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Evaluation of the Reproductive Performance of Gobra, Guzerat Breed Cattle and Their Cross-Breaking Products at the Dahra Djolof Zootechnical Research Center (CRZ) (Senegal)

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Abstract— *The aim of this study was to estimate and compare the reproductive performance of three cattle breeds (Guzérat, Gobra and their crossbreeds or products of crossbreeding) bred at the Centre de Recherches Zootechniques (CRZ) de Dahra (Senegal) for genetic improvement, through the use of data recorded in the center's zootechnical data archiving registers. The monthly breakdown of calvings observed during the study period (1963 to 2017) shows a peak in fertile breedings during the months of September to December (62.4% of fertilisations). Age at first fertilization was negatively and significantly correlated with weights at 3, 6, 12, 18 and 24 months. However, it did not show any relationship with birth weight. Age at first calving was late, at 47.8 (±0.3) months. Analysis of variance of this parameter revealed that the Guzérat cattle breed was sexually more precocious than other genetic types. Heifers calving between 1965 and 1994 had the shortest APV (age at first calving) than those calving after this period. On the other hand, no significant difference was found between heifers' age at first calving and their calving season. The average calving interval was 18.6 (± 0.11) months. It was significantly ($P < 0.001$) influenced by dam breed, calf fate (mortality or survival) at 6 months, calving season and calving rank, as well as the study period. Cows of the Guzérat breed are less sexually precocious than those of the Gobra and Gobra*Guzérat genetic types, but have shorter calving intervals. The study should be continued both on research stations and in the field, in order to confirm the results obtained in this study. It also needs to be extended to other productivity parameters (weight growth, survival, milk production) to better understand the reasons why breeders are interested in raising purebred Guzerat and Gobra crossbreds.*

Keywords— *Breeding performance, Gobra, Guzérat, half-breed , Senegal, West Africa*.

I. INTRODUCTION

In Senegal, livestock plays a central role in economic development. To this end, the animal genetic resources used for food production and agriculture are diverse and varied. In 2016, they contributed essentially to national production of meat and offal, estimated at 242.6 tonnes out of a target of 254.9 tonnes (i.e. 95% of demand). For milk, the contribution of national production remained low, at around 50% of demand for an estimated volume of 226.7 million liters. Other uses and functions of animal genetic resources include the production of eggs (571,000 tons), hides and skins, draught power, organic manure and their role in savings. Added to this are the socio-religious functions played by animals. The contributions of the various species to national meat and offal production are distributed as follows: 38% for poultry, 34% for cattle, 22% for small ruminants, and 6% for pigs (MEPA, 2016).

Three (03) local breeds and several exotic breeds are used to increase local milk and/or meat production. The local cattle breeds are represented by the Senegalese Peulh zebu or Gobra zebu, found mainly in the north and center of the country, the N'dama taurin found in the south and east, and the Diakoré, a cross between the Gobra and Ndama found in the center of the country. Exotic breeds of cattle are bred as purebreds, especially in the Niayes region. The most important in terms of numbers are Montbéliarde, Jersiaise, Holstein and Guzérat (WANE, 2017). This last breed is, in addition to the Moorish Zebu, (from Mauritania and Mali) also bred in the north of the country (sylvopastoral zone) by small or large breeders. Cross-breeding exists between local and exotic breeds. Initiated in breeding centers (Dahra and Sangalkam stations), they have multiplied mainly through the popularization of artificial insemination.

Per capita consumption of meat and offal was estimated at 15.8 kg/capita/year in 2015, which is relatively low given the low productivity of the breeds used (MEPA, 2016). Indeed, the rate of human population growth is far higher than that of meat production. The low meat productivity of our breeds is the result of genetic, dietary, sanitary and organizational constraints.

In Senegal, however, there are local breeds with a reputation for good meat production, but they are also poor milkers. This is the case, for example, of the Zebu Gobra (REDON, 1962; DENIS, 1971). This observation prompted public authorities to undertake genetic improvement programs very early on, aimed at raising (i) the genetic level of the Gobra for meat production through intra-breed selection (from 1954) (i) and for milk

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production through cross-breeding tests with breeds imported from India, Pakistan and Brazil (from 1963).

