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ABSTRACT

The presence of the Clarens nature reserve at the foothill of the mountainous Maluti is one of the treasured natural ecology of the Free State Province. A primary challenge to the ecological integrity of this small reserve is the nearby location of Kgubetswana Township, which boasts an increasing number of livestock owners. Hence, this study aims to assess the vegetation cover and socio-economic conditions associated with livestock grazing in the Clarens nature reserve. The objectives were to; i) identify vegetation cover; ii) assess the community' perception of environmental effects associated with livestock grazing at the Clarens nature reserve; iii) and assess the socio-economic conditions associated with livestock grazing at the Clarens nature reserve. Maximum likelihood classification and NDVI techniques were applied to remotely sensed images from the Landsat 5 TM, Landsat 7 ETM+ and Landsat 8 OLI sensors to map vegetation cover for the Autumn season of the years 2004, 2008 and 2016. A questionnaire survey was conducted to capture the perceptions of livestock owners and the reserve' management committee. Firstly, over 50% increase of unpalatable vegetation was detected in the vegetation cover of the Clarens reserve. Secondly, qualitative data reveal that 71% of livestock farmers attribute land degradation to rainfall variability, while the management maintain that livestock overgrazing is the source of negative environmental degradation in the reserve. Change in the vegetation cover has not demonstrated any noticeable effects on the socio-economic conditions of the community.

Keywords: Grazing, vegetation cover, Clarens nature reserve, socio-economic conditions, grazing management

INTRODUCTION

Primary objectives of protected areas (Glazewski, 2005; NEMA:Protected Areas Act, 2003; Burgess, 2012; Lesoli, 2011; Anderson, 2012; Samuels, 2013; Hanks and Glavovic (1999); Owino, Jillo and Kenana, 2012)

Protected areas: Legislation (Little and Theron, 2014; NEMA: Biodiversity Act, 2004; Botha, 2012; Samuels, 2013; Kori *et al*, 2013; Kgosikoma *et al*, 2013).

Environmental effects of grazing (Ferrar and Lötter, 2007; Du Toit *et al*, 2008; Van Oudtshoorn, 2012; Sprinkle and Bailey, 2004; Wangchuk, 2002)

Positive environmental effects of grazing (English Nature, 2015; Isacch and Cardoni, 2011; Kgosikoma *et al*, 2012; Van Oudtshoorn, 2012; Thompson and Gilbert, 2013)

Negative environmental effects of grazing (DEA, 2007; Kgosikoma *et al*, 2013; Samuels, 2013; Hall *et al*, 2005; Freitas, Roche, Weixelman and Tate, 2014).

Socio-economic importance of livestock keeping (Kori *et al*, 2013; Twine, 2013; Kgosikoma *et al*, 2013; Anderson, 2012; Samuels, 2013; Lesoli, 2013).

Conflicts in conservation (Owino *et al*, 2012; Mutanga, Vengesayi, Muboko, and Gandiwa, 2015; Redpath, Gutiérrez, Wood, Sidaway and Young, 2015)

AIM

To assess the effects of grazing on vegetation cover and socio-economic livelihoods in the Clarens Nature reserve.

OBJECTIVES

- To identify vegetation cover associated with livestock grazing at the Clarens Nature reserve;
- To assess the community' perception on environmental effects associated with livestock grazing at the Clarens Nature reserve;
- To assess the socio-economic conditions associated with livestock grazing at the Clarens Nature reserve



METHODOLOGY

Objective	Method	Data source	Data collection Tools	Data Analysis & Presentation
i. To classify land cover associated with livestock grazing at the Clarens Nature Reserve;	GIS mapping and Remote Sensing	Climate explorer Landsat image 5, 7 & 8 from USGS website	GPS Raster calculator	NDVI Maximum likelihood classification Shapefiles
ii. To assess the community' perception of environmental effects associated with livestock grazing at the Clarens Nature Reserve;	Quantitative and Qualitative Survey design	Livestock owners CNR management	Survey questionnaire	Correlation Tables
iii. To assess the socio-economic conditions associated with livestock grazing at the Clarens Nature Reserve	Quantitative and Qualitative Survey design	Livestock owners CNR management	Survey questionnaire	Regression analysis Graphs



RESULTS CONT'D

Based on the results as presented in table 3, on average (43%), the participants in the survey own between 6 to 10 livestock each. According to the livestock owners' agreement, each farmer can only graze up to 10 cattle in the reserve. The aim of this agreement is to maintain the carrying capacity of the reserve, and sustain palatable vegetation. Concerns where however around the influence of seasonal changes. In that during dry periods, livestock has to be moved onto the next camp before the end of a 3 months' term.

