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INTEGRATING LIVESTOCK PRODUCTION WITH FOREST MANAGEMENT AMONG LEROGHI FOREST ADJACENT PASTORAL COMMUNITIES IN SAMBURU COUNTY, KENYA

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Abstract: This study focused on nomadic or semi-nomadic pastoralists whose resources of concern are water, dry season fodder and pastures. This study envisages that the success of the traditional pastoral resource utilization system depends upon risk spreading and highly flexible mechanisms such as human and livestock mobility, communal land ownership, herd diversity and herd separation or splitting. The current livestock production system was unsustainable thus the basis for this study, which sought to assess the community's socio-economic characteristics; document the trends in the livestock population; and assess the level of forest use in livestock production by the forest adjacent local community. Seventy-nine respondents (30%) were studied using a structured questionnaire and data analyzed using Excel (MS office) and Statistical Package for Social Scientists (SPSS). Trade in livestock, livestock products and livestock inputs provide employment and income opportunities for the local communities. The majority of the local people derive 78% of their total income from livestock sales. The sustainable forest based livestock production system depends upon adoption of controlled grazing practices where incentives, taxation methods, environmental education and awareness programs, appropriate resettlement of forest dwellers and promotion of alternative sources of income such as agri-pastoral business development.
Keywords: Forest; Grazing; Livestock; Pasture; Community; Water.
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INTRODUCTION

Kenya's arid and semi - arid lands (ASALs), cover about 80% of the country's total land surface and account for more than 80% of eco-tourism interests in the country. ASALs accommodate 25% of the human population and over 50% of the country's livestock populations, which accounts for 90% of employment and more than 95% of the family incomes (GoK, 2003). The livestock populations are highly depended on weather, sales and the management of the rangelands and the environment. Leroghi forest, located to the south west of Samburu County, was gazzetted in 1936 and covers an area of 91,790 ha. The plateau reaches a height of 2580 m above sea level and receives an annual rainfall of between 900 - 1500 mm. Closed canopy forest (*Sirat*), characteristic of dry zone and *Juniperus-Podocarpus* evergreen forest, account for 25% of the total forest cover and is an important source of dry season water (*sere*), pasture, fodder, food, honey and medicine. Water is perhaps the most important resource and its availability for livestock and human consumption is perpetual preoccupation among pastoralists who have adopted watering regimes with positive impacts on rangelands. Traditional pastoral resource utilization is predicted upon risk spreading and highly flexible mechanisms such as human and livestock mobility, communal land ownership, herd diversity and herd separation or

splitting. Factors such as drought, insecurity, land alienation, human and livestock population increase have affected the livestock based wealth and increase vulnerability to famine and poverty. Over time the resource/man ratio change due to rapid increase in population resulting into changing the nature of resource utilization.

Livestock diversity, cattle (*Ngishu*), camels (*Ndamesi*), sheep (*Ngera*), goats (*Ngineji*) and donkeys (*Ngironi*), optimizes use of varied browsing and grazing fodder types and quality through mobility in management. Rights to land, livestock, grazing and browse resources, water, trees, honey and other gathered products are at the core of pastoral economic life and social relationships. Pastoralists have over the years developed system of norms, values, beliefs and practices for achieving sustainable resource use within fragile environments by assigning different resources to different users at specific periods of the year. The three broad rangeland production systems are nomadic pastoralism, agricultural production within an agro-pastoral or exclusively under traditional riverine agriculture and wildlife conservation within the protected areas.

There are apparent conflict between government institutions and traditional institutions at the community level over management of natural resources. Government institutions manage the local resources with little or no regard to local elders and their indigenous knowledge on resource management. The unfortunate results of this approach is overgrazed and overstocked pastures and inappropriate conversion of pastureland to other unsustainable use such as wheat farms in the central division of Samburu County. Due to the limitations of ever shrinking resource base and factors such as ecological degradation, episodic droughts and insecurity, pastoralism can no longer support the pastoral communities in the arid land of Kenya. Vulnerable members of the community are sedentarising around security posts causing a serious threat to the environment. The un-sustainable forest based livestock production practices was the basis for this study, which aimed at providing insight into economic, environmental and social motives of forest grazing. There was urgent need for information on which to base technical recommendation for sound management of these lands for future generations. Therefore, this study aimed at assessing the socio-economic characteristics of the Leroghi forest adjacent community; assess the level of forest use in livestock production; and make policy recommendation as pertains to the livestock production systems among local communities.

