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SMALL RUMINANTS IN AFRICAN AGRICULTURE

Les petits ruminants dans l’agriculture africaine

PROCEEDINGS OF A CONFERENCE
HELD AT ILCA, ADDIS ABABA, ETHIOPIA
30 SEPTEMBER – 4 OCTOBER 1985

Edited by
R.T. Wilson & D. Bourzat

NOVEMBER 1985

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
CENTRE INTERNATIONAL POUR L'ELEVAGE EN AFRIQUE
P.O. BOX 5689, ADDIS ABABA, ETHIOPIA
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SMALL RUMINANT AND CAMEL GROUP
GROUPE DE RECHERCHE SUR LES PETITS RUMINANTS ET LES CAMELIDES

NOVEMBER 1985

INTERNATIONAL LIVESTOCK CENTRE FOR AFRICA
CENTRE INTERNATIONAL POUR L'ELEVAGE EN AFRIQUE
P.O. BOX 5689, ADDIS ABABA, ETHIOPIA
RESUME

Ce volume contient 24 communications (14 en anglais et 10 en français) sur les recherches ovines et caprines, ainsi que le rôle de ces animaux dans les systèmes agraires africains.

Ces communications portent sur les sujets suivants: reproduction et croissance (6), nutrition (4), pathologie et mortalité (3), productivité (5) et socio-économique (6), en relation avec 14 pays africains couvrant une très large gamme de zones écologiques.

MOTS CLES

Petit ruminant, chèvre, mouton, reproduction, croissance, nutrition, santé animale, productivité, socio-économique, Afrique.

NOTA

Le Centre International pour l'Élevage en Afrique et les Editeurs ont choisi de publier ces actes au nom des participants. Les résultats et conclusions ainsi que les opinions pouvant en dériver n'appartiennent qu'aux différents auteurs. Le Centre n'en accepte aucune responsabilité.

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ABSTRACT

This volume contains 24 papers (14 English, 10 French) on goat and sheep research and on the role of these animals in agricultural systems in Africa. Papers cover topics on reproduction and growth (6), nutrition (4), diseases and death (3), productivity (5) and socio-economics (6) and relate to 14 African countries over a wide range of ecological zones.

KEY WORDS

Small ruminants, goats, sheep, reproduction, growth, nutrition, animal health, productivity, socio-economics, Africa.

NOTICE

The International Livestock Centre for Africa and the Editors have undertaken to publish these proceedings on behalf of the participants. Results and conclusions, and opinions deriving from them, are those provided by the authors and the Centre does not accept any responsibility for them.
AVANT-PROPOS

La Conférence sur les Petits Ruminants dans l'Agriculture Africaine, organisée par le Groupe de Recherche sur les Petits Ruminants et les Camélidés du Centre International pour l'Elevage en Afrique, s'est tenue du 30 septembre au 4 octobre 1985 au siège du Centre à Addis-Abeba.

L'objectif principal de cette Conférence était de rassembler des chercheurs de différents pays africains de façon à ce qu'ils puissent être mis au courant de l'état des recherches actuelles sur le continent.

Le second objectif était de permettre à ces chercheurs de présenter leurs travaux en anglais et en français et de pouvoir en discuter dans ces deux langues grâce à l'interprétation simultanée. Dans ces actes, les présentations sont dans leur langue d'origine avec un résumé dans l'autre langue.

Cette conférence a été parrainée par le Centre International pour l'Elevage en Afrique, et quelques chercheurs ont été pris en charge par d'autres organismes en particulier, l'Agence des Etats-Unis d'Amérique pour le Développement International (USAID), la Fondation Internationale pour la Science (IFS) et l'Université Agronomique de Wageningen.

Les personnels du Département Formation du CIPEA, du Département des Voyages et Liaison et des sections hôtelière et restauration ont très largement contribué au succès de cette conférence. Nous sommes aussi reconnaissants à la Section Publication pour leur assistance dans la rapide publication de ces actes, avec leur efficacité et leur bonne humeur habituelle.

R.T. Wilson
D. Bourzat

Addis-Abeba 4 novembre 1985

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PREFACE

A Conference on Small Ruminants in African Agriculture was organised by the Small Ruminant and Camel Group of the International Livestock Centre for Africa at the Centre's Headquarters in Addis Ababa from 30 September to 4 October 1985. The major aim of the Conference was to bring together scientists working in African countries so that they might be made aware of current research on the continent. A principal subsidiary aim of the meeting was to make it possible for the scientists to be exposed to presentations in both English and French and discussions were carried out in both these languages and translated simultaneously. Papers in these proceedings are presented in their original language with a summary in the other one.

The Conference was sponsored by the International Livestock Centre for Africa. Additional funds were provided by the United States Agency for International Development, the International Foundation for Science and the Agricultural University of Wageningen to enable some scientists to attend.

Staff of ILCA's Training, Travel/Liaison and Hostels and Cafeteria sections contributed substantially to the success of the Conference. We are also grateful to the Publications Section for assisting in their usual cheerful and efficient manner in the rapid publication of these proceedings.

R.T. Wilson
D. Bourzat

Addis Ababa 4 November 1985

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REPRODUCTION ET CROISSANCE
ETUDE DES HORMONES DE LA REPRODUCTION
CHEZ LA CHEVRE LOCALE EN OUGANDA

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2. Department of Animal Physiology, University of Nairobi, P.O.Box 30197, Nairobi, Kenya

RESUME

La progesterone et les oestradiol plasmatiques chez la chèvre et la testosterone plasmatique chez le bouc ont été déterminés par dosage radioimmunologique (DRI) chez la petite chèvre est-africaine. Pendant le cycle oestrien, le taux de progesterone plasmatique varie entre 2 et 18 nM/l. Le taux de progesterone est élevé pendant la gestation atteignant le maximum de 21,1 ± 1,46 nM/P pendant le dernier mois de gestation et reste en dessous de 3 nM/l durant plusieurs mois de la phase post-partum. Le taux d'oestradiol 17B varie de 120 à 900 pM/l pendant le cycle et est de 554 ± 424 pM/l pendant la seconde moitié de la gestation. Pendant la période post-partum, le taux d'oestrogènes est aussi élevé qu'à la fin de la gestation. La plupart des animaux sont gestants en mars coïncidant avec les riches pâturages du début de la grande saison des pluies. Les taux d'hormones post-partum laissent penser à l'absence d'ovulation et de formation d'un corps jaune pour plusieurs mois certainement dû à une déficience de LH, phénomène se traduisant par un intervalle entre mises-bas plus longs. Le niveau de testostérone chez le bouc varie de 0,5 à 12 nM/l montrant des décharges épisodiques de LH pas en liaison avec les conditions climatiques.
A STUDY OF THE REPRODUCTIVE HORMONES OF INDIGENOUS GOATS IN UGANDA

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2. Department of Animal Physiology, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.

SUMMARY

Plasma progesterone and oestradiol in females and plasma testosterone in males were determined by specific radioimmunoassays (RIA) in Small East African goats. During the oestrous cycles plasma progesterone was found to vary between 2 and 18 nM/l; progesterone was high during pregnancy reaching a maximum of 21.10 ± 1.46 nM/l during the last month of pregnancy, but was below 3 nM/l for several months during the postpartum period. Oestradiol-17β levels varied from 120 to 900 pM/l during a cycle and were at 554 ± 424 pM/l during the second half of pregnancy. During the postpartum period oestrogens were as high as in the second half of pregnancy. Most animals became pregnant in March coinciding with lush pastures after the start of the long rains. Hormone levels postpartum suggest absence of ovulation and corpora lutea formation for several months, most probably due to LH deficiency, resulting in a longer kidding interval. Testosterone levels in male goats varied between 0.5 - 12 nM/l indicative of episodic release of LH unrelated to climatic conditions.

INTRODUCTION

Sheep and goats are seasonal breeders in temperate climates, with the breeding season becoming longer as the equator is approached (Hafez, 1952). Tropical breeds of goats are thought to be aseasonally polyoestrus and thus can breed the year round (Mason & Maule, 1960; de Hass & Horst, 1979).

In seasonal breeders there are a number of factors which either stimulate or suppress the breeding activity. In sheep a high plane of nutrition such as caused by "flushing" is known to influence the rate of ovulation and increases the numbers of twins and triplets. The nutritional value of tropical pastures fluctuates widely between the dry and the rainy seasons. It was therefore considered necessary to measure reproductive hormones in goats at different times of the year to determine seasonal effects. This information is required before managerial decisions or artificial manipulations of the reproductive process can be undertaken in order to increase reproductive and productive efficiencies.

MATERIAL AND METHODS

Mature does and bucks of the Small East African (SEA) goat were bought in 1981 and kept at Makerere University campus. Management of the animals and regular detection of oestrus in the flock have been reported elsewhere (Katongole, 1983). All animals were bled regularly, once a week for young animals and twice a week for adult animals for a period of 16 months. Blood plasma was kept at -20°C and transferred in packed ice to Nairobi for assay.

Plasma progesterone, oestradiol and testosterone were assayed in accordance with the WHO protocol (WHO RIA Methods Manual). In each case 200 to 500 µl of plasma was mixed with 1000 c.p.m. tritiated hormone to estimate procedural loss. The sample was then extracted with ten volumes of diethylether and after freezing the aqueous phase the extracts were poured off into glass tubes. The ether extracts were dried under nitrogen and reconstituted in 2 ml of PBS-Gel. Two aliquots of 500 µl were taken for specific radioimmunoassay (RIA) and one aliquot of 500 µl for recovery estimation. To each sample or standard tube was added 10 000 c.p.m. in 100 µl of PBS-Gel of the appropriate tracer hormone and 100 µl of the specific antibody dilution. The mixture was incubated at 4°C for 18-24 hours before separating bound from free hormone using dextran-coated charcoal. After adding 200 µl of the charcoal
mixture the whole was vortexed and stood at 4°C for 15-20 minutes before centrifuging at 4°C for five minutes at 500 g. The bound hormone in the supernatant was counted in 4 ml of PPO-toluene scintillation fluid. For the standard curve the logit of B/Bo was plotted against log dose from which the samples were read. The concentration of the hormone was then corrected for procedural losses and dilution and expressed as nM/l for progesterone and testosterone and as pM/l for oestradiol.

RESULTS

The hormone assays were pooled on a monthly basis. Figure 1 gives progesterone and oestradiol results in four adult does which were showing psychic oestrus and which subsequently became pregnant and produced normal kids.

PROGESTERONE AND OESTRADIOL LEVELS DURING THE OESTROUS CYCLE

Animals showing oestrous periods before pregnancy had progesterone levels varying between 2.0 and 9.2 nM/l and oestradiol levels of 120 to 720 pM/l. Whereas low progesterone levels are most likely to have been around oestrus during the follicular phase, the higher levels occurred during the luteal phase.

PROGESTERONE AND OESTRADIOL LEVELS DURING PREGNANCY

Figure 2 shows hormone levels of several animals during pregnancy and the postpartum period at about the time of parturition. Reference should also be made to Figure 1 for the individual animals.

During the first month of pregnancy progesterone was found to be similar to the maximal levels of cycling animals at 9.3 ± 1.51 nM/l (n = 6) but had risen to 17.1 ± 1.98 nM/l by the second month of pregnancy and maximal levels of 21.1 ± 1.46 nM/l were present in the last month of pregnancy. In some animals progesterone levels as high as 27.3 nM/l were recorded. Oestradiol levels rose from 205.8 ± 30.1 pM/l during the first month of gestation to 554 ± 424 pM/l by the third month of pregnancy and remained at that level until parturition. The highest levels of oestrogens of over 1000 pM/l were recorded in some of the animals during the last month of pregnancy.
Figure 1: Plasma progesterone and oestradiol levels in four SEA goats.
POSTPARTUM PROGESTERONE AND OESTRADIOL LEVELS

Hormone levels during the postpartum period are shown in Figures 1 and 2. In the majority of animals the progesterone levels recorded were lowest in the first month postpartum, were below 3 nM/l for five or more months and in some exceptional cases remained low for up to eight months. Oestradiol levels ranged from 300 to 600 pM/l which were as high as the levels found in the second half of pregnancy. It would appear that during the postpartum period oestradiol was the dominant hormone for some time.

PREPUBERTAL AND PUBERTAL PROGESTERONE AND OESTRADIOL LEVELS

Figure 3 shows hormone levels recorded in two animals in samples taken before and after puberty. In one, first mating was not recorded until 15 months of age at
Figure 3  Plasma progesterone and oestradiol in two pubertal goats (Arrow indicates time of first mating after attaining sexual maturity)

![Graph of plasma progesterone and oestradiol in two pubertal goats]

A weight of 16.5 kg. In another first mating was recorded at eight months at a weight of 16.0 kg. Before puberty, progesterone level did not exceed 2 nM/l whereas after puberty progesterone ranged from 3 to 17 nM/l.

Oestradiol ranged from 300 to 900 pM/l being the dominant hormone before puberty whereas after puberty the range was 50 to 500 pM/l.

PLASMA TESTOSTERONE IN ADULT MALE GOATS

Figure 4 shows plasma testosterone in two adult male goats. This was found to vary greatly between 0.5 and 12.0 nM/l.

DISCUSSION

The levels of progesterone and oestradiol reported in this paper show great variation. As expected the levels vary according to the stage of the reproductive cycle or presence of pregnancy. In goats during the follicular phase around oestrus Thornburn & Schneider (1972) reported low progesterone levels of less than 0.2 ng/ml (ca 0.64 nM/l) and maximal levels were found by day 10 of the cycle. On the other hand oestrogens have been found to peak at or around oestrus (Scaramuzzi, Caldwell & Moor, 1970).

In the present study progesterone levels above 3.0 nM/l were taken to be
Figure 4  Plasma testosterone in two adult bucks

indicative of normal cycling with ovulation and corpus luteum formation if the animals were not pregnant. The levels of progesterone reported here of 2-18 nM/l in cycling animals are comparable to those reported by Kakusya (1979) in pygmy goats although his maximal levels are much higher (9.3 ± 0.3 ng/ml (ca 29.5 nM/l) with a range of 7.2 - 12.2 ng/ml (ca 22.9 - 38.8 nM/l). Since the present study reports monthly figures the lower maximal figures could be due to mixing high level samples with low hormone level samples.

Oestrogen levels of 120 - 900 pM/l during the cycle are in the range reported by other authors for the goat (Thornburn & Schneider, 1972; Kakusya, 1979). It has not been possible to show any seasonal effect in the level of circulating hormones in the present study, although there was a peak in conceptions in March. This could be due to a "flushing" effect at the beginning of the long rains following a prolonged dry period in December to February.

Progesterone was maximal during pregnancy, particularly in the second half. Oestrogens were also higher during the latter part of pregnancy. The trends in hormone levels are similar to those reported by other authors for the goat (Thornburn & Schneider, 1972; Kakusya, 1979; Mgongo, Gombe & Ogaa, 1983). In the goat pregnancy maintenance has been shown to be dependent solely on progesterone from the corpus luteum (Buttle, 1978) and there is a rise in progesterone production after 60 days of pregnancy due to placental lactogen stimulation which "rejuvenates" the corpus luteum to full function (Thornburn, Charrllis & Currie, 1977).

Low progesterone levels postpartum are an indication of lack of ovulation and corpus luteum formation and thus the animals could not become pregnant for several
months. This could be an explanation for the long kidding interval of 296.7 ± 8.5 days reported in the indigenous goat (Sacker & Trail, 1966). Another significant finding is the rather high levels of oestrogens in some animals postpartum, in some cases as high as those found in late pregnancy. This could be indicative of the existence of cystic ovaries and a deficiency of LH resulting in failure of ovulation. It is known for sheep that during pregnancy there is a marked reduction in the pituitary contents of LH reaching a nadir at parturition at levels below 25 per cent of the amount needed to induce ovulation (Moss et al, 1980). During the postpartum period there is recovery, pituitary LH returning to normal by about day 35 (Moss et al, 1980; Crowder et al, 1982). It has also been shown that high concentrations of oestradiol similar to those present in the last week or two of gestation reduce the pituitary content of LH to very low levels. The high concentration of oestradiol also causes a dramatic (98 per cent) reduction of mRNA encoded for the beta subunit of LH in the anterior pituitary of ewes (Glass, Aman & Nett, 1983; Nilson et al, 1983). The results from the present study would tend to indicate that there is a prolonged postpartum anoestrus/lack of ovulation because of high circulating oestrogens with a concomitant lack of adequate release of LH. Since most indigenous goats suckle their kids for prolonged periods, this may also be a factor in prolonging the postpartum anoestrus/annovulation as has been shown in other species (Wiltbank & Cook, 1958; Short et al, 1972). Poor or inadequate nutrition is also likely to occur during the dry periods and that too would exacerbate the postpartum anoestrus/annovulation (Wiltbank et al, 1962; Corah, Dunn & Kaltenbach, 1975; Bellows & Short 1978). On the other hand a higher plane of nutrition and shortened lactation will reduce the postpartum anoestrus and shorten the kidding interval. Lastly, heat stress could occur during the dry hot weather and this is known to cause reproductive failure in both males and females (Devendra & Burns, 1983).

In adult males plasma testosterone showed wide levels of variation with no obvious pattern. This may be due to episodic release of LH from the pituitary as occurs in the ram and the bull (Katongole, Naftolin & Short, 1971; 1974).
ACKNOWLEDGEMENTS

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![Small East African buck in house compound in Uganda](image-url)
AGE AT FIRST LAMBING AND LAMBING INTERVALS
OF PEUL EWES IN SENEGAL

R. Sow1), M. M'Baye2), I. Diallo1) & K. N'Diaye1)

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2. Centre de Recherches Zootéchniques, Kolda, Sénégal

SUMMARY

Analyses were carried out on a flock of Peul ewes which ran permanently with rams. Average age at first lambing was 739.5 ± 50.5 days and was significantly affected only by the season of birth, the most favourable period being the post-rains of October and November. Lambing intervals averaged 341.9 days. The cold dry season (December–February) was the least favourable period as reflected in lowest lifetime productivity of young.
AGE AU PREMIER AGNELAGE ET INTERVALLE ENTRE AGNELAGES CHEZ LA BREBIS PEULE AU SENEGAL

R. Sow1), M. M'Baye2), I. Diallo1) & K. N'Diaye1)

1. Centre de Recherches Zootechniques, Dahra, Sénégal
2. Centre de Recherches Zootechniques, Kolda, Sénégal

RESUME

L'analyse porte sur un troupeau de brebis peul laissées en permanence avec un bélier. L'âge moyen au premier agnelage est de 739,5 ± 50,5 jours. Il est seulement influencé par la saison de naissance, la saison favorable étant la saison post-pluviale (octobre-novembre). L'intervalle moyen entre agnelages est de 341,9 jours. Globalement, la saison sèche froide (décembre-février) apparaît comme la plus défavorable à la productivité totale des brebis en fin de carrière.

INTRODUCTION

L'âge à laquelle l'agnelle devient pubère ou sa fertilité constitue un important facteur dans la carrière d'une reproductrice. La fréquence des mises-bas (intervalle entre agnelages) est un élément primordial de la productivité numérique. Ceci est particulièrement vrai pour les animaux de la zone sylvo-pastorale, zone de naissance par excellence.

Les informations relatives aux caractéristiques de la reproduction (âge au premier agnelage, intervalles entre agnelages) sont disponibles pour le mouton Djallonké élevé au Centre de Recherches Zootechniques de Kolda (Fall et coll., 1982) mais font défaut pour les races peul et touabire. Cette note fait le point de plusieurs années d'étude sur les troupeaux de la station, en se limitant aux deux paramètres de reproduction.

MATERIEL ET METHODES

Pour l'étude de l'âge au premier agnelage, on dispose de 85 animaux nés entre 1976 et 1985.

L'étude de l'intervalle entre agnelages porte sur un troupeau de brebis adultes laissées en permanence avec un bélier de 1980 à 1984. La conduite alimentaire des animaux ainsi que les méthodes d'élevage ont largement été décrites (Rapports succints d'activités au C.R.Z./Dahra).

Les données sont étudiées par analyse de variance à effets fixes en introduisant dans le modèle les sources de variation suivantes:

- année de naissance et saison de naissance pour les paramètres âges au premier agnelage;
- saison d'agnelage et année d'agnelage de la mise-bas i pour l'intervalle entre agnelages (intervalle mise-bas i et mise-bas i+1).

L'année a été divisé en cinq saisons:

- Saison 1: sèche froide (Décembre à Février);
- Saison 2: sèche chaude (Mars à Mai);
- Saison 3: pré-pluviale (Juin à Juillet);
- Saison 4: pluviale (Août à Septembre);
- Saison 5: post-pluviale (Octobre à Novembre).
RESULTATS

AGE MOYEN AU PREMIER AGNELAGE

L'âge moyen au premier agnelage de la brebis peul calculée sur 85 mises-bas est de 739 ± 50,5 jours soit deux ans.

Au tableau 1, sont présentés les résultats d'analyses de variance. Seule la saison de naissance influence très significativement l'âge au premier agnelage. Le tableau 2 donne les âges moyens au premier agnelage en fonction de l'année et de la saison de naissance.

Tableau 1 Analyse de variance de l'âge au premier agnelage

<table>
<thead>
<tr>
<th>Source de variation</th>
<th>d.l.</th>
<th>Carrés moyens x 10²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Année de naissance</td>
<td>7</td>
<td>991</td>
</tr>
<tr>
<td>Saison de naissance</td>
<td>4</td>
<td>2841 **</td>
</tr>
<tr>
<td>Variation résiduelle</td>
<td>73</td>
<td>425</td>
</tr>
</tbody>
</table>

** P < 0,01

Tableau 2 Moyennes calculées pour l'âge au premier agnelage

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>𝜇 (j)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moyenne générale</td>
<td>85</td>
<td>739,5</td>
</tr>
<tr>
<td>Année de naissance:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1976</td>
<td>2</td>
<td>928,0</td>
</tr>
<tr>
<td>1977</td>
<td>13</td>
<td>766,4</td>
</tr>
<tr>
<td>1978</td>
<td>3</td>
<td>925,6</td>
</tr>
<tr>
<td>1979</td>
<td>5</td>
<td>882,6</td>
</tr>
<tr>
<td>1980</td>
<td>10</td>
<td>812,9</td>
</tr>
<tr>
<td>1981</td>
<td>30</td>
<td>641,6</td>
</tr>
<tr>
<td>1982</td>
<td>19</td>
<td>769,9</td>
</tr>
<tr>
<td>1983</td>
<td>3</td>
<td>612,6</td>
</tr>
<tr>
<td>Saison de naissance:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sèche froide</td>
<td>14</td>
<td>911,8a</td>
</tr>
<tr>
<td>sèche chaude</td>
<td>6</td>
<td>857,2ab</td>
</tr>
<tr>
<td>pré-pluviale</td>
<td>7</td>
<td>865,4ab</td>
</tr>
<tr>
<td>pluviale</td>
<td>22</td>
<td>764,0b</td>
</tr>
<tr>
<td>post-pluviale</td>
<td>36</td>
<td>619,9c</td>
</tr>
</tbody>
</table>

Pour la même classe, les moyennes suivies de la même lettre ne sont pas significativement différentes au seuil de 5 p.cent.

**INTERVALLE MOYEN ENTRE AGNELAGES**

Les deux facteurs introduits dans le modèle d'analyse de variance n'ont pas d'effet significatif (F = 1,46 pour l'année d'agnelage et 1,22 pour la saison d'agnelage). Au tableau 3 sont consignées les moyennes calculées pour l'intervalle moyen entre agnelages. Les plus courtes intervalles se rencontrent avec les agnelages de 1983. Les plus longs intervalles se sont produits en 1981. Quant à la saison d'agnelage, bien qu'il n'y ait pas d'influence significative, la saison d'agnelage s'accompagnant d'un court intervalle est la saison sèche chaude avec 278,1 jours. Le plus long intervalle se produit avec les agnelages de saison sèche froide.

**DISCUSSION**

**AGE AU PREMIER AGNELAGE**

L'âge moyen au premier agnelage est de 739 jours. Cette valeur est presque la même que celle trouvée sur d'autres brebis peul (Tchakériam, 1979).

---

### Tableau 3  Moyennes calculées pour l'intervalle entre agnelages

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>( \bar{X} ) (j)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moyenne générale</strong></td>
<td>76</td>
<td>341,9</td>
</tr>
<tr>
<td><strong>Année d'agnelage:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>17</td>
<td>348,6</td>
</tr>
<tr>
<td>1981</td>
<td>20</td>
<td>376,2</td>
</tr>
<tr>
<td>1982</td>
<td>23</td>
<td>345,1</td>
</tr>
<tr>
<td>1983</td>
<td>16</td>
<td>287,2</td>
</tr>
<tr>
<td><strong>Saison d'agnelage:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sèche froide</td>
<td>18</td>
<td>377,4</td>
</tr>
<tr>
<td>sèche chaude</td>
<td>9</td>
<td>278,1</td>
</tr>
<tr>
<td>pré-pluviale</td>
<td>12</td>
<td>302,9</td>
</tr>
<tr>
<td>pluviale</td>
<td>12</td>
<td>342,1</td>
</tr>
<tr>
<td>post-pluviale</td>
<td>25</td>
<td>354,5</td>
</tr>
</tbody>
</table>

L'année de naissance n'a pas eu d'influence sur l'âge au premier agnelage des brebis peul de Dahra. La moyenne générale de l'âge au premier agnelage anormalement élevée (739 jours) par rapport à ce qu'on trouve dans la littérature traduirait plus de problèmes liés à la gestion du troupeau (mise à la reproduction des agnelles, alimentation) qu'une caractéristique génétique de la race. En effet, cet âge a pu être abaissé à 374,8 jours (351-441 jours) en mettant les femelles en reproduction dès l'âge de cinq mois (expérience d'extériorisation de 1980; rapport annuel du CRZ/MARS, 1982).

L'existence d'un effet saison sur l'âge au premier agnelage prouve que l'on peut, par une bonne conduite d'élevage, utiliser les conditions naturelles pour abaisser l'âge au premier agneau. Ce sont les animaux nés en saison post-pluviale qui font leur premier agneau plus tôt. Cette saison correspond à la période de naissance des moutons peul du Ferlo.

INTERVALLE MOYEN ENTRE AGNELAGES

La valeur de 341,9 jours dépasse de 30 jours environ celle trouvée sur d'autres moutons du Sahel (Charray et coll, 1980). Ni l'année, ni la saison d'agnelage n'ont eu d'influence sur l'intervalle entre agnelages. Cependant, les brebis qui agnèlent en saison sèche chaude font un autre agneau plus rapidement (intervalle de 278 jours). La saison sèche froide présente les plus mauvais résultats. Cette saison de naissance est donc incompatible avec une bonne carrière de reproductrice, pour ce qui est de productivité numérique seulement (intervalle entre agnelages longs, âge au premier agnelage élevé). On peut donc déconseiller les naissances pendant cette saison donc les luttes allant en saison des pluies, mais ceci nécessiterait un contrôle de lutte.
PERFORMANCES DE REPRODUCTION
DE LA CHEVRE NAINE D'AFRIQUE OCCIDENTALE
DANS LE SUD-OUEST DU NIGERIA

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ILCA Humid Zones Programme
PMB 5320 Ibadan Nigeria

RESUME
Une étude des performances de reproduction de la chèvre naine d'Afrique occidentale était entreprise à Fashola (7°31'N, 4°00'E) dans le sud-ouest du Nigéria de 1982 à 1984. L'intervalle de naissance était de 261 ± 75 jours et la taille de la portée était de 1,6 ± 0,5. Le taux annuel de reproduction atteignait 2,3 chevreaux par chèvre. L'âge de la mère, le mois et l'année de la parturition influençaient d'une façon significative (P<0,05) l'intervalle de naissance ainsi que le village dans le groupe contrôle. Ni les interventions contre la PPR et la gale ni l'intervention contre la gale seule n'exerçaient d'effet sur l'intervalle. L'âge de la mère et les interventions avaient des effets significatifs (P<0,05) sur la taille de la portée. Les résultats sont discutés en fonction des autres données disponibles pour l'Afrique.
REPRODUCTIVE PERFORMANCE OF WEST AFRICAN DWARF GOATS
IN SOUTHWESTERN NIGERIA

S.A.O. Adeoye
ILCA Humid Zones Programme
PMB 5320 Ibadan Nigeria

SUMMARY

A study of the reproductive performance of West African Dwarf goats was undertaken at Fashola (7°31'N, 4°00'E) in southwestern Nigeria from 1982 to 1984. Kidding interval was 261 ± 75 days and litter size 1.6 ± 0.5. Annual reproductive rate was 2.3 kids per doe. Age of dam, month and year of parturition had significant (P<0.05) effects on the kidding interval as did the location in the control group. Neither of the two treatments (against PPR and mange and against mange alone) had any significant effect on the kidding interval. Age of dam and treatment both affected the litter size significantly (P<0.05). The data are compared with some other results obtained in Africa.

INTRODUCTION

Improvement in small ruminant production requires a multidimensional approach involving criteria such as basic knowledge about the quantity and quality of the animals being studied coupled with the environmental variables to which they are exposed.

This approach is essential in the humid zone of Nigeria which has for long depended on the less humid part of the country for supplies of beef, mutton and goat meat. This situation has resulted because trypanosomiasis has restricted ruminant production in southern Nigeria to trypanotolerant breeds of cattle, sheep and goats.

In spite of considerable movement of ruminants from northern Nigeria to the south, animal protein consumption is lowest in the south. The level of protein consumption in the south is dictated by the state of animal production in the north and requires urgent action to improve the output of the southern breeds of goats.

This paper provides some data on the reproductive performance of West African Dwarf (WAD) goats in the humid zone of southwestern Nigeria.

MATERIAL AND METHODS

Evaluation of reproductive performance of free roaming dwarf goats was based on data from 170 breeding does (i.e. over 12 months old) collected over a two-year period (1982-1984) in seven villages. There were three treatment groups, these being: vaccination with tissue culture rinderpest vaccine against Peste des Petits Ruminants (PPR) and dipped to control mange; dipping only; and a control group (no interventions). The study site was at Fashola (7°31'N, 4°00'E), 80 km north-west of Ibadan and 21 km north-west of Oyo.

The area is a fire subclimax of the rain forest referred to as the derived savanna, and is characterised by extensive grassland interspersed with a few tree species such as locust bean, shea butter, kolanut and oil palm (Hopkins, 1974; Chedda & Crowder, 1977)

The mean annual rainfall is 1100 to 1200 mm with a rainy period of seven to eight months and a dry season of four to five months. Mean annual temperature is 26°C and relative humidity between 80 and 90 per cent.
Data considered in this study were those relating to parturition and births collected from February 1982 to January 1984. Individual records were built up for each doe related to each parturition for type of birth and sex of young. These data were then used to calculate parameters such as kidding interval, time to reconception, litter size and kidding rate. All analyses were by least squares procedures (Harvey, 1977) using fixed models which included the effects of health regime, sex of young, age of dam, month and year of parturition, birth type, location and various interactions.

RESULTS

OBSERVED REPRODUCTIVE PERFORMANCE

The mean kidding interval was $261 \pm 75$ days with a coefficient of variation of 29 per cent while the mean litter size was $1.6 \pm 0.5$ with a coefficient of variation of 132 per cent (Table 1).

Time to reconception, derived from kidding interval and gestation period (the latter assumed to be 150 days) was 111 days.

Annual reproductive performance (calculated as: litter size x 365/subsequent parturition interval) was 2.3 kids per doe.

Table 1  Reproductive performance of West African Dwarf goats reared in villages in southwestern Nigeria

<table>
<thead>
<tr>
<th>Parameters</th>
<th>n</th>
<th>$\bar{x}$</th>
<th>s.e.</th>
<th>Coefficient of variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidding interval (days)</td>
<td>170</td>
<td>260.6</td>
<td>74.5</td>
<td>28.9</td>
</tr>
<tr>
<td>Time to reconception (days)</td>
<td>170</td>
<td>110.6</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Litter size</td>
<td>170</td>
<td>1.62</td>
<td>0.53</td>
<td>132.0</td>
</tr>
<tr>
<td>Annual kidding rate$^a$)</td>
<td>170</td>
<td>2.3</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Note: $^a$ Annual kidding rate = litter size x 365/subsequent kidding interval
LEAST SQUARES ANALYSIS

The mean squares for the analysis of variance are laid out in Table 2 and the estimated least squares means in Table 3.

Age of dam had a significant effect on litter size (P<0.01) while its influence on kidding interval approached significance. Year of kidding significantly influenced the kidding interval (P<0.05), the interval of 295 days following parturition in 1982 being 46 days longer than that following a parturition in 1983. The health package did not seem to affect litter size, this being significantly bigger in the control group than in the treatment group receiving both the vaccine and the mange control treatment. Location x treatment effects were significant in the control group only.

Table 2  Mean squares from the analysis of variance for reproductive performance of West African Dwarf goats

<table>
<thead>
<tr>
<th>Source</th>
<th>Kidding interval</th>
<th>Litter size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>d.f.</td>
<td>M.S.</td>
</tr>
<tr>
<td>Age</td>
<td>4</td>
<td>11521+</td>
</tr>
<tr>
<td>Month</td>
<td>11</td>
<td>8989+</td>
</tr>
<tr>
<td>Year</td>
<td>1</td>
<td>33231**</td>
</tr>
<tr>
<td>Birth type</td>
<td>1</td>
<td>2778</td>
</tr>
<tr>
<td>Health regime</td>
<td>2</td>
<td>1107</td>
</tr>
<tr>
<td>Village x Regime 1</td>
<td>2</td>
<td>5172</td>
</tr>
<tr>
<td>Village x Regime 2</td>
<td>1</td>
<td>13745</td>
</tr>
<tr>
<td>Village x Regime 3</td>
<td>1</td>
<td>33339**</td>
</tr>
<tr>
<td>Regime x Age</td>
<td>8</td>
<td>4984</td>
</tr>
<tr>
<td>Regime x Year</td>
<td>2</td>
<td>7818</td>
</tr>
<tr>
<td>Month x Year</td>
<td>10</td>
<td>9837+</td>
</tr>
<tr>
<td>Remainder</td>
<td>126</td>
<td>5693</td>
</tr>
</tbody>
</table>

** P < 0.01  * P < 0.05  + Approaching significance
Table 3  Estimated least squares means for reproductive traits of West African Dwarf goats in southwestern Nigeria

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Kidding interval (days)</th>
<th>Litter size (no)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mean</td>
<td>170</td>
<td>272</td>
<td>1.65</td>
</tr>
<tr>
<td>Age of dam:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18 months</td>
<td>27</td>
<td>284</td>
<td>1.27</td>
</tr>
<tr>
<td>30 months</td>
<td>37</td>
<td>296</td>
<td>1.48</td>
</tr>
<tr>
<td>42 months</td>
<td>61</td>
<td>241</td>
<td>1.81</td>
</tr>
<tr>
<td>48 months</td>
<td>29</td>
<td>261</td>
<td>1.82</td>
</tr>
<tr>
<td>Year:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>60</td>
<td>295</td>
<td>1.57</td>
</tr>
<tr>
<td>1983</td>
<td>110</td>
<td>249</td>
<td>1.74</td>
</tr>
<tr>
<td>Health regime:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>80</td>
<td>271</td>
<td>1.46</td>
</tr>
<tr>
<td>2</td>
<td>57</td>
<td>245</td>
<td>1.66</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>299</td>
<td>1.83</td>
</tr>
</tbody>
</table>

DISCUSSION

The reproductive performance evaluated in this study has given results similar to those obtained from previous studies with WAD goats in the humid zone of West Africa and with other types of goats in other parts of Africa. For instance, the kidding interval recorded in this study is similar to the interval obtained by other researchers which varies from 221 to 301 days in most cases (Buadu, 1972; Vohradsky & Sada, 1973; Otchere & Nino, 1976; Oppong & Yebuah, 1981; Mack, 1983).

Kidding interval appeared to decrease with increase in age of dam while the kidding rate increased with age. The optimal kidding rate was obtained between the ages of 36 and 48 months. This finding contradicts results in Devendra & McLeroy (1982) who say that the optimal reproductive performance in tropical goats is attained between five and six years. Surprisingly, time to reconception was prolonged six days (5 per cent) for every additional 100 mm precipitation falling in the post-partum period. This may be due to a higher disease incidence during this period.

The relatively short time to reconception observed in this study may be due to the absence of controlled breeding in goats under the free roaming husbandry system.
Does which abort return to oestrus early because they run continuously with bucks (Smith, 1978).

CONCLUSION

The results obtained from this study show that WAD goats reared traditionally prove to be fertile and prolific. These attributes may, however, be negated by constraints such as disease, nutrition and poor management. Village goats apparently perform better during the dry period when they are virtually free from diseases and/or parasites, can make use of crop by-products and can make good use of feed resources by browsing.

West African Dwarf doe in southwestern Nigeria
EFFETS DE LA VARIATION SAISSONNIÈRE DES DISPONIBILITES FOURRAGERES
SUR LES PARAMETRES DE FERTILITE
CHEZ LA PETITE CHEVRE EST AFRICAINE AU NORD DU KENYA

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RESUME

Des études sont en cours pour estimer différents paramètres de fertilité chez la petite chèvre est-africaine à Isiolo au nord du Kenya. Une politique non saisonnée de lutte est appliquée et les paramètres sont étudiés en relation avec la quantité et la qualité de fourrage disponible. Des lots d’élevage de 18 femelles sont mis avec un bouc pour deux mois. Le mâle est ensuite transféré dans un autre lot. Les données sont enregistrées concernant la lutte, les avortements, le poids de naissance, de sevrage et le poids pré- et post-partum des chèvres. Les premiers résultats des quatre premiers lots montrent un taux de conception élevé pour les animaux luttés pendant la saison des pluies et un taux faible pour ceux luttés en saison sèche. Les poids sont plus élevés pour les agneaux nés au début et sevrés après la grande saison des pluies quand le pâturage est bon. Les taux de survie les plus élevés sont enregistrés chez les animaux nés au début de la grande saison des pluies.
EFFECTS OF SEASONAL FORAGE SUPPLY ON SOME FERTILITY PARAMETERS IN THE SMALL EAST AFRICAN GOAT IN NORTHERN KENYA

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SUMMARY
Various fertility parameters are under investigation in the Small East African goat at Isiolo, northern Kenya. A programme of aseasonal breeding is used and parameters are examined in relation to the quantity and quality of forage available. Breeding groups consisting of 18 females each are used: bucks stay with one group for two months and are then transferred to another group. Records are taken for mating, abortions, birth weights, weaning weights and pre- and post-partum weights of dams. Preliminary results from the first four breeding groups indicate high conception rates in animals mated during the rainy season and low rates in those mated during the dry season. Weights were higher for kids born at the start of and weaned after the long rains when forage was good. High kid survival rates were recorded for animals born at the start of the long rains.

INTRODUCTION

The Small Ruminant Research Unit in the Department of Animal Production of the University of Nairobi carries out investigations of behavioural, physiological and morphological adaption of indigenous sheep and goats to seasonal changes of forage availability and forage quality on semi-arid and arid rangelands in northern Kenya. This paper reports preliminary results of a study of the effects of seasonal changes in forage supply on some fertility parameters in Small East African (SEA) goats kept on a semi-arid thornbush savanna pasture in Isiolo District. The breeding programme with the SEA goats was initiated in January 1984; the results reported below have not been subjected to detailed statistical analysis and only reflect rather general trends.

MATERIALS AND METHODS

EXPERIMENTAL ANIMALS

In early 1983 a herd of SEA goats comprising some 60 each mature and immature females was provided by the Research Division of the Ministry of Livestock Development. By culling unsuitable animals and further local purchases, 90 mature does and 50 immature females were present at the start of the breeding programme. The majority of the animals had age and previous birth records and if not, were tooth-aged. Ages ranged from one to six years. From this herd, breeding groups with a balanced age structure were established numbering 18 animals each. A systematic, aseasonal breeding programme was designed. Into one breeding group at a time a buck was introduced for two months and after that transferred to the next breeding group to achieve year round mating, kidding and weaning in the experimental herd.

EXPERIMENTAL PASTURES AND HERD MANAGEMENT

The studies were carried out at a small research station situated on a holding ground of the Livestock Marketing Division, Ministry of Agriculture and Livestock Development near Isiolo, 300 km north of Nairobi. The altitude is 1100 m a.m.s.l. and the mean annual rainfall is 510 mm in two rainy seasons (March to May and October–November). The soils are volcanic in origin with some alluvial floodplains along seasonal watercourses. The main vegetation type is a thornbush savannah dominated by various Acacia species with a sparse ground cover of annual grasses, herbs and dwarf shrubs. Along the seasonal watercourses Acacia woodland and dense bush dominated by Grewia species occur and perennial grassland is found on the floodplains.
For most of the year the holding ground is understocked and consequently most of the range is in good condition. The animals are watered from a deep borehole which is part of the station.

There are no fenced paddocks and animals are herded throughout the year. A normal grazing day starts at 07h00, is interrupted for watering at the station with a midday rest between 13h00 and 15h00 and ends at 18h00, when the animals return to the night enclosure. During a grazing day the animals walk 5-10 km, longer distances being travelled during the dry season.

The animals are drenched twice a year with an anthelminthic prior to the rainy season and are vaccinated once a year against Contagious Caprine Pleuro-Pneumonia. Injuries are treated as they occur and an acaricide is applied whenever necessary. A mineral lick is supplied in the night enclosure.

DATA COLLECTION

All events such as mating, abortion, birth and death were recorded continuously: liveweights and milk yields were measured regularly every two weeks. All dead animals were subjected to post-mortem examination to establish the cause of death. Pasture condition was judged every two weeks using a simple classification with four grades incorporating forage availability and greenness (Table 1).

<table>
<thead>
<tr>
<th>Pasture condition category</th>
<th>Condition of groundcover</th>
<th>Estimated available forage biomass (kg/ha)</th>
<th>Forage quality categories (% available forage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduced/dry</td>
<td>&lt; 500</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>2</td>
<td>Abundant/dry</td>
<td>500–1200</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>Reduced/green</td>
<td>700–1200</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>4</td>
<td>Abundant/green</td>
<td>&gt;1200</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

Notes: a) Excluding browse  b) crude fibre < 30%  c) crude fibre 30–60%  d) Crude fibre > 60%
RESULTS

The results reported refer to the first four breeding groups only, which at the time of writing had already completed the weaning stage. Figure 1 shows the dates of mating, kidding and weaning for the four groups in relation to the prevalent pasture condition. Table 2 summarises the observed fertility parameters. Group 1, which was mated prior to the long rains 1984 and kidded at the beginning of the long dry season, showed the highest conception and kidding rates. No abortions were observed. Group 4, mated at the end of the long dry season had the lowest conception and kidding rate combined with the highest abortion rate. The reverse trend was observed for the weaning rate which was highest in group 4 and lowest in group 1.

Figure 1 Reproductive events for four breeding groups of SEA goats related to pasture condition (Table 1 describes pasture condition categories)

![Graph showing reproductive events for four breeding groups]

Table 2  Fertility parameters observed in four breeding groups of Small East African goats (18 does per group)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conception rate (%)</td>
<td>100</td>
<td>94</td>
<td>78</td>
<td>50</td>
</tr>
<tr>
<td>Abortion rate (%)</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Kidding rate (%)</td>
<td>167</td>
<td>111</td>
<td>89</td>
<td>61</td>
</tr>
<tr>
<td>Weaning rate (%)</td>
<td>50</td>
<td>50</td>
<td>56</td>
<td>61</td>
</tr>
</tbody>
</table>
Figure 2 shows the number of kids born and surviving to weaning age in the four groups. Lowest survival was observed in group 1 (30 per cent of kids born) with kidding at the beginning of the long dry season and pasture condition 1 prevalent throughout lactation. Survival rate was better in group 2 (45 per cent) with kidding prior to the short rains and in group 3 (63 per cent) which kidded during the short dry season 1984-1985. Survival rate in group 4, where kidding took place at the onset of the long rains 1985, was highest (100 per cent). In all groups the survival rate of single kids was higher than that of twins.

The same trend as in survival to weaning was reflected in the liveweights of the kids from birth to weaning (Figure 3). Lowest mean weights at weaning (5 kg) were observed in group 1 and highest in groups 3 and 4. The lowest individual weaning
weight (2.1 kg) was recorded in group 1 and the highest (19.5 kg) in group 4. In all groups mean live weights of singles were higher than those of twins for the whole of the pre-weaning period, although the difference was significant only in group 3.

The overall productivity of does in terms of total liveweight of kids at weaning relative to total liveweight of does after parturition (n=18) was lowest in group 1 and highest in group 3 as shown in Table 3. That this ratio is less favourable for group 4 than for group 3 is due to the fact that does in group 4 were much heavier after parturition (37.3 kg) than those in group 3 (30.9 kg) because pasture was good throughout the pregnancy period.