The Gobra beef selection program produced interesting zootechnical results (DENIS, 1971, DENIS et al., 1976, SOW et al., 1988). As for cross-breeding, the results of mixed-breeds on milk production were judged to be of little interest, due to the heterosis effect (DIOP and NDIAYE, 1995). The exotic animals were then transferred to the Niayes area, while a residual nucleus of Guzérat was maintained at the Dahra zootechnical research center (CRZ). From this center, blood was distributed throughout the sylvopastoral zone and the rest of thecountry. Much later, the Ministry of Livestock, as part of its programs and projects, began importing Guzérat animals with a view to increasing milk production and, secondarily, meat production.

Today, it's clear that Guzérat blood is spreading throughout the herds of breeders in the Zone Sylvopastorale. The breed is sought after by a number of breeders, large and small, professional and otherwise. Its uncontrolled spread could, in time, pose a problem of erosion of the Gobra breed genes.

Since the late 1990s, Gobra breeding programs at CRZ Dahra have been in decline. This is partly due to insufficient resources (human, financial, infrastructure, etc.), and partly to the lack of security at the research station, which has led to the deterioration of pastoral resources (pasture, water, etc.) in the center. The aim of the study is to analyze the reproductive performance of three breeds of cattle (Gobra, Guzérat and the products of their crosses) reared at the CRZ de Dahra Djolof during the same period and under the same management. The aim is (i) to analyze the monthly distribution of calvings and fertile matings, (2) to estimate their ages at first calving and their intervals between calvings, (2i) to determine the environmental variation factors influencing these performances and, if possible, to evaluate their effects.

In addition to the introduction, the document comprises four (04) parts: the first deals with the literature review, the second with materials and methods, the third with results and discussion, and the fourth with conclusions and prospects.

II. Materials and Methods

2.1 Study site

The study took place at the Centre de Recherches Zootechniques (CRZ) in Dahra Djolof. This research station, created in 1950 by colonial research institutes, became part of the Institut Sénégalais de Recherche Agricole (ISRA) in 1974. It is located in the sylvopastoral zone of Senegal, commonly known as the Ferlo.

Like the sylvopastoral zone, the Dahra CRZ is characterized by two (2) distinct seasons: a long 9-month dry season (October to June) and a short 3-month rainy season (July to September). The average isohyet for the period (1964-2013) is 339 mm/year. Rainfall is highly irregular in time and space. The average temperature is 29.81±2.17°C, with a maximum of 41.06±0.72°C in May and a minimum of 18.84±0.84°C in January.

Average relative humidity is 43.75±17.02 mm, with a maximum of 72.63±2.67 mm in August and a minimum of 24.95±2.45 mm in February. The vegetation forms a thorny steppe (especially Acacia sp), closely linked to soil type and rainfall.

Figure 1: Map of senegal
Source: https://fr.m.wikipedia.org/wiki/Fichier:Senegal_N3_road.png

2.2 Equipment

2.2.1 Animal material

The animal material on which the work focuses is made up of Gobra and Guzérat zebus and their crosses.

The Gobra zebu is found in the northern regions of Senegal. It is a large, muscular animal, with an average adult height (5-6 years) of 1.23 m for females and 1.33 m for males. Average adult weight varies from 350 to 450 kg for males and 250 to 350 kg for females. On station, however, weights can reach 500 to 600 kg for males and 400 to 450 kg for females. The Gobra is sub-convex, lanky and hypermetic. The coat is generally white or slightly wheaten. Males in particular show brindling and smuttiness. It has a well-developed hump, high lyre-shaped horns, strong at the base and up to 70-80 cm long, a broad sub-concave forehead, protruding eye sockets, and a dark or depigmented muzzle. Milk production averages 1.5 to 2 liters over a lactation period of 6 months. Production can double in the rainy season. Milk is fairly rich in fat (50 g/kg). Fattening is rapid and slaughter yield varies from 48 to 53%. It is an excellent draught animal. It is hardy and adapted to transhumant farming conditions (CISSE, 1992; KABERA, 2007; SARR, 2014).

