The open nucleus breeding programme of the Djallonke sheep in Cote d'Ivôire

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The species involved is the domestic sheep (*Ovis aries*). The species is classified among the thin-tailed hair sheep, within the sub-group of Tropical Dwarf sheep based on fleece and tail types (Epstein, 1971; Mason, 1991). The dwarf sheep are believed to belong to various breeds because of their different phenotypic characteristics related to their breeding areas. However, various authors recognised that there is a unique breed or type from which varieties or strains have progressively developed with differentiation and fixation of characters as a result of the influence of ecological environment and breeding practices (Doutressoulle, 1946; Epstein, 1971). The dwarf trypanotolerant sheep are believed sufficiently homogeneous to be considered as one single population. While the name Djallonké is used in most francophone West African countries, the name West African Dwarf or Guinea sheep is commonly used in anglophone countries. Other names include Fouta Djallon, Mossi or Landin (Epstein, 1971; ILCA/FAO/UNEP, 1979a;b; Bradford and Fitzhugh, 1983; Mason, 1991).

National sheep breeding programme

Sheep species

The Djallonké breed is a small, horizontal eared and thin tail hair sheep. The breed is widely distributed throughout the humid and savanna zones of West and Central Africa (ILCA/FAO/UNEP, 1979a). Animals of that breed are compact of small mature height and size. Coat colour varies from spotted black and white to solid black or white. Some tan or brown coat colour and blackbelly are also encountered. Rams are horned but females are usually polled. The presence of mane or neck ruff on the males is a typical characteristic of the breed (Rombaut and Van Vlaenderen, 1976; Charray *et al.*, 1980). The breed is known for its adaptation to tropical humid and sub-humid environments. Although no scientific evidence has been unequivocally provided, the breed is widely believed to be trypanotolerant, mainly because of its ability to live and produce in the tse-tse infested zones.

Djallonké Breed

Management and production systems

Farmers involved in the scheme are in low to medium input production systems. Flock management on-farm varied from exclusive utilisation of natural savanna pasture with little supplementation (private farms) to the use of natural and cultivated pasture with high level of supplementation (state-owned farms).

Sheep population involved

The programme (Programme National de Sélection Ovine – PNSO) was designed to take into account the maximum number of Djallonké sheep raised in the country. However, not all the farms were included in the programme. After several years of extension work, some farmers were chosen, based on their experiences and skills in improved sheep production techniques, to start the selection programme on pure-breed Djallonké sheep.

At the end of 1992, the base population of ewes was composed of 71 farms (including the two state farms), representing 12 000 breeding ewes enrolled in the programme. Of these ewes 76 percent were from private flocks and 24 percent from the state-owned farms. In March 1999, 143 farms were involved in the programme, which represents 17 000 breeding ewes (88 percent from private farms and 12 percent from state farm).

The flock of selected rams maintained at the PNSO Headquarters performance testing station is considered to be the nucleus. The station holds selected rams only. There is no ewe in the nucleus flock on-station. The ewe flocks are those of the farmers. The size of the nucleus was of 153 breeding sires in 1992. Since then it has fluctuated between 180 and 200 breeding sires. Every year 100 to 120 second category rams are sold to farms not in the selection base.

Targeted breed

The targeted breed is the entire Djallonké breed. All the farms involved are instructed to breed only Djallonké ewes and to eliminate from their flock animals showing Sahelian sheep type phenotype. The choice of the Djallonké breed is the number one requirement to participate in the programme. The dissemination of the selected rams is so effective that the number of second category rams produced every year is not enough to supply the demand.

Approach to establish the breeding goal

The breeding goal was established based on results obtained from a study on the performance of the Djallonké sheep both on-farm (Rombaut and Van Vlaenderen, 1976; Rombaut, 1980, Van Vlaenderen *et al.*, 1980) and on-station (Poivey *et al.*, 1982). The objectives of the programme were to improve growth and live weight of pure-breed Djallonké sheep and provide sheep farmers with improved breeding stock.

The PNSO programme was initiated in 1983 with farmers involved in the extension service since 1977. These farmers were recognised to be capable of keeping records of their flocks, correctly identifying their animals and following the prophylactic programme of the Ministry of Animal Production and supplementing their animals during critical periods. The enrolled farms consisted of private (smallholders and companies) flocks receiving technical assistance from extension services and two state farms.

