FREQUENCE DES ALLELES DE LA CASEINE α_{S1}, EN RACE POITEVINE

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RESUME

Le polymorphisme de la caséine a_S, a été étudié en race Poitevine, dans les 7 élevages au contrôle laitier, sur 388 chèvres et 28 boucs présents en décembre 1993. Chez les chèvres, la fréquence des allèles “forts” en caséine as, est de 0,04 pour A, de 0,36 pour B et de 0,01 pour l'allèle C présent dans un seul élevage; la fréquence de l'allèle “intermédiaire” E est de 0,48 et celle de l'allèle “faible” F de 0,11. Cette race de petit effectif, traditionnellement élevée pour ses qualités fromagères dans la région Poitou-Charentes, se caractérise par une fréquence élevée du variant B, et l'existence de 3 allèles de type B (B_1, B_2 et B_3). L'allèle B, le plus fréquent (q = 0,21) est l'allèle originel de l'espèce caprine, donc le niveau "fort" (Grosclaude et al., 1994), ce qui confirme l'ancienneté de la race Poitevine. Chez les boucs les fréquences sont peu différentes, mais les risques de dérive génétique sont importants chez les éleveurs utilisant 1 ou 2 boucs et dans le cas d'IA avec un nombre limité de boucs.

SUMMARY

The as, casein polymorphism of the Poitevine breed was studied in 7 herds in mük çontrol, on 388 goats and 28 bucks, at the end of 1993. For goats, the frequency of "strong" variants is 0.04 for A, 0.35 for B and 0.01 for C which was found in only one herd; the frequency of "medium" and "weak" variants E and F are 0.48 and 0.11 respectively. The small population, traditionally bred for the cheese ability of its milk, is characterized by the high frequency of the B variant and the existence of 3 types of B alleles (B" B_z, B_3). The B, allele, the most frequent (0.21), is the original allele of the species, thus confirming the "ancienneté " of the Poitevine breed. For the bucks, the frequencies are almost similar, but the risks of genetic drift are important due to the small flock size and the limited number of AI. bucks.

1.0 HISTORIQUE

La Poitevine est une race de petit effectif, traditionnellement élevée en vue de produire un lait dont les qualités fromagères ont fortement contribué à donner à la région PoitouCharentes sa spécificité et son image de marque en matière de fromages de chèvre. En 1967, M. Toussaint a retracé l'histoire de cette race, en rappelant les différentes tentatives pour assurer son développement et son amélioration. "Dès 1906, il existait dans la région de Bougon, des chèvres se caractérisant par leur grande taille, le poil long, des raies blanches de chaque côté du chanfrein et le dessous du ventre blanc; elles devaient justifier à cette époque la création d'une fromagerie coopérative. On notait déjà une sélection sur le caractère motte. A la suite d'une épidémie de fièvre aphteuse en 1920, une introduction de chèvres alpines était réalisée dans cette région et se situait à la base des premiers croisements. Dès cette période, cette chèvre était considérée comme une excellente fromagère. A partir de 1947, les fromageries coopératives des départements des Deux-Sèvres et de la Vienne (dont Bougon et la Mothe Saint-Héray) constituent une Union de Coopératives, en vue de mettre en place un contrôle laitier fromager et un Livre Généalogique. Le standard de la race est défini en 1949. Cette organisation évolue à partir de 1964, avec la création des organismes départementaux de contrôle laitier et la constitution d'un syndicat d'éleveurs chargé de la gestion du Livre Généû[l]ugique. Pour favoriser l'expansion de la race, le Livre Généalogique est élargi à des produits nés de mères non inscrites mais de pères inscrits et, en 1967, le standard de coloration est assoupli afin d'admettre de nouveaux coloris. A ce moment, le nombre d'éleveurs adhérant au Livre Généalogique est de 52, soit près de 800 chèvres dans 5 départements".

En dépit de ces initiatives et face au développement des troupeaux Alpins et Saanen plus productifs, le renouvellement des boucs et des familles est menacé, ce qui justifie en 1977 la mise en place d'un programme de gestion de la population avec 11 familles réparties dans 12 élevages de 2 départements, les Deux-Sèvres et la Vienne (Malafosse, 1977). En 1986, l' UPRA CAPRINE ne compte plus que 545 chèvres dans 6 élevages dont 110 au Lycée de Melle, ce qui motive la création de l'Association pour le développement de la chèvre Poitevine (ADCP: Rousseaux, 1991) qui mobilise de nombreux adhérents. Ceux-ci soulignent les atouts de leur race: tempérament calme, résistance à la chaleur, aptitude au pâturage et au parcours, etc.; par ailleurs, le grain des fromages fermiers serait plus fn, donc plus apprécié. En 1992, l'effectif au contrôle laitier n'est plus que de 440 chèvres dans 7 élevages, d'où l'initiative d'un plan de sauvegarde prévoyant un volet technique pour conforter la population contrôlée et un volet scientifique consacré à l'étude du polymorphisme de la caséine a_{s},. En fait, cette recherche avait déjà été amorcée en 1986 par le Département de Génétique Animale de l'INRA, en même temps que dans les races Alpine et Saanen, mais l'identification précise de certains allèles n'a été possible qu'après l'introduction des techniques les plus modernes de ia gciiciique muléculaire, en particulier pour distinguer les allèles E, B" B_{Z} et B_{3}. Désormais, la détermination des allèles de la caséine a_{s1} se fait avec la mise en oeuvre parallèle de deux techniques, 1'électrophorèse des laits et le typage de l'ADN par la méthode "PCR". Ces travaux ont permis d'arriver à une connaissance plus complète des variants génétiques et de leur phylogénie (Fig. 1), d'où des retombées possibles pour l'ensemble des races.

En 1994, l'ADCP a entrepris un nouvel inventaire de la race qui concernerait environ 1 100 chèvres dans 56 élevages (O. Rosset, c.p.).

2.0 RAPPEL SUR LE POLYMORPHISME GENETIQUE DE LA CASEINE AS,

On retrouve chez la chèvre les mêmes caséines que chez les bovins: α_{s1}" αs_{2}, ß et γ. Les travaux du Laboratoire de Génétique biochimique et de Cytogénétique de l'INRA (F.) p , Grosclaude, G. Brignon, M.F. Mahé, C. Leroux et al. cf, Martin, 1993 ont ermis d étudier le polymorphisme de certaines d'entre elles, dont la caséine a_{s},. Celle-ci présente des aspects tout à fait inhabituels. En effet, elle se distingue par un fort polymorphisme et surtout par le fait qu'il existe, entre allèles ou groupes d'allèles, de nettes différences de niveau de synthèse prrotciqÏue. Ce polynrorphisn me est déterminé par au moins 7 allèles, correspondant à 4 niveaux de synthèses

différents: 3 allèles "forts" associés à une teneur élevée en caséine a_S, (A, Bmaintenant subdivisé en B" B" B; - et C), 1 allèle moyen (E), 2 allèles "faibles" associés à une faible teneur en caséine a_S, (F et D subdivisé maintenant en D et G), et 1 allèle nul qui entraîne l'absence de caséine a_S, à l'état homozygote. On sait maintenant que le niveau de synthèse "fort" est le niveau d'origine, normal chez la chèvre, et que les allèles E, faibles et nuls, sont des mutants défectifs. Par ailleurs, comme il existe une forte corrélation entre la teneur en caséine a_S, et la teneur en caséine totale des laits individuels, les allèles "forts" ont, en moyenne, un effet très favorable sur le taux de protéines des laits, donc sur les qualités fromagères et le rendement fromager, comme cela a été clairement déznontré dans les expérimentations récentes conduites à la Station Caprine de Moissac et en fermes (Grosclaude c.t al.,1994; Remeuf, 1993; Manfredi et al.,1993; Mahaut et Korolczuck, 1993; Vassal el al., 1994).

3.0 POLYMORPHISME DE LA CASEINE AS1 ET FREQUENCES ALLELIQUES EN RACE POITEVINE

Cette étude concerne 388 chèvres de 1 à 8 ans et 28 boucs de 1 à 6 ans présents en décembre 1993 dans les 7 élevages au contrôle laitier, 6 dans le département des Deux-Sèvres et un 7ème dans le Morbihan.

