FACTORS AFFECTING THE PRODUCTIVITY OF COMMUNAL AND PRIVATE LIVESTOCK FARMERS IN SOUTHERN BOTSWANA: A DESCRIPTIVE ANALYSIS OF SAMPLE SURVEY RESULTS

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Abstract

This article compares herd productivity, levels of investment and socio-economic characteristics of communal and private livestock farmers sampled in the southern region of Botswana during 1999/2000. The object is to determine whether land tenure and other socio-economic variables might contribute to differences in investment and herd productivity. Descriptive statistics show that levels of investment and herd productivity are higher on private farms than on open-access communal grazing. Private farmers are also better educated, more liquid, and have larger herd sizes, but do not differ from their communal counterparts in terms of age, gender, race or household size. Levels of investment in fixed improvements and operating inputs are negatively correlated with herd mortality, and positively correlated with calving and off-take rates, and with liquidity and private ownership of land. While these findings appear to support Botswana's agricultural policy of privatising some communal grazing land to individual farm households or to small, organized groups of farmers, it is clear that land tenure is not the only variable of policy interest. A more rigorous analysis of the data is required to untangle the causes of observed differences in herd productivity and investment.

1. INTRODUCTION

This paper compares socio-economic, productivity and investment indicators observed in a sample of private and communal cattle farmers in southern

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Botswana. The livestock sector is characterised by two distinct systems of land tenure; namely communal tenure, which accounts for most of the cattle and farmers in Botswana, and private tenure. Economic theory suggests that land tenure influences decisions about stocking rate and investment in fixed improvements. In particular, insecure tenure is expected to (a) encourage high - but not necessarily unsustainable - stocking rates that reduce herd productivity through low calving and high mortality rates, and (b) discourage investment in improvements such as watering points and better breeds (Gordon, 1954; Lyne & Nieuwoudt, 1990; Migot-Adholla *et al*, 1991). Botswana's agricultural policy of 1991 accepts this view as it proposes a shift away from open access grazing in communal areas to private access where privatisation is feasible and acceptable (Ministry of Agriculture, 1991). This study uses survey data to check for differences in productivity, investment and the socio-economic status of private and communal livestock farmers sampled in southern Botswana to determine whether the policy focus on land tenure is warranted.

The study is important because the vast majority of Botswana's rural households depend on livestock as a source of income, meat and milk, and as a store of wealth (Ministry of Agriculture, 1989). Crop production is severely constrained by erratic and unreliable rainfall (Behnke, 1987; Ministry of Agriculture, 1991; Abel, 1997; Panin & Mahabile, 1997; Panin *et al*, 1993). Cattle are also an important source of foreign exchange and employment (Ministry of Agriculture, 1989; Ministry of Agriculture, 1996). According to the Bank of Botswana (1999), the agricultural sector accounted for about 16.3% of total employment in Botswana during 1999/2000. However, high stocking rates have been linked to soil erosion, land degradation and a decline in Botswana's national herd from roughly three million in the early 1980's to about 2.4 million in the 1990's (National Development Plan 8 (1998-2003); Botswana Agricultural Census Report, 1995). A decline in the national herd could indicate a fall in household welfare as cattle represent an important source of rural wealth.

The paper begins with discussion a on the land tenure systems and its consequences for stocking rates and investment. Section 3 describes the technique used to collect data, and Section 4 compares descriptive statistics computed for communal and private farmers. Conclusions are drawn about the role that land tenure and other policy variables might play in explaining the presence or absence of observed differences. No attempt is made to isolate and rank the causes of productivity differences using a multivariate technique. This issue will be explored in a second paper.

2.   PROPERTY RIGHTS AND USE OF GRAZING RESOURCES

Communal grazing accounts for 86% of Botswana's cattle population and 71% of its rural area. This land is officially owned and administered by statutory Land Boards. Private ranches owned by freehold farmers account for 14% of the national herd and just five percent of the land (Ministry of Agriculture, 1991). National parks, forests and game reserves make up the remaining 24% of the land area.