The structure of the PNSO is composed of one central performance evaluation station for rams (the nucleus) and farmer flocks of only breeding ewes (the base population). The number of flocks (breeding ewes) fluctuates from year to year, as new flocks enter the base and some leave. Selection is on the male side only. The initial rams in the nucleus in 1983 were from the two state farms and the research station where selection for high growth rate was already in practice. Farmers in the base population use the selected rams from the nucleus for mating. In return ram lambs in those farms are brought to the nucleus for evaluation and eventually selected to be sire. The outline of the structure, showing the gene flow is presented in figure 1.

The plan designed and followed

Selected breeding rams maintained at the central station in Bouaké were brought to the farms for a mating period of about 45 days. After each mating, rams returned to the station for a minimum rest period of two months. Each ram was culled after three years of mating in rotation from one farm to another. Ewes were mated every eight months to a group of sires in a ratio of 30 to one with the number of sires in a group varying from one to 13. Replacement females were produced within the farmer's flock. However, farmers were allowed to purchase ewe lambs from other PNSO farmers.

- For economic reasons, since 1987, farmers have taken on the responsibility themselves for the endo- and ectoparasite controls;

- By 1987 the practice of zero-grazing was stopped for animals of 180 days of age on-station. The change from zero-grazing to savanna pasture was made in order to allow ram lambs to get used to grazing on natural pasture, the most common management practice in smallholder flocks where they would later be used;

- Despite precautions taken to prevent disease outbreak, a serious case of ovine brucellosis in 1990 caused more than 50 percent of the rams breeding stock to be culled. Consequently, almost all ram lambs entering the central performance evaluation station in 1990, were kept as sires.

Period of diversion

Performance Testing

Selection for 180 and 365 day weights

Cull (31%)

Ram nucleus flock (on-station)

Ram lambs (19%)

First category rams (36%)

Culls

Selection base flocks
(Average number of ewes per year = 8 945)
Selection for 80 day weight

Second category rams (33 %)

Flocks (0-21)
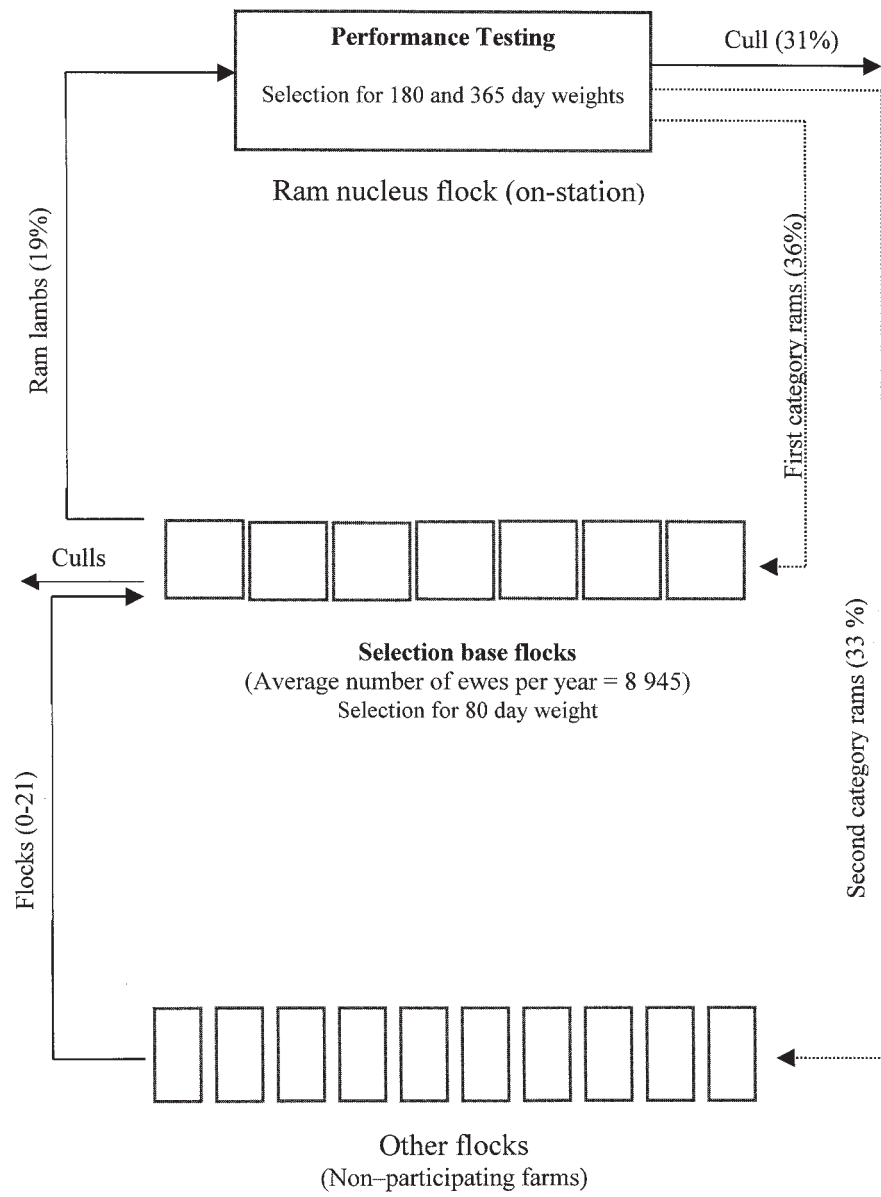
Other flocks
(Non–participating farms)

