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**RANGELAND DEGRADATION IN UGANDA:  
THE FAILURES AND FUTURE OF PRIVATIZATION**

by

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## **RANGELAND DEGRADATION IN UGANDA: THE FAILURES AND FUTURE OF PRIVATIZATION.**

***Dick Sserunkuuma and C. Ford Runge\****

Nearly two thirds of the world's livestock are found in developing countries, yet their productivity is such that they account for only one third of the world's meat and one fifth of its milk. In Africa, milk yields are only one tenth of those in North America and Europe (FAO/ILRI, 1995). Both genetic and environmental reasons have been forwarded to explain low animal productivity in sub-Saharan Africa (SSA). Genetic explanations include the "inferiority" of the native breeds, although these breeds often out-survive the imported stock. The main environmental explanation for low productivity is poor animal nutrition arising from overstocking and overgrazing. However, the contribution of overstocking to the low productivity remains ambiguous.

For many years, pastoral "irrationality" has been blamed for large herds that debase rangeland resources and lower animal productivity. Yet more recent studies suggest that livestock numbers do not explain irreversible effects on vegetation--which some regard as the true definition of overgrazing (FAO/ILRI, 1995; Behnke and Scoones, 1992). Others contend that overstocking, overgrazing and desertification are often assumed or invoked without evidence (Sandford, 1983 cited in Homewood and Rodgers, 1988).

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Notwithstanding these debates, eighty percent of Africa's rangelands and pastures have signs of damage (World Bank, 1992). This paper seeks to inform the debate over land degradation, based on empirical evidence from detailed ethnographic and economic studies carried out in the pastoral areas of Nyabushozi county, western Uganda. Based on a capital theory model that predicts the optimal age of sale for cattle, the paper uses a household level analysis to explain the inter-household disparity in the age at which cattle are sold--under a private grazing system--and the implications for rangeland degradation in Uganda. The data used was obtained through a survey of 125 pastoral households with private grazing land in the sub-counties of Nyakashashara and Kenshunga, in Nyabushozi county, western Uganda. This highly detailed ethnographic data set, gathered by the first author in the field, represents one of the most complete records of pastoral incentives in sub-Saharan Africa. Special care was given in accounting not only for economic but biophysical, social and cultural variables. One of the first findings of this study is that biophysical indicators of overgrazing such as severe bush encroachment, patches of bare ground, and animal trails are observed across grazing systems, including many private ones (Sserunkuuma, 1995).

Following this observation, subsequent ethnographic and survey data were gathered to assess the role of various factors, including property rights, as causes of degradation. One of the principle findings is that overgrazing occurs across property rights regimes, including state property, private property and communally grazed areas (see also Kisamba-Mugerwa, 1992). Under private property, it was found out that 39 out of the 125 surveyed households overstock by over three times the carrying capacity of their private rangelands. Given that these 39

households had no access to alternative animal feeds to supplement their private natural pastures, it was concluded that they overgraze (Sserunkuuma, 1998). These findings contradict the assertions (for example, Johnson, 1972 and Picardi, 1974 cited in Runge, 1981; and Demsetz, 1967; Anderson and Hill, 1977; Libecap, 1981 cited in Stevenson, 1991) that private tenure is a necessary and sufficient condition for the abatement overgrazing, because it induces the private rangeland owner to graze at the socially optimal rate--one that maximizes the net economic returns from the rangeland. Stevenson (1991) argues that even under private property, the socially optimal grazing rate may not be realized if there is divergence between social and private discount rates; externalities; and capital or other market imperfections.

