

## A comparison of the productive, reproductive and body condition score traits of the Simmental, Brown Swiss and Tyrol Grey breeds in smallholder herds in Kosovo

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### Summary

After the war in Kosovo, the Food and Agriculture Organization and the World Bank implemented an Emergency Farm Restocking Project, by allocating Simmental, Brown Swiss and Tyrol Grey heifers, 4-7 months pregnant, to farmers at the rate of one per farm. Data was monitored over a period of 14-16 months and the results showed that Brown Swiss had the highest milk production, while Tyrol Grey did worst. However, Tyrol Grey had the shortest service period and also changed the body condition score postpartum less than the other two breeds, making it best fitted of the three, to the extensive environment in Kosovo. Breeds were compared by growth rate, but this comparison was deemed highly inadequate as breeds with a high growth rate normally reach maturity at a high weight, and so need intensive feeding. Considering the extensive production environment in Kosovo, our results suggest that dairy cattle production should be based on a smaller breed, well adapted to the diet offered

### Résumé

Après la guerre du Kosovo, la FAO (Food and Agriculture Organisation) et la Banque Mondiale ont mis en place un programme

d'urgence pour le réapprovisionnement des fermes. Il s'est agi de fournir pour chacune des fermes du programme une génisse gravide de 4 à 7 mois appartenant à une des trois races suivantes : Simmental, Brown Swiss ou Tyrol Grey. Diverses données de production ont ensuite été collectées sur une période de 14 à 16 mois. Les résultats des analyses ont montré que la Brown Swiss présentait la meilleure production laitière et la Tyrol Grey la plus mauvaise. Cependant, cette dernière a la durée de service la plus courte et son score de composition corporelle est moins variable que les deux autres races, ce qui la rend plus adaptée aux conditions d'exploitation extensives du Kosovo. Les races ont également été comparées pour leur taux de croissance, mais la prise en compte de ce paramètre est jugée particulièrement inappropriée dans la mesure où les individus de race à fort taux de croissance arrivent à maturité à un poids élevé et donc nécessitent des conditions intensives d'alimentation. Ainsi, en considérant les conditions de production extensive du Kosovo, nos résultats indiquent qu'il est préférable pour l'élevage bovin laitier de s'appuyer sur des races de petit format, plus adaptées au régime alimentaire offert.

**Keywords:** Body condition scoring, Dairy cattle, Growth rate, Milk production, Non-return rate, Service period.

## Introduction

As a consequence of Kosovo war, during 1998-99 farmers lost approximately 200 000 cattle, or half the national cattle population (Kodderitzsch and Veillerette, 1999). After the war the Food and Agriculture Organization (FAO) and the World Bank (WB) implemented a joint cattle Emergency Farm-Restocking project (EFRP) in Kosovo aiming at improving nutrition and food security in households affected by the conflict. During this restocking process three dual-purpose cattle breeds [Simmental (S), Figure 1 and 2; Brown Swiss (BS), Figure 3 and 4; and Tyrol Grey (TG), Figure 5 and 6] were imported and randomly allocated to small-scale farmers. Before receiving the new breeds, these farms have had on average 2.4 cows per farm, making up 95% of the cattle population in Kosovo. The introduction of these breeds (S, BS and TG) raised discussion among local and international experts concerning their suitability to the local small scale farming system.

One way to identify the most appropriate cattle breed for Kosovo would be to rely on a profit approach, measuring all traits affecting profit. Alternatively, one could select the breed that is best fitted to the local environment as measured by some indicator traits, e.g. the interval from calving to first insemination, or body condition scoring. The latter approach was chosen here.

Hence, the objective of this study was to compare production, fertility traits and body condition scoring of the three imported breeds under the small scale farming system in Kosovo, to possibly identify the most appropriate cattle breed for Kosovo conditions.

## Materials and Methods

### Description of project

The project was carried out from October 2000 to June 2003, in three phases of

importation, in the years 2000, 2001 and 2002 (Table 1). In the first phase S and BS were imported, while only S and TG were imported later. Over the three phases, far more S heifers (3463) than BS (678) and TG (259) were imported.

Both S and BS were sourced from Germany and Austria, while TG was sourced from Austria (two international companies provided the animals).

