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HAIR SHEEP PRODUCTION SYSTEMS
A SURVEY OF GENETIC RESOURCES

FINAL PROJECT REPORT

H. A. Fitzhugh, Project Leader

G. E. Bradford, Principal Investigator

WINROCK INTERNATIONAL LIVESTOCK RESEARCH AND TRAINING CENTER

Morrilton, Arkansas

Supported by Grant No. AID/DSAN-G-0005

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Santa Ines ram and ewes, Brazil

Pelibuey ram, Mexico

SUMMARY

Ruminant livestock have an important role to play in improving the nutrition and income of citizens of developing countries. The need for these improvements is often greatest in the humid tropics.

Among the world's ruminants, sheep are second only to cattle in their production of high quality food protein. Most of the world's one billion sheep are found in temperate or arid/semi-arid tropical environments where a wool fleece is a favorable adaptation. However, an estimated one million sheep are more favorably adapted to the humid tropics because of their hair coat.

The small size, high fertility and resulting high offtake of hair sheep suit them well as an effective contributor to the productivity of small-holder systems in the tropics. Unfortunately, relatively little is known about the performance of hair sheep. This lack of knowledge sharply limits effective planning to achieve the potential of these genetic resources for the improvement of the welfare of producers and consumers.

Objectives

The principal objectives of this study were to:

1. Survey hair sheep resources in their native environment, emphasizing those hair sheep in the Western Hemisphere and Western Africa.
2. Document performance traits, including size, growth, fertility and adaptative traits.

3. Publish comprehensive comparison of hair sheep performance in their native environments.

Activities

An early decision was made to focus the study on the hair sheep resources of the Western Hemisphere and their probable sources in Western Africa. A questionnaire was mailed to scientists and other contacts with knowledge of hair sheep in these regions. Replies facilitated development of the travel itinerary and identification of principal contacts.

Between September, 1978 and May, 1979, Bradford and Fitzhugh traveled to sixteen countries to inspect hair sheep on private farms and public institutional stations. Countries visited included:

Fitzhugh & Bradford	Fitzhugh	Bradford
Mexico	Brazil	Columbia
Trinidad and Tobago	Cameroons	Venezuela
Barbados	Liberia	Guyana
St. Croix (U.S.V.I.)		Jamaica
Tortola (U.K.V.I.)		Ivory Coast
Nigeria		Mali
		Senegal

Performance data were reviewed (and, in some instances, collected) during these visits. Where data had not already been analyzed, arrangements were made to have the data analyzed by local scientists or, if appropriate, data were analyzed by Bradford and Fitzhugh on their return to the U.S.A. Variation in body size, shape, coat color and pattern was documented in an extensive collection of color photographs.

Considerable useful data on hair sheep were identified. Most of these data had not been previously published. It was determined that sufficient information was available to yield a useful reference document on hair sheep.

To this end, chapters were solicited from the scientists and technical officers who had collected the data. These contributions would serve the double purpose of properly acknowledging local efforts in collecting and analyzing performance data and of bringing wider recognition to those with first hand experience and expertise with hair sheep.

To date, twenty-seven chapters have been promised; eighteen have been reviewed and are now being edited. Bradford and Fitzhugh will edit the book, as well as contributing general chapters describing and comparing hair sheep resources in different countries. Photographs, probably including color, will further illustrate hair sheep resources. A comprehensive bibliography of references to hair sheep will be included. Publication is planned in early 1980.

Principal Benefits

The book will make available quantitative information on performance of different types of tropical sheep, relating this performance to the different environment and management conditions in which they are kept. This should permit much more realistic planning of agricultural development programs involving this class of livestock, and should therefore be useful in many countries throughout the tropics, especially in the improvement of productivity of smallholder production systems.

The opportunity for a comparative study of a segment of agriculture in so many different countries has provided an appreciation of the great range of genetic variability in this class of livestock and ideas on how this variation may be used for their improvement. It has contributed ideas for the development of research and extension related to sheep which will be valuable to the Title XII Small Ruminants Program; both participants in the project are Principal Investigators of Small Ruminants CRSP projects.

The visits and discussions have suggested ways in which U.S. graduate training programs in the Animal Sciences can be made more useful to students coming from tropical countries. The contacts made in the course of this project have established communication between U.S. scientists and those in several developing countries where none existed before in the field of sheep production.

INTRODUCTION

The approximately one billion sheep of the world are second among ruminants only to cattle in their contributions to the world food supply (Table 1). The majority of the world's sheep population are found in temperate areas and are also noted for wool production. There is another type of sheep which produces no wool but does produce the same desirable lamb and mutton.

These "hair sheep" are generally well adapted to the climatic stresses of tropical environments. Their tropical adaptation and small size fit well the needs of smallholder agricultural systems in developing countries. Meat and hides contribute to family subsistence and also provide good income potential. However, as is obvious from an inspection of Table 1, sheep in the developing regions (especially in the humid tropical countries) yield substantially less meat and milk than the sheep in developed countries.

Excerpts from the Winrock International study, "The Role of Sheep and Goats in Agricultural Development", illustrate the potential for hair sheep and the need for better information on this important genetic resource.

- The typical smallholder operation is subsistence oriented, low investment, low risk, low production and low return. The emphasis is on low risk, accomplished by spreading investment of land and labor over several small crops. Hair sheep using either the tethering or cut and carry feeding

Table 1. Productivity of regional goat populations.[a]

Region	Total number, millions	Head slaughtered % total	Carcass yield, kg[b]	Milk yield, kg[b]
North America	1.4	-	-	-
Western Europe	9.7	76	8	135
USSR, East Europe	7.3	55	8	79
Oceania	.1	47	7	-
Developed regions	18.4	52	9	104
Middle & South America	29.1	27	3	12
Central & South Africa	108.8	32	3	6
North Africa, Mid East	71.2	33	5	26
China, Mongolia	66.7	30	5	5
India, So. East Asia	115.8	44	4	12
Developing regions	391.6	35	4	12
World	410.0	36	4	16

[a] Population and production statistics for 1977 summarized from FAO Production Yearbook, 1978.

[b] Yield per head in regional herd.

techniques offer an opportunity for converting crop residues, weeds and grazing on nonarable land areas into animal products for family use and limited cash income.

- Land tenure and new land development policies need to take more cognizance of the smallholder's primary goal of survival and risk minimization. Small ruminants provide a low investment, low risk alternative food source while utilizing otherwise wasted feed resources. Their manure serves as fertilizer to improve crops.

- Small ruminants and smallholders are a common combination, often involving the grazing of unfenced common lands, and non-agricultural land (roadsides, urban areas). Contributions of small ruminants to subsistence of poor families are usually not adequately assessed.

- Recognition of the potential contributions of hair sheep and encouragement of their increased utilization will be most effective if improved stocks are available. Some types are noted for prolificacy; most are noted for their ability to survive in unfavorable environments without much attention.

- There is little documented information available to planners and policy makers with regard to available hair sheep or other small ruminant resources, levels of productivity, advantages and disadvantages specific to local production environments.

If small ruminants are considered at all in agricultural development plans, planners generally must rely on subjective opinions, sometimes biased by limited negative experiences or heresay.

Not only scientists and development officers are interested in the potential contributions of hair sheep to the food supply of the humid tropics. In 1975, the Heads of Government Conference of the Caribbean Community agreed to the implementation of a Regional Food Plan. This Plan specifically identified the need for establishing hair sheep multiplication centers to provide improved breeding stock to regional sheep producers. This plan is expected to improve the producers' income, increase supplies of sheepmeat to regional consumers and reduce foreign exchange losses due to sheepmeat imports which have exceeded seven million pounds in recent years.

OBJECTIVES

The present study focused on the hair sheep resources of the Western Hemisphere and on those of Western Africa, the probable origin of the hair sheep introduced to the Western Hemisphere. Although not included in the present study, the hair sheep of Asia, Middle East and Eastern Africa also make significant contributions to the agricultural economies of these regions.

The principal objectives of the study were:

1. Survey hair sheep resources under local production conditions.
2. Analyze available performance data, including growth, size, fertility and survivability traits.
3. Publish comprehensive comparison of hair sheep productivity.

ACTIVITIES AND RESULTS

Travel Itinerary and Principal Contacts

Hair sheep make significant contributions throughout much of the developing world; however, limitations on project financing and time available to principal investigators led to an early decision to focus on a subset of hair sheep. This subset includes those hair sheep in the Western Hemisphere and the probable principal genetic sources in West Africa.

A questionnaire was mailed to scientists and other contacts with knowledge of hair sheep in these regions. Replies facilitated development of the travel itinerary and identification of principal contacts.

Between September, 1978 and May, 1979, Bradford and Fitzhugh traveled to sixteen countries to inspect hair sheep on private farms and public institutional stations. Countries visited included:

Fitzhugh & Bradford	Fitzhugh	Bradford
Mexico	Brazil	Columbia
Trinidad and Tobago	Cameroons	Venezuela
Barbados	Liberia	Guyana
St. Croix (U.S.V.I.)		Jamaica
Tortola (U.K.V.I.)		Ivory Coast
Nigeria		Mali
		Senegal

More specific details of the travel schedule and a listing of principal contacts follows.

Date	Principal Activity/Destinations	Principal Contacts for Project
September, 1978	Barbados: Caribbean Regional Livestock Conference, "Small Ruminant Production" (HAF)	Hayden Blades, CARICOM Secretariat, Georgetown, Guyana J. M. Keoghan, UWI/IDRC Forage Legume Project, Antigua T. B. Cleland, Chief Vet. Officer, St. Vincents J. Robinson, Chief Vet. Officer, Barbados Ernest Payne, Dep. Chief Ag. Officer, Barbados H. Williams, Head, Department Livestock Sciences, St. Augustine
October, 1978	Italy: FAO, Rome (HAF)	J. Rendel, Chief, Livestock Research & Education Service, Rome P. Mahadevan, Senior Officer, Livestock Resources, Rome I. L. Mason, Consultant, Rome
November, 1978	Colombia: FAO/UNDP Consultation: "Evaluation and Conservation of Animal Genetic Resources in Latin America; Bogota (HAF)	Odon Pessoa Santana, EMBRAPA-Miniagricultura, Brazil Hector Munoz, CATIE, Costa Rica Oscar Humberto Cordon, Guatemala Patrick L. McKenzie, Ministry of Agriculture, Georgetown, Guyana C. G. Hickman, FAO, Rome Jorge De Alba, Asoc. Mexicana de Prod. Animal, Mexico Emilo A. Olivo, Centro de Investigaciones y Mejoramiento, Dominican Republic Vladimir Bodisco, CEMIAP, Venezuela Juan Jose Salazar, VECOL, Colombia Rodrigo Pastrana, ICA, Colombia

Date	Principal Activity/Destination	Principal Contacts for Project
November, 1978	Mexico: instituto Nacional de Investigaciones Pecuarias. Station at Palo Alto and Mococha, (GEB, HAF)	Everardo Gonzalez P., Deputy Director General, INIP, Mexico
		Leonel Martinez, Coordinator, Sheep & Goat Program, INIP, Mexico
		Roberto Ruiz, Head, Department of Animal Production, INIP, Mexico-Toluca, Mexico
		Mario Valencia, Centro Experimental Pecuarias Mococha, Yucatan, Mexico
		Francisco Pina, Centro Experimental Pecuarias Mococha, Yucatan, Mexico
		Armardo Rodriquez, Centro Experimental Pecuarias Mococha, Yucatan, Mexico
December, 1978	Trinidad: University of West Indies: Ministry of Agriculture (GEB,HAF)	Lawrence Iton, Head, Animal Production & Research Division Port of Spain (Min. of Agri.)
		Stephen Redman, Chief Technical Officer, Port of Spain (Min. of Agri.)
		Ronald Barrow, Central Experiment Station/Arima, (Univ WI)
		Keith Archibald, Department Livestock Science (UWI)
		Raj Rastogi, Department Livestock Science (UWI)
	Tobago: Blenheim Station, (GEB,HAF)	Jerome Keens-Dumas, Livestock Officer, Tobago
		Delano Davis, Blenheim Station, Tobago

Date	Principal Activity/Destination	Prinicipal Contacts for Project
December, 1978	Barbados: Ministry of Agriculture. (GEB, HAF)	Lionel Smith, Chief Technical Officer, Bridgetown
		Harold Patterson, Livestock Officer, Bridgetown
		A. Brathwaite, Agricultural Economist, Bridgetown
	CARDI	Hugh Jeffers, Animal Scientist
	Sheep Producers	A. Dowding, Golden Grove Estate
		John & Ronald Humphreys
	US Virgin Islands, St. Croix (GEB, HAF)	Harold D. Hupp, Agricultural Experiment Station, College of Virgin Islands
		Duke Dellers, Veterinarian, College of Virgin Islands
		Oskar Henry, Commissioner of Agriculture
		Darshan Padda, Dean & Director, Experiment Station
	Sheep Producers, St Croix	Mr. Christiansen; Ludwig Johausen; Halver Moolinaar
	US Virgin Islands, Tortola (GEB, HAF)	David Smith, Livestock Officer

Date	Principal Activity/Destination	Principal Contacts for Project
January-February, 1978	Brazil: Centro Nacional de Pequisa Caprinos, EMBRAPA; Sobral, Brazil; other Stations in Northeastern region including Ceara, Bahia, Pernambuco, Piaui (HAF)	Elino Alves de Moraes, Chefe, CNPC Ederlon R. de Oliveria, Tecnico, CNPC Elsio A. P. de Fiqueiredo, Tecnico, CNPC Claudio Bellaver, Tecnico, CNPC Aurino A. Simplicio, Tecnico Francisco de Asis Melo Lima, Tecnico, CNPC Jose Ismar Girao Parente, Director Tecnico, EPACE Francisco Helio F. Machado, Tecnico, EPACE Fernando A. B. de Menezes, Tecnico, EPACE Jose Carlos da Rocha, Tecnico, EPABA Renival Alves de Souza, Chefe, CAPATSA Manoel Abilio de Queiroz, Chefe, Adjunto Tecnico, CAPATSA Martiniano Cavalcanti de Oliviera, Tecnico, CAPATSA Luis Mauricio Cavalcanti Salviano, Tecnico, CAPATSA Raimundo N. L. Caminha, Chefe, UEPAE, Teresina Raimundo N. Girao, Tecnico. UEPAE, Teresina Carlos Alberto de Oliveira Ventura, Chefe, IPA, Serra Talhada Jose C. de Andrade, Tecnico, IPA, Serra Talhada Jose de Carvalho Reis, Univ. Federal Rural do Pernambuco