In addition to these factors, there is also a continuing debate over the cultural role of cattle in Africa, where herds allegedly serve as a store of wealth or savings account from which withdrawals are made for special social or ceremonial occasions or for emergency cash needs such as payments for education (de Wilde, 1967 cited in Doran et al., 1979). According to Doran et al. (1979), the wealth storage attribute of cattle induces pastoralists to retain or increase cattle numbers even under adverse environmental conditions, which increases the likelihood of overgrazing. This argument suggests that the absence of better wealth storage alternatives (and alternative investment opportunities) in the pastoral economy is a market imperfection that causes pastoralists to store much or all of their wealth in the form of cattle--and to retain them beyond the age of profit maximization, which leads to advanced age of cattle sales and a higher likelihood of overgrazing. Based on this argument, Doran et al. (1979)

hypothesized an inverse relationship between cattle sales and price, which is supported by the results of their Swaziland study.

However, Jarvis (1980) countered the sale-for-specific-cash needs theory, arguing that cattle are capital goods held by producers as long as their capital value in production exceeds their slaughter value. He argued that cattle have value because of their ability to convert forage into useful products (milk, beef, hides, draught power, etc.), and wealth can be invested in cattle with the likelihood that it will increase--not just to be maintained. Jarvis maintained that owners will find it profitable to prolong the life of an individual animal only so long as its daily production (including future beef) exceeds its current value as beef and hide. An increase in beef price will cause a short-run reduction in slaughter as producers try to expand production. But because cattle production can be increased only by increasing the size of the breeding herd and/or withholding animals for further fattening, producers must bid animals away from consumers to increase the capital stock--via fattening the steers to heavier weights and retaining more females for the breeding herd--which is the source of higher future beef production; and as a result, the negative supply response may persist for sometime (Jarvis, 1980).

In reply to Jarvis, Low, Kemp and Doran (1980) conceded that a negative short-run price response was consistent with both the store of wealth and profit-maximizing motives; and was not evidence in itself against profit-maximizing behavior. On the other hand, Ariza-Nino and Shapiro (1984) showed that in African pastoral production systems, the age of cattle sales is likely to be highly insensitive to changes in economic variables (prices and interest rates), and

strongly challenge the prospect of altering off-take rates or herd size through the manipulation of economic variables.

None of the studies cited above employed household level data to support or reject their claims. Instead, sectoral or economy-wide data on economic and non-economic variables affecting cattle sales was employed. Yet the decision to sell cattle (and at what age) is made at the household level. What is observed for the entire cattle sector is a cumulative result of individual household behavior. Therefore, focusing on the entire cattle sector instead of the decision making unit--the household--leads to a loss of information. Freeman (1993) maintains that the appropriate analytical framework for examining the effects of policy on the environment in sub-Saharan Africa is the household. By putting households in the center for policy analysis as key decision-making units enables one to achieve a focus on incentive structures; and to answer questions as to why farm households behave in a way that is often deleterious to the environment, and what policy makers need to do to create incentives for these households to behave the way they want them to (Holden, 1997). Based on a survey of 125 pastoral households, the empirical evidence presented in this paper indicates that in addition to wealth storage and profit maximization motives, subsistence motives play a pivotal role in determining the age of sale for cattle. The study also shows that the need to subsist makes herders overstock and, thus, degrade their private rangelands.



## **Modelling The Pastoral Households' Age-of-Sale Decision**

The maintained hypothesis in this paper is that the ethnographic, biophysical and economic characteristics of pastoral households differ across households. These differences shape the structure of incentives and constraints in different households and thus the decision-making process regarding when to sell cattle, how many, at what age, etc. The age of sale for cattle is a key variable determining the size, age and sex composition of the herd. This in turn affects the primary and secondary productivity of the rangeland because grazing pressure exerted on pasture resources differs across size, sex and age categories of cattle (Ariza-Nino and Shapiro, 1984; Hocking and Mattick, 1993).

