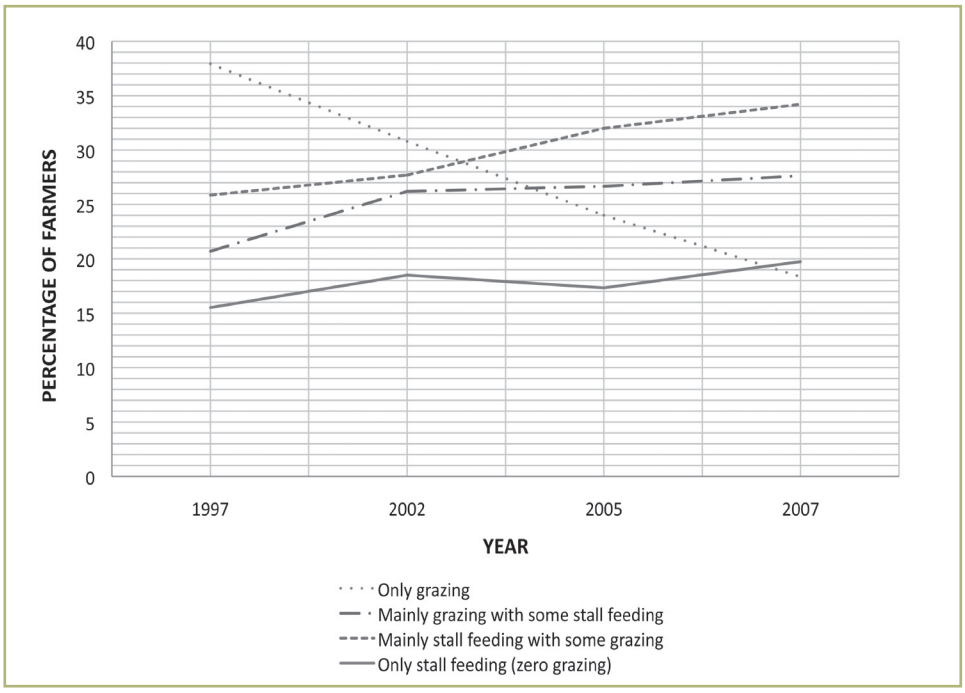
Changing Systems. A comparison of livestock production systems in 1997 and 2007 indicates that producers have been changing systems for a number of reasons. Faced with a shortage of pasture (30%) and increasing demand for livestock products, 15% of farmers reported changing management to increase productivity/output. Of the surveyed farmers, 22% cited changes in land tenure as critical factors in shifting production systems. Institutions that govern property rights play key roles in shaping agricultural producers' choice of production practices, outputs and, hence food security and poverty alleviation. Producers with high tenure insecurity tend to look for practices that give returns in the short run instead of engaging in more long-term investments. When producers gain more property rights through allocation of title deeds, they are more inclined to invest in long-term livestock structures and engage in more intensive production systems.

A previous SUMAWA study (Baldyga, 2005), revealed substantial changes in land cover between 1986 and 2003. Furthermore, as in many other areas of East Africa, the greater Nakuru district has been facing variability in rainfall, both in terms of quantity, predictability and distribution (Baldyga et al. 2007), with increasing runoff corresponding to changes in land cover. These changes have had drastic implications on farming systems as well, with more intensive systems emerging over time (Figure 1).

As previously noted there has been a shift from extensive methods of livestock feeding to more intensive methods. The percentage of farmers using pure *zero grazing* and *stall-feeding with some grazing* has been increasing rapidly since 1997. On the other hand, those utilizing systems based on *pure grazing* have declined within the same 10-year period from 37.9% to 19.7%. The semi-intensive methods of livestock feeding: mainly *grazing with some stall-feeding* and *stall-feeding with some grazing* has also been increasing at a steady rate. These changes have positive implications for the resource base supporting production (see Steinfeld et al. 2006). Due to the increase in the number of farmers using only stall-feeding, there is a tendency to have more

on-farm production of fodder and increased use of concentrates. Semi-intensive producers also tend to favor crop and livestock integration, and are better able to manage soil fertility through manure applications and planting of nitrogen-fixing fodder. In addition, these producers have the opportunity to benefit from the marketing and use of on-farm products such as for biogas production from manure, an alternative fuel source to strained firewood and charcoal supplies. The level of efficiency among these producers is generally high, due to the necessary utilization of varied resources within a smaller-scale intensified system.

Figure 1. Changes in livestock feeding systems, 1997 - 2007.



The size of the farm also plays an important role on the type of system adopted by producers. In the watershed, there has been a decline in the size of household farms over time. Findings indicate that the average land holding declined by 6.4% between 2004 and 2007, from 8.33 hectares to 7.8 hectares. This may be attributed to increased population growth and changing land ownership, though further investigation to fully understand the factors influencing dwindling farm size is required.