3.Î *Chez* les *chèvres,* l'allèle E est majoritaire (q_E = 0,48) devant les allèles B (0,36), F (0,11), A (0,04) et C (0,01), alors que l'allèle nul est présent chez un seul animal à l'état hétérozygote. Parmi les allèles B, B, est le plus fréquent (0,21), devant B_Z et B3 (0,05, 0,10). L'allèle A est présent dans 5 élevages sur 7 et l'allèle C n'est présent que dans le seul élevage du Morbihan. En effet, l'allèle C était encore présent dans les Deux-Sèvres en 1986 lorsque nous avons réalisé nos premières observations, mais il a disparu depuis par suite de la réduction des effectifs (chèvres et boucs). Il a été récupéré dans l'élevage du Morbihan, lors de sa création en 1983, grâce. à l'achat de reproducteurs nés dans les Deux-Sèvres dont un bouc fondateur de génotype B 3/C qui a été largement utilisé (plus de 80 filles contrôlées), de sorte qu'en 1993, la fréquence de l'allèle C était de 0,19 dans cet élevage. Cette fréquence élevée illustre un double phénomène de migration et de dérive génétique, et permet de supposer le retour probable de cet allèle "fort" C dans les élevages des Deux-Sèvres.

3.2 *Chez les boucs,* l'allèle A est absent, les fréquences alléliques de B, C, E et F sont respectivement de 0,45, 0,02, 0,46 et 0,07: 9 boucs sur 28 (32%) ne sont pas porteurs d'allèles "forts", d'où le risque de dérive génétique chez les petits éleveurs n'utilisant qu'un seul mâle pour le renouvellement. Parmi les 28 boucs, 6 ont été inscrits au catalogue des boucs d'IA en 1992 et 1993: 2 sont porteurs de l'allèle B" mais aucun des 6 n'est porteur des autres allèles "forts" A, B_Z, B_3 et C. Cette *non représentativité des boucs retenus pour l'insémination* en semence congelée, démontre la nécessité de typer préalablement les jeunes boucs, si l'on ne veut pas risquer de dégrader les fréquences des allèles favorables, voire d'entraîner la disparition de certains d'entre eux. D'où l'intérêt d'augmenter le nombre d'élevages et de boucs ainsi que les effectifs au contrôle laitier, pour disposer d'échantillons de reproducteurs représentatifs au niveau des allèles de caséines et des autres caractères.

4.0 DISCUSSION

Les reproducteurs Poitevins se caractérisent par une fréquence élevée du variant fort B (q = 0,36 chez les chèvres; q = 0,45 chez les boucs) et l'existence de 3 allèles de type B (B" B_2, B_3). L'un de ces allèles B" le plus fréquent (q = 0,21 chez les chèvres; q = 0,34 chez les boucs), est supposé être l'allèle originel de l'espèce caprine, donc le niveau fort, ce qui confirme également "l'ancienneté" de la Poitevine. Si les fréquences alléliques dans cette race sont très différentes de celles observées dans les races Alpine ou Saanen en ce qui concerne les allèles B, rares dans ces 2 races, on remarquera une similitude des fréquences avec les races du Sud de l'Espagne, Malaguena (à poil long), Murcia et Granadina (Grosclaude et al., 1994). Faut-il pour autant

donner raison "aux auteurs qui remontent aux invasions arabes pour expliquer la similitude de la longueur du poil de la Poitevine avec de nombreuses races du bassin méditerranéen?" (Toussaint, 1967). Ou considérer que la Poitevine est "la dernière représentante d'un type indigène commun", implanté depuis longtemps dans cette région de Bougon et la Mothe Saint-Héray où le récent Musée des Tumulus nous fait revivre une civilisation datant de 4 700 ans avant notre ère?

En fonction des animaux disponibles, il importe de mettre en place un programme permettant d'étudier la valeur fromagère et les caractéristiques physico-chimiques des laits homozygotes B, , B_Z et B; comparé s aux laits homozygotes A ou E, afm de mesurer l' intérêt de ces types génétiques de laits, comme cela a été fait pour les laits homozygotes A, E et F (Remeuf, 1993; Vassal et al., 1994; Jaubert et al., 1993). Si les effectifs contrôlés le permettent, nous chercherons également à estimer les effets de ces allèles B sur les performances laitières (quantité de lait et taux).

Les élevages au contrôle laitier dans les Deux-Sèvres sont en nombre insuffisant pour assurer le renouvellement des boucs et sauvegarder valablement le noyau d' éleveurs laitiers dont le rôle est essentiel, même s'il subsiste, dans ou en dehors du berceau de race, beaucoup de petits élevages dispersés, mais sans contrôle laitier et sans origine contrôlée. Pour éviter la dégradation de la situation, il faudrait - à l'image de ce qui a été fait au Lycée de Melle pour sauvegarder la race bovine Parthenaise - obtenir l'adhésion de nouveaux élevages au contrôle laitier et mettre en place un centre d'élevage pour récupérer les jeunes boucs issus des meilleures mères des élevages représentatifs, en tenant compte des familles, des allèles de caséine a " d'une certaine sélection sur la croissance en centre d'élevage. Il faut donc typer regulièremernt les reproducteurs pour éliminer progressivement les allèles faibles comme ceia est proposé maintenant en race Alpine (Manfredi et al.,1995), redéfmir des familles, organiser le choix des mâles et les accouplements en s'aidant de l'IA si nécessaire, indexer les chèvres comme dans les autres races (matière protéique et taux de protéines) en utilisant des facteurs de correction spécifques aux Poitevines, ceci afim de sauvegarder les caractères de la race, notamment les allèles forts en caséine α_{s1} qui constituent une des originalités de cette population et expliquent probablement la qualité fromagère de son lait.

Le centre d' élevage est une nécessité pour les "sélectionneurs" laitiers qui doivent renouveler leurs boucs. En effet, ces éleveurs sont très sollicités pour vendre des jeunes mâles, aussi ces ventes se font aux dépens d'un bon renouvellement dans les élevages contrôlés qui représentent le véritable noyau de sélection. A l'avenir, les élevages dispersés pourront constituer une réserve pour le renouvellement du noyau, à condition de mettre en place une identification des animaux et un contrôle simplifié. Il s'agit là de mesures urgentes pour éviter la disparition de cette race qui serait une "perte irréversible et dommageable".

5.0 REMERCIEMENTS

Nous tenons à remercier J.C Sauze, de l'ADCP, qui a réalisé une grande partie de prélèvements de laits et de sangs dans les Deux-Sèvres, ainsi que H. Coutineau (lycée Jacques I3ujault de Melle) et les éleveurs Poitevins que nous avons sollicités directement ou indirectement pour mener à bien cette étude et qui ont toujours répondu à nos demandes.

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TABLEAU 1:

Fréquences alléliques en caséine a.s., des reproducteurs de race Poitevine, dans 7 élevages au contrô le laitier, en décembre 1993

Allèles de cas as1	388 chèvres	28 boues
A	0,04	0
{Bl	0,21 }	0,34}
{B2	0,05} 0,36	0,02} 0,45
{B3	0,10}	0,09}
C	0,01	0,02
E	0,48	0,46
F	0,11	0,07
O	Σ	0,00
porteurs d'allèles forts	65%	68%

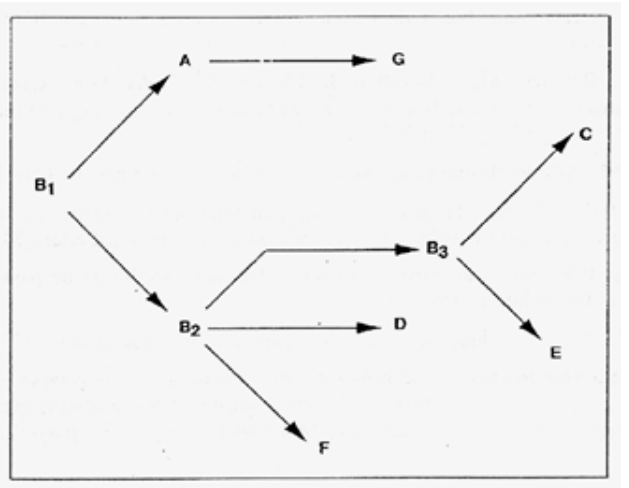

Figure 1: Phylogénie des variants génétiques de la caséine æ$_{S1}$ caprine. Le type originel, B$_1$, ainsi que les variants B$_2$, B$_3$, A et C sont les variants "forts". Les variants B$_3$, et E ont la même structure primaire mais un taux de synthèse différent. D'après F. Grosclaude et al., 1994.