In this section, a simplified form of Jarvis' (1974) capital theory model developed by Ariza-Nino and Shapiro (1984) is used to characterize the herders' decision-making process concerning the age at which to sell cattle. This model predicts the age of sale that would be chosen by a pastoralist wishing to maximize the net benefits from his/her herd. Although cattle are kept for beef, prestige, social, and other benefits, milk production is the primary goal of herders in Nyabushozi (Kisamba-Mugerwa, 1992). It remains their major food despite the fact that many have started growing food crops for home consumption. Therefore, it is only after meeting the household's consumption requirements that the surplus milk is sold to the market. However, when faced with emergency cash problems that cannot be solved with proceeds from surplus milk sales, pastoralists sell adult live animals for cash. Usually, these are adult females as

most of the males are sold off young to reduce competition for the limited resources, which would otherwise have a negative effect on the milk yield from the lactating cows<sup>1</sup> (Sserunkuuma and Olson, 1998).

The decision to keep or sell an animal hinges on a comparison of the benefits from keeping the animal one more period versus the costs of doing so. Choosing to keep the animal one more period benefits the owner in two ways: first, by increasing the animal's sale value due to its increased weight, second, by value added from the animal as a living resource in terms of milk, calves, security, prestige, etc. that s/he would otherwise forego. The costs of the choice not to sell include herding, feeding, veterinary and other costs incurred because of keeping the animal one more period, and the one-period gains foregone by not selling the animal and investing in an alternative asset.

Thus, the problem faced by a typical pastoral household is to choose the optimum age of sale ( $A^*$ ) that maximizes the present value of net benefits  $\Pi(A)$  from his/her herd.<sup>2</sup> This problem is expressed as:

$$\text{Max } \Pi(A) = pw(A)e^{-rA} + \int_0^A f(p,t)e^{-rt}dt - c \int_0^A e^{-rt}dt(1)$$

where:

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<sup>1</sup>The structure of the herds for the surveyed households depicts a bias towards milk production. The estimated average herd size for the respondents is 70 head of cattle, of which 13 are male. Out of the 13 male, 11 are mostly yearlings, leaving one or two adult bulls for breeding purposes.

<sup>2</sup> Naturally, Ugandan pastoralists do not literally solve such a maximization problem. However, the structure of incentives they face is exposed and clarified by use of such a model. On the question of treating economic decisions as optimization problems--even though the agents involved are not consciously or purposively behaving in a maximizing (minimizing) manner, see Samuelson (1947) in Foundations of Economic Analysis.

p is the price of meat per kilogram

A is the age of sale

f(p,t) is the summation of the flow benefits as a function of price (p) and time (t)

r is the interest rate

w is the liveweight of the animal

c is the direct cost of keeping the animal one more period

$e^{-rt}$  is the discount factor

Differentiating  $\Pi(A)$  with respect to A and setting the result equal to zero gives the following first order condition for the profit maximizing age of sale:

$$p[\delta w(A)/\delta A] + f(p,A) = rpw(A) + c(2)$$

This condition states that at the optimal age of sale ( $A^*$ ), the household benefits from keeping the animal one more period namely, the change in value of the animal due to changing weight

$(p[\delta w(A)/\delta A])$  plus the additional value flowing from the living animal ( $f(p,A)$ ) must equal the household costs in terms of foregone interest ( $rpw$ ) that could have been realized from selling the animal and investing the sale revenue ( $pw$ ) in some other asset plus feeding, herding, and other costs ( $c$ ) of keeping the animal for that additional period. Thus, the **decision rule** for a profit-maximizing pastoralist is to sell the animal if the left hand side (LHS) of equation 2 is smaller than the right hand side (RHS); and not to sell if the converse is true. We now apply the logic of equation (2) to the decisions of pastoralists to gain insight into the factors that may lead to rangeland degradation.

## **The Observed Influence of Ethnographic Characteristics on Cattle Age of Sale**

As noted earlier, the herd composition data from the surveyed households is indicative of a cattle production system that is biased towards milk production. In addition to milk being the major food for this area, the existence of a ready milk market from private and state-owned milk processing plants has also contributed to the inclination towards dairy as opposed to beef farming. In this kind of system, it is expected that flow benefits ( $f[p, A]$ ), exemplified by milk yield, play a greater role in determining the age of sale for individual animals than do weight-related benefits ( $p[\delta w(A)/\delta A]$ ).