EXPERIMENTAL

This study was carried out in Sanataa forest block, which is located in the northwest corners of Leroghi forest. The household survey was conducted in Angata Nanyikie sub-location with a population of 1,228 people or 267 households. A random sample of 79 households or 30% of the households distributed in five forest adjacent villages were studied. The household was the unit of study and comprised of an average of 10 family members. The survey was administered using a pre-tested structured questionnaire and data analyzed for descriptive and advanced statistics using Microsoft Excel and Statistical Package for Social Scientists (SPSS). Some of the information gathered includes household characteristics, livestock production, forest use, constraints and opportunities among other issues. The survey findings were verified in two village workshops.

RESULTS AND DISCUSSION

Socio-economic characteristics of the households

Leroghi plateau is dominantly home to the Samburu people who are traditional pastoralists. Women and girls are responsible for household chores whereas men make decision for livestock management: herd formation and choice of grazing grounds, livestock marketing and security issues. Livestock sales and salary contributes 78% and 18% respectively to the total household income of Ksh 8,872 or US$ 111 per month. In many instances, small stocks are sold to buy maize and the larger herds of camels and donkeys are retained as a symbol of wealth and economic security. Income from honey production and retirement benefits made up almost 2% of the income. Almost 95% of rural communities depend in one way or another on at

least one forest produce. The reported community by-laws that govern the sustainable use of forest resources in Leroghi include: no starting of fire in the forest (67%), no illegal harvesting of forests products (90%), catchment protection (13%), dry season grazing in the forest (9%) and fine to all forest abuses (4%).

Trends in livestock population

Pastoralism was the main economic activity in Samburu County and supports about 80% of the county's population for subsistence and income while 20% practice agro-pastrolism. The findings of this study tally with documented statistics for the county (Trench and Makee, 1994). In 2003, the total livestock population in the county stood at 798,045, which was almost equivalent to the population of 800,720 in 1993. There was a notable decrease in livestock numbers between 1991 and 1992 with cattle reducing by 40% while goats and sheep reduced by 14.5% and 30% respectively. The years 1984, 1992 and 1996 are remembered for drought leading to loss of livestock (GoK, 1997). In most cases, pastoralists loose upto 80% of their livestock due to drought, disease and high stocking rates.

Forest based livestock production system

Most of the cattle in the county comprises the Zebu, borans, sahiwal and a few dairy breeds like asyshire, fressians and their crossbreeds for socio - economic functions (100%) and ceremonial purposes (65%). Goats comprise mainly the small East African goats, red maasai, black headed persia, a few galla and dorper breeds of goats and somalia sheep. Camel keeping was gaining popularity in the county in recent years because of its unique qualities of drought resistance and milk production. Cattle were highly ranked with each household keeping an average of 21 heads of cattle, 36 goats, 31 sheep, 3 donkeys and 1 camel. The system of livestock production has evolved where 20% practiced herding, 32% free range (nomadism) and 48% combine herding and free-range practices.

The results of a regression analysis (Table 1) involving: level of education of head of household, the family size, family cash income, number of wives, constraints in livestock production, income from livestock sales and number of livestock sold (cattle, goats and sheep) as independent variables were highly significance and explained 75.4% of the number of livestock kept (cattle, goats and sheep) as dependent variable. The number of livestock sold was highly significant whereas the level of education, family size and income from livestock sales were significant at 99%, 90% and 95% confident intervals respectively.