Guzerat, originally from India in the northern state of Bombay, has been exported to Brazil and the United States. In Senegal, it was first introduced from Brazil in 1963. Males have a well-developed Phrygian hump. The ears are very large, open and pendulous. Coat varies from silver or iron gray to steel black. Its horns are lyre-shaped. At the Dahra zootechnical research center (CRZ), the Guzérat gave a minimum of 201 liters of milk in 133 days of lactation, and a maximum of 1,875 liters in 348 days. In India and Senegal, the breed is used for milk production. Age at first calving is 1618 ± 246.9 days (4-5 years), with a calving-to-calving interval of 480.6 ±11.4 days (LNERV, 1989). In Brazil and the United States (USA), it is used for meat production. In India, the breed is used not only for milk production, but also for animal traction. (KABERA, 2007; SARR, 2014)

2.2.2. Data collection equipment

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The information collected during herd monitoring is recorded on various media. A birth register recording the animal's buckle and thigh numbers, date of birth, and dam and sire numbers. An exit register, which records the date of death or culling, the reason for death or culling, and the cause of death or culling. A weighing register is kept, in which data on the weight of animals is recorded.

A pedigree and progeny register in which each cow's direct ancestors (sire and dam) and descendants (offspring) are recorded. Each member of the family is listed with date of birth, sex and weights at typical ages (0 to 24 months in three-month intervals).

A clinic register in which all sick animals treated at the bouverie are recorded with their number, the date of treatment, the symptoms observed or the suspected disease, the treatments carried out and the progress of the disease.

2.3 Methodology

2.3.1 Herd management

Selection objective, criteria and method

Mass selection is used, i.e. future male and female breeders are chosen on the basis of their own performance.

Indeed, the best calves (20 to 30) are placed after weaning (provoked at 6 months) in a so-called collective pre-testing herd. Then, after a period of 12 months spent on a natural grazing plot, the ten (10) best males, chosen on the basis of their growth rate and conformation, undergo an individual inspection that includes a study of the animal's growth and feed conversion ratio. In addition, post-training semen harvests are carried out on a regular basis, enabling spermatogenesis to be explored. Following this phase, the best 3 or 4 are retained, based on their various performances. They will be tested on progeny by artificial insemination or natural breeding on the station's females.

Dividing animals into batches

Since the end of 2016, the Dahra CRZ herd has been made up entirely of Gobra cattle. Indeed, genetic improvement research is focused on intra-racial selection of the Gobra Zebu. Animals resulting from crossbreeding between the Gobra and the Guzérat were culled to retain only a nucleus of the Gobra breed.

The Gobra herd is subdivided into 3 lots, each led by a shepherd:

✓ two breeding batches, one for heifers, primiparous cows and their calves, and the other for multiparous cows and their unweaned offspring. Each of these batches of breeding females has a sire in service;

✓ a batch of weanling males (aged between 1 and 2 years), or test batch, from which future breeding stock is selected.

Food management

The livestock's diet is essentially based on natural pastures. The animals are grazed twice a day, first at dawn (between 5 and 8 a.m.) and then for the rest of the day (from 10:30 a.m. to dusk). During the first grazing phase, the animals are brought back to the barn to allow the technicians to check their condition and carry out various other clinical or zootechnical interventions. Grazing itineraries are determined according to the quantity and quality of plant biomass available.

At the end of the dry season and during the period between the first rains and the establishment of the grass cover, the animals receive a supplement consisting of bush hay, groundnut hay, feed concentrates and mineral and vitamin complexes.

Watering is provided in the dry season from a trough supplied by the small concession's borehole. The animals have permanent access to water throughout their stay (from dusk to dawn and between 8 and 10 a.m.). In the rainy season, they also use water from temporary ponds.

2.3.2 Veterinary interventions

Animals are regularly vaccinated against botulism, pasteurellosis, anthrax (bacterial and symptomatic), foot-and-mouth disease and lumpy skin disease. They are dewormed at least twice a year against gastrointestinal, blood and external parasites.