Nevertheless, it is assumed that the herders are aware that weight-related benefits can be maximized--within certain limits--by selling older animals that have reached the profit-maximizing age of slaughter. Likewise, from the specific-cash needs point of view, herders will prefer to sell older, bigger and, thus, higher value animals because this enables them to sell the minimum number of animals to solve emergency cash needs. Whatever the motive for selling cattle, herders will as much as possible try to ensure that any animal sold causes minimum (maximum) reduction (increase) in the flow benefits derived from the remaining animals. Based on these assumptions, we make the following observations:

- 1 . Since the flow benefits for beef cattle (bulls or steers) are low or zero, the age at which they are sold is expected to be lower compared to the female cattle.
2. Given the bias towards milk production--on limited resources manifested in high stocking rates, the higher the stocking rate the lower will be the age of sale for male cattle, since

herders will tend to sell them off early to minimize their negative impact on fodder availability and therefore milk yield from lactating cows. However, because selling female cattle may have a negative impact on current and/or future aggregate milk output from the herd, it is difficult to make a priori predictions on the potential effect of stocking rate on the age of sale for female cattle.

3. Because government extension workers view milk output as a primary goal, they generally advise eliminating “unwanted” male cattle at the earliest opportunity. Hence, greater access to extension services is expected to lower the age of sale for male cattle. However, pasture and water resource constraints may force herders to sell or not sell female cattle notwithstanding extension recommendations.

4. In addition to the private rangelands grazed individually by the surveyed pastoralists, some had access to additional grazing land over which they had no secure, exclusive rights (but on which they could graze their animals). Access to this additional land has an effect of relaxing the fodder constraints faced by the herders, thereby moderating the negative impact of male (and female) cattle on the flow benefits from the rest of the herd. Hence, access to alternative grazing land is expected to increase the age of sale for male and female cattle, since selling older animals is consistent with profit-maximization as well as wealth storage motives.

5. Purchased chemical inputs such as tick-sprays (*acaricides*) are only obtainable from farm-supplies stores in trading centers or towns. Depending on the distance from the herders' homes to these stores, transportation costs can increase the healthcare costs for animals. Higher

healthcare costs increase the right hand side of equation 2, thus decreasing the age of sale of both male and female cattle.

6. In subsistence-oriented pastoral production systems, pastoralists tend to pursue the goal of maintaining a minimum number of cattle per person in their households so as to guarantee that, at any time, the aggregate output of milk (staple food) from the entire herd is enough to meet the family's current consumption needs (Sserunkuuma, 1998). Dahl and Hjort (1976) estimate that a cattle herd of 64 animals is needed to yield continually enough milk, meat and blood to satisfy all the calorie and protein requirements of a reference family of six. Beyond this ratio of approximately 11 animals per person, it is logical to assume that additional animals are kept for other motives--such as cash-income generation, wealth storage, power, prestige, etc. Assuming no overstocking problems (which would necessitate pre-mature sales, especially of male cattle, to reduce grazing pressure on the private range), a logical extension of the previous assumption is that those households with more than 11 animals per person will always have some surplus milk to sell and, thus, some cash to spend on the day-to-day expenses or even save for future emergency cash needs. This would reduce the pressure on these households to sell cattle often--and sometimes prematurely--to meet daily or emergency expenses. In such a setting, it is expected that individual animals (male or female) will be sold at older age, which is consistent with both profit-maximization and wealth storage hypotheses.