Table 1: Results of ANOVA analysis

Model	SS	DF	MS	F	Sign
Regression	1030925.2	7	147275.028	25.371	.000
Residual	336687.67	58	5804.960	-	-
Total	1367612.9	65	-	-	-

Lerodgi forest provides multiple functions and must be rationally and carefully managed to optimize benefit and satisfy all the user groups. The forest provides an important source of dry season feeds (97% grass and 62% fodder). January to March is the driest month in the study area and livestock take refuge in the forest. One or two milk cows, sheep and goats were left around homesteads. April to August is relatively wet and the livestock graze around homesteads. The months of September to December are transitional period and livestock graze around hills and river basins (*Lagaa*) at a distance of 5 to 15 km or more, depending on water and forage availability. Whereas conventional range management would opt for an adjustment in livestock numbers according to the existing land resource base, nomadic pastoralists prefer to seek access to natural resources to sustain their livestock rather than reduce their herd size. The goats, sheep and camels forage in the vicinity of the homestead throughout the year. This system makes optimal use of annual grass and herbs in the lowlands and allows perennial grasses on hills to set seed (Barrow, 1996). The estimated distance from the settlement to the forest was 1 - 5 km (65%), 6 - 10 km (33%) and 11 - 20 km (3%). Walking distance to water points varied with breed and environmental conditions; cattle had an upper limit of 16 km to water and sheep about 5 km to water (Humphreys, 1987). Insufficient watering points lead to overgrazing, trampling and pasture degradation near the water points (Fusco *et al,* 1995). Adjustment of stocking rate for distance from water and rotation of

access to watering points was a solution to degradation to watering points.

Forest user rights

It is important to understand and appreciate production goals of pastoralists such as subsistence milk production and contingency meat production; recognize and consider operational, ecological and socio economic forces that underlie survival strategies of pastoralists *e.g.* herd diversity, multiple herd species, herd mobility and tracking and herd splitting; manage pastoral ecosystems on the basis of their adaptability and flexibility rather than stability; understand the past and present conflicts and mismanagement than lack of sound technology; public attitudes about forest grazing; the economic importance of livestock grazing in the forest; rapid increase in human and livestock populations over the last two decades and consequent ecological degradation; breakdown in traditional authority structures for regulating access, control and management of grazing and water resources; and poor livestock markets due to limited infrastructure.

In Kenya, grazing in the forest is allowed on payment of a grazing fee of Ksh. 42 per cattle head and Ksh. 16 per sheep. Due to logistical problems this payment had not been levied on the local people in Angata Nanyikie. No user charges were levied on the community to graze in the Lerodgi forest (71%) due to: lack of payments mechanisms (56%), the current charges are too high (6%), grazing in the forest was considered as an incentive to conservation (6%), payment suspended (13%) and some community members were squatters in the forest (1%). The conflict of interest arises from overgrazing, which contribute to soil erosion and environmental degradation, loss of revenue and over dependency of the community on the forest for dry season grazing. In a study conducted in India, local communities had the right to graze in the forest at a fee of 14 cents per annum per cattle head. The density of cattle was estimated at 65 per km^2, far out numbering the wild herbivores (Ganesan, 1993). Dry fodder requirements were estimated at 6 to 9 kg per day. The average grass yield from forest area was estimated at 3 tons/ha/year (Ganesan, 1993).

Impact of grazing on the environment

The capacity of an ecosystem to sustain a specific function depends on the characteristics of its individual dynamics under the impact load (Fühler, 2003). Besides the tangible benefits, the vegetation of natural forests are important catchments reserves which serve to regulate surface runoff, prevent soil erosion and ensure adequate and consistent supply of clean water for human consumption. The forests also ameliorate and mitigate climatic variation by providing shade. The sources of forest ecosystem disturbance/perturbation are usually natural *e.g.* climatic factors, abiotic site conditions, fire and pests organisms, semi-natural (climatic change) or exclusively man-made. Lack of knowledge and/or break down in traditional and cultural beliefs by pastoral communities about sustainable forest grazing practices and motives constrain efforts towards effective utilization of natural resources. The long-term existence of any forests is threatened by human activities such as, overgrazing of livestock, illegal harvesting and indiscriminate forests fires (Kaoneka and Solberg, 1994 and Holechek, 1993). Grazing affects the process of plant succession through mechanical injury to plants, changing vegetation composition, restricting the growth of the plant due to compaction of soil, etc (Homewood and Roggers, 1991). Important measures for improvement of degraded rangelands is to eliminate grazing thus induce a progressive succession. Complete elimination of grazing too is not beneficial for the rangeland as it restricts the improvement of grass cover. If the grasses are not cut or grazed and left as such in the grassland the grass stump will become thick resulting in reduction in grass quantity and quality. The nine ways in which grazing influences its habitat include: intensity of defoliation, frequency of defoliation, selectivity of defoliation, seasonality of defoliation, distribution of animals, distribution of plants, distribution of minerals, physical effects and mineral cycling. The eating action involves biting, pulling and breaking off plant parts at random heights resulting in pulling from the plant unpalatable plant parts that will subsequently be discarded