**DISCUSSION**

The few preliminary results from this investigation demonstrate that the realisation of the productive potential is affected differently by the prevailing pasture condition at different stages in the reproductive cycle. High conception and high kidding rates do not necessarily result in high flock productivity and vice versa. Based on the present results only, one would find it difficult to make recommendations for a restricted breeding season. Further exploration of different combinations of prevailing pasture conditions with varying stages of the reproductive cycle are needed and are currently being carried out. Lines of investigation other than the present one will have to be followed before all mechanisms involved can be determined. It

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Survival rate of kids and total kid weight at weaning in four breeding groups of Small East African goats (18 does per group)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>1</td>
</tr>
<tr>
<td><strong>Survival rate:</strong></td>
<td></td>
</tr>
<tr>
<td>Singles as % singles born</td>
<td>46</td>
</tr>
<tr>
<td>Twins as % twins born</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total weaning weight:</strong></td>
<td></td>
</tr>
<tr>
<td>Weight of all kids (kg)</td>
<td>46.5</td>
</tr>
<tr>
<td>As % dam post-partum weight</td>
<td>7.6</td>
</tr>
</tbody>
</table>
is, for example, not clear if the low conception rates in groups 3 and 4 were caused by low ovulation rates in the females or by reduced semen quality in the male. Such information would be necessary before a feasible supplementation system for breeding stock could be designed. The effects of increased veterinary inputs on fertility under semi-arid range feeding conditions are also still largely unknown. Such studies should be initiated in future.
FACTEURS INFLUANT SUR LA CROISSANCE DES MOUTONS ET DES CHEVRES EN AFRIQUE

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Department of Animal Production
University of Nairobi
P.O.Box 29053 Kabete Kenya

RESUME

Les poids de femelles adultes d'un échantillon représentatif des zones écologiques africaines atteignent 30 à 45 kg pour les brebis et 20 à 35 kg pour les chèvres. Les taux de croissance pour le même échantillon sont de 75 à 140 g/j pour les agneaux et 50 à 100 g/j pour les chevreaux. Pour les deux espèces, la croissance de 3-12 mois est de 30 à 75 g/j. La transformation de ces données en vitesse spécifique de croissance montre que la plus grande part de cette variation est liée au poids adulte. Le dimorphisme sexuel est identique à la naissance à celui observé en zone tempérée mais moins marqué chez l'adulte. La rusticité varie beaucoup à l'intérieur d'une espèce à l'autre et semble-t-il ainsi entre espèces. Les différences saisonnières ont des effets importants et complexes qui souvent interfèrent avec d'autres paramètres de production. Les différences entre propriétaires montrent que le facteur humain peut être aussi important que n'importe quel autre facteur. La croissance compensatrice peut être affectée par le stade de croissance auquel elle intervient.
FACTORS AFFECTING THE GROWTH
OF SHEEP AND GOATS IN AFRICA

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SUMMARY

Phenotypic weight of mature females from a representative sample of African environments range from 30-45 kg for ewes and from 20-35 kg for does. Growth rates for the same sample range from 75-140 g/day for lambs and 50-100 g/day for kids, from birth to three months of age. This drops to between 30 and 75 g/day for both species at 3-12 months. Transformation of these to specific growth rates shows that much of the variation is due to differences in mature size. Sexual dimorphism is similar to that in temperate environments at birth, but less at maturity. Susceptibility to heat stress varies greatly within species and possibly between species. Seasonal differences have large and complex effects that often interact with other performance parameters. Differences between owners show that the human influence may be as important as any other factor. Compensatory growth may be affected by the stage of growth at which compensation is occurring.

INTRODUCTION

Several major changes occur as an animal passes from the zygote to its mature form and size. Perhaps the most obvious change is in size and mass—these have been termed growth. In addition to these, there are fundamental changes in shape and body composition which have been termed differentiation. Because growth and differentiation are inseparable their combination is called development.

Growth and development are essentially ecological responses and it is thus appropriate to consider the factors affecting their outcome in an ecological framework. Firstly there is the genotype. Factors of environmental origin can be attributed to the internal (or physiological) and external environments. The former comprises principally the hormones affecting growth. The latter is usually subdivided into the physical, nutrient and biotic components from which man is usually omitted. Man's effects are so important and widespread that it is more convenient to consider him separately rather than to include him amongst the biotic components. In this paper attention will be confined to growth, for which most data are available, and in a form that permits a greater degree of comparison. Of the factors affecting growth, nutrition and disease are considered in other papers in these proceedings and so attention will be confined to the remaining factors.

PHENOTYPE

The available data are inadequate for precise comparisons of the different genotypes of African sheep and goats and very few studies have been made where genetic effects have been separated from those of environmental origin. However this is probably less important at the present stage of development of Africa's small ruminant production systems than quantifying the phenotypic differences of different systems. Meagre though the data are, some broad comparisons are illuminating. Figure 1 is a comparative presentation of the mature weights of ewes and does for a selected sample of African breed types. The range of 30 to 45 kg covers the ewes, while does are rather smaller falling between 20 to 35 kg. No particular trend is suggested across the regions, or between the humid and arid zones.

Figure 2 gives the gross and specific growth rates for periods between birth and 12 months for the same sample, together with two goat types from Botswana. Between birth and three months, the average daily growth rates (ADG) of sheep appear
Figure 1  Mature weights (kg) of female small ruminants from dry (—-) and wet (---) areas

<table>
<thead>
<tr>
<th>Location</th>
<th>Breed</th>
<th>Source</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Africa</td>
<td>Forest</td>
<td>1</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>West Africa</td>
<td>Sahel</td>
<td>3</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Sudan</td>
<td>Desert</td>
<td>5</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>Afar</td>
<td>7</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Kenya</td>
<td>Masai</td>
<td>8</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Kenya</td>
<td>Somali</td>
<td>10</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Kenya</td>
<td>Dorper</td>
<td>8</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Sources:

Figure 2  Linear (g/d) and specific growth rates for African small ruminants from dry (—-) and wet (---) areas

<table>
<thead>
<tr>
<th>Location</th>
<th>Breed</th>
<th>Source</th>
<th>Sheep</th>
<th>Goats</th>
<th>Specific growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Africa</td>
<td>Forest</td>
<td>1</td>
<td>75</td>
<td>25</td>
<td>50 15</td>
</tr>
<tr>
<td>West Africa</td>
<td>Sahel</td>
<td>2</td>
<td>75</td>
<td>22</td>
<td>50 15</td>
</tr>
<tr>
<td>Sudan</td>
<td>Desert</td>
<td>5</td>
<td>75</td>
<td>25</td>
<td>50 15</td>
</tr>
<tr>
<td>Kenya</td>
<td>Masai</td>
<td>8</td>
<td>75</td>
<td>25</td>
<td>50 15</td>
</tr>
<tr>
<td>Kenya</td>
<td>Dorper</td>
<td>8</td>
<td>75</td>
<td>25</td>
<td>50 15</td>
</tr>
<tr>
<td>Botswana</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Breed Source:
- Forest: 2
- Desert: 6
- Masai: 12
- Dorper: 14
- Botswana:
  - Boer: 15
  - Tswana: 15

Note: The specific growth rate = (log W2 - log W1) / (T2 - T1) x 100, where W1 and W2 are the weights at ages T1 and T2.

Sources:
1-11. as for Figure 1
12. Ferguson, 1964
13. de Hoos and Chemitel, 1973
14. Chemitol, 1976
15. Ministry of Agriculture, Botswana, 1977
to range from 100 to 140 g, except for the two extremes - the very small West African Dwarf type and the improved Dorper. Goats have lower rates, with an ADG ranging from 50 to 100 g. Again no particular trend is apparent. When the comparisons are made on the basis of the specific growth rates, thus adjusting for differences in body size, differences are very much smaller amongst both sheep and goats, although goats are again lower ranging from 1.2 to 1.6, as compared with 1.5 to 1.9 for sheep.

For the period from three to twelve months the ADG drops to 30 to 75 g for sheep and approximately 50 g for goats. The main exception is the Sudan Desert sheep which exhibits a higher ADG, suggesting either an element of compensatory growth for the group studied, or a slower rate of maturing.

Of course there is great variation. These levels can only be considered as examples under existing production systems, the performance of which can fluctuate wildly. Certainly they are not an indication of genetic potentials: almost all present evidence indicates that these are far above existing levels. Where herds are small it is likely that sufficient inbreeding takes place to cause inbreeding depression. A more frequent exchange of sires among breeding groups could make a dramatic change unless an infectious breeding disease is present.

In a number of instances in the more humid zones exotic genotypes have been introduced, particularly with sheep. In the high altitudes of Kenya the Romney Marsh and Down breeds have shown that fat lamb of the same quality as in temperate areas can be produced from fifth and subsequent back crosses to these breeds (Macharia et al, 1975). The Dorset Horn has made a number of contributions to crossbreeding. Trail & Sacker (1969) report the results of one of these with the East African Blackhead. The growth of half-breds did not differ from indigenous lambs until post-weaning, when the growth rate was twice as great (both types suckled the indigenous ewe). A comparison of 75 per cent, 62.5 per cent and half-bred lambs showed no difference between the first two, but the half-breds were 26 per cent lighter at both weaning and 11 months of age. This indicated that the three-quarter and five-eighth breds were constrained by the environmental potential, which conforms with a number of findings that many tropical environments will not support much more than half-bred exotic crosses.

Perhaps the most extensive crossbreeding has been with the Dorper. It has been found that in a wide range of semi-arid tropical environments these cross-breds, and even the Dorper itself, have thrived, thus appreciably improving productivity.
(de Haas, Chemitei & Smith, 1973; Department of Agriculture, Zambia, 1973; Rudert, 1976). In the case of goats the Boer (Afrikander) has played a similar role (Kyeyune-Sendagi, 1970; de Haas & Chemitei, 1973; Department of Agriculture, Zambia, 1977; Mchau, 1979).

SEX

The degree of sexual dimorphism at birth, expressed as the male to female weight ratio, varies over the range 1.03 — 1.05 for sheep (Fitzhugh & Bradford, 1983), although Trail & Sacker (1969) reported a ratio as low as 1.02 for the East African Blackhead and Blackburn & Field (1985) report a ratio of 1.11 for Galla goats.

Data on mature weights of males are scarce. Those that are available generally indicate that ratios are in the range of 1.3-1.4 for both sheep and goats (Bradford, 1983; Carles, 1985), somewhat lower than the usual figure of 1.5 for temperate environments, although Bradford (1983) also reported a ratio of 1.6 for Sahel sheep in Senegal. The large variability with these mature ratios is probably due to varying levels of stress arising principally from the effects of uncontrolled breeding. The lower ratios indicate that males suffer more than females. This is supported by Carles' (1985) observations that the heaviest mature animals were castrates and the mature body weight ratio for castrates/females was approximately 2.0.

A seasonal breeding imposes a heavy stress on females whose lactation peaks occur in the dry season and to a lesser extent upon those in late pregnancy at this time.

MATERNAL ENVIRONMENT

The major component of the maternal environment is the milk yield but mothering ability includes a number of others, probably of greater significance for the physical environment of the young. Unfortunately insufficient examination has been made of mothering ability in African sheep and goat systems to throw any light on these other aspects.

A practice that is fairly common among the pastoralists of eastern Africa does warrant attention. This is the separation of the new born young from the dam and maintaining it in a small basket-like construction which is often raised 1-2 m from
the ground, until some six weeks of age. The young is allowed to suckle before going out to pasture in the morning and on return in the evening but otherwise remains in the basket. The technique is designed to improve survival and indeed is so effective during the first two months that mortality is the lowest for any age group, in contrast to the situation when the young run with their dams from birth in more favourable environments. However a considerable price is paid in lower growth rates. In Rendille these are so depressed that at six weeks of age the young have only doubled their birth weight (Carles, 1985). This is almost certainly due to the low level of milk intake but it is likely that other components also contribute.

CLIMATE

A major component of the physical environment is the climate. Its effects upon growth are brought about by a complex of interacting components resulting in both direct and indirect effects upon the growing animal. The indirect effects are usually the more important for the ruminant: they include ambient temperature and factors controlling the level of soil moisture available for plant growth thus affecting the quantity and quality of available nutrients. Much the same complex of factors determines the microclimate of many micro-organisms and their vectors, these playing a major role in the dynamics of parasitic organisms and hence the levels of disease.

Direct effects upon small ruminants determine the extent to which any stress occurs due to extremes of temperature. In the tropics heat-stress predominates, resulting in a chain of events that depresses growth. Unfortunately detailed studies of heat-stressed African sheep and goats are very few. Symington (1960) carried out some comparative studies on Merino, Blackhead Persian, and the Long-fat-tailed sheep of Zambia. Under his conditions the Merino was the most heat adapted, the fat-tailed sheep being susceptible to the levels of heat stress imposed. Undoubtedly there is considerable variation among the many types of sheep and goats across Africa. There is, for example, an apparent difference between Small East African kids and Somali lambs in Rendille, in shade seeking at midday, with the latter demonstrating a strong shade preference not shown by the former.

Cold, wet and windy conditions, most serious in the high altitude areas, cause acute stress leading to hypothermia of the neonate, or pneumonia in suckling young
and immatures. It is usually not sufficiently persistent to affect growth in the long term.

SEASON

A number of workers have examined the short term effects of seasonal changes upon growth. Most have examined the seasonal effects around the time of birth and almost all have found that these have had major influences upon growth. Trail & Sacker (1966) observed that the occurrence of a dry season during stages between late pregnancy and weaning at five months had the worst effect during the early stage of suckling (from birth to two months) although when they examined the effects of month of birth with the East African Blackhead x Dorset Horn these were significant but too complex to permit a straight forward explanation.

In Zimbabwe Blackhead Persian and Dorset Horn cross-breds exhibited the beneficial effects of early grass growth coinciding with lactation but this could also lead to serious damage due to grass awns at a later stage if growth continued during the seeding period (le Roux, 1970).

Wilson, Peacock & Sayers (1983) showed that the four main seasons in Kenya Masailand (short rains, short dry, long rains, long dry) produced large differences in growth rates. For both sheep and goats the optimal time for growth was birth in the short dry season preceding the long rains.

Blackburn & Field (1985), from observations in a very arid part of Kenya (Rendille) also concluded that lambs grew faster when born one to two months before the rains, but this was not so apparent with kids. Working in the same area with goats, Carles (1985) concluded that birth just before or just after the rains was most favourable. Blackburn (1984) using simulation analysis examined a time period of the Rendille sheep system comprising two normal years separated by a drought year and concluded for such a period that aseasonal births would be preferable in terms of flock performance.

Season is a composite of a number of environmental effects: in the tropics the most obvious is the relation of rainfall with pasture growth. However the effects upon the incidence of infectious disease and temperature stress must not be overlooked. In effect the relieving of nutritional stress with the onset of the rains, often increases the stress from these other sources, so that the final outcome may not be easy to
predict. There are additional correlated effects at subsequent stages of growth (e.g. the beneficial effect of early pasture growth for the young lamb may be correlated with the detrimental effect of grass awns post-weaning).

There is certainly sufficient variation in the response to seasonal differences to necessitate each main environmental type being considered on its own. Progress in predicting seasonal effects is going to depend upon increasing the precision with which the variable chosen for describing seasonal change does so.

It should also be noted that growth must not be considered in isolation and the final interpretation must also be based upon the levels of fertility and mortality as well as the body weights of the breeding females. When this was done by Wilson, Peacock & Sayers (1985) they concluded that with sheep the optimal combination remained the same, but the worst combination changed. In the case of goats the differences narrowed to the extent they were no longer significant.

In addition to short term effects there are evolutionary changes that have occurred in response to the extreme variation in food supplies across the seasons of the year. The most general adaptations to this situation have been reduced growth rates, a reduction in mature weight and the ability to lay down large fat reserves. Mature weight may be independent of height, as long limbs have often been developed to increase mobility, which is usually advantageous in such environments. The subcutaneous fat deposit, when confined to the tail and rump (and to some extent in the neck region) may be a response to heat stress.

The significance in the present context is that while these adaptations are eminently suitable for survival they conflict with the patterns of development required for meat production. As the latter is a lower priority, the environmental constraints must be relieved before much improvement in meat production is possible.

MAN

The human factor has only rarely been included, amongst the others considered so far, in the examination of sources of variation of growth. For domestic animals this is strange oversight. Fortunately this position is now changing and investigators are more frequently including man and his sociology amongst the factors they consider in their programmes for monitoring productivity of livestock. Wilson, Peacock & Sayers (1985) found large differences in all performance traits that were monitored.
among different herds. The ratio between the best and worst herds for a composite production index was 1.63 and 1.49 for goats and sheep respectively. They concluded that for most traits management was the factor responsible for most variation in performance.

Generally in the past sheep and goats have been a neglected and quite undeveloped resource in Africa. However the pressures upon resources that are developing today are changing this, and much more attention is being paid to them. This also behoves us to pay far more attention to the human factor.

COMPENSATORY GROWTH

The phenomenon of compensatory growth has been known for long, whereby the depression of growth due to some stress may be compensated in whole or in part when the stress is removed. This ability plays a major role in modifying the various stressful effects on growth as imposed by the environment.

In most tropical ecosystems it appears that levels of stress are sufficient to produce permanent stunting as well as slower growth rates. In addition to this, evidence obtained by Carles (1985) suggests that there may be some interaction between the stage of growth experiencing stress and the subsequent pattern of compensatory growth. He observed with goats in Rendille that improved nutritional conditions at 7-9 months of age increased growth rates, but if the improvement was at 4-6 months of age there was an interaction with helminth burdens. If helminth burdens were negligible then the improvement in growth rate was greatest but mature size was decreased, relative to animals that did not experience either of these benefits. If the helminth burden remained then growth rates were increased less, growth was prolonged, and the mature size was appreciably greater. The fact that this interaction was associated with improved nutrition at 4-6 months and not at 7-9 months suggests that the earlier stage of growth may be affecting the outcome. In view of this one wonders to what extent the very severe stunting at the stage of growth immediately following birth may be responsible for the subsequent abnormal pattern of growth.
CONCLUSION

It is apparent that the growth of sheep and goats in the tropics is susceptible to as wide a range of influences as elsewhere. However there are many areas where the data are meagre and our understanding is extremely limited. Even knowledge of the current levels of performance of many of the tropical phenotypes is woefully inadequate. The effects of the complexes of season and the human factors and the patterns of compensatory growth all warrant particular attention.

Finally it should be noted that in terms of productivity of the systems, any changes in growth need to be interpreted in the light of correlated changes of the other main performance traits. This would be assisted by research into developing appropriate production indices that incorporate correct measures of all performance traits.

West African long-legged goat, adapted to increased mobility
LES FACTEURS EXOGENES ENVIRONNEMENTAUX INFLUANT SUR LA CROISSANCE ET LA VIABILITE DES OVINS ET CAPRINS CROISES SUR PATURAGES EXTENSIFS AU ZIMBABWE

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Makoholi Experiment Station
Private Bag 9182 Masvingo Zimbabwe

RESUME

Les résultats des poids de naissance, poids au sevrage, croissance pré-sevrage et la viabilité de 237 chevreaux et 179 agneaux nés sur une période de quatre ans, 1981 à 1984, sont analysés. Tous les chevreaux sont nés durant la saison sèche alors que les périodes de naissance des agneaux s'étalaient chaque année sur la saison des pluies et la saison sèche. Chez les caprins, l'année de naissance a un effet significatif (P<0,05) sur le poids au sevrage et la croissance pré-sevrage. Les chevreaux nés en 1983 présentaient les poids vifs les plus faibles. L'année de naissance n'a pas d'effet significatif sur le poids à la naissance et la viabilité. Chez les ovins l'année de naissance avait un effet significatif (P<0,05) sur l'ensemble des paramètres étudiés. Les agneaux nés en 1982 ont cru plus vite avant sevrage que ceux nés les dernières années. La différence de viabilité est significative. Au cours des années, les agneaux nés en 1981 et 1984 ont eu les taux de mortalité les plus élevés alors que ceux nés en 1982 ont le mieux survécu. Chez les deux espèces, les mâles se développent plus vite que les femelles et sont plus lourds au sevrage. Les animaux simples sont plus lourds à la naissance et se développent plus vite que les doubles. La différence de viabilité due à la taille de la portée à la naissance, et le sexe des produits est faible. Les chèvres sont plus prolifiques que les brebis mais ont des produits plus légers. Les taux de survie sont identiques pour les deux espèces.
ENVIRONMENTAL FACTORS AFFECTING THE GROWTH AND VIABILITY OF CROSSBRED SHEEP AND GOATS ON RANGE GRAZING IN ZIMBABWE

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Private Bag 9182, Masvingo, Zimbabwe

SUMMARY

Analyses were conducted on birth weight, weaning weight, pre-weaning growth and viability of 237 kids and 179 lambs born over a four-year period, 1981 to 1984. All kids were born in the dry season while lambs were born in the wet and dry season each year. In goats, year of birth was important (P<0.05) for both weaning weight and pre-weaning gain, kids born in 1983 having the lowest liveweights; year of birth had no significant effect on birth weight and viability. In sheep, year of birth had a large effect (P<0.05) on all traits studied. Lambs born in earlier years were lighter at birth but grew more rapidly until weaning than those born in later years. Differences in viability were significant among years, lambs born in 1981 and 1984 having the highest mortality while all those born in 1982 survived. In both species males grew faster and were heavier at weaning than females. Singles were heavier at birth and grew faster than twins. Differences in viability due to litter size at birth and sex of offspring were small. Goats were more prolific but had lighter offspring than sheep. Survival rates were similar for both species.

INTRODUCTION

Studies have been carried out on the productivity of cattle and sheep in Zimbabwe over the years and adoptions of recommendations from research findings have resulted in improvement in production (Donkin, 1974; Bembridge, 1975). However very little work has been carried out on goats although the demand for goat meat appears high (Cross, 1974). Recent studies suggest that goats outnumber sheep in communal areas (Mombeshora, Agyemang & Wilson, 1985). The potential economic advantages to smallholder farmers of small ruminants over cattle have been emphasized (McDowell & Bove, 1977).

The main objective of this study was to determine environmental factors affecting pre-weaning growth and viability of crossbred sheep and goats on range. The second objective was to provide comparative information on productivity of the two species.

MATERIAL AND METHODS

The study was conducted at Makoholi Experiment Station in southern Zimbabwe. The station is at an altitude of 1200 m with a mean annual precipitation of 500 mm which falls between November and May. Consequently, the quality and quantity of herbage is seasonal.

The foundation goat herd comprised indigenous x Boer does. These were mated to purebred Boer bucks over the period of this study, 1981 to 1984, and replacement does were generated from the same herd. All goats were mated in the wet season to kid during the dry season (July and August).

Breeding ewes were German Merino x indigenous crosses which were mated to indigenous rams until 1982 and then to Dorper rams in subsequent years. There were two breeding seasons. All ewes were mated to lamb in the dry season (July and August) and those that failed to conceive were remated to lamb the following wet season (December and January).

All offspring were weighed within 12 hours of birth and at monthly intervals thereafter. They were weaned at five months of age and details of birth, weaning and deaths were recorded.

The data for each species were analysed separately to evaluate environmental influences on pre-weaning growth and viability. A further analysis was carried out to enable comparison between species. Only progeny born in the dry season were included in the latter analysis.
RESULTS

GOATS

Year of birth had a significant (P<0.05) effect on both weaning weight and pre-weaning gain, kids born in 1983 having lower weights and gains than those born in the other years. Year of birth did not have a significant (P>0.05) influence on viability although the difference between the extreme years, 1983 and 1984, was large (13 percent). Kids born as singles were 0.5 kg heavier at birth than those born as twins (P<0.05). No other litter size differences were important (Table 1).

Sex differences in birth weight and viability were not important, although males were heavier and experienced greater mortality than females. Males grew faster and were heavier at weaning (P<0.05).

SHEEP

Year of birth had a large effect on all traits studied. Lambs born in earlier years were lighter at birth than those born in later years but lambs born in earlier years grew more rapidly and were heavier at weaning (Table 2).

All lambs born in 1982 survived until weaning while those born in 1981 and 1984 had higher mortality than those born in 1983. Thus viability in sheep appeared more sensitive to the environmental influences of year than the same trait in goats.

Table 1 Environmental influences on pre-weaning growth (kg) and viability (percent) of goats

<table>
<thead>
<tr>
<th>Variable</th>
<th>Birth weight</th>
<th>Weaning weight</th>
<th>Pre-weaning gain</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n  x</td>
<td>n  x</td>
<td>n  x</td>
<td>n  x</td>
</tr>
<tr>
<td>Overall mean</td>
<td>237  3.0</td>
<td>128 15.4</td>
<td>128 12.2</td>
<td>237 86.1</td>
</tr>
<tr>
<td>Year of birth:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>24  2.9</td>
<td>-</td>
<td>-</td>
<td>24 83.3</td>
</tr>
<tr>
<td>1982</td>
<td>50  3.1</td>
<td>19 17.8b</td>
<td>19 14.8b</td>
<td>50 88.0</td>
</tr>
<tr>
<td>1983</td>
<td>76  2.9</td>
<td>51 12.5a</td>
<td>51 9.0a</td>
<td>76 78.9</td>
</tr>
<tr>
<td>1984</td>
<td>87  3.0</td>
<td>58 17.1b</td>
<td>58 14.2b</td>
<td>87 92.0</td>
</tr>
<tr>
<td>Litter size:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>single</td>
<td>63  3.3a</td>
<td>31 16.3</td>
<td>31 12.6</td>
<td>63 88.9</td>
</tr>
<tr>
<td>twin</td>
<td>174 2.8b</td>
<td>97 15.1</td>
<td>97 12.1</td>
<td>174 85.0</td>
</tr>
<tr>
<td>Sex:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>119 3.0</td>
<td>48 16.0a</td>
<td>48 12.9a</td>
<td>119 84.0</td>
</tr>
<tr>
<td>female</td>
<td>118 2.9</td>
<td>80 14.4b</td>
<td>80 11.0b</td>
<td>118 88.1</td>
</tr>
</tbody>
</table>

Within variables means in the same column without a common superscript differ significantly (P < 0.05)
Table 2 Environmental influences on pre-weaning growth (kg) and viability (per cent) of sheep

<table>
<thead>
<tr>
<th>Variable</th>
<th>Birth weight</th>
<th>Weaning weight</th>
<th>Pre-weaning gain</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>x</td>
<td>n</td>
<td>x</td>
</tr>
<tr>
<td>Overall mean</td>
<td>179</td>
<td>3.3</td>
<td>96</td>
<td>23.6</td>
</tr>
<tr>
<td>Year of birth:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>44</td>
<td>3.0^a</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1982</td>
<td>33</td>
<td>3.2^a</td>
<td>23</td>
<td>24.5^a</td>
</tr>
<tr>
<td>1983</td>
<td>55</td>
<td>3.5^b</td>
<td>48</td>
<td>23.7^a</td>
</tr>
<tr>
<td>1984</td>
<td>47</td>
<td>3.5^b</td>
<td>25</td>
<td>22.8^b</td>
</tr>
<tr>
<td>Season of birth:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>wet</td>
<td>81</td>
<td>3.4</td>
<td>45</td>
<td>25.6^a</td>
</tr>
<tr>
<td>dry</td>
<td>98</td>
<td>3.3</td>
<td>51</td>
<td>21.9^b</td>
</tr>
<tr>
<td>Litter size:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>single</td>
<td>83</td>
<td>3.4^a</td>
<td>35</td>
<td>24.7^a</td>
</tr>
<tr>
<td>twin</td>
<td>96</td>
<td>3.3^b</td>
<td>61</td>
<td>23.1^a</td>
</tr>
<tr>
<td>Sex:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>49</td>
<td>3.5^b</td>
<td>29</td>
<td>24.7^a</td>
</tr>
<tr>
<td>female</td>
<td>130</td>
<td>2.9^b</td>
<td>67</td>
<td>21.4^b</td>
</tr>
</tbody>
</table>

Within variables means in the same column without a common superscript differ significantly (P < 0.05)

Lambs born in the wet season had similar birth weights and viability to those born in the dry season. However lambs born in the wet season grew more rapidly after birth and were significantly (P<0.05) heavier at weaning. Single lambs were heavier at birth and grew faster than twins (P<0.05). Singles also had higher survival rates but the difference was not significant.

A comparison of Table 1 with Table 2 shows that litter size differences in sheep were larger than those observed in goats. Male lambs were superior in growth but experienced 9.2 per cent higher mortality than females, a trend similar to that observed in goats.

SPECIES COMPARISON

Sheep were heavier than goats at birth. They also grew faster and were heavier at weaning. Preweaning survival rates were similar although goats were more prolific (Table 3).
Table 3 Comparision between species pre-weaning growth, viability and prolifi-
cacy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Combined</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>x</td>
<td>n</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
<td>318</td>
<td>3.1</td>
<td>81</td>
</tr>
<tr>
<td>Weaning weight (kg)</td>
<td>178</td>
<td>18.1</td>
<td>50</td>
</tr>
<tr>
<td>Pre-weaning gain (kg)</td>
<td>178</td>
<td>14.3</td>
<td>50</td>
</tr>
<tr>
<td>Viability (%)</td>
<td>318</td>
<td>86.2</td>
<td>81</td>
</tr>
<tr>
<td>Litter size (number)</td>
<td>416</td>
<td>1.37</td>
<td>179</td>
</tr>
</tbody>
</table>

Means in the same row without a common superscript differ significantly (P < 0.05)

DISCUSSION

The observed increase in birth weight of lambs from 1981 to 1984 could have been due to the change in the sire breed used. Lambs born in 1981 and 1982 were sired by indigenous rams while those born in subsequent years were sired by the larger Dorper rams. Post-natal growth and pre-weaning viability declined from 1982 to 1984 probably as a result of progressive deterioration in forage due to drought conditions. Lambs born in the wet season had heavier weaning weights than their counterparts born in the dry season, although birth weights were similar. Thus birth weight appeared less sensitive to environmental influences of year and season of birth than subsequent growth. The lack of a significant difference in viability between seasons was not expected and could have been due to a reduced population of internal parasites as a result of the drought. Donkin (1974) and Asiedu (1983) found that lambs born in the wet season experienced higher mortality than those born in the dry season.

The significant effect of year of birth on pre-weaning growth rate and weaning weight in goats has also been reported by other workers (Moulick & Syrstad, 1970; Darokhan & Tomar, 1983; Mavrogenis, Constantinou & Louca, 1984). In the present study differences were mainly due to the poor performance of kids born in 1983. However goats appeared less sensitive to environmental effects of year of birth, suggesting their superior adaptation to harsh conditions (du Toit, 1972; McDowell & Bove, 1977; Mombeshora, Agyemang & Wilson, 1985).
The higher liveweight and growth rate of singles over twins in both species agrees with other studies (Darokhan & Tomar, 1983; Mavrogenis Constantinou & Louca, 1984). Viability among twins was lower than that among singles, also in agreement with published results (Hight & Jury, 1970; Smith, 1977). Hight & Jury (1970) suggested that physiological starvation, resulting in small and weak offspring at birth, was the major cause of death among twins.

Male offspring grew faster and were heavier at weaning than females, as has been shown by several workers (Smith, 1977; Arrowsmith & Ward, 1983; Mavrogenis, Constantinou & Louca, 1984). Sex differences were not significant for survival although males experienced higher mortality. Laster & Gregory (1973) observed that males, because of their superior birth weight, experienced higher mortality as a result of dystocia.

Goats were more prolific and were lighter in weight than sheep, as has been reported by several workers. (Animal Production Research Unit, 1980; Gall, 1981; Arrowsmith & Ward, 1983; Wilson & Durkin, 1983; Wilson, Peacock & Sayers, 1984). The higher liveweight in sheep could have been due partly to the high proportion of singles. This is supported by the fact that at birth differences between species were greater among twins (0.4 kg) than singles (0.1 kg) suggesting a species x litter size interaction.

Although sheep were 9.5 kg heavier at weaning than goats, the higher twinning rate in goats reduced the differences in weaner production per dam giving birth to 4 kg. Arrowsmith & Ward (1983) found that although sheep were heavier than goats, weaner production per dam mated was 17 per cent higher in goats due to their higher twinning rate and fertility. Therefore productivity of goats can be expected to be higher if conception rate proves to be higher than that among sheep in this environment.
Les contraintes nutritionnelles des petits ruminants en Afrique

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¹ SR-CRSP, P.O.Box 252, Maseno, Kenya
² Winrock International, Morrilton, Arkansas, USA

RESUME

NUTRITIONAL CONSTRAINTS
TO SMALL RUMINANTS IN AFRICA

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1. SR-CRSP, P.O. Box 252, Maseno, Kenya
2. Winrock International, Morrilton, Arkansas, USA

SUMMARY

Nutritional problems of small ruminants in five African ecological zones are described and analysed. Ways of overcoming nutritional constraints to increased productivity by a series of interventions are discussed. Possibilities include improved production of grasses, various methods (alley cropping, hedgerows) of introduction of legumes into the farming systems, the flattening of the food supply curve by means of conservation and the use of agro-industrial by-products such as molasses and sugarcane tops. The use of urea and the provision of adequate mineral supplements are also discussed.

INTRODUCTION

There are many species of small ruminants in the wild, including gazelles, impalas, antelopes and deer. The wild small ruminants are highly adapted to their various environments after thousands of years of natural selection. Domesticated small ruminants have, however, been protected by man to the extent that their adaptation to the environment is much less definitive and they appear to be susceptible to a number of constraints including nutritional ones.

This paper on nutritional constraints to domestic small ruminants in Africa is based on ecological zonation into highlands, humid, sub-humid, semi-arid and arid areas (Figure 1).

ZONAL PROBLEMS

HIGHLAND ZONE

This zone mainly covers the Ethiopian and East African highlands where the altitude ranges from 1500 to 4000 m, with a rainfall of over 1000 mm per year. Forage species that grow in this zone include grasses such as Pennisetum, Briachiaria and Panicum and legumes such as Desmodium, Medicago sativa and Trifolium spp.

There are few nutritional constraints to smallstock in this zone. Forage supply and water are adequate throughout the year. Animals are raised under a crop-livestock system with a well developed feed source from crop residues and

Figure 1  Relationships among climate, vegetation and soil in Africa
planted forages such as lucerne for sheep in Morocco and Desmodium and clover in Kenya and Ethiopia.

Two nutritional constraints in this area are mineral deficiencies and antinutritional metabolic factors in some of the forages.

Selinium levels in the blood of sheep and goats have been shown to be below the minimum levels in various parts of Kenya (Mbwiria, Dickson & Bell, 1984). Similarly, sodium and phosphorus are also often inadequate from available feeds. Low levels of minerals in highland forages are a result of many environmental factors including the type and composition of the soil and leaching due to heavy rainfall.

An example of this leaching problem may be illustrated by the response of clover to phosphorus application in the Ethiopian highlands. It can be seen from Table 1 that an application of only 5 kg/ha of phosphorus increased DM forage yields by about 180 per cent among five local species and 300 per cent among exotic species.

Some factors that affect animal nutrition and effective metabolism of some of the nutrients in the feeds and forage may be found in some of the plants in the highlands. Examples of these include bloat causing factors that are often associated with lush growth. A good source of protein in the highland zone is lucerne: however, this forage has high levels of esters that can cause abortions in sheep if fed in large quantities.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Maximum dry matter yields (kg/ha/day) for nine Trifolium species fertilized at different levels of phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Phosphate applied (kg/ha)</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Native:</td>
<td>T. quartinianum 8.15</td>
</tr>
<tr>
<td>T. tembense 8.30</td>
<td>17.50</td>
</tr>
<tr>
<td>T. decorum 5.83</td>
<td>15.00</td>
</tr>
<tr>
<td>T. steudneri 4.17</td>
<td>15.83</td>
</tr>
<tr>
<td>T. ruepellianum 3.85</td>
<td>8.46</td>
</tr>
<tr>
<td>T. schimperi 9.17</td>
<td>12.50</td>
</tr>
<tr>
<td>Exotic:</td>
<td>T. resupinatum 0.74</td>
</tr>
<tr>
<td>T. subterraneum 0.74</td>
<td>2.96</td>
</tr>
<tr>
<td>T. alexandrinum 0.74</td>
<td>1.48</td>
</tr>
</tbody>
</table>
HUMID ZONE

This is a high rainfall tropical forest zone. Farming is mainly tree-food crop based. There are about 14 million dwarf sheep and goats in the humid West African zone alone. Table 2 shows that Nigeria has 65 per cent of all the sheep and goats in seven West African countries in this zone. Except for Ivory Coast and Guinea where there are slightly more sheep than goats all countries have more goats than sheep. For the seven countries as a whole goats outnumber sheep by 17 per cent.

Nutritional limitations to sheep and goats are poorly researched and documented. The major tree crops are coconuts (Cocos nucifera), cocoa (Theobroma cacao), cashewnuts (Anacardium occidentale), Kola nuts (Cola spp) and oil palms (Elaeis guineensis). The staple food crops are predominantly root crops - cassava, (Manihot esculenta), aroids and sweet potato (Ipomoea batatas) - and maize (Zea mays). Sheep and goats are mainly free-grazing but are tethered during the cropping seasons. Sumberg & Cassaday (1985) have reported that small ruminants also obtain a large proportion of their feed by scavenging in the villages and towns. The scavenging town smallstock, especially goats, thrive extremely well. It would seem therefore that the dustbin and market place scraps provide them with adequate proteins and energy. Their small size helps in that their feed requirements for maintenance and production are also small.

Table 2  Small ruminant populations (10^6) in humid West Africa

<table>
<thead>
<tr>
<th>Country</th>
<th>Goats</th>
<th>Sheep</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria</td>
<td>5 621</td>
<td>3 476</td>
<td>9 097</td>
</tr>
<tr>
<td>Ghana</td>
<td>1 200</td>
<td>990</td>
<td>2 190</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>816</td>
<td>874</td>
<td>1 690</td>
</tr>
<tr>
<td>Liberia</td>
<td>190</td>
<td>190</td>
<td>380</td>
</tr>
<tr>
<td>Guinea</td>
<td>79</td>
<td>86</td>
<td>165</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>59</td>
<td>20</td>
<td>79</td>
</tr>
<tr>
<td>Togo</td>
<td>45</td>
<td>33</td>
<td>78</td>
</tr>
<tr>
<td>Total</td>
<td>8 010</td>
<td>5 669</td>
<td>13 679</td>
</tr>
</tbody>
</table>
There are several ways of improving the nutritional plane of sheep and goats in the humid zone. These include: supplementation with forage legumes such as *Gliricidia sepium* and *Leucaena leucocephala* grown, for example, as an alley crop; feeding high quality grasses grown in feed banks; and increased utilization of crop residues. Sumberg & Cassady (1985) have reported that lambs from dams which received supplementation with *Gliricidia* and *Leucaena* were 30 per cent heavier at 30 days old than those from non-supplemented dams. The ILCA humid zone programme has also demonstrated that through supplemental feeding with grasses like *Panicum* and *Pennisetum* from fodder gardens grown near homesteads, tethered sheep and goats have shown increased weight gains.

**SUB-HUMID ZONE**

The main characteristic of this zone is that it is predominantly one of food crops. Rainfall ranges between 750 and 1500 mm per annum. Human populations are generally denser here than in any other zone in Africa.

The dominant vegetation is deciduous trees with understories of a wide range of tall grasses, shrubs and herbs. Crop farming often takes large areas of land, thereby creating competition between livestock and crops. The little available land for grazing is therefore often overstocked, leading to overgrazing and soil erosion. A typical example of this zone may be illustrated by citing the work by the Small Ruminants—Collaborative Research Support Program (SR-CRSP) in western Kenya. Human population density in this area ranges between 300 and 900 people/km². Many families own less than 1 ha of land and forage available for livestock throughout the year fluctuates widely. There are severe shortage of feed from January to early April. When rains start, there should be adequate forages for the rest of the year, with surpluses from June to August.

**SEMI-ARID ZONE**

This zone covers approximately 60 per cent of Africa and it has the greatest potential for smallstock development. Smallstock are raised mainly by pastoralists. A small proportion are, however, produced from commercial ranches. Rainfall in the semi-arid zones is bimodal in East Africa and unimodal in southern and western Africa. The rainfall range is 200-700 mm. Where degradation is not yet a problem the grasses are perennial and are mainly *Hyparrhenia*, *Digitaria*, *Chloris*, *Pennisetum*...
and *Themeda* species. The woody vegetation is dominated by acacias.

The major nutritional limitation of the semi-arid zone is that of bridging the gap between wet and dry seasons. In the wet season forage is of high quality but because of the high temperatures rapid physiological maturation follows, leading to early lignification. In the dry season the forage is of very low quality with a crude protein content of less than seven per cent and an IVDMD of less than 45 per cent. Small ruminants in this nutritional status cannot meet energy requirements for maintenance. Ewes and does lactating at this stage have to mobilize their body reserves for milk production.

Pastoralists have traditionally been able to regulate grazing by designating grazing areas as either wet or dry. Recently, due to rapidly increasing human populations, much pastoral land has been taken for cropping and consequently mobility has been curtailed, leading to a severe reduction of their grazing area. In addition, legislation such as the Group Ranch Act of Kenya has forced pastoralists to settle. As a consequence of increased sedentarization overstocking has resulted, accompanied by overgrazed areas around the settlements.

**Arid Zone**

Approximately 25 per cent of Africa is made up of arid zones that are essentially deserts. Cropping without irrigation is not feasible and the only possible form of livelihood is raising of livestock. In these deserts there are acute shortages of forage and water. Smallstock in these zones generally have a low dry matter intake although there are often high concentrations of protein in their diets.

**Overcoming Nutritional Constraints**

One way of overcoming feed shortages during the dry season is by introducing interventions like planting feed banks and alley cropping forage with food crops or intercropping forage with food crops or hedgerow cut-and-carry forages (Onim et al., 1984). In western Kenya, these interventions improve the feed supply from a monthly average of 2250 Mcal of DE to 3500 Mcal of DE (Figure 2). However, where there is no feed conservation method developed, this improved feed situation cannot benefit the livestock throughout the year because of a poor distribution profile. It is therefore important to develop a suitable conservation method for small scale farmers.
If surpluses are conserved by deferred grazing or by hay baling or making into silage, these could be fed during periods of feed shortage. Hay baling is perhaps the easiest method. Results in western Kenya (Onim et al., 1985) show that a simple hay baling box is not only accepted by small scale farmers but is also very effective. The only materials required are a wooden box, a grass cutting sickle and sisal twine. One family can make 10 bales each of 20 kg in one month on a part time basis, and four bales a day on a full time basis.

Grasses and legumes are cut and left to dry in the field for two to three days. These can then be baled either in the field or at home. Forages that have been successfully baled include grasses and legumes. The quality of the hay remains good as long as the bales are stored in a dry place. Pigeon pea (Cajanus cajan), Sesbania and Leucaena leaves can be made into a fine leaf hay with a CP content of about 26 per cent. Fresh twigs of these forage legumes are cut and placed on a mat, on a polythene sheet or on cleared ground. After about 12 hours in the sun, the leaves drop and are collected and bagged for future use as feed supplements.
When hay baling is added to the traditional feed situation, the monthly feed distribution changes from about 2250 Mcal of DE with severe fluctuations to the same figure but stable throughout the year. Similarly, when hay baling is used in the traditional feed supply with improved feed interventions, then the monthly feed distribution changes (Figure 2).

Further improvements have been made to the feed supply by increasing the use of food-forage crops. Onim et al. (1985) have shown that selected cultivars of sweet potato in western Kenya can yield 21 t/ha of fresh tubers and 10 t/ha DM of vines with a CP level of 19 per cent in a period of eight months. Another food-feed crop is pigeon pea. Henke, Work & Burt (1940) have reported that when pigeon pea was grazed by cattle in Hawaii over a period of 179 days, the liveweight gains (kg/ha) were 248 as compared to 140 when the animals were on a mixed pasture of high quality grasses (Pennisetum clandestinum, Chloris gayana and Anoxopus compressus). Whiteman & Norton (1980) have listed 32 references on the uses of pigeon pea as a forage crop for goats, sheep, and cattle. Several other crops that fall into this category include maize, sorghum, pearl millet, finger millet, and cassava. Although cereal stovers have low DE, they can provide maintenance requirements to livestock. The use of sorghum and pearl millet stover in Nigeria's humid zone as a vital source of feed has been reported by Powell (1984).