At importation, heifers were 4-7 months pregnant, with bulls of the same breed. Farmers in the 228 villages that suffered the greatest losses to their livestock during the war were given for free, one heifer per farm. The average number of cows donated per village was about 20. For the first phase of importation calving was mainly from December until the end of May, with about 60% in January and February. In phase three, calving was from August to December, with more than 50% in October and November.

All heifers were re-mated to a bull of the same breed, the majority by artificial insemination, but also by natural mating to imported bulls (Table 1).

### Management practice

The climate in Kosovo is typically semi-continental, with annual averages for rainfall and temperature of 631 mm and 11°C respectively, during the last 20 years (Kosovo Hydrometeorology Institute, 2001). Normally, cattle are kept indoors from second part of November until the end of April (winter period). During this period all feeding takes place indoors, and consists mostly of hay. Farms are small and fragmented, each being on average 1.5 ha in size.

### Data recording

The FAO and Non-Governmental Organisations (NGO) staff and local veterinarians monitored the cows for



Figure 1. A Simmental cow.

Table 1. Number of imported heifers and bulls of Simmental (S), Brown Swiss (BS) and Tyrol Grey (TG) in three phases of importation.

Import phase	Simmental		Brown Swiss		Tyrol Grey	
	Heifers	Bulls	Heifers	Bulls	Heifers	Bulls
2000	1 749	32	678	13	-	-
2001	1 182	25	-	-	199	10
2002	532	10	-	-	60	2
Total	3 463	67	678	13	259	12

different events over a period of 14-16 months. The data collected consisted of ear tag number, breed, phase of importation, village of donation, birth date, calving date, data for milk production, sex of calf, birth weight of calf, calf growth rate, fertility, body condition scoring, and socio-economic variables. Due to lack of recording practice in some farms, incomplete records and obvious outliers were excluded from the analyses.

#### Milk production

The farmers carried out recording of milk production twice a day each month, in the morning and in the evening. From these

observations, average monthly milk production was derived, from which average daily milk yield over the first 305 days of lactation (AMY305, Table 2) was calculated.

Calf sex, birth weight and growth rate Calf body weights at birth (BWC, Table 2), at 3 (weaning) and at 10 months of age were used to calculate growth rate from birth to 3 (GRC3) and 10 (GRC10) months of age, respectively (Table 2). Actually, calf live weight records were predicted using heart girth circumference and non-elastic calibrated tape, by the national livestock specialist. For accuracy of recording, predictions were compared with actual weights of 20 individuals from each breed at birth, 3 and 10 months of age. Predictions

Table 2. Number of records (N), mean ( $\bar{X}$ ) and standard deviation (SD) for each trait<sup>1</sup> and breed.

Traits	Simmental			Brown Swiss			Tyrol Grey		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
AMY305	1 900	11.96	2.68	444	12.69	2.84	172	10.82	1.89
BWC	328	39.45	2.68	73	38.15	2.34	73	32.59	2.01
GRC3	281	0.86	0.16	62	0.74	0.10	68	0.65	0.08
GRC10	254	0.96	0.16	59	0.76	0.09	66	0.72	0.07
SP	3 179	102.33	47.35	582	119.37	50.23	242	97.02	40.23
NRR	3 261	0.46	0.52	623	0.33	0.53	244	0.52	0.57
BCSC	791	3.28	0.34	200	3.21	0.33	118	3.24	0.29
BCSS	791	2.52	0.34	200	2.35	0.34	118	2.62	0.30

<sup>1</sup>AMY305 = Average milk yield over first 305 days of first lactation (kg/day).

BWC = Birth weight of calf (kg).

GRC3 = Growth rate of calf over first 3 months of age (kg/day).

GRC10 = Growth rate of calf over first 10 months of age (kg/day).

SP = Service period (days).

NRR = Non-return rate at first insemination (%/100).

BCSC = Body condition score, within one week after calving (1-5).

BCSS = Body condition score, within one week after service (1-5).



Figure 2. Simmental cow.

were found to be accurate, deviating on average by 5.2%, 3.5% and 1.6%, respectively.

### Fertility

For each cow, the farmer and veterinarians recorded dates up until third mating and

whether this was by artificial insemination or by natural mating. From these, the interval from calving to first insemination defined the service period (SP; Table 2), while non-return rate at first insemination was coded 1 if a cow did not return to service after the first insemination and 0 otherwise (NRR; Table 2). Cows were serviced more often with artificial insemination (56%) than with natural mating (44%).