rather than being ingested. Trampling and treading of both the plant and the soil by hooves of grazing animal results in some plants being crushed, severed or bruised. Treading of soil by grazing animals has the potential of being deleterious to soil in the following ways: compacting, penetrating and disrupting, reducing infiltration, displacing soil vertically on steep slopes, developing animal trails and increasing erosion. Livestock grazing affects water shed hydrologic properties by removing protective vegetation as well as causing trampling disturbances. Reductions in vegetation cover may increase the impacts of raindrops, decrease soil organic matter and soil aggregates, increase surface soil crusting and decrease water infiltration rates (Vallentine, 1990 and Dìaz-Solis *et al,* 2003).

Studies have shown that the complexity of a grazing system arises from the interaction between climatic events; pasture production, animal grazing behavior, animal growth and herd or flock dynamics (Cacho *et al,* 1999). Grazing management involves managing and manipulating the grazing animal, forage plant, soil complex to obtain specified objectives through blending of ecological, economic and animal management principles such as plant growth requirements (plant vigor and reproduction), defoliation and other animal impacts and seasonality and fluctuations in forage production (Vallentine, 1990). Cattle intake under a combination of grazing intensities accounted for 36 to 47% of the herbage disappearance while more than 50% resulted from factors such as trampling, weather and wildlife. The positive attributes associated with grazing are sustenance of livelihoods *i.e.* source of manure, protein and income/revenues and reduction of risks in dry season forest fires to the community and the Forest Department. The identified benefits associated with forest grazing in the study area were: reduction in the incidence of fire (38%), seed dispersal (8%), biodiversity conservation by protecting the forest from potential loggers (20%) and social incentives (source of water (1%), pasture (1%), food and medicine (3%). Each household enjoyed a social welfare benefit of Ksh. 1,380 per month or Ksh. 4,140 per year by grazing in the forest. Cumulatively, Angata Nanyikie sub-location forego paying a total of Ksh. 339,480 per month or Ksh. 1,018,440 for a period of 3 month as revenue to the government assuming that only cattle and sheep graze in the forest and 92% of the households' use the forest for dry season grazing. This represents a net economic loss to the government in revenue while it represents a social gain/saving to the local community. The loss in revenue was far beyond the stated amount since very many individuals living in the whole county use the forest. The negative impacts associated with forest based grazing includes induced land degradation (erosion and retardation of secondary succession) through trampling, browsing and defecating of seedlings and saplings, accelerates colonization of old pastures by woody vegetation and slows down of the accumulation of biomass. Worse still is the fire used in the burning of vegetation for new pastures to emerge or in honey harvesting and competition between livestock and wild animals over pasture. The negative impacts associated with forest grazing as reported by the respondents in Angata Nanyikie include increased fire risks due to honey hunting and associated activities (38%), loss of biodiversity due to overgrazing (87%), increased soil erosion (48%), water catchment destruction (6%) and spread of tick borne diseases (18%). Preliminary findings from a study in India showed that areas subjected to heavy grazing and fires showed poor regeneration and low fodder productivity. Fire was the main constraint affecting regeneration, destroying seedlings and saplings of insufficient bark thickness especially within the community forest reserve (Homewood and Rogers, 1991). The other factors that affect the environmental conservation initiatives include the expansion of cultivation frontiers, reduction and/or removal of key production areas through creation of national parks, forest reserve and game reserve further contribute towards shrinking of range resources. Heightened insecurity due to banditry has rendered access to resources impossible. The impact of these influences (e.g. by increased sedentarisation) manifests itself through ecological degradation leading to environmental deterioration and therefore reduction in economic productivity of

pastoral households and ultimately to social disintegration.

