# Impact of Livestock Grazing to Fringing Wetlands of Lake Victoria (Tanzania Experience)

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## Abstract
A baseline study was carried out in October/November 1999 to assess the impacts of Livestock grazing on the fringing wetlands of Lake Victoria on the Tanzanian side. Two villages bordering the Western Corridor of the Serengeti National Park in the east and Lake Victoria in the west were selected. Lamadi and Mbalageti rivers drain them. The flood plains are utilized for livestock grazing and as a refuge of wild game during the dry season. The area has been experiencing a high influx of immigrant pastoral herds from Shinyanga region, which has resulted, into serious land degradations. Range conditions at Lamadi were rated fair with retrogressing range trend. The carrying capacity was estimated at 3.57 to 6.75 ha/LU, which were 5 overstocked. Range condition at Nyatwali was rated good and the dry season carrying capacity was estimated at 1.5 ha/LU. Immigrant pastoral herds in the study area accounted for 79% and 82% of the total herds at Nyatwali and Lamadi, respectively.

***Keywords*:** Lake Victoria; Overgrazing; Wetlands; Degradation

## Introduction
Wetland is a term used for large variety of ecosystems which have one thing in common; the presence of both land and water for most part of the year. In Africa wetlands cover an area of about 250,000 km$^2$, which represents about 1% of the total continental area and in Tanzania almost 10% of the country's surface area is covered by wetlands (NEMC/WWF/ICUN, 1990). Wetlands are among the most productive life support systems in the world and are of immense socio– economic and ecological importance to mankind. These ecosystems are complex and processes within them are poorly understood. Wetlands have been recognized as playing an important role in buffering inputs from the basin catchments.

Lake Victoria covers an area of 68,800 km$^2$, of which 51% lies in Tanzania. Wetlands around Lake Victoria like others play important roles to the lake ecosystem. These include: high biodiversity, buffering the lake from various pollutants and used for crop and livestock production (Loma, 1979; LRDC and ODA, 1987; Bwathondi and Ngoile, 1990; Mwalyosi, 1990; and Semesi, 1990.) Despite these benefits, wetland resources around Lake Victoria are continuously being overexploited thus making them unsustainable. Poor agronomic practices, overgrazing, wildfires, cutting of macrophytes for fuel, housing and commercial activities, illegal and improper fishing practices, pollution by domestic and industrial effluents and agro-chemicals and introduction, of non-traditional or alien species into wetlands are some of the threats to wetlands surrounding Lake Victoria.

With rising human population, pollution of the lake has undoubtedly increased. The lake is a depository of all kinds of wind and water born materials and its catchment is perceived to contribute heavily on siltation, sedimentation, pesticide, heavy metals and

nutrients loading. During the last two decades the water quality and ecology of Lake Victoria have changed dramatically. The runoffs contribute significantly to sediment loading as a result of increased soil erosion in the catchment.
Livestock production in Lake Victoria basin wetlands constitutes an important component in the agro-pastoral farming system predominant of Mwanza and Mara regions. The communities in this area are mainly sedentary operating subsistence mixed farming combining livestock and crop production.

Livestock in this area serves as: main source of income, source of draught power and manure, provide household food security and other social functions. The area is also highly populated by both human and livestock, also supports high populations of grazing wild game from Serengeti National Park plains. The increasing human as well as animal populations and precarious climatic conditions are exerting immense, pressure on environmental resources, leading to varying levels of land degradations such as soil erosion.

The livestock sector, in particular, gets severely affected during dry seasons. Large herds of cattle and wild game get concentrated in few dry season grazing areas, like the wetlands.

This has led to varying levels of over exploitations of wetland resources and there is now increasing conflicts over these resources by multiple users. As such livestock production in this area poses a great threat to the fringing wetlands because overgrazing is the major cause of increased soil erosion. This study was carried out in October/November, 1999 as part of the Lake Victoria Environmental management Project (LVEMP) in Tanzania.

**Site Description**

The two villages lie at $2^0$ 14’ S; $33^0$ 55’ E and $2^0$ 16’ S; $33^0$ 55’ E, Lamadi and Nyatwali respectively. They are located on the flood plain that drains westwards to the Speke Gulf of the Lake, and bordering the western corridor of the Serengeti National Park in the East. The relief of the two villages is similar whereas the topography is generally flat. The climate is typical semi-arid with a weak bi-modal rainfall. Short rains start from early November to late December and long rains begin in early March to late April.