Date	Principal Activity/Destination	Principal Contacts for Project
January-February, 1978	Colombia: Instituto Colombiano Agropecuario; Caja Agraria; Bogota, (GEB)	E. Ceballos, Director, Animal Science Section, ICA
		R. Pastrana, ICA
		J. Salazar, VECOL, Colombia
		A. Naranjo, ICA
		R. Camacho, in charge of sheep projects, Caja Agraria
	Venezuela: Universidad de Maracay; Estacion El Cuji, Barquisime Universidad de Zulia, Venezuela	T. Shultz, Facultad de Ciencias Veterinarias
		F. Chicco, Centro de Invest. Agron.
		D. Plasse, Facultad de Ciencias Veterinarias
		A. Reveron, Centro Nacional de Investigaciones Agropecuarias
		C. Gonzalez-Stagnaro, Facultad de Agronomia, Universidad del Zulia
	Guyana: Ministry of Agriculture	P. McKenzie, Principal Agricultural Officer
		A. Chesney, Chief Agricultural Officer
		G. Nurse, Livestock Officer
	Trinidad: University of West Indies, Ministry of Agriculture	R. Rastogi, Geneticist, UWI
		K. Archibald, Department of Livestock Science, UWI
		L. Iton, Head, Animal Production & Research Division

Date	Principal Activity/Destination	Principal Contacts for Project
January-February, 1978	Barbados: Ministry of Agriculture	W. Combs, Animal Husbandry Deptartment H. Patterson, Acting Permanent Secretary J. Lauckner, Statistician
	Jamaica: Ministry of Agriculture, Agricultural Develop-Corporation	J. Muschette, Senior Livestock Officer D. Miller, Livestock Officer V. Little, Livestock Officer
April-May, 1979	Nigeria: International Livestock Center of Africa (Small Ruminants Project); University of Ibadan; University of Ife; Institute of Agric. Research and Training (GEB, HAF)	D. H. Hill, ILCA A. Mosi, ILCA R. Borel, ILCA N. O. Adedipe, Dean of Agriculture, Univ. of Ibadan A. U. Mba, Nutritionist, University of Ibadan L. O. Ngere, Animal Breeder, University of Ibadan G. N. Egbunke, Animal Physiologist, Univ. Ibadan A. A. Ademosun, Nutritionist, University Ife K. Benni, Animal Breeding, University Ife E. A. Olaloku, Animal Scientist, IART, Ibadan E. A. Onatinka, Head, Animal Science, IART, Ibadan

Date	Principal Activity/Destination	Principal Contacts for Project
April-May, 1979	Cameroons: Centre for Small Animal Research; ONAREST. (HAF)	E. G. Tebong, Chief of Centre, ONAREST R. Dia Ndumbe, Director, Bambul Station F. A. Gandji, Director General, ONAREST S. Nelle, Director General Adjunct, ONAREST
	Liberia: Central Experiment Station, Ministry of Agriculture (HAF)	J. H. Mason, Director, Ministry of Agriculture S. W. Wiles, Animal Scientist, Ministry of Agriculture J. Jarrett, Director, Central Experiment Station, Suakoko
	Ivory Coast: Centre Recherche Zootechnique; SODEPALM (GEB)	Y. Berger, Sheep & Goat Specialist, Bouake P. Lhoste, Directeur, CRZ G. Courau, Directeur, Centre Nationale Ovin E Cesellina, SEDEPALM, Toumodi
	Mali: ILCA Sahel Program; Centre Nacional Recherche Zootechnique	A. Cisse, OMBEVI Dr. Diop, Chief, CNRZ, H. Coulibaly, Deputy Director, Service D'Elevage H. N. Le Houerou, Director, ILCA Sahel Program
	Senegal: Institut Senegalais de Recherche Agricole	Mr. Sauger, Directeur General, IRSA L. N'Diaye, Directeur, de L'Ecole Inter-Etats des Sciences et Medecine Veterinarias

Date	Principal Activity/Destination	Principal Contacts for Project
	Senegal - Continued	A. K. Diallo, Director, Dakar-Hann Veterinary Research Laboratory H. Calvert, Nutritionist, Laboratoire Nationale L'Evevage et de Recherches Veterinaire de Dakar J. P. Denis, Zootecnicien, Laboratoire Nationale L'Evevage et de Recherches Veterinaire de Dakar P. I. Thiongane, Directeur du CRZ de Darha

Origin, Distribution and Types of Hair Sheep in West Africa and the Western Hemisphere

Sheep without wool are referred to as hair, hairy or woolless sheep. Their coat is similar to that of wild sheep, with an outer coat of hair covering a short fine underwool; the length of the coat ranges from 2 to 6 cm. In appearance, the hair coat is similar to that of cattle, accounting for the name Pelibuey which translated is "hair of the ox", for the common breed of hair sheep in Mexico.

Hair sheep are the predominant type of the sheep kept at lower altitudes between latitudes 20° north and south, with a few outside this latitude, for example in Cuba. They are thought to have originated in Asia, but have been widely distributed throughout Africa. They were apparently introduced into Brazil and the West Indies early in the 17th Century, with their presence recorded in Barbados as early as 1657 (Devendra, 1977). Many of them are believed to have been brought to the Americas on slave ships, which would indicate a West African origin. This origin is strongly supported by similarities between present populations of hair sheep in West Africa and in the Western Hemisphere.

The total number of hair sheep is not known, since census data on sheep do not provide a breakdown of numbers of wool and hair types. FAO (1977) statistics indicate more than 88 million sheep in African countries under 20° latitude. In the Americas, hair sheep are numerically most important in northern Brazil where there are estimated to be more than 6

million. In addition, they are present, often as the principal or only sheep, in countries across northern South America, in Central America, southern Mexico, and throughout the Caribbean. They occur also in southern India and in a few other Asian countries. In total, we estimate they represent between 7 and 10% of the world's sheep.

Types and Breeds

I. West Africa

Epstein (1971) identifies two general types of thin-tailed hair sheep in Africa; the small forest type and the taller savanna type.

A. Forest Types

The term West African Dwarf is widely used for the forest or humid zone type, for example by Mason (1969) and Epstein (1971). Epstein accepts the term dwarf on the basis of the relatively small size of these sheep, less than 60 cm. in height at the shoulder. While it is true that these sheep are small, the ones we saw in several West African countries were definitely not achondroplastic as are many West African Dwarf goats.

We recommend that the term dwarf not be used for these sheep. Mason (1969) gives the following synonyms for West African Dwarf: Djallonke, Fouta Djallon, Kirdi, Kirdimi or Lakka, Nigerian Dwarf, Southern, West African Maned. The term Djallonke is used through French West

Africa, and because of its extensive use it would appear to be a good choice as a name for all sheep of this type. If that is not acceptable we feel West African Forest would be preferable to West African Dwarf. In this publication we will use the terms Djallonke or Djallonke type for this kind of sheep.

In general, these sheep are characterized by small size and relatively compact conformation. White, white with varying degrees of black spotting, and black are the most common colors. Reds and browns, either solid or spotted, and the blackbelly pattern are also found in many flocks.

Most rams are horned but some are polled. The typical horn shape is a single curve or crescent. Practically all ewes are polled. Rams typically have a mane and throat ruff of coarse hair which may become quite long in mature individuals.

Wattles (also called throat tags, lappets, toggles, or Appendices colli) occur in a small percentage of rams and ewes. According to Epstein (1971) the condition is inherited as a single dominant gene, presumably autosomal.

The tail is usually relatively short, rarely extending below the hocks.

The populations of Djallonke type sheep we saw in Cameroon, Nigeria, Ivory Coast and Liberia were relatively free of wool, suggesting either that there has not been much crossbreeding with wool sheep, or that wool is quickly eliminated by natural selection in this environment.

Perhaps the most noteworthy characteristic of the Djallonke type sheep in West Africa is that they appear healthy and perform well where the tsetse fly and, hence, trypanosomiasis, are endemic.

B. Savanna Type

The savanna or Sahelian type of hair sheep is found across Africa between the Sahara and the humid, tsetse fly infested areas. There is a gradient in precipitation, from less than 200 mm in the north to 800-1000 mm in the south, but in general the zone occupied by these sheep would be classified as arid. Even in those areas where mean annual precipitation is 600 mm. or more, the dry season may last 6 to 8 months or more, and hence adaptation to arid conditions is a requirement of the livestock of the area. The exceptional leg length of sheep (and goats) of the region is probably an adaptation to browsing the trees and shrubs which characterize much of the area; during the later stages of the dry season each year there is virtually is virtually no other feed available to the animals. In

fact, it is a common practice in the region to cut branches from the trees to feed the livestock for the last several weeks before the annual rains.

Names of breeds of the savanna type sheep vary from country to country. Mason (1969) lists Fulani (and its French equivalents Peul, Peulh, Peul-Peul and Foulbe), West African Long-legged and Guinea Long-legged as general terms, with Bornu, Samburu, Torouke, Uda and Y'ankassa as varietal names. Doutressoulle lists Maure, Peuls and Tuareg as general types of hair sheep, and lists, in addition to most of the names mentioned by Mason, Bali-Bali as a variety name for these sheep in Nigeria. Ibrahim from Niger mentions Balami as a large variety of the Peul type, and Targui as a different breed. In Senegal, Dia describes two main types, the Touabire and Peul-Peul, distinguished primarily on the basis of size, distribution of spotting, and horn shape.

Our observations were not sufficiently extensive to permit us to offer an opinion on the extent to which these names refer to distinct populations, or are simply regional names for the same general type of sheep. There is considerable variation in color and color pattern, within as well as between flocks, and there are two distinct horn types in rams, i.e. those with a single curve, similar to the Djallonke but often closer to the

head, and the spiral type. From first hand observation of flocks of Peul-Peul and Touabire in the same environment, it appears there is considerable overlap between these two breeds in most characteristics.

Characteristics which appear to be common to all groups of savanna type sheep in West Africa and which distinguish them from the Djallonke type include:

1. Much longer legs and on average heavier weights.
2. Longer, more pendulous ears.
3. Longer tail.
4. All rams and many females horned.
5. Most rams do not have a mane and throat ruff.
6. Higher frequency of red and brown colors, both solid and in spots of various sizes.
7. Much higher frequency of wattles.

With regard to intermixture between the two major types of West African sheep, the possibility certainly exists, since many of the Sahelian sheep are marketed in cities in the south, near or on the coast. Though many now go by truck, the traditional practice has been to trail them. Under the circumstances, one might expect a high proportion of Sahelian inheritance in forest zone flocks. The rather pronounced differences between the two types for both simply inherited and quantitative traits is, therefore, surprising. Two possible explanations are

suggested. One is that little intermating occurs, because the trails avoid the villages where the forest zone sheep are kept. This is supported by the observation (Y. Berger, personal communication) that sheep in and around humid zone cities with livestock markets, such as Bouake and Abidjan, show more Sahelian characteristics than village sheep in the same areas. The second explanation is that the lack of trypanotolerance of the Sahelian type of sheep, which makes it difficult to raise the pure type in the forest zone, is sufficiently characteristic of crosses that any Sahelian inheritance is quickly eliminated by natural selection. In a small crossing experiment at the Centre Recherche Zootechnique at Bouake, Ivory Coast, mortality of Sahelian-Djallonke F_1 lambs was appreciably higher than in pure Djalonke lambs (CRZ Rapport Annuel, 1977), though larger numbers would be needed to establish if this is generally true.

Additional information on all types of hair sheep in Africa is presented in the book by Epstein (1971).

II. Western Hemisphere

A. "West African"

The most widespread type of hair sheep in the Western Hemisphere is one for which we will use the general term "West African". Breed names and locations of sheep of this type include the following:

Country	Common Designation	Alternative Terms
Mexico	Pelibuey (Peliguey)	Tabasco
Colombia	Africana	West African
Venezuela	Africana	Rojo Africana
Guyana	West African	
Trinidad and Tobago	West African	
Virgin Islands (U.S. and U.K.)	St. Croix	Virgin Islands White
Brazil	Pelo de Boi	Santa Ines, Morada Nova
Cuba	Rojo Cubano	

Although there are differences among the strains of this type in frequency of certain color genes and in other characteristics, they have many characteristics in common. These include:

1. Relatively small size: mean mature weights of ewes generally 30-35 kg., rams 40-45 kg.
2. Compact conformation (compared to Barbados Blackbelly or Sahelian type.

3. With the possible exception of the St. Croix, mean litter size is less than 1.5, ranging from 1.1 to 1.45. Triplets are rare.
4. Rams and ewes polled.
5. Ears small and carried horizontally.
6. Rams with pronounced mane and throat ruff.
7. Most flocks include animals with various shades of red or brown, white, and with spotting.
8. Most flocks show some evidence of crossing with wool sheep.

From comparison of these sheep with those presently common in West Africa, it appears that the primary source of the Western Hemisphere "West African" sheep was the Djallonke or West African Forest type. The latter have a higher frequency of black and black spotting and a higher frequency of horns, but practically all of the colors found in the Western Hemisphere can be found also among the Djallonke type sheep in West Africa. The Western Hemisphere Sheep are somewhat larger on average than the Djallonke. Assuming this is a genetic difference, it is probably due to crossing with various European breeds such as the Wiltshire Horn, Suffolk, or Mediterrean breeds. It might also be due in part to inclusion of some savanna type sheep in the early importations, which could have occurred via ships coming from such ports as Dakar, Senegal. The two populations could of course have diverged

in the time they have been separated due to either natural or artificial selection, without any outcrossing. Considering all of these factors, it is perhaps surprising that the two types are still as similar as they are.

B. Barbados Blackbelly

A breed that has received considerable notice in recent years, the Barbados Blackbelly, was developed on the island of that name. Its origin is not well known, but apparently sheep of this type have existed on Barbados for a long time (cf. excerpts from chapters by Combs and Patterson).

The blackbelly color pattern, which appears to be simply inherited, is found in present day populations of Djallonke type sheep in West Africa. This observation, and several other characteristics which the breed shares with the "West African" sheep, including ear shape and size and of course the hair coat, indicate a West African origin for the Blackbelly breed. However, the latter has at least two distinctive features, namely a taller stature on average than any of the "West African" populations, and higher prolificacy. The former could have come from inclusion of Sahelian sheep in their ancestry, but several differences between the Blackbelly and the Sahelian breeds argue against that explanation. These include: 1) prolificacy, with the Blackbelly being the most prolific

strain of hair sheep and the Sahelian strains among the least prolific, 2) the absence of the blackbelly pattern in Sahelian sheep, 3) the absence of wattles in the Blackbelly breed. More probable explanations for the distinctive characteristics of the Barbados Blackbelly breed are selection, both natural and artificial; perhaps from a foundation gene pool including West African and prolific European strains.

This breed is now fairly widely distributed throughout the Western Hemisphere, at least in experimental flocks, with pure or high grade Barbados Blackbelly flocks known in Mexico, Venezuela, Guyana, Trinidad-Tobago, Granada, Jamaica and the U.S.A.

C. Somali (or Persian) Blackhead

Unlike most hair sheep found in the Western Hemisphere, this breed originated in Eastern Africa, probably Somalia although they are also found in Ethiopia, Kenya and Tanzania. Their distinguishing characteristics include a fat rump, short tail and an unusual color pattern of genetically dominant black head and neck with a white body. Both sexes are hornless. Mature body weight is approximately 40 kg although considerable variation exists.