Figure 1. Outline structure of the national sheep selection programme.

Additionally, 79 rams were bought from farms outside the selection base population (only in 1990) in order to maintain mating schedules because of insufficient number of breeding sires.

All ram lambs born on-farm in the base population flocks are candidates for selection. Two to three weights of each lamb born in the selection base were recorded and used to estimate 80 day weight. The first weight was taken when the first born lamb reached about 80 days of age. Subsequent weights were taken at about 23 day intervals. Male lambs were selected based on their 80 day weights linearly extrapolated using recorded weights.

Traits included in the breeding goal

On-farm 80 day weight

Ram lambs selected from the base flocks were brought and maintained at Bouaké central performance testing station to go through further selection at two ages: 180 and 365 days of age. Animals were weighed three to four times over a period of ten to 12 weeks and their 180 day weights linearly extrapolated. Selected rams continued to be monitored with a second series of three to four weights until they reached 12 to 14 months of age. Their 365 day weights were then calculated and the final selection made.

On-station 180 and 365 day weight

Rams were selected based on their individual live weights measured at 80, 180 and 365 days of age.

Selection criteria

Ram lambs having a weight equal to flock average plus one standard deviation were selected. In practice lambs having a weight greater or equal to 13 kg were selected. Non-selected ram lambs were castrated. Selected rams are bought by the programme from the farmers and transferred to the central performance testing station in Bouaké to be selected for the nucleus flock.

On-farm 80 day weight

Rams with 180 day weights less than 20 kg were culled. From 1987 rams with weights greater or equal to 23 kg were classified as first category rams; those with weights between 20 and 23 kg, were classified second category rams.

On-station 180 day weight

After the second series of three to four weightings, selected rams that reached 12 to 14 months of age had their 365 day weights calculated and the final selection made. The truncation point for first category rams at 365 days of age, was 35 kg and for second category, between 30 and 35 kg. Only rams of more than 35 kg enter the nucleus flock to be used as breeding sire in the base population. Any ram with a weight below 30 kg is culled.

On-station 365 day weight

Dissemination method

Selected first category rams, the top ranking rams, were distributed to the selection base flocks. Matings were scheduled from the programme Headquarters in Bouaké to ensure that only selected rams were used for breeding. Second category rams were sold to non-PNSO farmers.

Breeding structure

The breeding strategy follows that of an open nucleus breeding scheme with selection based on individual performance. The selection scheme included three phases: on-farm pre-selection phase, on-station first selection phase and on-station final selection phase followed by the distribution of selected rams to farmers for mating. The selection yielded two categories of rams: first category rams used in base flock matings and second category rams sold to non-PNSO farmers.

Farmers and Government involvement

Up to 1998 the Governments of the Ivory Coast and France and the EEC through the European Development Fund, provided funding for the selection programme. Since 1999 the programme is funded by the Government of the Ivory Coast.

Farmers involved in the programme were required to have a property right on the land where their farm was located and easy access to a water source (river or agro-pastoral dams). The farm had to be accessible by car for the extension workers. Farmers were taught how to build night enclosures, shelters, collecting yards, sorting pens with traditional local material and footbaths. They were also instructed on how to castrate unwanted rams, to identify lambs at birth and to keep records.

A national commission on domestic ruminant genetic improvement was set up based on the experience of the PNSO programme.

Technical support

The technical assistance offered by the extension service consisted of organizing sheep producers in rural areas, promoting and rationalising private or communal sheep enterprises, encouraging villagers to establish new flocks using improved techniques and organizing the production and marketing of slaughter animals. In addition, the technical assistance collaborates with the veterinary health service in the vaccination, once a year, of farmers' flocks against major and the oversees prophylactic programme for endo- and ecto-parasites.