Communal grazing is predominantly an open access resource in Botswana. Open access means that users have unrestricted rights to the resource. Although the Ministry of Agriculture recommends maximum stocking rates, these limitations are not enforced by the Land Boards, nor are they observed by farmers (Carl Bro International, 1982). Likewise, water rights assigned to farmers in communal areas do not impose a quantitative restriction on the volume of water used or the number of cattle kept by individual livestock owners (Carl Bro International, 1982). Some grazing is used by small groups (syndicates comprising roughly ten livestock farmers) as a common property resource, but these arrangements are relatively scarce and were not included in this study.

Gordon (1954) explained that, under conditions of open access, the equilibrium use rate occurs when the private cost of using the resource (adding another animal) is equal to the value of the (herd's) average product. This implies over-utilization of the resource in the economic sense (and possibly in the biological sense), as rents are zero at the equilibrium-stocking rate. Individual users have no incentive to stint because the benefits (positive rents) accrue to other users ("free–riders"). Individual users also have little incentive to improve the quality of an open access resource for the same reason - benefits are externalised to free-riders (Lyne & Nieuwoudt, 1990; Anim & Lyne, 1992). If an individual does make improvements to the land (*e.g.* a watering point) he or she is unable to realise any capital gains by selling the land. There is no market for open access land as the cost to a potential buyer or lessee of negotiating and transacting with a large (possibly infinite) number of users is prohibitive (Kille & Lyne, 1993). For this reason, open access also results in allocative inefficiency because land is unlikely to transfer from less effective to more effective users.

Private farmers often rest their own grazing by driving their cattle into the communal areas for part of the year (usually during the spring months). An owner-operator has a strong incentive to conserve and improve his or her (exclusive) property as the benefits are fully internalised. Allocative efficiency is also likely when an individual privately owns property. First,

land markets operate because transaction costs are relatively low (Kille & Lyne, 1993). Second, land tends to transfer to the most effective users because the market imposes an opportunity cost (in the form of forgone rental income) on land that is under-utilised. If farmers are profit maximisers, an efficient land market will shift land to its highest use, *i.e.* where rents are maximised (Nieuwoudt, 1990). The presence of an active market for land also strengthens the incentive and ability to invest in fixed improvements. Incentives are stronger because capital gains can be realised at any time by selling or leasing the land out (Pasour, 1990:200-201). The ability to invest is strengthened because land that has market value also has collateral value to financiers (Place, Roth & Hazell, 1994:17).

For these reasons, it was anticipated that productivity and investment indicators would be more favourable on private ranches than on communal grazing land. Such a finding would lend support to the 1991-policy objective of converting some open access grazing into private property (Ministry of Agriculture, 1991; National Development Plan 8 (1998-2003). It may also support a more radical conversion of user groups into non-user groups resembling company operations where stockowners surrender use rights for benefit rights by exchanging livestock for equity (shares) in the operating company. However, it would be wrong to ignore other socio-economic factors that contribute both directly and indirectly to observed productivity and investment differences. Private ownership may, to some extent, only reflect underlying differences in socio-economic status.

3.   METHODOLOGY

The data used in this study were collected from a sample of 96 livestock owners in the southern region of Botswana during the 1999/2000 agricultural seasons. The study area comprised of two strata, one for private farmers and the other for communal farmers. Households with cattle were identified and listed, and a simple random sample was drawn from each list. A total of 65 communal farmers and 31 private farmers were interviewed using a pre-tested and structured questionnaire. Although a larger sample (n=120) was identified and drawn, several of the selected farmers had left the area and some refused to participate in the survey. Additional cases were not selected owing to the high cost of travelling long distances between farmers, especially those on private ranches.

Interviews were conducted with the assistance of four enumerators. The data were captured in a computerised database, and descriptive statistics computed using the Statistical Packages for Social Science (SPSS), 1999. Estimates of mean herd size, herd composition, calving and off-take rates

compared favourably with regional statistics obtained from the Veterinary District Office and the Botswana Meat Commission. Independent t-tests were calculated to check for significant differences between the group means computed for private and communal farmers (SPSS, 1999; Gujurati, 1995). Zero order correlation coefficients were also computed to assess the degree of linear association between pairs of variables relevant to the objective of the study. Particular attention was given to tenure status, a dummy variable scoring a one for private farmers and a zero for communal farmers.