The potential role of sugarcane tops as a forage could be widely exploited in this zone. Dry matter yields in western Kenya are over 40 t/ha at harvesting. Although this material has high fibre content, it has a mean IVDMD of 45 per cent and a mean CP of 7.6 per cent. These results indicate that sugarcane tops are comparable in quality to medium quality range grasses and hence can constitute a vital source of livestock feed. Sugarcane belts in Africa also have large supplies of energy-rich molasses (Preston, 1985). By using cane tops in conjunction with molasses and nitrogen-rich legumes, a high quality nutritional plane is realisable.

It is important that small ruminants have access to adequate quantities of forages and feeds. The available pastures and browse may not provide adequate feeding at certain times of the year. Supplementation is then the answer. This may take simple forms like utilizing deferred pastures, lopping branches and providing leguminous tree pods to small stock. It may also take more sophisticated forms such as utilization of conserved materials like silage, hay, crop residues and food processing by-products. Any form of supplementation intensifies management but it also
increases productivity of the livestock. The economics of such supplementations must be worked out for each situation.

Inadequate levels of CP in most feeds is the most important nutritional constraint in smallstock. The use of urea as a source of nitrogen has been advocated. However, this is a product that is expensive and may not be available to the majority of smallstock producers in Africa when they need it. We strongly advocate increased use of tropical forage legumes as excellent sources of nitrogen (CP of about 26 per cent) that are cheap to produce by smallstock producers even in the humid and semi-arid parts of Africa.

Some of the plant nitrogen sources may, however, have antinutritional and antimetabolic problems. These include hydrogen cyanides (HCN) in cassava and sorghums, esters in clovers, and mimosines in some legumes. There are two possible solutions to these problems: scientists should collect and screen germplasm of species with high CP for lower levels of such factors; or find mechanisms of rendering such factors harmless to ruminants. An exciting example of this is the use of mimosine degrading rumen microbes in goats (Jones & Lowry, 1984). These microbes have been found in the rumens of goats in Hawaii and South East Asia but not in Australia. However, when rumen liquor from the mimosine resistant goats was infused into the Australian goats, they were immediately able to consume large quantities of *Leucaena* without any harm. Multiplying and infusing these microbes into experimental goats and perhaps even sheep in Africa may also increase their consumption of mimosine containing plants and hence productivity.

Energy is the second most important nutritional limitation to ruminants in Africa (Preston, 1985). Much research has been done on the use of crop stover and residues by treating them with sodium hydroxide (NaOH), urea, etc., to make them more acceptable to ruminants. It should, however, be borne in mind that both NaOH and urea are not only expensive but also very corrosive. Using them therefore requires knowledge which small scale farmers may not have. Less corrosive alternatives like soda ash (sodium carbonate) may be used with the same results. We feel that by baling good quality hay and feeding by-products like molasses, brewers' wastes and grain bran whenever available, energy needs of smallstock for maintenance and production can be met. Finally, mineral needs of smallstock should be met by using traditional salt licks where possible, and encouraging the use of commercial mineral licks.
THE CONTRIBUTION OF BROWSE TO THE NUTRITION OF SMALL RUMINANTS IN SEMI-ARID CENTRAL MALI

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International Livestock Centre for Africa
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SUMMARY

In central Mali, browse is the principal food source for goats and contributes considerably to the diet of sheep. There are wide seasonal variations in availability of browse and much of it is not accessible to small ruminants except when herders lop it for them. This practice could have severe long-term consequences. Suggestions are made for better management of the browse resource and for a better integration of it in the agro-sylvo-pastoral system in order to improve the productivity of small ruminants.
CONTRIBUTION DES PEUPLEMENTS LIGNEUX A L'ALIMENTATION DES PETITS RUMINANTS EN ZONE SEMI-ARIDE DU MALI CENTRAL

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Centre International pour l'Elevage en Afrique
B.P. 60 Bamako Mali

RESUME

En zone semi-aride du Mali central, les peuplements ligneux fournissent la principale pâture des caprins et interviennent de façon notable dans la ration des ovins. Le disponible fourrager aérien connaît de fortes fluctuations saisonnières et n'est pas entièrement accessible aux petits ruminants sans l'intervention des bergers qui procèdent à des ébranchages sévères aux conséquences préjudiciables pour le développement des peuplements ligneux. Des suggestions sont faites pour une meilleure gestion de ces ressources et leur intégration dans le cadre des systèmes agro-sylvo-pastoraux en vue d'une amélioration de la production des petits ruminants.

INTRODUCTION

Dans la zone semi-aride du Mali central étudiée par le CIPEA, l'effectif des ovins et caprins a été estimé à un million de têtes (Wilson, de Leeuw & de Haan, 1983). Ils constituent le "compte courant" des pasteurs et agro-pasteurs, aussi leur élevage permet-il de satisfaire la consommation en viande des ménages et d'obtenir suffisamment d'argent pour faire face aux nécessités du moment (céréales, impôts, vêtements...).

Leur production laitière quoique peu élevée, s'est avérée d'une certaine importance, pour ceux qui en détiennent, au cours de ces années de sécheresse où le cheptel bovin principal fournisseur de lait a été décimé.


PARTICULARITE ALIMENTAIRE DES PETITS RUMINANTS


Il ne s'agit là que d'estimations globales masquant d'importantes variations saisonnières particulièrement marquées chez les ovins (10 à 15 p.c. en saison des pluies où l'herbe est abondante et de bonne qualité et 15 à 75 p.c. en saison sèche où la paille des espèces herbacées est de faible valeur nutritive).

Une expérience faite au ranch de Niono de la fin septembre à début novembre 1978 (Hiernaux, Cissé & Diarra, 1979) a permis de vérifier que les caprins pouvaient se contenter d'une alimentation uniquement composée de feuilles d'arbre d'une seule essence. A cette fin, deux essais ont été menés simultanément: l'un sur Acacia seyal et l'autre sur Pterocarpus lucens. Dans chaque cas, deux lots semblables de 10 boucs, chacun pesant ensemble 250 kg, soumis à une pesée hebdomadaire et à une récolte journalière de fèces ont été constitués:
le premier est conduit sur pâturage dont le peuplement ligneux est homogène et presque monospécifique, sous la garde d'un berger leur coupant au besoin des branches;

le second est nourri à l'auge avec des branches fraîchement coupées de la même espèce ligneuse préalablement pesées et dont les refus ont été ensuite pesés.

Le tableau 1 rassemble les principaux résultats à savoir: la consommation moyenne quotidienne (CMQ), le gain moyen quotidien (GMQ) et le rendement de production (RP) par animal.

On peut en déduire que:

les espèces ligneuses sont différemment appétées par les caprins d'une part et d'autre part selon que ceux-ci sont conduits au pâturage ou nourris à l'auge.

A titre d'exemples, *A. seyal* est mieux consommé que *P. lucens* et ce, tant à l'auge qu'au pâturage. Par ailleurs, la consommation de *A. seyal* est plus élevée au pâturage et par contre, *P. lucens* est mieux appété à l'auge.

Les quantités ingérées exprimées en kg de matière sèche par 100 kg de poids vif s'élèvent respectivement à l'auge et au pâturage à 3,6 et 6,2 pour *A. seyal* et 2,6 et 2,4 pour *P. lucens*. Dicko & Sangaré (1981) estiment à 2,5 kg/100 kg de poids vif, le niveau moyen d'ingestion des caprins dans les parcours de la zone, seules les valeurs obtenues avec *P. lucens* s'en rapprochent.

Tableau 1 Consommation primaire et performances zootchniques de boucs nourris avec du fourrage aérien

<table>
<thead>
<tr>
<th>Fourrage</th>
<th>Auge</th>
<th></th>
<th>Pâturage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CMQ</td>
<td>GMQ (g)</td>
<td>RP (g/kg MSI)</td>
<td>CMQ</td>
</tr>
<tr>
<td><em>Acacia seyal</em></td>
<td>0,90</td>
<td>+ 17,1</td>
<td>19,0</td>
<td>1,58</td>
</tr>
<tr>
<td><em>Pterocarpus lucens</em></td>
<td>0,64</td>
<td>+ 51,4</td>
<td>79,7</td>
<td>0,59</td>
</tr>
</tbody>
</table>
les différentes espèces n'ont pas la même efficacité.

En considérant la situation où les deux espèces expérimentées sont les mieux consommées, on peut constater, qu'en dépit de la faiblesse relative de son niveau d'ingestion, *P. lucens* donne d'excellentes performances à l'auge (GMJ de 51 g) et un rendement fort élevé (80 g de poids vif/kg de matière sèche ingérée). De telles performances justifient la distribution des feuilles de cette espèce aux animaux de case. Quant à *A. seyal*, son efficience sur pâturage (GMJ de 37 g) lui vaut d'être très recherché par les chevriers qui l'ébranchent souvent de façon excessive en début et en fin de saison sèche.

**DISPONIBILITE EN FOURRAGE AERIEN DES PARCOURS DU MALI CENTRAL**

La méthode mise en œuvre pour évaluer le disponible fourragier de la zone d'étude (Hiernaux, 1980) intègre une description précise des peuplements ligneux (composition floristique, densité par espèce, distribution des troncs dans des classes de circonférence...) et des abaques de production donnant la biomasse foliaire de chaque espèce à partir de la circonférence du tronc (Cissé, 1980b). Le relevé du peuplement est effectué par formation végétale échantillonnée sur la base de la topographie, du type de sol, de la composition floristique et du degré d'artificialisation. La biomasse foliaire maximale est calculée espèce par espèce puis les résultats sont rapportés à la formation végétale puis au secteur bioclimatique en établissant une moyenne pondérée par la superficie occupée par chacune des formations.

Les résultats par secteur bioclimatique sont consignés au tableau 2. Ces valeurs ne sont données qu'à titre indicatif car elles ne tiennent compte ni des fleurs ni

<table>
<thead>
<tr>
<th>Secteurs bioclimatiques</th>
<th>Production foliaire moyenne (t MS/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Totale*</td>
</tr>
<tr>
<td>Nord Sahel</td>
<td>0,3</td>
</tr>
<tr>
<td>Centre Sahel</td>
<td>1,0</td>
</tr>
<tr>
<td>Sud Sahel</td>
<td>1,0</td>
</tr>
<tr>
<td>Nord Soudan</td>
<td>2,4</td>
</tr>
</tbody>
</table>

* Toutes espèces confondues
des fruits qui sont aussi consommés par les petits ruminants. Toutefois, elles dénotent un potentiel fourragier annuel important car les espèces appétibles fournissent dans tous les secteurs plus de 50 p.cent du disponible ligneux.

L'importance des fluctuations saisonnières (Cissé, 1982) du disponible fourragier rend nécessaire une expression saisonnière de ces ressources. Le tableau 3 donne une estimation de la répartition saisonnière par secteur bioclimatique. On y mesure tout l'intérêt du fourrage ligneux qui vaut surtout par sa disponibilité tout au long de l'année, et surtout en saison sèche où il apporte aux ovins protéines et vitamines dont sont dépourvues la paille des espèces herbacées.

Toute l'année les petits ruminants disposent de fourrage ligneux, ce qui pourrait expliquer qu'ils fassent montrer d'une saisonnalité de reproduction moins marquée que celle du gros bétail comme le montrent les données du tableau 4. Le pic sensible de conception enregistré en saison sèche et chaude chez les petits ruminants (surtout chez les caprins) pourrait être rapproché de l'émission par les ligneux de jeunes pousses et de nouvelles feuilles qui, bien qu'en faible quantité, améliorent qualitativement la ration.

Seule une faible part du disponible fourragier ligneux est directement accessible aux petits ruminants. Si l'on considère la hauteur de deux mètres comme limite supérieure d'accès direct, le tableau 5 donne pour trois espèces un exemple de la stratification de la biomasse foliaire. On constate que près de la moitié de la biomasse foliaire n'est pas directement accessible même aux caprins, aussi les bergers sont obligés de recourir à des pratiques d'ébranchage pour mettre à la portée de leurs animaux les fractions inaccessibles.

<table>
<thead>
<tr>
<th>Tableau 3</th>
<th>Estimation de la répartition saisonnière du disponible fourragier aérien (kg MS/ha) du Mali central par secteur bioclimatique</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secteurs bioclimatiques</strong></td>
<td><strong>Saison</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Pré-pluviale</strong></td>
</tr>
<tr>
<td></td>
<td>mai-juin</td>
</tr>
<tr>
<td>Nord Sahel</td>
<td>50</td>
</tr>
<tr>
<td>Centre Sahel</td>
<td>242</td>
</tr>
<tr>
<td>Sud Sahel</td>
<td>295</td>
</tr>
<tr>
<td>Nord Soudan</td>
<td>431</td>
</tr>
</tbody>
</table>
Tableau 4  Taux de conception de divers ruminants (en % par mois) pour les différentes saisons en zone semi-aride où la monte n'est pas contrôlée

<table>
<thead>
<tr>
<th>Saison</th>
<th>Bovins</th>
<th>Caprins</th>
<th>Ovins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saison froide et sèche</td>
<td>2,2</td>
<td>4,3</td>
<td>6,6</td>
</tr>
<tr>
<td>(décembre-février)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saison chaude et sèche</td>
<td>6,7</td>
<td>11,8</td>
<td>9,6</td>
</tr>
<tr>
<td>(mars-juin)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saison des pluies</td>
<td>18,3</td>
<td>7,8</td>
<td>9,1</td>
</tr>
<tr>
<td>(juillet-septembre)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saison différée</td>
<td>5,8</td>
<td>8,4</td>
<td>7,2</td>
</tr>
<tr>
<td>(octobre-novembre)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


PROBLEMES POSES PAR L'EXPLOITATION PASTORALE DES LIGNEUX

L'exploitation des ligneux fourragers revêt deux formes:

une forme extensive où le bétail broûte directement ce qui est à sa portée: la stratification du peuplement ligneux joue alors un rôle important et les ovins et les caprins exploitent surtout les buissons.

une forme plus intensive où les bergers interviennent par taille, ébranchage ou gaulage pour mettre à la portée du bétail, les fractions inaccessibles des ressources fourragères.

Tableau 5  Stratification verticale de la biomasse foliaire de trois espèces fourragères sahéliennes

<table>
<thead>
<tr>
<th>Espèces</th>
<th>Biomasse foliaire en % du total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strate 0-2 m</td>
</tr>
<tr>
<td>Pterocarpus lucens</td>
<td>37</td>
</tr>
<tr>
<td>Ziziphus mauritiana</td>
<td>60</td>
</tr>
<tr>
<td>Acacia seyal</td>
<td>51</td>
</tr>
</tbody>
</table>
L'effet du broutage n'a pas été directement mesuré mais divers régimes d'effeuillage pratiqués sur des buissons sahéliens (Cissé, 1980a) permettent d'affirmer que modéré et avant le maximum de feuillaison, l'effeuillage a souvent un effet stimulant sur la production, mais plus tard il diminue celle-ci bien qu'il prolonge la phase de verdure. À long terme, les buissons prennent un port en coussinet considéré comme indice de surpâturage.

Divers ébranchages effectués sur Acacia seyal et Pterocarpus lucens en zone sud sahélienne et sur Acacia albida en zone nord soudanienne de 1978 à 1983 (Cissé, 1984) ont montré que rythme et époque d'ébranchage influent sur la production foliaire.

En effet, la comparaison des biomasses foliaires moyennes cumulées résultant de divers traitements à la biomasse foliaire maximale de témoins jamais exploités (tableau 6), révèle que suivant les espèces, l'ébranchage répété a soit un effet dépressif (cas de A. seyal et P. lucens où les baisses peuvent atteindre 90 p.cent), soit

<table>
<thead>
<tr>
<th>Tableau 6</th>
<th>Comparaison de biomasse foliaire moyenne cumulée (kg MS) résultant de divers régimes d'ébranchage à la biomasse maximale moyenne de témoins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rythme</td>
<td>Epoque</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Témoins</td>
<td></td>
</tr>
<tr>
<td>2 fois/an</td>
<td>Avant et après S.P. a)</td>
</tr>
<tr>
<td>1 fois/an</td>
<td>Avant S.P.</td>
</tr>
<tr>
<td>1 fois/an</td>
<td>Après S.P.</td>
</tr>
<tr>
<td>1 an sur 2</td>
<td>Avant S.P.</td>
</tr>
<tr>
<td>1 an sur 2</td>
<td>Après S.P.</td>
</tr>
<tr>
<td>**p b)</td>
<td></td>
</tr>
<tr>
<td>P.P.D.S. c)</td>
<td></td>
</tr>
</tbody>
</table>


b) F : test de F. ** P < 0,01

c) P.P.D.S.: Plus petite différence significative (méthode Dunnett)
stimulateur (*A. albida*) sur la production foliaire cumulée. La production des repousses est surtout importante en première année, puis elle diminue rapidement par la suite. Les ébranchages pratiqués après la saison des pluies, tant chez *Pterocarpus* que chez *A. albida* fournissent les biomasses cumulées les plus élevées, aussi cette période serait la plus propice pour ces interventions et ce, pour prolonger la feuillaison et fournir du vert en saison sèche où les sujets non exploités en sont dépourvus (figure 1). En se référant aux taux de mortalité enregistrés chez les différentes espèces au cours des six années d'expérience (tableau 7), on peut constater qu'aucune de ces espèces ne supporte un rythme d'exploitation de deux fois par an qui entraîne à plus ou moins longue échéance, la mort des sujets. Celle-ci intervient au bout de trois ans chez *A. seyal* préalablement soumis à l'ébranchage traditionnel en parapluie. La mise à la portée des animaux des parties inaccessibles, la nécessité pour les caprins d'avoir un contre poids quand ils coupent les feuilles et enfin l'étalement de la phénophase feuillée dans la deuxième moitié de la saison sèche sont les principales raisons avancées par les bergers pour justifier cet écimage en parapluie. Mais peut-on faire cas davantages dès que cette pratique porte atteinte à la survie même de l'arbre? En effet, la branche traînant au sol se dessèche au bout de quelques mois, subit l'attaque des termites et en cas d'incendie finit par être la proie des flammes qui se communiquent à toute la souche.

L'exploitation dirigée des espèces fourragères peut conduire, à long terme, à une modification de la production par modification du peuplement. Cette évolution

---

Figure 1  Évolution comparée de la biomasse foliaire chez a) *Acacia seyal* et b) *Pterocarpus lucens*. 

![Diagramme comparant la biomasse foliaire](image_url)
Tableau 7  Taux de mortalité (%) enregistrés chez trois espèces fourragères soumises à divers régimes d’ébranchage de 1978 à 1983

<table>
<thead>
<tr>
<th>Ebranchage</th>
<th>Pterocarpus lucens</th>
<th>Acacia albida</th>
<th>Acacia seyal</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 fois/an</td>
<td>Avant et après S.P.</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>1 fois/an</td>
<td>Avant S.P.</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>1 fois/an</td>
<td>Après S.P.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1 an sur 2</td>
<td>Avant S.P.</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>1 an sur 2</td>
<td>Après S.P.</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

se fait au détriment des espèces les plus recherchées pour leur fourrage et au bénéfice des refus. Ainsi, Combretum micranthum et Acacia ataxacantha peuvent progressivement se substituer aux espèces appétées (Pterocarpus lucens, Acacia seyal, Combretum aculeatum) d'une pterocarpaie trop exploitée. Cependant, il peut arriver que la formation secondaire soit composée d'essences plus intéressantes sur le plan fourrager que la formation originelle. C'est le cas d'un enrichissement en Balanites aegyptiaca, Acacia seyal et Ziziphus mauritiana d'une formation qui était dominée par Combretum ghazalense (Hiernaux, 1980).

PROPOSITIONS POUR UNE MEILLEURE GESTION DES LIGNEUX

Une bonne gestion des peuplements ligneux consistera:

à limiter les pratiques d'ébranchage en veillant à ne jamais dépouiller la totalité d'un houppier, ni revenir ébrancher un arbre déjà mutilé au cours des deux ou trois années précédentes et il faudrait donc encourager le gaulage et le rabattage des branches et tendre vers l'émondage qui, pratiqué en fin de feuillaison, permettrait une meilleure répartition des ressources fourragères;

en mesures conservatoires de mises en défens cycliques qui permettraient surtout la consolidation des régénérations (jeunes plants, rejets) et la reconstitution des houppiers des espèces les plus exploitées.
Au niveau des systèmes agro-pastoraux, on pourrait procéder à un déboisement sélectif avec coupe des essences non appétées et taille en t tard des espèces fourragères pour les animaux de case essentiellement constitués par les petits ruminants. La multiplication par graines ébouillantées et/ou par éclats de souches (Gosseye, 1980) pourrait être envisagée en vue de la création des haies fourragères. Cette activité serait le point de départ de l'agro-foresterie qui intègre l'aboriculture à la production agricole, le rôle des arbres étant le recylage des éléments nutritifs permettant au sol de retrouver sa fertilité. Le choix d'espèces fourragères permettrait la mise en place de systèmes agro-sylvo-pastoraux dans la perspective d'une amélioration de la production animale et particulièrement celle des petits ruminants qui valorisent le mieux le pâturage aérien.

*Bouc de Sahel broutant de l'Acacia seyal coupé à son intention par le berger*
Necrosyrtes monachus and Capra "urbana" on high fibre diets at a town midden in Ouahigouya, Burkina
BROWSE OR CONCENTRATE SUPPLEMENTATION OF SETARIA SPHACELATA FOR SMALL RUMINANTS IN RWANDA

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National University of Rwanda
P.O.Box 117 Butare Rwanda

SUMMARY

Results of two fattening trials are presented. The basal diet comprised Setaria sphacelata grown as an anti-erosive measure on contour bunds. In the first trial, it was supplemented by concentrates and in the second by browse plants. The groups receiving concentrates did not realise better gains than those on grass alone. The best proportions of browse in the ration allowed high DM intakes and better daily gains than for animals fed only on grass.
COMPLEMENTATION DE SETARIA SPHACELATA AVEC DES LIGNEUX OU DES CONCENTRES POUR LES PETITS RUMINANTS AU RWANDA

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Université Nationale du Rwanda
B.P. 117 Butaré Rwanda

RESUME

Les résultats de deux essais d'engraissement des chevreaux de la race locale sont présentés. L'aliment de base est une culture fourragère utilisée comme haie de lutte anti-érosive au Rwanda; il est complémenté de concentrés dans le premier essai, et de plantes ligneuses dans le deuxième essai. Les lots recevant les compléments concentrés ont réalisé des GMQ comparables à ceux recevant seulement le fourrage. Les meilleurs taux d'incorporation des plantes ligneuses ont permis une bonne ingestion de MS et des GMQ supérieurs à ceux d'animaux nourris d'herbe seule.

INTRODUCTION

Au Rwanda, différents arguments font opter pour l'amélioration de l'élevage du petit ruminant, "vache du pauvre". Pays surpeuplé, à économie nationale basée sur l'agriculture, secteur occupant 92,9 p.c. de la population active, tant de facteurs font que les pâturages deviennent de plus en plus rares. Les agriculteurs éleveurs sont alors obligés de limiter leur nombre de bovins à élever sur leurs exploitations agricoles familiales et de se tourner de plus en plus vers les petits ruminants.

C'est dans le but d'apporter notre contribution à l'amélioration de l'alimentation de la chèvre commune rwandaise (Small East African goat) que nous avons entrepris ces essais d'engraissement. Dans le premier essai, le Setaria sphacelata est complémenté de son de riz, dans le deuxième essai il est complémenté de plantes ligneuses comprenant Ficus thonningii, Leucaena leucocephala, et du mélange de Gliricidia maculata, Bambusa vulgaris, Vernonia amygdalina et Erythrina abyssinica. Les sous-produits agricoles et les plantes ligneuses constituent d'importantes sources d'éléments nutritifs, surtout en périodes de soudure telles que la saison sèche.

MATERIEL ET METHODES

Les animaux utilisés dans les deux essais sont des chevreaux de la race commune rwandaise et l'aliment de base est constitué de Setaria sphacelata.

Les aliments complémentaires sont le son de riz, le maïs, le soja grillé et le tourteau de coton pour le premier essai et les plantes ligneuses pour le deuxième essai.

Les taux d'incorporation de chaque plante ligneuse sont de zéro et de 10, 30 et 50 p.c. dans la ration.

Les ingestions journalières de matière sèche et les gains moyens quotidiens (GMQ) furent mesurés.

RESULTATS ET DISCUSSIONS

ESSAI D'ENGRAISSEMENT DE CHEVREAUX DE LA RACE COMMUNE RWANDAISE A QUATRE TYPES DE RATION A BASE DE SETARIA SPHACELATA

Le fourrage distribué comme aliment de base est le Setaria sphacelata. Les quatre types de ration distribués sont:
L1 *Setaria sphacelata* seul;
L2 *Setaria sphacelata* plus son de riz *ad libitum*;
L3 *Setaria sphacelata* plus son de riz *ad libitum* plus soja grillé;
L4 *Setaria sphacelata* plus un concentré côn csé de maïs, soja grillé et tourteau de coton.

Les comparaisons de ces lots de chevreaux recevant ces différentes rations, sur base de leurs gains moyens quotidiens de la naissance à 11 semaines et de 12 à 20 semaines nous montrent que le lot ayant reçu le concentré équilibré a un GMQ 1,6 fois plus élevé que celui du lot recevant le *Setaria sphacelata* seul, ceci au cours de la première période d'engraissement. Les lots recevant les compléments farineux ont réalisé des GMQ comparables et non significativement différents de ceux réalisés par le lot recevant le fourrage seul (Tableau 1). Serait-il dû à l'adaptation de la chèvre rwandaise aux fourrages de faible valeur nutritive et que, au cours des années, elle aurait acquis une très bonne capacité d'utilisation digestive de protéines que le fourrage contient?

De même pour les rendements carcasses, on trouve que les chevreaux bénéficiant de concentrés ont de meilleurs rendements-carcasses, supérieurs de 25 p.cent comparés aux animaux nourris uniquement au *Setaria sphacelata* (50 p.cent contre 40 p.cent environ).

Ces résultats nous montrent nettement une mauvaise valorisation du concentré par la chèvre commune rwandaise et son faible potentiel génétique à produire de la viande.

**Tableau 1** Gains moyens quotidiens de 0-11 et de 12-30 semaines d'engraissement (g/jour)

<table>
<thead>
<tr>
<th>Lots</th>
<th>GMQ (0-11 semaines)</th>
<th>GMQ (12-20 semaines)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{x} ) e.t.</td>
<td>( \bar{x} ) e.t.</td>
</tr>
<tr>
<td>L1</td>
<td>24,03 10,44</td>
<td>30,18 5,59</td>
</tr>
<tr>
<td>L2</td>
<td>26,84 13,18</td>
<td>10,89 17,75</td>
</tr>
<tr>
<td>L3</td>
<td>26,51 13,00</td>
<td>–</td>
</tr>
<tr>
<td>L4</td>
<td>38,53 14,58</td>
<td>10,18 16,35</td>
</tr>
</tbody>
</table>
EXAMEN DE LA VALEUR FOURRAGERE DE DIX ESPÈCES DE PLANTES LIGNEUSES DU RWANDA

Les dix espèces de plantes ligneuses sont: *Acacia seyal*, *Acanthus pubescens*, *Bambusa vulgaris*, *Calliandra sp.*, *Erythrina abyssinica*, *Ficus thonningii*, *Gliricidia maculata*, *Leucaena leucocephala*, *Sesbania sesban* et *Vernonia amygdalina*.

L'aliment de base témoin était le *Setaria sphacelata* auquel on a incorporé 10, 30 et 50 p.cent de matière sèche de chaque espèce de plante ligneuse, pour avoir les différentes rations des chevreaux.

L'incorporation de 50 p.cent de *Ficus thonningii* ou d' *Acanthus pubescens* à l'aliment de base a permis d'avoir de bonnes ingestions de matière sèche et de bons gains moyens quotidiens.

Avec le *Leucaena leucocephala*, le taux d'incorporation qui donne de bonnes ingestions de matière sèche et de bons GMQ est celui de 30 p.cent. Celui-ci est encore inférieur au seuil pouvant causer des risques de toxicité.

L'incorporation de 30 p.cent du mélange de *Gliricidia maculata*, *Bambusa vulgaris*, *Erythrina abyssinica* et *Vernonia amygdalina* dans la ration des chevreaux a permis de meilleures ingestions de matière sèche et de meilleurs GMQ comparativement à ceux des chevreaux nourris au *Setaria sphacelata* seul ou avec l'incorporation de 10 p.cent de ce mélange (Tableaux 2 et 3).

Tableau 2  Consommation de matière sèche (kg/tête/j) durant l'essai d'alimentation des chevreaux avec complément de ligneux

<table>
<thead>
<tr>
<th>Ration</th>
<th>Acanthus pubescens x ± e.t.</th>
<th>Ficus thonningii x ± e.t.</th>
<th>Leucaena leucocephala x ± e.t.</th>
<th>Mélange x ± e.t.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>0,331 ± 0,066a</td>
<td>0,353 ± 0,024a</td>
<td>0,381 ± 0,007a</td>
<td>0,389 ± 0,005a</td>
</tr>
<tr>
<td>I I</td>
<td>0,405 ± 0,042a</td>
<td>0,407 ± 0,021b</td>
<td>0,499 ± 0,008b</td>
<td>0,530 ± 0,006b</td>
</tr>
<tr>
<td>I I I</td>
<td>0,312 ± 0,056a</td>
<td>0,423 ± 0,023b</td>
<td>0,556 ± 0,190c</td>
<td>0,562 ± 0,017c</td>
</tr>
<tr>
<td>I V</td>
<td>0,459 ± 0,009b</td>
<td>0,538 ± 0,021c</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nota: Ration I: *Setaria* seul; I I: *Setaria* 90 p.cent + 10 p.cent ligneux
I I I: *Setaria* 70 p.cent + 30 p.cent ligneux; I V: *Setaria* 50 p.cent + 50 p.cent ligneux

Les valeurs d'une même colonne portant des lettres différentes diffèrent significativement (P < 0,05)
Tableau 3 Comparaison des GMQ (g/j) réalisés par les chevreaux durant les essais d'alimentation aux différentes espèces de plantes ligneuses

<table>
<thead>
<tr>
<th>Ration</th>
<th>Acanthus pubescens</th>
<th>Ficus thonningii</th>
<th>Leucaena leucocephala</th>
<th>Mélange</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± e.t.</td>
<td>X ± e.t.</td>
<td>X ± e.t.</td>
<td>X ± e.t.</td>
</tr>
<tr>
<td>I</td>
<td>15,0 2,0a</td>
<td>14,8 1,5a</td>
<td>16,0 2,3a</td>
<td>14,2 2,87a</td>
</tr>
<tr>
<td>I I</td>
<td>15,3 1,6a</td>
<td>15,0 1,5b</td>
<td>16,0 2,2a</td>
<td>17,2 5,19a</td>
</tr>
<tr>
<td>I I I</td>
<td>19,2 1,6a</td>
<td>22,4 3,2c</td>
<td>27,4 2,2b</td>
<td>30,0 7,48b</td>
</tr>
<tr>
<td>I V</td>
<td>25,0 2,5b</td>
<td>29,1 1,8b</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Les valeurs d'une même colonne portant des lettres différentes diffèrent significativement (P < 0,05)

En comparant ces GMQ à ceux de l'Institut des Sciences Agronomiques du Rwanda/Station de Karama (54 g/j) et ceux retenus au projet agro-pastoral de Nyabisindu (50 g/j), les taux d'incorporation de plantes ligneuses dans la ration des chevreaux ont donné des GMQ inférieurs à la moyenne de ceux des chevreaux de la race locale.

**CONCLUSION**

Malgré les écarts de gains de poids que manifestent les petits ruminants alimentés au fourrage plus un complément, ces gains restent faibles et l'utilisation rentable des concentrés ne peut se justifier qu'après des analyses économiques précises.

Par contre, l'incorporation de sous-produits agricoles dans l'alimentation des petits ruminants exige peu de dépenses du côté de l'agriculteur-éleveur, mais au contraire lui permet de rentabiliser les déchets des récoltes.

S'agissant des plantes ligneuses, elles constituent une source d'éléments nutritifs pour les petits ruminants. Il faudra donc en déterminer les meilleurs systèmes de culture, d'exploitation et les différents taux optima d'incorporation dans les rations.
ESSAIS D'ALIMENTATION
SUR LA CHEVRE NAINE GUINEENNE
DANS LA ZONE SOUDANIENNE HUMIDE DU NIGERIA

A.A. Ademosun, H.G. Bosman, & P.L. Roessen

Goat Research Project
Department of Animal Science, University of ife
Ile-Ife, Nigeria

RESUME

Les résultats de deux essais d'alimentation complets et un en cours d'amélioration sont rapportés et discutés. Alimentés avec du Panicum maximum et du concentré ad lib, les boucs guinéens atteignent un GMQ de 60 g avec une consommation de MS digestible de 53,3 g/kg P0,75/j. qui peut être considéré comme 1,8 fois les besoins d'entretien. Ces animaux ont une carcasse parée plus lourde (7,15 contre 4,75 kg) et avec plus de gras abdominal (0,70 contre 0,11 kg) que ceux alimentés avec Panicum maximum et Leucaena leucocephala. Les vitesses de croissance des caprins nourris avec Gliricidia sepium seulement sont identiques à celles observées en milieu villageois. La supplementation avec du jeune Panicum maximum (A) ou Manihot esculenta (B) ou Leucaena leucocephala (C) augmente la quantité de matière sèche ingérée (A: 40,6 g; B: 45,7 g; C: 42,3 contre 37,9 (Gliricidia seul)/kg P0,75/j). Une supplémentation à base de Leucaena a des effets significatifs sur la vitesse de croissance (36,0 contre 23,3 g/j avec du Gliricidia seul). La réponse à une supplémentation à base de manioc est peu nette et nécessite de plus amples investigations.
SUMMARY

Results of two completed and one continuing feeding/growth trials are discussed. When fed Panicum maximum plus concentrates ad lib, West African Dwarf (WAD) bucks attain a growth rate of 60 g.d⁻¹ at a DDMI of 53.3 g kg⁻⁰.⁷⁵.d⁻¹, which is estimated to be approximately 1.8 times the DDMI needed for maintenance. These animals had a heavier dressed carcass (7.15 vs 4.75 kg) and more abdominal fat (0.70 vs 0.11 kg) than WAD bucks receiving P. maximum plus Leucaena leucocephala. Growth rates of WAD goats fed on Gliricidia sepium only were similar to those reported for goats at village level. Supplementation with either young fertilized Panicum maximum (A), Manihot esculenta (B) or Leucaena leucocephala (C) improved DDMI (A:40.6, B:45.7, C:42.3 vs 37.9 (Gliricidia only) g.kg⁻⁰.⁷⁵.d⁻¹). Leucaena supplementation also gave significantly higher growth rates (36.0 vs 23.3 g.d⁻¹) than Gliricidia alone. The response to cassava supplementation was confusing and further investigation is required.
INTRODUCTION

The Goat Research Project is carried out in collaboration among the National Agricultural University at Wageningen, ILCA and the University of Ife, Nigeria and was started in September 1981.

One of its main objectives is to study the management and economics of production of West African Dwarf (WAD) goats in the humid tropics. This includes not only an evaluation of the present situation but also the development of possible improvements. Since nutrition is seen as one of the most important limiting factors for improved goat production most research has been directed to this area. As the locally available fodder resources are considered as the most promising, investigations have been aimed at the assessment of their nutritive value.

In this paper the results of three experiments are presented. The objectives of experiment 1 were to determine the growth potential of Nigerian WAD goats and to compare concentrate with browse as a supplement to Panicum maximum. Experiment 2 was designed to evaluate the effect of supplementation of a diet consisting of Gliricidia sepium only with any of young and fertilized Guinea grass (Panicum maximum), cassava (Manihot esculenta) or Leucaena leucocephala on growth rate and feed intake. The assessment of the effect of substitution of part of a diet consisting only of Gliricidia sepium by Leucaena leucocephala on growth rate and feed intake was the main objective of experiment 3.

MATERIALS AND METHODS

EXPERIMENT 1

Six young WAD bucks (3-8 months old) were fed ad lib a ration consisting of Panicum maximum and concentrate (A) while five young bucks were offered ad lib a diet of Panicum maximum and Leucaena leucocephala (B). During an adaptation period of about 44 days, animals in treatment B also received a small and decreasing amount of concentrate to introduce them gradually to Leucaena leucocephala. Concentrate composition was (in per cent): maize 50.0, rice bran 30.0, brewers' dried grains 10.0, groundnut cake 7.5, dicalcium phosphate 1.5, salt 0.5, Vit.mineral mix 0.5. Every fifth to sixth week intake and digestibility were measured over a seven-day period. In total four of these collection periods were effected.
EXPERIMENT 2

Twenty-four WAD goats aged 3-5 months at the beginning of the experiment were divided into four treatment groups of six animals each (four castrates plus two females). The first group (A) received ad lib Gliricidia sepium only; the other three received as basic diet Gliricidia (ad lib) supplemented with either young, fertilized Panicum maximum (B), Manihot esculenta (C) or Leucaena leucocephala (D) each at a level of 30 g DM kg$^{-0.75}$. Of the browse, only the leaves and petioles were fed while the cassava supplement consisted of sun dried chopped tubers. Supplements were fed each morning before the rest of the ration. The first 40 days were considered an adaptation period. Every fifth to sixth week digestibility and feed intake were measured. Four of these periods were covered. The experiment was carried out between May and November 1984.

EXPERIMENT 3

Eighteen WAD goats (3-5 months old) were divided into three groups (two females plus four castrates per treatment). Group A was offered a ration of Gliricidia sepium only (ad lib), which in groups B and C was partly substituted by Leucaena leucocephala (25 and 50 per cent respectively). Stems were offered separately from the leaves plus petioles by hanging them inside the cage. All animals within the same treatment received equal amounts of stem according to the proportion of Gliricidia and Leucaena in their ration. The first 40 days were considered an adaptation period. Every fifth to sixth week, feed intake and digestibility were measured over a seven-day period. The trial started in May 1985 and is still in progress.

In all three experiments animals were housed in individual metabolism cages after treatment against endo- and ecto-parasites. They had free access to clean drinking water and a salt lick throughout. The animals were weighed weekly (except during collection periods) and their rations adjusted accordingly.

RESULTS

EXPERIMENT 1

Preliminary results have been presented elsewhere (Ademosun et al, 1985). Mean weights increased linearly after the adjustment period until day 156 of the experiment.
The growth depression observed between days 156 and 200 was probably due, as appeared during the carcass evaluation, to a subclinical pneumonia outbreak. Growth performance and feed intake were therefore evaluated on the basis of the data recorded between days 44 and 156.

Data on feed intake and growth rate are summarized in Table 1. Dry matter intake and digestibility were higher in the concentrate treatment (A) resulting in a higher DDM intake in this group (55.1 vs 35.0 g·kg\(^{-0.75}·d^{-1}\)). Animals in the Leucaena

Figure 1  Weight gains of young WAD bucks on two different rations
Table 1  Feed intake and growth rates of WAD bucks fed ad lib Panicum maximum plus concentrates (n=6) or ad lib Panicum maximum plus Leucaena leucocephala (n=5)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Parameter</th>
<th>Panicum + concentrate</th>
<th>Panicum + Leucaena</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DM intake (g.kg^{-0.75}.d^{-1})</td>
<td>16.3{a} 2.6</td>
<td>23.5{b} 4.6</td>
</tr>
<tr>
<td></td>
<td>Leucaena</td>
<td>-</td>
<td>40.8 2.7</td>
</tr>
<tr>
<td></td>
<td>Concentrate</td>
<td>61.7  6.8</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Digestibility (%)</td>
<td>69.3{a} 2.8</td>
<td>51.1{b} 3.2</td>
</tr>
<tr>
<td></td>
<td>DDMI (g.kg^{-0.75}.d^{-1})</td>
<td>55.1{a} 4.2</td>
<td>35.0{b} 2.6</td>
</tr>
<tr>
<td></td>
<td>Growth rate days 44-156 (g.d^{-1})</td>
<td>60.0{a} 12.8</td>
<td>34.8{b} 5.3</td>
</tr>
</tbody>
</table>

Means in the same row without a common superscript differ significantly (P < 0.01)

Treatment (B) ate absolutely and relatively (as percentage of DMI) more P. maximum. (B: 23.5 g.kg^{-0.75}.d^{-1} and 36 per cent vs A: 16.3 g.kg^{-0.75}.d^{-1} and 25 per cent). Goats in group A grew faster (60.0 vs 34.8 g .d^{-1}) although the variation in the concentrate group was higher (s.d.12.8 vs 5.3).

The results of the carcass evaluation are given in Table 2. All components of the empty carcass were heavier in group A, except the empty gut. Animals in the Leucaena group put on relatively less fat but had a more developed gut system.

EXPERIMENT 2

Table 3 shows feed intake and weight gains for experiment 2. Two animals on each of treatments B and C had to be removed from the experiment because of illness (not due to treatment). Supplementation resulted in a higher DDM intake in all treatments, with the highest value for the cassava group (37.9 (A) vs 40.6 (B) and 42.3 (D) vs 45.7 g.kg^{-0.75}.d^{-1} (C)). At the same time the mean intake of Gliricidia decreased in the grass and especially the Leucaena and cassava groups (66.7 (A) vs 56.8 (B) vs 42.5 (C) and 45.3 g.kg^{-0.75}.d^{-1} (D)). However, as the standard deviation

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*Note: The table and text are written in a clear and concise manner, without any abbreviations or technical jargon that might not be readily understandable to a general audience.*
**Table 2** Carcass composition of WAD bucks (four animals per treatment) fed ad lib on *P. maximum* + concentrates (A) or *P. maximum* + *L. leucocephala* (B)

<table>
<thead>
<tr>
<th>Body components</th>
<th>Weight (kg)</th>
<th>As % empty body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>0.55</td>
<td>0.41</td>
</tr>
<tr>
<td>Skin + feet + head</td>
<td>2.99</td>
<td>2.12</td>
</tr>
<tr>
<td>Empty gut</td>
<td>0.74</td>
<td>0.72</td>
</tr>
<tr>
<td>Organs</td>
<td>0.79</td>
<td>0.59</td>
</tr>
<tr>
<td>Abdominal fat</td>
<td>0.70</td>
<td>0.11</td>
</tr>
<tr>
<td>Dressed carcass</td>
<td>7.15</td>
<td>4.75</td>
</tr>
<tr>
<td>Empty weight</td>
<td>12.95</td>
<td>8.70</td>
</tr>
</tbody>
</table>

*** P < 0.001  ** P < 0.01  n.s. not significant

indicates, the response in group C was inconsistent (maximum/minimum: 67.2/15.4 g.kg⁻¹.75.d⁻¹).

Only *Leucaena* supplementation resulted in an improved growth rate and cassava tended to have a negative effect (23.3 (A) and 14.3 (C) vs 36.0 g.d⁻¹ (D)). Growth rates of individual animals showed a considerable variation in the *Leucaena* (cv=19 per cent, minimum/maximum 23.3/52.0 g.d⁻¹) and cassava groups (cv=76 per cent, minimum/maximum 0/30 g.d⁻¹). It appeared that the poor performers in (C) had a lower DDM and a relatively higher cassava intake than the good performers (and as a consequence they had a diet with a rather low protein content).

**EXPERIMENT 3**

Table 4 gives some preliminary results on feed intake and weight gain up to and including the first collection period.