Some confusion exists as to origin, as indicated by the alternative name, Persian Blackhead. This confusion is a consequence of the introduction of the breed into South Africa via a ship from the Persian Gulf (Epstein, 1971). The breed is well established in South Africa. Crosses with the British breeds, such as Dorset Horn and Wiltshire Horn, are the basis for new breeds such as the Dorper and Wiltiper.

Blackhead sheep are found in Tobago, Granada, Colombia and Brazil. They have also been recently introduced into Guyana, Venezuela and other Western Hemisphere countries. They tend to be smaller (mature weight, approximately 30 kg) than those in Africa. Twinning is infrequent.

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Hair Sheep - Genetic Resource for Tropical Agriculture

Contrary to initial expectations, experimental activities have been and are being conducted with hair sheep at numerous locations. Numbers of animals, traits observed, years of replication are generally quite limited at any one site, the cumulative value of reports from many sites is considerable. Therefore, a major contribution of this study will be the publication of a general reference document on hair sheep in the Western Hemisphere and Western Africa.

Most chapters for this document have been contributed by the scientists principally responsible for collection and analysis of performance data. This procedure was chosen to bring appropriate recognition to those who had done the original work and had specific experience and expertise with hair sheep. In addition, Bradford and Fitzhugh will develop chapters which compare sheep performance and production environments between different countries and regions and which collate information from individual country chapters.

The chapter outline for the publication, Hair Sheep: A Genetic Resource for Tropical Agriculture, indicates that drafts for 18 chapters have been received. Data have been collected and analyzed for an additional nine chapters; however, first drafts have not been completed. Chapters originally written in Spanish or Portugese are now being translated to English.

Chapter Outline; September, 1979

TITLE: HAIR SHEEP

Genetic Resource for Tropical Agriculture

Edited by G. E. Bradford and H. A. Fitzhugh

Chapter	Topic	Author(s)
1.	Origin, distribution and types of hair sheep in West Africa and the Western Hemisphere [2]	G. Bradford H. Fitzhugh
2.	Color inheritance in hair sheep [3]	M. Valencia
Western Hemisphere		
3.	Reproduction and growth of Pelibuey sheep in Mexico [3]	M. Valencia
4.	Reproduction in Pelibuey sheep, Mexico [2]	A. Gonzalez-R J. de Alba W. C. Foote
5.	Reproduction and growth of hair sheep in an experimental flock in Venezuela [3]	A. Reveron G. Mazgami A. Martinez
6.	Performance of hair sheep and wool x hair sheep crosses in an experimental flock in Venezuela [3]	E. Gonzalez-Jiminez J. Cornbellas
7.	Reproductive efficiency and productivity of hair sheep in commercial flocks of a semi-arid region in Venezuela [2]	C. Gonzalez-Stagnaro
8.	African sheep in Colombia [1]	R. Pastrana-B R. Camacho-D
9.	Performance of hair sheep in Brazil [2]	E. de Oliveira E. de Figueiredo C. Bellaver
10.	Performance of hair sheep in Guyana [3]	P. McKenzie
11.	Sheep production in Tobago with special reference to Blenheim sheep station [2]	R. Rastogi, A. Archibald, M. Keens-Dumas

Western Hemisphere
(con't)

Chapter	Topic	Author(s)
12.	Performance of Barbados Blackbelly and crossbred sheep in an experimental flock in Barbados [2]	H. Patterson
13.	Reproduction and birth weight of Barbados Blackbelly sheep in the Golden Grove flock, Barbados [1]	G. Bradford H. Fitzhugh A. Dowding
14.	Toward a more definitive history of the Barbados Blackbelly sheep [2]	W. Combs
15.	Virgin Islands White Hair Sheep [2]	H. Hupp D. Dellers
16.	Performance of hair sheep and their crosses in Jamaica [3]	V. Little D. Miller J. Muschette

West Africa

17.	Some performance data on sheep in West Africa [2]	A. Dettmars
18.	Djallonke hair sheep in Ivory Coast [1]	Y. Berger
19.	Sedentary sheep in the Sahel and Niger Delta of Central Mali [2]	R. Wilson
20.	Genetic improvement of Djallonke sheep in Senegal [2]	E. Gueye
	Note: There is a possibility of additional contributions from Nigeria, Cameroons and Ghana.	

U.S.

21.	Research with Barbados Blackbelly sheep in North Carolina [1]	L. Goode (& 4 co-authors)
22.	The Barbados Blackbelly sheep in Texas [2]	M. Shelton
23.	Crossbreeding with Barbados sheep for market lamb or wool production [2]	M. Shelton

U.S.
(con't)

Chapter	Topic	Author(s)
24.	The St. Croix sheep in the United States [2]	W. Foote
25.	Barbados Sheep in Mississippi [2]	L. Boyd
26.	Performance of Barbados Blackbelly sheep in California [3]	G. Spurlock

Summary

27.	Comparison of the different breeds and types of hair sheep and potential for increased production [3]	G. Bradford H. Fitzhugh

Appendix: Bibliography on hair sheep

[1] Paper written and first editing completed (4)

[2] Paper received, not yet edited (14)

[3] Contribution promised, not yet completed (9)

Excerpts from selected chapters follow. These excerpts provide a general overview of the current state of knowledge of types , production conditions and performance. These chapters have not, however, been closely edited for analytical errors, consistency of style, format and terminology. This careful editing will be completed for the publication of the book, Hair Sheep.

AFRICAN SHEEP IN COLOMBIA

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The African sheep, also known as "pelona" or "camura", has played an important role in the animal economy of Colombia for more than 300 years; adaptation to hot climates, hardiness and meat quality are some of the outstanding features of this breed. However, there have been few performance records kept and little in the way of selection or other programs to improve these sheep. In the last few years, the Secretaria de Agricultura del Tolima and the Caja Agraria have selected some animals and organized flocks with the purpose of multiplying the sheep and selling animals to local farmers.

Origin and Distribution - Due to the long time they have been in the country and their adaptation, the African sheep are often considered as native to Colombia. Nevertheless, it is commonly accepted that they came from West Africa (probably Ivory Coast, Cameroon, Guinea, Chad, etc.) on ships which brought slaves to the New World.

The port of entry to Colombia probably was the Peninsula de la Guajira, from which they spread through the Departaments of Magdalena, Atlantico, Boliva and Cordoba (all along the Atlantic Coast). They are also found in the Departaments of Cundinamarca, Tolima, Valle and Llanos Orientales, and in the central regions of Colombia. They are an important part of the economy of the Indian people of the Pennisula de la Guajira, with an

estimated 500,000 head of African sheep in the area today. It is also worth noting that the first wool sheep from Spain were also introduced via La Guajira, and substantial crossing among the types has no doubt occurred. However, the characteristics of the African type are more evident.

In Colombia, hair sheep are usually kept in small flocks, grazing the less productive areas of farms. They receive little in the way of special care and get much of their feed from browse and from scraps and by-products on the ranches. On cattle ranches, sheep rather than cattle are often slaughtered to provide meat for the workers. Other uses include maintenance as a source of ready cash, and slaughter of a lamb for special occasions. In the Guajira, flocks are larger, since a large flock is a matter of wealth and prestige for the Indians of the area.

Description of the sheep - The African sheep can be described as having short red hair, the color carying from deep red to light red. Both rams and ewes are polled. The ears are small, and carried horizontally; the absence of hair facilitates tattooing. Males are maned, and in some animals patches of wool are found on the back.

Table 1-1. Reproduction and Lamb Birthweights, "El Palmar"

Trait	Group	No.	$\bar{x}$	s
Litter size		70	1.29	.54
Gestation period (days)	ewes with singles	50	151.7	2.58
	ewes with twins	20	152.0	1.50
Lambing interval (days)	all intervals	31	213.6	36.1
	(excluding 2 over 300 days)	29	205.8	19.8
Birthweight (kg.)	male singles	25	2.8	.50
	female singles	25	2.5	.58
	male twins	13	2.2	.63
	female twins	27	2.2	.48

Table 1-2. Weights and Body Measurements on African and Persian Blackhead Sheep, "La Gaetana", Colombia.

				Weight(kg)		Heart girth(cm)		Height at Wither(cm)		Length (cr	
Breed	Sex	Age(yrs)	No.	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
African	F	2-7	15	36.7	2.9	78.0	3.1	62.9	2.2	65.1	2.0
		1.5	3	33.7	2.5	76.0	1.0	63.7	4.0	63.0	1.7
	M	3	3	48.7	9.9	84.0	5.3	68.7	5.5	73.0	6.1
Persian	F	2-8	11	35.6	2.7	78.8	3.4	60.1	1.7	61.1	3.2
	M	6	1	50	-	87	-	63	-	66	-
		1.5	1	38	-	78	-	63	-	59	-

1 From point of shoulder to pin bone.

REPRODUCTION IN PELIGUEY SHEEP (MEXICO)

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Reproductive performance was measured on Peliguey sheep managed primarily under pasture conditions near Aldama, Tamaulipas, Mexico during 1974 and 1975. There were 40 ewes, 1-5 years of age and older, two mature rams and lambs born during the experimental period involved in the study. The rams were kept with the ewes continuously. The mean age and weight at puberty were 245 days and 22.9 kg. The mean ovulation rate for ewes in which ovulation was observed was 1.0. The mean age at first lambing was 426 days. The following information was based on ewes of all ages. The mean lambing rate was 1.2 lambs per ewe lambing and the overall mean birth weight was 2.5 kg. A great deal of variation occurred in lengths of estrous cycle and the cycles were divided into short (9-13 days), medium (14-20 days) and long (21-41 days). The mean estrous cycle length and frequency of occurrence for each division respectively were 11.0 days and 14.8%, 18.2 days and 62.9%, and 27.3 days and 22.2%.

The mean interval from parturition to first estrus and to conception was 42.9 and 46.6 days, respectively; the mean gestation length was 148.4 days and the mean lambing interval for non-laparotomized ewes was 198.2 days. Seventy nine percent of the ewes demonstrated lambing intervals between 6-7 months.

At 23 days postpartum the mean uterine horn length was 24.1 cm, 83% of the uteri contained debris, ovarian follicles of 3 mm or larger were found in 87.5% of the ewes, 41.7% of the ewes had ovulated with a mean ovulation rate of 1.3, and 8% of the ewes had demonstrated behavioral estrus.

Table 2-1. Reproductive Performance of Peliguey Ewes.

	Number of Observations	Mean	S.E.	Maximum	Minimum
Puberty					
Age (days)	18	245	14.6	376	187
Weight (kg)	10	22.9	.73	25.4	17.8
Ovulation rate [a]	9	1.0	--	1	1
Age at first lambing	24	425.6	16.9	557	319
Lambing rates [b]					
First	30	1.13	--	--	--
Second and later	98	1.22	--	--	--
Overall	128	1.2	--	--	--
Reproductive Interval (days)					
Estrous cycles [c]					
Long cycles	6	37.3	2.4	41	29
Normal cycles	17	18.2	.42	24	16
Short cycles	4	11	.82	13	9
Parturition to first estrous	49	42.9	3.3	125	6
Parturition to conception	25	46.6	3.4	100	16
Gestation length	50	148.4	.39	154	141
Lambing intervals (days)					
All ewes					
First	17	213.5	9.3	296	181
Second and later	50	205.6	2.9	365	166
Overall	67	207.6	4.5	365	166
Non-laparotomized ewes	47	198.2 [d]	2.9	258	166
First	13	198.3	5.1	243	181
Second and later	34	198.2	3.5	258	166
Laparotomized ewes	20	229.8	12.2	365	179
First	4	263 [e]	23.3	296	195
Second and later	16	221.5	13.6	365	179
Mature weight females (kg)					
One week postpartum	55	32.7	.65	43	22.6
Initial weight	38	28.1 [f]	1.2	43.3	13.5
Final weight	38	33.9	.84	48	25

a) Number of C.L. per ewe based on ewes with C.L.; C.L. were observed on 9 of 12 ewe lambs laparotomized.
b) Values given as number of lambs born per ewe lambing.
c) Cycle lengths were divided in long 21 to 41, normal 14 to 20 and short cycles 9 to 13 days.
d) 198.2 vs 229.8 ($p<.01$).
e) 263 vs 221.5 ($p<.10$).
f) 28.1 vs 33.9 ($p<.01$).

Table 2-2. Milk Production of Peliguey Ewes During the First Six Weeks of Lactation

Days of Lactation	Number of Lambs Nursing														
	Singles [2]					Twins					Singles and Twins				
	N	$\bar{x}$ [1]	SE	Max	Min	N	$\bar{x}$	SE	Max	Min	N	$\bar{x}$	SE	Max	Min
6-8	33	508.9	22.2	795	325	5	703	129.5	1207.5	470	38	542.4	26.7	1207.5	321
20-22	25	573.3	32.6	1000	360	4	690	193.7	1265	435	29	589.4	27.4	1265	360
42-44	33	452	25.3	945	242.5	5	509.5	52.4	700	385	38	459.5	23	945	242.5
Mean [2]	91	506	15.8	1000	242.5	14	630.2	72.4	1265	385	105	522.5	17.1	1265	242.5

[1] The weights of milk production are given in grams.

[2] The mean milk production for singles and twins were significantly (p .025) different.

MORADA NOVA OF BRAZIL

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The name given to the red variety of hair sheep is derived from the Municipality of Morada Nova, State of Ceara. Other names which have been used are Deslanado do Nordeste (Northeastern woolless), Deslanado vermelho (red woolless) and Deslanado branco (white woolness). Subsequently, it was decided to use the name Morada Nova for both varieties, red and white. The white Pelo de Boi of Bahia was included with the Santa Ines breed (white variety). This breed may be red, pied, black or white.

Distribution and Number. The woolless sheep inhabit an extensive area which includes practically all the Sertao (drylands) of the northeast. Domingues (1954) recorded the occurrence of woolless sheep in all the northeastern States. It is typical of the Sertao but a few isolated individuals are found away from this area or in the mountains.

Of all the States of Brazil, Ceara seems to be the one in which there is the greatest concentration of woolless sheep, particularly in the Jaguaribe valley and that of its tributary, the Salgado. The Sertao of the lower and middle Jaguaribe had 185,480 head (the largest population of sheep in the State), and the Sertao of the Salgado and Jaguaribe, 144,210 head (Domingues, 1954). These two zones included one third of Ceara's sheep population which numbered 942,180 head in 1954. At present it is 1,134,000,

the largest number of the States of Brazil (Anuario Estatistico do Brasil, 1976).

Environment: The basic environmental factor in the semi-arid zone is the scarcity and poor distribution of rainfall which is concentrated in a single period (3 to 5 months). Rainfall is so irregular as to make averages meaningless; they vary between 150 and 1300 mm. Rainfall is also irregular during the rainy period and from one place to another, coming in the form of heavy cloudbursts.

