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HEALTH, PRODUCTION AND ECONOMIC INDICATORS FOR ASSESSING THE PERFORMANCE OF SMALL RUMINANT HERDS IN AFRICA

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Les auteurs présentent un ensemble d'indicateurs zootechniques, d'échanges économiques et financiers permettant de comparer les performances des troupeaux de petits ruminants et d'établir un diagnostic sur le fonctionnement des systèmes d'élevage. Les indicateurs zootechniques retenus sont les taux de fertilité, de fécondité, de mortalité avant 3 mois et le poids à 90 j. Les paramètres d'échanges économiques sont la variation de l'effectif des femelles reproductrices, les taux d'introduction d'animaux, d'achat, d'exploitation et de vente. Les taux utilisés sont des taux vrais. Les indicateurs financiers sont calculés sur une base annuelle: ce sont les produits économiques, les produits monétaires, les charges économiques et les charges monétaires. Ils peuvent être ramenés en unités monétaires par tête ou servir en l'état au calcul du compte d'exploitation.

Un exemple est présenté sur un jeu de données recueillies de juillet 1995 à juin 1996 dans la région de Kaolack (Sénégal central). Deux groupes d'éleveurs sont comparés: les membres d'une coopérative de producteurs ovins et des agro-pasteurs traditionnels. Ce dernier groupe obtient de meilleurs résultats de croissance et de mortalité, mais les conditions de milieu sont différentes, ce qui est susceptible de biaiser la comparaison.

L'ensemble d'indicateurs et les modes de calculs proposés ont été choisis afin d'être utilisables dans une large gamme d'enquêtes et de situations zoo-économiques. Cette liste n'a pas la prétention d'être exhaustive ni incontournable. L'objectif visé par les auteurs est d'instaurer un débat sur les indicateurs, afin de proposer, à terme, un ensemble de définitions précises et pertinentes qui pourraient être adoptées par le plus grand nombre de chercheurs et de développeurs confrontés à l'analyse d'un système d'élevage de petits ruminants en milieu tropical. Nous pensons que la comparaison des résultats d'enquêtes pourrait s'en trouver facilitée.

INTRODUCTION

The livestock services of Senegal asked that researchers supply a synthesis of information on the productivity of small ruminant herds to help their staff, other development agents, and farmers' groups in their decision-making. Considerable data has already been collected on small ruminant production in Senegal. This paper shows how these data can be synthesized, taking into account the different systems of small ruminant production, to supply useful information to these target groups.

Small ruminant production systems vary between 2 extremes in Senegal. In the drier north, animals are larger, have longer reproductive cycles and experience marked seasonal climatic variations. In the wetter south, animals are smaller, have shorter reproductive cycles but higher mortality rates, and live in an environment with much less seasonal variation. Available data were assembled from several longitudinal studies of health and production conducted in Senegal since 1983. These data were from a range of agro-ecological areas, collected during periods of different climatic variation and in different production systems. Data on individual demography and growth were collected in a standardized manner during fortnightly visits by field teams and entered in the PANURGE database system (Faugère and Faugère, 1993).

MATERIAL AND METHODS

We estimated zootechnical and economic measures which are either components of an annual herd indicator of economic performance or help describe: target groups of herds, target sub-populations (i.e. breeding females, suckling lambs, weaned lambs, ...) or key time periods (monthly, seasonal or annual variations). Three types of indicators were defined : zootechnical, economic exchange and financial. They are displayed in Tables I, II and III, respectively.

Fertility, fecundity and mortality rates from birth to 3 months or age were calculated as true rates (Martin et al., 1987, p. 48-58); as were rates for overall inputs, purchases, overall outputs and sales. The financial indicators were computed on an annual basis. They can be expressed in either monetary units per head as suggested in Table III, or for the whole herd. In this latter case, they become components of the total farm budget related to small ruminant production.

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Table I
Zootechnical indicators for assessing the performance of small ruminant herds in Africa

Indicator	Numerator	Denominator	Range
true fertility	sum of term lambings	average herd[1] size of breeding females[2]	0 ; +4
fecundity	sum of live births	average herd size of breeding females	0 ; +4
mortality < 3 months	sum of deaths before 3 months	average herd size of lambs < 3 months	0 ; +4
average weight at 90 d	sum of weights at 90 d[3]	number of animals from which these weights were computed	w_1 ; w_2[4]

[1] : sum of days of presence of the target animals divided by length of the study period in d ; [2]: female older than the median age at the first lambing minus length of pregnancy ; [3] : linear interpolation between the former and the following weight around the age of 90 d ; [4] : positive real numbers = minimal and maximal observed weights

Table II
Economic exchange indicators for assessing the performance of small ruminant herds in Africa

Indicator	Numerator	Denominator	Range
relative herd size variation	difference between the instant herd sizes at the end and the beginning of the study period	average herd size[1]	-4 ; +4
overall inputs	sum of all inputs but births (purchase, exchange, loan, gift...)	average herd size	0 ; +4
purchases	sum of all purchased animals	average herd size	0 ; +4
overall outputs	sum of all utilized animal (sale, slaughter, loan, gift...)	average herd size	0 ; +4
sales	sum of all sold animals	average herd size	0 ; +4

[1] : sum of days of presence of the target animals divided by 365

Table III
Financial indicators for assessing the performance of small ruminant herds in Africa

Indicator	Numerator	Denominator	Range
annual economic product[1]	overall wealth[2] produced by small ruminant farming activities	average herd size[3]	0 ; n[4]
annual monetary product[1]	overall value of sold animals and animal productions (milk, meat...)	average herd size	0 ; +4
annual economic cost[1]	overall wealth[2] expenses induced by small ruminant farming activities	average herd size	0 ; +4
annual monetary cost[1]	overall expensed money for small ruminant farming activities	average herd size	0 ; +4

[1] : per head of small ruminant ; [2] : monetary and non monetary ; [3]: sum of days of presence of the target animals divided by 365 ; [4] : positive integer up to maximum overall wealth.

