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Research application summary

Seasonal distribution and yields of common roughages in coastal Lowlands of Kenya

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Abstract

In the Coastal Lowlands of Kenya, small-scale integrated crop-livestock system is the dominant form of agricultural production. Feed quantity and quality are inadequate and rarely meet the nutrient demands of lactating cows especially in the dry seasons. The objective of this study was to determine the seasonal distribution and estimate seasonal yields of common roughages in Coastal Lowlands of Kenya. A cross-sectional survey was conducted in Kwale and Kilifi counties on a random sample of 415 dairy cattle farms followed by a longitudinal survey on a purposive sample of 32 farms from the cross-sectional sample over a period of 12 months. The seasonal estimated yields varied significantly ($P < 0.05$) between various common roughages. The seasonal DM yields ranged from 674.7 t DM in season III (long rains dry season: January – March 2014) to 1,642.8 t DM in season IV (long rains season: April – June 2014). Farmers experienced the most acute feed shortages in season III. Pastures grasses were the most important feed resource and contributed 50.6, 42.6, 69.5 and 52.5% in seasons I, II, III and IV of feed resource, respectively. Natural pastures mixture had the highest yields throughout the year and constituted 34.3% of feed resource produced on-farm. *Asystacia gangetica* had the lowest yields throughout the year and constituted 2.3% of feed resource produced on-farm. There was a deficit in DM availability during the dry season which could be remedied through conserving excess feed during the wet season. These results could be used to develop an integrated forage production and livestock nutrition management plan to provide sufficient year-round feed supply based on animal requirements and supplementation strategies.

Key words: Coastal Kenya, feed quantity, feed shortages, livestock production, nutrients, seasons, yields

Résumé

Le système intégré agriculture-élevage à petite échelle est la forme dominante de production agricole dans les basses vallées côtières du Kenya. La quantité et la qualité des fourrages sont inadéquates et ne répondent presque jamais aux besoins en nutriments des vaches en lactation, surtout en saisons sèches. L'objectif de cette étude est de déterminer la distribution saisonnière et d'estimer les rendements saisonniers des fourrages dans les basses vallées côtières du Kenya. Une enquête transversale a été menée dans les comtés de Kwale et Kilifi sur une période de 12 mois, avec un échantillon aléatoire de 415 exploitations bovines laitières, suivie d'une enquête longitudinale auprès de 32 exploitations choisies à dessein parmi les 415 exploitations ayant fait l'objet de l'étude transversale. Les rendements saisonniers estimés variaient considérablement ($P < 0,05$) entre les différents fourrages. Les rendements saisonniers de MS ont varié de 674,7 t pendant la saison III (saison sèche de longues pluies: janvier - mars 2014) à 1642,8 t pendant la saison IV (grande saison pluvieuse: avril - juin 2014). Les producteurs connaissent les plus graves pénuries en fourrage au cours de la saison III.

Les herbes des pâturages se sont révélées l'aliment de bétail le plus important et ont contribué pour 50,6, 42,6, 69,5 et 52,5% au cours des saisons I, II, III et IV, respectivement. Le mélange de pâturages naturels avait les rendements les plus élevés tout au long de l'année et constituait 34,3% des ressources fourragères produites dans les exploitations. *Asystacia gangetica* avait les faibles rendements tout au long de l'année et constituait 2,3% des ressources fourragères produites dans les exploitations. Il y avait un déficit de disponibilité de MS pendant la saison sèche qui pourrait être rémédié en conservant l'excès de fourrage pendant la saison des pluies. Ces résultats pourraient être utilisés pour développer un plan de gestion intégrée de la production fourragère et de la nutrition du bétail afin d'assurer pour le bétail une alimentation suffisante tout au long de l'année, en réponse aux besoins des animaux et des stratégies de supplémentation.

Mots clés: Côte kenyane, quantité d'aliments, pénuries d'aliments, nutriments pour la production animale, saisons, rendements

Introduction

The major constraint to livestock production in Kenya is poor nutrition due to scarcity of feeds (Muriuki *et al.,* 2003; GoK, 2010; Salami *et al.,* 2010). As a result, animals suffer severe nutritional stresses which often lead to low calving rate, low birth weight, high calf mortality, reduced mature body size, low growth rate, delayed maturity and, more importantly, low milk production (Muinga *et al.,* 1999; Omore *et al.,* 1999). In the coastal region of Kenya, forage productivity is largely dependent on rainfall (Mureithi *et al.,* 1998; Muinga *et al.,* 1999; Nicholson *et al.,* 1999) which, is highly variable and often unpredictable (Jaetzold and Schmidt, 1983). The situation is further compounded by decreasing farm sizes. This inadequacy is mostly related to seasonality of feed supply due to dependence on precipitation for forage production. The availability of good quality natural pastures and cultivated fodders dwindles during the dry season with farmers using crop residues as the main source of dairy cattle feed. As a result, forage biomass yield, quality and availability varies substantially from season to season. This creates a need to develop strategies to synchronize feed availability with the nutritional requirements of dairy cattle throughout the year in the Coastal Lowlands of Kenya. Therefore, the objective of this study were to: (i) determine the seasonal distribution of common roughages in Coastal Lowlands of Kenya, and (ii) estimate seasonal yields of common roughages in Coastal Lowlands of Kenya.