## Materials and Methods

### Methods

Ecological as well as Socio –economic surveys were conducted at Lamadi and Nyatwali villages in Magu and Bunda districts respectively in order to obtain baseline – data. Both secondary and primary data were collected from the study areas. Secondary data were collected from publications, reports and information from various people. Primary data were collected through quantitative ecological and socio-economic surveys. A field survey was conducted at the two sites during August/September 1999 (the dry season). The survey included: Reconnaissance, range and socio-economic surveys.

**Forage Yield and Chemical Composition**

Estimation of forage production used in this study was the clipping method. In this procedure, a $0.25m^2$ quadrant was used. A transect of one kilometre distance was purposely selected across the most representative vegetation of a given locality. Along this transect, a sample was taken after every 100 meters, thus making a total of 10 samples per kilometre. The clipped material was sorted out to discard dead litter. Then it was weighed in a large envelope using a suspended spring balance. All species within a quadrant were recorded for the determination of species composition. All sampling points were geo-referenced for future reassessment. Plant cover was estimated directly from quadrants. It was important to set a proper use factor (PUF) of key species at a level, which could not impair the productivity of each plant. In other words, some foliage must be left on these plants to provide for the physiological needs of the plants themselves. So the PUF for key species was set at 50%, although this could vary somewhat depending on vigor of plants, growth form of plants, season of grazing and soil types and slope. There after a dry matter (DM) coefficient was multiplied by each fresh weight sample, to get the DM weight per quadrant. The weights were extrapolated on per hectare basis to get forage yield per Ha. (Pieper, 1975). Some samples were dried at room temperature for 2 days before they were packed for further chemical analysis at Sokoine University, Morogoro. They were then oven-dried at $70^0$ C for 48 hours to get a constant weight. The samples were re-weighed to get a DM content in percentage before they were ground to pass through a one-millimeter sieve in a Christy and Norries hammer mill. After grinding, samples were sealed in jars ready for chemical analysis. The samples were analyzed for: Crude protein (CP), Acid detergent fiber (ADF), Neutral detergent fiber (NDF), Acid detergent lignin (ADL) and ash. The fibrous components (NDF, ADF and ADL) were determined by the methods of Van Soest (1987).

**Range Condition Assessment**

Range condition was determined according to the method outlined in the Range Management Task Force (1981). In this study, paced transects were used to determine range condition using composition, vigor, plant cover, and soil condition data. Transects were run in the same transects previously selected for determining potential forage yield. Hits on vegetation, litter, rock and bare ground were recorded immediately in front of a toe of the right shoe. Hits and tallies were classified as decreasers, increasers and invaders. Then the composition score was determined from a rating scale.

Four condition classes were used to express the degree to which the composition of present plant community reflects that of the climax (Table 1).

Table 1: Range condition classes

| **Range condition class** | **Percentage score** |
|---|---|
| Excellent | 76 – 100 |
| Good | 51 – 75 |
| Fair | 26 – 50 |
| Poor | 0 - 25 |

**Socio-Economic Survey**

The participatory rural appraisal (PRA) tools: community meetings, community mapping, transect walks, interviews and group discussions were employed during the field surveys. Farming systems, livestock production and constraints, community needs and the opportunities for solving the constraints were the kind of data collected. The information obtained through household, key informants interviews and group discussions was verified during community review meetings.

A purposeful sampling procedure involving all cattle owning households was conducted in the two villages. Eighty-one households were sampled at Lamadi while thirty-four at Nyatwali. Names of livestock keepers were obtained from all villages (from registry book at the village office). Data on herd characteristics and pastoral constraints were obtained through interviews. Semi-structured checklist questions were used to guide the interviews. The information on agriculture production, farm-holdings and demographic data were obtained by interviewing a sample of 30 households selected at random from each village.

Community meetings were conducted in seven sub-villages in the two villages; Mwabasabi A, Mwabasabi B, Mwabayanda, Kalago, Kashishi, and Mwalukonge sub villages in Lamadi, while in Nyatwali meeting was held at Kilabela sub village. During the meetings community members produced village resource maps, prioritised problems and proposed possible solutions and calendar of work.