RESULTS AND DISCUSSION

We present, as an example, a summary of an analysis of data collected from July 1st, 1995 to June 30th, 1996 in central Senegal (Kaolack district). These data are from a prospective study involving 2 cohorts of sheep flocks: (1) 66 member flocks of a sheep production co-operative (AG) and (2) 52 traditional (low input) flocks (PV). The AG production system (peanuts and sheep) is in the process of intensifying. The average sheep flock size for AG farms was 41 (range 4 - 140) and for PV farms 8 (range 1 - 65).

Four zootechnical and economic exchange indicators are compared between AG and PV farms in Figure 1. The variance of these indicators was much higher for PV than for AG farms. This is almost certainly a function of the smaller PV herd sizes and probably also due to the more extensive nature of the PV production system, since PV herds have less feed and other inputs and are thus potentially more susceptible to environmental extremes. Fecundity was similar between the 2 cohorts (mean herd fecundity : 101.6% (AG) vs 103.4% (PV)) and the difference between utilization (overall output) rates was also not significantly different (mean herd utilization : 43.6% (AG) vs 36.9% (PV), Wilcoxon test : $Z = 1.6$, $p = 0.10$). Lamb performance was better on PV farms, with lower mortality before 3 months (mean herd mortality of 0.0% on PV vs 15.7% on AG farms, Wilcoxon test : $Z = 4.5$, $p = 0$) and higher weights at 90 days (mean herd weight: 13.4 kg on PV vs 12.2 kg on AG farms, Wilcoxon test : $Z = 2.4$, $p = 0.02$). The better zootechnical results for the PV flocks may indicate that AG farmers have not yet developed sufficient management skills to overcome nutritional and sanitary problems within their intensifying production system. However, we need to be cautious in this interpretation since these 2 production systems, while in the same general area, are not overlapping and thus differences in environmental conditions or other spatial factors might have influenced the differences seen in this comparison.

In addition to the bi-monthly follow-up visits which collected zootechnical data, an additional visit was made to a sub-sample of 32 AG farms to obtain more detailed economic data. From these 32 flocks, we were able to compute both financial and economic exchange indicators for 26. These are presented in more detail in a companion abstract and poster (Lancelot et al., 1997). Figure 2 shows the relationship between per head

economic revenue or income (economic products minus economic costs) and overall output or utilization rate. A positive trend between income and utitlization was observed but the slope parameter estimate was not significant ($p = 0.19$).

Clearly, small ruminant herd health and productivity can be measured by many indicators estimated by many computational methods. Our choice of indicators and methods was guided by 2 considerations: (1) that indicators should allow herd-level comparisons and (2) that they could be calculated in cross-sectional as well as longitudinal studies (although less well presumably). The latter consideration was because there is increasing pressure for rapid appraisals of livestock production systems. True rates can be calculated in almost all study situations and have the major advantage that they take into account additions and withdraws of animals during the study period (Martin et al., 1987, p. 50). Movements of small ruminants are frequent in most African farming systems and intense in this part of Senegal (Moulin et al., 1994).

Figure 1 : Boxplots of 4 zootechnical and economic exchange indicators

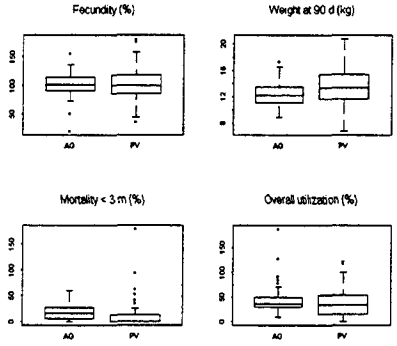
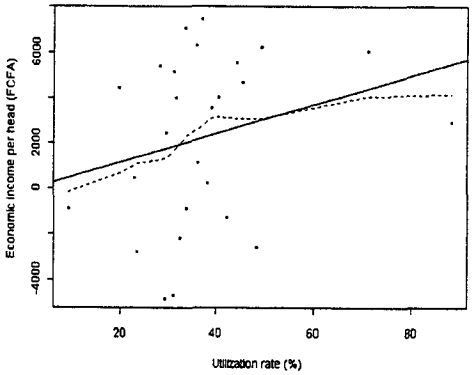


Figure 2 : Scatterplot of per head revenue vs utilization for 26 AG herds



AG: co-operative herds (n = 66); PV extensive herds (n = 52)

CONCLUDING REMARKS

We hope that this paper will stimulate further discussion and debate on developing and standardizing indicators for assessing the performance of small ruminant herds in Africa and other developing regions. Our goal is to provide indicators to farmers and their advisors which provide useful information for decision-making. While certain indicators may be more or less appropriate under different small ruminant production systems, we think it will be very helpful for interested parties to work together to improve the accuracy and relevance of indicators and their utility for farmers. More agreement on indicators would also facilitate, or at least improve, the comparison of results across different farming systems and ecological areas.

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