THE EFFECT OF CROP RESIDUES ON CATTLE PRODUCTIVITY WITHIN AGROPASTORAL PRODUCTION SYSTEMS IN SOUTHERN MALI.

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ABSTRACT
The effect of seasonal diet on cattle productivity was studied in a village in southern Mali. A comparison of measured and simulated liveweight changes of cattle proved that crop residue consumption during the dry season has become indispensable for animal production. Correspondingly, maximum livestock numbers to be fed during the dry season appeared to be directed by crop residue availability. Apparently crop residue availability determines cattle productivity in this village. This is likely to be the case in most of southern Mali where the importance of rangelands' perennial grasses is decreasing.

KEYWORD
animal performance, fodder, diet, rangeland condition, village territory

INTRODUCTION
While many of Africa's rangelands are considered to be degraded, cattle productivity seems unaffected (e.g. Scoones 1992). This paper seeks to explain this situation. Based on seasonal diet and fodder quality, liveweight changes of cattle in a village in Mali were simulated and compared to measured data. In addition, the estimated maximum number of livestock to be fed during the dry season were compared to the number of livestock observed.

METHODS
The village of Minso (13°17'N, 4°35'W) is located in the Sudanian zone of Mali showing a distinct rainy season from about June to September and an average rainfall of 700 mm. Of the village territory of 2700 ha 17 % was cultivated for the production of sorghum (*Sorghum bicolor*), millet (*Pennisetum americanum*), groundnut (*Arachis hypogea*) and fonio (*Digitaria exilis*). The rangelands were for common use for both transhumant and sedentary livestock. Of the villages livestock 64% - expressed in Tropical Livestock Units (TLU)- consisted of cattle and the rest of small ruminants, donkeys and horses. During the dry season of 1989/1990, 595 TLU - transhumant and sedentary - were recorded in the village.

Measured liveweight changes were obtained from Leloup et al. (1994). For the simulations, average liveweight changes (LWC) of young cattle were estimated for the periods corresponding the weighings. The method of simulation followed Breman and De Ridder (1991) using the N concentration and digestibility of DM of the fodder as the quality parameters. The fodder consumed and its average quality was obtained from Leloup et al. (1994).There were four fodder resources distinguished: browse (twigs, leaves and fruits of woody species), herbs, crop residues of moderate quality (cereal straw) and crop residues and by-products of good quality (pulse crop foliage, cotton seed cakes). The limited use of crop residues and by-products of good quality was ignored. When the simulated data based on average quality of the fodders appeared far from the measured data, another simulation was conducted assuming selection for leaves of crop residues. The quality of these leaves was derived from the literature: viz. 9 g N/kg DM (Powell 1985) and a DM digestibility of 53 % (ILCA cited by Diarra and Bosma 1987).

The estimated maximum number of livestock (TLU) to be fed during the dry season of 1989/1990 in Minso was defined as: the number of TLU that could be fed based upon the diet composition and the amount of fodder available from November 1989 until May 1990 within the village. A consumption of 6.25 kg of DM a day per TLU was assumed. From the division of total material available for each fodder resource and the amount of this fodder consumed per TLU, the total number of TLU that can be fed per fodder, according to the observed diet, was calculated. The maximum number of TLU to be fed then was equated to the lowest number of TLU that could be fed.

RESULTS AND DISCUSSION
Crop residues and livestock productivity. The simulated LWC (Figure 1), without accounting for selection of leaves in crop residues, corresponded with the measured data only during the rainy season (June-September). For the dry season (October-May) the simulated values were well below those measured, in particular just after crop harvest. The selection-based simulations were much closer to the measured values but underestimated LWC at the beginning and overestimated LWC at the end of the dry season, suggesting a more intense selection in the beginning of the dry season probably including grain heads, and a limited availability of quality material in the late dry season. Selection of crop residue leaves was already mentioned by others (e.g.. Powell 1985). Simulated cumulative LWC over the whole period, without accounting for selection, resulted in a loss of nearly 60 kg/head. When selection was included, a gain of 78 kg/head was comparable to the measured cumulative LWC of 70 kg/head.

During the dry season, crop residue availability was relatively low, whereas the diet composition consisted for 70 % of crop residues (Table 1). Therefore crop residue availability determined the maximum number to be fed. This number was higher than the observed grazing pressure, which is likely to be due to including the less consumed stalks in crop residues availability.

Apparently, crop residues availability determine livestock productivity in this village. This may be the case in most of southern Mali where the importance of perennial herbs in the rangelands are decreasing. This also explains conflicts between transhumants and sedentary livestock owners, since transhumants herds access to crop residues can be restricted by farmers. The influence of crop residues on cattle productivity explains how cattle productivity can be maintained while rangelands are degraded. Increased crop residue availability - caused by agricultural expansion - allows more livestock to survive during the dry season. Consequently, grazing pressure on the surrounding rangelands will be increased and herds will be moved toward better rangelands. Hence, only when all the rangelands within reach are degraded or access to better rangelands is denied, will rangeland degradation limit livestock productivity.

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Table 1
The total amount available per fodder resource, the diet composition, the maximum number of TLU to feed per fodder resource and the grazing pressure observed from November until May 1989 in Minso.

Fodder	Availability (tonnes)	Diet (kg/TLU)	Maximum number (TLU)
Herbs	2103	294	7153
Browse	2848	110	25891
Crop residues	720	921	782
Grazing pressure (TLU)			592

Figure 1
Liveweight changes of cattle per period of two months measured and simulated without and with accounting for selection for leaves in crop residues from August 1988 until April 1990 in Minso.