7. Other things being equal, complete dependence on cattle for food (milk) and income causes pastoralists to over-invest in cattle (overstock), since fewer cattle--particularly of the local breed type--mean less aggregate milk output and, thus, less food and income

(Sserunkuuma and Olson, 1998). However, much as it induces the pastoralists to overstock, complete dependence on cattle is expected to sometimes take away their opportunity to hold animals until they reach the profit-maximizing age of slaughter. This is because compared to households with alternative sources of food and income, the pressure to sell cattle--especially beef cattle--before they reach their profit-maximizing age of slaughter (to solve emergency cash problems) is expected to be higher for the households that completely depend on cattle for a living. Therefore, insofar as they can satisfy the emergency and daily food and cash needs of the pastoral households, alternative sources of food (such as crops) and income (such as off-farm employment) are expected to give pastoralists the opportunity to hold individual animals until they are older, which is consistent with profit-maximization and wealth storage motives.<sup>3</sup>

8. If the absence of wealth storage alternatives induces pastoralists to store all their wealth in cattle, and/or to retain them beyond the profit-maximizing age of sale (for beef purposes), the presence of banking opportunities or other wealth storage alternatives to cattle should reduce the age of sale. Therefore, the use of bank savings as a wealth storage alternative is expected to reduce the importance of cattle as a wealth store and, thus, reduce the age of sale.

9. The herder's age may affect the age of sale for cattle. Older herders are presumed to

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<sup>3</sup> A contradictory argument could be raised regarding the impact of alternative sources of income on age of sale. For example, if the alternative source of income is in the form of trading or shop-keeping, which usually require cattle to be sold before investing or expanding investment in these areas, this may instead lead to more frequent, and possibly younger-age cattle sales, if the investments in trading are perceived to be more profitable than cattle. However, for this study, the alternative sources of income were mainly in the form of crop sales and off-farm employment.

have more herding experience and, thus, more knowledge about the pros and cons of holding individual animals for long periods, coming from lessons learnt over the years. Therefore, the age of sale is expected to increase with the herder's age, assuming a good past experience about holding cattle for long periods.

10. Education is expected to expose herders to new ideas and to influence their perception of the herding business towards commercial and away from traditional and cultural motives that increase the propensity to hold animals longer than is necessary for profit maximization. In this respect, the age of sale is expected to reduce with education.

## **Hypotheses**

The observations above lead to the following hypotheses:

1. Male cattle will be sold at ages less than female cattle
2. The higher the stocking rate, the lower the age of sale for male cattle
3. Greater access to government extension advice will lower the age of sale for male cattle
4. Access to additional grazing land with insecure tenure increases the age of sale for male and/or female cattle
5. Distance from trading centers (towns) decreases the age of sale for male and/or female cattle
6. The higher the cattle-per-person ratio in the household, the higher the age of sale for male and/or female cattle
7. Alternative food and income sources will increase the age of sale for male and/or female cattle



- 8 . Bank savings alternatives will reduce the age of sale for male and/or female cattle
- 9 . Pastoralists' age increases will increase the age of sale for male and/or female cattle
- 10 . Higher education will decrease the age of sale for male and/or female cattle

### **Empirical Analysis**

The empirical model below tests these ten hypotheses. Survey data from 125 pastoral households with private rangeland tenure in Nyabushozi was used to fit an ordinary least squares (OLS) regression model that explains the variation in the average age at which cattle are sold across households. Following the theoretical model (equations 1 and 2) which predicts a differential impact of the parameter changes on the value and, thus, the optimum age of sale for cattle of different sex, the equations explaining the age of sale are disaggregated by the sex category of cattle. Equation I shows the results in which the average age of sale for male cattle (sold in the 12 months that preceded the survey) is the dependent variable. Equation II shows the same results for female cattle.<sup>4</sup> In both equations, the natural log of the average age of sale is regressed against a set of explanatory variables described and summarized in Tables 1 and 2, respectively. Table 3 presents the regression results for male and female cattle.