BHADAWARI BUFFALOES IN INDIA

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SUMMARY

Bhadawari buffaloes are reputed for high milk fat and are found in the Agra & Etawah districts of Uttar Pradesh and the Bhind & Morena districts of Madhya Pradesh. Information on the status, management practices, morphological characteristics, body measurements and performance of the Bhadawari breed were recorded from its breeding tract. Animals true to the breed are copper in colour and have a white ring on the lower side of the neck. The population of this breed is declining at a fast pace and efforts are needed for its conservation. Strategies for its improvement and conservation are also discussed.

RESUME

Les buffles Bhadawari sont reconnus pour leur contenu élevé en gras dans le lai.t. Les animaux se trouvent dans les districts de Agra et Etawah de Uttar Pradesh et dans les districts Bhind et Morena de Madhya Pradesh. Les informations sur l'état, les modes de conduites, les caractéristiques morphologiques, les mesures corporelles et les performances de la race Bhadawari ont été enregistré es dans les stations d' amélioration. Les animaux purs sont de couleur cuivre avec un anneau blanc à la base du cou. La population de cette race est en nette diminution et il est nécessaire d'entreprendre des actions afin de la conserver. On présente également les stratégies pour l'amélioration et la conservation de cette race.

1.0 INTRODUCTION

The term Bhadawari was coined from its place of origin "Bhadawar Estate", which comprised the Agra and Etawah districts of Uttar Pradesh (UP) and Bhind & Morena districts of Madhya Pradesh. This breed is well adapted to the extremely hot humid climate of the area. These buffaloes have a distinct advantage, being of medium structure and size with a high feed effïciency and thus can be reared even by marginal and landless farmers.

As compared to other breeds of Indian buffaloes, Bhadawari produces less milk but this is well reputed for high butter fat percentage which goes up to 13% (Singh and Desai, 1962). The males of the breed are frequently used for draught and are superior than that of other breeds with respcct to speed and heat tolerance. Because of the high butter fat percentage and high efficiency of converting coarse vegetation of the area into milk fat, this breed is suitable and profitable in the remote areas, where transportation and preservation facilities are not available. The Bhadawari buffaloes for the last two decades are being upgraded with Murrah for increasing milk production as a result of which the population of this breed in the area has declined to a large extent and needs immediate attention for its conservation.

2.0 POPULATION-STATUS AND NEED OF CONSERVATION

Bhadawari buffaloes in U.P. constituted 0.82 percent of total Indian buffaloes in 1977, which then declined to 0.54 percent in 1991 (Report,1991 U.P. Govt., cited from Singh et al. 1993) showing an overall decline of 13.78 percent in its population (table 1). During the same period, the buffalo population of India increased by 8.16 percent and that of U.P. by 30.9 percent. Talcing into consideration the trend of the buffalo population in U.P., the Bhadawari population in 199I was less by 34.13 percent from its projected population of 1.491 lacs.

TABLE 1:

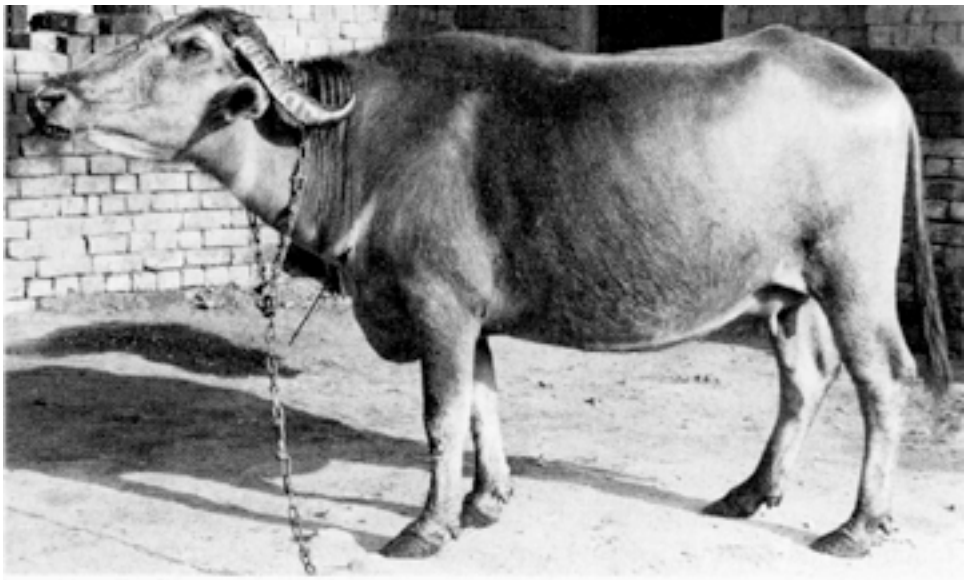
Population trend of Bhadawari buffalo

Year/trend	Total buffaloes (lacs)*		Bhadawari buffalo
	India	Uttar Pradesh	(UP) (lacs)
1977	619	139	1.139
1991	770	182	0.982
% change (1977-91)	+ 8.16	+ 30.9	- 13.78

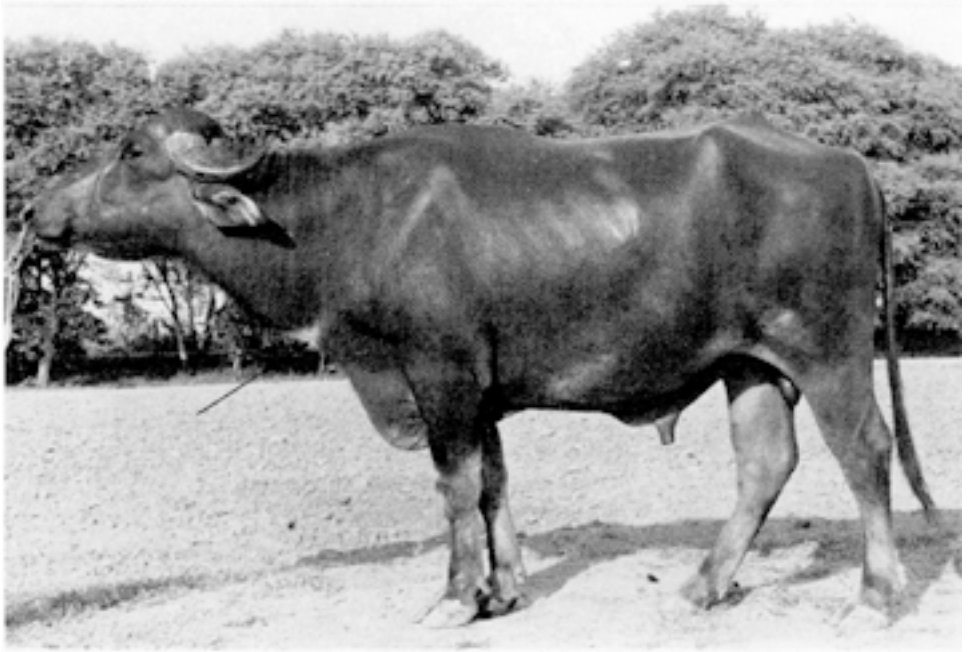
** 1 lac = I00 000*

A similar trend was also reported by Singh et al. (1993) who made a preliminary survey covering three blocks of Agra, one block of the Etawah and Bhind districts. In all 40 villages, 8 from Pinnahat block (Agra), 11 from Bah block (Agra), 7 from Jaitpura block (Agra), 4 from Brahpura block (Etawah) and 1.0 villages of Bhind district were surveyed. It was observed that none of the surveyed villages had even 20 Bhadawari buffaloes excepting the Pachhay village of Brahpura block. It was also observed that only 11 percent of the buffaloes reared by farmers were Bhadawari buffaloes. The population of this breed is declining day by day and is only at a few thousand.