Livestock stocking capacity

Overgrazing, browsing and lopping of the rangeland causes deterioration in the quality and quantity of grass, herbage and fodder resources respectively. It is important to balance the number of animals with grazing capacity of the rangeland. The grazing capacity or carrying capacity or stocking capacity can be defined as the number of animals that produces the greatest return without damage to the physical resources and other values received for the land. Optimum carrying capacity expresses the most profitable levels of all products and services; optimum grazing capacity suggests the most profitable stocking rate (Lal, 1990, Mic Halk *et al,* 2003 and Baars and Jeanes, 1997).

The grazing capacity per hectare on animal basis can be expressed as:

$$\frac{Total\ annual\ forage\ production}{Forage\ requirement\ per\ animal\ per\ day\ x\ 365\ x\ a}$$

Where a is the area of the grazing land.

The natural factors affecting grazing capacity include climate and weather, height of water table, root zone depth, soil texture and structure, natural soil fertility, level of soil salinity, physiography of area, amount of vegetation, quality of vegetation and amount and distribution of drinking water. Management factors affecting grazing capacity are condition of forage stand resulting from past use, adequacy of grazing distribution, meeting drinking water needs, season of grazing, kind/mixture of grazing animals, forage removal by other non-assigned animals, grazing system used, cultural treatments: weeds control, fertilization, seeding, irrigation and operational objectives (Gruber *et al*, 1999; Vallentine, 1990 and Lal, 1990). Stocking systems should be planned to meet various objectives such as control of vegetation composition, provision for particular animal needs, improved feed use, higher pasture growth rates or convenience of farm operations. It's appropriate to use germplasm well adapted to local biotic and abiotic condition. Equations have been developed to estimate annual net primary production based on range condition, annual precipitation and soil characteristics typical of a region. Simulations were conducted for annual precipitation levels of 300, 500 and 700 mm to estimate total and green standing crop dynamics, cattle grazing efficiency and range conditions trend for different stocking rates. The model-estimated stocking rates to achieve stable or slight improvement of range condition for three precipitation levels at 58, 15 and 6 ha per animal unit – year (AUY) respectively (Dìaz-Solis *et al* 2003). In Samburu County, the land carrying capacity varied from 2.4 for Lorroki and Kirisia to 10.15 in Wamba.

There is need to encourage efforts to promote the establishment of fodder crops and their conservation for use during scarce feed period to avoid fluctuations of beef and milk production. In addition, experiment on stocking rates needs to be conducted to include light grazing stocked at 0.6 animal – unit – month (AUM) ha^{-1}, moderate grazing stocked at 1.8 AUM ha^{-1}, heavy grazing stocked at 3.0 AUM ha^{-1}, very heavy grazing stocked at 4.2 AUM ha^{-1} and control with no grazing (Mwendera and Saleem, 1996). Such stocking experiments combined with pasture recovery rates of grazed land after being exposed to different grazing and trampling intensities. Grazing at light to moderate stocking rates results in a stable, with diverse, fibrous rooting systems conducive to soil organic matter formation thus carbon sequestration in the soil (Reeder and Schuman, 2002). Selective grazing and high stocking rates of domestic animals have marked effects on soil and vegetation and enhance species diversity and the composition (Eccard *et al,* 2000). Heavy grazing may be more profitable than conservative grazing for a few years, in the long run (5 to 10 years) it gives a lower rate of return and increases financial risk. Under heavy grazing, livestock are forced to select a diet lower in nutritional quality, consume less forage, eat more poisonous plants and extend more energy in foraging and other daily activities (Holechek, 1993) and cause the disappearance of the more valuable perennial species which are replaced by weeds. Controlled grazing can be used to maintain and improve wildlife habitat, reduce wildlife hazards, increase vegetation diversity and improve vegetation

productivity and provide employment, red meat, wool and economic growth (Holechek, 1993).