Table 3: Environmental effects associated with livestock grazing in the CNR

Environmental activities		Response %
Number of livestock owned by farmers	Less than 5 (%)	29
	6-10 (%)	43
	10-15 (%)	29
Does livestock roam or there are herders	Roam (%)	71
	Herdsman (%)	29
Grazing strategy practised	Weekly rotation (%)	14
	3 months rotation (%)	29
	6 months rotation (%)	14
	No strategy (%)	14
	I do not know (%)	14
Farming experience	Other (specify) (%)	14
	Approximately	25 years
Livestock farmed	Cattle (%)	100
Reasons for keeping livestock	Commercial (%)	33
	Secondary source of income (%)	33
	Subsistence (%)	20
	Inheritance (%)	13

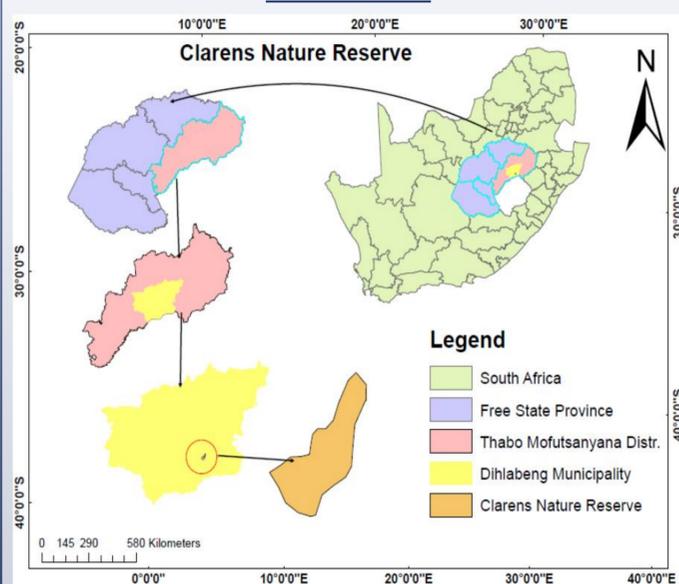
CONCLUSION & RECOMMENDATIONS

The study was able to show that there are observed vegetation cover changes associated with livestock grazing at the Clarens Nature reserve, those changes where a major overtake by unpalatable grass species. For the community of Kgubetswana, the ability to own livestock for commercial purposes and maintain the livelihood of households are the two major socio-economic conditions associated with livestock keeping at the Clarens Nature reserve. This research should therefore be viewed against the present socio-economic conditions that are prevailing in many Afrumontane communities. Short term recommendations are to establish a formal structure between the livestock owners and the reserve management; develop a database of livestock present in the reserve; regular consultations and meetings by management with the livestock owners should be introduced; enforce sustainable grazing management practises such as rotational grazing, herding, duration of grazing and number of cattle in a grazing camp and resting period; regular environmental awareness workshops should be provided for farming community; and annual veld evaluation. Long term recommendations are to develop local grazing models and policies; introduce payment of levies for the number of cattle owned by each pastoralist; restore the natural infrastructure of the reserve, including fencing the reserve; and the adoption of a linear plant succession model and the balance-of-nature succession model.

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STUDY AREA



RESULTS

The results as presented in Table 1 reflects a continuous decrease in water and bare soil from 2004 to 2016, but an increase in non-palatable grass from 2004 to 2016. Palatable grass increased moderately from 2004 to 2008, but experienced a decrease from 2008 to 2016. Premised on the first objective of this study, vegetation cover over the study area has changed significantly. The Maximum Likelihood classification method of analysis has proved this change. Table 1 shows the extent of land cover change after supervised classification for all images was conducted.

Table 1: The spatial extent of land cover after classification

Land cover type	% of the Area			% Change		
	2004	2008	2016	2004 - 2008	2004-2016	2008-2016
Non-palatable	38.91	38.95	52.14	+0.04	+13.23	+13.19
Palatable	32.71	40.46	29.78	+7.75	-2.93	-10.68
Water	13.89	10.18	9.48	-3.71	-4.41	-0.7
Bare soil	14.49	10.41	8.60	-4.08	-5.89	-1.81

The results as presented in Table 2 provides a comparative display of NDVI values of the three years that are in question. The minimum vegetation reflectance value was observed in March 2004 at -0.27, while the maximum vegetation reflectance was witnessed in February 2016. Variations in the mean and standard deviation over a 12-year period is also seen.

Table 2: The NDVI values of Clarens nature reserve for 2004, 2006 and 2016

Year	Minimum value	Maximum value	Mean	Standard deviation
March 2004	-0.27	0.38	0.07	0.10
March 2008	-0.28	0.41	0.15	0.13
February 2016	-0.42	0.85	0.51	0.13

RESULTS CONT'D

Based on the results as presented in table 4 below, on the question of the initially agreed upon number of livestock allowed to graze per farmer in the reserve, the committee pointed out that the original arrangement was that poverty stricken households that relied on cattle as their sole source of income would be granted permission to graze not more than 5 cattle per owner. In contrast, some committee members stated that currently, there is no agreement between the CVC, CNR and cattle owners.

Table 4: Environmental effects associated with livestock grazing in the CNR

Environmental activities		Response %
Agreed number of livestock to graze	Not more than 5	50
	For destitute families only	33
	No agreement with livestock owners	17
Database of cattle	None	100
	No branding on cattle	33
	Virtually no legal compliance with stock laws	33
	Incorrect information given by the livestock owners	17
Management strategies	Reserve not fenced, allows for easy access of livestock	17
	Farmers should seek permission to graze from management	50
	Arrange meetings with cattle association, foster participation	33
	Consultations with herders and shepherds	17
Candid approach of awareness and environmental education		17