In the semi-arid zone average yearly temperatures are high, between 23 and 27° C., varying very little from one region to another and with daily and monthly fluctuations of 10°C and 5-10° C, respectively.

Breed Description: (Associacao Brasileira de Criadores de Ovinos, 1977). The weight and body measurements of this breed are shown in Table 3-1.

Table 3-1. Some Weights and Heights of Morada Nova Sheep

	FEMALES			MALES		
		Body Weight (kg)	Wither Height (cm)		Body Weight (kg)	Wither Height (cm)
Age	No	Mean	Mean	No	Mean	Mean
Suckling	36	11.5	49.0	26	12.7	50.7
Milk Teeth	43	23.9	60.0	15	24.4	61.1
2-tooth	19	26.7	60.1	9	25.9	61.2
4-tooth	20	26.8	61.4	4	29.2	64.7
6-tooth	37	29.7	62.0	5	37.4	69.2
Full mouth	74	31.4	62.0	17	38.8	66.8

These figures were established on the basis of measurements on approximately 360 individuals by technicians of the EMBRAPA National Goat Research Centre (CNPC), and are part of the biometric work being carried out by the Centre. Sheep are slaughtered at an age of 18-24 months and a weight of 27-35 kg. Cull ewes and rams weigh about 30 kg.

Reproduction and breeding. Males are put to service for the first time at the age of 12 to 14 months. Ewes lamb for the first time at the age of 14 to 16 months.

Studies under way by CNPC on 21 individuals of this breed at one breeding station gave the following results between 16 February and 17 April 1978: 91.3% births, 4.3% abortions and 4.3% embryonic deaths or non-fertilization, gestation period of 149.0 $\pm$ 1.3 days; 28.6% single, 66.7% double and 4.8% triple births giving a birth rate of 176.1%.

Rams are obtained from neighbouring farms, breeders associations, agricultural fairs or are bred by the owner. The criteria for selection are phenotypic such as coat, girth, length, weight and age. The selection of ewes is less critical.

Crossing is indiscriminate due to lack of organization of farm holdings, whereby animals can be in touch with neighbouring farms due to lack of fences.

(Editorial note: This excerpt was taken from a report by E. A. Pereira de Fiqueiredo. This report was similiar to the not yet completed chapter).

SHEEP PRODUCTION IN TOBAGO WITH SPECIAL REFERENCE TO BLENHEIM SHEEP STATION

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The rearing of sheep by small farmers has been of traditional interest in the Commonwealth Caribbean countries and dates back to the days of colonisation. Guyana and Barbados have relatively large sheep populations. In the Republic of Trinidad and Tobago, sheep number only about 7,000, of which about 5,000 are found in Tobago.

The regional demand for mutton is high and is met by continuous importation from outside the Caribbean. In Trinidad and Tobago, local sheep production satisfies only about 15 per cent of the home market for mutton.

The climate of Tobago is humid-tropical with relative humidity varying from 80 to 85%. In general, the mean daily temperatures range between 25° and 31° C. Temperatures vary significantly between day and night, and the climate is tempered by sea breezes.

There is a major dry season from January to May, and a short dry season (Indian Summer) in October. The mean annual rainfall is 1,700 mm.

History and Description of Sheep in Tobago. Sheep production has been practised in Tobago for well over 100 years. There were no indigenous

sheep in Tobago and the present sheep are descendants of the imported breeds.

As early as 1909, one half-bred West Arican ram and two woolless sheep in lamb to a pure bred West African ram were imported from Barbados. Around 1912, a few Romney Marsh sheep were imported from the U.K. A pure bred Southdown ram was imported from England which died after serving for 12 months and thus leaving his descendants. This gave way to the re-introduction of two West African rams.

Around 1930, 72 ewes and eight rams of Blackhead Persian breed were imported from South Africa into Trinidad for distribution throughout the West Indies, Demerara (now Guyana), and Venezuela. Early in 1931, these sheep were sold to private owners in Trinidad as well as Tobago. The Government Farm in Trinidad kept five ewes and two rams; one of these rams was later sent to the Tobago Government Farm. By 1936, the Blackhead Persian sheep had earned a good reputation for themselves as a meat breed and rams of this breed were being mated with local ewes to produce market lambs of good conformation. By the end of 1948, the Tobago Government Farm had a total of 55 sheep comprising Blackhead Persian and West African types. Around 1950, yet another breed was introduced: the Wiltshire Horn, from Scotland. These sheep did not do well and disappeared soon afterwards.

It is not clear as to when the first importation of Barbados Blackbelly sheep into Tobago occured, by by 1953 the breeding policy of the Tobago

Government Farm was geared towards the gradual establishment of a flock of sheep graded to the Barbados Blackbelly breed and by 1958 there were being maintained three breeds of sheep, viz. Blackhead Persian, West African and Barbados Blackbelly. Sometime in the late 1960's or early 1970's, sheep of Suffolk breed were also introduced into Tobago. Recently, importations of Barbados Blackbelly sheep have been made from Antigua (in 1976) and Barbados (in 1977-78). Thus, the present sheep population in Tobago comprises the above mentioned three pure breeds and creoles which resulted from indiscriminate crossing among the breeds introduced. Of the three pure breeds, Blackhead Persian appears to be the least numerous.

Systems of Production and Management. The majority of sheep in Tobago are reared by small farmers in groups of one to five as a ready source of cash or meat for special occasions. These farmers use the tethering system of management whereby sheep are pegged to a rope about three to five meters long to feed on roadside grazing or on communal pastures. By changing the peg location once or twice daily, free access to a fresh browsing area is provided. Sheep graze about seven hours every day starting around seven o'clock in the morning. Thus, family labour is made use of to manage the sheep. Very little or no concentrates are provided except for household scraps and to guard against death by starvation in cases of an extended dry season.

Apart from a few large flocks (50 to 150 ewes and followers) kept by private estates, the only sheep "Station" in the country is the Government farm at the Blenheim Estate. These larger flocks are reared

under an extensive system whereby sheep are allowed free grazing on partially-improved pastures during the day and are penned during the night for protection against predators and to guard against praedial larceny. Large flock owners may supplement grazing with concentrates, especially during the dry season.

Sheep are provided with varying kinds of housing during the night, usually in the immediate vicinity of the farmer's home. The house may comprise a shed erected at ground level and the shelter may be provided in the form of corrugated iron sheets, wood or even leaves.

Not much is known about the general health status of sheep in Tobago. The gastro-intestinal parasites appear to be the major health problem though, the sheep are free of any major diseases. Other common diseases are pneumonia and footrot.

A very real problem connected with sheep production in Tobago is the practice of wide spread larceny and damage due to dogs. This problem acts as a strong deterrent to any one contemplating raising sheep; thus, it presents a serious barrier for the expansion of the sheep population.

Marketing. Sheep are generally sold 'on the hoof' in close proximity to the point of production, either to neighbours, to butchers for slaughter in Tobago, or to market traders (middlemen) for shipping to Trinidad for slaughter. The Tobago butchers visit the farms regularly to purchase

the sheep which are then slaughtered mainly in their own backyards and rarely at the two Municipal abattoires. The majority of surplus sheep in Tobago are, in fact, shipped live to Trinidad to be slaughtered there.

The selling price of sheep is based on size and visual appraisal of the animal and is often biased in favour of the butcher. The current price of fresh mutton in the Tobago market is about T.T. $7.20 (U.S.$3) per kg.

Table 4-1. Least squares breed means and approximate standard errors for lamb body weights and gain

	Body weigths (kg) at:				Daily gain (g) from	
	Birth		12 wks.		birth to 12 wks	
Breed	No.	Mean	No.	Mean	No.	Mean
Blackbelly	29	3.1 ± 0.1	27	13.8 ± 0.6	27	127 ± 6
Grade Blackbelly	29	2.8 ± 0.1	26	13.8 ± 0.6	26	130 ± 6
West African	31	2.9 ± 0.1	23	14.9 ± 0.7	23	141 ± 7
Blackhead Persian	9	3.0 ± 0.2	9	14.4 ± 1.1	9	136 ±11

Source: Rastogi et al., 1979.

Table 4-2. Mature body weight by breed of ewe and month of weighing[a]

		Mean body weight (kg)					
		Dec., 1978		March, 1979		Overall	
	No.	Mean	Range	Mean	Range	Mean	Range
Barbados Blackbelly	98	31.9	24-42	32.7	28-45	32.3	24-45
West African	66	30.3	11-45	28.9	18-41	29.6	11-45
Blackhead Persian	29	28.5	20-36	26.8	18-36	27.6	18-36
Mixed grades	49	32.2	22-45	29.3	20-38	30.7	20-45

a: Ewes of different breeds were of comparable average age of three years.

Table 4-3. Ewe Reproductive Performance by Breed

Item	1976				1977				Overall			
	BB	WA	BP	Mixed	BB	WA	BP	Mixed	BB	WA	BP	Mixed
No. ewes lambing	50	105	24	75	18	25	14	28	68	130	38	103
Total lambs born/ewe	1.28	1.25	1.08	1.21	1.56	1.28	1.14	1.32	1.35	1.26	1.10	1.24
Total lambs born by type birth %												
Single	72.0	73.3	91.7	65.9	55.6	72.0	85.7	67.9	67.6	73.8	89.5	76.7
Twins	28.0	26.7	8.3	30.8	33.3	28.0	14.3	32.1	29.4	26.2	10.5	22.3
Triplets	-	-	-	3.3	11.1	-	-	-	3.0	-	-	1.0

BB - Barbados Blackbelly WA - West African BP - Blackhead Persian

PERFORMANCE OF BARBADOS BLACKBELLY AND CROSS-BRED SHEEP IN AN EXPERIMENTAL FLOCK IN BARBADOS

Harold C. Patterson

Ministry of Agriculture, Barbados

Sheep in Barbados have traditionally been in the hands of very small householders or farmers as a source of ready cash. They are usually kepy on land where no other agricultural enterprise occurs or seems possible. The highest distributions are in the drier districts in the North, East and South of the Island especially near the coast. The parishes of St. Peter, St. Lucy, St. Andrew, St. Philip and Christ Church are the areas of highest concentration of sheep.

The 1971 census of agriculture gave a population size of 27,064 sheep from 9,728 farmers. Twenty-two thousand and twenty-nine head of sheep (81.6 percent), were owned by 8,526 farmers (87.6 percent). This group of sheep keepers possessed 0.45 ha of land or less and 5,841 of them had less than 0.05 ha of land were classified as 'Landless'.

The majority of sheep in the Island are therefore owned by persons whose major means of securing pasturage and roughage is by grazing their sheep on open lots, parks, other people's pastures or along roadsides. In these cases some supplementary feeding is provided. Among this subsection are many part-time farmers whose sheep production activities are not motivated by profit but rather regard sheep as a compulsory savings or "piggy bank".

At present Blackbelly Sheep are never marketed through supermarkets and Hotels. The most common system of marketing is through local butchers or kept for one's own use in the home.

Historical Review. The first historical reference to the presence of Blackbelly Sheep in Barbados appears to be in Ligon's History of Barbados, 1657. In this work, reference is made to an unidentified wool breed, which seemed not to have been very well adapted to the environment and as a pure breed seemed quite unsuitable for use in any serious sheep production system. This wool breed however, appeared to be quite prolific - "as the ewes bore always two lambs". Obvious reference to Blackbelly Sheep was made when Ligon states: 'other sheep we have there, which were brought from Guinny and Binny and those have hair growing on them instead of wool and are more like goats than sheep, yet their flesh tastes more like mutton than the other."

Barbados Blackbelly Sheep is thought to be of African origin and is believed to have been brought to Barbados during the slave trade. The reference is Ligon's history to Guinny and Binny is thought to be in fact Guinea (either Equitorial Guinea or Guinea Bisau), and Benin - two West African countries.

It has also been postulated that because of the preference of butchers for Blackbelly Sheep and their better suitability to the tropics, than the wooly sheep, there could have been, over the years, some natural as well as intended selection towards the hardier hair type sheep and their crosses; with the resulting establishment of the fairly uniform type

of sheep we know today as Barbados Blackbelly Sheep.

General Breed Characteristics. Barbados Blackbelly Sheep are covered with hair, which ranges in colour from light brown to dark reddish brown. They have black bellies (under surfaces) with black points on the face and legs. The face sometimes has two whitish lines running down from the forehead to the nose.

The rump is quite steep from the hips to the forehead and the tail is set very low. The legs are generally quite well set and the sheep are active and lively. There is a slight tendancy to Roman nose, especially in the ram.

By comparison to more recognized mutton types, Blackbelly Sheep are less 'squatty' and slower growing. Weaning weights and subsequent growth rates are usually also lower than for true mutton types. However, well fed, well grown Blackbelly Sheep at maturity could weigh between 150-200 pounds (45-90 kg) for rams and 90-130 pounds (40-59 kg) for ewes. Typical farmers' sheep in Barbados would fall towards the lower part of these weight ranges.

Table 5-1. Weaning Weight by Sex and Birth Type

		Mean (lb)	S.D	No: of OBS
Weaning weight	Male	21.3	.41	231
No: in litter	1	26.5	1.28	34
No: in litter	2	21.3	.54	109
No: in litter	3	19.5	.59	82
No: in litter	4	17.8	1.25	6
Weaning weight	Female	20.7	.48	217
No: in litter	1	25.5	.89	45
No: in litter	2	20.6	.54	105
No: in litter	3	17.8	.61	62
No: in litter	4	15.7	.63	4

Table 5-2. Number Lambs Weaned Per Ewe Lambing

No: Weaned/ewe	0	1	2	3	4
No. of ewes	38	117	139	25	2
% of ewes	11.8	36.4	43.3	7.8	0.6

Table 5-3. Lamb Survival by Sex and Birth Type

	No. Born		No. Weaned					
			M		F		Both Sexes	
Litter Size	M	F	No:	%	No.	%	No.	%
1	44	44	38	86.4	34	77.3	72	81.8
2	151	143	123	81.5	123	86.0	246	83.7
3	98	102	64	65.3	73	71.6	137	68.5
4	18	12	13	72.2	10	83.3	23	76.7
TOTAL	311	301	238	76.5	240	79.7	478	78.1

Table 5-4. Some Performance Traits in Barbados Blackbelly Sheep

Production Traits	Mean (Days)	S.D.	No. of Observations
Age at First Breeding	429.7	31.9	37
Age at First Lambing	581.0	32.6	37
Lambing Interval	256.8	3.0	414

REPRODUCTION AND BIRTH WEIGHT OF BARBADOS BLACKBELLY SHEEP IN THE GOLDEN GROVE FLOCK, BARBADOS

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The Golden Grove Estate flock of Barbados Blackbelly sheep is a privately owned flock in Barbados. The sheep are maintained on pastures during the day, and confined to a corral during the night. In addition to forage species typical of the island, the sheep also graze harvested vegetable crop fields. Level of management and condition of the sheep are good.