Figure 3. Brown Swiss cow.

#### *Body condition scoring*

Body condition was scored at the loin, pelvis and tail head within one week after calving (BCSC; Table 2) and within one week after service (BCSS; Table 2), by the project national livestock specialist and national veterinary specialist. A scale from 1 (very thin) to 5 (very fat) was used for evaluation (Edmonson *et al.*, 1989).

#### *Socio-economic variables*

Several socio-economic indicators were recorded;



Figure 4. Brown Swiss cow.

1. Household headed by a female - yes (1), or otherwise (2);
2. Size of land - <1 Ha (1), 1 ha ≤ <2.5 ha (2), and ≥ 2.5 ha (3);
3. Size of the family - <7 (1), 7 - 11 (2), and >12 (3);
4. Existence of members within the family older than 65 years of age - yes (1), or otherwise (2);
5. Existence of members within the family younger than 12 years of age - yes (1), or otherwise (2);
6. The family had cow before the donated one - yes (1), or otherwise (2); and
7. Sex of beneficiary - female (1), or male (2).

The data was obtained from village representatives and local agricultural authorities and recorded by project staff (national data base specialist and national livestock specialist).

#### *Information on feeding*

Information on feeding was available for 166 randomly selected farms. Farms were blocked into two groups (rations) 1 and 2, made up of farms using forage and concentrate, or only forage, respectively. This allowed for estimation of a breed x ration interaction effect on different traits.

## Statistical analyses

All analyses were carried using the SAS-package and the PROC GLM procedure (SAS Institute Inc., 1999). Generally, univariate fixed effect models were used to estimate breed effect. The final model was chosen by backward elimination of non-significant ( $P \geq 0.05$ ) variables, one at time. All effects were considered as classification variables. Effects were tested and their respective levels of significance are shown in Table 3. The same approach was used when estimating for a breed  $\times$  ration effect (Table 4). However, due to few records for weight traits being available (Table 2), they were not analysed. Furthermore, socio-economic variables were hardly significant in the completed material (Table 3), so they were omitted from these analyses, in which importation phase and village were considered as major effects.

## Results

Overall mean and standard deviations for the various traits and breeds are presented in

Table 2, while the levels of significance of breed differences are shown in Table 3. In table 5, least-squares mean with corresponding standard error and levels of significance in tests of differences in least-squares means between breeds are given. Generally, least squares mean results were in accordance with those from simple means.

For milk production, breed differences were significant ( $P < 0.0013$ ; Table 3), and so were all least-squares mean differences ( $P < 0.0270$ ; Table 5), the highest average daily milk yield was for BS, exceeding the milk yield of S and TG with 0.59 kg and 2.72 kg milk per day, respectively (Table 5). The month of calving had a clearly significant effect on milk yield ( $P < 0.0001$ ; Table 3), with the highest yield obtained during the winter period (results not shown). Furthermore, cows from households headed by a man produced a slight but highly significant increase (0.42 kg) in milk yield per day compared with cows from female-headed households ( $P < 0.0051$ ; Table 3).

For birth weight of calves and their growth rates until 3 or 10 months of age, breed differences as well as least-squares mean of breed differences were significant



Figure 5. Tyrol Grey cow.

Table 3. Level of significance<sup>1</sup> for effects modeled<sup>2</sup> to affect various traits<sup>3</sup> in analyses of a breed effect.

Traits	Importation		Age - 1 <sup>st</sup> insemination		Sex of calf	Method of insemination	HHF	SL	SF	FM>65	FM<12	FCBD	SB
	Breed	phase x village	Calving month	in 1 <sup>st</sup> lactation									
AMY305	<0.0013	<0.0001	<0.0001	-	-	-	<0.0051	NS	NS	NS	NS	NS	NS
BWC	<0.0001	NS	NS	-	<0.0001	-	NS	NS	NS	NS	NS	NS	NS
GRC3	<0.0001	NS	NS	-	<0.0001	-	NS	NS	NS	NS	NS	NS	NS
GRC10	<0.0001	NS	NS	-	<0.0001	-	NS	NS	NS	NS	NS	NS	NS
SP	<0.0001	<0.0001	<0.0001	-	-	-	<0.0366	NS	NS	NS	NS	NS	NS
NRR	<0.0048	<0.0001	NS	NS	-	<0.0001	<0.0191	NS	NS	NS	NS	NS	NS
BCSC	NS	<0.0056	NS	-	-	-	NS	NS	NS	NS	NS	NS	NS
BCSS	<0.0059	<0.0129	NS	-	-	-	NS	NS	NS	NS	NS	NS	NS

<sup>1</sup>NS = Not significant, i.e. level of significance  $\geq 0.05$ .