These results indicated a shift towards high milk production rather then high milk fat producing buffaloes in the native tract of Bhadawari breed - a trend which may be dangerous for the existence of this important germplasm.



Bhadawari buffalo



Bhadawari bull

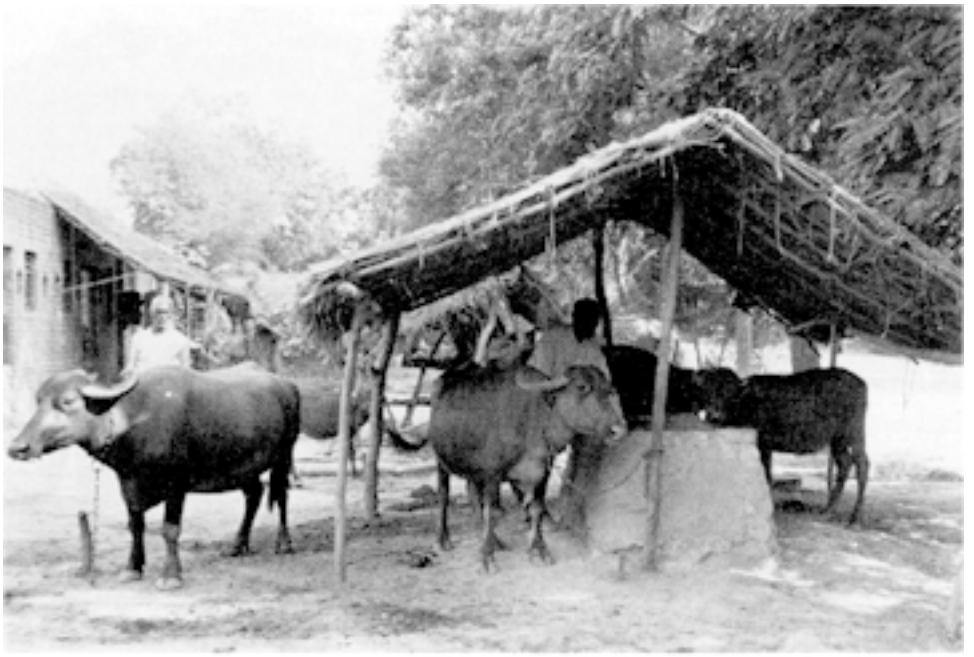
3.0 PHYSICAL CHARACTERISTICS

Bhadawari buffaloes are medium sized animals having usually a copper colour with scanty hair and pale legs. The slcin colour is generally grey or greyish black. Presence of a whhite c[C]ool.oured rinn.g on the lower side of neclc is a typical characteristic of this breed. Trhe head is comparatively small, bulging between the horns. In some cases the forehead has white markings on it. Horns are blaclc in colour, curving slightly outward, downward before running baclcwards parallel and close to the neck and finally turning upwards. In case of slightly blackish coloured animals, the horns are turned inward at the end. The muzzle is black. Eyelids are copper in colour but some animals have light brown or black coloured eyelids. Ears are horizontal and medium in size. Hooves are black. The tail is thiclc and long sometinzes touuching the ground, ending in a brown or white coloured switch. The udder is small and not well developed, teats are cylindrical and centrally placed with pointed tips. The vulva is very close to the anus. Calves are generally lighter in colour than the acdult animals.

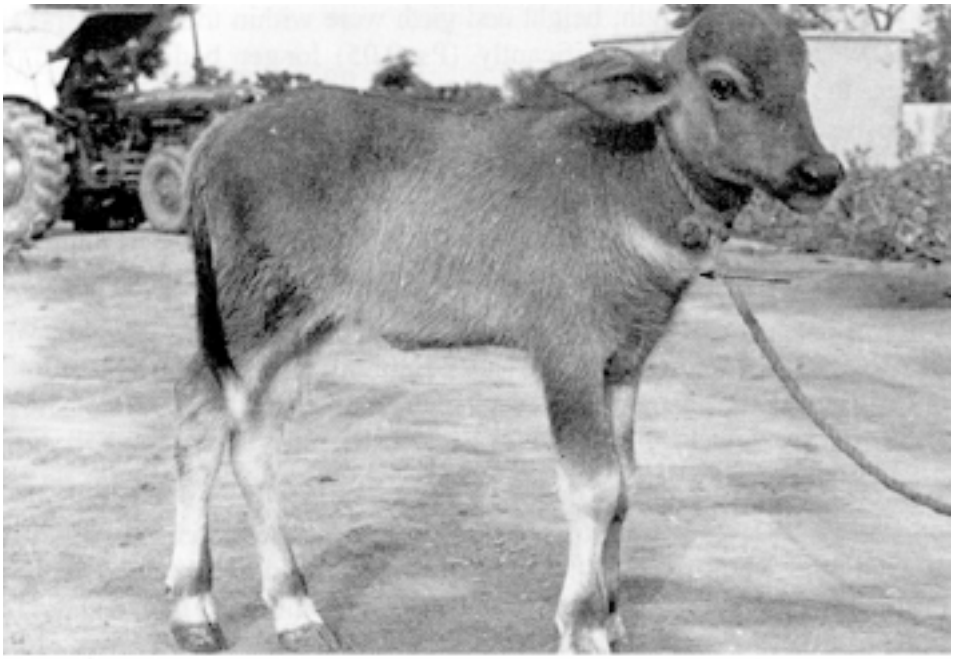
4.0 BODY MEASUREMENTS

Body measurements on 69 animals of different ages were recorded at the Bhadawari buffalo farm., Etawah, Uttar Pradesh. The least square means, standard error and nu.mber of observations for different measurements are shown in table 2.

The estimates of body length, height and girth were within the range reported by Singh and Desai (1962). Females had signifcantly (Ps 0.05) longer bodies as compared to the males. However, the sample size was very small.



Housing under field conditions



Bhadawari calves

5.0 MANAGEMENT PRACTICES

A total of 81 farmers from three blocks of Agra were contacted to know the animal husbandry practïces and feed and fodder availability in the area. The animal husbandry practices being followed to rear the Bhadawari breed of buffaloes in its breeding tract are given in table 3.

In the area, 70% farmers kept buffaloes for milk and 30% for draught. They are purchasing animals from farmers (30%) and businessman (30%) and 40% of the animals are farm born. Animals are sold to farmers (60o/o) and to businessmen (40%).

8.5% of farmers kept animals in the open, 8.4% in closed sheds and the remaining 83.1 % in both types of houses. Two types of animal houses kachha (46.8%) and pacca (53.2o/o) were available. The majority of the farmers (96%) tied animals day and night. About 52% of the farmers had animal sheds as a part of their residence and rest of them had separate Ilouses for animals. All the farmers reared the calves through milk suckling. In the case of colostrum feeding, 97.3% fed colostrum to new born after disposal of placenta. Only 41.3% farmers adopted the practice of cutting the naval by a new blade, the rest of them by other means lilce Khurpi, Daranti and knife etc. Dehorning was not practised. Only 17% of the farmers give wormicides to newborn calves.

The majority of the farmers (97%) practised cleaning of teats and udder prior to milking and 89% of the farmers adopted the practices of cleaning the milking utensils. Regarding milk disposal, 40% farmers sold whole milk, 17% in the form of ghee, 12% both millc and ghee while 31 % utilized it for home consumption. All the farmers prepared ghee by the dahi method.

Among the farmers rearing buffaloes, only 11 % had Bhadawari breed. All the farmers of the area adopted natural service, while very few (2.6%) adopted artificial insemination.

5.1 FEED & FODDER

In the area following feeds and fodders are available:

- Dry feeds: Wheat-bhusa (Triticum aestivum), karvi of Bajra (Pennisetum typhoides), Maize (Zea mays) and Jawar (Sorghum vulgare).
- Green fodder: Berseem (Trifolium alexandrinum), Lucerne (Medicago sativa), Bajra, Maize and Jawar.
- Concentrate: Mustard cake (Brassica spp.), meals of Bajra, Barley (Hordeum vulgare), oat (Avena sativa), gram (Cicer arietinum) and wheat grain.

Concentrates are fed prior to milking by mixing with fodder.