**Results**

Results for forage chemical composition showed that protein and ash (Table 2) were higher on fair sites than the sites in good condition. On the other hand, forage plants from good range condition were higher in lignin compared with those of poor sites

Results for percentage cover, dry matter yield, density of woody species (trees per ha), range condition and carrying capacity (Ha. /LU) are outlined in Table 3. Plant cover for all the sub-villages at Lamadi, was below 50% but well above 25%. This means that their rating score was fair. Forage yield at Lamadi was highest at sub-villages of Mwabasabi A and B with 1320 kg/Ha while the lowest figure was scored at Kalago with only 680 kg/Ha. Tree and shrub densities were highest at Nyatwali with a score of 1318/Ha. Mwabayanda and Mwabasabi B had the least tree densities by having 19 and 40/ha respectively. Nyatwali had a higher carrying capacity compared to Lamadi. From the data (Table 3), 1.5ha supports one animal unit per year at Nyatwali, while all sub-villages at Lamadi fell within a range of 3.5 to 6.97 hectares per animal unit.

Table 2 Effect of range condition on percentage forage chemical contents

| Location | Condition | Chemical contents of natural pastures | | | |
|---|---|---|---|---|---|
| | | Crude protein | Lignin | Ash | Dry matter |
| Kashishi | Fair | 11.80 | 6.50 | 13.09 | 91.00 |
| Mwalukonge | Fair | 10.48 | 6.84 | 13.91 | 92.02 |
| Mwabasabi A | Fair | 7.90 | 7.32 | 9.42 | 92.02 |
| Mwabayanda | Fair | 6.98 | 4.89 | 12.00 | 91.01 |
| Mwabasabi B | Fair | 6.69 | 8.34 | 10.32 | 93.3 |
| Kilabela | Good | 6.40 | 10.67 | 10.61 | 94.04 |
| Kalago | Fair | 10.37 | 8.31 | 15.11 | 91.48 |

Vegetation at Lamadi and Nyatwali was characterized as short grassland, which is an extension of the Serengeti plains. Their species composition was slightly different, since Lamadi was more disturbed than Nyatwali.

Dominant grass species included: *Cynodon, Chloris,Digitalia* and to less extent *Panicum.* Those of Nyatwali were: *Pennisetum, Dichanthium, Themeda* and *Chloris (Table 4).* Cyperus was encountered more frequently at Mwabayanda (Lamadi) than Nyatwali. *Acacia drepanolobium* and *Solanuma incanum* were more widely distributed at Lamadi than at Nyatwali. However, the overall tree density was higher at Nyatwali than at Lamadi.

## Socio-Economic Results

### Farming system

Three farming systems have been identified in the study areas; pure agriculturists, agro-pastoralists and immigrant pastoralists. The immigrant pastoralists were the minority, but own the largest proportion of livestock accounting for 81.6% at Lamadi and 79% at Nyatwali village.

### Land tenure

Two land owning systems were identified in the study villages. Legal ownership, this is through a communal land lease given to the village. The other one is the individual families own the field plot through customary land owning systems. However land can be acquired through purchase, inheritance and free allocation by village government.

### Livestock herd characteristics

Two livestock keeping systems were identified; the agro-pastoralists and immigrant pastoralists. The number of cattle owned by individual immigrant pastoralists varied from 80 – 370 (averages of 202) heads at Lamadi and between 350-600 (average 438) heads at Nyatwali village. The agro-pastoral herders own between 5 – 70 (average 27) heads of cattle at Lamadi and between 10 – 80 (average 26) heads at Nyatwali village. The livestock population during the study period were 12,243 cattle 702 goats and 173 sheep at Lamadi; and 2,286 cattle, 500 goats and 93 sheep at Nyatwali village. The rangelands were 5 to 9 times overstocked at Lamadi.