In addition to intensification, producers in the River Njoro watershed have adapted by developing various production strategies. These include selling livestock at the onset of the dry season to minimize herd loss to drought and take advantage of weight gain due to quality forage, renting of grazing land to ensure adequate livestock nutrition, and purchasing fodder to further enhance livestock diet.

Support services: extension, credit, and veterinary. Livestock support services play an important role in determining the quality of animals. Surveys indicate that there has been a slight increase in producers who access extension and credit facilities. Most of the farmers accessing credit use it for household development and business purposes other than direct investment in agriculture. The authors assume that due to the mutually interchangeable nature of credit within the household, there are some indirect benefits to agriculture from enhanced credit access, as agriculture is the primary livelihood activity in the area.

Practical Implications

Characterizing livestock producers in the watershed is critical to understand the constraints and opportunities that exist within each livestock production system, thereby allowing for appropriate development of policy recommendations specific to each system. Understanding these production systems is also synonymous to understanding the possible environmental impact of livestock, as the systems define how livestock interact with the environment.

The majority of producers analyzed by this study fall into the *extensive semi-commercial* category. For these farmers, policies should target improving access to credit and extension services by encouraging farmers to form Common Interest Groups (CIGs), which would enable them to better access to services. The government of Kenya through the National Agricultural and Livestock Extension Programme (NALEP) is currently channeling extension services to farmers through such groups. Banking and non-banking financial institutions are also using the group lending approach (GLA) to reach out the rural producers. Producers in extensive systems should also be encouraged to participate in communal participatory resource management programs, such as the Water Resource Users Association (WRUA) developed by SUMAWA, as their stocking rates are high, and can have potentially harmful effects on the natural resource base. Because of the strong link between security of land tenure and greater investment in long-term activities that benefit natural resources, government and associations within the watershed should make land tenure security a major focus of future programs and policy. Farmers involved in intensive production

systems, on the other hand, are more market oriented, and require policies improving physical and financial infrastructure that enable increased market access and participation on a larger scale. Another major challenge for livestock producers is responding to natural variability through adjustments in production decisions. These decisions are influenced by a number of factors, some of which households have little or no control over. By better understanding the circumstances of producers and the reasoning influencing their decision-making, government and development agencies are better able to create an enabling policy environment that allows flexibility for producer response with minimal environment impact.

Producers are responding to climate variability and market changes by adjusting production systems through a reduction in herd sizes and expansion in production of monogastric livestock, especially broilers. As these systems employ a larger percentage of concentrates and off-farm inputs, demand for raw materials for the production of livestock feeds, such as maize is also increasing. The recent dramatic global fluctuation in prices for concentrates and the local shift in demand will make local market prices difficult to predict and monogastric production quite challenging, reinforcing the need to strengthen production systems and provide support networks or producers like the SUMAWA Watershed Resource User Associations.

Further Reading

Baldyga, T. J. 2005. "Assessing Land Cover Impacts in Kenya's Njoro River Watershed using Remote Sensing and Hydrological Modeling." Unpublished Msc. Thesis, Department of Renewable Resources, University of Wyoming.

Baldyga T.J., S.N. Miller, C.M. Gichaba, and W. Shivoga. 2007. "Suitability of the Automated Geospatial Watershed Assessment (AGWA) Tool in Assessing Hydrologic Response and Land Cover Change in River Watershed, Kenya." *Egerton Journal of Science and Technology* VII(1).

Galvin, K.A., R.B. Boone, N.M. Smith and S.J. Lynn. 2001. Impacts of climate variability on east African pastoralists: Linking social science and remote sensing. *Climate Research* 19:161-172.

Mburu, L. M., J.W. Wakhungu, and W.G. Kang'ethe. 2007. "Characterization of Smallholder Dairy Production Systems for Livestock Improvement in Kenya highlands." *Livestock Research for Rural Development* 19(8).

Steinfeld, H., P. Gerber, T. Wassenaar, V. Castel, M. Rosales, and C. deHaan. 2006. *Livestock's Long Shadow: Environmental Issues and Options.* Rome: Food and Agriculture Organization of the United Nations (FAO).

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The GL-CRSP Sustainable Management of Rural Watersheds (SUMAWA) project was established in 2003 and is a multidisciplinary research effort focusing on biophysical, livestock and human-related factors. The Project Principal Investigators are Dr. Scott Miller (snmiller@uwyo.edu) and Professor William Shivoga (shivoga@sumawa.or.ke). Ms. Njeri Muhia (njeriwamuhia@yahoo.com) serves as the CO-PI for Socio-Economics Component.

The Global Livestock CRSP is comprised of multidisciplinary, collaborative projects focused on human nutrition, economic growth, environment and policy related to animal agriculture and linked by a global theme of risk in a changing environment. The program is active in East and West Africa, Central Asia and Latin America.

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