<sup>2</sup>Breed = (Simmental (1), Brown Swiss (2), or Tyrol Grey (3)).

Importation phase x village = (1,2 or 3) x (1, ..., 228)).

Calving month = (1, ..., 12).

Age-1<sup>st</sup> insemination in 1<sup>st</sup> lactation = (months 22, ..., 45).

Sex of calf = (female (1), or male (2)).

Method of insemination = (artificial (1), or natural (2)).

HHF = (household headed by a female (yes (1), or otherwise (2)).

SL = (Size of land (<1 Ha (1), 1 Ha  $\leq$  - < 2.5 Ha (2), and  $\geq$  2.5 Ha (3)).

SF = (size of the family (< 7 (1), 7 - 11 (2), and  $\geq$  12 (3)).

FM>65 = (members within the family older than 65 years of age (yes (1), or otherwise (2)).

FM<12 = (members within the family younger than 12 years of age (yes (1), or otherwise (2)).

FCBD = (family had cows before donated one (yes (1), or otherwise (2)). and

SB = (sex of beneficiary (female (1), or male (2)).

<sup>3</sup>AMY305 = Average milk yield over first 305 days of first lactation (kg/day).

BWC = Birth weight of calf (kg).

GRC3 = Growth rate of calf over first 3 months of age (kg/day).

GRC10 = Growth rate of calf over first 10 months of age (kg/day).

SP = Service period (days).

NRR = Non-return rate at first insemination (%/100).

BCSC = Body condition score within, one week after calving (1-5).

BCSS = Body condition score, within one week after service (1-5)

Table 4. Level of significance<sup>1</sup> for effects modeled<sup>2</sup> to affect various traits<sup>3</sup> in analyses of a breed x ration effects.

Traits	Breed x ration	Importation phase	Village	Calving month	Age - 1 <sup>st</sup> insemination in 1 <sup>st</sup> lactation	Method of insemination
AMY305	<0.0750	<0.0298	<0.8570	NS	-	-
SP	<0.0011	<0.7863	<0.3386	NS	-	-
NRR	<0.5992	<0.5611	<0.3974	NS	NS	NS
BCSC	<0.1329	<0.2183	<0.2741	NS	-	-
BCSS	<0.0017	<0.2497	<0.2245	NS	-	-

<sup>1</sup>NS = Not significant, i.e. level of significance  $\geq 0.05$ .

<sup>2</sup>Breed x ration = (Simmental (1), Brown Swiss (2), or Tyrol Grey (3) x forage and concentrate (1), or only forage (2)).

Importation phase = (1,2, or 3). Village = (1, . . . , 64). Calving month = (1, . . . , 12).

Age-1<sup>st</sup> insemination in 1<sup>st</sup> lactation = (months 22, . . . , 45).

Method of insemination = (artificial (1), or natural (2)).

<sup>3</sup>AMY305 = Average milk yield over first 305 days of first lactation (kg/day).

SP = Service period (days).

NRR = Non-return rate at first insemination (%/100).

BCSC = Body condition score, within one week after calving (1-5).

BCSS = Body condition score, within one week after service (1-5).



Figure 6. Tyrol Grey cow.

( $P < 0.0001$  and  $P < 0.0026$ , Table 3 and Table 5, respectively). S calves had the highest birth weight, 1.28 kg and 6.85 kg higher than BS and TG, respectively (Table 5). S grew faster than BS and TG, 130 g/day and 220 g/day at 3 months of age, and 180 g/day and 240 g/day at

10 months of age, respectively (Table 5).

Birth weight and growth rate traits were significantly ( $P < 0.0001$ ; Table 3) affected by the sex of the calf.