Total DMI was highest in the 75 per cent *Gliricidia*/25 per cent *Leucaena* (B) group (73.1 g.kg⁻¹.0.75.d⁻¹) whereas these values for 100-per cent *Gliricidia* (A) and 50 per cent *Gliricidia*/50 per cent *Leucaena* treatment (C) did not differ (65.2 and 66.9 g.kg⁻¹.0.75.d⁻¹ respectively). The same pattern was observed for the DDMI (45.3
Table 3  Feed intake and weight gain of WAD goats fed on Gliricidia only (A) or supplemented with P. maximum (B), cassava (C) or L. leucocephala (D)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>n</th>
<th>DM offered</th>
<th>DM intake</th>
<th>Total DMI</th>
<th>DDMI</th>
<th>Growth rate (days 40-168)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gliricidia</td>
<td>Supplement</td>
<td>Gliricidia</td>
<td>Supplement</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>6</td>
<td>94.0</td>
<td>-</td>
<td>66.7</td>
<td>-</td>
<td>66.7 37.9b 23.3bc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± s.d. 5.9</td>
<td>-</td>
<td>6.2</td>
<td>-</td>
<td>6.2   3.2 3.7</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>93.7</td>
<td>32.4</td>
<td>56.8b</td>
<td>13.8b</td>
<td>70.6 40.6b 28.7ab</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± s.d. 5.8</td>
<td>2.2</td>
<td>6.6</td>
<td>5.1</td>
<td>4.5   3.2 4.9</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>94.2</td>
<td>30.1</td>
<td>42.5c</td>
<td>23.0a</td>
<td>65.5 45.7a 14.3c</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± s.d. 6.2</td>
<td>0.4</td>
<td>22.9</td>
<td>7.0</td>
<td>19.3 10.1 11.3</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>93.0</td>
<td>32.4</td>
<td>45.3c</td>
<td>25.6a</td>
<td>70.9 42.3b 36.0a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>± s.d. 5.5</td>
<td>1.5</td>
<td>9.4</td>
<td>4.4</td>
<td>7.5   3.5 10.6</td>
</tr>
</tbody>
</table>

All values are g.kg⁻⁰.⁷⁵.d⁻¹ except for growth rate which is g.d⁻¹. Means in the same column without a common superscript differ significantly (P < 0.05).
Table 4 Preliminary results on feed intake and growth rate of WAD goats (six animals per treatment) fed diets containing 100 per cent Gliricidia sepium (A), 75 per cent Gliricidia sepium plus 25 per cent Leucaena leucocephala (B) or 50 per cent Gliricidia plus 50 per cent Leucaena leucocephala (C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \bar{x} ) + s.d.</td>
<td>( \bar{x} ) + s.d.</td>
<td>( \bar{x} ) + s.d.</td>
</tr>
<tr>
<td>DM offered:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gliricidia</td>
<td>106.7 0.6</td>
<td>78.8 0.4</td>
<td>53.0 0.5</td>
</tr>
<tr>
<td>Leucaena</td>
<td>17.6 3.4</td>
<td>24.9 0.3</td>
<td>50.4 1.5</td>
</tr>
<tr>
<td>Bark</td>
<td>17.6 3.4</td>
<td>14.9 2.1</td>
<td>13.7 1.5</td>
</tr>
<tr>
<td>DM intake:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gliricidia</td>
<td>54.3a 4.3</td>
<td>39.2b 4.4</td>
<td>28.5c 9.8</td>
</tr>
<tr>
<td>Leucaena</td>
<td>- -</td>
<td>22.1 0.5</td>
<td>28.8 10.2</td>
</tr>
<tr>
<td>Bark</td>
<td>10.9 4.4</td>
<td>11.7 1.8</td>
<td>9.6 2.7</td>
</tr>
<tr>
<td>Total</td>
<td>65.2b 3.7</td>
<td>73.1a 3.7</td>
<td>66.9b 3.4</td>
</tr>
<tr>
<td>DDMI</td>
<td>38.0b 1.8</td>
<td>45.3a 3.9</td>
<td>41.7b 4.9</td>
</tr>
<tr>
<td>Growth rate day 40-84</td>
<td>16.4 4.5</td>
<td>33.5 11.8</td>
<td>25.9 5.8</td>
</tr>
</tbody>
</table>

All values are g.kg\(^{-0.75}.d^{-1}\) except growth rate which is g.d\(^{-1}\)

Means in the same row without a common superscript differ significantly (P < 0.05)

(B) vs 38.0 (A) and 41.7 g.kg\(^{-0.75}.d^{-1}\) (C)). Bark DMI accounted for about 16 per cent of total DMI and did not differ among treatments.

Animals on the low Leucaena level ate almost all the Leucaena on offer (89 per cent) whereas on the high level, mean Leucaena intake equalled mean Gliricidia intake. However, as can be seen from the relevant standard deviations, variation among individual animals was considerable. It appeared that three goats did not consume more Leucaena as in treatment B \( (\bar{x} = 20.9 \text{ g.kg}^{-0.75}.d^{-1}) \) while two goats showed a pronounced preference for it \( (\bar{x} = 38.5 \text{ g.kg}^{-0.75}.d^{-1}) \).

The first weight records showed that most animals were gaining weight constantly after the adaptation period. Since growth rates have been calculated over a short period these should be regarded as a first indication, especially in view of the possible harmful effect of Leucaena when fed for an extended time.
DISCUSSION

Growth rates and feed intake data found when offering ad lib P. maximum and concentrates are comparable to those obtained by Zemmelink, Tolkamp & Meinderts, (1985) feeding ad lib good hay plus 60 g.kg$^{-0.75}.d^{-1}$ concentrates (58.5 g.d$^{-1}$) and by Adebowale & Ademosun (1981) including 15 per cent brewers' dried grains in a Stylosanthes based diet (56.1 g.d$^{-1}$).

Zemmelink, Tolkamp & Meinderts, (1984) estimated the energy requirements for maintenance and growth respectively at 26.0 g DOM (kg$^{-0.75}$) and 2.41 g DOM per gram of liveweight gain. Assuming an ash content of 10 per cent, this means that 28.9 g DDMI is needed for maintenance only. Animals on the concentrate treatment consumed 1.8 times this requirement which is about 11 per cent lower than the ratio found in the Netherlands where dwarf goats were fed high quality hay and concentrates ad lib.

It is not clear whether this difference is due to genetic or other effects such as climate or feed. Nevertheless, the value obtained in this experiment is a useful guide for the evaluation of the nutritive value of locally available feed resources.

Animals fed only on Gliricidia ate only 30 per cent more than needed to meet their estimated maintenance requirements. Growth rates at this level of intake were similar to the estimated daily gain of 20 g.d$^{-1}$ between 90 and 150 days of age at village level (Mack, 1983).

Inclusion of more components in the diet tends to increase DDMI and hence, except in the case of cassava supplementation, animal performance. The combination of Leucaena and Gliricidia seems, in this respect, the most promising with a daily DDMI up to 57 per cent above estimated maintenance requirements, allowing a growth rate of about 35 g.d$^{-1}$, which is 75 per cent higher than the weight gain at village level.

The continuing evaluation of different levels of Leucaena and Gliricidia might provide interesting information about the optimum levels in rations of both browse species, although it is still too early to draw clear conclusions.

The fact that the poor performers on the cassava treatment had a relatively as well as an absolutely higher cassava intake and relatively low DDMI might suggest a possible negative effect of cassava on total DMI. In this respect it is perhaps useful to recall that the supplements were offered before the rest of the ration. More
research is needed to determine the exact effect of level and method of offering cassava on both feed intake and animal performance.

The carcass evaluation data show that young bucks fed intensively are able to put on considerably more meat (and not only fat) than bucks fed roughage only.

CONCLUSIONS

The following main conclusions can be drawn:

West African Dwarf bucks in Nigeria can attain a growth rate of 60 g per day when fed intensively;
diets containing Leucaena leucocephala and Gliricidia sepium are quite promising as basic rations for fattening WAD goats, giving considerably higher growth rates than those achieved at village level;
more research is needed to assess the effect of cassava supplementation on feed intake and animal performance.

ACKNOWLEDGEMENTS

The authors acknowledge the contributions of the whole project team especially H.J. Jansen, M. van Houtert, J. Ikpea and O.B. Smith. They are also grateful to students who participated in the project, in particular A.A. Egbe, Idowu and M. Boon.
DISEASES AND MORTALITY

SANTE ET MORTALITE
QUELQUES CONSIDERATIONS GENERALES SUR LA SANTE DES PETITS RUMINANTS: GESTION, TECHNOLOGIE, VULGARISATION

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Department of Large Animal Clinical Sciences and Microbiology
Michigan State University
East Lansing MI 48823 USA

RESUME

Des aspects généraux de la santé des petits ruminants et leurs effets sur la productivité sont discutés. Des exemples sont cités de technologies nouvelles, de pratiques de gestion et d’améliorations à l’infrastructure qui pourraient augmenter la productivité et faciliter la commercialisation des petits ruminants. L’amélioration de la santé à travers l’éducation par les services de vulgarisation et l’utilisation rationnelle des médicaments sont considérées comme des moyens efficaces pour augmenter la productivité.
GENERAL ASPECTS OF SMALL RUMINANT HEALTH:
MANAGEMENT, TECHNOLOGY AND EXTENSION

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Department of Large Animal Clinical Sciences and Microbiology
Michigan State University
East Lansing MI 48823 USA

SUMMARY

Some general aspects of small ruminant health and the effect of health on production are reviewed. Examples are given of the management practices, new technologies and infrastructural changes which may improve the production and marketing of sheep and goats. Health improvement mainly by means of education through extension services and minor use of drugs and vaccines may considerably increase productivity.

INTRODUCTION

Health is still a major constraint to efficient livestock production. Interventions which enhance health are very popular among livestock owners in Africa and elsewhere, and appear to have an attractive short term return. Despite these optimistic observations, there is still a lot to be learned about the improvement of health and production in African livestock. Although we are fairly knowledgeable about the deficiencies and disease problems, the control and prevention effort has been less successful than expected. Various reasons are given, as discussed elsewhere (Eicher, 1984; Schillhorn van Veen, 1984), but poor organization and low priority for livestock services in, and outside, governmental organizations seems to be a major cause.

This paper discusses some of the constraints on production, the economic benefit and difficulties of introducing interventions and the effects of health on international marketing. It also lists some technological developments which may, ultimately, have some impact on livestock production in Africa.

The bias towards discussing mainly West African examples is partly related to the author's personal interest and experiences but also to the lack of published material from other parts of Africa.

MEASUREMENT OF PRODUCTION LOSSES

Until recently disease in African livestock was only measured in terms of mortality. Production diseases and deficiencies were rarely considered important. In the last decade, however, there has been an increased interest in measurement of production losses, which in some cases shows that the benefit of preventing diseases with a high morbidity but low mortality may be greater than preventing occasionally fatal epidemics (Akerejola, Schillhorn van Veen & Njoku, 1979; Aklaku, 1980; Matthewman, 1980; Sumberg & Mack, 1985).

The methodology of measuring production losses is unfortunately still not universally standardized and criteria developed in Europe or the USA are often not applicable to African conditions. The common denominators for production in developed countries, e.g. weight (either body weight, fleece weight or milk production), total production per unit area and mortality, may not be the exact criteria to measure production under conditions in Africa. Firstly, because animals are kept for additional reasons (manure production, skins, ceremonial use). Secondly, because the residual
value of old, diseased or dying animals is higher than in developed countries. During a survey in rural slaughterhouses in northern Nigeria in the early 1970s, for example, the value of a diseased animal at the slaughter house was approximately 50 per cent of the price of a normal animal of the same size and 25 per cent if the animal had to be slaughtered in the compound of the owner or in the field.

The measurement of production losses as such is extremely difficult, especially under field conditions where control animals are still exposed to a variety of diseases, parasites and deficiencies.

Bioscientists have made further efforts to define normal animals by looking at clinical and biochemical parameters (Oduye & Adadevoh, 1976; Saror & Schillhorn van Veen, 1977; Thomas & Chiboka, 1984) or physiological criteria (Schillhorn van Veen & Folaranmi, 1978; Preston & Allonby, 1979; Buvanendran et al, 1981). The latter studies revealed that the small ruminant population in Africa shows considerable variability in genetic make-up which opens up interesting avenues of research on genetically determined disease and production factors. Results of this research should not be expected too soon and, in the meantime, improvement in production can and has to be achieved by improvement of husbandry and management.

MANAGEMENT

Management is often a major factor in the success or failure of a farm enterprise but little effort is made to study management except in a few specialized areas (Schillhorn van Veen, 1983). Table 1 provides an example of a number of production losses and diseases, nearly all of which are influenced by management. There is ample evidence that the traditional African livestock owner is well aware of the role of management in the avoidance and control of animal disease (Croix, 1945; Ba, 1984). There is little evidence in the literature, however, that controlled studies have been done on the effect of certain husbandry practices and their impact at farm and village level. Typically, the discussion about these practices is performed along disciplinary lines: sociologists and economists rarely make an effort to understand the techniques of livestock raising and veterinarians and animal scientists respond in kind. More effort should be made to integrate these different aspects or viewpoints, as tried in an example in Table 2.

On-farm management is strongly influenced by local conditions. Spharim &
Table 1  Major causes of production losses and constraints which are the underlying causes

<table>
<thead>
<tr>
<th>Condition</th>
<th>On-farm management</th>
<th>Government</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Local</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Central</td>
</tr>
<tr>
<td>Lamb mortality</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Predator losses</td>
<td>**</td>
<td>-</td>
<td>*?</td>
</tr>
<tr>
<td>Accidents</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Poisoning</td>
<td>**</td>
<td>*?</td>
<td>-</td>
</tr>
<tr>
<td>Disease (epidemic, PPR, etc.)</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Disease (stress)</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Disease (production)</td>
<td>**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parasitism</td>
<td>**</td>
<td>*?</td>
<td>*?</td>
</tr>
<tr>
<td>Tickborne disease</td>
<td>**</td>
<td>*?</td>
<td>*?</td>
</tr>
<tr>
<td>Undernourishment</td>
<td>**</td>
<td>*?</td>
<td>*?</td>
</tr>
<tr>
<td>Deficiency</td>
<td>**</td>
<td>*?</td>
<td>*?</td>
</tr>
</tbody>
</table>

** major role:  *? indirect role - mainly related to availability of vaccine, medicine and supplement:  * minor role

Table 2  Impact of certain changes in management and disease control

<table>
<thead>
<tr>
<th>Management practice</th>
<th>Social</th>
<th>Technical</th>
<th>Economic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Material</td>
</tr>
<tr>
<td>Enclose animals at night</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Separate male/females</td>
<td>-</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Fence pasture</td>
<td>**</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Vaccination</td>
<td>-</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>Keeping records</td>
<td>***</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Feeding salt</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Controlled breeding</td>
<td>***</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Preserve fodder</td>
<td>***</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Introduce legumes</td>
<td>-</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

* impact at farm level:  ** impact at village or district level:  *** impact at farm and village or district level
Seligman (1983) identified 18 different husbandry systems in the relatively small northern Negev in Israel and reviewed these with respect to various inputs. Their model indicated, for example, that highly fertile Finn sheep required a more labour intensive system than the less fertile Awasi sheep: a similar situation is found in arid western USA where high fertility is considered a liability rather than an asset.

Management capabilities are difficult to measure, especially under varying field conditions but simple management improvements that are widely promoted are not widely accepted. These include: feeding from feed troughs rather than from the ground; provision of trace mineral supplements; controlled breeding; adequate feeding of pregnant ewes or does; ensuring intake of colostrum in day-old lambs and kids; and foot care.

Introduction of such management practices requires an adequate extension network and a continuous effort, which should be combined with other health related activities (Boundy, 1981; Hindson, 1982).

NEW DEVELOPMENTS IN ANIMAL HUSBANDRY AND HEALTH

Among the many developments in animal science and biomedicine are some which may be of benefit to the African livestock industry in the foreseeable future.

HERD HEALTH APPROACH

The herd health systems presently developed in Europe and the USA may have some benefit for Africa. Ideally the method provides for sound data collection, either by farmers themselves or through enumerators. Dedicated record keeping over a period of a year or more does indeed provide valuable data (Wilson, 1980; Mack, 1983). Ten years ago the method was used in Nigeria to obtain data on production constraints and on seasonal changes in disease incidence as measured by emergency slaughter in small villages (Figure 1). Sound data on a given system are crucial for the introduction of interventions and are a minimal requirement for any development project.

UNDERNOURISHMENT

Seasonal or general undernourishment is a major problem in African livestock. Livestock management interventions such as planned breeding, fodder preservation,
Figure 1 Seasonal distribution of reasons for slaughter of sheep at a rural abattoir in northern Nigeria

- Lafiya (healthy)
- Zowo (diarrhoea)
- Samore (unthriftiness)
- Hanta (liverfluke inf.)
- Broken legs/accidents
- Others

Early slaughter, mineral supplementation, and treatment of chronic disease are of value to prevent serious losses but they are rarely implemented.

On the other hand, bioscientists are better able to understand the physiology of undernourishment. Examples are the effect of hormones such as cholecystokinin which influence feed intake (Symons, 1978) and the purification of cachectin, a macrophage factor which suppresses the activity of the enzyme lipoprotein lipase, leading in experimental models to a chronic wasting disease (Beutler et al, 1985). A better understanding of the role of such hormones may help to solve disease problems in African livestock such as chronic parasitism and trypanosomiasis.

BIOENGINEERED VACCINES AND DIAGNOSTICS

During the early 1980s a number of technological innovations in biochemistry and immunology led to an explosion of new ideas and approaches to health problems in man and animals. So far, however, the substantial and mainly commercially sponsored research has not led to major applications in animal health.

It is doubtful whether these developments may in the next decade indeed produce innovations which will be both applicable and affordable in Africa. The bioengineered foot-and-mouth disease and malaria vaccines produced in the USA are still in the
development stage and other vaccines lag behind. Improvement in the diagnosis of disease with the help of monoclonal antibodies still has considerable drawbacks but has successfully been used to identify East Coast Fever strains in cattle in Kenya.

NEW DRUG DELIVERY SYSTEMS

There exists an increasing interest in drug delivery in veterinary medicine. This has led to drugs and feed additives being incorporated in feedblocks, to intraruminal slow-release devices and to subcutaneous implants. At present, technology is being developed for pulse release mechanisms, removable implants and local release devices. These methods may have benefits in the control of many livestock diseases which currently require frequent single treatments and the use of long-acting drugs. The unwelcome consequences of long-acting drugs are residues in meat and milk which are a potential hazard to the consumer and, at the national level, restrict export markets. A more delicate use of drugs and feed additives with the help of these newer devices would not only improve the image of the livestock industry but could also in the long run lead to economic benefits as the volume of drugs used is reduced. Most are still in the developmental stage and may well be too expensive for routine use.

UTILIZATION OF DISEASE RESISTANT BREEDS

The utilization of resistance has attracted increasing attention during the last decade, especially with respect to trypanotolerance (ILCA, 1979). In cattle this appears to be an incomplete dominant trait. Biochemists try to determine the genetic base at the molecular level for resistance factors and are now considering inserting genetic material into the nuclei of embryos to improve their genetic make-up.

The two diseases in which applied research on resistance has been carried out are trypanosomiasis (Griffin & Allonby, 1979; Toure et al, 1983; Murray, Trail & Grootenhuis, 1984) and haemonchosis (Preston & Allonby, 1979). In addition, efforts are being made to improve tick and ectoparasite resistance. The results of these research efforts are promising but many problems need to be solved before wider application can be expected (Albers, Burgess & Adams, 1984). Whitelaw et al (1985) were unable to demonstrate resistance against T. congolense in a selected number of breeds and crossbreeds and suggested that "resistance" was probably related to the fact that goats are less attractive to tsetse flies.
Most African breeds are naturally selected for their particular environment. Movement out of that environment or cross-breeding may lead to a decline in adaptation as demonstrated by numerous experiments over the last 50 years. The view that a certain disease or deficiency is the major or only constraint is biased, and other factors (drought resistance for instance) may be more important in the natural selection process (Schillhorn van Veen & Folaranmi, 1978). Moreover, with an intensification of production, the disease pattern changes: important diseases in nomadic systems may be a minor problem in settled systems (Wilson et al., 1984). Research should be continued, as improvement in the knowledge of the immunological basis of disease resistance may ultimately lead to applicable innovations.

DISEASE AND MARKETING

Small ruminants are an attractive export product for many African countries. Potential markets in North Africa, the Middle East and southern Europe are fairly close. For various reasons, live animal export has been preferred by these countries, thus enhancing the advantage of African producers over competitors in Australia and New Zealand (Holtzman, 1982). Production for export is risky, however, as demand may rapidly change, influenced by political considerations, currency changes and, most of all, by the quality of the product.

Animal health is important not only from a quality viewpoint, but also from a political one. Too often markets are closed for public health reasons whether justified or not. Governments interested in export of small ruminants should provide an infrastructure which reduces the risk of market changes for disease reasons. With respect to Europe and the USA this may be impossible, at least in the short term in most African countries but for nearby markets it should be feasible. Table 3 shows that many of the infectious diseases in producing countries in Africa are also present in most potential market countries. This should provide little comfort, however, as most Middle East countries are active in the development of animal health programmes, which include eradication of these diseases. Also, economic situations may change rapidly as was experienced by East African cattle producers in the 1970s when the beef market collapsed (Shapiro, 1980) and many countries imposed import restrictions to protect their livestock industry, often using "disease risk" as the justification. Fortunately, small ruminants are a special product and their marketing
Table 3 Prevalence of some contagious diseases of small ruminants in selected countries which import African livestock or are potential markets

<table>
<thead>
<tr>
<th>Disease</th>
<th>Saudi Arabia</th>
<th>Southern Europe</th>
<th>Iran</th>
<th>Israel</th>
<th>United Arab Emirates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rinderpest</td>
<td>*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Blue tongue</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>*</td>
<td>*</td>
<td>nd</td>
<td>*</td>
<td>nd</td>
</tr>
<tr>
<td>Caprine arthritis</td>
<td>-</td>
<td>nd</td>
<td>nd</td>
<td>-</td>
<td>nd</td>
</tr>
<tr>
<td>Foot-and-mouth</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Maedi/Visna</td>
<td>nd</td>
<td>*</td>
<td>nd</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Sheep pox</td>
<td>*</td>
<td>-</td>
<td>**</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Scrapie</td>
<td>-</td>
<td>*</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Caprine pleuro-pneumonia</td>
<td>*</td>
<td>-</td>
<td>*</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Pulmonary adenomatosis</td>
<td>nd</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>nd</td>
</tr>
<tr>
<td>Contagious agalactica</td>
<td>-</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>-</td>
</tr>
<tr>
<td>Heartwater</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>nd</td>
</tr>
</tbody>
</table>

nd no data: * reported sporadic: ** reported commonly

in Africa is not directly influenced by the world market.

Some of the restrictive diseases which prevent export of cattle or beef are, however, also carried by sheep and goats (e.g. foot-and-mouth disease, brucellosis and blue tongue) and restrictions aimed at cattle may affect export of small ruminants (Watson, 1984).

CHANGE

Understanding the constraints, developments and options of current small ruminant production systems allows a decision about change and/or improvements. In many respects we should be reluctant to make such decisions as there are still too many unknowns. Often, however, farmers themselves make changes without outside help or advice, using available means and remedies (Chavanduka, 1984). This is probably the best model of change: let the livestock owner decide and let all others involved in livestock support or research provide him with the information needed
to make sound decisions, but not interfere with his decision making. This requires a good extension system backed up by research data.

Livestock extension is neither well developed nor well supported in many African countries. Agents are young and inexperienced and as such not accepted by producers. Often they are not kept up-to-date, especially in those extension services not connected with a university or research institute. Extension efforts combined with dipping services and/or vaccination campaigns have various advantages but may be less accepted when such services are enforced (Muriithi, 1984). A critical evaluation of the extension effort, especially in the area of small ruminant health and management, could lead to major improvements in the industry.

Few data are available on the cost/benefit ratios of health interventions in the tropics. A few crude data on the effects of certain interventions (Table 4) show that vaccination for PPR, anthelmintic treatment and mineral supplementation are beneficial in particular areas of study. Such data need to be developed at many sites in Africa as local conditions and diseases vary. Extrapolation from different countries as well as from different species may be risky and suggestions to introduce large scale vaccination campaigns for the control of PPR similar to those for rinderpest in cattle (Sumberg & Mack, 1985) may need further discussion considering the longevity and number of goats at risk and the logistics and costs involved. Based on earlier findings, ILCA has introduced health packages in some trial villages (Mack, 1983)

Table 4  Effect of technical interventions on small ruminant production

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Effect on production</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mortality</td>
<td>Growth</td>
</tr>
<tr>
<td>Vaccination:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthelmintics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly in wet season</td>
<td>- 90%</td>
<td>+ 40-60%</td>
</tr>
<tr>
<td>Twice per year</td>
<td>- 75%</td>
<td>+ 30%</td>
</tr>
<tr>
<td>Trypanocide</td>
<td>n.d.</td>
<td>+ 60%</td>
</tr>
<tr>
<td>Supplementation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobalt</td>
<td>n.d.</td>
<td>+</td>
</tr>
</tbody>
</table>
but still has to demonstrate that such packages will, in the long run, be accepted (i.e. paid for) by livestock owners. Comparable packages which included anthelmintic treatment and dipping for mange were popular in Nigeria during the 1950s, indeed so popular that they became a drain on government resources (Schillhorn van Veen, 1978). For some time they were then offered by private suppliers but were later discontinued. It is clear that ultimately it is not the role of government fully to care for the livestock sector but rather to provide information and incentives for producers to sustain and expand production. In this respect, governments should take a closer look at livestock development support structures which are often divided over different ministries and are poorly supported.

LIVESTOCK SUPPORT INFRASTRUCTURE

Government support for the livestock industry is poor in most African countries (Anteneh, 1985). Indirect, non-measurable, support such as stimulation of private industry, improved transport (roads and railways from rural areas), marketing and export facilities can also be improved. Livestock marketing systems work but are not very beneficial to the producer. Private veterinary services (partly subsidized) and supplies of feed and supplements are also deficient or at least unreliable. Data on livestock experiments are either not published or written up in cryptic reports not available to the general public. Provision of such services should have high priority for without these there is little hope of sustained improvements.

RECOGNITION OF OPPORTUNITIES

Most of the livestock industry in Africa is still out-of-date. Changes proposed are often expected to be applicable across the board in a particular country, if not in most of Africa. Innovations which make use of local opportunities are rarely initiated. Breeding and marketing sheep for Muslim festivals, for instance, tried in Nigeria in the early 1970s did not receive wide application. The profitability, however, was demonstrated and has recently been confirmed (Kolff & Wilson, 1985). Other opportunities with respect to marketing (religious festivals, proximity of urban markets), availability of fodder (river flood plains, crop residues), use of by-products, availability of expertise, etc., should be considered and stimulated at the local level.
Examples of such opportune foci of small ruminant production are abundant in other parts of the world and could provide a sound base for production in a given area. Computer model data as well as field observations (Spharim & Seligman, 1983) demonstrate the viability of different systems in a limited geographical area. Existing opportunities are however not always utilized because of government constraints or inflexibility of local social structures.

Identification of opportunities requires considerable effort and cannot be achieved on research stations. Cooperation between extension and research staff is paramount in these, as well as in other, efforts to improve the small ruminant industry.

*Stall-fed ram (Sahel x West African Dwarf) being fattened for slaughter at Muslim festival*
LA MORTALITÉ CHEZ LES PETITS RUMINANTS DANS DEUX SYSTEMES D'ELEVAGE
A BAMENDA AU CAMEROON

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RESUME
La mortalité chez les petits ruminants est étudiée dans un système d'élevage semi-intensif (station de recherche de Mankon, Cameroon) et en milieu villageois. Les taux de mortalité, dépendant du type de naissance, du sexe et de l'âge, sont étudiés chez les races locales et importées. La mortalité chez les chevreaux est significativement plus élevée que chez les agneaux (P<0,01). La mortalité est plus élevée chez les nés doubles ou triples que chez les simples. Les chevreaux simples ont une mortalité plus élevée que les agneaux simples. Dans tous les cas, sauf pour les caprins locaux, la mortalité maximum est observée pendant les quatre premières semaines de vie, la plupart mourant dès la naissance. Le taux de mortalité dans cette classe d'âge est plus élevé chez les agneaux que chez les chevreaux. Il mourrait plus de chevreaux sevrés que d'agneaux. Comparé à la mortalité chevreau/agneau, la mortalité des adultes est généralement plus faible. Les races importées présentent une mortalité plus élevée que les races locales. La mortalité est généralement faible pour les animaux conduits selon le système villageois traditionnel. Chez les espèces exogènes, les taux de mortalité ne sont pas significativement différents (P>0,05). Il n'apparaît pas de variation saisonnière de la mortalité sauf en milieu villageois où elle est plus élevée en saison des pluies. Sauf cas spécifiques les causes de mortalité semblent être la résultante de la nutrition, de la conduite de troupeau et de la pathologie. Les conséquences de ces observations sont discutées.
EFFECTS OF MANAGEMENT SYSTEM ON MORTALITY OF SMALL RUMINANTS IN BAMENDA, CAMEROON

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P.O. Box 125 Bamenda Cameroon

SUMMARY

Mortality in small ruminants was examined under semi-intensive management at the research station at Mankon, Cameroon, and under traditional village management. Mortality rates as influenced by type of birth, sex and age were compared in local and exotic breeds. Significantly more kids than lambs died (P<0.01). Mortality rates were higher in offspring of twin/triplet births than in those of single births. More singles of goats died than of sheep. In all cases except local goats, the highest number of deaths occurred during the first four weeks, the majority dying soon after birth, the mortality rate in this group being higher amongst lambs than kids. More weaned kids than lambs died. Compared to kid/lamb mortality, adult rates were generally lower. Exotic breeds had higher mortality than local breeds. Mortality rates were generally low for all animals reared under the traditional management system. Among exotics, breed differences in mortality rates were not significant (P>0.05). There was no apparent variation in mortality rate during the dry and rainy seasons except in the traditionally managed sheep and goats where the mortality rate was higher in the rainy season. Except where otherwise identified, causes of death were considered to be a complex of nutrition, management and disease factors. The implications of these findings are discussed.

INTRODUCTION

Sheep and goat production in Cameroon is largely in the hands of village farmers who rear them in small flocks of one to ten sheep or goats. A few farmers keep higher numbers, up to three hundred in some cases. Larger flocks (300-800) are found at Government livestock and research stations.

Management of small ruminants at Government stations is semi-intensive. At the Animal Research Station in Mankon, for example, the animals are fed 500 g of 16 per cent protein concentrate (cotton seed cake, corn and rice bran mixture) in the morning, allowed to graze in fenced paddocks for about eight hours during the day and then penned for the night. The traditional village management system requires tethering of animals during the cropping season but allows free range grazing during the non-cropping season.

The principal indigenous breeds of goats in Cameroon are the Cameroon Dwarf and the Red Sokoto. Indigenous sheep breeds include Dwarf Forest sheep, Black-belly, Fulani Bornu, Fulani Ouda, Foulbe and Kirdi (Massa). In addition to these indigenous breeds, some exotic breeds were imported several years ago for adaptability studies and possible use in upgrading local animals for milk and meat production. Exotic goat breeds include Saanen, Nubian and Toggenburg and exotic sheep include Suffolk, Dorset and Katahdin.

Increased productivity of small ruminants in the tropics is thwarted by poor management which predisposes the animals to disease. Productivity rates are therefore generally low with low kidding/lambing percentages and high mortalities. Peters et al (1981) reporting on low income economic units in West Malaysia indicated an average loss in kids of 14.3 per cent, with a range from 7.4 per cent under intensive to 17.4 per cent under semi-intensive conditions. Adult losses were 6.4 per cent in a range from 3.6 per cent in intensive systems to 7.5 per cent in semi-intensive and semi-extensive ones. Wilson (1982) recorded pre-weaning losses of up to 40 per cent in goats and 30 per cent in sheep and up to 10 per cent in older animals. Losses due entirely to disease were difficult to categorize. Gall & Huhn (1981) report losses of 30-40 per cent of the goat stock, with the young animals being the most strongly affected.

Nutrition has been shown to have a bearing on the severity of infection and the ability of parasites to invade tissues and produce lesions (Riek, 1970). Shortage of food often aggravates parasite damage so that goat stocks suffer severe losses.
as a result of lowering of resistance (Kurtze, 1982).

Wilson (1982) pointed out that despite the availability of a voluminous and rapidly growing literature on small ruminant disease, real causes of most mortalities are only suspected rather than known. This is because, except in clear-cut cases, death usually supervenes as a result of a complex of factors involving nutrition, management and disease.

In Cameroon data on livestock numbers and accurate assessment of disease, mortality and morbidity rates are not readily available for small ruminants yet this information is indispensable if any positive steps are to be taken to increase productivity. This paper is an attempt to assess mortality rates not only under the traditional village management but also under semi-intensive management at the Animal Research Station in Mankon, Cameroon.

MATERIALS AND METHODS

Routine records on births and deaths and veterinary reports on post-mortem examination findings kept at Mankon were analysed. Kid and lamb mortality rates were measured over the period for which accurate records were available. A preliminary survey of disease problems and mortalities in sheep and goats under traditional village management was carried out in Mezam and Momo divisions of Cameroon by use of a questionnaire for the year 1984. Significant differences in mortalities were tested using chi-square.

RESULTS

Mortality rates for kids and lambs are presented in Table 1 and for adults in Table 2. The data are based on mortalities in lambs and kids born at Mankon Station between March 1984 and May 1985 and on traditionally managed kids and lambs from interviews with 40 farmers randomly selected from Mezam and Momo Divisions. From Table 1 it can be seen that more deaths occurred among offspring of twin/triplet births than those of single births. Whereas mortalities occurred at about the same rate in twins/triplets of sheep and goats, significantly more singles of goats died than of sheep (P<0.01). The overall mortality rate was significantly higher (P<0.01) in kids than in lambs and more males than females died. Adult mortality rates were
Table 1 Kid and lamb mortality rates at Mankon station and under traditional management in Cameroon

<table>
<thead>
<tr>
<th>Animal type</th>
<th>Number in sample</th>
<th>Mortality rate (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Singles</td>
</tr>
<tr>
<td>Station kids: local goats</td>
<td>74</td>
<td>42.0</td>
</tr>
<tr>
<td>dairy goats</td>
<td>61</td>
<td>51.5</td>
</tr>
<tr>
<td>all goats</td>
<td>135</td>
<td>45.8</td>
</tr>
<tr>
<td>Station lambs: local sheep</td>
<td>111</td>
<td>19.8</td>
</tr>
<tr>
<td>exotic sheep</td>
<td>27</td>
<td>21.1</td>
</tr>
<tr>
<td>all sheep</td>
<td>138</td>
<td>20.0</td>
</tr>
<tr>
<td>Traditionally managed kids</td>
<td>143</td>
<td>20.0</td>
</tr>
<tr>
<td>Traditionally managed lambs</td>
<td>35</td>
<td>20.0</td>
</tr>
</tbody>
</table>
higher for exotic than for local breeds, this being significant (P<0.01) in sheep. Of
35 goat and 15 sheep farmers interviewed, 48.6 per cent with goats and 46.7 per cent
with sheep reported the incidence of losses in their flock. In this sector losses on
average were higher in kids and adult goats than in lambs and adult sheep.

A breakdown of mortalities in kids and lambs by age (Table 3) shows that
comparatively more kids of dairy goats and lambs of local and exotic sheep died
between birth and four weeks of age, the majority dying within the first day of life.
Very few kids of the local goat breed died within the same age range.
A comparison of breed mortality rates showed no significant differences (P>0.05) among the exotic breeds of each species. Similarly there was no significant variation of mortality rate during the dry and rainy seasons except for traditionally managed animals where mortality was higher during the rainy season.

Case histories of animals that died at Mankon Station and in the villages are shown in Table 4. The frequency of the different diseases was not significantly different between sheep and goats. For the animals under traditional village management, only diseases and ailments known to the farmer were considered. The common post-mortem examination findings for the Station are presented in Table 5.

<table>
<thead>
<tr>
<th>Disease syndrome</th>
<th>Mankon station (per cent)</th>
<th>Village management (per cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sheep</td>
<td>Goats</td>
</tr>
<tr>
<td>Weakness/Emaciation</td>
<td>28.6</td>
<td>25.0</td>
</tr>
<tr>
<td>Diarrhoea</td>
<td>7.1</td>
<td>19.1</td>
</tr>
<tr>
<td>Pyrexia</td>
<td>7.1</td>
<td>11.8</td>
</tr>
<tr>
<td>Recumbency</td>
<td>3.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Inappetence</td>
<td>14.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Dullness</td>
<td>-</td>
<td>5.9</td>
</tr>
<tr>
<td>Sudden death</td>
<td>3.6</td>
<td>5.9</td>
</tr>
<tr>
<td>Anaemia</td>
<td>14.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Salivation</td>
<td>7.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>7.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Lameness</td>
<td>-</td>
<td>2.9</td>
</tr>
<tr>
<td>Anorexia</td>
<td>3.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Nasal discharges</td>
<td>-</td>
<td>1.5</td>
</tr>
<tr>
<td>Abortion</td>
<td>3.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Coughing</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Helminthiasis</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mange</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Others</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 5  Post-mortem diagnoses of diseases in sheep and goats at Mankon Station, Cameroon

<table>
<thead>
<tr>
<th>Post-mortem examination findings</th>
<th>Percentage frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sheep</td>
</tr>
<tr>
<td>Gastro-enteritis</td>
<td>11.1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>-</td>
</tr>
<tr>
<td>Congestion of blood vessels/organs</td>
<td>11.1</td>
</tr>
<tr>
<td>Hydropericardium</td>
<td>29.6</td>
</tr>
<tr>
<td>Hydrothorax</td>
<td>11.1</td>
</tr>
<tr>
<td>Helminthiasias</td>
<td>18.5</td>
</tr>
<tr>
<td>Oestrus ovis larvae</td>
<td>-</td>
</tr>
<tr>
<td>Anaemia/emaciated carcass</td>
<td>11.1</td>
</tr>
<tr>
<td>Intestinal torsion</td>
<td>3.7</td>
</tr>
<tr>
<td>Hydroperitoneum</td>
<td>7.4</td>
</tr>
</tbody>
</table>

DISCUSSION

This study confirms that the mortality rate is generally higher in kids and lambs than in adults. The results agree with Halpin (1975) who pointed out that the age of the animal has a great effect on its ability to withstand attack by both physical and biological agents. Thus younger animals are particularly susceptible to certain enteric and respiratory infections since they lack immunity. This age group therefore requires greater protection from the harshness of the environment through provision of adequate nutrition, housing and management.

Offspring of twin/triplet births were more prone to death from any cause than offspring of single births. This finding agrees with observations by Wilson (1976a) who pointed out that the death rate of twin lambs was almost twice that of single lambs. Twins/triplets are usually weaker and most of them die of weakness and failure to drink milk soon after birth. Dunn (1982) emphasized that this first milk is essential to provide energy for the kid/lamb, without which it will starve and chill to death. Thus, unless the dam is a good mother, the newly born young should be helped to suck as soon as possible. The time factor is important because the neonate intestine can only absorb colostrum for a time limited to about twelve hours (Dunn, 1982). Newly born kids are comparatively stronger than lambs and so have a greater chance of
obtaining colostrum from the mother even if not helped, hence the fewer deaths in kids than lambs between birth and four weeks of age. The first week of life is critical for survival and so greater attention should be given to ensuring that the dam is receiving high quality nutrition in order to produce sufficient milk for its young. Both young and dam should preferably be confined together during this first week. Wilson (1976a) confirmed this observation and attributes many deaths to mismothering. The high mortalities between two and three months are due to debility and weakness, probably as a result of poor lactation performance of the dams and a lack of adequate forage once the dry season has commenced (Wilson, 1976a).

Adult mortalities were higher among exotic than local breeds and among local goats than local sheep. It is now generally agreed that local breeds are more adapted to their environment than exotic breeds and so are more resistant to infection. In terms of disease alone, one might expect a higher mortality rate in sheep than goats because, as Williamson & Payne (1974) have said, sheep are more susceptible to the ill-effects of intestinal parasites than other livestock. Mortality rates in the traditionally managed stock were considerably lower than on station and were approximately the same for both species.

A careful look at the disease syndromes and signs recorded in this paper show the need for improved nutrition and better housing and management. Two points mentioned by Peters et al (1981) need to be re-emphasized here: intensification of control and care of kid/lamb rearing and improving the standard of herd hygiene and disease monitoring. If this is done, most of these disease problems can be overcome and mortality rates in small ruminants could be considerably reduced.

ACKNOWLEDGEMENTS

I acknowledge my indebtedness to Fabian Ekue, Alphonse Nfi, Daniel Awa and John Tamufor for allowing me access to the veterinary reports on post-mortem examinations. I also thank Moses Asanji for his patience in reading through the manuscript and making valuable criticisms. The Cameroon Government provided the funding for this work.
Cameroon grassland (West African Dwarf type) buck at Mankon Station, Cameroon
CAUSES OF PRE-WEANING MORTALITY
IN SHEEP AND GOATS
IN THE CENTRAL MALI AGRO-PASTORAL SYSTEM

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SUMMARY
A study in six areas of central Mali, involving 1500 head of sheep and goats, was carried out from January-December 1983. The principal causes of pre-weaning mortality were identified. Reasons for death included weakness at birth, malnutrition, and pneumonia and pneumonia-complexes, haemorrhagic septicaemia, enteritis, peste des petits ruminants and sheep pox. The causes of 18 to 20 per cent of deaths could not be identified. Some suggestions for reducing pre-weaning mortality are made.
CAUSES DE MORTALITÉ AVANT LE SEVRAGE
CHEZ LES OVINS ET CAPRINS
DU SYSTEME AGROPASTORAL DU MALI CENTRAL

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RESUME

Au niveau de troupeaux d'ovins et de caprins de six localités appartenant au système agropastoral de la zone du Mali central et totalisant un effectif d'environ 1500 têtes, une enquête sur la base d'observations cliniques et d'examen post mortem fut menée de janvier à décembre 1983, afin d'identifier les causes de mortalité avant sevrage les plus courantes chez les agneaux et chevreaux. Les principales causes recensées furent la subvitalité à la naissance, la malnutrition, les pneumopathies, l'entérite, la pasteurellose, la peste des petits ruminants et la clavelée. Le pourcentage des causes inconnues ou indéfinissables est relativement important (18 à 20 p.cent). Des réflexions sont faites sur les possibilités de réduction de la mortalité avant sevrage chez les petits ruminants.
INTRODUCTION

Espèces très prolifiques, les petits ruminants pourraient encore contribuer d'avantage au mieux-être des éleveurs, s'ils ne payaient un lourd tribut à la pathologie.

La classe d'âge des jeunes avant le sevrage est particulièrement touchée.

L'étude de l'âge des animaux morts (toutes espèces confondues) montre que plus de 60 p.cent des mortalités se situent chez les jeunes avant sevrage avec 26,6 p.cent de morti-natalité et de mortalité au premier jour, 14,5 p.cent de un à sept jours, 8,2 p.cent de huit à trente jours, 22,8 p.cent entre un et trois mois et 16,4 entre trois et quatre mois (Wilson, de Leeuw & de Haan, 1983). Des études récentes confirment en général les niveaux de mortalité constatés (Traoré, 1983; 1984).

De ce fait, si les niveaux de mortalité sont assez bien connus à présent, les causes de mortalité, particulièrement celles intervenant avant le sevrage, restent à identifier.

L'objet de la présente étude est donc de déterminer, en partant d'observations cliniques faites tout au long de l'année 1983 au niveau des troupeaux de petits ruminants suivis par le CIPEA, les causes de mortalité avant sevrage les plus connues, afin de pouvoir entreprendre au niveau des mêmes troupeaux des essais visant à leur réduction.

MATERIEL ET METHODES

L'étude s'est déroulée au niveau de troupeaux ovins et caprins (1500 têtes environ dont les deux tiers de caprins) suivis depuis 1977 par le CIPEA et répartis entre six localités appartenant aux sous-systèmes agropastoraux du mil et du riz.

Le mode d'élevage est traditionnel et de type sédentaire. Les pâturages constituent l'essentiel de l'alimentation. Les jeunes sont gardés à la naissance dans des enclos séparés. D'abord en divagation dans les alentours immédiats du parc après le départ du troupeau au pâturage, ils suivent les adultes au pâturage à partir de trois mois. Le sevrage intervient vers cinq mois, le plus souvent à la faveur d'une nouvelle gestation. Les interventions vétérinaires sont occasionnelles.

Sauf à Dalonguébougou où une visite mensuelle fut effectuée compte tenu de l'éloignement, tous les troupeaux ont fait l'objet de visites médicales bihebdomadaires avec souvent des visites intermédiaires (pesées et contrôle) ou sur sollicitation des propriétaires d'animaux. Il convient de signaler que tous les animaux sont identifiés par des bagues numérotées à l'oreille.
Les cas de morbidité et de mortalité sont recensés. Le mois et la saison de mortalité ainsi que le type de naissance sont notés. Les antécédents sanitaires aussi bien du petit que de la mère sont enregistrés. Des examens post-mortem furent menés quand ceci était possible et des échantillons ont été envoyés au laboratoire pour examen microbiologique.

Les diagnostics posés ici sont le plus souvent basés sur des observations cliniques; ils sont de ce fait plus symptomatiques qu'étiologiques. Là où il y a manque de présomption sérieuse, la cause de mortalité est désignée comme inconnue.

L'analyse des données n'a concerné que les cas de mortalité avant sevrage intervenus entre janvier et décembre 1983 chez les sujets né-vivants âgés de un jour à cinq mois (la date de naissance pouvant être antérieure à janvier 1983). Les causes de mortalité sont étudiées selon l'espèce, l'âge, la saison et les troupeaux.