Study description

The study was conducted in Kwale and Kilifi counties of the Coastal Lowlands of Kenya which fall in five agro-ecological zones characterized by different climatic, topographic, soil and environmental features that influence the potential of agricultural development (Jaetzold and Schmidt, 1983). A cross-sectional survey was conducted on a random sample of 415 small-scale dairy cattle producers for three months to determine the main basal feed resources. Thereafter, feed samples were collected from 150 plots from a purposive sample of 32 farms of the cross-sectional sample during a longitudinal survey for 12 months. Data on type and acreage of cultivated and natural fodders, pastures and crop residues were collected during season I (short rains dry season: July – September 2013), season II (short rains season: October – December 2013), season III (long rains dry season: January – March 2014) and season IV (long rains season: April – June 2014) from the 32 farms. To determine natural pastures species composition, two diagonal transect lines were laid out in each pasture field. Along each transect line five regularly spaced 1 m^2 quadrants were thrown. In each quadrant, the relative composition of different plant species was determined, clipped and weighed. Significant means were compared using the Duncan's Multiple Range Tests at $p \leq 0.05$.

Results and discussion

The seasonal distribution and estimated yields of the common roughages in the study area varied across seasons as shown in Table 1. The estimated seasonal yields varied significantly ($P < 0.05$) between various common roughages. Natural pastures mixture had the highest yields throughout the year and constituted 34.3% of feed resource produced on-farm. *Asystacia gangetica* had the lowest yields throughout the year and constituted 2.3% of feed resource produced on-farm.

Table 1. Seasonal distribution and yields of some common roughages types

Roughages	Seasonal distribution				Seasonal yields (t DM/ season)				%
	Season I	Season II	Season III	Season IV	Season I	Season II	Season III	Season IV	
Asystacia gangetica	x	v	x	v	43.0i	7.2j	10.1i	32.7i	2.3
Commelina benghalensis	v	v	x	v	86.0e	71.1c	27.7f	23.8j	5.2
Maize stover	v	x	v	x	118.5c	56.9e	86.0b	284.4c	13.6
Green maize forage	x	v	x	v	107.5d	193.5b	35.7d	118.5e	11.3
Napier grass	v	v	v	v	145.6b	69.9d	46.6c	320.3b	14.5
Panicum maximum	x	v	x	v	74.3f	21.2h	21.2h	95.6f	5.3
Panicum coloratum	v	x	v	x	43.7h	26.2g	24.4g	80.3g	4.3
Cynodon plectostaychus	v	x	v	x	56.5g	28.2f	30.8e	141.2d	6.4
Rottboelia exaltata	v	x	x	v	35.1j	13.6i	5.7j	62.9h	2.9
Natural pastures mixture	v	v	v	v	303.7a	207.0a	386.5a	483.1a	34.3
P value					0.05	0.05	0.05	0.05	

Season I: July - September (2013); Season II: October - December (2013); Season III: January - March (2014), and Season IV: April - June (2014);

v indicates seasons of forage abundance, x indicates seasons of low abundance

* Means with the same letter along the column are not signifcant

Pastures grasses were the most important feed resource and contributed 50.6, 42.6, 69.5 and 52.5% in seasons I, II, III and VI of feed resource, respectively. This is in agreement with Mureithi *et al.* (1998) who reported that natural pastures contributed 60% during the wet season and 75% during the wet season in two agro-ecological zones (CL3 and CL4) in Coastal Lowlands of Kenya. In addition, Mburu *et al.* (2016) reported that natural pastures were the main source of forage and occupied 52.2% of arable land and produced 55.2% of feed.