For the service period breed differences were again significant ( $P < 0.0001$ , Table 3), as were the least-squares mean differences



Table 5. Estimates of least-squares mean (LSM), their standard error (SE) and level of significance on the test of differences in least-squares mean between Simmental (S), Brown Swiss (BS), and Tyrol Grey (TG), for various traits<sup>1</sup>.

Traits	Simmental		Brown Swiss		Tyrol Grey		S vs. BS	S vs. TG	BS vs. TG
	LSM	SE	LSM	SE	LSM	SE			
AMY305	11.76	0.26	12.35	0.29	9.63	0.92	<0.0037	<0.0270	<0.0058
BWC	39.24	0.17	37.96	0.31	32.39	0.31	<0.0002	<0.0001	<0.0001
GRC3	0.87	0.01	0.74	0.02	0.65	0.02	<0.0001	<0.0001	<0.0004
GRC10	0.96	0.01	0.78	0.02	0.72	0.02	<0.0001	<0.0001	<0.0026
SP	125.29	4.13	113.79	4.67	97.07	9.88	<0.0001	<0.0035	<0.2282
NRR	0.53	0.02	0.44	0.03	0.40	0.11	<0.0023	<0.2355	<0.7374
BCSC	3.28	0.02	3.21	0.04	3.14	0.17	<0.0611	<0.4552	<0.7415
BCSS	2.54	0.03	2.40	0.05	2.54	0.19	<0.0014	<1.0000	<0.4937

<sup>1</sup>AMY305 = Average milk yield over first 305 days of first lactation (kg/day).

BWC = Birth weight of calf (kg).

GRC3 = Growth rate of calf over first 3 months of age (kg/day).

GRC10 = Growth rate of calf over first 10 months of age (kg/day).

SP = Service period (days).

NRR = Non-return rate at first insemination (%/100).

BCSC = Body condition score within, one week after calving (1-5).

BCSS = Body condition score, within one week after service (1-5).

between, respectively, S and BS and S and TG. ( $P < 0.0035$ ; Table 5).

The service period was the longest for S (125 days), followed by BS (114 days) and TG (97 days). The service period was affected by calving month ( $P < 0.0001$ , Table 3) with calving during spring resulting in the shortest period (results not shown). The service period was significantly ( $P < 0.0366$ ; Table 3) longer (4 days) for cows from female-headed households than for cows from households headed by a man.

For non-return rates, the overall test of the breed effect was significant ( $P < 0.0048$ ; Table 3) with a clear ( $P < 0.0023$ ; Table 5) least-squares mean difference between S and BS. S had the highest success rate on conceiving at first insemination (53%), followed by BS (44%) and TG (40%). Non-return rate was significantly affected by the method of insemination ( $P < 0.0001$ ; Table 3), with about 57% success rate for natural service compared with 34% in artificial insemination. Whether the household was headed by a man or a woman also significantly affected non-return rate ( $P < 0.0191$ , Table 3), with female headed

households being (0.09 %, results not shown) better than those headed by a man.

At calving breed differences in body condition score were not significant ( $P < 0.1701$ ).

However, significant breed differences were found for body condition scores within one week after service ( $P < 0.0059$ ; Table 3) as indicated by the least-squares mean differences between S and BS ( $P < 0.0014$  Table 5). Actually, BS reduced its body condition score more than S, while TG cows showed the smallest reduction (Table 5).

For the length of service period and body condition score at service, the overall test of a breed x ration effect was significant ( $P < 0.0011$  and  $P < 0.0017$ , respectively; Table 4). When looking at the differences in least-squares mean between rations within breed, body condition scoring within one week after service was significantly reduced for both S and BS, on the ration without concentrate ( $P < 0.0012$  and  $P < 0.0444$ , respectively; Table 6). Notably, the S non-return rate was higher when feeding extensively ( $P < 0.0012$ ; Table 6).

Table 6. Estimates of least-squares mean (LSM), their standard error (SE) and level of significance of differences in least-squares mean between rations, within Simmental, Brown Swiss and Tyrol Grey, for various traits<sup>1</sup>.