RESULTATS ET DISCUSSIONS

CAUSES DE MORTALITE AVANT SEVRAGE CHEZ LES CAPRINS

Les principales causes de mortalité chez les chevreaux de la naissance jusqu'à cinq mois sont présentées au tableau 1. Les pneumopathies et les affections à composante pulmonaire telles la peste des petits ruminants et la pasteurellose, constituent à elles seules plus de 50 p.cent des causes de mortalité. Celles-ci sont suivies des causes de mortalité d'origine non infectieuse (18 p.cent), caractérisées essentiellement par la subvitalité des chevreaux à la naissance mourant le plus souvent d'inanition dès les premiers jours ou succombant un peu plus tard à la première infection banale (non consommation du colostrum!). On peut noter ici que les naissances multiples (jumeaux, triplets) constituent des facteurs favorisants, dans la mesure où les causes de mortalité précitées y sont plus fréquemment rencontrées.

La répartition par classe d'âge des causes de mortalité (figure 1) montre deux périodes de "crise" pathologique: la période de huit à trente jours d'âge et celle de trois à cinq mois d'âge.

La première période (8-30 j) est caractérisée par des affections à étiologie non précisée et par un pourcentage relativement important de causes inconnues. Chez les chevreaux de trois à cinq mois, l'apparition d'affection à étiologie spécifique (pasteurellose, peste des petits ruminants) laisse percevoir des possibilités d'intervention plus concrètes (vaccination).
Tableau 1  Causes de mortalité avant sevrage chez les caprins  
(Pourcentage basé sur 60 mortalités)

<table>
<thead>
<tr>
<th>Causes de mortalité</th>
<th>Prévalence (%)</th>
<th>Facteurs prédisposants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immaturité/Subvitalité</td>
<td></td>
<td>Naissance multiple; maladie antépartum de la mère (Pasteurellose/Brucellose); mammite; mortalité de la mère</td>
</tr>
<tr>
<td>Lésion ou malformation</td>
<td>18,33</td>
<td></td>
</tr>
<tr>
<td>génétique/Inanition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malnutrition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entérite</td>
<td>11,67</td>
<td></td>
</tr>
<tr>
<td>Pneumopathie (non identifiée)</td>
<td>26,67</td>
<td>Saison froide</td>
</tr>
<tr>
<td>Septicémie/Pasteurellose.</td>
<td>13,33</td>
<td>Saison froide</td>
</tr>
<tr>
<td>Peste des petits ruminants</td>
<td>11,67</td>
<td>-</td>
</tr>
<tr>
<td>Inconnues</td>
<td>18,33</td>
<td>-</td>
</tr>
</tbody>
</table>

Figure 1  Répartition selon certaines variables des causes de mortalité avant sevrage chez les caprins au Mali central
La figure 1 montre également que l'essentiel des problèmes pathologiques chez les chevreaux s'observe en saison sèche. Les pneumopathies et la pasteurellose dominent entièrement le tableau pathologique en saison froide, cette saison étant la plus meurtrière. À cette période, la pasteurellose est redoutée des éleveurs chez lesquels une réelle psychose de la maladie règnera jusqu'au mois de Mars-Avril. En saison sèche chaude à côté de la peste des petits ruminants, on note une prépondérance des problèmes d'ordre nutritionnel (naissances des chevreaux subvitaux).

L'analyse des causes de mortalité à l'échelle du troupeau ou de la localité (figure 1) montre le caractère localisé de certains problèmes de santé. C'est ainsi que le Ranch/Niono, Kanabougou, Minimana et N'Tila se présentent comme des zones d'enzootie de pasteurellose et de peste des petits ruminants. B 10, Siraouma et Dalonguébougou, plus isolés et situés à des distances plus éloignées des premiers en ont été épargnés. Par contre, les affections à étiologie non spécifique telles les pneumopathies et l'entérite, les problèmes de naissances de chevreaux subvitaux, la malnutrition, sont présents à des degrés divers au niveau de tous les troupeaux visités.

CAUSES DE MORTALITE AVANT SEVRAGE CHEZ LES OVINS

Les causes de mortalité avant sevrage recensées chez les agneaux morts pendant la période de l'étude sont présentées au tableau 2. La clavelée et ses suites (malnutrition des agneaux) ont été à la base d'une grande partie des mortalités constatées. Elles sont suivies par ordre d'importance par les causes de mortalité inconnues. Les pneumopathies et la pasteurellose ont été beaucoup moins fréquentes que chez les chevreaux mais les cas d'indigestion et de diarrhée ont été sensiblement de même importance. Chez les agneaux également, les antécédents sanitaires de la mère influencent nettement les taux de survie du petit. Compte tenu du nombre plus limité des naissances multiples chez les ovins il n'a pas été possible d'étudier leur influence sur les causes de mortalité.

La figure 2 montre de façon nette l'existence des deux périodes de "crise pathologique" précédemment constatées chez les chevreaux: la classe d'âge de huit à trente jours et celle de trois à cinq mois. Les pneumopathies et l'effet indirect de la clavelée ont été essentiellement à la base des pertes au niveau de la classe d'âge de huit à trente jours alors que celles de trois à cinq mois ont surtout fait l'objet de perte directe de cette maladie. Les mortalités entre un à sept jours d'âge sont le plus souvent dues à l'immaturité et la subvitalité des agneaux à la naissance.
Tableau 2 Causes de mortalité avant sevrage chez les ovins
(Pourcentage relatif à 60 cas de mortalité)

<table>
<thead>
<tr>
<th>Causes de mortalité</th>
<th>Prévalence (%)</th>
<th>Facteurs Prédisposants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immaturité/Subvitalité</td>
<td></td>
<td>Maladies antépartum</td>
</tr>
<tr>
<td>Inanition/Malnutrition</td>
<td>23,33</td>
<td>(Pasteurellose? Brucellose?)</td>
</tr>
<tr>
<td>Accident/Traumatisme</td>
<td>1,67</td>
<td></td>
</tr>
<tr>
<td>Indigestion/Diarrhée</td>
<td>8,33</td>
<td>Début saison des pluies</td>
</tr>
<tr>
<td>Pneumopathie/Pasteurellose?</td>
<td>10,00</td>
<td>Saison froide</td>
</tr>
<tr>
<td>Clavelée (perte directe)</td>
<td>23,33</td>
<td></td>
</tr>
<tr>
<td>Clavelée de la mère (malnutrition de l'agneau)</td>
<td>13,33</td>
<td></td>
</tr>
<tr>
<td>Inconnues</td>
<td>20,00</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2 Répartition selon certaines variables des causes de mortalité avant sevrage chez les ovins au Mali central

Pourcent de tous les morts

Saisons: 1 Sèche et Froide; 2 Sèche et Chaude; 3 Pluvieuse; 4 Post-pluviale
Troupeaux: 1: B10; 2: Ranch/Niono; 3: N'Tila; 4: Siraouma; 5: Dalonguébougou
Chez les ovins également, les saisons sèche froide et sèche chaude constituent des périodes de crise. Elles sont caractérisées par l'évolution des pneumopathies, de la clavelée et de la malnutrition. Les diarrhées et indigestions plus fréquentes chez les agneaux de trois à cinq mois dominent en saison pluvieuse du fait de l'abondance d'herbes très jeunes et pauvres en cellulose (typanie/diarrhée). Les examens coprologiques ont permis de constater que certains agneaux étaient infestés de coccidies et de strongles. Partant de l'étude par troupeau ou localité, on remarque ici également une grande disparité dans les fréquences de causes de mortalité.

En se référant aux observations faites chez les deux espèces (figures 1 et 2), on constate que sauf au Ranch/Niono où les problèmes de santé semblent être aussi aigus chez les chevreaux que chez les agneaux, les autres localités présentent des situations pathologiques très différentes d'une espèce à l'autre. Ceci s'explique en partie par la réceptivité sélective aux agents pathogènes: la peste des petits ruminants constatée était adaptée à l'espèce caprine et la clavelée n'est pathogène que pour l'espèce ovine. Par ailleurs, les pneumopathies et la pasteurellose semblaient causer d'avantage de mortalités chez les caprins que chez les ovins.

POSSIBILITES DE REDUCTION DES TAUX DE MORTALITE AVANT SEVRAGE

Tout en ayant permis une certaine stratification des grandes composantes pathologiques responsables des mortalités de la zone, les résultats de cette étude manquent encore d'éléments d'appréciation définitive; au-delà des symptômes et qualifications cliniques l'objectif final serait une identification des pathogènes en cause. Par ailleurs, la situation rencontrée entre années, peut n'avoir pas été celle ayant prévalu plus tôt; par exemple, la clavelée qui a causé de sérieux dégâts à Dalonguébougou n'avait jamais été connue des villageois. Les résultats de cette étude demandent à être confirmés et approfondis (diagnostic microbiologique).

Mais il apparaît certain, compte tenu de la complexité des causes recensées, que toute tentative de réduction des taux de mortalité par des mesures isolées sera vouée à l'échec. Le problème doit être examiné dans sa globalité et sa résolution nécessitera une approche intégrant des actions telles que:

l'amélioration de la gestion des troupeaux;
le relèvement des niveaux alimentaires en saison sèche chez des catégories-cibles (gestantes, femelles suîties) et de façon prioritaire chez les ovins;
un programme de prophylaxie adapté à la situation épidémio-logique et aux possibilités financières des propriétaires d'animaux.
S'agissant de la composante sanitaire elle devrait viser l'élimination progressive des affections à étiologie spécifique telles la peste des petits ruminants, la pasteurellose et la clavelée dans les zones d'enzootie. Les maladies à étiologie complexe et moins spécifique (les pneumopathies, les entérites), les causes de mortalité d'origine non infectieuse (subvitalité et malnutrition) ainsi que les pertes "inconnues" ou dues aux prédateurs, pourraient être combattues de façon satisfaisante par l'amélioration des niveaux nutritionnels et de la gestion des troupeaux.

En ce qui concerne la gestion des troupeaux, il est souvent avancé l'idée d'un contrôle des périodes de monte afin d'orienter les mises-bas vers des périodes favorables. Les observations faites quant à l'effet des périodes et intervalles de mise-bas sur la mortalité avant sevrage (Wilson, de Leeuw & de Haan, 1983) montrent qu'un tel contrôle pourrait présenter des avantages en matière de santé animale; mais il convient de vérifier dans quelle mesure il ne conduirait pas à une perte pour l'éleveur en considérant l'indice de productivité annuelle par unité de reproductrice exprimé en kg de poids vif sevré par femelle. Il reste entendu qu'un tel contrôle serait peu profitable pour les éleveurs vivant en "symbiose complète" avec leur troupeau, compte tenu de la contribution quotidienne de celui-ci en lait. Ceci est rarement le cas chez les paysans-éleveurs des sous-systèmes agropastoraux de notre zone d'étude, plus portés sur la reproduction et l'exploitation numérique de leur cheptel.

CONCLUSION

Les taux de mortalité avant sevrage sont très élevés et appellent la prise de mesures visant à leur réduction. L'importance des mortalités à causes inconnues nous exhorte à intensifier les investigations de diagnostic. Certaines des causes connues laissent espérer une possible réduction des taux de mortalité enregistrée. Il s'agit d'une part des causes relatives à des problèmes de gestion (pertes, prédateurs, malnutrition) et d'autre part de celles consécutives à des maladies à caractère spécifique et contre lesquelles on dispose actuellement de possibilité de lutte par vaccination (pasteurellose, peste des petits ruminants, clavelée ou variole caprine).
PRODUCTION

PRODUCTIVITE
EVALUATION DE LA PRODUCTIVITE DES CAPRINS ET OVINS EN AFRIQUE

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RESUME

Les indices les plus fréquemment utilisés dans la littérature pour évaluer la productivité des ovins et des caprins sont analysés et leurs limites sont données. La productivité des ovins et caprins d'un groupe de ranches Masaï au Kenya est analysée et présentée sous forme de différents indices de production: indice de sevrage et à 18 mois, indice de troupeau, indice traditionnel et marge brute. Les analyses de la sensibilité des indices de sevrage et à 18 mois permet de montrer l'utilisation de ce type d'analyse pour identifier les priorités de la recherche et du développement. Il apparaît qu'un indice de production utilisable doit comporter: une caractéristique des extrants; une composante des intrants; la période considérée sur laquelle l'indice s'applique; des unités pertinentes aux extrants: une description la plus complète possible de l'environnement physique, économique et social. À partir de ces éléments, on peut conduire correctement l'interprétation de ces résultats. Une attention particulière doit être apportée à la définition claire des objectifs de l'analyse, et à l'utilisation d'indices appropriés à ce type de travail.
MEASURES FOR ASSESSING THE PRODUCTIVITY OF SHEEP AND GOATS IN AFRICA

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SUMMARY
A brief review of indices of sheep and goat production used in the literature is given and their limitations noted. Sheep and goat production on Masai group ranches in Kenya is described and results are presented in the form of various indices of production: weaning and 18-month indices, a flock production index, traditional index and gross margins. The results of sensitivity analyses on the weaning and 18-month indices are provided in order to demonstrate the use of this type of analysis in identifying research and development priorities. It is concluded that characteristics of useful production indices are: an output component; an input component; clear specification of the time period; units relevant to the output component; and accompaniment by as full a description of the physical, economic and social environments as possible so that a correct interpretation of results can be made. Care should be used in clearly defining the purpose of the analysis and using indices appropriate to that purpose.

INTRODUCTION

Events in Africa in recent years have highlighted the need for development of its agricultural production. There is a tendency for livestock to be relatively more important in the economies of the poorest countries in Africa, which are some of the poorest countries in the world. Within African society, sheep and goats comprise a greater proportion of the total wealth of poor families than of richer families (Peacock, 1984). Thus improvements in the production of sheep and goats is likely to improve the welfare of some of the poorest of the poor but in order to improve production it is important to make quantitative assessments of present biological and economic productivity. This paper reviews measures of output used by the International Livestock Centre for Africa (ILCA) and others, assesses the advantages and disadvantages of each type of measurement and proposes new indices and methods for their analysis.

For many years animal breeders have based selection between or among breeds on comparisons of productivity in the same environment (Trail & Durkin, 1982). Recently enough data has become available to allow the comparison of breeds in different ecological zones, production systems and under different management levels (Wilson, 1980).

MEASUREMENTS OF PRODUCTIVITY

Many possible measures can be used to quantify sheep and goat productivity (Knipscheer, Kusnadi & de Boer, 1984). The measure used should be appropriate to its purpose and will be tempered by the availability of suitable data. Possible purposes may be broadly categorised as: description; analysis; and prescription. Breed evaluation aims at describing performance within a given environment such as a research station (e.g. Fall et al, 1982), whereas offstation studies of traditional livestock production are more concerned with an analysis of performance in order to prescribe improvements directly or identify areas needing further research.

Measures used in the literature so far may be classified as describing:

- individual production traits;
- reproductive performance;
- reproductive performance and offspring growth;
- flock production indices.
INDIVIDUAL PRODUCTION TRAITS

Single parameters such as growth rate, weaning weight, mortality and parturition interval describe individual aspects of production. Under experimental conditions they are used to identify causal relationships between a specific input and a particular output. In studies of traditional animal production they can isolate weak aspects of production but generally off the research station it is more appropriate to place emphasis on the cumulative effects of individual traits on whole flock productivity as that should be the focus of attention.

REPRODUCTIVE PERFORMANCE

An example of a reproductive performance index is that used by Fitzhugh & Bradford (1983) which they erroneously define as a Flock Productivity Index (FPI):

\[
FPI = \frac{\text{Litter size} \times \text{offspring survival} \times \text{birthweight}}{\text{Parturition interval}}
\]

This index has many limitations. No account is taken of lambing or kidding rate (females giving birth per females exposed to male) or female longevity and normally yearly production is a more useful time period than per day of parturition interval.

REPRODUCTIVE PERFORMANCE AND OFFSPRING GROWTH

The indices favoured by ILCA for sheep and goats in Fall et al (1982), Wilson (1983b) and Wilson, Peacock & Sayers (1985) are:

\[
\text{Index I} = \frac{\text{Total liveweight of litter at 150 days} \times 365}{\text{Subsequent parturition interval in days}}
\]

This index expresses parturition interval as a percentage of a full year and considers the production of young to weaning. This index may then be expressed per kg dam weight, considering her as the major input to the weight of young at weaning:

\[
\text{Index II} = \frac{\text{Index I}}{\text{Post-partum weight dam}}
\]
or further expressed per metabolic weight of dam:

\[
\text{Index III} = \frac{\text{Index I}}{\text{Post-partum weight dam}^{0.73}}
\]

As the feed requirement of the dam is more closely correlated with metabolic rather than with the real weight, Index III more accurately considers the main input (feed) to the offspring production. Fall et al. (1982) also include dam viability in their index of 'flock' productivity.

There are many shortcomings to the indices so far examined. First, they do not take into account the number of males which have to be maintained to serve the flock. Second, they do not include post weaning growth as production nor the detrimental effects of maintaining 'old' males (those past optimum selling age) and their depressive effect on overall production when considered in commercial terms. Third as the indices can only be calculated from the records of individual productive females any unproductive members of the breeding flock will not be included and so their maintenance cost is not accounted for. Peacock (1983) found that 36 per cent of potential breeding females in Masai flocks had never given birth.

**THE KENYA STUDY SAMPLE**

A two year study of sheep and goat production on three adjacent group ranches in Kajiado district was carried out as part of a multidisciplinary system study of Masai pastoralism. The ranches had been developed for different periods of time: Olkarkar was the most developed, Mbirikani the least and Merueshi intermediate. Data were obtained from a random sample of 89 households, stratified according to a measure of relative wealth. Animals were tagged and individual records established of growth, mortality and reproductive performance as each entered the continuous survey. Data on each household's income, expenditure, economic uses of livestock and grazing management were also recorded. A survey of population structures was carried out at the beginning of the study and a rapid survey of population structure and reproductive performance took place at the end of the study (Peacock, 1983; King et al., 1984).
Rainfall throughout the study was below average, particularly on Mbirikani (<400 mm per year) and these harsh conditions were further exacerbated by an outbreak of the tick-borne virus disease, Nairobi sheep disease, which spread out from Mbirikani. These circumstances resulted in high mortality rates among both adult and young stock and, when combined with the Masai practice of seasonal breeding control, caused poor reproductive performance. During this difficult period many sheep and goats were slaughtered in extremis. The difference between this forced slaughter and that of stock voluntarily slaughtered was recorded in the study.

Although cattle provide the majority of Masai subsistence sheep and goats have many economic and cultural functions. They are also used in a number of customary transactions (gifts, loans and exchanges) which contribute to maintaining the owner's social network. Increasingly, Masai are selling sheep and goats to meet small cash demands. Of the ILCA study sites, Olkarkar residents, due to their greater access to markets, engaged in a greater proportion of cash transactions whereas those on Mbirikani were more traditional in their use of sheep and goats.

**CALCULATION OF INDICES**

The indices used to assess the productivity of sheep and goats in this study were developed for particular analytical purposes and need to be understood in the context of the social and environmental conditions which prevailed during its course.

In order to compare the performance of ranches and strata (per year) at producing young and rearing them to weaning and to a reproductively active age (18 months) the index used was:

\[
\text{Weaning and 18-month Index} = \frac{\text{Number of parturitions} \times \text{Litter size} \times \text{Survival} \times \text{Weight}}{\text{Mean weight of flock}}
\]

These indices use the proportion of potential breeding females giving birth per year (lambing/kidding rate) as the reproductive component of the index. This circumvents problems associated with the use of mean parturition interval in a study of only two years duration. The mean weight of the flock is a representation of the demographic structure of the flock.
To assess overall flock production where units may be numbers, weights or monetary value a Flock Productivity Index was developed:

\[
\text{FPI} = \frac{\text{Sales slaughter} + \text{Net inventory change}}{\text{Initial flock size}}
\]

Gross margins were calculated to estimate the economic efficiency of the sheep and goat enterprises:

\[
\text{Gross Margin} = \left( \frac{\text{Value of net inventory change} + \text{stock sales} + \text{value of voluntary slaughter} + \text{sale of hides}}{\text{costs of maintenance} + \text{cost of stock purchases}} \right)
\]

Finally, to make some judgements of Masai sheep and goat production according to the society's own criteria, an index was developed to assess the relative success of the provision and use of male castrate animals in the flock:

\[
\text{Traditional Index} = \frac{\text{Voluntary slaughters} + \text{Sales} + \text{Social transactions} + \text{Increase in number of castrates}}{\text{Total flock size}}
\]

RESULTS OF ANALYSES OF PRODUCTIVITY

WEANING AND 18-MONTH INDICES

Weaning and 18-month indices are presented by ranch and wealth stratum in Table 1 and represent the liveweight (g) produced per kg of flock weight maintained per year. As previously noted these indices were calculated for a period of generally unfavourable conditions. They show that conditions were more favourable on Olkarkar than Mbirikani and that the year following weaning is an important period in production. On Olkarkar there were no production difference between species. At Mbirikani sheep produced more offspring, more successfully, than goats. These indices may also, of course, be calculated for different types and seasons of birth, parity number
Table 1  Weaning and 18-month indices (liveweight (g) produced per kg flock maintained per year)

<table>
<thead>
<tr>
<th>Ranch/stratum</th>
<th>Weaning</th>
<th>18 month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sheep</td>
<td>Goats</td>
</tr>
<tr>
<td>Olkarkar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor</td>
<td>107</td>
<td>98</td>
</tr>
<tr>
<td>medium</td>
<td>106</td>
<td>110</td>
</tr>
<tr>
<td>rich</td>
<td>116</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>94</td>
</tr>
<tr>
<td>Mbirikani</td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor</td>
<td>60</td>
<td>29</td>
</tr>
<tr>
<td>medium</td>
<td>62</td>
<td>36</td>
</tr>
<tr>
<td>rich</td>
<td>57</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>61</td>
<td>25</td>
</tr>
</tbody>
</table>

or flock in the same manner as the indices I, II and III of Wilson, Peacock & Sayers (1985)

SENSITIVITY ANALYSIS

In order to determine the parameters which have the greatest effect on production (to weaning and to 18 months) and the extent to which the indices are responsive to change in one or more parameters, sensitivity analyses were undertaken. Sensitivity analysis can also be used to estimate the risks involved in production as well as helping to define research priorities (Dent & Blackie, 1979).

Various approaches can be adopted. If a feasible range of parameter values is known this can be divided into 100 parts and the level raised to assess its impact on an output criterion (index). However, more appropriate to survey statistics is to change a variable by one standard error which is an objective quantity with a known probability of occurrence. In order to do this the standard errors must be tied to a common number of animals: in the example presented the mean holding size in Mbirikani of 65 sheep and 64 goats was adopted. Litter size, mortality rates, and weights at 150 and 550 days were all varied positively and negatively by one standard error. Flock weight was altered by one standard error of the proportion of 'old'
castrates in Mbirikani flocks. The number of births per year was estimated from the rapid survey data. Standard errors were obtained from the variation in this parameter among sample flocks. Developed over several breeding seasons, the rapid survey estimate better represents a mean than the rather extreme value recorded during the two year study.

Results from the sensitivity analyses for Mbirikani indices are presented in Figures 1 and 2. The slope of the line is an indication of the effect of the parameter on the output criterion. The slope will be straight if the parameter is part of the numerator and bent if in the denominator or if it is from a combination of parameters.

Figure 1 Sensitivity analyses of parameters in the weaning index for a) sheep and b) goats on Masai group ranches in Kenya
In sheep the parameter accounting for the greatest variation in output to weaning was the proportion of breeding females giving birth per year. Mortality was next most important followed by the percentage of 'old' castrates. Weight at weaning and litter size were of negligible importance. When an increase in the proportion breeding was combined with a decrease in the 'old' castrates the largest improvement resulted this also being greater than the simple sum of the component parameters.

In goats, mortality was the parameter accounting for most variation. Mortality, proportion giving birth and proportion of 'old' castrates were grouped ahead of litter size and weaning weight. Forming a third group were the combinations of: mortality with proportion giving birth; mortality with percentage 'old' castrates; and proportion giving birth with percentage 'old' castrates. Clearly, improved reproductive performance and reduced mortality should be priority areas for research and development.

FLOCK PRODUCTION, OFFTAKE RATES AND TRADITIONAL INDICES

Table 2 shows FPI in numbers of animals used or produced per head of flock maintained and from these gross (including animals in social transactions) and net
Table 2  Flock production indices (number per head flock per year), gross and net offtake (per cent) and traditional index (number per head of flock per year)

<table>
<thead>
<tr>
<th>Ranch/stratum</th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FPI</td>
<td>Gross</td>
</tr>
<tr>
<td>Olkarkar</td>
<td>0.30</td>
<td>12.4</td>
</tr>
<tr>
<td>poor</td>
<td>0.35</td>
<td>20.0</td>
</tr>
<tr>
<td>medium</td>
<td>0.29</td>
<td>12.5</td>
</tr>
<tr>
<td>rich</td>
<td>0.25</td>
<td>4.8</td>
</tr>
<tr>
<td>Mbirikani</td>
<td>0.16</td>
<td>28.0</td>
</tr>
<tr>
<td>poor</td>
<td>0.27</td>
<td>44.4</td>
</tr>
<tr>
<td>medium</td>
<td>0.18</td>
<td>27.8</td>
</tr>
<tr>
<td>rich</td>
<td>0.05</td>
<td>11.7</td>
</tr>
</tbody>
</table>

offtake rates of each species by ranch and stratum.

At Olkarkar sheep were more productive (in these terms) than goats and managed to achieve a slightly higher gross offtake rate than goats while flock size also increased, whereas the goat flock decreased by 5.6 per cent. Mbirikani sheep and goats were similar in overall production but had higher gross offtake rates mainly due to forced slaughterings. They did not manage to compensate for this offtake because of poor reproductive performance so, in fact, net offtake rates were higher than gross rates. Trends for higher gross offtake rates in the poor strata and lower rates in the richer ones emphasise the greater use of sheep and goats by poor families.

The traditional index is a measure of the capacity to use castrated stock for a variety of purposes as well as the ability to replace the animals used. When considered in these terms the poor performance of Mbirikani flocks calculated by other indices was no longer evident as both Mbirikani and Olkarkar performed equally on this index. This emphasises the need for care in the choice of an index to fit the purpose of the analysis, as very different results can be obtained through different measurements.
GROSS MARGINS

Economic analyses, in monetary terms, are difficult to apply to traditional production where many outputs do not enter the market and most inputs are not purchased. Assigning monetary values to all outputs and inputs can only be achieved by application of certain assumptions to the calculations. This is quite legitimate as long as any such assumptions are explicitly stated and consistently applied.

Table 3 presents gross margin calculations for Olkarkar and Mbirikani. Income was credited as money derived from livestock and hide sales plus the value of any change in livestock inventory. Stock which were voluntarily slaughtered were assumed to be adults and were valued at the mean adult sale price. Stock involuntarily slaughtered were excluded from the calculations. The main costs considered were those of purchased inputs (acaricide, antibiotics, anthelmintics and salt) and those of purchased stock. Forage and labour were assumed to have no cost. Employment opportunities in Kajiado are extremely limited and applying even a minimal opportunity cost to labour would create artificial distortions.

As might be expected from the poor biological performance, economic returns were low. Mbirikani sheep made a net loss. The return on capital from Olkarkar sheep and from Olkarkar and Mbirikani goats was also low. Again it must be emphasised that this was performance during a period of drought and epidemic disease. In 'normal' years, if certain simple innovations were adopted, a sustainable yield of 30 per cent for sheep and 26 per cent for goats could be achieved (Peacock, 1984).

<table>
<thead>
<tr>
<th></th>
<th>Sheep</th>
<th>Goats</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Olkarkar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flock gross margin</td>
<td>1,248</td>
<td>-348</td>
</tr>
<tr>
<td><strong>Mbirikani</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross margin: per head</td>
<td>13</td>
<td>-5</td>
</tr>
<tr>
<td>per breeding female</td>
<td>27</td>
<td>-4</td>
</tr>
<tr>
<td>Return on capital (per cent)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Kenya shillings 12 = US$ 1.00 approximately
CONCLUSIONS

The indices used have given different pictures because each index represents a different viewpoint. Even a cursory examination of the different indices shows that they rank the ranches and livestock species in different orders. This shows the distortions which may emerge if a partial analysis is carried out by examining only one aspect of production. For example, at weaning Olkarkar sheep were the most productive but when the analysis was extended to 18 months goats at Olkarkar were the most productive. There is evidently a need to be aware of the limitations of indices and to accept that one index alone cannot provide a definitive account of production.

For an index of production to be useful it must possess the following characteristics:

- an output component;
- an input component;
- a clear specification of the time period;
- units relevant to the subject;
- a description of the context under which the results were obtained and to which the index applies.

Indices specifically developed for the analysis of a particular situation are probably of greater assistance in improving that situation than the use of standardised measures. Standard measures may allow the comparison of species among countries or production systems but may not necessarily reveal weaknesses in the internal operation of the production system. The exception to this might be if the concept of a 'yield gap' was applied (Knipscheer, Kusnadi & de Boer, 1984). The term yield gap applies to the differences between production on research stations and that offstation, the magnitude of which indicates the potential for improvement.

The output part of the index should include all relevant components and if output included hair, wool or milk then they should be incorporated into the index. If they were traded, a monetary value could be assigned but if not conversion into units of energy or protein might be considered.

The input to the index should be that resource which is considered as most requiring improvement. In the Masai case this is the flock itself, as in areas of communal pasture this is the resource which is owned and can be manipulated by
the owner. If production were from a fixed area of land then it might be more appropriate to examine production per land unit. If labour was limiting through competition with another enterprise then production per unit of labour would perhaps be a more suitable measure.

The time period should normally be one year unless there is good reason to use an alternative. The units of the index should be associated with the type of output and the purpose of the analysis. In order to interpret indices correctly an adequate description of the physical, economic and social environment of production should accompany their presentation.

The use of production indices can be extremely useful and enlightening but care must be exercised in the choice of appropriate ones so that correct conclusions are made about present production. It is only in this way that reliable recommendations can be made to improve sheep and goat production in Africa.

ACKNOWLEDGEMENTS

Field work was carried out by the author while employed by ILCA. Interpretation of results and conclusions are, however, the author's own responsibility. Mike Ole Make, Tole Narok and Robin Sayers are thanked for their various contributions.
PRODUCTIVITY UNDER STATION MANAGEMENT
OF AFRICAN LONG-FAT-TAILED SHEEP IN SOUTHERN RWANDA

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SUMMARY

Results of preliminary analyses of the production of the Rwanda sheep (African long-fat-tailed type) under station management are presented. Age at first lambing was 713.7 days, lambing interval was 406.0 days and litter size was 1.38 young per birth. Liveweight gain to 150 days (weaning) was 81.3 g/d. Abortions totalled 2.9 per cent of all parturitions. Total mortality rate to weaning was 17.5 per cent. Litter weight at weaning was 18.8 kg. Production of the local sheep, expressed as productivity indices, could be improved without resorting to out-crossing by reducing both the parturition interval and the pre-weaning mortality rate.
PRODUCTION EN STATION DU MOUTON A QUEUE GRASSE LONGUE
DE L'AFFRIQUE AU SUD DU RWANDA

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2. Centre International pour l'Elevage en Afrique (CIPEA), B.P. 5689, Addis Abéba, Ethiopie

RESUME

Les résultats d'analyses préliminaires des données ISAR sur le mouton local au Rwanda, mouton du type à queue grasse longue de l'Afrique sont rapportés. L'âge à la première mise-bas était de 713,7 jours, l'intervalle entre agnelages successifs était de 406,0 jours et la taille de la portée de 1,38 produits. Le gain quotidien moyen jusqu'à 150 jours était de 81,3 g par jour. Le taux d'avortement était de 2,9 p.cent. Avec les morts-nés et la mortalité des jeunes jusqu'à 150 jours, ce taux atteint les 17,5 p.cent. Le poids de la portée sevrée par femelle et par an était de 18,8 kg. Les indices de productivité du mouton local pourraient être améliorés en race pure en diminuant notamment la longueur de l'intervalle entre les mises-bas et le taux de mortalité.

INTRODUCTION

Le mouton rwandais appartient au groupe africain des moutons à queue grasse couvrant la zone allant de l'Ethiopie au nord à l'Afrique du sud au sud. De nombreuses petites différences permettent de distinguer dans ce groupe quelques sous-groupes, dont celui du mouton à queue grasse de l'Afrique (East-African long-fat-tailed) constitué de moutons de petite taille, à la robe aux couleurs variables, auquel appartient le mouton local du Rwanda et du Burundi. Ce mouton est rustique, adapté à une diversité d'écoclimats, allant des zones arides aux zones sub-humides et du niveau de la mer à 3000 m d'altitude. Le poids des femelles à l'âge adulte est d'environ 30-35 kg, les mâles étant légèrement plus grands. Il donne souvent naissance à des jumeaux et parfois à des triplets. Il peut donner 15 à 18 kg de carcasse parée à 1,0-1,5 an d'âge. Malgré ces caractéristiques, il est considéré comme peu productif par beaucoup de chercheurs et agents de développement.

A l'Institut des Sciences Agronomiques du Rwanda, des recherches ont été menées sur le mouton local depuis 1972. Il était même prévu d'essayer son croisement avec des moutons de races importées, en l'occurrence le mouton Dorper et le mouton Corriedale, mais il ne fut pas possible d'obtenir les géniteurs.

MATERIEL ET METHODES

Le programme de recherche fut conduit dans les stations de Songa (1800 m altitude; 2°24'S, 29°47'E) et de Rubona (1706 m; 2°29'S, 29°46'E) dans la région sud de la zone des hauts plateaux du Rwanda. La station de Songa offre 775 ha de pâturages dont seulement 40 sont réservés aux moutons. À Rubona, 20 ha de pâturages sur un total de 400 sont utilisés pour les moutons. La station de Songa compte environ 500 ovins et 900 bovins tandis que Rubona compte 200 ovins et environ 350 bovins. La pluviosité annuelle s'élève à 1100 mm et 1200 mm de pluies respectivement à Songa et à Rubona, réparties sur deux saisons; une grande saison allant de mars à mai, et une petite saison allant de mi-septembre à décembre. La "petite saison sèche" de janvier-février peut en effet connaître beaucoup de pluies, alors que de juillet en début septembre c'est la grande saison sèche. Il ne tombe pratiquement pas de pluies en juin et en juillet et seulement très peu en août.

Des espèces épineuses d'acacias constituent la végétation principale d'arbres, tandis que le Brachiaria platynota et l'Eragrostis violaceum à Rubona d'une part, le Brachiaria platynota, l'Hyparrhenia filipendula et le Themeda triandra à Songa.
d'autre part, constituent l'essentiel de la végétation herbacée.

Tous les renseignements nécessaires à la bonne marche d'un programme de recherche sont gardés à la station; des fiches individuelles sont tenues régulièrement à jour à partir des registres de terrain. La mise en reproduction est périodique mais les femelles sont mises en lutte pour la première fois à 23 kg ou à 16 mois d'âge. Le sevrage est en principe fait pendant le quatrième mois après la naissance: pour 1689 cas répartis sur la période de 12 ans la moyenne était de 110 jours. La castration des mâles non retenus pour la reproduction en station ou la diffusion en milieu rural devrait se faire à trois mois, mais la moyenne était de 109 jours.

Les données présentées ici proviennent des analyses préliminaires. Ces analyses ont été menées pour fournir à l'ISAR des indications sur le progrès réalisé jusqu'ici et pour l'aider à mieux planifier sa recherche future.

RESULTATS

PERFORMANCE DE REPRODUCTION

Age à la première mise-bas

L'âge moyen à la première mise-bas était de 713,7 jours. La distribution pour ces âges est donnée à la figure 1. Pour l'ensemble des femelles, la première mise-bas est groupée autour de la moyenne de 24 mois dû à la politique ISAR de mise en reproduction des antenaises.

La saison a un effet hautement significatif sur ce critère; les animaux nés sur les périodes janvier, mai, juin, septembre et novembre agnèlent plus jeunes que ceux nés au cours des autres périodes. Compte tenu de la politique de mise au bélier d'animaux pesant au moins 23 kg, les animaux ayant le meilleur pâturage après leur naissance ont les meilleures croissances et donc sont susceptibles d'être luttés plus jeunes.

L'année de naissance a également un effet hautement significatif sur l'âge au premier agnelage. Les animaux nés en 1979 ont mis bas plus tardivement que ceux nés les autres années. Cet effet est peut-être dû à une mauvaise année ou à une réorganisation de la gestion des stations.

Le rang de naissance n'a pas d'effet sur ce critère mais par contre, les animaux nés doubles sont significativement plus tardifs que les animaux nés simples.
Figure 1 Répartition des âges à la première mise-bas pour les ovins au Rwanda

L'intervalle entre agnelages successifs étaient de 406,0 jours. Leur distribution est donnée à la figure 2. Il apparaît que le planning de conduite du troupeau en matière de reproduction est suivi avec rigueur. Les intervalles entre agnelages montrent que seulement 10,0 p.cent de l'effectif des reproductrices sont non gravides. Ce résultat apparaît remarquable dans la mesure où la lutte est très courte (quatre semaines), la majorité des reproductrices ne présentent qu'une seule ovulation durant cette période. Ces performances pourraient être améliorées en augmentant la durée de la lutte d'une semaine (pour augmenter le nombre de brebis ayant deux oestrus) et en utilisant "l'effet mâle" (introduction quatre à cinq semaines avant la lutte d'un mâle vasectomisé) comme inducteur d'oestrus.

L'analyse de variance et les moyennes estimées montrent une influence hautement significative de la station sur l'intervalle entre deux mises-bas consécutives. Les meilleures conditions de pâturage et de complémentation alimentaire à la station de Songa peuvent expliquer les meilleurs résultats obtenus à cette station.
La saison d'agnelage a également un effet hautement significatif sur l'intervalle. Les animaux ayant mis bas en saison des pluies octobre, novembre, décembre présentent un intervalle d'agnelage significativement plus court que ceux ayant mis bas en saison sèche. Il est possible que cette différence soit imputable au régime climatique mais la conduite d'élevage peut aussi avoir une influence.


La répétabilité de ce caractère a été évalué à 0,18 ± 0,039.

Taille de la portée
La taille de la portée est de 1,38 produit. Sur 1351 mises-bas observées, 746 furent simples, 589 doubles et 16 triples. Il n'existe pas d'effet station sur la taille
de la portée. La saison de naissance influe significativement sur la taille de la portée; les portées de novembre et décembre sont plus grandes que celles des autres mois. L'effet année est également important, les années 1979, 1981 et 1982 furent très bonnes. Le rang de mise-bas enfin intervient sur la taille de la portée: les primipares ont moins de naissances multiples que les multipares. La répétabilité du caractère a été de 0,19 et l'héritabilité a été de 0,18.

Taux de reproduction annuel

La politique de sélection du mouton local en race pure a permis, pour la taille de la portée, de gagner environ 0,04 jeunés par portée et par an entre 1975 et 1982. Le taux de reproduction annuel obtenu à partir de la taille moyenne de la portée x 365/l'intervalle moyen de mise-bas, était de 1,24 agneau né par brebis et par an en moyenne.

De façon synthétique, les principaux paramètres de reproduction sont présentés dans le tableau 1.

PERFORMANCES DE CROISSANCE

Le gain quotidien moyen était de 92 g/jour jusqu'au sevrage. Du sevrage à 18 mois, le taux de croissance était de 47,1 g/jour. Les mâles croissaient plus vite que les femelles à tel point qu'à 18 mois les femelles ne pesaient que 87,5 p.cent du poids des mâles (figure 3).

Les facteurs agissant sur le poids eurent des effets attendus. A la naissance, les mâles pesaient 200 g de plus que les femelles. Les agneaux nés simples pesaient

Tableau 1 Principaux paramètres de reproduction des ovins aux stations de l'ISAR, Rwanda

<table>
<thead>
<tr>
<th>Paramètres</th>
<th>n</th>
<th>x</th>
<th>± e.s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age au premier agnelage (j)</td>
<td>343</td>
<td>713,7</td>
<td>9,38</td>
</tr>
<tr>
<td>Intervalle entre agnelages (j)</td>
<td>587</td>
<td>406,0</td>
<td>7,61</td>
</tr>
<tr>
<td>Taille de la portée (nombre)</td>
<td>1084</td>
<td>1,38</td>
<td>0,06</td>
</tr>
</tbody>
</table>
en moyenne 510 g de plus que ceux nés multiples et ceux nés des primipares étaient plus légers que ceux nés des multipares. Le poids à la naissance a baissé au fil des années, sans doute à cause du progrès réalisé sur les naissances multiples.

Au sevrage, les différences dues au sexe devenaient plus grandes, et celles dues au type de naissance se maintenaient. Les agneaux nés des mères âgées sont plus lourds que ceux nés des primipares. Le poids au sevrage a baissé entre 1975 et 1982, ce qui, lui aussi, doit être la conséquence du progrès réalisé sur la taille de la portée pendant cette période.

A l'âge de 18 mois et au-delà, le dimorphisme sexuel se faisait encore sentir, alors que l'effet du rang de naissance, de la saison, de l'année et de la station avaient disparu. La sélection n'a pas encore eu d'effet significatif sur le poids adulte des animaux.

MORTALITÉ

Le taux d'avortement était de 2,9 p.cent de toutes les naissances. La mortalité avant sevrage (jusqu'à 150 jours) s'élevait à 17,5 p.cent en moyenne et était un peu plus élevée chez les mâles (18,7 p.cent) que chez les femelles (16,3 p.cent). Les
agneaux nés des mères plus âgées (> cinq rangs) ont un taux de mortalité plus élevé que ceux nés des mères plus jeunes. Au-delà de 150 jours, cependant, la situation est inversée. Il meurt plus d'agneaux nés de mères jeunes (< trois rangs) que d'agneaux nés de mères plus âgées. Le type de naissance influe beaucoup sur les taux de mortalité. Jusqu'à 150 jours d'âge, il meurt en moyenne plus d'agneaux nés multiples (22,0 p.cent) que d'agneaux nés simples (13,0 p.cent). Cette différence se maintient au fil du temps.

La saison de naissance influe beaucoup sur le taux de mortalité. Les animaux nés ou élevés à leurs jeunes âges pendant la grande saison sèche et les agneaux nés au mois d'octobre, sont plus vulnérables que ceux nés à d'autres saisons. Les agnelages différés de novembre à décembre sont plus favorables à la survie des agneaux: les taux de mortalité sont deux à trois fois plus faibles, comparés aux agnelages aux autres moments de l'année.

Un grand effort a été fait pour réduire ce taux de mortalité. Entre 1975 et 1982, ce taux a baissé de 0,7 p.cent par an en moyenne pour les 150 premiers jours de vie. Il a fallu exclure les taux de mortalité de l'année 1977 qui, très faibles, paraissaient anormaux. Il se pourrait qu'il y ait eu quelques négligences dans l'enregistrement des données pendant cette période.

INDICE DE PRODUCTIVITÉ

Dans le but de fournir quelques indications comparatives des performances, des indices de production ont été mis au point à partir des données relatives aux poids de la portée au sevrage, et à l'intervalle entre agnelages successifs. La mortalité est implicitement incluse dans ces indices vu qu'ils s'annulent quand un agneau naît simple, et qu'ils se réduisent d'autant quand un agneau ou plus d'un agneau né d'une portée multiple meurent. L'indice utilisé (poids de la portée à 150 jours x 365/intervalle à la mise-bas suivante) n'est qu'un modèle pour exprimer le poids vif total d'agneaux produit par femelle mise en reproduction par an. Des indices relatifs à la production par kg de femelle mise en reproduction par an et par kg de poids métabolique de la femelle mise en lutte et par an auraient également pu être utilisés. Le tableau 2 fournit des données sur ces indices pour chacune des variables agissant sur eux.