More than 90% of the ewes in the flock, are of typically Blackbelly phenotype. A small number carry 25% or less of inheritance from the Devon longwool breed, and a few carry a small percentage of Wiltshire Horn ancestry.

Lambing records on the flock were available for the period March, 1975 to May, 1978, providing information on litter size and lambing interval. The 554 lambings recorded were from a total of 303 different ewes. Many of the ewes were past first lambing when recording was initiated, and age and litter size at first lambing were positively known for only 22 ewes.

Birth weights were recorded on 279 lambs. Perinatal mortalities were recorded for all 554 lambings.

Rams were with the ewes continuously, except for two periods of approximately 3 months each, i.e. March-May, 1977 and July-December, 1977. A small number of matings occurred during this period, probably by unweaned ram lambs, but the numbers of lambings from August to October, 1977 and from December, 1977 to February, 1978 were less than 10% than in the immediately preceding and following periods. Data on lambing interval were therefore analyzed in two groups: all data, and data for intervals completed on or before July 31, 1977.

Litter Size. Mean number born per ewe lambing is summarized in Table 1. Means and distributions are given for those known to be first lambings, those known to be second and later lambings, and for all lambings. Crossbred ewes, including those recorded as having some wool, had only slightly lower litter size (1.75) than the pure Blackbelly ewes (1.86). The small number of ewes known to be lambing for the first time were appreciably lower (1.45).

Table 6-1. Litter Size at Birth

Group	Lambing Sequence	No. Ewes	No. Lambings	No. ewes with 1	2	3	4	5	Mean	Std. Dev.
Blackbelly	First	20	20	12	7	1	-	-	1.45	.60
	Second & Later	125	216	75	94	43	4	-	1.89	.78
	All	273	489	170	229	78	10	2	1.86	.78
	% of Total			34.8	46.9	15.8	2.1	0.4		
Crossbred[1]	All	30	65	24	33	8	-	-	1.75	.66

Table 6-2. Mean Litter Size by Month or Season of Lambing

Month	No. Lambings	Mean Litter Size	Seasonal Mean	Mating Dates
March	69	1.81		
April	45	1.80	1.83	Oct-Dec.
May	76	1.86		
June	41	1.73		
July	29	1.90	1.73	Jan-Mar.
August	24	1.54		
September	17	2.11		
October	50	2.06	1.96	Apr-June
November	110	1.89		
December	31	1.84		
January	38	1.76	1.82	July-Oct.
February	24	1.88		

The lowest seasonal litter size followed matings during the dry season (January-March), and the highest followed matings during the earlier part of the wet season and probably represents a flushing effect. There is no evidence of a lowered litter size following "out-of-season" matings, which is characteristic of seasonal breeds including those with a relatively long breeding season (Dun et al. 1964; Land, 1977).

Age at First Lambing. The mean age at first lambing for 22 ewes was 467 days, with a range from 329 to 730. Excluding the ewe which lambed at 730 days, the mean was 454 and the maximum 519 days. The modal age class was 470-500 days, or 16 months.

Lambing Dates and Lambing Interval. Lambings occurred in every month during which records were kept. There were two three-month periods when there were few lambings, resulting from a deliberate attempt to group lambings as explained earlier.

The mean lambing interval for all ewes was 253.3 days. The 151 intervals completed before July 31, 1977 (Group I) was 244.0 days with a standard deviation of 76.0, and a range from 158 to 520 days. For the 100 intervals completed after July 31, 1977 (Group II), the mean was 267.3 days, reflecting an increase as expected on the basis of the management practised.

The interval for pure Blackbelly ewes and for those carrying some inheritance of other breeds was compared, and was virtually identical for the two groups. Therefore, the data presented are for all ewes in the flock.

Lambing intervals following birth of 1, 2, 3 and 4 lambs are shown in Table 6-3. Intervals exceeding 365 days were excluded. In both groups of ewes, the interval following birth of twins is longer than that following birth of singles, the difference being significant (p .05) in the first group. This might be expected if length of postpartum anestrus is positively correlated with level of lactation stress. The surprising result is that ewes with triplets (and the few with quadruplets) had shorter intervals than ewes with twins and in fact intervals of similar length to those with singles, in both groups.

Table 6-3. Lambing Interval (days) Following the Birth of Different Numbers of Lambs

Group	n	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s	n	$\bar{x}$	s
Ewes completing intervals before 8/1/77	50	212.8	36.7	62	233.6	46.2	19	215.8	35.8	4	206.2	36.5
Ewes completing intervals after 8/1/77	28	237.2	52.6	36	255.6	53.7	26	243.5	49.0			

Birth weights. Birth weights were recorded on a total of 279 lambs from this flock. The data are summarized in Table 6-4. All lambs were included, since all were sired by Blackbelly rams and hence all were at least seven-eighths Blackbelly.

Table 6-4. Mean individual birth weights (kg) of Blackbelly lambs by sex and litter size.

Size	Males			Females			$\frac{\bar{x}_M + \bar{x}_F}{2}$	$\bar{x}$ Multiples/ $\bar{x}$ Singles
	n	$\bar{x}$	s	n	$\bar{x}$	s		
1	20	3.72	.91	29	3.32	.76	3.52	
2	89	2.89	.37	59	2.86	.31	2.88	0.82
3	31	2.94	.49	39	2.58	.59	2.76	0.78
4	4	2.61	.39	8	2.47	.23	2.54	0.72

Unfortunately, there were no recorded mature weights of ewes in this flock with which to compare these birth weights. We estimated the mean mature weight to be between 40 and 45 Kg.

Lamb Survival. Lambs born dead or lost during the first few weeks after birth were recorded in this flock. The data thus provide a minumum estimate of preweaning mortality, but should provide an unbiased estimate of relative mortality of males and females and of lambs in different litter sizes. These data are summarized in Table 6-5.

Table 6-5. Lamb Mortality by Sex and Litter Size

No. Born in Litter	Males			Females			Total		
	Born	Died	%	Born	Died	%	Born	Died	%
1	114	5	4.4	80	4	5.0	194	9	4.
2	270	19	7.0	254	15	5.9	524	34	6.
3	123	26	21.1	135	26	19.2	258	52	20.
4	18	6	33.3	22	7	31.8	40	13	32.
5	6	3	50.0	4	1	25.0	10	4	40.
	531	59	11.2	495	53	10.7	1026	112	10.

Mortality was very similar in the two sexes at all litter sizes. Mortality was low in both twins and singles, and although mortality increased with litter size, the number of viable lambs in litters of 3, 4 and 5 confirm the potential advantages of high prolificacy when management is good.

TOWARD A MORE DEFINITIVE HISTORY OF THE BARBADOS BLACKBELLY SHEEP

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Barbados Blackbelly sheep have aroused special interest among sheep breeders because of their rare combination of adaptation to tropical environments and their high reproductive efficiency which includes an average of two or more lambs per litter and average lambing intervals of 8 to 9 months.

Several writers have speculated on the origin of the breed which has widely been accepted as African. While there can be no doubt that the Blackbelly has African ancestry, there is compelling historical evidence that the Barbados Blackbelly originated and has evolved as a breed on the island of Barbados following colonization by the English in 1627 as the result of fortuitous factors which may not have existed in this particular combination in any other of the early European colonies in the Americas. These factors were:

1. The introduction with the slave trade of tropically adapted hair sheep from the "slave coast" of West Africa. There is, of course, good reason to believe that African sheep were taken independently to other colonies in the West Indies and Latin America and, in combination with other stocks founded various local types and breeds possibly including wooled criollo breeds.

2. The concurrent introduction to Barbados of a poorly adapted, but prolific, wooled sheep of as yet undiscovered origin. This probable parent may, more than any other factor, set the Barbados Blackbelly history apart genetically from other breeds in the region. The most probable country of origin may be 17th Century Holland or England as each had active colonization and commerce in the region.
3. An environment including the heat, humidity and parasites common to the region to which recently introduced wooled sheep were not well adapted but, more particularly, including small burrs in the pastures which cling to and penetrate the fleece. These so afflicted the wooled sheep as to have placed constant selective pressure against wooliness thus preventing the evolving gene complex of the Blackbelly from being overwhelmed by wooled breeds imported from time to time to "improve" the mutton characteristics of the Barbados sheep. But, selection against wooliness would not have precluded introgression of other genes, such as for prolificacy or polledness into the Blackbelly.
4. Sugar cane culture which rapidly forced livestock into the roadsides and unimproved "rab" lands where burrs abound and into a systems of management which provided the opportunity for a measure of control of matings and for artificial selection

The evidence reviewed supports the view that the Barbados Blackbelly and probably other local breeds of the region originated locally from African hairy sheep and/or European wooled breeds. In the case of the Barbados

Blackbelly, Ligon (1657) clearly establishes that in the first quarter century of colonization, the parent stocks necessary for the evolution of a highly prolific tropically adapted breed had been established in Barbados. Speculation that the Barbados Blackbelly might have been introduced from elsewhere is not consistent with available historical or genetic evidence.

Thus, it is no more appropriate to attribute the origin of the Barbados Blackbelly to West Africa than to attribute the origin of a breed such as the Colombia to England or to France just because the parent stocks were the Lincoln and the Rambouillet.

Neither is it appropriate to include all hairy sheep of the region under the name of "West Indian" Blackbelly or Hair Sheep. The hairy breeds reportedly differ in performance characteristics and probably originated independently from crosses of African sheep with various European wooled breeds. For this reason caution should be taken in accepting performance of other hairy sheep in the region as being representative of Barbados Blackbelly. There is an urgent need to characterize the Barbados Blackbelly more fully from the performance of stocks on the island.

However, the definitive history of the Barbados Blackbelly is yet to be written. The prolific, wooled ancestral breed is not yet identified. Few wooled breeds are known to be so prolific as to "bear always two Lambs" and to produce a litter size of two lambs or more among crosses with an African breed which rarely twinned.

The drawing by Ligon of long-tailed wooled sheep would seem to disqualify the highly prolific Finnish Landrace, Romanov and other Northern European Short Tail breeds. Sufficiently prolific British breeds do not come readily to mind though the possible effects of selection after the original crossing must be considered. The Dutch Texel seems a possible candidate. The woolless legs of the Texel seem consistent with Ligon's drawing, however the modern Texel was derived by crossing the British Lincoln and Leicester with the "Old Texel", 1845-1859 (Behrens et al., 1969). Knowledge of the appearance and prolificacy of the Old Texel would be helpful.

Historical clues may lay in the national archives of The Netherlands, England or other countries. The possibility must also be held open that breed introductions may have been accidental and unrecorded. It is the aim of this paper to provide a documented framework within which to more effectively pursue the true history of the Barbados Blackbelly and other sheep breeds of the West Indies and American tropics.

VIRGIN ISLANDS WHITE HAIR SHEEP

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In the Virgin Islands the sheep flocks are usually small, and serve as a source of supplemental income with the family members caring for the flock. There is a strong preference for mutton by the native population. There has been a slight increase in sheep numbers in the Virgin Islands. In the 1975 Agricultural Census there were 3122 head of sheep on 64 farms, up from 1970 of 2185 head on 31 farms which is about the same for 1960 (2152 head on 93 farms). The majority of the flocks have 100 head or less. Small livestock is still a significant source of protein.

Management. Tethering and extensive management systems are the level of local sheep management. Sheep and goats are often run together as one flock. Sheep either range freely or graze fenced pastures. There is minimal rotational grazing. Pastures are old sugarcane fields that are marginally managed. Rams and ewes are maintained on a low plane of nutrition.

The flocks are managed as a unit with little or no division into contemporary groups. The flocks are corraled at night since dog and pilferage problems are very serious. At lambing, ewes and young lambs are corraled for 1-2 weeks until lambs are strong enough to go to the pasture. Rams remain with the flock continuously except at lambing time.

Rams are exchanged with other flocks periodically. Most female replacements are raised. Some of the ram lambs are usually castrated at 2-4 months of age. Lambs are wormed at 2-4 months and sometimes again at 6-8 months. Mature animals are usually wormed once or twice a year.

Marketing. Sales of live animals are private. The producers deal directly with individuals or restaurants. Occasionally when the supply exceeds the private demand the excess animals are sold to the local meat markets at a reduced price. A common marketing weight is about 60 pounds.

Origin. The origin of the Virgin Islands White Hair Sheep is not clear. These sheep probably originated from West Africa due to their similarity to other sheep in the Caribbean area. It has also been suggested that the Wiltshire Horn may have been imported and crossed on the native creole sheep.

Description. The White Hair Sheep is a small breed with fairly good mutton characteristics. Both sexes are polled. The "pure" sheep have a white head and body, light short hair which is longer over the back and rump, and pink skin with occasional dark spots. White Hair type occasionally have some wool on the back quarters. Offspring with a solid tan, or brown, or black, or brown and black spots occur. Medium size ears are carried out and forward. The tail hangs down to the hocks. The tarsus of the eye is black with dark eyelashes. The iris of the eye is amber. The legs are squarely set and clear. The feet are of ample size with light gray hooves. Mature rams have a very pronounced mane and throat ruff.

Table 8-1. Weight and Measurements of the Virgin White Hair Sheep[a]

Classification[b]	Weight[c]			Wither Weight[c]			Heart Girth[c]			Body Length[c]			Sex Ratio[d]
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	
PB Lambs	78	16.6	4.7	70	16.7	2.6	70	12.2	1.7	70	12.2	2.0	42:36
XB Lambs	36	16.4	4.1	31	16.8	2.5	31	16.9	1.7	31	11.7	1.8	19:17
PB Yearlings	16	48.6	6.3	16	25.6	3.8	16	23.2	3.8	16	15.9	1.7	13:3
XB Yearlings	10	48.9	6.8	10	25.4	14	10	22.8	1.6	10	15.4	1.1	8:2
PB Ewes	63	78.9	16.9	63	30.1	2.5	63	25.3	2.9	63	17.1	1.5	
XB Ewes	71	76.7	12.5	71	29.8	4.6	71	24.9	1.2	71	16.7	2.0	
PB Rams	2	100.0	25.5	2	31.5	3.5	2	27.8	1.8	2	18.3	0.3	

a. Data collected from 2 flocks on St. Croix and one flock on St. Thomas between January 24 and May 1, 1979.

b. PB = Purebred; XB = Crossbred; Lambs = less than 4 months of age; Yearling = 6-12 months of age; Ewes and rams = older than 14 months of age.

c. N = Number, $\bar{X}$ = average, SD = Standard Deviation; Weight in pounds, Length in inches.

d. Sex Ratio = Females : Males at the weigh date.

Fertility. The shepherd's lambing records were used to determine the fertility of the sheep (Table 8-2). The sex ration at birth could not be determined from these records. Lamb death loss was classified as still birth (SB) if they were born dead and as other causes (OC) if they kied between birth and four months. The low lamb crop and high death loss are due to worms, the poor pasture conditions and dogs. Ewes are reported to have their first lamb at 12-14 months of age and at 6 month intervals thereafter.