**Table 3: Summaries of plant cover, forage yield, woody densities, range condition and estimated carrying capacity**

| Village | Sub-village | Herbaceous | Plants | Woody density | Condition | Estimated carrying capacity | Remarks |
|---|---|---|---|---|---|---|---|
| | | % cover | Kg DM/ha | | | | |
| Lamadi | Kashishi | 40 | 1000 | 165 | Fair | 4.75 | _Bare ground is 60%. Over utilized area with signs of erosion. Has bush encroachment. Is an agro-pastoral area. |
| | Mwalukonge | 43 | 1200 | 190 | Fair | 4.00 | _Slightly over-utilized with evident signs of erosion. Paddy field area and bush encroachment was evident. Bare ground is 57%. |
| | Mwabasabi A | 47 | 1320 | 146 | Fair | 3.57 | _There was a lot of Acacia bush regeneration most of them at knee height. The area was mostly under paddy fields. However, plant cover was only 51%. A number of cattle were seen grazing around. |
| | Mwabasabi B | 49 | 1320 | 40 | Fair | 3.57 | _Cover was 53% and a lot of trees have been cleared. Cattle were all around. |
| | Mwabayanda | 30 | 920 | 19 | Fair | 5.3 | _It was a serious fire hazard area. Bare ground was 70%. Trees were scanty. It was a cattle grazing area. |
| | Kalago | 35 | 680 | 291 | Fair | 6.97 | _Bare ground is 65%. Over-grazed area with bush encroachment. Agro-pastoral area. Has Poisonous plants and signs of tree cutting were evident. |
| Nyatwali | Kilabela | 67 | 3280 | 1318 | Good | 1.5 | _The land is still in good condition. Again there were sings of tree cutting for the construction of kraals (night biomass for cattle). A number of immigrant pastoralists were seen, and it was said they came from Shinyanga. |

Table 4: Summary of plant species composition for sub-villages at Lamadi and Nyatwali

| Site | Species | % Species composition |
|---|---|---|
| **Kashishi** | **Cynodon** | **14** |
| | **Echinochloa** | **7** |
| | **Chloris** | **10** |
| | **Cyperus** | **7** |
| | **Acacia** | **3** |
| | **Solanum** | **7** |
| | **Cynodon** | **17** |
| **Kalago** | **Eragrostis** | **3** |
| | **Dactyloctenium** | **7** |
| | **Cyperus** | **6** |
| | **Acacia** | **9** |
| | **Solanum** | **5** |
| **Mwalukonge** | **Cynodon** | **40** |
| | **Chloris** | **40** |
| | **Acacia** | **16** |
| | **Solanum** | **4** |
| **Mwabasabi A** | **Cynodon** | **30** |
| | **Digitalia** | **9** |
| | **Dactyloctenium** | **4** |
| | **Cyperus** | **4** |
| **Mwabasabi B** | **Cynodon** | **14** |
| | **Digitalia** | **11** |
| | **Dichanthium** | **6** |
| | **Echinochloa** | **3** |
| | **Cyperus** | **6** |
| **Mwabayanda** | **Chloris** | **25** |
| | **Panicum** | **19** |
| | **Cynodon** | **13** |
| | **Cyperus** | **31** |
| | **Commelina** | **6** |
| | **Indigofere** | **6** |
| **Nyatwali** | **Pennisetum** | **19** |
| | **Cynodon** | **25** |
| | **Dichanthium** | **6** |
| | **Themeda** | **7** |
| | **Echinochloa** | **6** |
| | **Chloris** | **13** |
| | **Cyperus** | **6** |

## Ownership of livestock

Household head (in most cases was a man), owns the livestock and he is the one who make important decisions concerning animal sale or slaughter. Women owning cattle was only 0.01%. (Table 5).

Table 5: Gender roles in agro–pastoral system at Lamadi and Nyatwali Villages

| **Activity/ Role** | **Male (Adult)** | **Female (Adult)** | **Children Male** | **Children Female** | **All family** | **Hired labour** | **Others** |
|---|---|---|---|---|---|---|---|
| Ownership of cattle | 99.3 | 0.1 | - | - | - | - | |
| Construction of bomas | 83.6 | - | 10 | - | - | 2 | - |
| Cattle herding | 28 | - | 16 | - | - | 40 | - |
| Calf rearing | 4 | 2 | 30 | - | - | 10 | - |
| Goat herding | 2 | - | 7 | - | - | 11 | - |
| Sheep herding | 2 | - | - | - | - | 5 | - |
| Water the livestock | 33 | - | 27 | - | - | 49 | 1 |
| Livestock | | | | | | | |
| • Selection | 80.4 | 0.1 | 2.3 | - | - | - | - |
| • Advice | 62 | 15 | - | - | - | 22 | - |
| • Identification | | | | | | | |
| - Sick | 51 | 6.0 | 21 | 33 | - | 15 | - |
| - Mating | 75 | 7.4 | | | | | |
| • Sales | 99.1 | 0.01 | | | | | |
| Milking | 32.8 | - | 32 | - | - | 40 | - |
| Milk marketing | 14 | 38 | 8 | 1.2 | 13 | 8 | 7 |
| Slaughtering | 96 | - | 3.8 | - | - | - | 0.2 |