L'influence de la saison sur les taux de mortalité des agneaux se répercute sur les indices de productivité des brebis mettant bas. Les mises-bas intervenant autour ou pendant la grande saison sèche résultent en des indices de productivité plus faibles.
Tableau 2  Indices de productivité du mouton à queue grasse longue de l’Afrique en station au Rwanda

<table>
<thead>
<tr>
<th>Variables</th>
<th>Indice I (kg)</th>
<th>Indice II (g)</th>
<th>Indice III (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moyenne générale</td>
<td>16,89</td>
<td>0,50</td>
<td>1,30</td>
</tr>
<tr>
<td>Saison de naissance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Janvier-Mai</td>
<td>17,87</td>
<td>0,51</td>
<td>1,33</td>
</tr>
<tr>
<td>Juin-Septembre</td>
<td>13,92</td>
<td>0,41</td>
<td>1,07</td>
</tr>
<tr>
<td>Octobre</td>
<td>14,64</td>
<td>0,44</td>
<td>1,14</td>
</tr>
<tr>
<td>Novembre</td>
<td>18,29</td>
<td>0,53</td>
<td>1,39</td>
</tr>
<tr>
<td>Décembre</td>
<td>19,72</td>
<td>0,69</td>
<td>1,55</td>
</tr>
<tr>
<td>Année de naissance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>7,83</td>
<td>0,15</td>
<td>0,97</td>
</tr>
<tr>
<td>1979</td>
<td>19,01</td>
<td>0,58</td>
<td>1,49</td>
</tr>
<tr>
<td>1982</td>
<td>20,71</td>
<td>0,68</td>
<td>1,71</td>
</tr>
<tr>
<td>Rang de naissance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>22,63</td>
<td>0,80</td>
<td>1,96</td>
</tr>
<tr>
<td>2</td>
<td>18,82</td>
<td>0,63</td>
<td>1,58</td>
</tr>
<tr>
<td>3</td>
<td>17,88</td>
<td>0,58</td>
<td>1,38</td>
</tr>
<tr>
<td>4</td>
<td>15,74</td>
<td>0,42</td>
<td>1,14</td>
</tr>
<tr>
<td>5</td>
<td>14,26</td>
<td>0,36</td>
<td>0,99</td>
</tr>
<tr>
<td>6+</td>
<td>12,00</td>
<td>0,25</td>
<td>0,74</td>
</tr>
<tr>
<td>Type de naissance:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>11,65</td>
<td>0,34</td>
<td>0,89</td>
</tr>
<tr>
<td>Multiple</td>
<td>22,13</td>
<td>0,66</td>
<td>1,70</td>
</tr>
</tbody>
</table>

Les meilleurs indices de productivité sont obtenus pour les mises-bas différées de novembre-décembre.

L’effet du rang de mises bas sur les indices de productivité des brebis reflète également son effet sur la mortalité des agneaux. Les brebis les plus jeunes ont des indices de productivité plus élevés que les brebis plus âgées. Les mises-bas multiples sont plus bénéfiques pour les indices de productivité que les mises-bas simples, les indices de ces premières étant presque le double de ceux pour les mises-bas simples.

Entre 1975 et 1982, les indices de productivité ont subi une amélioration très nette. L’indice I a augmenté de 1,8 kg par an en moyenne, l’indice II de 75,7 g et l’indice III de 177,1 g.

Au tableau 3 sont consignées des indications du progrès fait sur les principaux paramètres de production au cours des 12 ans d’expérience.
Tableau 3  Effet de la sélection sur les principaux paramètres de production des moutons rwandais entre 1975 et 1982

<table>
<thead>
<tr>
<th>Paramètres</th>
<th>Valeur par an</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taille de la portée (nombre)</td>
<td>+0,04</td>
</tr>
<tr>
<td>Poids à la naissance (kg)</td>
<td>-0,14</td>
</tr>
<tr>
<td>Poids au sevrage (kg)</td>
<td>-0,34</td>
</tr>
<tr>
<td>Taux de mortalité 0-150 jours (%)</td>
<td>-0,70</td>
</tr>
<tr>
<td>Indice I de productivité (kg)</td>
<td>+1,61</td>
</tr>
</tbody>
</table>

**DISCUSSION**

L'âge à la première mise-bas apparaît retardé en milieu contrôlé comparé à celui habituellement observé en système d'élevage traditionnel. La politique ISAR de ne mettre les brebis au bélier qu'à 23 kg de poids vif ou 16 mois d'âge paraît en tout cas bien suivie. Les premières mises-bas sont fortement groupées autour de la moyenne de 24 mois, différente, mais assez proche de l'âge attendu de 21 mois.

L'intervalle entre agnelages est très artificiel dans cette étude. Il est le fruit de la politique ISAR de mise en reproduction. Dans des conditions d'élevage où le mâle est laissé dans le troupeau des brebis pendant toute l'année, l'intervalle moyen entre agnelages est généralement plus court. Au centre-sud du Kenya, en territoire Masaï, un intervalle de 311,6 jours entre agnelages dans un élevage extensif où la reproduction est contrôlée a été observé (Wilson, Peacock & Sayers, 1984). Dumas (1980) cite des valeurs comprises entre 210 et 270 jours entre agnelages dans les élevages africains traditionnels où la reproduction des brebis n'est pas contrôlée.

Pour le même mouton à queue grasse mais appartenant au sous-groupe Masaï, il a été rapporté une taille de la portée de 1,05 dans des conditions contrôlées d'élevage extensif traditionnel (Wilson, Peacock & Sayers, 1984). Cette valeur est apparemment en dessous de la prolificité potentielle de ce mouton car avec le Red Masai en station Chemitei et coll (1975) observent une valeur de 1,14 encore inférieure à celle du mouton local rwandais. N'est-ce pas là peut-être la preuve de l'amélioration obtenue en station pour le mouton local rwandais. Il est généralement admis qu'en milieu
tropical les moutons possèdent encore des potentialités considérables pour la taille de leur portée.

La croissance du mouton local avant sevrage est satisfaisante, même si avec d'autres moutons on peut avoir des valeurs supérieures. Pour le mouton Red Masai, par exemple, Chemitei et coll (1975) observent un GMQ de 128 g/jour en station.

Les performances de croissance du mouton local au jeune âge, exprimées par le poids au sevrage, ont diminué au fil des années. Cette diminution est toutefois moins que proportionnelle à l'augmentation du poids d'agneaux sevrés par femelle et par an occasionnée par le progrès réalisé sur la taille de la portée pendant la même période.

Le taux de mortalité semble assez élevé pour des conditions d'élevage en station. En élevage traditionnel, le taux de mortalité pour le mouton africain varie entre 20 et 30 p.cent (Wilson et coll, 1985), mais il pourrait être réduit en milieu contrôlé.

Les indices de productivité témoignent d'un progrès remarquable. L'amélioration des conditions d'élevage et la sélection pour une meilleure productivité y ont sans doute joué le plus grand rôle. Le mouton à queue grasse longue de l'Afrique peut répondre à des plans judicieux d'amélioration en race pure.

Comme les différences de productivité dues à la saison d'agnelage semblent assez faibles, il est probable que les indices de productivité en station pourraient être améliorés en réduisant l'intervalle entre agnelages. Il faudrait déjà mettre en lutte au moins un troupeau tous les huit mois et comparer sa productivité globale à celles des troupeaux mis en lutte seulement tous les 12 mois. Cela nécessiterait sans doute quelques ajustements dans la conduite et la gestion des troupeaux mais pourrait être payant.
PERFORMANCES ZOOTÉCHNIQUES, NUMÉRICES ET PONDERALES DES OVINS ET CAPRINS LOCAUX AU MOZAMBIQUE

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RESUME
Les performances comparées du mouton Nguni et de la chèvre Landim observées à la station expérimentale de Chobela sont décrites. Les caprins présentent les meilleures performances de reproduction mais les deux espèces ont une bonne prolificité. Le manque de précocité relativement long à la première mise-bas et l'intervalle entre deux parturitions semblent être liés au mode de conduite du troupeau. De récents travaux tendent à montrer la possibilité d'amélioration spectaculaire de ces paramètres. Les ovins apparaissent plus saisonnés que les caprins; cela implique le choix des meilleures périodes pour la lutte et l'agnelage. Les taux de mortalité ne sont pas aussi élevés que l'on aurait pu penser. Les vitesses de croissance des deux espèces au cours de leur jeune âge ne diffèrent pas de façon significative. De nouveaux axes de recherche sont proposés pour la station, mais comme les recherches effectuées en station risquent de ne pas refléter la situation actuelle de l'élevage traditionnel, il apparaît important de lancer un programme de recherche dans ce secteur.
REPRODUCTION, MORTALITY AND GROWTH
OF INDIGENOUS SHEEP AND GOATS IN MOZAMBIQUE.

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SUMMARY

The comparative performances of Nguni sheep and Landim goats reared at Chobela Experimental Station are described. Goats have the better reproductive performance, but both species are rather prolific. Late age at first parturition and long inter-parturition intervals seem to be a result of management, as recent results tend to show considerable improvement in these parameters. Sheep seem to be more seasonally affected than goats related to better periods for mating/lambing. Mortality rates are not as high as could be expected. No significant advantage in growth rate exists for sheep over goats in the early ages. Subjects for future investigation at station level are proposed. As investigations done on station may not reflect the actual situation in the traditional sector it is considered important to launch a programme of research at village level.

INTRODUCTION

Small ruminants in Mozambique play an important role in the life of the peasant farmer, not only providing meat and cash all year round but also having an important place in certain aspects of traditional village life. They can be found in areas where cattle do not exist: tsetse fly infested country; in the drier areas where their advantages over cattle are most pronounced during extreme drought seasons; and in the boundaries of the urban zones where cattle cannot be reared. Small ruminants are kept mainly in agro-pastoral systems under sedentary management although in some drier areas pastoral/transhumant systems can be found.

The native fat-tailed sheep belong to the Nguni type (Mason & Maule, 1960) and the goat is of the Landim type, described by the same authors. Both species are referred to in Mozambique by the name Landim. Another type of goat, the Pafuri (Mason & Maule, 1960), is to be found in an area in the south-west of the country but their number is very limited.

There is no recent census on the number of small ruminants. Censuses done by two different governmental departments for the same year - 1969 - gave 1.95 and 0.64 million head respectively, with a ratio of sheep:goat of 1:10 and 1:4 (Anon. 1969-1971; 1972). In the same way other aspects of small ruminants, including characteristics of the native breeds, are largely unknown although some work has been done at Chobela Experimental Station (Pinho Morgado, 1955; Paiva do Amaral, 1969).

The present work attempts a comprehensive description of the main characteristics of economic importance for Nguni sheep and Landim goats at Chobela, in order to clarify the characteristics of the breeds and identify the more important fields for future investigation.

MATERIAL AND METHODS

Chobela has an area of 3000 ha and is located on the right bank of the Nkomati river, at 25°00'S and 32° 14' E, 40 m above sea level. Average rainfall is 700 mm, ranging from 550 to 950 mm. Most rain falls in the hot rainy season from November to April. Mean relative humidity is 71 per cent. Annual average temperature is 23°C, the minimum being 7 - 10°C in June and July with maximum temperatures of 45°C in November to January.
The main grasses are *Themeda triandra*, *Urochloa pullulans*, *Panicum maximum*, *Digitaria* spp. and *Eragrostis* spp. Typical trees are *Acacia subalata* and *Acacia mossambicencis*. Increasing bush encroachment by *Sclero cafra* can be seen. Other species utilized by small ruminants (especially goats) are *Amaranthus deflexus*, *Panthemin hysterophorus* and *Crotalaria monteire* plus small amounts of the introduced *Leucaena leucocephala*.

The Chobela flocks comprise 170 and 130 breeding females, sheep and goats respectively. Breeding is year-round, with three per cent of males. New born animals are kept indoors until two months and then allowed out with their dams for one month before being weaned at three months; males are separated from females at weaning. The animals are allowed to graze/browse in a restricted herding system (<8 hours), starting at 07h30 and are confined in the afternoon. At this time water is provided and some hay is also occasionally given, especially to weaned and sick animals.

Adult animals are treated against taeniasis, round worms, and coccidiosis, before and after the rainy season. Weaned animals receive the same treatments every three months until they are one year of age. Animals are dipped for tick control at intervals of one to three weeks, depending on the level of infestation.

Data on reproductive performance, measured as number of parturitions and number born per mated female per year were calculated for 1983 and 1984, as well as litter size. For the study period, each ewe and doe had an average of 1.24 and 1.28 mating seasons per year respectively.

Mean (\( \bar{x} \)), standard error (s.e.) and coefficient of variation (cv) were calculated (on a pre-existing data set) for age at first lambing/kidding, for first parturition interval and for total parturitions intervals, for the period 1962 to 1970 in the case of sheep and 1955 to 1970 in the case of goats.

Twinning percentages were also calculated for total parturitions and individually from the first to the seventh parturition for periods between 1962 to 1970 and 1955 to 1970 for sheep and goats respectively and compared with the results from the 1982–1983 first and second parturitions.

The relationships between season of mating/season of parturition and number of young born and their viability up to eight months were also determined for both species, with reference to the birth season 1983–1984.

For the same period, the mortality rate of adults, and from birth to eight months
old are presented, as well as the comparative mortality of singles and individual twins.

Weights at birth, three, six and twelve months for 1983 were calculated for sheep and for goats.

Standard statistical procedures were utilized for data analyses.

RESULTS

Number of parturitions, number of young born and litter size, are presented in Table 1. An average of 63 per cent of ewes lambed in each breeding season while 71 per cent of goats kidded.

The figures for age at first lambing/kidding, first parturition interval, and all parturition intervals for the period 1962-1970 in the case of sheep and 1955-1970 for goats are shown in Table 2.

Percentage of total parturitions and percentage of parturitions for the first to the seventh lambing/kidding are shown in Figure 1 for the period 1962-1970 and 1982-1983 for sheep, and 1955-1970 and 1982-1983 for goats.

The relationships between season of mating/season of parturition and number of young born and their viability up to eight months are presented in Table 3, for animals born in 1983 and 1984.

The total mortality rate for years 1983-1984 was very similar for both species (16 per cent for sheep and 15 per cent for goats) and for animals to eight months.

Table 1  Reproductive data for years 1983 and 1984 for small ruminants in Mozambique

<table>
<thead>
<tr>
<th>Species</th>
<th>n</th>
<th>Births</th>
<th>Total young</th>
<th>Litter size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n</td>
<td>%1)</td>
<td>n</td>
</tr>
<tr>
<td>Sheep</td>
<td>340</td>
<td>269a</td>
<td>79.1</td>
<td>366a</td>
</tr>
<tr>
<td>Goat</td>
<td>260</td>
<td>239b</td>
<td>91.9</td>
<td>388b</td>
</tr>
</tbody>
</table>

Note: 1) % of females in sample
Means in the same column without a common superscript differ significantly (P < 0.01)
Table 2  Age at first birth, first parturition intervals and total parturition intervals (days) in Mozambique

<table>
<thead>
<tr>
<th>Species</th>
<th>Age at first birth</th>
<th>Interval between first and second parturitions</th>
<th>Total parturition interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>x + s.e.</td>
<td>cv</td>
</tr>
<tr>
<td>Sheep</td>
<td>115</td>
<td>772⁹</td>
<td>12</td>
</tr>
<tr>
<td>Goats</td>
<td>155</td>
<td>738⁸</td>
<td>12</td>
</tr>
</tbody>
</table>

Means in the same column without a common superscript differ significantly (P<0.05)

Figure 1  Distribution of twin births by parity for two different observation periods in a) sheep and b) goats in Mozambique

Table 3  Relationships among timing of reproductive events, number of young born and viability in Mozambique sheep and goats

<table>
<thead>
<tr>
<th>Species</th>
<th>Mating season</th>
<th>Lambing season</th>
<th>Females (%)</th>
<th>Young born as % of females</th>
<th>Viability at 8 months as % of births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>Dec-Mar</td>
<td>May-Aug</td>
<td>225</td>
<td>100.4</td>
<td>78.7</td>
</tr>
<tr>
<td>Apr-Jul</td>
<td>Sep-Dec</td>
<td></td>
<td>76</td>
<td>69.7</td>
<td>84.9</td>
</tr>
<tr>
<td>Aug-Nov</td>
<td>Jan-Apr</td>
<td></td>
<td>118</td>
<td>73.7</td>
<td>91.9</td>
</tr>
<tr>
<td>Goats</td>
<td>Dec-Mar</td>
<td>May-Aug</td>
<td>99</td>
<td>121.2</td>
<td>75.3</td>
</tr>
<tr>
<td>Apr-Jul</td>
<td>Sep-Dec</td>
<td></td>
<td>133</td>
<td>115.0</td>
<td>83.7</td>
</tr>
<tr>
<td>Aug-Nov</td>
<td>Jun-Apr</td>
<td></td>
<td>102</td>
<td>112.7</td>
<td>77.4</td>
</tr>
</tbody>
</table>
of age it was 20 per cent. Mortality was 63 per cent and 71 per cent for individual twins, in the case of sheep and goats, respectively.

Weights of animals at birth, three (weaning), six and twelve months of age are presented in Table 4 for animals born in 1983.

DISCUSSION AND CONCLUSIONS

The reproductive parameters presented have shown that in all but one of the reproductive traits analysed goats were better than sheep. This is in agreement with the findings of other authors (Peacock, 1982; Wilson, 1982; Okello & Obwolo, 1984). Sheep had a significantly shorter ($P<0.01$) parturition interval than goats (Table 2). However, this can be partially due to failing to incorporate individual does regularly at the mating season, as in the type of management practised on the station goats are more difficult to control than sheep.

Paiva do Amaral (1969), working at the same station, found a 79.9 per cent lambing rate, from which 64.0 per cent were twin births: the former value is very similar to the 79.1 per cent lambing rate in the present study but twin births in this study were only 44.6 per cent. However, even the lower figure for twinning rate compares favourably with other African races of sheep reared under experimental station conditions (Fall et al., 1982), in the Masai pastoral system (Peacock, 1982) and under central Mali's traditional management (Wilson, 1984), where values of 12 per cent, 3.9 per cent and 6.0 per cent, respectively, were found.

<table>
<thead>
<tr>
<th>Species and sex</th>
<th>Mean weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birth</td>
</tr>
<tr>
<td>Sheep: males</td>
<td>2.3</td>
</tr>
<tr>
<td>females</td>
<td>2.3</td>
</tr>
<tr>
<td>Goats: males</td>
<td>2.4</td>
</tr>
<tr>
<td>females</td>
<td>2.2</td>
</tr>
</tbody>
</table>
The Landim goat with a litter size of 1.62 and 56.7 per cent twinning rate compares very favourably with the 10-15 per cent multiple birth rate attributed to the other indigenous breeds of East Africa (Mason & Maule, 1960). It has a slightly inferior twinning percentage to the 59 per cent reported for the West African Dwarf goat under experimental station management (Oppong & Yebuah, 1981).

The late age at first parturition (Table 2) seems to be largely a result of management rather than an expression of late maturing animals since by putting females to mating at a younger age during the period from September 1982 to January 1984 a highly significant (P<0.001) age reduction at first parturition was achieved — from 772 to 614 days for sheep and 738 to 590 days for goats. In the same way utilization of more than one mating season per year reduced the first inter-parturition interval (400 to 384 days for sheep, and 390 to 348 days for goats) although this was not significant (P>0.05) the non-significance probably being due in part to the problems of early detection of non-pregnant females thus not allowing a prompt re-mating of these animals.

The decreased age at first parturition resulted in a decreased percentage of twin births at this stage but the percentage of twins at second parturition returned to the "normal". The pattern of twinning expressed in Figure 1 shows that sheep have maximum twinning at the fifth parturition, while for goats maximum twinning percentage was achieved at the third parturition.

In Table 3 it can be seen that the better mating season for sheep seemed to be March (rainy season), the worst being the dry season period that ranges from April to July. Goats seemed to be less affected by season of mating, achieving the best results during the dry season mating. Explanations for these results might be found in the different feeding behaviour of the two species. Sheep, being predominantly grazers, should be more affected by the drop in nutritional value of the native grasses during the dry season. Goats' browsing behaviour should allow them to maintain a better nutritional status as a result of utilizing leaves and husks of shrubs and small trees, simultaneously being less affected by gastro-intestinal parasites. However the observations cover only two birth seasons and more information is needed before definite conclusions can be drawn.

The mortality rates — 16 per cent for sheep and 15 per cent for goats — are not high, compared with results elsewhere in Africa (Oppong & Yebuah, 1981; Fall et al, 1982; Mack, 1982; Wilson, 1982; Wilson et al, 1984). However, the mortality results
presented for sheep are much higher than those previously found by Paiva do Amaral (1969) who reported very low mortality rates—1.6 per cent and 9.0 per cent for adult and young animals respectively. The higher mortality rate for individual twins in comparison to singles is in agreement with the results presented by Peacock (1982) in Kenya. While in Kenya individual twins had higher mortality in sheep than in goats the opposite was found at Chobela where individual twin goats had a higher mortality rate (71 per cent) than sheep (63 per cent).

The weights of sheep and goats were similar at birth and weaning (three months) but at six months sheep were heavier, both for females and males, although at one year, females of both species had the same weight. Paiva do Amaral (1969) found slightly heavier weights for sheep at three months, six months and one year old both for females (13.5, 17.0 and 28.0 kg) and males (13.5, 18.0 kg, 29.0kg) than is reported in this work.

The results from this study suggest that Nguni sheep and Landim goats are rather productive small ruminants, and that further investigation should be done, particularly in the response of the animals to management techniques aimed at decreasing age at first parturition and to shorter inter-parturition intervals. The possible existence of more appropriate seasonal mating periods, the total production per life of females giving birth at earlier and later ages as well as the desirability of selection for twinning are also interesting subjects for future research. However as small ruminants are mainly reared by the traditional farmer and, as referred to by Wilson & Durkin (1983), the findings obtained under research stations management may not reflect the real situation of the small scale farmer, it is important to launch a programme of research in this sector in order to understand the systems utilized, the characteristics of small ruminant production and the constraints acting against improved productivity.
CARACTERISTIQUES DES PETITS RUMINANTS
DE LA ZONE DE MITUNDU AU MALAWI

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RESUME

Cette étude des variations saisonnières du nombre de petits ruminants abattus, du sexe, du poids vif et du poids de carcasse, du poids d'organe, a été réalisée par enquête à Mitundu, partie centrale du Malawi de décembre 1984 à juin 1985. Les raisons socio-économiques en partie responsables de la variation du nombre d'animaux abattus au cours de l'année (2-6 têtes par semaine de février à avril, 8-20 le reste du temps) sont discutées. Les femelles (67 p.cent des animaux abattus) sont plus lourdes (25,7 ± 0,47 kg) que les mâles entiers (19,6 ± 0,81 kg) ou castrés (21,7 ± 0,83 kg). Les femelles abattues sont en moyenne plus âgées (60 p.cent ont plus de 32 mois) que les mâles (80 p.cent ont moins de 24 mois). La proportion des mâles castrés abattus est de 44 p.cent par rapport au nombre total de mâles sacrifiés. Le rendement carcasse varie de 52,3 à 55,1 p.cent. Les poids vifs des différents organes et leur contribution au poids vif et poids de carcasses ne présentent pas de différences sensibles intra- et inter-races à l'exception du fait que le bélier a des testicules plus lourds (660 ± 30 g) que le bouc (420 ± 10 g). Les ovins Dorper et croisements locaux conduits sur des pâturages naturels à Chloris gayana présentent les performances zootechniques suivantes: taux de gémellarité: 2,2 p.cent; intervalle de mise-bas: 255 ± 13,5 jours; poids à la naissance agneau mâle, 2,63 ± 0,19 kg et agneau femelle, 2,65 ± 0,14 kg. Le poids à la naissance des agneaux représente 8,8 p.cent du poids vif des brebis.
CHARACTERIZATION OF SMALL Ruminants in the Mitundu Area, Lilongwe, Malawi

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SUMMARY

A survey was conducted between December 1984 and June 1985 to determine the sex, live and dressed weight, organ weight and the seasonal variation in small ruminants slaughtered at Mitundu, Central Malawi. Least numbers (2-6 per week) were slaughtered between February and April; numbers varied from 8-20 per week the rest of the time. Socio-economic reasons contributing to this variation are discussed. Females (67 per cent of animals slaughtered) were heavier than males (25.7 ± 0.47, 19.6 ± 0.81 and 21.7 ± 0.83 kg for females, entire males and castrates respectively). More than 60 per cent of slaughtered females were over 32 months of age while 80 per cent of males were less than 24 months old. Slaughtered males were 44 per cent and 56 per cent castrate and entire respectively. The dressing percentage ranged from 52.3 and 55.1. Weights of various organs and their contribution to live and dressed weight were similar within and between species except that rams had heavier testes (0.66 ± 0.03 kg) than bucks (0.42 ± 0.01 kg). Reproductive and growth potential of sheep (Dorper and local crosses) on natural pastures and Chloris gayana were also investigated. Twinning rate of ewes was 2.2 per cent and lambing interval was 255 ± 13.5 days suggesting that post-partum anoestrus averaged 105 days. Ram and ewe lamb birth weights averaged 2.63 ± 0.19 and 2.65 ± 0.14 kg. Birth weight of lambs was 8.8 per cent the liveweight of ewes.

INTRODUCTION

Climatic conditions in Malawi range from hot (25°C) and wet (3050 mm) to warm (18°C) and dry (890 mm). The vegetation is characterized by a mixture of scattered low trees, shrubs and grasses which vary according to soil type, moisture and altitude. Most savanna is dormant for several months during the annual dry season (April–November). In 1980–1981 the populations of sheep and goats were 114 200 and 1 575 700 respectively (Anon, 1984). Most small ruminants are on smallholder mixed crop–livestock production systems and have so far received little attention in formulation of research projects. According to a recent survey in Unit 23 of Lilongwe Agricultural Development Division (LADD) the average goat herd size is six animals (Khaila, 1985). Generally, small ruminants complement crop production by grazing vegetation around the home, in bottomlands, on uncultivated areas and on crop residues. In Malawi there is a general scarcity of data on growth, reproductive and other characteristics of small ruminants. This study was initiated to determine the sex, liveweight, weight of various organs and seasonal variation in small ruminants slaughtered at Mitundu market in LADD. Within the same area the reproductive and growth potential of the Malawi hair sheep (Dorper, local and their crosses) were also assessed. It is hoped that once this study is completed both the farmer and middleman will understand the significance of proper management and price controls.

MATERIALS AND METHODS

MARKET STUDY

Once a week (1 December 1984 – 30 June 1985) a visit was made to Mitundu market to determine the following: number of sheep or goats slaughtered, sex, liveweight, dressed weight and weights of the head, liver, heart, lung, skin and testes (where appropriate). In total, 274 goats and 16 sheep were slaughtered during this period.

BUNDA STUDY

Various reproductive and growth data were collected from a flock (25 ewes and two rams) of sheep (Dorper, local and their crosses) at Bunda College of Agriculture in order to ascertain the potential of sheep production on a small scale. The flock was allowed to graze indigenous pasture and Chloris gayana between 1983 and 1985. Occasionally the sheep were supplemented with maize bran. Breeding was not
controlled as the ewes ran with rams at all times. The flock was weighed monthly and birth weights of lambs were taken within a day of birth.

RESULTS AND DISCUSSION

MARKET STUDY

Figure 1 shows weekly variation in total number of goats slaughtered at Mitundu market. For the months of December and January the number of goats slaughtered varied from eight to twelve per week. From February to the first week of April the number was two to six, rising sharply thereafter. There are several possible socio-economic reasons for this variation. In December/January farmers may sell goats to obtain money since the growing season for most crops has just started. However between February and March most farmers get money from green crops (e.g. maize, groundnuts and beans) therefore they are not desperate to sell animals. This trend should continue from April through June: however, the number of goats slaughtered increases (8-20 per week) possibly because most people have money from sales of crops, the demand for meat therefore increases and goat owners can sell animals at a higher price. Generally this is also a time when beef is scarce. The data agree

Figure 1  Numbers of goats slaughtered and changes in liveweight (kg ± s.e.) over time at Mitundu market, Malawi
with the observation that when beef and chicken are not available low income families prefer goat meat to mutton or pork (Phoya & Whelehan, 1982).

Of a total of 274 animals studied 66.8 per cent were females while 18.6 per cent and 14.6 per cent were entire males and castrates respectively. Figure 2 shows that except for one week most goats slaughtered were females while Table 1 shows the percentage of each class of age. About 60 per cent of females slaughtered were over 33 months of age (eight permanent incisors). This may indicate that they have been used for breeding for some time. Half of the males slaughtered were between 18 and 24 months (2-4 teeth). Of these males 44.0 per cent were castrates while 56.0 per cent had their testes intact. This survey may indicate an awareness among rural farmers of the need to keep only sufficient males for breeding. The rest are either sold early or castrated. Peters et al (1981) reported that only 36.0 per cent of goat keepers in their survey in Malaysia practised castration, this being influenced by religious misconceptions and cultural habits. These aspects were not evaluated in the present study. Sheep accounted for 5.5 per cent of total small ruminants slaughtered at the market which corresponds well with the percentage contribution of sheep (6.8 per cent) to total number of small ruminants in Malawi (Anon, 1984). Of the sheep slaughtered 38.0 per cent were females while 42.9 per cent were older than 33 months.

The mean weights of various part and dressing percentages of goats and sheep by class are shown in Tables 2 and 3. The liveweight of female animals tended to
be heavier than that of males. This may have been due to the fact that most females were slaughtered at a much older age than males (Table 1). The liveweights of goats slaughtered (Figure 1) were slightly lower in April and May. The reasons for this were not investigated but they could be related to management at this time. There do not appear to be any differences in the dressing percentages and weights of the head, liver, skin, lung and heart between and within species except for rams which had heavier testes than bucks (Table 2 and 3).

Table 1  Distribution by sex and age class of goats slaughtered at Mitundu market, Malawi (per cent)

<table>
<thead>
<tr>
<th>Class of animal</th>
<th>Milk teeth</th>
<th>Number of permanent incisors</th>
<th>Broken mouths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Female</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (entire)</td>
<td>27.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (castrate)</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2  Data on live and slaughter weights and weights of body organs of Malawi goats (kg)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Class of animal</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Entire male</td>
<td>Castrate</td>
</tr>
<tr>
<td>Number in sample</td>
<td>183</td>
<td>51</td>
<td>40</td>
</tr>
<tr>
<td>Liveweight</td>
<td>15.7</td>
<td>19.6</td>
<td>21.7</td>
</tr>
<tr>
<td>Dressed weight</td>
<td>13.4</td>
<td>10.3</td>
<td>11.6</td>
</tr>
<tr>
<td>Body parts:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>head</td>
<td>1.8</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>liver</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>skin</td>
<td>1.7</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>lungs</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>heart</td>
<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>testes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dressing percentage</td>
<td>52.3</td>
<td>52.4</td>
<td>53.6</td>
</tr>
</tbody>
</table>
Table 3  Data on live and slaughter weights and weights of body organs of Malawi sheep (kg)

<table>
<thead>
<tr>
<th>Class of animal</th>
<th>Parameter</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number in sample</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Liveweight</td>
<td>32.3</td>
<td>28.8</td>
</tr>
<tr>
<td></td>
<td>Dressed weight</td>
<td>17.8</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>Body parts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>head</td>
<td>1.9</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>Liver</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>skin</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Lungs</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>heart</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>testes</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Dressing percentage</td>
<td>55.1</td>
<td>52.4</td>
</tr>
</tbody>
</table>

The relative contribution of various organs to the live and dressed weight is shown in Table 4. The contribution of these organs is similar across species.

BUNDA STUDY

The data were collected from a group of 25 ewes (Dorper, local and their crosses) between 1983 and 1985. The twinning rate in the flock was 2.2 per cent. The average lambing interval was 255 ± 13.5 days. Assuming a gestation length of 150 days the time from parturition to subsequent conception would be 105 days. Berger (1983) reported that the postpartum anoestrus in females fed a high level of nutrition averaged 52.4 days (range 22 to 60 days) while Wilson (1983a) reported a lambing interval of 258–298 days in sedentary sheep in Mali.

Ram and ewe lamb birth weights averaged 2.63 ± 0.19 and 2.65 ± 0.14 kg respectively. Figure 3 shows the mean liveweight of ewes between September 1983 and August 1984. The variations in weight are due to lambing, lactation and pregnancy and are also confounded with season. The loss in weight due to lambing was 12.9 per cent. When the ewe and lamb were weighed soon after lambing the birthweight of lambs was approximately 8.8 per cent of the liveweight of ewes. The difference
Table 4 Percentage contribution of various parts of live and dressed carcass weight of small ruminants in Malawi

<table>
<thead>
<tr>
<th>Body part</th>
<th>Goats</th>
<th>Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% l.w.</td>
<td>% d.c.w.</td>
</tr>
<tr>
<td>Head</td>
<td>7.2</td>
<td>13.7</td>
</tr>
<tr>
<td>Liver</td>
<td>2.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Hide</td>
<td>6.9</td>
<td>13.1</td>
</tr>
<tr>
<td>Lung</td>
<td>2.0</td>
<td>3.8</td>
</tr>
<tr>
<td>Heart</td>
<td>1.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Testes</td>
<td>2.1</td>
<td>4.1</td>
</tr>
</tbody>
</table>

is due to the placenta and fluids expelled in the process of lambing. During lactation the ewes lost 13.8 – 15.6 per cent of body weight. Scott (1975) reported that during lactation ewes should lose 5 – 7 per cent of body weight. The excessive loss may be attributed to a low level of nutrition during the dry season.

Figure 3 Liveweight changes of ewes at Bunda College, Malawi, in relation to reproductive and climatic events
CONCLUSIONS

The number of goats slaughtered at the market varied with season. Most of the animals slaughtered were females and they were slaughtered at a much older age than males. The data presented indicate that the farmers keep females in the breeding herd for a long time and may be aware of the problems of inbreeding since males are slaughtered while young and castration is practised. The longer lambing interval (255 ± 13.5 days) and the drop in weight of ewes during lactation may signify a lower level of nutrition. These results are important in the determination of the price of various parts by middlemen, the biological understanding of small ruminants, the formulation of various models to predict the optimal liveweights for slaughter and the formulation of supplementary feeding regimes to make small ruminant production profitable.

ACKNOWLEDGEMENTS

The authors acknowledge G. Mkanansi, M. Phiri, G. Banda and the various people who slaughter small ruminants at Mitundu Market for services rendered during the course of this study. The draft manuscript was typed by Mrs. M.C. Piringu. Financial assistance from the University of Malawi Research and Publications Committee and the Livestock Production Department is also appreciated.
Mouton d'Afrique à queue grasse longue -
Bélier de sélection N°991 à la Station de Songa, Rwanda
ENQUETE RAPIDE SUR LA PRODUCTION OVINE
EN MILIEU PAYSAN AUTOUR DE DEBRE BERHAN
SUR LES HAUTS PLATEAUX ETHIOPIENS

K. Agyemang1)  Negussie Akalework1)  A. Voorthuizen2)
& F.M. Anderson1)

1. Programme des Hauts Plateaux Ethiopiens, CIPEA, Addis-Abeba
2. Agricultural University, Wageningen, Pays Bas

RESUME

Une enquête rapide sur la propriété, la démographie et la productivité du cheptel ovin menée auprès de 120 troupeaux répartis dans quatre associations paysannes montre que les ovins représentent 64,7 p.cent du nombre de têtes de bétail. Le troupeau moyen est de 23,8 têtes (2 à 83) et appartient à 1,5 personnes (1 à 6). Le troupeau est constitué de 74,8 p.cent de femelles; 22,4 p.cent sont des mâles entiers et 2,8 p.cent sont des mâles castrés. Le rapport reproducteur-reproductrice est de 1 pour 26. Les femelles reproductrices constituent 49 p.cent du troupeau. L'agnelage a lieu toute l'année mais un pic apparaît en octobre et novembre (52 p.cent de mise-bas) résultant d'une lutte de début de grande saison des pluies. L'âge à la première mise-bas apparaît plus élevé que dans d'autres régions africaines. L'intervalle de mise-bas est d'environ 350 jours et 4,2 p.cent des naissances sont gémellaires. La mortalité totale est estimée à 6,5 p.cent. Ces résultats sont discutés en regard des recherches du CIPEA menées à la station de Debre Berhan.
A RAPID SURVEY
OF SHEEP PRODUCTION
IN THE TRADITIONAL SECTOR OF DEBRE BERHAN, ETHIOPIAN HIGHLANDS

K. Agyemang1) Negussie Akalework1) A. Voorthuizen2)
& F.M. Anderson1)

1. Ethiopian Highlands Programme, ILCA, Addis Ababa
2. Agricultural University, Wageningen, The Netherlands

SUMMARY

A rapid survey of livestock ownership patterns, flock demography and sheep productivity was undertaken on 120 flocks in four Peasant Associations. Sheep account for 64.7 per cent of the numbers of livestock owned. Mean flock size was 23.8 head and each flock was owned on average by 1.5 people. Flock sizes ranged from 2 to 83 and owners from 1 to 6. Females totalled 74.8 per cent of the flock, entire males 22.4 per cent and castrates 2.8 per cent. The ratio of breeding males to breeding females was 1:26, breeding females being about 49 per cent of the flock. Lambing occurred all the year round but 52 per cent of lambs were dropped in October and November resulting from conceptions in the early part of the main rains. Age at first lambing appeared to be older than in many other African areas. Lambing interval was about 350 days and 4.2 per cent of births resulted in twins. Total flock mortality was estimated at 6.5 per cent. The results are discussed in relation to ILCA's research on Debre Berhan station.

INTRODUCTION

The ILCA Highlands Programme has been carrying out research on the local Menz breed of sheep on station for a number of years. It intends to link future station research with testing of innovations on smallholder flocks in the area of its research station at Debre Berhan.

The testing of innovations and monitoring of sheep on farms outside the station requires the description of existing management practices, ownership patterns and the estimation, in general terms, of flock structure, reproductive and productive parameters. A formal survey with a pre-designed questionnaire was carried out in 120 flocks in four Peasant Associations to determine these parameters. In addition, some farmers were asked on an informal basis to provide information on management practices in their flocks, by answering specific questions put to them by enumerators.

It is estimated that there are 850 households in the four Peasant Associations of which about 80 per cent own five or more sheep with an average number of 16 per flock. Thus, the estimated number of flocks is 640 with a sheep population of about ten thousand. The 120 flocks surveyed represent about 18 per cent of the total.

This report presents results of a preliminary analysis of the data obtained during the survey. It is hoped that based on these results some 80 flocks will be selected for monitoring. Some of these will receive tested innovations from ILCA while the rest will serve as a control group. In both cases, monthly visits will be made to record events such as births, deaths, sales, slaughter, disease situations, and to weigh individual sheep. This will enable a 3-way comparison of performance at the ILCA station, in smallholder flocks receiving innovations from ILCA and in control flocks where only traditional husbandry is practised.

MATERIALS AND METHODS

Four Peasant Associations near the Debre Berhan research station were selected as the target population from which samples of flocks were to be taken. Flocks belonging to 60 farmers who were already participating in ILCA's livestock inventory exercise and an additional 60 flocks chosen at random were selected to constitute the sample. Thirty flocks, 10 small sized (1-13 sheep), 10 medium (14-26 sheep) and 10 large (27 or more sheep) were selected from each Association.
For the formal survey, the sampling unit was the "flock" as herded together and the "farmer" was the caretaker of the flock. A given "flock" could therefore be a collection of smaller flocks, each owned by different persons but all under the management of the "farmer".

A questionnaire designed to generate the relevant information was pre-tested with a few farmers. Questions were framed in such a way that farmers would provide information that was most recent and easy to recall. Four enumerators and two supervisors undertook the survey in November and December 1984.

All species of livestock were included in the survey for the purpose of establishing livestock composition but detailed information was collected only on sheep. All sheep were individually handled and aged by dentition characters, correlated in each case by owners' information. A career history was established for each breeding ewe present in the flock. Information on all offspring, dead, alive or sold was compiled. Historical information on sheep, 77 goats, 448 donkeys, 317 horses and 30 mules was recorded. Of the 5041 sheep on which information was collected, 2852 were in the flocks at the time of the survey.

RESULTS

MANAGEMENT

Housing

Most farmers (82 per cent) housed sheep separately from other species. Among small flocks, the percentage of farmers who housed all livestock together was higher than in medium and large flocks. In addition, pregnant ewes were housed separately during the last few weeks of pregnancy until about 2-4 weeks post-partum.

Feeding

The main feed resource for sheep was native pasture. Grazing took place on fallow land, communal grazing areas, and on stubble, depending on the season. Sheep generally grazed for 10-11 hours a day (07h00 - 18h00) with once a day watering at noon. Source of water was usually a river(s) 1-2 kilometres from the homestead. Sheep and other species of livestock were usually herded together for watering and grazing, although in certain cases cattle were allowed to graze the better pastures. Sheep had access to some hay and straw supplements in periods of severe shortages.
but farmers in general preferred to feed crop residues to cattle. Sheep in the last stages of pregnancy and lactating ewes also sometimes got supplementary feeding. Barley straw, grass and hay were the main supplements. By-products from local beer, small amounts of grain and salt were also occasionally fed.

**Diseases and disease control**

From the description of symptoms, it was obvious that many farmers were able to identify diseases such as liverfluke (swelling of neck), coenurus (animal going in circles), diarrhoea, and bloat (swelling of the stomach). Farmers mentioned liverfluke, coenurus, diarrhoea and anthrax, in that order, as the most common diseases. Some farmers treated sheep against liverfluke and lungworm. Drugs were purchased from the Ministry of Agriculture. However, the decision to treat sick animals depended on the availability of cash to the farmer.

**Lamb rearing**

Most farmers kept new-born lambs and their dams in the house during the first 24-72 hours after which the dams joined the flock for grazing. Farmers also tended to keep lambs inside for periods of up to 60 days during the rainy and drought periods. Some farmers gave cow's milk to weak lambs or when the dam did not produce enough milk.

**Shearing**

Most farmers sheared their sheep once or twice a year, October to November and April to June. Shearing was mostly done either to get rid of ticks or as a means of cleaning sheep of mud and seeds. Only a small percentage sheared for sale.

**Mating**

Most farmers had one to three rams running with the flock throughout the year. Rams were usually used for service the first time at about 12 months although rams in exceptionally good body condition were used at younger ages. Rams were usually taken out of service for castration or for sale at the eruption of the second pair of permanent incisors. Exceptionally good rams were not taken out of service until about four years of age.

**Castration**

Castration was done by a majority of farmers. Age at castration varied, from
the appearance of the second pair of permanent incisors to the appearance of the fourth pair. Castration at these ages allows for a service period of one to three years. Rams with exceptionally good body conformation were the ones selected for castration. Castration was primarily a means of getting higher sale prices at a later date. Almost all farmers provided extra feed, mainly barley and beans, to the castrates. Stones and handles of sickles were used to crush the vas deferens.

**Culling**

Most farmers culled animals for sale in times of financial difficulties. Infertile and old ewes and male lambs were usually first to be culled. Female lambs, castrates and rams were occasionally culled. If the magnitude of the financial problem was such that it would require the sale of large numbers of ewes or other smaller animals, then castrates and rams were first to be culled.

**COMPOSITION OF THE LIVESTOCK MIX**

Table 1 shows that sheep are the commonest livestock species found in the area. Cattle, donkeys and horses rank second to fourth, respectively. Goats and mules were rare.

**FLOCK OWNERSHIP PATTERNS**

Of the sheep covered by the survey, 27.1 per cent were in Kormargefia Peasant Association, 23.0 per cent in Karafino, 24.9 per cent in Milki and 25.0 per cent in

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Composition of livestock holdings in four Peasant Associations in the Debre Berhan area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Number</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Sheep</td>
<td>2852</td>
</tr>
<tr>
<td>Cattle</td>
<td>937</td>
</tr>
<tr>
<td>Goats</td>
<td>54</td>
</tr>
<tr>
<td>Donkeys</td>
<td>287</td>
</tr>
<tr>
<td>Horses</td>
<td>198</td>
</tr>
<tr>
<td>Mules</td>
<td>30</td>
</tr>
</tbody>
</table>
Faji Bokafia. The ranges in numbers of sheep per flock in the four Peasant Associations were 2-83, 2-51, 6-47 and 2-81.

The 2852 sheep in the 120 flocks were said to belong to 183 individuals. The mean number of sheep per flock was 23.8, each contributing owner having 15.6 animals. On average, 1.5 persons had ownership claims in a given flock.

In total, 66.7 per cent of all flocks were owned by one person, 21.7 per cent by two people, 5.8 per cent by three, 4.2 per cent of the flocks by four; and five or six people had sheep in 1.6 per cent of the flocks. The pattern varied a little among associations but overall the picture was the same.

FLOCK DEMOGRAPHY

Of the total live sheep enumerated, 2133 (74.8 per cent) were female, 640 (22.4 per cent) entire males and 79 (2.8 per cent) castrates. Across all sexes, 1325 (45.9 per cent) had only temporary incisors, 201 (7.0 per cent) had one pair of permanent incisors, 177 (6.2 per cent) had two pairs, 233 (8.2 per cent) had three pairs, 468 (16.4 per cent) had four pairs and 464 (16.3 per cent) were broken mouthed. The correlation coefficient between number of permanent incisors (excluding sheep with broken mouths) and approximate age provided by owners for 1081 sheep was 0.89 (P < 0.01). Owners were thus quite accurate in assessing the ages of the animals in their flocks. The mean ages and standard deviations for the various teeth classes are given in Table 2.