Traits	Simmental		Brown Swiss		Tyrol Grey	
	LSM	SE	LSM	SE	LSM	SE
<i>Forage and concentrate</i>						
AMY305	13.25	0.58	15.31	1.31	9.46	1.29
SP	72.44	8.46	93.15	23.42	109.92	21.56
NRR	0.58	0.09	0.61	0.23	0.46	0.21
BCSC	3.36	0.06	2.94	0.14	3.34	0.14
BCSS	2.65	0.07	2.38	0.16	2.71	0.16
<i>Forage only</i>						
AMY305	12.29	0.46	13.74	1.33	9.24	1.13
SP	113.18	10.88	131.80	22.97	140.00	22.29
NRR	0.64	0.11	0.50	0.23	0.18	0.22
BCSC	3.33	0.07	3.19	0.15	3.24	0.14
BCSS	2.35	0.08	2.00	0.17	2.62	0.16
<i>Level of significance for differences between rations</i>						
AMY305	<0.1349		<0.3050		<0.8407	
SP	<0.6068		<0.6711		<0.2063	
NRR	<0.0012		<0.1404		<0.1833	
BCSC	<0.7868		<0.1441		<0.5232	
BCSS	<0.0012		<0.0444		<0.5592	

<sup>1</sup>MY305 = Average milk yield over first 305 days of first lactation (kg/day).

SP = Service period (days).

NRR = Non-return rate at first insemination (%/100).

BCSC = Body condition score, within one week after calving (1-5).

BCSS = Body condition score, within one week after service (1-5).

## Discussion

BS is known as a high yielding cow of medium size, while both S and TG are dual-purpose breeds, with TG being a small breed with low milk production. Compared to the countries from which the breeds were imported, milk production was definitely lower in Kosovo, approximately 35 % for S and BS and 20 % for TG (Cattle breeding in Austria, 2002; Rinder production, 2002; Tiroler Grauvieh, 1999). In this rather extensive production environment, milk in kg/per day was highest for BS, followed by S and TG. When comparing breeds on the basis of service period or change in body condition scoring, we are, to a large extent, comparing them on indicators of energy

balance (e.g. Van der Lende, 1998, for service period). This gives an indication of how well the breeds fit the local environment. In this respect, TG did best, followed by BS for service period, and S for body condition scoring. TG was closest to achieving a 12 month calving interval, as recommended by Schultz-Rajalla and Frazer (2003) and Schmidt (1989).

With respect to the breed x ration interaction effect, data was rather limited. The results indicated, again, that S and BS were more sensitive to the extensive production environment than TG, especially regarding changes in body condition score, which was significantly reduced in these two breeds when fed only forage.

There is evidence in the literature (Van der Lende, 1998) that the quality of follicles ovulating early may be poorer than those ovulating later, thus explaining the highest non-return rate for S, followed by BS and TG. It may be the reason why the larger breeds need more time to come to first ovulation after parturition as a result of energy balance. When showing oestrous they have a higher ability to conceive (Butler and Smith, 1989). The result also agrees with results shown by Averdunk *et al.* (1995), reporting that cows coming early to heat have the lowest conception rate.

Another physiological explanation for the differences in non-return rates is that return to oestrous is heavily influenced by early embryonic mortality (Van der Lende, 1998). Non-return rate and service period are rather different traits; this is also shown in the results (Andersen-Ranberg *et al.*, 2004), manifesting a genetic correlation of close to zero between these two traits in first lactation of the Norwegian Red breed.

To date in Kosovo, specialized beef cattle production is almost non-existent. Hence, dual-purpose cattle breeds (S and TG) may have preference over more specialised milk breeds (BS). A significantly higher growth rate was found in S compared with TG. However, breeds with higher growth rates normally reach maturity later and also require more intensive feeding than those reaching maturity earlier (Geay and Robelin, 1979).

Many farmers are used to dealing with local cattle and their crossbreeds of a smaller type, with limited milk production, and small feed requirements compared with the large imported breeds. Thus the quality and quantity of the feed offered were probably not sufficient to meet the requirements of the imported breeds, especially for S and BS. Hence, under current extensive environmental conditions in Kosovo, results suggest that dairy cattle production should be based on a smaller breed, well adapted to the diet offered.

## Conclusion

Our results support the finding that under the extensive production environment in Kosovo, dairy cattle production should be based on a small breed with limited milk production potential, which is more adapted to the extensive environmental production conditions. More relevant information about the best cattle type for small-scale farming in Kosovo would have been obtained if local cattle and their crossbreeds had been included in the study.

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