## Discussion

Findings during range surveys and socio-economic field studies gave indications of increasing environmental degradations of the wetland resources in the area. The extend of degradations was dependent on human and animal population, type of farming system, social economic activities of stakeholders, as well as ecological factors. Measures aimed at reversing such degradation processes should take into consideration the needs of stakeholders and livelihood support systems. The wetlands around Lake Victoria (in Mwanza and Mara regions in particular) are traditional dry season grazing areas for livestock from inland districts in Mwanza, Mara and Shinyanga regions, which experience prolonged dry seasons. They also serve as dry season refugee for wild game (especially in Mara region). The areas were until early 1960s sparsely populated, rapid population growth followed the villagilization program during mid 1970s. The recent trade liberalisation has triggered off a lucrative Tanzania – Kenya cross border cattle trucked – trade. Some of the villages residing the lake Victoria such as Lamadi became cattle loading centres. This attracted a number of cattle speculators and immigrant pastoralist, who are now settling in these wetlands.

The increasing inter-dependence was identified between crops and livestock production system. Crop residues are used as animal feeds particularly during the dry-season when livestock are allowed to graze in fields after harvest. Animal manure and draught power are also applied directly for crop production. However, there is intensifying competition for land between the two production systems. The increasing demand for arable land is putting much pressure on the available grazing lands.

Under conditions of heavy stocking rates, grass cover is destroyed, fires are normally eliminated, and erosion sets in and there after encroachment ensues. The development of grass cover was prevented by continuous grazing (van Rensburg, 1969). Rensburg also emphasized that, haphazard shifting cultivation followed by uncontrolled grazing and trampling cause near devastation of land and encourage rapid encroachment of undesirable wood plants. Therefore, the absence of plant cover through overgrazing and discontinuity of cover in some places lead to poor or no fires at all. In like-manner, livestock and wild herbivores feed on pods of bushes/trees thereby spreading their seeding at the disadvantage of grasses. The total result is bush/tree encroachment in areas previously occupied by pastoralists.

Therefore, the grazing intensity on fair range should be monitored in order to leave stubble that will guarantee good plant vigour and to check the run-off during rains. By checking the speed of run-off, the stubble encourages more water to infiltrate into the soil thereby prolonging the provision of green forage during dry season.

Continued grazing pressure by livestock and wild herbivores may also result in serious soil erosion problems. Soil erosion is a formidable obstruction to progress in the development of agriculture and livestock. Over large areas of sub-villages at Lamadi, their protective natural vegetation has been destroyed and this has caused a remarkable deterioration in the structure and water retaining capacity of the soil with consequent loss of soil and fertility. Also by disturbing water catchment areas, the balance of water distribution in the hills and valleys, a great deal of damage is caused by flooding of fields.
Range condition, which is defined as the relative health and vitality of a range Stoddart et al., 1975) or the current productivity of a range relative to what that range is naturally capable of producing or the state of health of the range based on what that range is naturally capable of producing (Pratty and Gwynne, 1977). Range condition is therefore influenced by the interaction of grazing management practices like, grazing intensity, frequency and season. Frequent grazing coupled with the observed high stocking rates caused continuous heavy defoliation of photosynthetic shoot growth thereby disturbing the absorption of nutrients from the soil. When these phenomena are continued, palatable and preferred forage plants get depleted thereby increasing unpalatable and poisonous plants i.e. *Solanum spp* (Cook et al., 1953). A number of increasers that were encountered, during the study, were; *Solanum incanum*, *Sporobolus piramidalis, Linchelitrum repens, Ricinus communis* e.t.c.