Constraints affecting livestock production

The major constraints affecting the development of livestock industry in Kenya depends on the supportive infrastructure and legal framework. Low productivity of the animal breeds, poor milk handling techniques and lack of animal feeds especially during drought (86%), cattle rustling and animal diseases (86%), incidences of insecurity (80%), competition for water and pasture (68%) and poor markets (67%) can explain the poor performance of this industry in Samburu County. The other constraints include break down of community cultural and traditional rules and regulations as signified by change in the life style of the local communities *e.g.* diet, type of housing, energy saving devices, wildlife/human conflict resulting into wildlife migration to open grassland as a result of forest destruction and fire hazards caused by honey hunters, early burning and arsonists contribute towards loss of biodiversity. Insecurity involves cattle rustling and banditry that leads to loss of life, livestock, creates disputes amongst the pastoral communities and disrupts the original grazing patterns and forced pastoralists to resort to environmentally unsustainable resource use system leading to over exploitation of resources, low quality livestock and vulnerability to famine and drought.

Community based forest conservation strategies

Land belonging to the government has freedom of access and use at any time by all pastoral communities. The local community consider themselves as the custodians of the forest. Effective management is not a matter of adhering to a single, conservative stocking rate but a game of calculating probabilities the object of which is to seize opportunities and to evade hazards (Dìaz-Solis *et al* 2003). A simple simulation model simulates forage production as a function of grazing efficiency; and livestock performance as a function of forage standing crop, stocking rate and energy requirements. A regression model explained 64% of the variability in stocking rate change over time, with the rainfall/drought variable explaining the majority of the variability. Other factors with significant (α = 0.05) path coefficient on stocking rate change were age, grazing rights (owned vs. leased), traditional stocking rate factors, traditional grazing factors and weed/brush invasion factors (Eneboe *et al,* 2002, Behnke and Abel 1996 and Cacho *et al,* 1999). Inclusion of sociological data in path analysis may reduce explanatory power of regression models because of extraneous influences, but the interpretations on human behavior are no less important (Rowan *et al,* 1994). The economically optimal stocking rate, while sensitive to both herbage mass and economic variables, is higher than that which maximizes individual animal performance and lowers than that which maximizes pasture productivity (Wachenheim *et al,* 2000 and Behnke and Abel 1996).

Pastoralists have co-existed with natural resources and strategies adopted include livestock mobility (49%), herd splitting (54%), reduction in herds size (56%), impose fine to all environmental abusers (3%) and adoption of community based conservation committees (61%). Despite the existence of a ten-member committee on the conservation of the Sanataa forest block, the committee had not asserted its authority in the area though the level of awareness on conservation was high. Some of the regulation the government had put in place to ensure sustainable forest use include; allow only dry season grazing (19%), no fire risks (13%), no squatters allowed in the forest (5%), no harvesting/cutting live trees (8%) and observance of a presidential ban on harvesting/logging (1%). The government had embarked on the exercise of evicting 6,000 squatters residing inside the Lerodgi forest.

The strategies pastoralists adopted for efficient use of the environmental resources include: movement of marginal members in and out of the system to settlements; wage labour and agriculture; restrictions on the use of certain water sources, grazing areas and tree products; high valuation of livestock bride-wealth; reciprocal claims on livestock; dividing livestock into smaller herds; moving to areas considered insecure for grazing and selling livestock to buy grain (Barrow, 1996).

CONCLUSION

Pastoralism was the livelihood of the local community living in Angata Nanyike sub-location of Samburu County. Sound management and utilisation of land related resources (particularly water and pasture) demanded that pastoral communities are responsible and accountable for setting guidelines for a legal framework and land administration mechanisms that are flexible and respond to technological and socio-economic changes in a pastoral environment. Furthermore, there is need to promote and strengthen traditional institutions that empower pastoral communities to sustainably regulate access, control, use and disposal of pastoral lands, diversify income generating activities and introduce a forest based grazing management plan. The other available options may include working out the appropriate stocking rates, putting in place mechanism on disaster preparedness, justifying the need and establishment of effective conflict resolution mechanisms that would address the prevailing problems of resource use conflicts and land disputes and provide appropriate legal and economic incentives that promote the socio-economic well-being of pastoralists while enhancing gender equity. Restoration of community control over resources requires some careful consideration of flexibility in utilisation of water and grazing resources. Building rural managerial capacity and strengthening of institutional arrangements previously superseded by absolute state control may ensure sustainability of the development process. The potential in arid lands can be realized through technological interventions such as runoff water harvesting and conservation for forage production, range rehabilitation, selective bush clearing and improved range management practices.

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