6.0 PERFORMANCE

6.1 Production and reproduction

Production and reproduction records pertaining to 491 lactation records of 108 Bhadawari buffaloes from 1976 to 1990, maintained at Chander Shelchar Azad University of Agriculture and Technology, Kanpur and Dalip Nagar farms were analyzed by the least square method to study the performance of this breed. Least square means of various economic traits are shown in table 4.5.

The least square means of first lactation milk yield, pooled lactation milk yield, and lactation length were 693.2+63.1 lcg., 650.4+44.9 kg and 284.8+10.7 days respectively. Singh and Desai (1962) and Singh and Singh (1977) reported higher estünates of pooled lactation millc yield and first lactation milk yield respectively. Influence of period of calving was significant on all three traits.

The least square means of milk yield per day of lactation length and milk vield per day of calving interval were 2.45+0.12 lcg. and 1.52+0.10 kg respectively. The estimate of milk yield per day of lactation length was higher than that reported by Singh and Singh (1977). Both traits were significantly affected by farm and period of calving.

The least square means of birth weight, age at first calving, gestation period and calving interval were 25.5+0.4 kg., 1 540.7+46.6 days, 308.9+1.8 days and 524.7+25.9 days respectively.

The estimate reported by Singh and Desai (1962) for age at first calving was closer and for calving interval was lower than the present study. Parity and period of calving had significant (P<0.01) effects on birth weight.

6.2 Lifetime performance

Lifetime performance of the breed is shown in table 5. The herd life was considered from birth to disposal/death, Productive life as first calving to disposal/death and lifetime milk yield as sum of milk yield in different lactations. In Bhadawari buffalo lifetime milk yield was considerably lower than that of Surti (Biradar et al.,1991) and Murrah buffaloes (Pundir, 1993). Effect of period of calving was significant on lifetime milk yield and number of lactations completed.

It has been postulated that this breed is poorer in production, reproduction, lifetime performance and millc production efficiency traits than the other breeds of buffaloes.

6.3 Fat and solid non fat (SNF)

A total of 25 milk samples of Bhadawari buffalo (6 from morning and 19 from evening) were collected from Etawah farm to test fat and SNF percentage. The overall means of fat and SNF percentage were 7.53+0.94 and 9.55+0.35 respectively. The means of fat and SNF percentage from morning milk were 7.66+0.09 and 7.71+0.41 respectively and from evening milk were 7.41+1.09 and 9.39+0.41 respectively. Singh and Desai (1962) reported that the butter fat percentage of individual buffalo ranged from 6.1% to 12.5% and the mixed milk samples were found to contain 8.1 % fat and 10.98% SNF.

7.0 ATTEMPTS FOR IMPROVEMENT

In 1985, the Indian Council of Agricultural Research (ICAR) started a Research project at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur for the üzmpïoveinent of Bliadawari buffaloes with the following objectives:

- to study production, reproduction, growth, heat tolerance and feed efficiency;
- to study the milk constituents fat and solid not fat (SNF).

They concluded that Bhadawari animals are economical as compared to Murrah. It does not need high care and can survive easily even on grazing. It is well suited to landless or marginal farmers. But it is not a commercial animal.

The project was started with 58 breedable females but in 1990 there were only 16 breedable females. The project was terminated in 1990.

Uttar Pradesh Government has also realized the need of conservation of this breed and has talcen few steps.

a. A farm of Bhadawari buffaloes was established at Saidpur in I971-72, which was later shifted to Etawah in 1988-89.
b. 63 Bhadawari bulls were selected on the basis of dam's milk yield. Of these, 58 are being used for natural services in villages of Agra, Allahabad, Jhansi and Kanpur divisions of Uttar Pradesh and 5 are being used for semen collection for freezing and artificial insemination. Simultaneously, a very large number of IVIurrah bulls (826) for natural service and frozen semen of 327 Murrah buffaloes for artificial insemination were distributed throughout the state covering even Bhadawari tract under the breed improvement programme (REPORT, 1991). This programme has diluted the efforts made for conservation of Bhadawari buffaloes by adopting selective breeding and genetic im.provement as farmers in the breeding tract are using either Murrah bulls or their semen for breeding. To conserve the Bhadawari buffalo germplasm, large numbers of Bhadawari bulls should be selected and distributed and the Government should restrict the distribution of Murrah bulls/semen in its breeding tract.

National Bureau of Animal Genetic Resources (NBAGR) Karnal, has also initiated a research project entitled "Characterization of the Bhadawari breed" to study the population status, management practices and breed characteristics which includes morphological characteristics, production, reproduction and growth traits, cytogenetic profile, blood group and polymorphism under the field conditions existing in its breeding tract.

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Table 2: *Body measurements (cm) of Bhadawari buffalo*

Age	Sex	No.	Body length	Heart girth	Paunch girth	Hip width	Pin width	Face length	Face width	Height
Birth	F	1	54.0	62.0	61.0	13.0	6.0	22.0	26.0	60.0
6-12 months	M	9	80.0±3.7	103.1±13.6	119.4±7.5	22.0±1.7	9.3±1.4	31.4±0.9	36.0±1.2	85.8±2.5
12-24 months	F	8	88.6±3.9	110.8±14.4	117.0±8.0	25.1±1.8	11.3±1.5	33.1±1.0	38.5±1.3	88.3±2.7
	M	4	85.7±5.6	106.5±20.4	117.2±11.3	23.7±2.6	11.0±2.1	32.0±1.4	35.5±1.8	86.2±3.8
Adult	F	2	131.0±7.9	179.5±28.9	190.5±16.0	47.5±3.6	23.5±3.0	47.5±2.1	57.0±2.6	124.0±5.4
	M	44	142.6±1.6	198.0±6.1	211.6±3.4	51.7±0.7	26.8±0.6	49.9±0.4	53.1±0.5	127.3±1.1

M: Male, F: Female

TABLE 3:
Animal husbandry practices in the breeding tract

Parameter	% of respondents
l. Utility	
l.l Milk	70.0
1.2 Draught	30.0
2. Sale of animals to	
2.1 Farmers	
2.2 Businessmen	60.0
3. Repurchase of animals from	
3.1 Farmbred	40.0
3.2 Purchase from farmers	30.0
3.3 Purchase from businessmen	30.0
4. Housing	
4.1 Type	
4.1.1 Open	8.5
4.1.2 Closed	8.4
4.1.3 Both	83.1
4.2 Shed	
4.2.1 Kachha	46.8
4.2.2 Packka	53.2
4.3 Confinement of animals	
4.3.1 Only for day	NIL
4.3.2 Only for night	3.9
4.3.3 Both day and night	96.1
4.4 Situation	
4.4.1 Part of residence	57.1
4.4.2 Away from residence	42.9
5. Calf management	
5.1 Type of rearing	
5.1.1 Suckling	100.0
5.1.2 Weaning	NIL
5.2 Colostrum feeding	
5.2.1 After parturition	2.7
5.2.2 After disposal of placental	97.3
5.3 Cutting of navel cord	41.3
5.3.1 By new blade	58.7
5.3.2 Khurpi/Daranti etc.	NIL
5.4 Dehorning	
5.5 Wormicides	
5.5.1 Yes	17.3
5.5.2 No	82.7

TABLE 3 (cont.):
Animal husbandry practices in the breeding tract

Parameter	% of respondents
6. Clean milk production	
6.1 Cleaning animals before milking	
6.1.1 Teat and udder	97.1
6.1.2 Whole animal	1.5
6.1.3 None	1.4
6.2 Cleaning of miliking utensils	
6.2.1 Yes	89.2
6.2.2 No	10.8
7. Milk utilization	
7.1 Sale of milk	40.4
7.2 Sale of ghee	17.0
7.3 Sale of milk and ghee	12.0
7.4 Family use	30.0
8. Method of ghee preparation	
8.1 Dahi	100.0
8.2 Cream	NIL
9. Breeds of buffaloes	
9.1 Badhawari	10.7
9.2 Murrah	89.3
10. Method of breeding	
10.1 AI	2.7
10.2 Natural	96.0
10.3 Both	1.3