On the other hand impacts of over-grazing extend further by affecting nutritive values of range forage. Although Protein and Ash contents were higher on fair sites than good sites, forage yield and total dry matter were higher on good sites than fair areas. The difference in forage chemical contents was largely attributed to the differences in stem leaf ratio. Forage plants from good range condition were higher in lignin compared to the samples from poor sites. This would be expected, since both leaves and stems were somewhat larger structurally and gave the general appearance of being coarser than those on poor sites (Dermarchi, 1973) Table 2. Stoddart et al. (1975) reiterated that, poor sites deteriorate more rapidly than good sites during grazing because plants on unfavorable sites are more preferred and consequently are utilized more intensively. However these plants were not as tolerant to heavy use as plants on favorable sites because of the generally poorer growing conditions.

The immigrant pastoralists own about 80% of the total herd and the majorities are concentrated in Lamadi village. Cattle and small ruminants are kept in kraals constructed from thorny bushes to deter thieves or wild predators. The kraals were not roofed.

There were no areas that have been demarcated for grazing purposes in both villages. Livestock have had free access to the available non-cultivated lands, field fallows and flood plains. The agro-pastoralists graze their animals mostly in the fallow and open areas nearby their homesteads. The immigrant pastoralists tended to settle on the periphery of villages and grazed their cattle on distant grazing areas and usually they crossed village borders to nearby villages depending on the grazing pressure. Serious shortage for grazing areas is experienced during rainy seasons when most of the areas nearby the settlements are cultivated. The animals are then driven to distant flood plains. During dry seasons, nutrition is very low due to shortage of pastures and lack of drinking water. All pastoral categories do not practice feed conservation.

The most important sources of water for livestock in the study areas were; the lake, earth dams, shallow wells, rivers and streams. Most of water sources with exception of the lake were seasonal. Hence, livestock herds centred at a distance from the lake faced serious water shortages during the dry seasons. Livestock have to trek for 16 to 20 km to watering points. The important water sources for the livestock are the lake, rivers Mbarageti and Lamadi

The perceived livestock production constraints were obtained through preference ranking by pastoral groups in the study areas. The main constraints at Lamadi in descending order were: high disease incidences, shortage of water, shortage of pastures, lack of veterinary drugs and lack of animal health knowledge. At Nyatwali; high disease incidences, lack of veterinary drugs lack of extension services and lack of dipping facility were the main constraints. The highest disease incidences in the study areas were: tick born disease, East coast fever (EFC), heart water, babesiosis, and anaplasmosis. This disease complex can be controlled through routine dipping using appropriate acaricides. Other reported important diseases were: Foot and Mouth Disease (FMD) Contagious Bovine Preural Pneumonia (CBPP), Trypanosomiasis, Haemmorrhagic septiceamia, Brucellosis and lumpy skin diseases (LSD). Rinderpest, anthrax and black quarter were some of diseases found in the study areas.

**Conclusion**

The existing pastoral/agro-pastoral system of keeping livestock has aggravated a number of problems pertaining to land resources. It was concluded that overgrazing had adversely resulted into: Decreased plant species composition Loss of forage yield, leaving a lot of bare ground, Bush encroachment, Poor range condition, Encroachment of undesirable forage apecies including poisonous plant spcies i.e. *Sporobolus, Linchelitrum*, and *Solanum incanum,* Siltation and eutrophication of the Lake, Increased run-off and erosion hazard(s), Low livestock weights which may result in loss of economic potential and loss of soil moisture content that could have resulted into prolonged green pastures in dry seasons.

**Recommendations**
Several recommendations were brought forward and these included; Basic training programs for pastoralists as well as agro-pastoralists in the following areas; Pasture improvement with particular emphasis on deferment and resting skills; Proper grazing management skills so that enough stubbles are left on the ground for the sake of checking the speed of run-off as well as encouraging the filtration process of water that enters into the Lake; Indicators of range deterioration including poisonous plants to livestock and Disease control and proper procedures for safe-use and disposal of of veterinary drugs in order to minimize the pollution problem on the Lake.

More studies to be done in all areas surrounding the Lake, in order to come up with a recommended carrying capacity that is in line with proper conservation measures for the purpose of safeguarding it.

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