Table 8-2. Fertility of the Virgin Islands White Hair Sheep

Lambing Season	Ewes	Lambs Born	Lamb Death	Lamb Crop	
				Birth	4 Months
Jan. 28 - March 28, 1978	7	15	2 SB	2.1	1.9
Aug. 13 - Dec. 31, 1978	12	20	1 OC	1.7	1.6
Feb. 24 - April 15, 1979	54	78	5 SB 5 OC	1.4	1.3
Total	73	113		1.55	

SB = Still Birth OC = Death due to other causes

SOME PERFORMANCE DATA ON SHEEP IN WEST AFRICA

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West Africa covers the area South of the Sahara from the Atlantic Ocean to about a straight North-South line from Lake Chad. It is geographically located approximately between 4° and 16° N of the Equator and stretches from 16° W to 14° E longitude including quite a number of countries (Figure 1). These are from West to East Senegal, Gambia, Guinea-Bissau, and the West of the Cameroons.

Among the coastal countries Nigheria is the largest covering 960,000 km^2 of which only 1/5 belongs to the humid tropics, while 4/5 are Savannah. The humid tropics are characterized by a long rainy season from March to October with a short dry spell in August, followed by the dry season also interrupted by some rains during December or January. Annual rainfall ranges from 1000 to 3000 mm. Temperatures vary very little, they range between 25 and 35° throughout the year. In this zone is much natural unimproved pasture, forage and bush, but the area is infested with tsetse flies, the carriers of trypanosomes. About 90% of the cattle and 80% of the small ruminants are kept in the arid zones. Problems with water and feed during the long dry season in the Northern regions have not been solved, so that nomads own and herd the animals migrating South when these commodities are scarce, and returning North when the rains arrive.

Comparatively few animals are raised in the South of the country in spite of more rain there with consequent better supply of forage, availability of industrial by-products and large centers of consumers. Zebu cattle and hair sheep are the most widely spread breeds in the arid zone, while in the humid South we find what is referred to as dwarf breeds, which are in general more tolerant towards the tsetse fly. Among cattle these are the Muturu, Ndama and Keteku and among the small ruminants the West African Dwarf sheep and goats.

Sheep of Nigeria. Sheep are an important source of meat (mutton) in Nigeria and mutton is the main reason these animals are kept. Other products from sheep (hides, wool, milk) are insignificant. There are about 8 million sheep in Nigeria (Oyenuga, 1974) and on the average 100 people share 10 sheep. About 18% of all livestock are sheep (Igoche, 1974). Average harvest from these has been estimated as 20 kg (Oyenuga, 1974), while total yields from 7.5 million sheep were given with 86,000 tons (UN, 1975) which would amount to less than the above figure. Considering the great shortage of animal protein in the present diet of Nigerians there is not only a need to increase livestock production in general but especially sheep production because sheep have much in their favor in countries such as Nigeria due to their self-sufficiency, extensive management, and utilization of cheap and readily available feeds. They do not need much shelter, thus require low investment. African sheep are non-seasonal and reproduce throughout the year because day length does not fluctuate much and temperatures vary little so close to the equator.

There are three major breeds of sheep in Nigeria: The Uda and Yankasa, two hair sheep in the North (and a small population of Balami in a special niche of Northeast Nigeria), while all sheep in the humid South are called West African Dwarf, even though they may vary to some extent from location to location.

The West African Dwarf Sheep. Only a few large flocks of sheep are maintained at farms of agricultural ministries and universities; but the majority is owned in small numbers by individuals in villages and towns. From a recent survey of two villages near Ibadan (Matthewman, 1977) it emerged that about 2-3 sheep belong to a household besides 3-4 goats and 5-8 chickens. These sheep are allowed to roam freely.

They feed on natural forage and scavenge scraps and garbage. The ewes breed randomly; there are no records available. The village flocks had a 115% lambing rate, and breeding efficiency was estimated with 77%, while losses were only 15% (Matthewman, 1977). This is a remarkable performance. Observations in these two villages indicated further that 90% of male lambs were sold to local markets at about weaning age and about 40% of young females also, so that nearly 2/3 of young stock was sold for cash, in addition to 1/5 of the adult animals. This left only a small proportion of mutton for home consumption; it was estimated as 5% of total offtake. Yet this meat is not consumed on a regular basis, but rather for ceremonial purposes (birth, death and other traditional or religious occasions). Management, feeding practices, health care, shelter were far from any standard.

Ewe Productivity. Fully grown ewes of the West African Dwarf sheep stand about 58 cm high (at withers), are 55 cm long and measure a heart girth of 65.5 cm in open females as compared to fully grown rams which show the same length but have a height of 63 cm and a 86.5 cm circumference.

Since there has been no culling or selection in the flock variation for any of the reproductive traits was large. Breeding efficiency measured as number of ewes lambing out of those exposed was 77.5% from a recent study, a figure similar to the estimate of 77% for village sheep.

West African Dwarf ewes are early maturing. Even though it was found that their age at first lambing was on the average 20½ months with a range from 8 to 72, about 37% of them had their first lamb when younger than one year and 66% when below 15 months of age. These values were for all ewes available from 1971-73 while a different group of the same flock showed less variation, obviously somewhat selected for a particular study. Age at first lambing, lambing percent, lambing interval describing the ewes' productivity are summarized in Table 9-1.

Table 9-1. Ewe Productivity of West African Dwarf Sheep at the University of Ibadan

Mean	Range	Reference
Age at first lambing (months)		
-	11 - 14	Hill, 1960
14.1	10.3 - 23.1	Orji *et al.*, 1975
20.5	8 - 72	Dettmers *et al.*, 1976 a
Lambing percentage		
120.0	-	Hill, 1960
140.0	-	Orji *et al.*, 1975
145.6	121.4 - 200.0	Dettmers *et al.*, 1976 a
Lambing interval (days)		
240	-	Hill, 1957
234	151 - 571	Orji *et al.*, 1975
248	203 - 277 *	Dettmers *et al.*, 1976 a

* Range between means for parity.

As ewes are non-seasonal they lamb on the average three times in two years with lambing intervals between 234 and 248 days (Table 1). Average interval was 277 days between first and second lambing; it decreased as parity advanced and ewes got older. Lambing percent was 121% at first lambing and increased to nearly 190% at fourth. 146% was the record of an unselected flock comparing very well with the prolificacy of other breeds in the world.

West African ewes produce a high proportion of multiple births, the highest reported for any Nigerian sheep, with 55% born twins and 8% triplets.

Occurrence of multiple births increased from about 1/3 of lambs born with first lambings to 2/3 when ewes lambed for the fourth time. The twinning rate of 63% in the University of Ibadan flock was equal to the performance of dwarf sheep at Nkwele, Southeast Nigeria and compared well to a range of 45-64% reported for a flock at Onitsha. The low figure of 21 and 20% twins in the Ibadan flock was confirmed with 20.6% twins and 3.0% triplets a year later and with only 16% in 1969.

Lamb Performance. Birth weights of West African Dwarf lambs rarely exceed 2 kg. Higher birth weights of 2.5 kg were reported for West African Dwarf lambs for the University of Ife flock. Male lambs weighed a trifle more than females, singles and twins. Only male triplets weighed 250 g (P 0.05) more at birth than their female counterparts. There was a slight increase in birth weight with parity of dam.

Survival and growth of the lamb depend much on provision with milk by the dam and on feed and management later on. There is an interesting study on milk production of ewes in relation to preweaning growth of lambs. Three sets of ewes were each supplied with 75%, 100% and 125% standard energy ration during the later part of pregnancy and lactation. Milk-yield of the ewes differed, and so did birthweights of their lambs and subsequent gains (Table 9-2).

Table 9-2. Milk yield (10 weeks) and milk composition of West African Dwarf Ewes and Weight and Daily Gain of Their Lambs.

Variable	A*	B	C
Number of ewes	6	6	6
Milk yield (g)/day	321	408	533
Peak yield (g)	481	697	670
Total 10 week yield (kg)	159	238	251
Birth weight of lambs (kg)	1.18	1.78	1.82
Daily gain (g), only suckled	48	57	66
Daily gain (g), suckled+creep	86	93	83

*) A, B, C = groups of ewes fed 75%, 100%, 125% energy.

Growth. Live weights of lambs and their daily gain before and after "weaning" are shown in Table 9-3 for sheep of the UI flock during different periods.

Table 9-3. Live weights (kg) at different ages (months) and pre and postweaning daily gain (ADG,g) of West African Dwarf.

Age, Mo.	No.	Weight	ADG	No.	Weight	ADG
1	28	5.01	-	-	-	-
2	24	6.60		205	5.7	-
3	29	8.75	85	178	8.2	50
6	105	11.3	-	139	11.7	-
9	94	14.7	-	117	14.6	-
12	81	16.8	-	76	16.8	-
15	79	20.4	-	70	18.2	-
18	48	23.3	-	63	19.8	-
24	45	28.4	31	47	24.1	25
36	53	27.2	-	22	25.4	-
48	30	30.3	-	-	-	-
60	24	30.1	-	-	-	-
72	12	30.8	5	-	-	-

Table 9-4. Retail cuts (kg) for two groups of West African Dwarf ewes.

Variable	Mean	S.D.	Percent	Mean	%
Age (months)	43.2	22.1		35.4	
Yield (%)	42.5	4.1		44.0	
Leg	3.0	0.11	35.7	3.0	32.2
Shoulder	1.7	0.40	20.3	1.8	19.6
Rack	1.4	0.32	16.7	1.3	14.1
Loin (+ flanks)	0.9	0.21	10.7	1.0	10.3
Shanks (+ breast)	0.8	0.21	9.5	0.9	9.9
Neck	0.6	0.12	7.2	0.6	6.5

Table 9-5. Carcass merit of young West African Dwarf Sheep

Variable	Ewes			Rams		
Number	8			13		
Age (months)	13			15		
Live weight (kg)	13.3			15.7		
Cold weight (kg)	6.5			6.2		
Yield (%)	44.1			39.9		
Composition of cuts, %	M*)	B	F	M	B	F
Leg	73.3	20.2	6.5	71.7	22.8	5.5
Shoulder	69.1	22.1	8.8	68.5	23.8	7.7
Rack	65.8	30.5	3.7	57.9	35.4	6.7
Loin (+ flanks)	68.7	19.1	12.2	67.5	24.3	8.2
Shanks (+ breast)	58.2	31.4	10.4	61.7	31.7	6.6
Neck	66.8	31.1	2.1	64.5	30.8	4.7

*) M = Muscle, B = Bone, F = Fat

Sheep of the Arid Zone. In Nigeria there are two distinct "Northern" breeds of sheep, the Uda (Ouda) and the Yankasa. They are larger and long-legged hair sheep with strong legs since they are herded separately or together with cattle by nomads. The Uda is a sheep with the front half of the body black and the hind part white. The Yankasa is predominantly white (also called the White Fulani sheep) with black spectacles. Both belong to the West African Long-legged sheep. Their birth weights are given with 3.5 kg and one year weights with 25-29 kg in contrast to 17 kg for the West African Dwarf.

Table 9-6. Ewe performance of purebred Yankasa and Uda sheep and their crosses with Merino at the Shika Station (compiled from Ferguson, 1964) for 1959, 1960, 1961.

Breed or Cross	Y	U	MxY	MxU
Number ewes	70	56	113	47
Lambings	102	71	147	64
Lamb/ewe ratio	1.46	1.26	1.30	1.36
Lambing rate %	183	145	153	155
Lambs born S	76	61	121	55
T	52	20	52	18
Twinning rate %	40.7	24.7	30.1	24.7
Male	81	33	81	29
Female	42	42	90	44
Dead	5	6	2	0
Mortality %	3.9	7.4	1.2	0
Lambing interval days	236	270	284	273

DJALLONKE HAIR SHEEP IN IVORY COAST

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The total number of sheep in Ivory Coast has been estimated as 720,000 head. Most of them are of the Djallonke breed, also called Guinea Sheep or Dwarf West African. This breed of two different types can be found from Senegal to Angola all along the African Coast. The taller type is rather found in the drier countries of the north. In this study we will only be concerned with the smaller type, better adapted to the tropical climate. The Research Center of Bouake has been working on the Djalonke hair sheep since 1975. After a three year period of zootechnical knowledge of the breed, the Research Center is now working on improving the performances of the breed by means of management, nutrition, and selection.

Description of the breed. The Djallonke sheep is a wooless breed. The color is generally piebald black and white with a white dominance, although completely white or completely black are not an exception. A few are piebald yellow and white. The adult male shows a very well developed mane of hair, 10 to 30cm long and horns making a complete spiral from rear to front. Ears are small, narrow, and horizontal. The tail is thin and small (25 cm). The legs are generally short, giving the animal a very stout aspect. As an average we can give the following measurements:

	1 year old male	Adult female	Adult male
Weight	24 kg	23.3 kg	30 to 40 kg
Height at withers	57.7 cm	54.7 cm	50 to 60 cm
Heart Girth	67.4 cm	61.9 cm	
Under Sternum Height	29.5 cm	30.8 cm	
Scapulo-Ischial Length	60 cm		

Management practices in the area. Animals are generally free and loose in the village, living on garbage, grasses on the roadside and more often than not, on cultures which cause great discussions or "palabres" between neighbors. At night the sheep go back by themselves around the hut of their owners who have absolutely no notion of breeding and nutrition. No care is given to the animals. Although each family possesses a few head of sheep, they are not raised in commercial purposes but rather as a piggy bank in which the owner would take when he needed it. Moreover the little flock of three to four animals is meant to show wealth and is used as gifts, dowry, and sacrifices for religious purposes. However under the action of development organizations some villages are starting to follow a few management rules; such as putting all the sheep of a village together with a shepherd, gathering them at night in a park, and determining breeding seasons.

Lambing performance. Prolificacy (number of lambs born/number of ewes lambing). Vallerand in Cameroon gives an average of 117% with yearly varations going from 107% to 120%. Ewe lambs have a prolificacy of 100%, ewes at second lambing 103% and the prolificacy goes up to 120% for mature ewes. The results obtained at the Research Center of Bouake are quite similar to the ones of Cameroon. The response of the breed in prolificacy to a better nutrition has not been well determined, although we note a tendency of a better prolificacy in the groups that have been complemented before and during the breeding season. Perhaps a more determinate difference would be observed between groups if a better understood flushing was applied.

Fertility (number of ewes lambing/number of ewes at breeding). When the interval between lambing is of eight months the fertility is high and all authors agree that it is 94% to 96%. The results at the Research Center of Bouake show generally lower figures because of a high abortion rate. The level of nutrition does not seem to affect seriously the fertility, but the abortion rate is much lower in the complemented group during the year the abortion rate is high (19% vs 46.7% in April 1976 and 24% vs 56% in May 1978.

Fecundity (number of lambs born per year and per ewe). Taking the average of three lambings (Dec. 1976, Sept. 1977, and May 1978) the intensive group gave 1.48 lambs per year and per ewe, the intermediate group 1.39, and the control group 1.13. We observed a difference between the complegroups and the control group but no difference between the two complemented groups.