4. EMPIRICAL RESULTS

4.1 Herd productivity indicators

Table 1 presents sample means and proportions for indicators of herd productivity and investments made by private and communal farmers. With regard to herd productivity, the calving and off-take (*i.e.* sales) rates are much higher on private farms than amongst communal farmers. This is consistent with findings reported by Behnke (1987) and Scones (1992). On the other hand, the mortality rate is lower on private farms where the incidence of de-worming, dehorning, supplementary feeding, vaccination and dipping against tick-borne diseases is much higher. The incidence of fencing and ownership of a borehole is substantially higher on private farms.

Table 1: Productivity and investment indicators for open access and private livestock owners in the southern region of Botswana, 2000 (n=96)

Variable	Unit	Private ranches (n=31)	Open access communal grazing (n=65)	t-value
Calving rate	%	66	35	7.75**
Off-take rate	%	20	12	2.46*
Mortality rate	%	2	5	2.15*
Herd size	LU[1]	262	30	2.59*
De-worming	%	87	37	5.64**
Dehorning	%	86	84	3.00**
Supplementary feeding	%	80	63	2.91**
Vaccination	%	87	38	5.74**
Treat cattle against ticks	%	71	44	3. 21**
Fencing	%	100	0	
Own borehole	%	77	7	8.20**
Annual cost of variable inputs	Pula[2]	36419	82	3.00**
Annual gross margin per LU	Pula	1336	211	1.23

Notes: ¹LU = Livestock Unit defined as a mature animal with a live weight of 500 kg.

²1 Pula= 0.1865 US$ in 2000.

* and ** show statistical significance at the 5% and 1% level of probability respectively.

4.2   Livestock ownership

Herd size and composition on private and communal grazing land are presented in Table 2. The term "*Mafisa*" refers to a system of livestock borrowing or lending that gives the borrower benefit rights to products such as milk and draught power, and possibly a calf if the Mafisa cattle are still in good condition at the end of the year. Otherwise, the lender retains ownership of the cattle and their progeny.

Herds are much larger on private farms. Almost 60% of the herds kept by private farmers exceeded 280 head of cattle, while 80% of those kept by communal farmers numbered less than 80 head. Communal farmers tend to have fewer calves per cow, and more bulls per cow than do private farmers who adhere more closely to the recommended ratio of one bull per 25 cows. The lower proportion of calves is consistent with the higher mortality rate observed for herds grazing on communal land (Table 1). The higher proportion of bulls may indicate that communal farmers value cattle primarily as a store of wealth because they cannot maximise profit under conditions of open access. This would also explain why the off-take rate is so much lower amongst communal farmers.

Table 2: Mean herd size, composition and distribution on private and communal grazing land in the southern region of Botswana, 2000 (n=96)

Variable	Private ranches (n=31)	Open access communal grazing (n=65)
Number of cattle	495	55
Number of cows	198	17
Number of calves	141	8
Number of bulls	5	1
Number of oxen	56	5
Mafisa in	12	1
Mafisa out	1	1.4
Distribution of herd size (%)		
1 – 40	9.4	52.9
41 – 80	6.3	27.9
81 – 120	3.1	4.4
121 – 160	0.0	4.5
161 – 200	3.1	1.5
201 – 240	9.4	2.9
241 – 280	9.4	0.0
281 – 320	15.6	0.0
> 320	43.7	5.9

Notes: * and ** shows statistical significance at 5% and 1% level of probability respectively.

4.3   Farmer characteristics

Table 3 summarizes key attributes of sample farmers and their households. No significant differences were detected between the mean age, gender, race, family size or residential status of private and communal livestock farmers. Most herds are managed by older, married men who reside with their (large) rural families and who regard livestock farming as their main occupation.