Farmers contributed to the programme by selling their selected ram lambs to be monitored until the final selection process. They offer their farms as field training laboratories for future candidates who are in the process of establishing their sheep farms. In the long run farmers will take over the management of the programme and will be responsible for looking for funding.

The contribution of the research institution has been the estimation of breeding values of the animals in the selection programme and the development of correction factors for some traits. About 98 percent of the lambs are born of unknown sires in groups of two to 13 sires. Prior probability that a progeny is out of a sire was used in the estimation of the breeding values. The research contribution is published by Yapi-Gnaoré *et al.* (1997 a,b).

The drought of 1972-1973 in the Sahel, brought changes in Government policy towards livestock development. During the drought most countries were no longer able to keep up with rising demand for animal products of coastal West African countries for example the Ivory Coast. The Government, concerned with the future of livestock supplies of the country, declared animal agriculture as a high priority sector for development with emphasis on short or medium reproductive cycle species (MPA, 1976). A long-term campaign to promote livestock production throughout the country was launched by the Ministry of Animal Production through one of its extension agencies SODEPRA (Société pour le Développement de la Production Animale), with a mandate to initiate in 1977 a national sheep programme in the central region. One of the major objectives was to select and provide farmers with improved breeding stocks of Djallonké sheep throughout the country.

Reasons for introducing the scheme

The desire of the farmers, most of who are smallholders, to move from traditional husbandry practices to new improved management techniques, has been the major factor that has keep the programme going. In addition, extension officers have been closely involved in all aspects of the programme since the beginning and financial support was available and non-interrupted.

Significant activities

- The use of single sire mating is necessary in order to obtain an accurate estimate of genetic changes. So far the programme was based on group mating. The proportion of lambs born of unknown sire was very high. Most lambs had unknown sire because of the sire group mating. The percentages of lambs born of unknown sires were 6.9, 55.7 and 60.6 in the analysis of 80, 180 and 365 day weights, respectively.

- Correction factors were derived. It would be worth trying to use them in the evaluation process. Lambs and rams were evaluated based on their own performance without any correction for non-genetic factors such as birth type, season or month of birth, ewe age or parity on-farm and on-station.

Changes to be made to design and operation

- There is a need to maintain high selection pressure throughout the year. It is more than likely that selection pressure has been declining over the years. Several rams were inappropriately selected. On average 28.1, 20.6 and 52.1 percent of ram lambs selected at 80, 180 and 365 days, respectively, had weights below the respective truncation points. The high demand for breeding sires sometimes forced the use of inferior ranking rams or even non-tested rams. When ovine brucellosis occurred among selected rams, most of them were culled (Oya, 1990). Four farms recognised as having the best performing rams, have been used since last year (1998) as test multiplier farms.

Future directions

The national commission on livestock genetic improvement and some funding agencies recommended that farmers themselves managed the breeding programmes. Farmers are being organized into cooperatives for each species and breed. For the Djallonké breed, a farmers' association called APRODJALCI (Association de Producteurs de Djallonké de Côte d'Ivoire) has already been created. This association is taking an active part in many forums related to livestock genetic improvement.

The Livestock Research Station in Bouaké of the Centre National de Recherche Agronomique (CNRA) has been designed to provide scientific back up and serve as a genetic evaluation centre to the national genetic improvement programme for all species.

Genetic changes

Genetic changes were estimated using data from 30 farms on the PNSO programme recorded from 1983 to 1992. Lamb breeding values were averaged over year of birth. Phenotypic values were obtained by deviation of year mean from overall mean. Phenotypic and genetic trends were obtained by regression of annual phenotypic and breeding values on year of birth using 1983 or 1984 as the base year.

Lamb weights at all ages were the lowest in 1989 and subsequent years. There was an average decline in phenotypic trend from 1984 to 1992 of the weights at 80, 180 and 365. Breeding values increased at rates of 28 ± 18.7, 11 ± 5.8 and 14 ± 3.2 g/year for 80-, 180- and 365 day weight, respectively. These increases represented respectively, an annual progress of 0.28, 0.05 and 0.04 percent of the base year. Although the results of the analysis did not indicate a large rapid genetic progress for the Djallonké weight, the genetic trend was positive, in the desired direction. The genetic analyses indicated that genetic value was maintained or slightly increased during the period of selection. On the contrary, the environment has been significantly deteriorating over the years, causing a significant decline in phenotypic value.

This low selection response of the PNSO should not be counted as a failure. Although the data analysed was collected over a ten year period, it represents only three to four generations of selection. The selection programme was designed as a development project with farmers being the primary target. Results cannot expect to be like one that can be achieved theoretically or on an experimental station.

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