Due to spillover from long rains season IV, there was more DM output during season 1 despite being the short dry season than season II which was the short rains season. *Asystacia gangetica* and *C. banghlensis,* which were weeds in maize fields were abundant during long rains (season IV) and short rains dry season (season I). Perhaps due to its prolific growth habits and abundance, *C. benghalensis* was also available during the short rains dry season (season I). Maize stover was abundant during seasons I and IV while green maize forage were abundant during seasons II and IV but with a spillover to season I. Utilization of maize stover during the dry season, in agreement with Said and Wanyoike (1987), was constrained by the low crude protein concentration (Nicholson, 1984; Little and Said, 1987). Various forms of maize stover storage were observed on the farms including stacking outside around ornamental or fruit trees and within the zero-grazing units leading to considerable losses in amounts and nutrients due to weathering and leaf shattering. Improper management and storage methods drastically reduce the proportions of maize stover available as feed as well as the efficiency of utilization (Promma *et al.,* 1994).

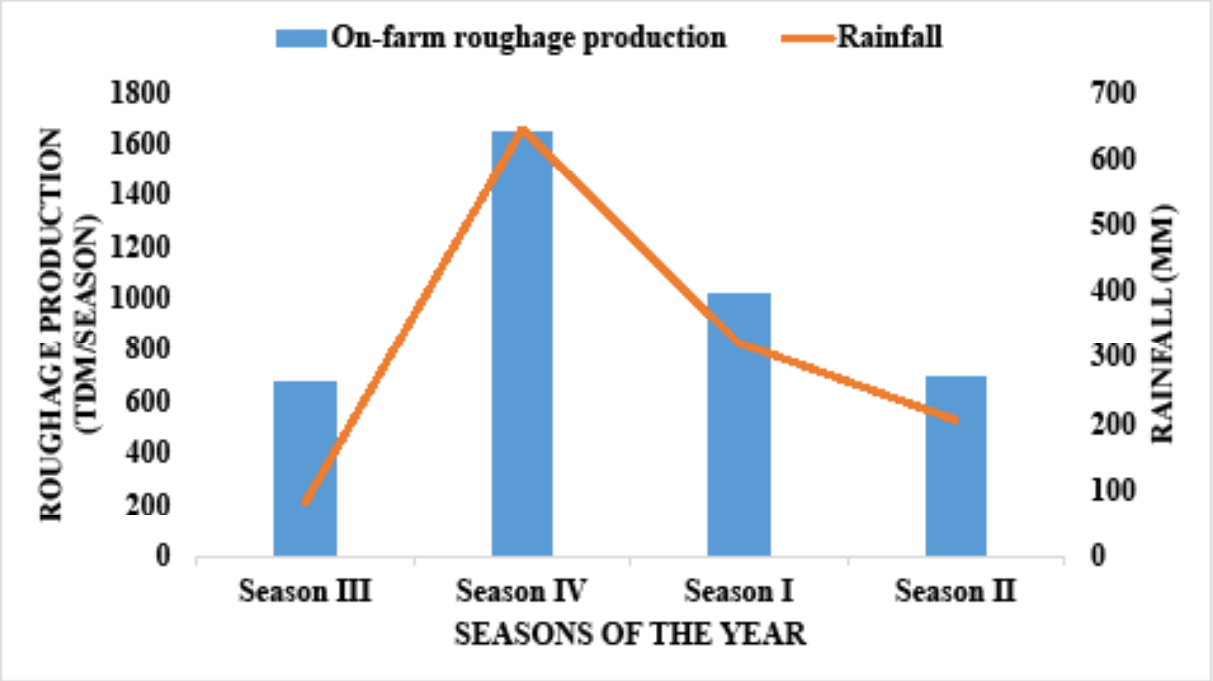

Figure 1. Effects of seasonal rainfall variability on on-farm forage production

The seasonal on-farm forage production followed the rainfall patterns with most forages being available during the long rains season (season IV) from April to June (Figure 1). Farmers experienced the most acute feed shortages in season III when they had difficulties satisfying the DM requirements of their animals. This was in agreement with Mburu et al. (2016) that feed shortage was critical during the long dry period of January to March and experienced by 88.2% of households in coastal lowlands. During dry seasons, there was reduction in herbage growth rate, quality, species composition and DM yield which is associated with reduced nutrient available to the animals and ultimately leads to a reduction in their milk productivity. During this season, farmers practicing zero-grazing or semi zero-grazing systems had to walk for long distances in search of fodder. Similarly, farmers practicing semi zero-grazing and free range grazing system had to walk long distances in search of pastures.

Conclusions

Majority of small-scale farmers in coastal lowlands relied mostly on various types of roughages produced on-farm during wet and dry seasons to meet the nutrient needs of their livestock. Farmers experienced the most acute feed shortages in season III and perhaps practical options for improving fodder availability for livestock productivity should be explored and exploited like conservation of surplus harvested fodder and pastures grasses either in form of hay or silage.

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