TABLE 4:
Production and reproduction performance of Bhadawari buffaloes

Traits	No.	Mean ± S.E.
Birth weight (kg)	436	25.5±0.4
Age at first calving (days)	89	1540.7±46.6
First lactation total milk yield (kg)	94	693.2±63.1
First lactation 300 days milk yield (kg)	93	678.2±53.9
Pooled lactation total milk yield (kg)	326	657.9±48.6
Pooled lactation 300 days milk yield (kg)	332	650.4±44.9
Lactation length (days)	332	284.8±10.7
Dry period (days)	255	213.1±22.7
Service period (days)	259	213.3±26.7
Gestation period (days)	409	308.9±1.8
Calving interval (days)	255	524.7±25.9
Milk yield per day of lactation length (kg)	332	2.5±0.12
Milk yield per day of calving interval (kg)	255	1.5±0.10

Bhadawari buffaloes at breeding farm

TABLE 5:
Lifetime performance of Bhadawari buffalo

Traits	No.	Mean ± S.E.
Herd life (days)	45	3337 ± 263
Productive life (days)	78	1375 ± 153
Lifetime milk yield (kg)	105	1689 ± 183
Total days in milk	105	719 ± 68
Number of lactations completed	105	2.96 ± 0.26
Lifetime milk yield per day of herd life (kg)	45	0.602 ± 0.063
Lifetime milk yield per days of productive life (kg)	78	1.396 ± 0.089
Lifetime milk yield per day of total days in milk (kg)	105	2.326 ± 0.097
Lifetime milk yield yp to 3rd lactation (kg)	74	1904 ± 122
Total days in milk up to 3rd lactation	74	782 ± 41
Lifetime milk yield per day of total days in milk up to 3rd lactation (kg)	74	2.47 ± 0.11
Lifetime milk yield up to 4th lactation (kg)	45	2619 ± 176
Total day in milk up to 4th lactation	45	1051 ± 6.5
Lifetime milk yield per day of total days in milk up to 4th lactation (kg)	45	2.52 ± 0.13
Lifetime milk yield up to 5th lactation (kg)	34	3038 ± 329
Total days in milk up to 5th lactation	34	1175 ± 12.3
Lifetime milk yield per day of total days in milk up to 5th lactation (kg)	34	2.54 ± 0.24

THE CRIOLLO SHEEP IN PERU

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SUMMARY

There are approximately ffteen million sheep in Peru, with more than 50% of this population being located in peasant communities and considered to be Criollo. Sheep were introduced by the Spanish, producing an almost complete displacement of the native camelid population. These animals were the foundation of the Criollo sheep presently found in the peasant communities of the Peruvian Andes. The Criollo sheep has a typically pear-shaped body, with a relatively small head, most often with horns. Productive characteristics among the Criollo sheep in the sierra are highly variable and depend mainly on the locations where they were raised. Criollo sheep and their crosses with improved breeds show a higher survival rate than crosses among the improved breeds of sheep in Peru. This indicates that although not as productive in conventional terms (weaning weight or fleece production) the criollo are well adapted to their environment.

RESUMEN

Existen aproximadamente 15 millones de ovinos en Perú y más del 50% del efectivo se considera Criollo y se encuentra en las comunidades rurales. Los ovinos fueron introducidos por los españoles, desplazando así la población local de camélidos. Para las comunidades campesinas peruanas de los Andes estos animales eran la base que representan ahora los ovinos de raza Criolla. La raza Criolla presenta un cuerpo típicamente en forma de pera, con una cabeza relativamente pequeña, a menudo con cuernos. Las características de producción de los ovinos Criollos de la sierra son altamente variables y dependen principalmente de las localidades donde se crían. Los ovinos Criollos y sus cruces con razas mejoradas muestran un mayor índice de supervivencia en comparaci ón con los cruces obtenidos con las razas mejoradas del Perú. Esto indica que, a pesar de no ser muy productivas desde el punto de vista convencional (peso al destete y producción de lana), la raza Criollo está bien adaptada a su entorno.

1.0 INTRODUCTION

There are approximately fifteen million sheep in Peru, more than 50% of this population being located in peasant communities and considered to be Criollo sheep (Jamtgaard, 1989). Criollo sheep represent a very important part of the mixed livestock herds of the families in peasant communities in the highlands, and are also important for the smallscale farmers of the interandean valley. The proportion of different animals depends on the environinental conditions where the production system has developed (Martínez; 1985).

Although Criollo sheep represent the majority of the sheep population in Peru, they have received little attention from institutions entrusted with animal production research. As in other countries, there has been a growing tendency among sheep producers to introduce foreign breeds as alternatives to the Criollo. The disadvantage of foreign breeds is that they are often ill-adapted to the Peruvian environment (Burfening and Carpio, 1994).

The objective of this paper is to characterize Criollo sheep production in Peru and will focus on Criollo sheep in the sierra where most of the population is found.

2.0 HISTORY

The remarkable decline of the indigenous human population in Peru during the first fifty years of the Spanish conquest was accompanied by a similar decrease in the native camelid populations. Simultaneously, sheep were introduced, producing an almost complete displacement of the native camelids and, to a much lesser extent, cattle. Martínez (1985), reported that sheep existed in Peru prior to 1537 and their origin was from the Castille region of northern Spain. Apparently, the first sheep introduced were not Spanish Merino, but rather animals having coarse fibre, suggesting that the initial breeds could have been the Latxa and Churra (Chávez et al., 1989). The Indian population adopted the sheep relatively rapidy, probably due to political and religious measures favouring the sheep over the native camelids (Martínez 1985).

Sheep were first introduced into valleys of the central coast especially in the Rimac valley where Lima is the capital. The Indians, subjected to slavery, worked as shepherds in the new property system established by the Spanish conquerors. Because seizure of their lands caused the destruction of the communities; especially along the coast, the indigenous people retreated to the foothills of the Andes, taking the sheep with them. The Criollo sheep started from these animals and are the ancestors of the present sheep which are located in the Peruvian Andes in peasant communities (Martínez 1985, Chávez et al.,1989). Later hacienda owners allowed peasants to raise Criollo sheep along with the hacienda's animals as a compensation for unpaid labour. These sheep were often called "huaccha" animals (Calle, 1968; 1982).

Due to the environment and lack of planned production systems, genetic and phenotypic changes occurred gradually in the introduced sheep. These adaptive changes were frequently described as "degenerations". Likewise, the word "chusco" was also used. In Peru "chusco" is used to describe an animal which is ugly and with no value while in other Latin Ainerican countries as well as Spain, chusco has the opposite meaning (Chavéz et al., I989).

3.0 POPULATION AND DISTRIBUTION

Of the approximately 15 million sheep in Peru, 99% are found in the sierra. Most are located in the South and Central regions (56.11 and 35.92 %, respectively) where the altitude, rough topography, and the low feeding quality of the native pasture make cultivation or raising bovine livestock impossible. Nearly all of the sheep in peasant communities can be grouped as "Criollo" or native sheep. Most of the Criollo sheep are distributed in the highlands of the Andes at 3 500 m above sea level, although some are found along the coast and a small number in the Amazon jungle.

The sierra of Peru represents an area of 335 million ha, which is one third of the land area of Peru. The productive base of the sierra has only 18 million ha of native pasture and 2.5 million

Typical Criollo ram

Criollo ram with bifuricated horns

ha of cropland. The human population of the sierra represents 44% of the national population and of this percentage, 55% depends primarily on agriculture and livestock activitics to sustain a living. The large and medium-sized production units are of smail numerical importance when compared to small-scale producers. Small scale production is dominant, with one million agricultural units with less than IO ha of total land, and the small scale producers control more than 1.5 million ha of cultivated land (Franco, 1987). At the present time, sheep constitute the most typical animal husbandry .among most peasants.

4.0 PHENOTYPIC AND PRODUCTIVE CHARACTERISTICS

The Criollo sheep has a typically pear-shaped body. The head is relatively small, most often with horns. It is possible to find individuals with bifurcated horns. The head colour and conformation are variable, although in general, brown spots are found on the face. In addition the neck is light, the body trim, the rump dropped, with long, thin legs (Calle, 1968).