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<sup>4</sup> Equation I:  $\text{Log}(\text{SEL.AGE} [\text{MALES}]) = f\{\text{SR, EXT., ADD.LAND, MKT.DIST, CATPERPSN, CROPLAND, ALT.INC, AGE, EDU}\}$   
Equation II:  $\text{Log}(\text{SEL.AGE} [\text{FEMALES}]) = g\{\text{SR, EXT., ADD.LAND, MKT.DIST, CATPERPSN, CROPLAND, ALT.INC, AGE, EDU}\}$

**Table 1: Description of Variables**

<b><u>Variable</u></b>	<b><u>Description</u></b>
SEL.AGE	<i>Average age of sale for male/ female cattle:</i> This is the dependent variable. It is the mean age of sale computed over the total number of male/female cattle sold by each surveyed household within the 12 months that preceded the survey.
SR	<i>Stocking Rate:</i> Defined as the number of animals per hectare of grazing land.
EXT.	<i>Access to Extension Services:</i> Measured as the number of visits--to the pastoralist--by government extension agents within the 12 months that preceded the survey.
ADD.LAND	<i>Additional grazing land:</i> This variable takes on a score of 1 if in addition to the private land, the pastoralist has access to some other land (rented or communal land); and 0 otherwise.
MKT.DIST.	<i>Distance to the Nearest Trading Center or Milk Collection Center</i> (scale: 1-3): This is a proxy variable used to capture the differences in the input and output prices faced by different pastoral households, since all pastoralists are price takers.
CATPERPSN	<i>Number of cattle per person:</i> The number of animals per person in the family, calculated as the ratio of herd size to family size. A family is defined as people living and eating together in a household.
CROPLAND	<i>Cropland:</i> The amount of land allocated to growing food crops--an alternative source of food.
ALT.INC	<i>Alternative income:</i> The household monthly-income (in Uganda Shillings) earned from other sources--off-farm or on-farm--that are not related to cattle.
B/Acc.	<i>Type of Bank Account held by the head of household:</i> This variable is used as a proxy for the pastoralists' use of banking services to store wealth or savings. It takes on a score of 0 if no bank account; 1 if savings account; and 2 if current account. This variable measures the effect of a wealth storage alternative on the age of sale for cattle; and the scoring (0 to 2) represents increasing use of banking to store wealth. The current account was given a higher score than the savings account for two reasons: (1) the primary purpose of opening the account; and (2) the length of time the account has been in use. In 1995, all pastoralists who sell their milk to the Dairy Corporation Milk Collection Centers were told to open savings accounts, so that the Corporation would fortnightly deposit their proceeds directly into their accounts. Those who had bank accounts (mainly current accounts) before 1995 were not required to open new accounts, and we assume that they opened these accounts voluntarily for the purpose of storing their wealth/savings. On the other hand, those who opened savings accounts in 1995 didn't do so for the purpose of depositing their savings, but for receiving payment from the Corporation, and their accounts have been in use for a shorter time than the current accounts. That is why holders of current accounts were given a higher score, to represent more use of the bank to store wealth.
AGE	<i>Age of Household Head:</i> Used as a proxy-measure of cattle rearing experience.
EDU	<i>Education:</i> The number of years of formal education acquired by the head of household.

**Table 2: Summary Statistics on Regression Variables\*\***

<u>Variable</u>	
Average SEL.AGE for Male Cattle	1.64 (0.70)
Average SEL.AGE for Female Cattle	5.45 (2.85)
Average SR	1.07 (0.66)
Average EXT	3.62 (3.40)
% of Respondents with ADD.LAND	15.3
% of Respondents 1 mile to Nearest Town	25.4
% of Respondents 2 - 4 miles to Nearest Town	52.5
% of Respondents 5-10 miles to Nearest Town	22.1
Average CATPERPSN	8.12 (7.65)
Average CROPLAND (Ha)	1.25 (1.16)
Average ALT.INC	32,530 (54,930)
% of Respondents with Savings B/Acc.	55.2
% of Respondents with Current B/Acc.	24.0
Average AGE	48.75 (15.56)
Average EDU	5.57 (3.96)

**\*\*N = 125 and the numbers in parentheses are the standard deviation**

The summary statistics (Table 2) show that male cattle are sold at a much younger age than female cattle, as predicted. However, for both categories of cattle, the age of sale figures are significantly lower than the profit-maximizing slaughter age of 6 for males and 10 or 11 for females predicted by Ariza-Nino and Shapiro (1984) for the Sahel. This is partly attributable to the differences in the grazing systems in Nyabushozi (private) and the Sahel (communal).