The ratio of males with no permanent incisors to females of the same dentition class was 1:1 (431 vs 432). The ratio for older males (one to four pairs of teeth and

<table>
<thead>
<tr>
<th>Number of permanent incisors (pairs)</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>5 ± 6</td>
<td>18 ± 5</td>
<td>27 ± 6</td>
<td>39 ± 7</td>
<td>51 ± 15</td>
</tr>
<tr>
<td>Male</td>
<td>4 ± 3</td>
<td>19 ± 8</td>
<td>24 ± 6</td>
<td>36 ± 6</td>
<td>36 ± 6</td>
</tr>
<tr>
<td>Castrate</td>
<td></td>
<td>29 ± 0</td>
<td>26 ± 5</td>
<td>34 ± 8</td>
<td>53 ± 15</td>
</tr>
</tbody>
</table>

Table 2 Mean ages (months) ± sd provided by farmers of sheep by teeth and sex classification at Debre Berhan, Ethiopia
broken mouth) to females of the same dentition was 1:26 (55 vs 409) suggesting a heavy offtake of males at an early age. If breeding females are considered as those with one or more pairs of permanent incisors, then these were 49 per cent of the total flock. This figure agrees well with the 52 per cent classified by owners as breeding females. Breeding males (six months or older) were estimated to be five per cent of the flocks.

About eight per cent of all sheep were reported as purchased or exchanged from other flocks. If the exchanges and purchases include rams and if out-breeding among flocks grazing on communal land occurs regularly, then this would suggest a substantial reduction in inbreeding within the flocks.

REPRODUCTION

Seasonality in lambing

Information on month of birth was available for 899 sheep. The distribution among months of the year suggests year-round lambing with a peak in October and November. Most conceptions took place in June and July, which is the beginning of the major rainy season in the area (Table 3).

Table 3  Distribution of recorded parturitions by sheep in the Debre Berhan area

<table>
<thead>
<tr>
<th>Months</th>
<th>Nº of lambings</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>15</td>
<td>1.7</td>
</tr>
<tr>
<td>February</td>
<td>19</td>
<td>2.1</td>
</tr>
<tr>
<td>March</td>
<td>16</td>
<td>1.8</td>
</tr>
<tr>
<td>April</td>
<td>19</td>
<td>2.1</td>
</tr>
<tr>
<td>May</td>
<td>41</td>
<td>4.6</td>
</tr>
<tr>
<td>June</td>
<td>71</td>
<td>7.9</td>
</tr>
<tr>
<td>July</td>
<td>70</td>
<td>7.8</td>
</tr>
<tr>
<td>August</td>
<td>55</td>
<td>6.1</td>
</tr>
<tr>
<td>September</td>
<td>69</td>
<td>7.7</td>
</tr>
<tr>
<td>October</td>
<td>160</td>
<td>17.7</td>
</tr>
<tr>
<td>November</td>
<td>314</td>
<td>34.9</td>
</tr>
<tr>
<td>December</td>
<td>50</td>
<td>5.6</td>
</tr>
</tbody>
</table>
Age at first lambing

Of 876 ewes, some 37 (4.2 per cent) without permanent incisors and 93 (12.6 per cent) with one pair had already produced one lamb: 18 ewes (2.0 per cent) with one pair had produced two lambs. These percentage figures are lower than in traditional flocks in many other parts of Africa and it appears that age at first lambing is generally delayed to beyond two years of age.

Annual reproduction rate

In the absence of information on lambing intervals, annual reproduction was computed as the total number of lambs reported born (alive, stillbirths and abortions) in 1984 as a percentage of all breeding females in the flocks in 1984. This gave an annual reproduction rate of 1.03 lambs/ewe/year.

Lambing interval

An approximate lambing interval, assuming an average litter size of 1.0, was calculated as the ratio of 365 (days in a year) to annual reproduction rate 1.03 lambs/ewe/year. This gave a lambing interval of 11.5 months.

Multiple births

Of the 3556 sheep for which owners recollected the birth status, 3278 were listed as single and 288 twin born. This gave a twinning rate of 4.2 per cent. The twinning rate calculated for lambs in the flock during the time of survey was 3.9 per cent.

GROWTH AND WEIGHT

All sheep in the flocks at the time of the survey were weighed. The months of the year at weighing represent the early part of the dry season when sheep would be expected to be in average condition. Overall mean body weight for 2388 sheep was $18.9 \pm 8.5$ (s.d.) kg. The mean body weights of sheep for different teeth classes and for three sexes is shown in Table 4. In general, castrates were heavier than males and females in the same dentition class and males were generally heavier than females of the same class.
Table 4  Mean weights (kg) of sheep by teeth and sex classification

<table>
<thead>
<tr>
<th>Sex</th>
<th>Number of permanent incisors (pairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>13.0 ± 6.6</td>
</tr>
<tr>
<td>Male</td>
<td>12.3 ± 6.3</td>
</tr>
<tr>
<td>Castrate</td>
<td>-</td>
</tr>
</tbody>
</table>

MORTALITY AND DISPOSALS

Of the 5041 sheep on which owners gave information, 6.5 per cent were said to have died, 7.8 per cent had been slaughtered and 25.1 per cent sold. Of the 977 lambs reported born in 1984, only 44 were said to have died, giving an estimated mortality rate of 6.5 per cent (birth to 12 months) for lambs. The overall mortality of 4.5 per cent for 1984 is probably biased downwards. It is possible that some of the animals said to have been sold or slaughtered actually died.

DISCUSSION

OWNERSHIP PATTERNS AND FLOCK STRUCTURE

The ownership pattern of sheep flocks in the four Peasant Associations surveyed was very similar. The relationships between owner(s) of sheep and the caretaker were not established in this study. If the average relationship between a caretaker and owner(s) is that of kinship or if a formal "contract" exists between caretaker and owner(s), then preferential treatment of sheep based on ownership of individual sheep within a flock would not be expected. On the other hand, preferential treatment, for example selective feeding of supplement in drought periods, could occur if caretaker-owner(s) relationships were far removed from kinship or if there was no proper arrangement between them. The high percentage of single ownership gives some guarantee that any tested innovations passed on to farmers would be applied to entire flocks rather than parts of flocks.
Ranges in flock size in the four Peasant Associations were also similar, though the classification of flocks into sizes and subsequent selection of samples might have partly accounted for the similarity in the range. The practical implication of the similarity in ownership and flock size is that future work on sheep could be carried out in one or two Peasant Associations should manpower and other resources be limiting.

REPRODUCTIVE PERFORMANCE

Estimates of reproductive parameters from this survey could only be approximate since information provided by farmers over a period of time would necessarily carry some element of unreliability. Nevertheless, those estimates from the survey do not differ very much from those obtained from performance recorded flocks at ILCA's station and may be judged to be a good indication of the breed performance in the traditional production systems.

BODY WEIGHT

From station flock data mean weight for females at four months of age was 10 kg and that of females which had three or more lambings and at four months post-partum status was 26.6 kg. While the estimates from station and survey flocks are not directly comparable because of large standard deviations on the ages in the latter group, the figures indicate that body weights achieved in the traditional production systems are within the range achieved by ILCA's station flocks. The weights of sheep in small, medium and large flocks were found to be similar.

CONCLUSIONS

From the comparisons of reproductive and productive performance for the Menz sheep flocks at ILCA's research station and in flocks from the traditional production systems, it would appear that the gap between reproductive performance at the station and outside the station is wider than the gap between productive performance (body weight). It is possible that the lower annual reproduction rate ensures the maintenance of good body weight in traditional flocks.

Future analyses of station data should explore the relationships between long lambing intervals and weight changes. If such a relationship is found not to be
important, more emphasis should be put on developing innovations that will improve the reproductive performance of flocks in the traditional production systems.

ACKNOWLEDGEMENTS

The authors wish to acknowledge the contributions of Trevor Wilson during the design of this survey and for useful suggestions in preparing the report. Wolde Ab W/Mariam and Abebe Misgena established contacts with the Peasant Associations' leaders without which the survey could not have been carried out.

*Ram of the Menz breed (East African fat-tailed type) in the Ethiopian highlands*
Cette étude compare deux types de conduite d'élevage des ovins et caprins: l'une selon les méthodes Rendille traditionnelles, l'autre avec un suivi sanitaire. La contribution nutritive du lait et de la viande des petits ruminants aux besoins d'un ménage type est estimée en termes d'apports énergétique et protéique. Ces apports sont comparés à ceux des bovins et des camélidés dans les deux modes de conduite. L'enquête montre qu'en système traditionnel les contributions des petits ruminants sont de 22 à 26 p.cent pour les besoins énergétiques et de 55 p.cent pour les protéines. Avec le programme sanitaire, ces proportions passent à 25 à 31 p.cent pour l'énergie et 65 p.cent pour les protéines. Les apports des petits ruminants sont toujours supérieurs à ceux des bovins et seuls les dromadaires apportent plus de protéines dans la conduite d'élevage sous suivi sanitaire. Les ovins et caprins sont une source importante de viande en particulier pendant la saison sèche. Leur lait contribue peu au système alimentaire des Rendille. Par contre, les animaux mâles sont vendus et le produit de la vente est utilisé à acheter des céréales qui vont contribuer à réduire le déficit énergétique dans les besoins de la famille.
THE IMPORTANCE TO RENDILLE SUBSISTENCE PASTORALISTS
OF SHEEP AND GOATS IN NORTHERN KENYA

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P.O. Box 147 Marsabit Kenya

SUMMARY

Milk and meat production by sheep and goats was monitored under traditional Rendille management and also with a veterinary input. The nutritional value of these products to a typical Rendille household was estimated in terms of protein and energy. The contribution of smallstock to the nutritional requirements of the household is compared with that of camels and cattle under the two regimes. It is concluded that smallstock supply from 22-26 per cent of energy requirements and 55 per cent of protein requirements under the traditional system; with the health programme these proportions increase to 25-31 per cent and 65 per cent. The contribution of smallstock is greater than that of cattle and under the health programme their production is only exceeded in protein by camels. Smallstock are an important source of meat in dry seasons in particular. Milk contributes little to the Rendille diet. Male animals are sold and the proceeds used to purchase cereals which help reduce the energy deficit in the human diet.

INTRODUCTION

It has been estimated that at the present rate of growth (four per cent per annum) the human population of Kenya will have doubled by the turn of the century and at that time will be increasing at the rate of one million per annum. In fact, in less than half a century there may be five people for every one living in Kenya today (Field & Simpkin, 1984).

Recently, it was stated that the number of people living in the dry areas of Kenya, which cover 80 per cent of its surface, is expected to increase from the current 6 million to 11 million in the next decade and a half (Muturi, 1985).

The national economy is growing at a much slower rate than this and more people will be forced back to the land and subsistence agriculture. As the remaining high- and medium-potential land is settled and cultivated there will be intensification of the use of semi-arid lands of marginal agricultural potential. There is little hope for the survival of forests and woodlands, water conservation will be forfeited and there will be accelerated erosion and desiccation of the land.

In northern Kenya, nevertheless, extensive rangelands which cannot be cultivated because of the low and unreliable rainfall will remain. Attempts to transpose the existing beef economy from the Kenya highlands to these rangelands should be resisted since in the arid zone, where water is at a premium, water-dependent cattle are a major factor in the elimination of the herbaceous layer over large areas of annual vegetation around permanent water points (Field & Simpkin, 1984). Greatest emphasis should be placed on improving the productivity of camels, sheep and goats which are better adapted to arid conditions.

This paper is a synthesis of several simultaneous studies on the productivity of camels, cattle and small ruminants under traditional management and with a veterinary health programme. The data are combined with information on household stock ownership to determine the relative importance of the different livestock species in fulfilling the nutritional requirements of the Rendille pastoralists in Marsabit district. They also show the relative advantages of a strategic health programme in raising the productivity of the different species of livestock.
MATERIAL AND METHODS

STUDY AREA

The study area covered 11,300 km$^2$ of the Rendille home range in Western Marsabit district.

LIVESTOCK NUMBERS AND HOUSEHOLD OWNERSHIP

Methods used involved aerial survey and household questionnaires.

Aerial Survey

Results from 11 systematic reconnaissance flights over a six per cent sample of the study area are used. The method is described in Norton-Griffiths (1975) and Field et al (1981). Data from the 1979 national census of the human population were used to determine average household ownership (Government of Kenya, 1981).

Household Questionnaires

In the household survey separate questions were asked of the men and women. Data were collected on family size and food consumption. Measurements were taken, on site, of: livestock numbers and flock compositions; animal weights; age; and milk production. Data are from 150 household surveys among Rendille, Ariaal and Samburu.

PRODUCTIVITY EXPERIMENTS

Measurements were taken of the main production parameters (milk, liveweight gain, recruitment and mortality) of herds of all four species of livestock. The minimum size of the herds was 100 animals and the composition approximated to that of traditional Rendille herds. The herds were monitored between 1979 and 1982, the minimum period being 18 months for cattle while the other three species were monitored for two to three years. Monitoring was on a monthly basis for camels and cattle and every two weeks for smallstock.

The health programme was introduced after a period of observation of six to twelve months during which all main diseases were identified. The herds were then divided, one half receiving a comprehensive veterinary input known as the health programme while the other half was maintained under a husbandry regime which permitted treatment of disease on traditional lines.
Further details are given for sheep and goats in Carles (1985) and Simpkin (1985) and for cattle in Field (1981).

RESULTS AND DISCUSSION

HOUSEHOLD OWNERSHIP OF LIVESTOCK

Results calculated from aerial and household surveys are presented in Tables 1 and 2 respectively.

In Table 2 the age-specific composition of the herds of each species, together with data on weights-for-age, have been used to calculate mean liveweight. In Marsabit district these are quite low where a cow is equivalent to 0.66 TLU, a camel 1.2 TLU, a sheep 0.09 TLU and a goat 0.10 TLU.

From these two tables it can be seen that from 31 to 36 TLU are owned per household and smallstock comprise from 17 to 31 per cent of the total depending on the method of calculation.

MINIMUM REQUIREMENTS OF LIVESTOCK

An average family of eight persons is estimated to have dietary needs equivalent to 6.5 adults (Brown, 1971). Daily energy requirements for pastoralists have been

Table 1 Average stock ownership per family in Western Marsabit district (from aerial survey data)

<table>
<thead>
<tr>
<th>Species</th>
<th>Number</th>
<th>Density N°/km²</th>
<th>Percent of TLU</th>
<th>Number owned</th>
<th>TLU per family</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Person b)</td>
<td>Per family c)</td>
</tr>
<tr>
<td>-------------</td>
<td>--------</td>
<td>----------------</td>
<td>---------------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Camels</td>
<td>18 643</td>
<td>1.65</td>
<td>40.3</td>
<td>1.4</td>
<td>11.6</td>
</tr>
<tr>
<td>Cattle</td>
<td>24 552</td>
<td>2.17</td>
<td>42.4</td>
<td>1.9</td>
<td>15.2</td>
</tr>
<tr>
<td>Smallstock</td>
<td>107 547</td>
<td>9.52</td>
<td>16.9</td>
<td>8.3</td>
<td>66.7</td>
</tr>
<tr>
<td>Donkeys</td>
<td>235</td>
<td>0.02</td>
<td>0.4</td>
<td>0.02</td>
<td>0.1</td>
</tr>
<tr>
<td>Total</td>
<td>150 977</td>
<td>13.36</td>
<td>100.0</td>
<td>11.62</td>
<td>93.6</td>
</tr>
</tbody>
</table>

Notes: a) One Tropical Livestock Unit (TLU) is equivalent to a 250 kg cow or 0.8 of a camel or 11 smallstock.

b) Assumes a population of 12 900 Rendille people.

c) Assumes eight people per family.
Table 2  Average stock ownership per family in Western Marsabit district
(from household surveys)

<table>
<thead>
<tr>
<th>Species</th>
<th>Number per family</th>
<th>Tropical Livestock Units (TLU)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Per family</td>
</tr>
<tr>
<td>Camels</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Cattle</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Smallstock</td>
<td>101</td>
<td>9.2</td>
</tr>
<tr>
<td>Total</td>
<td>124</td>
<td>35.2</td>
</tr>
</tbody>
</table>

estimated to range from 2000 Kcal for a woman to 2800 Kcal for a man (Dahl & Hjort, 1976). However, a pastoralist has been described as "an active individual doing no heavy work" needing 2300 Kcal per day (Brown, 1971). Thus, family requirements are calculated to range from 15 000 Kcal (Brown, 1971) to 18 300 Kcal per day (Dahl & Hjort, 1976) after adjusting for a family of eight. Protein requirements are about 422 g per family per day.

Brown (1971) suggested that in most African pastoral societies a standard family consumes a diet of 75 per cent milk and 25 per cent meat over a year: this amounts to 16 litres of milk and 2.41 kg of meat per day. Today however, many families have access to cereals with which they supplement their diet.

Daily milk requirements of a family can be supplied by about seven cows or four camels in milk on any and every day of the year (Brown, 1971). A pastoralist must keep 35 to 40 cattle but only half this number of camels in order to maintain this level of production (Lamprey, 1983). Brown (1971) concluded that in whatever manner this figure is calculated a family of eight must maintain 27 to 31 TLU's and if these figures are adjusted to the smaller size of animals in our area, equivalents lie within the following ranges for each species: camels 23 to 26; cattle 41 to 47; sheep 278 to 326; goats 275 to 311.

Tables 1 and 2 show that average Rendille stock ownership should provide at least these minimum requirements. In practice pastoralists try to keep more animals to provide for disasters such as drought, disease and theft and also for social reasons. Clearly there is considerable variation in stock ownership in terms of numbers, species and productivity and this may determine whether or not a household will be dependent on food aid.
ESTIMATED YIELDS OF SHEEP AND GOATS

**Milk Yields**

Under the two management regimes the year round average daily yields of milk have been estimated per adult female. The calorific values of sheep and goat milk are taken as 1114 and 700 Kcal/kg and the protein values as 63 and 36 g/kg, respectively. From Table 3 it can be seen that the health programme did not lead to an increase in milk production or in energy and protein in sheep.

**Meat Production**

Growth rates of small ruminants have been converted into daily gains in carcass weights. With an energy of 2.36 Kcal and a protein value of 0.145 g/g of carcass, the energy and protein available per day has been calculated in Table 4.

The normal ratio of sheep and goats in Rendille flocks is 1.0:1.5. Therefore household ownership of goats ranges from 40 to 61 and sheep from 27 to 40 depending on whether data are used from Table 1 or 2. A survey of flock compositions showed that 40 per cent of sheep and goats are adult females while the remainder can be considered to be meat producers.

In the final analysis, the flock size from the household surveys has been taken to be more accurate as the aerial surveys yield one-third less small ruminants. This is understandable as the noise from an aircraft causes goats and sheep to aggregate and makes counting from oblique photographs difficult.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Milk, energy and protein yields from small ruminants in Western Marsabit district</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Management regime</td>
</tr>
<tr>
<td></td>
<td>Traditional</td>
</tr>
<tr>
<td>Sheep</td>
<td>17.5</td>
</tr>
<tr>
<td>Goats</td>
<td>35.1</td>
</tr>
</tbody>
</table>
Table 4  Daily production of meat and energy and protein yield for small ruminants in Western Marsabit district

<table>
<thead>
<tr>
<th>Species</th>
<th>Traditional</th>
<th>Health programme</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Carcass yield (g/d)</td>
<td>Energy (Kcal)</td>
</tr>
<tr>
<td>Sheep</td>
<td>23</td>
<td>54</td>
</tr>
<tr>
<td>Goats</td>
<td>20</td>
<td>47</td>
</tr>
</tbody>
</table>

For the estimation of overall yields the assumption is that in an average flock of 101 animals, 24 goats and 16 sheep are milk producers and 37 goats and 24 sheep are meat producers.

OVERALL YIELDS OF THE FAMILY HERDS

Similar estimates have been made of milk and meat production for camels and cattle. Details of the procedures followed for each species are given in Field & Simpkin (1984).

Results are presented in Table 5 and 6 for a typical family herd. Information is also presented to show the extent to which each livestock category fulfills the needs of the owners.

From Table 5 it is apparent that under traditional management there is adequate protein available from the family herds but there is a shortfall in energy requirements ranging from 39 to 50 per cent. Small ruminants may supply from 22 to 26 per cent of energy requirements and 55 per cent of protein needs.

Under the health programme protein is in surplus while there is still a shortfall of 26–39 per cent in energy. Clearly the purchase of cereals, sugar and fat will remain a necessity for some time.

Goats and sheep have an important function as a source of meat which may, under the health programme, supply about a quarter of the energy needs and over a half of the protein needs in dry seasons. Their milk contributes little to the diet.
Table 5  Estimated mean daily yields from all livestock under traditional management in Western Marsabit district

<table>
<thead>
<tr>
<th>Species</th>
<th>Sheep</th>
<th>Goats</th>
<th>Camels</th>
<th>Cattle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number owned</td>
<td>40</td>
<td>61</td>
<td>12</td>
<td>11</td>
<td>124</td>
</tr>
<tr>
<td>Energy from milk (Kcal)</td>
<td>312</td>
<td>590</td>
<td>2541</td>
<td>940</td>
<td>4383</td>
</tr>
<tr>
<td>Energy from meat (Kcal)</td>
<td>1296</td>
<td>1739</td>
<td>327</td>
<td>1478</td>
<td>4840</td>
</tr>
<tr>
<td>% of required minimum</td>
<td>11</td>
<td>15</td>
<td>19</td>
<td>16</td>
<td>61</td>
</tr>
<tr>
<td>% of required maximum</td>
<td>9</td>
<td>13</td>
<td>16</td>
<td>13</td>
<td>50</td>
</tr>
<tr>
<td>Protein from milk (g)</td>
<td>18</td>
<td>30</td>
<td>142</td>
<td>47</td>
<td>237</td>
</tr>
<tr>
<td>Protein from meat (g)</td>
<td>80</td>
<td>107</td>
<td>69</td>
<td>91</td>
<td>347</td>
</tr>
<tr>
<td>% of required diet</td>
<td>23</td>
<td>32</td>
<td>50</td>
<td>33</td>
<td>138</td>
</tr>
</tbody>
</table>

Sheep and goats are also a convenient size for minor trade negotiations and to meet social obligations. By selling a castrated goat or sheep, a pastoralist may obtain about US$10 with which he may then purchase 32 kg of maize meal or 16 kg of sugar. These rich sources of energy go a long way to filling the shortfall in energy in the diet: they also remove the reliance of the pastoralist on milk in an environment which is hostile for milk production.

Table 6  Estimated mean daily yields from all livestock under the health programme in Western Marsabit district

<table>
<thead>
<tr>
<th>Species</th>
<th>Sheep</th>
<th>Goats</th>
<th>Camels</th>
<th>Cattle</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean number owned</td>
<td>40</td>
<td>61</td>
<td>12</td>
<td>11</td>
<td>124</td>
</tr>
<tr>
<td>Energy from milk (Kcal)</td>
<td>312</td>
<td>658</td>
<td>3581</td>
<td>1040</td>
<td>5591</td>
</tr>
<tr>
<td>Energy from meat (Kcal)</td>
<td>1536</td>
<td>2109</td>
<td>519</td>
<td>1404</td>
<td>5568</td>
</tr>
<tr>
<td>% of required minimum</td>
<td>12</td>
<td>18</td>
<td>27</td>
<td>16</td>
<td>74</td>
</tr>
<tr>
<td>% of required maximum</td>
<td>10</td>
<td>15</td>
<td>22</td>
<td>13</td>
<td>61</td>
</tr>
<tr>
<td>Protein from milk (g)</td>
<td>18</td>
<td>34</td>
<td>199</td>
<td>52</td>
<td>303</td>
</tr>
<tr>
<td>Protein from meat (g)</td>
<td>94</td>
<td>129</td>
<td>110</td>
<td>86</td>
<td>419</td>
</tr>
<tr>
<td>% of required diet</td>
<td>26</td>
<td>39</td>
<td>73</td>
<td>33</td>
<td>171</td>
</tr>
</tbody>
</table>
CONCLUSIONS

In this simultaneous survey of all four major livestock species in northern Kenya, we conclude that the camel is the most important source of food to the pastoral herd owner. However, when sheep and goat production is combined, which we consider legitimate as they are always run as a mixed species flock, we find that their production of energy is the greatest while protein production is only exceeded by camels under the health programme.

Evidence that even higher productivities may be possible from small ruminants has recently been obtained from the Project's experimental flock which increased by 64 per cent over a one-year period, one-third of which was extreme drought.

ACKNOWLEDGEMENTS

I wish to thank H. Blackburn of Texas A and M University and A. Carles of the University of Nairobi for information on small ruminants. T. Rutagwenda and P. Simpkin both completed their theses with the Project on different aspects of camel productivity. Research could not have been completed without the dedicated contribution of our Field Support Staff. They are too many to mention individually, but I am sincerely grateful for their work which was carried out under continual threat from either predators, theft or personal injury. Finally I wish to thank the livestock owners who cooperated with us, in particular Councillor Hassan Mussa and Messrs Lengima and Lenangaya.
A STRATEGY FOR THE INTENSIFICATION OF PRODUCTION SYSTEMS
USING SMALL RUMINANTS IN THE IVORY COAST

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08 B.P. 1295 Abidjan 08 Côte d'Ivoire

SUMMARY

With a view to the intensification of production systems, the Ivory Coast is placing a strong emphasis on the integration of agriculture with livestock production. Unfortunately, in the past the methods used to achieve this goal have not always been successful and results have so far proved disappointing. Most emphasis was originally placed on a cattle-Stylosanthes mini-farm system. It was then considered that animal traction would provide the answer to integrating the two sub-sectors and at the same time a forage rotation system would restore soil fertility. Small ruminants have been ignored but these animals are those which traditionally have been integrated into the cropping system. They do not suffer from any sociological constraints, their meat is well liked and they provide the most regular source of cash income. Small ruminants appear to be the most appropriate domestic animals to allow a real integration of the agricultural and livestock sub-sectors at the present time.
LE ROLE DES PETITS RUMINANTS DANS LA STRATEGIE D'INTENSIFICATION DES SYSTEMES DE PRODUCTION EN COTE D'IVOIRE

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RESUME

Dans une perspective d'intensification des systèmes de production, la Côte d'Ivoire s'est résolument engagée dans la mise en place de schémas d'association agriculture-élevage. Malheureusement, le choix des instruments d'intensification n'a pas toujours été judicieux, ce qui a entraîné les mauvais résultats enregistrés jusqu'à présent: on a voulu en effet, à tout prix privilégier le tandem bovins-stylosanthes selon le modèle de la fermette de polyculture-élevage. On a pensé ensuite que la traction animale résoudrait immédiatement le problème de l'intégration, pendant que la sole fourragère résolvait celui de la fertilité de la terre. On a laissé de côté les petits ruminants, alors que, dans le contexte du pays, ce sont véritablement ces animaux là qui font partie du système agricole traditionnel, qui ne souffrent d'aucun préjugé sociologique ou alimentaire et qui constituent pour les populations rurales la source de revenus la plus régulière. Les petits ruminants apparaissent les plus aptes dans le contexte actuel à réaliser un modèle d'intégration véritable de l'agriculture et de l'élevage en Côte d'Ivoire.

INTRODUCTION

Globalement, la Côte d'Ivoire est déficitaire en produits animaux. Pour l'essentiel de son approvisionnement, elle est tributaire des pays limitrophes du Sahel, dont le potentiel de production a été très sérieusement entamé ces dix dernières années, en raison de la succession et de la persistance des vagues de sécheresse.

C'est pour se prémunir contre cet aléa que les pouvoirs publics, par l'entremise des sociétés de développement ont mis en place des stratégies d'intensification des systèmes de production, avec comme thème central l'association agriculture–élevage. Notre propos est plus un réquisitoire de cette stratégie, notamment dans le choix des instruments (végétal et animal) d'intensification, qu'une véritable plaidoirie pour un autre type de modèle dont nous connaissons les composantes théoriques et que nous cherchons à mettre en place en ce moment même dans le nord du pays.

BILAN CRITIQUE DES TENTATIVES D'INTENSIFICATION

La plupart des schémas d'intensification qui ont été expérimentés jusqu'à ce jour cherchaient à intégrer l'élevage bovin au système agricole, afin de résorber à terme le déficit en viande bovine (en 1980, le taux de couverture était seulement de 18,3 p.cent pour la viande bovine, contre 42 p.cent pour les ovins/caprins). La première de ces expériences a été l'opération noyaux d'élevage.

LES NOYAX D'ELEVAGE

Cette opération a démarré dès 1962, au lendemain de l'indépendance. Elle consistait à importer (principalement du Mali) des matrices de reproduction et des géniteurs sélectionnés, puis à constituer des noyaux de 19 génisses et un taureau qui étaient ensuite attribués sous forme de prêt à long terme à des paysans, selon des normes bien établies: être agriculteur à pâturages, de point d'abreuvement. Beaucoup d'exploitants du nord du pays remplissaient ces conditions et ont donc bénéficié de cette forme assez originale de prêt, le remboursement devant se faire sur le croît du troupeau, sur sept ans, après un différé de quatre ans.

Techniquement, l'opération paraissait fort alléchante et avec les remboursements escomptés, on prévoyait d'étendre l'expérience à l'ensemble de
la région, et transformer par la même occasion les agriculteurs en agriculteurs-éleveurs.

Les enquêtes zootechniques de routine permirent très tôt de se rendre à l'évidence. La plupart de ces animaux étaient conduits exactement comme les autres animaux du village, c'est-à-dire sans aucun suivi sanitaire, sans complémentmentation, laissés en divagation une bonne partie de l'année. En conséquence, la plupart de ces noyaux ont disparu aujourd'hui, car les attributaires les ont simplement utilisés comme animaux sacrificiels de prestige ou simplement pour investir dans des secteurs jugés plus rentables.

LES FERMES AGRO-PASTORALES

Cette seconde opération avait pour but de promouvoir des exploitants individuels dans le cadre de fermes intensives de type polyculture élevage, avec une sole fourragère (stylosanthes) dans l'assolement. Malgré un appui soutenu des sociétés d'encadrement, on a constaté que seulement six p.cent des paysans du nord et deux p.cent du cheptel pourraient fonctionner selon ces normes. Il s'agissait donc d'un modèle de type élitiste qui pouvait juste servir de démonstration, mais n'était pas vulgarisable dans le contexte actuel.

LA TRACTION ANIMALE

La traction animale diffuse progressivement dans les exploitations cotonnières grâce à l'action de l'encadrement CIDT. Elle recueille l'adhésion des paysans car elle permet dans un premier temps de diminuer la pénibilité du labour, dans un second temps d'accroître les superficies cultivées et par conséquent d'augmenter les revenus tirés de la vente du coton. Logiquement donc les paysans possédant des bovins et candidats à la culture cotonnière attelée ne devraient pas hésiter à prélever sur leur troupeau des taurillons, à les dresser pour la traction animale, ce qui n'a pas été le cas.

Une enquête menée par l'auteur auprès des planteurs de coton a montré que plus de 90 p.cent des attelages étaient acquis hors du troupeau villageois. La diffusion de la traction animale n'a donc pas entraîné de spécialisation fonctionnelle du troupeau. Elle n'a pas modifié non plus l'attitude des paysans vis-à-vis de leurs animaux.
Toutes ces expériences ont ceci de commun : elles ont échoué, c'est-à-dire qu'il y a eu en réalité un phénomène de rejet.

Au lieu d'être une réponse à un besoin, une action qui s'inscrit dans le système des valeurs sans le bouleverser, une initiative qui épouse le modèle social, l'intensification est apparue comme une greffe sur tissu mal préparé, mal connu.

Avant d'entreprendre de telles opérations, il était nécessaire de connaître les mécanismes de fonctionnement des élevages traditionnels, leur fonction économique et sociale et leur articulation avec le système agricole.

**L'ELEVAGE BOVIN : CONCEPTION ET SIGNIFICATION**

L'élevage bovin apparaît, aux yeux de l'observateur, comme un véritable paradoxe. En effet, chaque unité de production cherche à acquérir des bovins en mobilisant et en commercialisant le surplus agricole, lorsque les récoltes sont abondantes.

Mais dès que le paysan entre en possession de l'animal, il s'en débarrasse la minute qui suit, en le confiant à une tierce personne. Et si d'aventure il tardait à trouver cet intermédiaire de confiance, l'animal est laissé en divagation dans le village à charge pour les enfants de l'éloigner des zones de cultures à coup de pierres parfois le fusil!

Des préjugés d'ordre sociologique interdisent à un adulte de s'occuper de bovins. En effet, dès l'âge de 12 ans, dans le cadre des rites initiatiques, (le 'poro') qui préparent l'adolescent vers la maturité, en même temps que les vertus agrariennes lui sont enseignées, on lui interdit désormais de toucher à la vache car il s'agit là d'une activité mineure, castée, réservée aux peuls. Les bovins sont donc toujours conduits et gérés par personnes interposées. Au niveau de chaque village, les animaux sont regroupés dans des parcs collectifs sous la responsabilité d'un chef de parc et sous la conduite de bergers Peuls originaires des pays limitrophes à traditions pastorales.

Au plan de la gestion et de l'exploitation du troupeau, il peut s'écouler deux ans sans qu'un propriétaire se rende au parc pour savoir ce que sont devenus ses animaux. Dans la plupart des cas, il n'arrive plus à les connaître. Il éprouve à leur égard une phobie et une crainte presque viscérale.
Par ailleurs, lorsqu'on s'intéresse à la typologie des propriétaires, on s'aperçoit qu'en moyenne un paysan possède moins de deux bovins. Le caractère congloméral du troupeau bovin fait que les sous-produits ne sont pas utilisés. Le bouvier s'approprie le lait tandis que les déjections s'accumulent jusqu'à ce que le parc devienne un véritable bourbier et qu'on lui trouve un nouvel emplacement.

Le troupeau bovin n'entre pas dans les préoccupations quotidiennes des unités de production. Ce n'est pas une source de revenus, les animaux ne sont jamais abattus pour l'auto-consommation, leur principale utilisation étant de servir d'aniiaux sacrificiel lors des cérémonies funéraires. A cette occasion, le paysan va réclamer les animaux confiés il y quelque temps! Parfois des troupeaux entiers disparaissent lors de ces festivités, ils auront pleinement rempli l'objectif qui leur était assigné.

LE SYSTÈME AGRICOLE

Comme dans tous les pays en développement, l'agriculture ivoirienne revêt un caractère dualiste: le secteur moderne ou agriculture de plantation est tout à fait à l'avant garde du progrès de la science et de la technologie tandis que le secteur vivrier est encore au stade de l'auto-suffisance. Lorsqu'on essaye d'identifier l'exploitation agricole traditionnelle et d'en saisir la dynamique, on constate que de nombreux obstacles s'opposent à l'intégration des bovins dans une optique d'intensification.

STRUCTURE DE L'EXPLOITATION ET MODE DE PRODUCTION

Les exploitations sont généralement de petite taille d'environ 3,5 ha en moyenne et les parcelles ont une valeur modale de moins de deux hectares environ, sont dispersées tous azimuts, donnant à l'espace agraire une configuration de type micro-fiduciaire. Elles sont généralement en culture manuelle avec équipement élémentaire (daba, machette). Elles sont à mode faire valoir direct, le paysan vivant en véritable symbiose avec sa terre qui est souvent réputée sacrée.

Elles sont de type monolithique linéaire, ou sous forme de parcelles portant deux ou plusieurs cultures associées. Dans tous les cas, les associations culturales et les rotations ne procèdent jamais de considérations agronomiques, mais plutôt
d'un gradient d'intérêt dont le seul souci est d'assurer la sécurité alimentaire du groupe.

LE STATUT ET LE MODE D'ACCES A LA TERRE

La terre est un patrimoine collectif inaliénable. Elle est gérée par les gérontocratie villageois sous la responsabilité d'un chef de terre. Les parcelles sont attribuées aux familles et aux lignages à titre d'usu.

Dans certaines régions où la densité de la population est encore faible, les jachères sont très longues, parfois elles durent plus de 100 ans et sont réservées au patrimoine du village. Cette conception de la terre interdit de mettre en place une sole fourragère dans l'assolement. Car cela traduirait la volonté de l'exploitant de revenir sur la parcelle de régénération après trois rotations seulement, ce qui équivaudrait à une appropriation définitive du sol, pratique contraire aux us et coutumes.

En définitive, tel qu'il fonctionne à l'heure actuelle, le système agricole ne peut pas insérer les bovins dans le processus d'intensification; la taille de l'exploitation, le niveau d'équipement et de technicité du paysan et les coûts ne permettent pas de mettre en place et de gérer une parcelle fourragère dans le système agricole. Le statut de la terre ainsi que la conduite et l'attitude vis-à-vis des bovins ne le permettent pas non plus. Il faut donc rechercher d'autres instruments d'intensification.

ROLE ET PLACE DES PETITS RUMINANTS DANS LE SYSTEME AGRICOLE

Il convient tout d'abord de rappeler que ce n'est que très récemment que l'on s'est préoccupé de ces espèces, ce qui était une lacune, car il est apparu dans les enquêtes d'opinion que la viande de mouton était la plus préférée par le consommateur ivoirien. Mieux, les petits ruminants sont véritablement intégrés dans le système agricole. Alors qu'on a en moyenne moins de quatre bovins par exploitation ayant des bovins, on dénombre 10 ovins/caprins par exploitation qui en possèdent.

Si ces petits ruminants ne sont pas encore systématiquement encadrés, s'ils sont encore en divagation aux alentours des villages, il ne sont l'objet d'aucun préjugé
ou interdit sociologique ou religieux. Le paysan les côtoie, leur partage parfois son abri, leur donne volontiers ses excédents de cuisine et les soigne. Ils entrent également dans ses préoccupations quotidiennes. Le mouton et le cabri sont également des animaux sacrificiels. Le mouton en particulier est le seul animal exigé pour la fête de Tabaski. Les baptêmes et les mariages sont l'occasion de sacrifier un ou plusieurs moutons.

En milieu rural, les moutons locaux avec 10 à 15 kg de carcase correspondent exactement à ce qu'une collectivité peut absorber par jour alors que même une carcase de taurillon ne pourrait se vendre dans la journée.

Sur le plan agricole, les capacités théoriques de charge de la savane ne permettent d'entretenir que 0,5 UBT/ha, ce qui est impossible à réaliser dans le cadre d'une exploitation individuelle de 3,5 ha en moyenne, même avec une sole fourragère.

Compte tenu de ses contraintes, il convient de rechercher d'autres schémas d'intensification.

**LE MODELE PETITS RUMINANTS - RESSOURCES INTERNES DE LA FERME**

Il convient de rappeler de prime abord que ce schéma est le fruit de notre réflexion; il n'est encore réalisé nulle part dans le pays.

Compte tenu des observations que nous venons de faire et de la nécessité de passer des modèles traditionnels vers des schémas intensifs plus performants, pour répondre aux besoins sans cesse croissants à la fois en vivriers de base et en protéines animales, nous allons très prochainement essayer d'expérimenter un modèle fermier à partir de ressources internes de la ferme.

**BESOINS ENERGETIQUES**

L'une des particularités de ces modèles sera de couvrir tout ou partie des besoins en énergie à partir des ressources produites sur place. Et pour ne pas être en rupture avec l'équilibre et la dynamique du système agricole, cet apport reposera essentiellement sur les pâturages naturels hors des zones de culture, sur les vivriers cultivés dans l'exploitation (palies de riz, maïs, mil, sorgho, sous-produits des récoltes de racines et tubercules, épluchures d'igname, cossettes de manioc, farine basse de riz) et sur la disponibilité de mélasse dans la région Ferke et de sous-produits d'huilerie (tourteaux, coton, arachide...).
CONCLUSION

L'élevage traditionnel d'ordre ethno-culturel entre l'agriculture et l'élevage est encore d'actualité en Afrique. Si l'élevage bovin et l'agriculture sont encore techniquement dissociés en Côte d'Ivoire, c'est essentiellement en raison de l'absence de tradition pastorale.

Ni la diffusion de la traction animale ni les stratégies volontaristes n'ont pu ébranler le comportement du paysan vis à vis du troupeau bovin. Les modèles d'association agriculture-élevage, pour être viables, devront tenir compte de cette réalité en s'appuyant sur d'autres instruments partie d'intensification notamment les petits ruminants qui font véritablement partie du système agricole traditionnel et des préoccupations quotidiennes du monde paysan.

Bélier Djallonké de la zone littorale de la Côte d'Ivoire
ENQUETE SUR LA PRODUCTIVITE ET LES ROLES DES CAPRINS EN OUGANDA

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Makerere University
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RESUME

L'importance économique et sociale des caprins dans les systèmes agraires ougandais est identifiée et évaluée en termes de productivité et de fonctions. Le rôle le plus important des caprins est la fourniture de viande. La chèvre naine est africaine de la région orientale montre un rendement carcase plus élevé que celles d'autres régions. Une enquête menée dans les abattoirs montre que l'âge à l'abattage varie entre un an et demi et trois ans. Les femelles représentent 53,6 p.cent, les mâles castrés 34,9 p.cent et les mâles entiers 11,5 p.cent des animaux abattus. Les caprins sont utilisés pour les cérémonies religieuses, les rites funéraires et certains rituels culturels. Les gens pourraient utiliser les caprins pour suppléer au manque de protéines de leur régime mais cela réclame un changement dans les habitudes encore inhibées par les coutumes et la tradition. Une gestion moderne de conduite de l'élevage devrait être adoptée et les races capables d'amélioration identifiées.
A SURVEY OF THE PRODUCTIVITY AND FUNCTIONS OF GOATS IN UGANDA

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SUMMARY

The social and economic importance of goats in the agricultural systems in Uganda is identified and evaluated in terms of their productivity and functions. The most important role of goats is the provision of meat. Small East African goats from the eastern region show a higher dressing-out percentage than from other regions. In an abattoir study goats slaughtered were between one and half and three years old and their composition was 53.6 per cent females, 34.9 per cent castrates and 11.5 per cent entire males. Other roles are religious ceremonies, funeral rites and cultural rituals. There is however, still need for people to utilise goats to bridge the protein gap by directly supplementing family diet. This requires a change in attitude which is still inhibited by custom and tradition. Modern management regarding goat husbandry should be adopted and breeds capable of improvement should be identified.

INTRODUCTION

Uganda is a landlocked country with an area of 236,860 km² between 1°S and 4°N. Inland lakes and rivers account for 14 per cent of the area. The greater part of the country has an average rainfall of about 1000 mm which falls in March – May and August – November. The driest and hottest period is December to February in the northern part of the country while in the west the driest period is between June and August. Average maximum temperature is 27°C and average minimum 16°C. Because of the adequate rainfall, the vegetation types are varied and remain lush and green throughout the year in most parts of the country.

There are an estimated two million goats in Uganda, almost all of them indigenous types reared in the villages in the traditional way (Okello & Obwolo, 1984). The distribution of goats has a direct relationship to the type of habitat found in a particular region. As shown in Figure 1, the goat population is largely concentrated in the western, eastern and northern regions where the habitat consists mainly of a mixture of dry acacia and grassland savanna.

The economic importance of goats in the provision of animal proteins in the developing countries has been extensively reviewed elsewhere (Devendra, 1981). In Uganda however, apart from the provision of meat, goats are also important culturally, socially and economically to the small farmer. It is against this background that this paper examines the importance of these animals in the agricultural system by describing their productivity and functions.

MATERIAL AND METHODS

Evaluation of carcass yields of different types of goats in Uganda was done at the abbatoir of Uganda Meat Packers in Kampala. Before slaughter, data on each goat (district of origin, age, sex, breed and liveweight) were recorded. Approximate age was determined from the incisor teeth of the lower jaw. After slaughter, the dressed carcass was weighed and the dressing-out percentage calculated on the basis of live body weight. A total of 209 goats from different breeds and of various age groups and sexes were subjected to this treatment, selection being at random.

In relation to other functions of goats, visits were made to all the regions of Uganda where the roles of goats were identified by observation and interviews of the local people.
Results

BREEDS OF GOATS

There are three distinct types of goats in Uganda (Mason & Maule, 1960). The Small East African (SEA) goats are the most numerous and are distributed throughout the country but are more concentrated in northern and eastern regions. Average liveweight for adult entire males is 27.4 kg, castrates 33.5 kg and females 26.1 kg. Mubende goats are found mainly in the central region, with a concentration in the Masaka area in the south. The colour of this goat is predominantly black although a mixture of brown and black is not uncommon. Average liveweight for adult entire males is 35.7 kg, castrates 36.0 kg and females 31.5 kg; individual male castrates

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Figure 1 Distribution of goats by district in Uganda (1983)
may weigh up to 42.0 kg. Kigezi goats are found mainly in south-western Uganda with some in Ankole and other bordering regions. The colour of this goat is black and the hair is long. Average liveweight for adult males is 28.8 kg, castrates 30.0 kg and females 30.3 kg.