Table 10-1. FERTILITY TRAITS

Lambings	Groups	Ewes at breeding	Fertility %	Prolificacy %	Abortion %	Mortinatality %	Lambs surviving at weaning %
April	Intens.	60	46.7	103.6		10.3	
1976	Inter.	60	16.7	100	19.2	20	
	Control	60	21.7	100	46.7	0	
Dec.	Intens.	70	91.4	118.7	4.3	1.3	97
1976	Inter.	57	87.7	116	2	6.9	91
	Control	64	87.5	110.7	3.12	6.4	95
Sept.	Intens.	71	90.1	109.4	4.2	7.1	85.7
1977	Inter.	61	85.2	117.3	4.9	6.0	93.5
	Control	59	83	102	3.4	4	54
May	Intens.	69	69	129.1	25	0	17.7
1978	Inter.	60	72	109	24	4	23.4
	Control	57	42	108	56	4	19.2
Jan.	All						
1979	Inter.	143	92.3	104.5	2.8	2.9	
Jan.	All Inter.						
1979	old ewes and young ewes	224	84.4	105.3	4.9	2.5	96.5

Lamb performances after weaning. Some intensive feeding has been done in order to investigate the growth possibilities of the Djalonke male lambs. In 1976 and 1977 the experiments started two months after weaning while in 1978 it started on weaning day. Teh feed was composed of sugar cane molasses (50% in 1976 and 1978, 40% in 1977)? rice bran (25% in 1976 and 978, 30% in 1977), and cotton seed cake (25% in 1976 and 1978, 30% in 1977). All lambs were penned. Water, mineral complex and second quality hay were distributed ad libitum.

Table 10-2. POSTWEANING TRAITS

Year	No.	Length of trial (days)	Weight at start (kg)	Weight at end (kg)	ADG (g)	Feed * consumption (g)	Feed per kg of gain (kg)
1976	30	182	12.2	25	70	606	8.6
1977	15	90	15.4	23.8	93.3	690	7.4
1978	22	123	8.3	19	87	607	7.0
			+1.6	+3.3	+19		

* Average feed consumption per day and per animal.

SEDENTARY SHEEP IN THE SAHEL AND NIGER DELTA OF CENTRAL MALI

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The study area, the main features of which are shown in figure 1, was about 70.000 km2 in area, the extent being determined rather arbitrarily in relation to national boundaries and other development projects with only the southern limit being related to a natural feature. The study area cannot therefore be considered as a natural, historical or administrative entity. It can not, in addition, be considered the domain of a particular pastoral or agro-pastoral system. On the contrary, it includes a variety of natural areas which by their characteristics and their geographical position allow the development of a variety of agricultural cropping and pastoral systems and interacting agro-pastoral systems.

Technical data on sheep. During the period January, February and March, 1978 field studies were undertaken in a number of villages in the vicinity of Niono of two types of sedentary livestock systems - the cultivators, primarily Bambara whose main crop is millet; and the settlers ("colon") of the Office du Niger who principally cultivate rice under irrigation.

No objective attempts were made to quantify the numbers of families owning smallstock. It would appear however, that a figure of the

order of one family in every four owning smallstock would be very close to the actual ownership figure, in both Bambara and Office du Niger villages.

In respect to flock size there are considerable differences between the flocks of the settlers of the Office du Niger and those of the Bambara. An initial sample to determine the relative numbers of goats and sheep showed that the former outnumbered the latter in the ratio of 8 : 3. Estimates of numbers of smallstock in relation to the numbers of people, based on Administration records give 0.15 head per person for colon villages and 0.56 head for Bambara villages.

Sheep physicaltype. Most of the sedentary sheep are of the "Sahel" type and can be ascribed to the Peul variety. However, there is some evidence of out-crossing to other types, particularly the wooled "Macina" and possibly also the "Djalonke" or forest-type sheep of a more southerly origin.

In the typical Sahel type, the coat colour in more than 90 percent of sheep is white, occasionally with some black markings, in particular aroung the eyes. A few black sheep occur as do red ones and black pied and red pied animals can also be seen. The coat is generally short and fine, longer hair usually being associated with varying degrees of Macina blook or probably (particularly in the case of colours other than white) indicating some admixture of the long haired Maure

type. Males often carry an apron of long hair from the throat, down the chest to between the front legs.

About 25 per cent of all sheep carry toggles which are variable as to size and position. Horns are almost universal in males being slightly flattened in cross section, deeply ribbed, of the classic "Rams horn" pattern and up to 65 cm in length. Horns are present in about 32 per cent of females, up to 15 cm long, but usually light and rudimentary. Ears are of medium length, in the range 11 cm to 14 cm and semi pendulous: vestigial ears occur in a minute proportion of animals. In males the profile is markedly convex while in females it is less so. The tail is thin, usually extending to just below the hocks.

The average shoulder height of 48 full mouth females was 74.1 $\pm$ 4.09 cm, while their average live weight was 34.6 $\pm$ 4.91 kg, this latter being related to a chest girth of 80.1 $\pm$ 3.85 cm. No full mouth males were encountered during the survey but two with three pairs of incisors averaged 88 cm shoulder height and 51.4 kg live weight. Intensively fed castrated sheep with three pairs of permanent incisors reached shoulder heights of 95.0 cm and weights of 66.00 kg.

Table 11-1. NUMBER OF PARTURITIONS PER BREEDING EWE

Age (dentition)	Number of parturitions								
	0	1	2	3	4	5	6	7	8
Milk teeth	9	7							
1 pair permanent	8	29	2	3					
2 pairs permanent		10	4	5	3				
3 pairs permanent	1	3	6	6	4	1			
Full mouth			9	8	13	4	2		1
All ewes	18	49	21	22	20	3	2		1

Table 11-2. LAMBING DATA FOR 24 FLOCKS OF SEDENTARY SHEEP

	Age of dam (expressed by means of dentition)					
	Full mouth	3 pairs incisors	2 pairs incisors	1 pair incisors	Milk teeth	All sheep
Number in sample	37	21	22	42	16	138
Type of birth:						
Triplet	1					1
Twin	9	2	2	1		14
Single	124	52	43	41	7	267
Total births	134	54	45	42	7	282
Total lambs born	145	56	47	43	7	298
Average litter size	1.08	1.04	1.04	1.02	1.00	1.06
Parturitions per ewe						
Mean	3.62	2.57	2.05	1.0	0.43	1.84
Mode	3	2+3	1	1	0	1
Range	2-8	0-5	1-4	0-3	0-1	0-1

Table 11-3. BIRTH WEIGHTS OF LAMBS BY SEX AND TYPE OF BIRTH

	Number	Birthweight ± (kg)	Standard deviation (kg)	Range (kg)
Single births				
Males	43	3.20	0.935	1.4-5.5
Females	37	3.01	0.808	1.5-5.5
Twin births				
Males	11	2.53	1.288	1.4-4.8
Females	17	2.85	0.687	1.7-3.8
Triplet births				
Males	2	2.4	--	--
Females	1	3.5	--	--
All births (unweighted for sex or type of birth)	111	3.00	0.904	1.4-5.5

Table 11-4. LIVEWEIGHT, CARCASS WEIGHT AND WEIGHTS OF BODY OF SHEEP SLAUGHTERED AT NIONO

Body part	Weight (kg)		As % of live weight	
	Mean	± SD	Mean	± SD
Live weight	21.9	8.84	--	--
Carcass weight[a)]	14.8	4.79	46.0[e)]	5.29
Stomachs + contents[b)]	5.4	4.81	13.9	3.82
Intestines + contents[b)]	2.2	1.48	5.5	2.19
Kidneys	0.2	0.08	0.60	0.28
Liver	0.6	0.15	1.8	0.55
Heart + Lungs	0.9	0.25	2.9	0.40
Diaphragm + Mesenteric fat	1.5	0.81	4.7	2.25
Spleen	0.2	0.25	0.6	0.67
Head	2.1	0.39	6.7	1.1
Feet	0.9	0.22	2.1	0.93
Skin	2.1	0.40	6.7	0.96
Testicles or Udder[c)]	0.3	0.15	0.8	0.51
Losses[d)]			7.0	2.21

RESEARCH WITH BARBADOS BLACKBELLY SHEEP IN NORTH CAROLINA

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Sheep production is not a mjaor enterprise in North Carolina. There are approximately 10,000 brood ewes in the state, and these are located mainly in the Appalachian Mountain area. Hampshire, Suffolk and Dorset are the main breeds used. Crossbred Western ewes (Suffolk or Hampshire x Rambouillet) are purchased by some commercial producers. Most of the flocks are small and poorly managed. The average lamb crop marketed usually ranges from 95-105%. This level of production is not adequate for a viable sheep industry since the market lamb accounts for approximately 90% of the gross income per ewe.

Two "exotic" breeds of sheep, the Finnish Landrace and the Barbados Blackbelly, were obtained and used in a crossbreeding program in an attempt to improve ewe productivity to the point where market lamb production would be a profitable enterprise. TheFinnish Landrace originated in Finland and is a small breed noted for prolificacy and lamb vigor at birth. The Barbados Blackbelly is a small, hairy breed that apparently developed from West African stock on the island of Barbados. The breed was reported to breed out of season and to be heat tolerant, hardy and prolific. The foundation of Blackbelly sheep was obtained from several sources in Texas, Louisiana and Mississippi. They were obviously carrying varying percentages of other breeds and may or may not be representative of those sheep found on Barbados.

The basic plan was to cross the Landrace and Blackbelly with other available breeds so as to produce a brood ewe with a maximum of the following desirable traits: (1) heat tolerance, (2) out of season breeding and the potential to lamb regularly at 8-month intervals or less, (3) low lamb death loss at birth and (4) adequate performance in market lambs. The next step was to evaluate the crossbred ewes for market lamb production in a terminal sire mating to Suffolk or Dorset rams.

Table 12-1. SUMMARY OF REPRODUCTIVE PERFORMANCE OF TWO AND THREE YEAR OLD DORSET, DORSET X BLACKBELLY, DORSET X LANDRACE AND RAMBOUILLET X LANDRACE EWES. (EXPERIMENT I, 1971-1972)

Item	Breed Group			
	D	D X B	D X L	R X L
No. ewes[1]	4	10	7	10
No. possible lambings	8	20	14	20
Avg. gestation length (days)	143.3[a]	146.4[b]	144.4[a]	143.9[a]
Avg. lambing date	Nov. 28[a]	Nov. 25[a]	Jan. 15[b]	Jan. 11[b]
Avg. litter size[2]	1.63	1.45	1.64	1.90
Ewe weight at lambing (lb)	131.3[a]	108.4[b]	135.1[a]	127.3[a]
Avg. lamb birth wt. (lb)[3]	5.2[a]	8.6[b]	6.4[a]	6.7[a]

[1] Statistical analysis based on only those ewes lambing each year. Actual numbers per breed group were 7, 10, 9 and 10 for D, D X B, D X L and R X L groups, respectively.

[2] Avg. litter size based on total possible lambings were 1.14, 1.45, 1.39 and 1.90 for D, D X B, D X L and R X L groups, respectively.

[3] Least squares means, adjusted for age of ewe, sex of lamb, type of birth.

[a,b] Means on same line with different superscripts differ significantly (P .05)

Table 12-2. Summary of Reproductive Performance of Two-Year Old Dorset and Dorset X Blackbelly Ewes (Experiment I, 1971-1972)

Item	Breed Group	
	D	D X B
No. ewes per group	18	21
Avg. gestation length (days)	143.2[a]	145.8[b]
Avg. lambing date	Nov. 29	Dec. 13
Avg. litter size	1.44	1.52
Avg. lamb birth wt. (lb)[1]	6.0[a]	7.6[b]
Avg. ewe wt. after lambing (lb)	118.4[a]	107.5[b]

[1] Least squares means, adjusted for type of birth and sex lamb.

[a,b] Means on same line with different superscripts differ significantly (P .01).

Table 12-3. Post-Weaning Gain of Lambs from Two and Three Breed Crosses

Item		No. Lambs	Average Daily Gain (lb)
Two-Breed Crosses			
Sire breed	Ewe breed		
Blackbelly	Dorset	32	.45
Landrace	Dorset	16	.51
Landrace	Rambouillet	12	.42
Three-breed Crosses			
Sire breed	Ewe breed		
Dorset	Dorset x Blackbelly	10	.63
Dorset	Dorset x Landrace	12	.64
Dorset	Rambouillet x Landrace	14	.67
Suffolk	Dorset x Blackbelly	8	.65

Table 12-4. Summary of Performance of Dorset X Blackbelly, Dorset X Landrace, Rambouillet X Landrace and Grade Suffolk Ewes Bred for Four Lamb Crops in an Accelerated Lambing Study[1]

Item	Breed Groups			
	D X B	D X L	R X L	G. Suffolk
Avg. No. ewes per breed group	15.75	15.75	15.50	15.50
Avg. No. ewes lambing	13.75[a]	11.00[ab]	9.25[b]	9.50[b]
No. of lambs born per ewe	6.48	5.97	5.29	4.45
No. of lambs marketed per ewe	5.71	4.70	4.52	3.81
Lamb weight per day of age (lb)[2]	.60[a]	.60[a]	.60[a]	.68[b]
Lamb age at market wt (days)	164.0[a]	165.0[a]	164.0[a]	149.0[b]
Lbs. lamb marketed per ewe	559.6	465.3	447.2	377.2
Ewe weight at lambing (lb)	125.0[a]	159.0[b]	148.0[b]	188.0[c]
Lbs. lamb marketed per lb. ewe	4.48[a]	2.93[b]	3.02[b]	2.00[b]

[1] Data are summarized over a 26 month period (September 1, 1973 to November 1, 1975).

[2] Includes lamb birth weight.

[a,b,c] Means on same line with different superscripts differ significantly (P .05)

THE BARBADOS BLACKBELLY ("BARBADO") BREED IN TEXAS (U.S.A.)

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Perhaps the world's largest collection of the Barbados type of sheep is to be found in Texas. It is reported that Barbados Blackbelly sheep were first introduced to the U.S. by the United States Department of Agriculture in 1904. Other introductions are thought to have occurred in the years following. These sheep early became concentrated in Texas, and more especially, in and around the Edwards Plateau geographical region. Data on their numbers are not available, since statistical reports do not show a classification by types. However, the author estimates that a peak in numbers in the range of 200,000 to 300,000 occurred in the early part of the 1970's. Recently, numbers have been reduced markedly through slaughter and through export to Mexico and other Central American and Caribbean countries. This reduction in numbers appears to be explained by three factors: (a) a high demand for non-wool producing sheep in the more tropical regions of Central America and the Caribbean, (b) a generally increased demand and price for red meat of any source tempting sale for slaughter, and (c) a general revival of interest in the sheep industry in the areas where Barbados were found. This resulted in a liquidation in their numbers, due to the fact that they were not able to compete with more traditional breeds in the production of meat and fiber for the U.S. market.