The productive characteristics among the Criollo sheep in the sierra are highly variable, depending mainly on the locations where they are raised. In the interandean valleys, body weights are heavier than those found in the higher altitudes probably because of better pasture conditions and access to crop aftermath. Little information is available on body weights of rams and ewes; particularly mature animals. A summary of three studies is presented in table l. Birth weights ranged between 2.5 and 3.5 kg with mature weights ranging between 20 and 33 kg.

Carcass dressing percents from Criollo in the Ayacucho area were reported to be 5 3.6%%o for males and 41.98% for females (Paquiyauri et al., 1987). A total of 30 males, 18 months of age, raised in the Puno area, were slaughtered at an average weight of 33 kg and carcasses yielded 14.9 kg (45%). The carcasses were composed of 32, 20, 20, 18 and 10% leg, arm, rack, neclc-shoulder and loin, respectively (Castelo, 1989). In interviews with members of the peasant communities it was reported that they prefer to eat the meat of Criollo sheep instead of that of improved sheep. However, no blind taste testing has been done.

In Criollo flocks, it has been found that animals produced an average fleece of 1.3 kg, and in some cases 2.3 kg (Reynoso, 1979). However, under these conditions the Criollo sheep are not shorn on a yearly basis but rather are shorn when wool is needed either for home processing into clothing or when income is needed. Shearing may be done with a variety of instruments including brolcen glass, sharp knives, scissors and occasionally hand shears. Rarely are Criollo sheep shorn with shearing machines. Cabrera and Chávez (1988) working in the community of Mantaro (3 750 m above sea level), reported fleece weights of 2.1 and 2.7 lcg and staple lengths of 9.0 and 9.8 cm for ewes and rams, respectively. In Ancash, the diameter of the fibre reported in ewe lambs and ewes were 30 and 35 micrometers, respectively (Valenzuela, 1965). Aceituno (1989), compared productive characteristics between Criollo sheep raised at an experimental station vs. those raised in a peasant community. Both groups, were studied under the same conditions at 3 979 m above sea level, grazing natural pastures but differing in the management of the animals (table 2).

5.0 REPRODUCTIVE CHARACTERISTICS

Reproduction is not planned in the peasant communities and among small-scale producers. There is no separation by sex and ewes and rams remain together all year round. The proportion of males in the herd is about 8 to 10%. As a consequence of this, lambing does not have a defined season. The major lambing periods occur during two lambing seasons (most important November and December; May and June). However, it is common to observe young lambs all year round. The lambing season in November and December coincides with the start of the rainy season in which grasses grow and provide high quality forage for lactation. It is not uncommon to see many young lambs in peasant communities 5 to 6 months after the start of the rainy season and

probably indicates that the improved nutrition associated with green grass induced the cycles of some ewes.

When this occurs the mortality of the lambs is very high because they are born during the dry season when nutrients are insufficient for lactation (Chávez el al. , I 989). The presence of oestrous in Criollo ewes is distributed all year around, and the ovulation frequency is higher than in Junín (a locally developed breed) and Corriedale breeds. The highest ovula.tion frequency (90o/o) for Criollo ewes is in March (Novoa, 1989). Ovarian activity is initiated 19 days post partum, four days earlier than Junín ewes. Huamán (1989) indicated that in spite of a shorter post-partum interval to first ovulation, Criollo ewes were less impacted by ramstimulation than Corriedale ewes.

At puberty in males, the separation of the preputial attachments occurs when the animal reaches seven months of age. The first ejaculation is at eight months of age (57o/o of the adult weight). The Criollo rams are small animals with bigger scrotal circumference (during the liberation of the penis) than Corriedale and Junín rams. In adult Criollo rams, the size of the scrotal circumference is still large with respect to the size of the animal (table 3). The semen volume and the sperm concentration in Criollo rams tend to be less than Junín and Corriedale, although, the motility was highest in Criollos (table 4) (Novoa, 1989).

6.0 CROSSING WITH IMPROVED BREEDS

Although much crossing with improved breeds of sheep has been done in Peru, few results have been reported in the literature. Junin (an improved breed developed in Peru), Targhee, 1/2-Finn (Finn x Targhee), both imported from the United States, and Criollo rams, were mated to Criollo and Junin ewes. The number of lambs born per ewe exposed for breeding was affected by the breed of sire, the imported sires having a lower percentage of lambs born compared to Junin and Criollo sires (74.9 vs 81.9%; $P<0.05$). Lambs born to Criollo dams had much higher survival rates to weaning compared to lambs born to Junin dams (91 % and 71 %, respectively, $P<0.05$). As a result of the high capacity to survival of lambs from Criollo dams, the number of lambs weaned per ewe exposed for breeding was higher ($P<0.01$) in the Criollo ewes (69.6%) than the Junin ewes (55.2). Lambs born to Junin dams were heavier ($P<0.05$) at birth, weaning, and shearing than lambs born to Criollo dams. Lambs sired by Junin, Targhee and Finn rams and raised on Criollo dams were lighter than those raised on Junin dams but heavier than straightbred Criollo lambs ($P<0.05$). Straightbred Criollo lambs had lighter ($P<0.05$) fleeces than those of other breed crosses.

No differences were observed in kilograms of lamb weaned per ewe exposed for breeding. However, Criollo ewes raising lambs sired by either Junin, Targhee or Finn cross rams had more ($P<0.05$) kilograms of lamb weaned per ewe lambing compared to the other crosses. There is no question that the Criollo sheep which adapted to the high altitude environment offer better survival to their lambs under the conditions that exist in the highland of the Andes.

7.0 SOCIO-ECONOMIC IMPLICATIONS

Approximately 99o/o of the peasant communities recognized in Peru use agropastoral production systems. The agropastoral and pastoral communities contain 45.1 % and 44%, respectively of the sheep flocks (table 6; Jamtgaard, 1989).

Within these communities communal herds exist that belong to all members of the community as well as herds that belong to each family of the peasant community. In the Mantaro valley, the sheep communal production is 7% compared with family sheep production of 93a/o (Torres, 1985).

Particularly in the agropastoral communities, the livestock production represents a great diversity of animal species, and each one has a specifc function within the system. These species

are divided in two groups: one, called "hato" which are composed of cattle, sheep, horses, camelids, swine and goats; the second group raised consists of small animals such as guinea pigs, hens, ducks and rabbits. This latter group of animals are generally managed inside the house. Within each of these two groups, each specie plays a specific role and competes for the same natural resources (Fernández et al., 1986).

Women and children are in charge of grazing and moving the animals daily, avoiding scattering of animals or mingling with the neighbour's flocks. Women have most of the responsibil.ity for the flocks and small animals raised at home. Management and production decisions are also made by women, while men are in charge of crop production (Chávez et ul., 1989; Jamtgaard, 1989).

Within the community, most of the peasants are small-holders with herds ranging from ?0 to 30 animals while some peasants have up to 400 animals. In general, the small-holders utilize overgrazed lands near the villages and the larger group takes advantage of better quality range, situated further away (several hours of travel) (Jamtgaard, 1986). In the highland agropastoral communities, of Cuzco, Puno and Ayacucho, a family has an average of 3.5 cattle, 20 sheep, 1 horse or mule, 1 Ilama or alpaca, 2.3 pigs, 11 guinea pigs and 3 hens.

Málaga (1986) affirmed that sheep, cattle and small animals represent their main source of protein, as well as the income from the sale of their products for peasants. Sheep and small animals constitute a renewable source of capital that is kept to use as money to purchase inputs on certain occasions (Gonzáles de Olarte, 1986). The production is used as raw material for artisan manufacture of textiles, ropes and leather. Manure is used as a organic fertilizer for agriculture and fuel for homes. Generally, sheep consumption and sales take place on important dates or when an animal is sick or has died by accident. The wool is sold after shearing or as a pelt with fleece. Part of this wool production is utilized for manufacturing clothing for the family. The annual percentage of culled Criollo sheep in the communities of Mantaro valley is approximately 20%. Out of this percentage, 33% is used for consumption vs. 77o/o for sale (Torres, 1985).

All the products are sold in fairs that take place on specific days near towns. In the communities in Ancash during the rainy season (March, April and May), animals are sold to middlemen or butchers. The most valued animals are males with 6 to 8 teeth and of 3 to 4 years of age with good conformation and good muscling. Females are zealously guarded by the peasants (Valenzue?a, 1965).