CARCASS YIELD

The majority of goats brought for slaughter were over one and half years old. Young goats below one year old were rarely slaughtered. Of the animals slaughtered 53.6 per cent were females, 34.9 per cent were castrates and 11.5 per cent were entire males.

Tables 1, 2 and 3 show the carcass yields of the different breeds of goats in terms of dressing-out percentage. The SEA goats from Soroti showed a higher dressing percentage than those from other regions. Male castrates slaughtered between the ages one and half and two years had a higher dressing-out percentage than those slaughtered between the ages of two and half and three years.

Table 4 shows the effect of body weight on dressing-out percentage of the three breeds. Generally physiological age had an effect on dressing-out percentage. Ueckermann (1969) showed that heavier goats (45.4 kg) dressed higher than lighter goats (31.8 kg) by about 2–4 per cent depending on the plane of nutrition. Heavier

Table 1  Dressing-out percentage of Small East African goats in Uganda

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (years)</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Eastern</td>
</tr>
<tr>
<td></td>
<td></td>
<td>l.w. dcw (kg) (%)</td>
</tr>
<tr>
<td>Male castrate</td>
<td>1½-2</td>
<td>31.0 57.7</td>
</tr>
<tr>
<td></td>
<td>2½-3</td>
<td>33.9 53.9</td>
</tr>
<tr>
<td>Male entire</td>
<td>1½-3</td>
<td>28.8 58.3</td>
</tr>
<tr>
<td>Female</td>
<td>1½-3</td>
<td>29.7 58.2</td>
</tr>
</tbody>
</table>
Table 2  Dressing-out percentage of Mubende goats in Central Region

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (years)</th>
<th>Liveweight (kg)</th>
<th>dcw (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male castrate</td>
<td>1½-2</td>
<td>28.4</td>
<td>44.1</td>
</tr>
<tr>
<td>Male castrate</td>
<td>2½-3</td>
<td>36.0</td>
<td>50.7</td>
</tr>
<tr>
<td>Male entire</td>
<td>1½-3</td>
<td>35.7</td>
<td>56.4</td>
</tr>
<tr>
<td>Female</td>
<td>1½-3</td>
<td>31.5</td>
<td>54.4</td>
</tr>
</tbody>
</table>

Table 3  Dressing-out percentage of Kigezi goats in Western Region

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (years)</th>
<th>Liveweight (kg)</th>
<th>dcw (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male castrate</td>
<td>1½-3</td>
<td>28.8</td>
<td>52.0</td>
</tr>
<tr>
<td>Male entire</td>
<td>1½-3</td>
<td>30.0</td>
<td>49.4</td>
</tr>
<tr>
<td>Female</td>
<td>1½-3</td>
<td>30.3</td>
<td>51.6</td>
</tr>
</tbody>
</table>

Mubende goats (40-50 kg) gave dressing percentages higher by 7.8 per cent than those at 20-30 kg liveweight.

FUNCTIONS OF GOATS

Goats have important roles in the traditional, cultural, social and economic sectors of the Ugandan small farmer. The most important role, however, is the provision of meat. In all regions of Uganda, goat meat ranks only second to beef in quantity, but in terms of palatability and delicacy, it is preferred to beef. In all areas, goat meat is a favourite food on special occasions such as the celebration of funeral rites, Christmas day, Easter day, wedding ceremonies and thanksgiving ceremonies for the birth of a new baby.

Because of its small size, a goat is often slaughtered in honour of a special guest, a visiting relative or a friend. The carcass is easy to store and can readily
Table 4 The effect of body weight on dressing-out percentage of breeds of goats in Uganda

<table>
<thead>
<tr>
<th>Breed/sex</th>
<th>Liveweight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15-20</td>
</tr>
<tr>
<td>Small East African:</td>
<td></td>
</tr>
<tr>
<td>male castrate</td>
<td>46.10</td>
</tr>
<tr>
<td>male entire</td>
<td>46.17</td>
</tr>
<tr>
<td>female</td>
<td>50.50</td>
</tr>
<tr>
<td>Mubende:</td>
<td></td>
</tr>
<tr>
<td>male castrate</td>
<td>46.05</td>
</tr>
<tr>
<td>male entire</td>
<td>-</td>
</tr>
<tr>
<td>female</td>
<td>54.65</td>
</tr>
<tr>
<td>Kigezi:</td>
<td></td>
</tr>
<tr>
<td>male castrate</td>
<td>-</td>
</tr>
<tr>
<td>male entire</td>
<td>-</td>
</tr>
<tr>
<td>female</td>
<td>-</td>
</tr>
</tbody>
</table>

be preserved by smoking and drying. In Lango and Acholi (northern Uganda), goats are often slaughtered to provide meat for consumption during communal work. Roast goat is liked by many people because it is tender, juicy and soft. In Bunyoro, goat meat is sometimes mixed with herbs when preparing traditional medicines.

Goat's blood is also a delicacy in certain regions. For example in Buganda (central region) when a goat is slaughtered, its blood is collected, clotted and cooked together with the intestines to make a delicious meat known in the local language as 'Kafeche'. In Bugishu (eastern region) the blood is cooked and made into a soup, then mixed with a bitter leaf to make a common popular diet among old people.

Other important aspects are the roles it plays in the religious and ritual customs of the peasant farmers. In all parts of Uganda goats are normally offered as sacrifices by witch doctors and traditional healers to appease local gods, the spirits of dead people and ancestors.

The circumstances which necessitate this kind of practice may be a result of unexpected upheavals in the community, for example failure to have children, the death of an infant or prevailing mysterious disease conditions within the community. In Busoga (eastern region) instances are known where it is believed that a child may be crippled by a particular angry crippling god. This condition is claimed not to respond
to medical treatment. However, remedy and relief is believed to be brought by offering a goat as a sacrifice. Likewise such gods, referred to as 'Lubaale' in Buganda, are given the same attention if there is any similar calamity in the community. In this region witch doctors use goats (normally black or white) as sacrifices in the belief that one's personal misfortune such as failure to get a wife or finding a job can be overcome.

Traditional divine healers also use goats of specific colours, normally pure black or white, in healing their patients. The bones of goats are used as diagnostic tools. These are thrown down and the healer studies the pattern in which they have fallen in order to predict the nature of the sickness of his client.

Among the Acholi, goats are often slaughtered as a sacrifice following incorrect social behaviour, as for example in the committing of sexual offences between relatives (Okello & Obwolo, 1984). The Lugbara in West Nile use hairy goats to make sacrifices to their gods.

In Bugishu and Sebei, goats are often slaughtered to purify a candidate for circumcision rituals. The soothsayers of Sebei often slaughter a goat and examine its abdominal contents in the belief that fortunes will be revealed to them.

In all regions of Uganda goats are given as bride price in marriage, either alone or with cattle. The number given for this purpose varies from one region to another. In Teso, for example, a large number is often demanded by the parents of the bride. In Buganda and Bunyoro if the bride is found to be a virgin the groom is supposed to give a very fat black and white buck to the parents of the bride to thank them for having looked after their daughter so well. The groom also gives a goat to the father of the bride and one to the person who officially gives the bride to her husband. During negotiations for the dowry a skin is normally donated to the parents of the bride.

Goats also play other social functions as a symbol of exchange. In Kigezi a goat is exchanged between families in order to cement family relationships. In Acholi and Lango, a goat is normally paid as compensation when cattle destroy a neighbour's crops. It can also be used by a man as payment of fines to the parents whose daughter he has made pregnant outside marriage. Disputes and petty crimes in the village can also be solved by using a goat as payment for the offence. In Teso and Lango, goats are used as barter for cereals and other foods during periods of famine. A landlord may also sell some part of his land to landless people in exchange for goats.
In all regions of Uganda, goats are preferred, valued and recognised as presents in honour of special guests or beloved relatives. In Lango a goat can be offered to seal and strengthen brotherhood and friendship between a visiting member of another tribe and his hosts, as a symbol of acceptability in that village. This often occurs when the visitor decides to stay and live in that community.

Goats also play direct roles as a source of income. This can be done by selling to butchers who slaughter the goats at abattoirs. However, village slaughter for sale of goat meat is minimal: most homes have goats and local buyers are therefore few. The goats from such a village are normally bought by traders who subsequently send them to large urban centres where the demand is higher. Money obtained from sale of goats is normally used to pay school fees, graduated poll tax, and for other small family requirements. Where goats are sold in large numbers, the money can be used for big investments like building shops and residential houses.

The skin is used for a variety of purposes. In all regions it is used as mats for sitting on, especially by women, and for sleeping on by children. It can also be used as clothing, especially in Sebei where it is oiled before sowing. Traditional dancers also use it as costumes. The skin is also used for making drums, bags, handles of knives, and for covering milk gourds. Certain good quality skins are hung on house walls for decoration. It must be emphasised that Mubende goats provide better quality skins than the other breeds. Nowadays, goat skins are sold to the tannery at Jinja.

The amount of goat milk consumed by people is negligible. However, in Sebei and Bugishu, goat's milk is considered delicious (especially the colostrum) and normally reserved for young children and herdsmen. Among the Iteso and Karamojong in eastern Uganda there is a belief that goat's milk has medicinal value in curing epilepsy (Okello & Obwolo, 1984).

Horns and hoofs are used for various functions like treating headaches and other ailments in Buganda. In Teso they are used for decorative purposes, while in Acholi and Lango horns are used as a flute for communicating messages during hunting, at traditional dances and at funeral rites.

While in some quarters goats are blamed for destroying environments in Uganda they may be used to control growth of bush and grass. Because of their browsing habits, goats feed on small shrubs thus controlling their growth especially near the homesteads. Their droppings are used as manure, thereby improving soil fertility.
Crop residues (potato, cassava or banana peel) are fed to goats thus helping in the disposal of these waste products.

Not everyone in Uganda keeps goats for their economic and cultural usefulness. There are some who keep them for prestige and as a sign of wealth. This is most commonly true of elderly people who take pride in the size of their herd and will hardly sell a single animal even when faced with vital needs. Such a person may prefer to go in rags than sell his goats to buy clothes.

DISCUSSION

As revealed by the survey the primary function of goats in Uganda is the provision of meat. However, it is important that the people be properly educated to rid them of the belief that goats should mainly be slaughtered at funeral rites, in honour of special guests or at sacrifices (Maher, 1945). Since the goat seems to be the ideal animal for a peasant farmer, it is important that it should play a direct role in supplementing family diet of protein in order to bridge the protein gap prevalent in most developing countries. In these countries average protein consumption per person per day is only about 11 g while in the western industrialised countries it is about 72 g. (Pugiese & Coulomb, 1981). This requires a change of attitude of the small farmer about the traditional roles of the goat in his society.

Accurate statistical data regarding the total population of goats in Uganda should be established. This would help policy makers in the Ministries both of Agriculture and of Animal Industry in deciding how the production of goats can be improved. However, under the Uganda revised recovery programme the national census of agriculture and livestock will soon be launched. This programme is to be sponsored by FAO for a period of three years. Already FAO under its technical co-operation programme with the Government of Uganda has plans to launch a dairy goat keeping project with the Young Women's Christian Association (YWCA). This project will initially involve the importation of 300 exotic European dairy goats to be distributed to 180 YWCA clubs around the towns of Jinja, Mbale and Entebbe (FAO, 1984).
THE IMPORTANCE OF SMALL RUMINANTS
IN DJIBOUTI

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SUMMARY

Livestock husbandry and fisheries are two of the rare natural resources of Djibouti. Because of the climate, vegetative cover is very limited and transhumant management of goats and sheep is the only possible way of using the desert environment. Livestock are the only food source for the rural population. Consumption of meat from small ruminants accounts for 70 per cent of livestock output. Government has placed a high priority on livestock development projects. These will also be used as research vehicles for the establishment of production parameters and the genetic basis for the improvement of local breeds.
ROLE DE L'ELEVAGE DES PETITS RUMINANTS 
EN REPUBLIQUE DE DJIBOUTI

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RESUME

L'élevage représente pour la République de Djibouti l'une des rares ressources naturelles avec la pêche. Du fait du climat de type désertique qui prévaut, le développement de la production végétale reste limité et l'élevage de type transhumant des petits ruminants est la seule activité possible, susceptible de valoriser le milieu désertique. L'élevage est la seule source d'alimentation de la population rurale. La viande des petits ruminants représente 70 p.cent de la consommation totale des divers produits d'origine animale. Le gouvernement a réservé une place importante aux projets relatifs au développement de la production animale. Ces projets de développement serviront de cadre des recherches portant sur les différents paramètres zootechniques afin de mieux identifier le potentiel de la collection génétique des races locales des petits ruminants.

INTRODUCTION

La République de Djibouti se trouve à mi-distance de l'équateur et du tropique de Cancer, sa surface totale est de 23 000 km². Elle est située exactement dans le prolongement est des steppes sahéliennes.

ENVIRONNEMENT ET CLIMAT

Le climat y est beaucoup plus désertique que sahélien et beaucoup plus sec que ce à quoi on pourrait s'attendre en fonction de l'altitude. Ce climat est caractérisé par une faible pluviométrie très irrégulière. Dans la zone côtière, les précipitations annuelles sont de l'ordre de 50 mm alors que dans la zone montagneuse elles avoisinent 300 mm.

En fonction des types de sol et de la pluviométrie, nous distinguons plusieurs types de formation végétale:

les milieux semi-désertiques composés de steppes herbacées dans les plaines alluviales, à base de graminées à basse altitude dans les zones basaltiques et rhyolitiques;

les steppes herbacées arborescentes claires apparaissent composées essentiellement de plusieurs espèces d'acacias, de Balanites et dans les chaînes montagneuses, ces formations prennent un caractère beaucoup plus dense et leur composition devient de plus en plus hétérogène et, dans les Monts Gouda, on dénombre une vingtaine d'espèces arborescentes;

la forêt du Day, plus dense, est un milieu remarquable tant par sa composition végétale que par l'adaptation des espèces végétales à un milieu climatique relativement sévère les principales essences sont le génévrier, le buis, l'olivier et quelques terminalias;

sur la zone littorale quelques mangroves se développent, notamment dans le nord du pays ainsi que sur les îles Muscha et Mascali.

La population humaine est estimée à 350 000 habitants dont 120 000 en milieu rural. Cette population rurale tire la quasi-totalité de sa subsistance de l'élevage et son alimentation est constituée essentiellement de produits laitiers.
LE SECTEUR DE L'ÉLEVAGE

Bien que le secteur de l'élevage ne représente que cinq p. cent du produit national brut, il est la seule activité de la population rurale. Le cheptel djiboutien est constitué principalement de petits ruminants; en effet, le dernier recensement a permis de dénombrer 500 000 caprins, 400 000 ovins, 50 000 bovins et 50 000 camelins. Les petits ruminants sont répartis sur l'ensemble du territoire, principalement dans les zones semi-désertiques où ne peuvent vivre les autres animaux domestiques.

L'élevage est de type transhumant. En été (avril à septembre) les déplacements se font des régions côtières vers le nord-ouest et sud-ouest au-delà de la frontière car la pluviométrie y est plus élevée à cette période de l'année. En hiver (octobre à mars) les animaux reviennent et se regroupent sur les régions côtières qui sont soumises aux pluies de moussons.

La pathologie est dominée par les affections parasitaires externes (tiques et gales), les pneumopathies et diarrhées. Pour lutter contre ces affections, le Service de l'Elevage représenté par neuf postes vétérinaires répartis sur l'ensemble du pays dispose de baignoires dans lesquelles est utilisée une solution acaricide à base de lindane.

En ce qui concerne les pneumopathies, il s'agit d'un complexe (virus-bactérie) traité par les antibiotiques et les sulfamides. Les diarrhées apparaissent surtout après les pluies lorsque les animaux pâturent de l'herbe jeune.

L'alimentation des populations rurales est principalement à base de lait fourni par les chèvres. Les petits ruminants sont aussi la source essentielle de la viande à Djibouti, en effet les Djiboutiens préfèrent la viande des petits ruminants et elle constitue 67 p. cent de la consommation totale.

Par ailleurs, les peaux représentent la principale exportation nationale. A cet effet, le Service de l'Elevage a aménagé dans les chefs lieux de districts des échoirs à peaux et très prochainement une tannerie sera construite à Djibouti-Ville.

Compte tenu de l'importance que revêt l'élevage des petits ruminants pour la population rurale et que celui des bovins est peu adapté aux conditions climatiques du pays, le gouvernement dans le cadre de sa politique de développement du secteur primaire a élaboré les projets suivants:

un projet d'hydraulique pastorale qui a pour but la remise en état ou la création de points d'abreuvement (puits, gueltas, retenues d'excavation, citernes) pour une meilleure utilisation des pâturages;
un projet régional dans le Nord-Ouest du pays qui a pour objectif une meilleure connaissance de la gestion du troupeau et une amélioration des circuits de commercialisation.

En conclusion, nous pouvons affirmer que pour la République de Djibouti l'élevage des petits ruminants est très important car c'est la seule forme d'exploitation de notre milieu et il fournit l'alimentation de base des populations rurales. Malheureusement, nos connaissances sur leurs besoins et leurs capacités de production sont très limitées. Un effort particulier doit être fourni pour combler ces lacunes.

Brebis du type de l'Afrique de l'Est à queue grasse en zone désertique djiboutienne
LA PRODUCTION CAPRINE
DANS LE MIDDLEVELD DU SWAZILAND

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P.O. Luyengo Swaziland

RESUME

A l'aide d'une enquête pilote sur 150 fermiers tirés au hasard dans le district de Manzani au Swaziland, les caractéristiques des systèmes traditionnels de production caprine sont définies afin de cerner les contraintes pour améliorer la productivité. Les techniques de production sont essentiellement traditionnelles et peu efficientes. Une conduite d'élevage disparate, un logement précaire, la malnutrition, une mauvaise utilisation des pâturages, un service vétérinaire inadapté, l'absence de circuits commerciaux ordonnés et de politique nationale d'élevage des petits ruminants apparaissent comme les contraintes majeures au développement de cet élevage. Des recommandations sont formulées à la fois pour les services gouvernementaux et pour les éleveurs afin d'accroître ce secteur d'élevage potentiellement intéressant.
GOAT PRODUCTION
IN THE SWAZILAND MIDDLEVELD

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University of Swaziland
P.O. Luyengo Swaziland

SUMMARY
This study attempted to define the characteristics of traditional goat production systems and to identify constraints to increased productivity. A pilot survey was carried out by questionnaire using a total of 150 randomly selected farmers in the Manzini district of Swaziland. Goat production practices are essentially traditional and characterised by low productivity. Poor overall management, inadequate housing, malnutrition, improper use of grazing resources, inadequate health services, lack of organised marketing and lack of a national policy on small ruminant production, were identified as major constraints. Suggestions are made for the consideration of both government and farmers to improve this potentially viable sub-sector of the livestock industry.

INTRODUCTION

The Kingdom of Swaziland is a small country (17,364 km²), with a human population of approximately 650,000. Two-thirds of the population on half the land depend on subsistence agriculture; the remaining land is freehold, operated as large farms and using modern technologies.

The livestock industry is an important sub-sector of the national economy. The agrarian sector contributes about 70 to 74 per cent of the total domestic export earnings of which livestock account for 18–23 per cent. About 98-99 per cent of this contribution could be attributed to cattle and the rest to the poultry sub-sector. Goats, like sheep, do not contribute to export earnings.

Although goats do not contribute to the official cash economy, they contribute to the food and cash needs of the rural households. This is evident from the large number of goats and their popularity in rural areas. In 1983, there were 642,447 cattle, 333,895 goats, 38,820 sheep, 16,420 pigs and 682,592 poultry in the Kingdom. Thus, about 32.6 per cent of ruminants were goats, 99 per cent of which were managed traditionally. Compared to goats, only 79 per cent of the total cattle production is found on Swazi Nation Land (SNL). It has been estimated (de Vletter et al., 1983) that 32.7 per cent of SNL homesteads owned goats.

The goat's adaptability, prolificacy and modest nutrient requirements make it ideal for exploitation under the semi-arid conditions of Swaziland. Except for socio-economic studies (de Vletter et al., 1983) no information has been documented on goat production systems and their productivity.

The basic objective of this study was to examine goat production systems among the rural farmers in the Middleveld of Swaziland and to identify constraints so that improvement strategies might be formulated.

MATERIAL AND METHODS

A diagnostic survey was undertaken in December 1984 in the Manzini District of the Middleveld of Swaziland. The survey was done using a questionnaire designed to solicit both factual information and the attitudes of farmers with regard to goat production. As a pilot project, it was restricted to one of the four districts of the country. Manzini was chosen because of two technical advantages: its proximity
to Mbabane; and because it has about 32.6 per cent of the goat population compared to 26.6, 21.1 and 19.7 per cent for Shiselweni, Hhohho, and Lubombo districts.

A random sample of 150 homesteads was interviewed in three sub-districts. In addition to the questionnaire, most agricultural extension officers in the district and at the agricultural headquarters were also interviewed in order to determine the involvement of government in this sub-sector.

As expected, not all information sought from farmers was received, especially that related to income. Being a descriptive study, comparisons were made purely on a percentage or absolute number basis.

RESULTS AND DISCUSSION

SOCIO-ECONOMIC PROFILE OF RESPONDENTS

Details of marital status and sources of income of the 150 respondents are provided in Table 1. The greater popularity of goats among married homesteads could be largely attributed to available human resources. In addition to the parents, the average number of children was estimated at eight (range 6-10). In most cases,

<table>
<thead>
<tr>
<th>Feature</th>
<th>Goat herd size ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-10</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>25</td>
</tr>
<tr>
<td>Widowed</td>
<td>5</td>
</tr>
<tr>
<td>Single</td>
<td>-</td>
</tr>
<tr>
<td>Source of income</td>
<td></td>
</tr>
<tr>
<td>Livestock and crop(a))</td>
<td>21</td>
</tr>
<tr>
<td>Livestock, crops and wages</td>
<td>3</td>
</tr>
<tr>
<td>Livestock, crops and business</td>
<td>6</td>
</tr>
</tbody>
</table>

Note: \(a\) Livestock include cattle, goats and sheep.
young children provided the labour to herd goats and other livestock while older ones and parents were occupied in other economic activities (growing crops, trading or working for wages). Single individuals found it difficult to cope with the conflicting demands of tending goats and other income providing activities.

About 74 per cent of respondents derived cash income from raising livestock and growing crops, 18 per cent from livestock, crops and wages and eight per cent from livestock, crops and business (Table 1). While it was not possible to obtain estimates of income derived, it was obvious that respondents who were not engaged in business or earning salaries depended largely on crops for their annual cash income. Livestock, including goats, only supplemented crop earnings. According to de Vletter et al (1983), the average annual income per homestead at the national level was E1075.00 (E1 = 49 US cents), 8.7 and 6.2 per cent of which came from crops and livestock respectively. They also observed that in the peri-urban rural development areas, the average annual cash income per homestead was E1089.00 of which 6.2 and 5.2 per cent came from crops and livestock. Russel & Ntshingila (1984) estimated that 10.9 and 7.0 per cent of the average annual income per homestead in central Swaziland came from crop and livestock sales.

Although overall cash income derived from animals, and particularly goats, is small, they contribute largely to home consumption. Based on studies of 1150 homesteads, de Vletter et al (1983) estimated that 64.6 per cent of homesteads owning goats slaughtered an average of 2.9 per year while 31.0 per cent of the homesteads owning cattle slaughtered an average of 1.6 cattle per year.

CHARACTERISTICS OF LIVESTOCK HOLDINGS AMONG RESPONDENTS

All the respondents indicated owning goats. Some 50.7 per cent raised goats jointly with cattle and sheep, 30.0 per cent with cattle only and 17.3 per cent raised goats only. At the national level, de Vletter et al (1983) noted that 14 per cent of the homesteads owning goats did not own cattle.

Goat herd size varied widely among respondents (Table 2). Only 3.3 per cent owned more than 40, with an average flock size of 60 goats for the group. The average flock size for all respondents was 21 goats. This figure can be compared with the national average of 15.4 - 20.6 and the 23.2 average derived for the whole of the Middleveld (de Vletter et al, 1983).


Table 2  Goat population and distribution in the Swaziland Middleveld

<table>
<thead>
<tr>
<th>Herd size ranges</th>
<th>Respondents</th>
<th>Number of goats</th>
<th>Average herd size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number  %</td>
<td>Total  %</td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td>30 20.0</td>
<td>240 7.5</td>
<td>8</td>
</tr>
<tr>
<td>11-20</td>
<td>45 30.0</td>
<td>630 19.8</td>
<td>14</td>
</tr>
<tr>
<td>21-30</td>
<td>36 24.0</td>
<td>864 27.1</td>
<td>24</td>
</tr>
<tr>
<td>31-40</td>
<td>34 22.7</td>
<td>1156 36.2</td>
<td>34</td>
</tr>
<tr>
<td>40+</td>
<td>5 3.3</td>
<td>300 9.4</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>150 100.0</td>
<td>3190 100.0</td>
<td>21</td>
</tr>
</tbody>
</table>

The respondents as a group owned a total of 3,190 goats of which 32.3 per cent were six months old or less. Of the animals over six months, 48.0, 13.8 and 5.9 per cent were does, bucks and wethers, respectively. The low percentage of wethers is indicative of minimum castration practices among goat owners. This may be responsible for the high ratio of bucks to does (1:3.5). High buck to doe ratios are characteristic of traditional goat husbandry systems. In Nigeria, Sellers et al. (1974) and Matthewman (1977) observed buck to doe ratios of 1:4.3 and 1:2.7 respectively. In rural southern Botswana, Matlho (1983) noted a buck to doe ratio of 1:3.5. Respondents stated that high ratios of buck were an insurance against losses during drought conditions. They also indicated that male goats took longer to reach market size, hence the greater numbers.

REPRODUCTIVE PERFORMANCE

Reproductive performance data suggest a relatively low level of productivity. The estimated fertility for the 12 months prior to our study was 67.3 per cent. Of a total of 819 births reported, 78.14 per cent were singles, 21.37 per cent twins and 0.49 per cent triplets. Prolificacy was thus 1.16 goats per birth.

These fertility and prolificacy rates are low compared to other African estimates, though from different regions and breeds. In Ghana, Buadu (1972) reported average fertility and prolificacy rates among goats to be 154 and 184 per cent, and
Vohradsky & Sada (1973) recorded fertility and prolificacy rates of 124 and 184 per cent. ILCA (1980) reported fertility rates of 83.2 and 124 per cent for goats raised respectively in the forest and derived savannah zones of Nigeria.

None of the respondents practised controlled breeding. Males and females, run together at grazing and are put together in kraals overnight. As many as 12 per cent of the respondents had no mature bucks in their flocks: these indicated that since their flock mingled with others during grazing or at dip tanks, their does could be mated at no cost to them. They also said mature bucks had a tendency to escape from kraals and ravage crops, thus creating unnecessary problems for them.

MORTALITY

It was difficult to get actual or meaningful mortality figures, as all farmers relied on their memory of deaths for the previous 12 months. As such we decided to record mortality in terms of losses equal to five or less and losses above five animals. For young goats (birth to six months), 27.3 per cent of the respondents claimed to have lost five or less kids through death, 16.7 per cent lost over five and 56.0 per cent were not sure. For adults, 20.6 per cent lost five or less, 5.3 per cent lost over five and the rest were not sure. On the question of reasons for deaths, all respondents believed most animals died during the drought period which the country experienced for the greater part of 1984. About 90 per cent believed that in addition to deaths from drought, internal parasite infestations were partly responsible for the deaths. The rest believed their animals, especially the younger ones, died of cold in winter and other unknown reasons.

FEEDING

Goats owned by all respondents scavenged and fed entirely on the natural veld, even during winter and drought periods when both quality and quantity on the veld are at their lowest. Salt licks were provided mainly for cattle, but where goats were raised jointly with cattle they could use these.

Watering points for goats included streams, rivers and ponds. All respondents indicated providing water occasionally, particularly during drought periods.
HEALTH MAINTENANCE

Health maintenance practices considered were vaccination, dipping and drenching.

Only 39.3 per cent of respondents claimed their goats were vaccinated by the veterinary extension officers in their area. The veterinary extension officers involved stated that most treatments were related to pneumonia and quarter evil, particularly among the young and for non-specific infestations. Vaccines were paid for by the stock owners. Those who did not vaccinate (61.7 per cent) relied on traditional remedies including the barks of various trees and leaves, roots and flowers of numerous plants.

In Swaziland, dipping against ectoparasites is compulsory, and the government has provided an extensive network of 350 dip tanks covering all SNL. Drenching was done by 40.7 per cent of respondents at their own expense. The majority of those who drenched had 30 or more goats in their flocks.

FLOCK UTILISATION AND DISPOSAL

A majority of respondents (82 per cent) raised goats for meat, skins, traditional obligations and income. None of the respondents milked his goats. About 62 per cent slaughtered goats for home consumption and 38 per cent for cash income as and when necessary. On average, two goats were slaughtered per year by those who claimed to do so.

The bulk of cash sales (87.7 per cent) was to individual buyers. The rest were to local butcheries. Farmers preferred to sell to individuals as they paid more than butchers. Individual buyers bought goats to meet urgent traditional needs or household obligations.

Unlike cattle, goats have no organised marketing channels. Prices quoted by respondents for a mature goat of about 30 kg live weight ranged from E50 – E80 (US$ 25 – US$ 40).

OTHER MANAGEMENT ASPECTS

All respondents identified their animals by physical features such as colour, size and special features. No "modern" identification methods were used. There
was a common consensus, however, that since all goats raised were of the local breed, the success of the using of physical features to claim ownership depended largely on the honesty of the goat owners in any particular area.

None of the respondents weaned young goats.

**MAJOR CONSTRAINTS TO GOAT PRODUCTIVITY**

**SOCIO-ECONOMIC CONSTRAINTS**

The average flock size of 21 provides limited scope for a commercially oriented approach to production. A market oriented approach will require substantial cash input to purchase more animals, for better housing, improved pastures and the necessary infrastructure. Currently, the annual cash income per homestead is too low to meet these costs. The limited number of goat owners vaccinating and drenching their goats may be largely a result of financial constraints. This has serious repercussions as untreated animals continue to contaminate the environment for treated ones.

**TECHNICAL CONSTRAINTS**

Uncontrolled breeding does not only lead to some females being bred too early, resulting in low conception rates, low birth weight and poor kid survival but also allows for the perpetuation of inferior genotypes.

The low productivity and common non-specific disease problems encountered could largely be due to inadequate nutrient intake by the goats which survive by scavenging and feeding on the natural range. These unimproved grasses are of low nutritional quality, this situation becoming worse in winter and during droughts.

**MARKETING CONSTRAINTS**

Goat farmers do not seem to have any problem selling their goats as most are consumed at home. However, a market oriented approach will need organised marketing channels, services and facilities.

**INSTITUTIONAL CONSTRAINTS**

The communal land tenure and grazing system currently operating is a
disincentive to individuals or groups to institute measures such as fencing or rotational grazing for better land utilization. The result is general overgrazing of the SNL.

The scattered nature of the homesteads which form the base for goat production, makes it difficult for government to provide essential services such as electricity, good roads and water supplies.

**STRATEGY AND RECOMMENDATIONS**

Our study indicates that goat production has great potential for development in Swaziland. This potential lies in the animal, human and land resources. Goats are second to cattle in terms of the ruminant population. Present fertility and prolificacy rates are low. The large family units provide adequate labour potential. The strong agricultural base provides a range of non-conventional feed resources, such as pineapple waste, citrus waste, sugarcane tops, straw, corn stalks and molasses, which could be used to supplement feed from the rangelands. The semi-arid nature of the environment in itself provides ideal conditions for goat production.

Strategies and/or policy recommendations should be aimed at fully exploiting this potential by removing or minimising the current and future constraints against improved productivity.

There is, therefore, a need to improve the feeding base and practices, adopt a stratified modification of the traditional methods and infrastructure, improve livestock resources, institute more efficient health maintenance programmes, and improve marketing services and facilities.

Feeding of concentrates does not appear worthwhile at present but farmers, in addition to grazing, can feed household scraps, crop residues and industrial by-products. Research into the economic viability of feeding concentrates, use of improved pastures and use of feedlots or zero grazing is needed to provide the basis for any further development programme.

Controlled breeding could be achieved by keeping fewer bucks and tethering the few males when they are not wanted with the females. Fencing and creation of paddocks to allow for separation requires high inputs which most families cannot afford. Controlled breeding will ensure that kids are not dropped at times of the year when they are most likely to die of starvation. Productivity could be improved
if farmers did not keep animals over eight years old or that have not dropped kids after two years of mating. These practices would reduce the pressure on the limited grazing resources, provide better grazing and improve productivity.

There is a need to revise the land tenure system and to encourage individuals or groups to develop better land utilization. Land tenure systems are highly sensitive issues and therefore caution is needed. Initiation of farm settlement schemes on a voluntary basis could probably be a starting point. The single tribal structure makes such settlements relatively easier to establish.

Swaziland has an enviable health control programme and is a net exporter of meat and meat products to the EEC. However, the lack of legislation to ensure that livestock owners, in addition to dipping, must drench and vaccinate their stock is counter productive. With the present communal grazing practices and intermingling of stock, drenching and vaccination by a few is ineffective as the untreated animals continue to contaminate the fields.

The Swaziland Meat Corporation should extend its services to goat producers. Currently, it deals mainly with cattle and with pigs and sheep on a small scale. There is a need for the establishment by Government of a formal institutional framework within which to work, such as a Small Ruminant Production Unit, as a sub-sector of the livestock industry.
SMALL RUMINANTS IN NIGER

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SUMMARY
Sheep and goat breeds in Niger are described as is the importance of these two species in the national economy. In total, small ruminants produce 48.8 per cent of the meat supply and 200 000 hl of milk. They also have an important socio-economic role. Production constraints, particularly those related to nutrition and health, are described. Reproductive performance of the Red Sokoto goat is also described and some recommendations are made concerning the wider use of this breed in village flocks.
LES PETITS RUMINANTS EN REPUBLIQUE DU NIGER

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RESUME

Les races ovine et caprine les plus importantes présentes au Niger et la situation de l'élevage dans l'économie nationale sont décrites. Globalement, les petits ruminants produisent 48,8 p. cent de la viande du pays, 200 000 hl de lait et ont un rôle socio-économique important. Les contraintes à la productivité sont citées avec, en premier lieu, les difficultés d'ordre nutritionnel et sanitaire. Les performances de reproduction de la chèvre rousse de Maradi sont rapportées à la fin de cette communication avec quelques recommandations concernant la diffusion de cette race en milieu villageois.

INTRODUCTION

La République du Niger, d'une superficie de 1 180 000 km² est un pays où l'élevage constitue l'un des principaux piliers de l'économie. A côté de l'élevage des bovins (3 472 553 têtes en 1982), l'élevage des petits ruminants occupe une place importante (7 295 160 caprins et 3 315 452 ovins, aussi en 1982).

Cet élevage se situe dans toutes les zones climatiques, depuis la zone soudanienne jusqu'aux oasis de Ténéré et occupe toute la population aussi bien sédentaire que nomade. Cet aspect de l'élevage nigérien fait apparaître un élevage extensif caractérisé par une transhumance de grande amplitude à côté duquel se situe un noyau de sédentaire sous forme d'embouche uniquement en zone agricole.

Les troupeaux de petits ruminants sont constitués de deux espèces. Pour les ovins, on distingue les moutons peuls qui comprennent deux variétés (le bali-bali et le Ouda) et le mouton touareg (ara-ara). En plus, il y a les métis issus du croisement de ces races. L'aire de dispersion correspond pour le mouton touareg à la zone sahélienne et sub-saharienne, le mouton peul occupe la même aire de dispersion que le zébu peul, c'est-à-dire la zone agro-pastorale.


IMPORTANCE ECONOMIQUE ET SOCIALE DES PETITS RUMINANTS

Les petits ruminants contribuent pour une large part à l'économie nationale. Le capital bétail apporté par les petits ruminants en 1982 était de l'ordre de six milliards de Francs CFA pour les caprins et 3 450 000 000 FCFA pour les ovins pour un capital bétail global de 50 milliards de FCFA. L'exploitation des chèvres et moutons pour la même année nous a apporté 37 487 000 FCFA pour les exportations et consommations locales (animaux sur pied) et 1 907 000 000 FCFA des peaux de moutons et chèvres.
La production laitière tient aussi une place non négligeable dans cette économie. Avec une production annuelle de 209 365 000 litres de lait les petits ruminants contribuent pour une valeur de 18 424 120 000 FCFA. La production de viande demeure un secteur important. Sur un total de 76 978 tonnes de viande produite, la part des petits ruminants est de 37 578 tonnes soit 48,8 p.cent.

En milieu rural, l'animal est au centre de la vie sociale du paysan. Les petits ruminants constituent un capital de départ pour la constitution de troupeaux bovins. C'est un trésor important qui contribue à la renommée des familles. En société pastorale, la chèvre occupe une place privilégiée. Son endurance au climat, sa sobriété par rapport aux moutons et bovins, sa prolificité, son aptitude aux longues marches lui confèrent l'estime de l'homme Touareg qui en fait un animal de choix.

Les petits ruminants en somme sont une source d'économies à laquelle on fait appel en beaucoup de circonstances: achat de vivres et besoins familiaux; manifestations religieuses; cérémonies de baptême et de mariage; et réception d'hôtes de marque.

OBSTACLES NUTRITIONNELS A LA PRODUCTIVITÉ


Pour pallier à ce phénomène, des aliments complémentaires sous forme de graines de coton et son de blé sont distribués pendant la période de soudure. Cette mesure malheureusement ne peut toucher qu'une minorité d'animaux car tous les besoins ne peuvent pas être couverts avec ces seuls aliments.
FACTEURS AFFECTANT LA CROISSANCE

La croissance est liée à l'alimentation. Celle-ci étant insuffisante, on assiste à des baisses de poids à certaines périodes, surtout pendant les périodes de soudure, et à une légère hausse en hivernage; ce qui présente une courbe en dent de scie. Les jeunes à la mamelle sont surtout les plus touchés. Il arrive que les mères refusent leurs petits car, épuisées par l'exportation de toutes les réserves alimentaires au cours de la gestation, elles se trouvent incapables de les nourrir.

PROBLEMES DE SANTE ET LEUR IMPACT SUR LA PRODUCTION

La santé est le facteur favorable à toute production, or elle fait défaut assez souvent dans nos troupeaux nous contraignant à des interventions sanitaires perpétuelles. Cette santé est perturbée par plusieurs maladies. Les plus importantes fréquemment relevées au niveau des petits ruminants sont les parasitismes gastro-intestinaux et pulmonaires, les coccidioses, les affections respiratoires sous forme de pneumonie, les affections digestives se traduisant par des entérites diarrhéiques consécutives à un déséquilibre alimentaire, des foyers isolés de Peste des Petits Ruminants, des pasteurelloses et de l'ecthyma.

Parmi toutes ces maladies, les parasitoses sont les plus constantes et les petits ruminants lui paient un lourd tribu. Elles contribuent avec la sous-alimentation à la baisse de production et demeurent les facteurs prédisposant à certaines maladies infectieuses par affaiblissement de l'organisme.

Tout comme l'alimentation, des déparasitages collectifs sont menés tous les jours, touchant la majeure partie des effectifs contrôlables.

MORTALITES CHEZ LES PETITS RUMINANTS

Les mortalités sont consécutives aux maladies surtout parasitaires, aux affections respiratoires en périodes fraîches pendant lesquelles les animaux sont exposés au froid et à la pluie mais aussi à la sous-alimentation devenue un handicap important ces dernières années. On se souvient encore des hécatombes enregistrées en zones sahéliennes en 1973 et tout récemment en 1984-1985 où des milliers d'animaux sont morts par inanition. Parmi les petits ruminants, les ovins sont les premières victimes car ils sont moins résistants et plus fragiles que les caprins.
LA PRODUCTION CHEZ LES PETITS RUMINANTS

Les petits ruminants sont prolifiques et féconds. Ils se reproduisent facilement donnant souvent deux et parfois trois et même quatre petits par portée. La première mise-bas a lieu généralement vers la fin de la première année de vie pour les races précoces, vers 12 à 15 mois pour les autres. L'intervalle entre les mises-bas est de l'ordre de cinq à six mois pour les premières et jusqu'à huit à neuf mois pour les secondes. De tout cela, les conditions sanitaires et alimentaires doivent être réunies pour arriver à de bons résultats.

LA CHEVRE ROUSSE DE MARADI

Parmi les caprins nigériens, la chèvre rousse de Maradi se distingue par ses aptitudes économiques. C'est un animal sédentaire dont l'aire de dispersion se limite au département de Maradi et dans le sud-ouest à celui de Zinder, ce qui justifie la création d'un centre d'élevage caprin à Maradi.

CARACTERES ETHNIQUES

La chèvre rousse de Maradi a des traits communs avec la race naine guinéenne du Fouta Djallon, mais son individualité bien marquée permet de la considérer comme une variété fixée. Le poids des mâles adultes se situe entre 25 et 30 kg, celui de la femelle entre 23 et 28 kg. En station, le poids moyen à la naissance est de 2,0 kg; à un mois il est de 3,9 kg; à trois mois de 8,1 kg et à cinq mois de 12,1 kg.

Du point de vue du phénotype, la chèvre rousse de Maradi est harmonieuse, assez élancée, de type médioligne, eumétrique. La robe est homogène, brillante à reflet acajou, le poil est ras, dense, sur une peau souple. Tout allongement accompagné d'un éclaircissement du pelage, de l'apparition de teintes délavées et surtout de poils blancs, marque un signe rédhibitoire dans la pureté du type. Le mâle présente constamment une teinte plus foncée allant jusqu'à l'apparition d'une raie dorsale noire, les muqueuses visibles sont noires; la tête est fine, le front bombé, couvert de poils longs plus foncés chez le mâle que chez la femelle. Les oreilles sont longues, horizontales ou tombantes, le chanfrein est rectiligne, parfois subconcave. Le cornage est moyennement développé et les cornes sont peu épaisses, toujours présentes, aplaties d'avant en arrière et à insertion rapprochée offrant
un léger mouvement de torsion et divagent à leur extrémité. L'encolure est courte, 
la poitrine ample, le garrot noyé, le dos rectiligne, le gigot, l'épaule et la croupe 
sont bien musclés, reposant sur quatre rayons aux articulations fines à aplomb 
ramassé. La mamelle est bien développée gênant l'animal en déplacement. La 
queue aux poils plus touffus et souvent noirs est courte et relevée à son extrémité.

PERFORMANCES DE PRODUCTION

La femelle atteint la puberté vers cinq à six mois. La durée de gestation 
est comprise entre 145 et 155 jours. La première mise-bas intervient entre 10 
et 14 mois avec des variations selon les conditions d'élevage et du milieu. Les 
enquêtes menées par des chercheurs ont révélé en effet que 93 p.cent des premières 
naissances ont lieu avant l'âge de 12 mois. La répartition des chaleurs semble assez 
irrégulière, de 15 à 30 jours en moyenne en l'absence de cause pathologique décelable.

L'intervalle entre deux gestations successives menées à terme est généralement 
variable. À la station de Maradi, 20 p.cent des intervalles étaient de 5-6 mois, 
25 p.cent de 6-7 mois, 35 p.cent de 7-8 mois, 15 p.cent de 9-11 mois et 5 p.cent 
auch de 11 mois.

Les naissances gémellaires et bisannuelles sont fréquentes et se poursuit 
pour une bonne femelle pendant cinq à six ans. La fréquence de mises-bas doubles, 
triples ou quadruples augmente à partir de la première mise-bas (généralement 
unique) et se poursuivent jusqu'en fin de carrière. Ce caractère tient absolument 
là la pureté de la race. Les portées uniques constituent 60 p.cent de toutes les 
parturitions, les doubles 36 p.cent et les triples 4 p.cent.

Les taux de fertilité des femelles en station de Maradi se situent entre 95,5 
et 98,7 p.cent; le taux de fécondité de 122,2 p.cent; le taux de prolificité de 127,9 
p.cent et le taux d'avortement de 5,3 p.cent.

La chèvre rousse de Maradi, par ses qualités économiques, est un animal à 
retenir pour les diffusions et la constitution des troupeaux caprins familiaux. Mais 
cette diffusion malheureusement ne peut s'effectuer qu'en zone agricole pure, car 
la race pure ne peut effectuer de longues marches et nécessite un appoint alimentaire 
pour extérioriser ses performances. Elle ne peut en aucun cas se substituer à la 
race sahélienne apte à la marche et résistante aux privations.


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