The original Barbados was apparently a polled animal, but in the U.S. it has been converted to a horned condition similar to that characteristic

of fine-wool sheep. There is little evidence of continued crossing or mixing with fine-wool sheep, as the vestigial fleece cover, which was characteristic of these animals in earlier years, has been largely bred out of them.

With the development of sport hunting and game farming as an industry in the state, the keeping of Barbados tended to shift in this direction. In fact, most flocks have had some infusion of Mouflon breeding to provide a more suitable game animal. Although this was done intentionally and sometimes repeatedly, random matings have been followed in subsequent generations, and the Barbados tends to remain the dominant influence. This can apparently be explained by the Barbados being more adaptable, more fertile, less seasonally restricted in breeding, and less subject to certain disease and parasite conditions than the Mouflon. The relative concentration of Mouflon in the flock can be estimated from observations of color, temperament, and body form. Those carrying significant Mouflon breeding will seldom have a blackbelly, and the ewes will tend to be fawn-colored, and the males will often have white patches or saddles. They will be wilder in temperament and more streamlined in form.

In exploiting these Barbado-like or mixed type as game animals, the males may be hunted on the ranch where produced. In this situation, they have sometimes been known as "Wild Corsican Rams". For this purpose, they have the advantage of not being classified as a native game animal, and thus have no seasonal hunting restriction. Another and more widespread practice, is to gather the more mature males

periodically and sell them through intermediaries to game farms or hunting clubs scattered throughout the country. For such a market, they usually sell at a price per head equal to or above that of domestic sheep sold for meat production. However, they must be kept to an older age than necessary for meat production, and the harvest rate of huntable males is low. Most such flocks can be gathered for marketing, but with difficulty.

Table 13-1. Feedlot Performance and Carcass Traits of Barbados Sired Lambs Compared to Finewool or Crossbred Lambs.

	Feedlot Performance					Carcass Traits		
Breed Type	No. Animals	Ave. Daily Grain/lbs.	Daily Feed Intake	Feed/lb. Gain	Dress %	Est. % Consumer Cuts	area/ 50/lb. Carcass	% Kidney Pelvic Fat
Rambouillet	14	.553	3.25	5.88	54.7	83.8	1.97	4.43
Blackface Rambouillet	20	.559	3.08	5.85	56.8	82.9	1.94	3.57
Barbados Rambouillet	20	.389	2.48	6.42	55.7	82.2	1.83	6.17

Table 13-2. Performance of Certain Types of Ewes on an Accelerated Lambing Program Under Range Conditions

Breed or Cross	Mean Annual Fleece wt. lbs.	Mean Body Body wt. lbs.	Mean No. Lambings per ewe per year	Mean No. lambs born per ewe lambing	No. Lambs weaned per ewe per year
Rambouillet	8.9	112.6	1.12	1.41	1.22
Finnish Landrace X Rambouillet	6.0	116.3	0.98	1.80	1.27
Karakul X Rambouillet	6.1	121.9	1.19	1.34	1.33
Barbado X Rambouillet	3.8	103.1	1.24	1.71	1.64

THE ST. CROIX SHEEP IN THE UNITED STATES

Warren C. Foote

International Sheep and Goat Institute, Utah State University

A review of records in the U.S. Virgin Islands and in the United States show that the first St. Croix sheep imported into the United States were taken to Maine from the Island of St. Croix in the 1960's by Michael Piel. Less than 10 animals were imported and were used for crossbreeding and no longer exist as a pure genotype.

In 1975 another group of St. Croix sheep was imported into the United States from the U.S. Virgin Island of St. Croix by the International Sheep and Goat Institute, Utah State University, Logan. Twenty two ewes and three rams were selected by Warren C. Foote from three flocks (one ram died in quarantine) and were taken to Utah in June 1975. No production records were available on the animals. The criteria used in making the selections was that they were white, as free from wool as possible and average or better in body size and general conformation. Younger animals were selected to provide for a longer production period after importation. The three flocks from which the animals were selected were chosen because the sheep appeared to be the most homogenous or pure as indicated by color, size and conformation, and freedom from wool.

Many of the ewes were pregnant when purchased. Records of some production parameters were started on their arrival in Utah. The major initial effort was to increase numbers as rapidly as possible and the ewes were exposed for breeding throughout the year.

Behaviorally St. Croix sheep are very tractable and easy to handle. They are active and vigorous but show no tendancy to be wild. The males are very active breeders. They have adapted to the more severe and variable climatic conditions of Utah very well. They grow a very heavy winter coat which is shed in the spring.

The major purpose in bringing the St. Croix into the United States was to measure their reporduction and production performance and to determine their usefulness as a pure genotype of through crossing to increase sheep production in appropriate geographic-environment areas of the U.S. and also in other countries of the world including the Middle East and Africa. This flock of sheep is considered to constitute a separate genotype of sheep and is being established as the St. Croix breed. Reproduction and production standards are being developed from the information being collected and will be used by the Internaional Sheep and Goat Institute to characterize the breed. None of the sheep will be released for private or commercial use until this is completed and numbers are sufficient to warrant such an expansion.

In 1976 a cooperative research program was arranged as a part of the North Central Regional Research Project (NC-111) for St. Croix sheep to be taken to the Ohio Agricultural Research and Development Center, Wooster, Ohio, under the direction of Charles F. Parker and to the University of Florida, Gainesville under the direction of Phillip E. Loggins. In December of 1976 approximately 30 ewes were divided into three groups by age and reporductive performance. One group was sent to Ohio, one group to Florida, and one group kept in Utah. In addition

5-6 rams were sent to Ohio and to Florida. The objectives of the research with St. Croix included measuring their production and reproduction in the different geographic locations under pure breeding and crossing. In this cooperative work 6 month lambing intervals were established at Ohio and Utah by allowing a 40 day breeding period beginning August 1 and February 1. At Florida the ewes were exposed for breeding for a 40 day period annually beginning on July 15. Lambs at all three locations are weaned at 60 days of age. Sire lines are being established to prevent inbreeding. In 1978 a small group of St. Croix (5 rams and 3 ewes) were taken to California State Polytechnic University, Pomona, for research primarily with reproduction.

Table 14-1. Mean Body Weights of St. Croix, St. Croix x Rambouillet and Rambouillet Lambs at Birth and of Mature St. Croix Ewes and Rams (in kgs) (R. C. Evans, A. J. Svejda and W. C. Foote, Utah State University, unpublished data, 1979).

Genotype	Male		Female		Single		Twin		Triplet		Quadruplet		Total	
	No.	Wt. ±S.E.	No.	Wt. ±S.E.	No.	Wt. ±S.E.	No.	Wt. ±S.E.	No.	Wt. ±S.E.	No.	Wt. ±S.E.	No.	Wt. ±S.E.
St. Croix x St. Croix														
Birth	72	2.86 ±.06	71	2.63 ±.08	27	3.13 ±.12	81	2.69 ±.07	30	2.70 ±.13	8	2.12 ±.10	146[1]	2.74 ±.17
Mature 3 yr & older	2	74.0 ±1.86	12	54.4 ±3.58	--	--	--	--	--	--	--	--	--	--
St. Croix x Rambouillet														
Birth	12	4.54 ±.12	10	3.71 ±.24	8	4.45 ±.12	14	3.98 ±.22	--	--	--	--	22	4.16 ±.28
Rambouillet x Rambouillet	9	5.25 ±.30	10	4.65 ±.44	11	5.23 ±.41	8	4.69 ±.34	--	--	--	--	19	4.94 ±.49

1) Sex was not recorded in 3 animals making the total number for sex 143 compared to 146 for the total based on type of birth.

Table 14-2. Reproductive parameters for St. Croix and Rambouillet ewes placed on 6 month lambing intervals in Utah[1] (R. C. Evans, K. E. Panter, A. J. Svejda and W. C. Foote, Utah State University, unpublished data, 1979).

Breed of ram	Breed of ewe	No. ewes exposed	Ewes in estrus		Ewes lambing		No. lambs born	Lambing Rate		Normal live lambs at birth		Weaning rate[4] (of live normal lambs born)			
			no.	%	no.	%		lambs born/ ewe exposed	lambs born/ ewe lambing	No.	%	No.	%	Per ewe Lambing	Per ewe exposed
August, 1977 - January, 1978[2]															
St. Croix	St. Croix														
6 months[3]		8	6	75	5	62	8	1.00	1.60	8	100	4	50	50	80
1 yr. and older		13	12	92	11	85	27	2.08	2.45	24	89	17	63	1.31	1.54
February, 1978 - July, 1978															
St. Croix	St. Croix														
6 months		0	-	-	-	-	-	-	-	-	-	-	-	-	-
1 yr and older		21	18	86	13	62	26	1.14	2.00	24	92	17	71	.81	1.31
August, 1978 - January, 1979															
St. Croix	St. Croix														
6 months		9	9	100	8	89	14	1.56	1.75	14	100	11[5]	78	1.22	1.38
1 yr and older		13	12	67	8	44	24	1.00	2.50	18	75	16[5]	75	.89	2.00
Rambouillet	Rambouillet														
1 yr. old		20	20	100	14	70	19	.90	1.36	18	95	15[5]	79	.75	1.07
St. Croix	St. Croix														
1 yr. old		19	19	100	16	84	23	1.16	1.44	22	96	21[5]	95	1.10	1.31

[1] 40 day breeding periods beginning February 1 and August 1. [2] Breeding-lambing interval with 40 day breeding period. [3] Age at beginning of breeding-lambing interval. [4] Weaned at 60 days of age. [5] Data based on preweaning age.

Table 14-3. Lambing performance of St. Croix and Barbados ewes (Charles F. Parker, Ohio Agricultural Research and Development Center, unpublished data, 1979).

Date exposed to rams	Lambing			Lambs			Lambing rate per:	
	No. exposed	No. lambing	% lambing	No. born	No. survived	% survived	ewe exposed	ewe lambing
St. Croix								
Older ewes								
9/76	10	10	100	17	15	88.2	1.70	1.70
8/77	8	8	100	17	16	94.1	2.12	2.12
2/78	8	2	25	3	3	100.0	0.38	1.50
7/79	8	8	100	16	16	100.0	2.00	2.00
Lambs								
8/77	7	2	29	2	1	50.0	0.28	1.00
Yearlings								
2/78	7	3	43	5	4	80.0	0.71	1.67
7/78	7	5	57	9	9	100.0	1.29	1.80
Barbados[1]								
Older ewes								
9/76	9	9	100	14	11	78.6	1.56	1.56
8/77	9	6	68	9	6	66.7	1.00	1.50
2/78	6	4	68	5	5	100.0	0.83	1.25
7.78	4	2	50	3	3	100.0	0.75	1.50
purchased,78	4	2	50	4	4	100.0	1.00	2.00
Lambs								
8/77	9	9	0	0	0			
purchased,78	3	1	33	1	1	100.0	0.33	1.00
Yearlings								
2/78	7	3	43	2	2	50.0	0.57	1.33
purchased,78	4	4	100	6	6	85.7	1.75	1.75

1) Ewes were quite variable in age and limited in base and not considered to be typical of the genotype.

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Education:

B. S.	Animal Science, Texas A&M University,	1961
M. S.	Meats Science, Texas A&M University,	1963
Ph.D.	Animal Breeding, Texas A&M University,	1965

Postdoctorate: ARC Animal Breeding Research Organisation; Institute of Animal Genetics, University of Edinburgh, Scotland, 1965-66

Employment History:

1975-Date	Director of Research, Winrock International Livestock Center.
1975	Research Geneticist; Coordinator, Germ Plasm Evaluation Program; U.S. Meat Animal Research Center, ARS/USDA, Clay Center, Nebraska.
1973-75	Executive Vice President (chief operating officer); Member, Board of Directors, AGRI-LINK Corp., Irvine, California.
1966-73	Associate Professor, Animal Breeding Section, Animal Science Department, Texas A&M University, College Station, Texas. Partner, Genetics Applied to Production (agricultural consulting), College Station, Texas.
1965-66	NATO Postdoctoral Fellow, ARC Animal Breeding Research Organisation.
1963-65	Research and Teaching Assistant; Genetics Section, Dept. Plant Science; Institute of Statistics, Texas A&M University, College Station, Texas.
1962	Research Coordinator, Estacion Experimental de los Llanos, Consejo Bienestar Rural; Calabozo, Venezuela.
1960	NSF Undergraduate Science Fellow, Biochemistry, Texas A&M University.

Selected Professional Experiences:

Dr. Fitzhugh has authored over 50 scientific and technical articles on animal breeding and management with emphasis on livestock production systems.

1975-Present -- Implementation of research and development programs involving economic and biological evaluation of livestock production and marketing systems, emphasizing adaptation of theory and technology to needs of limited resource producers.

1973-75 -- Directed operation of vertically integrated beef production, processing and retail marketing firm with over 20,000 breeding cattle and over 40,000 feeder cattle in 18 states; total investment in production and marketing enterprises exceeded $20 million.

1966-73 -- Taught graduate and undergraduate courses in animal science, genetics, animal breeding and statistics. Supervised degree programs for 12 M.S. and 4 Ph.D. students. Leader of beef and dairy cattle breeding research projects.

1962 -- Coordinated research and development program in Llanos of Venezuela for improving range and cattle management.

Foreign Experience:

Latin America, Caribbean, Europe. Good reading and fair conversational knowledge of Spanish.

Membership in Professional and Honor Societies:

American Society of Animal Science, Biometric Society, Asociacion Latinoamericana de Producion Animal, Alpha Zeta, Phi Kappa Phi, Sigma Xi, Cosmos Club.

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Employment:

1978-79 Visiting Scientist, Winrock International Livestock Research and Training Center, Morrilton, AR 72110.

1973-78 Chairman, Department of Animal Science, University of California, Davis.

1969-70 Associate Dean, College of Agricultural and Environmental Sciences, University of California, Davis.

1957-Date Assistant Professor, Associate Professor (1964), Professor (1969), Department of Animal Science, University of California, Davis.

1955-57 Assistant Professor, Departments of Animal Husbandry and Genetics, McGill University, Montreal.

1951-55 Research Assistant in Animal Husbandry, University of Wisconsin.

Other Professional Experiences:

1978-79 Sabbatic leave, Winrock International Livestock Research and Training Center, Morrilton, Arkansas.

1970-71 Sabbatic leave, ARC Animal Breeding Research Organization, Edinburgh, United Kingdom.

1963-64 Sabbatic leave, Cornell University, with L. D. Van Vleck and C. R. Henderson.

Foreign Experience:

1978 Lectures on sheep improvement at Universities of Baghdad, Sulaimaniyah and Mosul, Iraq.

1976 Review of animal breeding research in Chile.

Short professional visits to Japan, France, Spain, Norway, Sweden, Argentina. Good reading and fair conversational knowledge of French.

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Genetics of growth and reproduction in sheep; effects of long term selection in laboratory animals and in livestock; utilization of breed resources for livestock improvement.

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