One interpretation of this finding is that privatization reduces the land and, thus, pasture resources available to individual pastoralists, “forcing” them to sell animals earlier than they probably would have preferred. Therefore, the tendency of African pastoralists to retain cattle even under adverse conditions (leading to advanced age of sale) may be more applicable to communal than private grazing systems (see Doran et al., 1979).

**Table 3: Regression Results of the Age of Sale Explanatory Model.<sup>1</sup>**

	<b><u>EQUATION I</u></b>	<b><u>EQUATION II</u></b>
<b><u>DEPENDENT VARIABLE</u></b>	<b><i>LOG (SELAGE [MALES])<sup>2</sup></i></b>	<b><i>LOG (SELAGE [FEMALES])<sup>2</sup></i></b>
<b><u>EXPLANATORY VARIABLES AND STATISTICS</u></b>		
Intercept	1.462 (4.995) ***	2.016 (4.725) ***
SR	-0.173 (-2.142) **	-0.124 (-0.969)
EXT	-0.031 (-2.503) **	-0.013 (-0.728)
ADD.LAND	0.268 (2.003) *	0.197 (0.947)
MKT.DIST	-0.185 (-2.442) **	-0.011 (-0.104)
CATPERPSN	0.011 (2.229) **	0.018 (2.254) **
CROPLAND	-0.013 (-0.854)	-0.025 (-1.035)
ALT.INC	0.0001 (0.114)	0.002 (1.847) *
B/Acc.	-0.121 (-1.367)	0.087 (0.760)
AGE	-0.005 (-1.658)	-0.004 (-0.906)
EDU	-0.006 (-0.397)	-0.030 (-1.508)
Adjusted R <sup>2</sup>	0.27	0.13
F-Statistic	2.61	1.78
N = 125		

<sup>1</sup>Numbers in parentheses are t-values.

<sup>2</sup>\*, \*\*, \*\*\* = Statistically significant at the 10%, 5% and 1% levels of significance respectively.

The regression results (Table 3) show that the age of sale for male cattle significantly decreases with stocking rate, access to extension services and distance from the herders' homes to the nearest trading center or market; and increases with access to alternative grazing land, as predicted. This suggests that when the herders' primary goal is to maximize milk output on limited resources; and when the government extension workers' advice to the herders is consistent with this goal, the age at which male cattle are sold drops significantly. This is

because, in this case, the motive of reducing grazing pressure to increase milk output plays a bigger role in determining the age of sale, than does beef-profit maximization and wealth storage motives--which require animals to be sold at older age.

The evidence of a strong impact of stocking rate on the age of sale for male cattle--but not for females--corroborates two arguments made by Sserunkuuma (1998). First, that it is not out of ignorance that many herders in Nyabushozi overgraze. That is, in most cases, those who overgraze know that they do, and they know the consequences, but they continue to do so. The fact that at higher stocking rates the herders sell male cattle at an early age (and forego the benefits of selling them when they are older and bigger) is evidence, in itself, that they recognize that they are overstocking. The premature sale of male cattle is an attempt to ease grazing pressure and increase fodder availability on the private range. Second, even when they recognize that they are overstocking, the need to maintain a certain level of aggregate milk output from the herd causes pastoralists not to sell milk cattle (females) to ease grazing pressure. The insensitivity of the age of sale for female cattle to stocking rate supports this argument.

The results also strongly support the predicted positive relationship between the age of sale, for both male and female cattle, and the number of cattle per person in the household. That is, pastoral households with a higher cattle-per-person ratio and, thus, a higher possibility of having more cattle than is needed to meet their current consumption requirements, sell animals at older age than those with lower cattle-per-person ratios. This is because they face less pressure to sell cattle often to meet daily or emergency expenses; and they have more animals--and possibly in various age categories--to choose from (if they have to sell) than households

with lower cattle-per-person ratios, leading to older age sales as selling older, bigger animals is desirable both for profit maximization and wealth storage purposes.