Nevertheless, the sample data do reveal some noteworthy differences between private and communal farmers. Private farmers appear to have accumulated a greater stock of human capital through both formal education and farming experience. In addition, private farmers have much larger cash inflows from wage remittances and livestock sales, and are therefore more liquid than communal farmers.

Table 3: Demographic and personal characteristics of 96 stock-owners in the southern region of Botswana, 2000 (n=96)

Variable	Unit	Private ranches (n=31)	Open access communal grazing (n=65)	t-value
Average age	Years	61-70	51- 60	1.93
Male	%	94	95	0.40
Average size of household	#	6	7	-1.12
Resides at rural home	%	88	92	0.61
Married	%	97	63	4.62**
Average years of schooling	Years	10	2	8.32**
Average years of farming	Years	31	20	4.85**
Race:				
Black	%	97	100	
White	%	3	0	
Main source of income:				
Farming	%	55	55	
Wage work	%	10	23	
Other	%	35	22	
Average monthly income remitted by wage workers	Pula	2308	715	-2.74**
Wage (Pula) per month:				
0 - 2000	%	61	85	
2001 - 4000	%	21	12	
>6000	%	17	3	
Gross annual livestock income	Pula	98363	3049	1.23

Notes: * and ** shows statistical significance at 5% and 1% level of probability respectively.

4.4   Zero order correlation coefficients for policy variables

Table 4 presents zero-order correlation coefficients for productivity indicators and some possible explanatory variables. Within the set of productivity measures, off-take rate is significantly and positively correlated with gross margin per livestock unit (GM/LU), and calving rate is significantly and negatively correlated with the herd mortality rate. These relationships suggest a role for Principal Components Analysis in constructing a "*productivity index*" (Nieuwoudt, 1977). Welch (1978) postulates a positive relationship between farm scale, education and the adoption of technology. The data are consistent with this view as variable costs (associated with de-worming and treatment for tick-borne diseases) and investment in fencing are positively correlated with education and herd size (LU).

As anticipated, private land tenure is positively correlated with investment in technology and fixed improvements, and hence with productivity measures such as the calving and off-take rate. However, private ownership is also positively correlated with education, experience, wage remittances and herd size. This suggests that a multivariate, recursive model is required to untangle the causes of observed differences in herd productivity and investment. While land tenure appears to be an important determinant of investment and herd productivity, it is clearly not the only variable of policy interest.

Table 4: Correlation coefficients for important livestock variables in the southern region of Botswana, 2000 (n=96)

	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Land tenure	1.00										
2	Off-take rate	.281**	1.00									
3	Mortality rate	-.166	-.047	1.00								
4	Calving rate	.520**	.016	-.307**	1.00							
5	GM/LU	.181	.440**	-.030	.141	1.00						
6	LU	.376**	.038	-.103	.220*	-.024	1.00					
7	Fencing	1.00**	.281**	-.166	.520**	.181	.376**	1.00				
8	Variable cost	.225*	.258*	-.058	.143	.657**	.651**	.225*	1.00			
9	Experience	.239*	.139	.049	.383**	.036	.118	.239*	.052	1.00		

| 10 | Education | .701** | .191 | -.027 | .382** | .170 | .204* | .701** | .131 | .097 | 1.00 | |
| 11 | Wage income | .346** | .146 | -.064 | .240* | .097 | -.102 | .346** | -.011 | -.078 | .447** | 1.00 |

Notes: * and ** shows statistical significance at 5% and 1% level of probability respectively.

5. CONCLUSION

The findings of this sample survey show that herd productivity (measured in terms of mortality, off-take and calving rates) is significantly higher amongst private landowners than communal farmers. Levels of investment in fencing, vaccination and de-worming are also significantly higher for private farmers. These results appear to support Botswana's policy of privatizing some communal grazing land to individual farmers and to small, organized groups of farmers. However, strong relationships between land tenure and education, farming experience, herd size and wage remittances suggest that private ownership of land may, to a large extent, mask the important effects that these socio-economic variables have on herd productivity. Clearly, a more rigorous analysis of the survey data is required to isolate and quantify the partial contribution of land tenure to herd productivity.

ACKNOWLEDGEMENTS

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