In the agropastoral communities in the southern sierra of Peru, three quarters of the peasant family's income is divided from crops, livestoclc and family labour. The family income generally comes from cultivation (14%), livestock (23%), non-agricultural activities (24%), including commerce, salaries from local labour (22o/o) and salaries from non-local labour (17%). Of their monetary expenses, only 5% goes toward input acquisition and less than 2% for procuring productive services. An additional 4% is destined for the purchase of capital goods which means that 90% is destined for consumable goods (Figueroa, 1987; Martínez and Barrera, 1989).

Sheep manure is highly valued as a fertilizer. Each peasant household requires trom 1.5 to 2 tons of fertilizer annually (principally from sheep) to provide adequate fertilization for the land. Criollo sheep serve as gatherers of nutrients from distant and less productive areas to be concentrated on peasant land, thereby increasing the land production potential (Jamtgaard, 1989). The use of sheep manure as a currency in the agropastoral communities is an indicator of its productive utility. For example, salaries for agricultural labour, land and corral rents; even fines are frequently paid with manure. Criollo sheep manure constitutes a basic product in the peasant economy, since commercial fertilizers are beyond the peasants' economic reach. The "irrational" tendency for keeping mature or less productive animals in the peasants' flocks, could be explained by the basic importance of animal manure (Jamtgaard, 1989).

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Children herding a small flock of Criollo sheep

TABLE 1:
Body weights (kg) of Criollo sheep in Peru from three study locations

Reference	Velenzuela (1985)		Lencinas et al. (1985)		Caprio and Burfening (1988)	
Sex	**F**	**M**	**F**	**M**	**F**	**M**
Birth			2.5	3.5	2.5	3.4
Weaning	19	20	15.0	15.4	16.8	19.4
8 months			16.2	16.7	20.0	19.6
1 year	25	30				
2 years	28	33	20.0	23.0	28.8	24.7
3 years	30	40				
4 years	32					
Location	Ancash		Puno		Cerro de Pasco	
Elevation (m)	3000		3800		3900	

TABLE 2:
Fleece characteristics in Criollo sheep raised under two management systems in the Puno area of Southern Peru

	Production system	
Characteristics	**Experiment Station**	**Community**
Fleece wt. (kg)	1.58 ± 0.06	1.73 ± 0.02
Staple length (cm)	6.42 ± 0.13	9.50 ± 0.02
Fibre diameter (μ)	27.09 ± 0.12	26.97 ± 0.04
Medullated Fibre (%)	11.20 ± 0.27	9.42 ± 0.09
Clean yield (%)	60.01	57.33

TABLE 3:
Body weight and scrotal circumference in Criollo, Corriedale and Junin rams in the Central Sierra of Peru (Novona, 1989)

	Body wt. (kg)		Scrotal circumference (cm)	
Breed	**n**	**mean ± S.E.**	**n**	**mean ± S.E.**
Criollo	165	41.7 ± 0.5	251	29.4 ± 0.2
Corriedale	145	50.6 ± 0.8	243	31.1 ± 0.2
Junin	177	64.7 ± 0.7	270	59.9 ± 0.1

TABLE 4:
Semen characteristics in Criollo, Corriedale and Junin rams in the Central Sierra in Peru

	Volume (ml)		Concentration n x 10^9/ml		Motility (%)	
Breed	**n**	**mean ± S.E.**	**n**	**mean ± S.E.**	**n**	**mean ± S.E.**
Criollo	351	1.1 ± 0.03	338	2.2 ± 0.1	348	56.4 ± 1.1
Corriedale	296	1.2 ± 0.04	284	2.1 ± 0.1	295	54.8 ± 1.2
Junin	381	1.2 ± 0.03	368	1.9 ± 0.1	379	51.9 ± 1.0

TABLE 5:
Reproductive perfórmance of Junin and Criollo ewes mated to Junin (J), Targhee (T), one half I/2-Finn (F) or Criollo (C) rams (Burféning and C.arpio, I994)

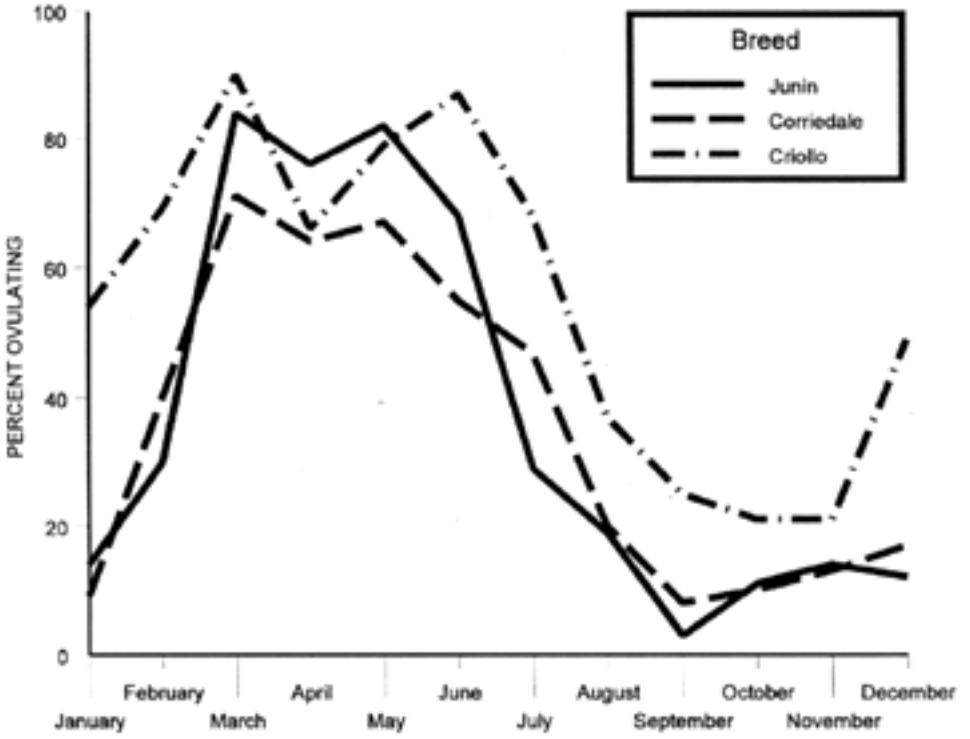
Sire breed x Dam breed	Number of ewes lambing (%)[a]	Number of lambs weaned (%)[a]	Weaned per ewe exposed (%)	Ewe Productivity, wt. weaned per ewe (kg)	
				Lambing	**Exposed**
JxJ	494(82)[b]	353(71)[b]	59.0[b]	15.2[b]	12.6 [b]
TxJ	427(78)[b]	297(69) [b]	54.2[b]	15.3 [b]	12.1[b]
FxJ	402(72)[c]	287(71)[b]	52.0[b]	15.9[b]	11.6[b]
JxC	77(74)[c]	71 (92) [c]	68.9[c]	18.6 [c]	14.0[b]
TxC	75(70)[c]	67(89)[c]	63.2[c]	17.8[c]	12.6[b]
FxC	70(74)[c]	66(94)[c]	69.4[c]	18.3[c]	13.5[b]
CxC	118(84)[b]	105(89) [c]	75.0[c]	14.5[b]	12.3[b]
Junin dams	1323(78)[d]	937(71)[d]	55.2[d]	15.6[d]	12.7[d]
Criollo dams	340(77)[d]	309(91)[e]	69.6[e]	17.0[e]	l3.0[d]

[a] *Ewes with multiple births deleted from data set.*
[b,c] *Means vvithin a column in the breed cross comparisons without lacking a common superscript differ (P<0 OS).*
[d,e] *Means within a column in the dam breed comparisons without lacking a commmon superscript differ (P<0.05).*

TABLE 6:
Sheep and camelid numbers in peasant communities by type of production system (Jamtgaard, I986)

Production system	Sheep	
	Number	**%**
Agropastoral	3502251	45.2
Pastoral	3416596	44.0
Others	838404	10.8
Total	7757251	100.0

Figure 1: *Percent of ewes ovulating by month of the year (Novoa, 1989)*



Women shearing a Criollo ewe with knives