The relationship between the age of sale and alternative income sources is positive and significant for female but not male cattle. Other explanatory variables (Table 3) are not significantly important in explaining variation in the average age at which cattle (male and/or female) are sold across households.

## **Conclusion**

Compared to the predicted optimum age of slaughter (for profit-maximization purposes) in the Sahel (Ariza-Nino and Shapiro, 1984), both male and female cattle are sold “prematurely” in Uganda. This could be partly explained by the fodder supply constraints associated with private grazing. Doran et al. (1979) associate the wealth storage motives of raising cattle to advanced age of slaughter and overgrazing in Swaziland. The fact that Nyabushozi herders do not seem to retain individual animals for long periods should not be interpreted to imply that there is no overstocking or overgrazing in Uganda, because without grazing pressure information, the age of animals per se is not a conclusive indicator of whether or not overgrazing is taking place. Instead, the early age of sale, especially for male cattle, should be seen as an attempt to reduce grazing pressure, which indicates that there are indeed overstocking problems in Nyabushozi.

The empirical evidence suggests that when herders are faced with a problem of inadequate pastures, they react by selling off the male cattle at an early age and retaining females. This practice--retaining as many females as possible--is driven by the need to maintain a certain level

of aggregate milk output from the herd. Overstocking is thus a means of increasing aggregate milk output from the herd (Sserunkuuma, 1998).

The positive relationship between the age of sale and the cattle-per-person ratio suggests that, in addition to wealth storage and profit maximization motives, a less recognized but very important motive--subsistence--plays a significant role in determining the age of cattle sales. In subsistence-oriented production systems--whether private or communal--it is only after herders accumulate enough animals to meet their subsistence requirements that other motives of wealth storage come into play.<sup>5</sup> If a household with barely enough animals to subsist is hit by an emergency cash problem, the choice of which animal to sell from among the different age and sex categories is limited, as there may be no animals in certain categories to begin with. If the emergency need finds no male cattle in the herd, such a household may in fact sell a young female animal--instead of an adult cow--to solve the emergency cash problem without disrupting the current and/or immediate future milk output from the remaining herd. Otherwise, there may not be enough milk for the family to subsist. The practice of selling young animals instead of older ones is inconsistent with beef-profit maximization and wealth storage motives, but is understandable from the subsistence point of view. In addition to age of sale determination, subsistence motives may also play a pivotal role as an engine for rangeland

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<sup>5</sup> The importance of meeting primary subsistence goals first suggests an approach to decision making first proposed by Stone (1954), known as the “Stone-Geary utility function”, in which minimum requirements are met first, followed by secondary or “supernumerary” spending (Raunikaar and Huang, 1987, pp. 92-93).

degradation. A herder with a small private range and a big family will overstock and, hence, overgraze as s/he tries to maintain a herd size that s/he perceives as being appropriate for the subsistence of his/her family.

Finally, the need to mitigate the degradation of communal rangelands has often been used to justify tenure reforms away from “the commons” and toward private ownership of rangeland resources. Such reforms are intended to abate overgrazing by taking advantage of the efficiency and incentive compatibility of decentralized decision-making purported to follow from privatization and enclosure. However, land reform programs that ignore subsistence requirements of the herders may well exacerbate rather than abate overgrazing problems. Many such programs, including the ongoing privatization scheme of communal rangelands in Nyabushozi base land allocation to individual herders entirely on existing herd sizes. The less cattle you have, the less land you get. If a person is allocated less land than is needed to hold enough animals for the subsistence of his/her family, it is not hard to see why in the future this might exacerbate overgrazing. Hence, a more equitable allocation of land that does not “punish” small herders for being small would probably yield better results in the long-run.<sup>6</sup>

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<sup>6</sup> It is the equity of common property that offers a partial explanation for its appeal in traditional subsistence economies (Runge, 1986).



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