2.3.3 Breeding management

The most widely used method of reproduction is breeding on natural heat, with the sire permanently present in the breeding batches. Artificial insemination on induced heat has sometimes been used to group births together during the most favorable period of the year in terms of feeding, and to obtain good growth and better calf survival.

2.3.4 Demographic and zootechnical monitoring

Individual monitoring requires individual identification of all animals in the herd (SISSOKHO, 1985). From birth, calves are identified by a number worn on the ear on a barrette (buckle). Around a year old, after weaning, they are branded on the thigh with a red iron. Until recently, the first digits of the numbers were even for males and odd for females. It is the latter marking that is considered the animal's definitive identifier.

All demographic events (births, other entries, mortalities, culls) are recorded as they occur. All animals are weighed at birth. Weighing continues on a monthly basis for all animals up to 36 months of age. Thereafter, weights are measured quarterly. The information gathered during this demographic and zootechnical monitoring enables us to estimate the parameters of

Data processing

Organization and preparation of data for analysis

The documents used for this report are registers found on site. The information they contain is described above. Based on the above documents, Excel files are created for statistical analysis:

• A "reproduction" file containing the following information for each cow: identification number, breed, date of birth, successive calving dates and their corresponding numbers (or ranks), calf number, sex, sire and genetic type. This file contains a sample of 1,217 cows, including 79 Guzérat, 49 half-breeds and 1,089 Gobra. The number of validated and analyzed calving intervals is 3450.

• A "primiparous" file extracted from the breeding file by selecting calvings with a rank equal to 1. This file includes the cow number, breed, birth and first calving dates, and birth, 6, 12, 18, 24 and 36-month weights. For each primiparous cow, age at first calving (AFC) was calculated as the time interval between first calving and date of birth. The age at first fertilization (ASF) is calculated from the date of calving (DV) and the average length of gestation (DMG) (estimated at 285

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days according to work by DENIS, (1971) and MBAYE, (1999). The age at first calving file contains 1402 validated observations.

Statistical data analysis methods

The data to be analyzed were entered using the Excel component of Microsoft Office 2010, which was also used to produce graphs. Statistical analyses were carried out using SPSS 20 (Statistical Package for Social Science), and the document was entered using the WORD component of Microsoft Office 2010.

Depending on the case, the data were subjected to descriptive statistical analysis (calculation of frequencies, averages and standard deviations) or inferential analysis.

A frequency distribution was made on the months of calving and fertile breeding to determine their repair according to the month of the year.

Correlation and regression analyses were carried out on the relationship between heifer weight growth and age at first fertilization.

Analyses of variance were carried out on VPA and VIF.

For the PVA, the variation factors introduced into the model are the cow's season of birth, its breed (Gobra, Guzérat or Gobra*Guzérat crossbred) and the study period. Subsequent seasons were defined on the basis of months:

• Winter and post-winter season (SHP): July to November;
• Cool dry season (CDS) months of December, January and February;
• Hot dry season (HDS): months from March to June.

The data were subdivided into two periods:

• Period 1 corresponds to calvings between 1965 and 1994;
• Period 2 covers calvings recorded from 1995 to 2017;

For VVI, the factors of variation introduced into the analysis model are the period (1 and 2), the calving season (SHP, SSF and SSC), the genetic type of the mother (Gobra, Guzérat orhalf-breed between the two aforementioned breeds), and the fate (survival or mortality) of the calf in the six months preceding birth.

III. Results and Discussion

3.1 Results

Reproductive efficiency is determined by sexual precocity, the visible signs of which are the age at which the cow calves for the first time, the regularity of calvings and the length of the reproductive career.

3.1.1 Monthly distribution of calvings and fertile matings

Figure 2 shows the distribution of calvings during the study period. For all three breeds, there was a period of concentrated calving. This period runs from June to October (72.7% of calvings) for the Gobra breed, and from June to August (62.5% of calvings) for the Gobra*Guzérat crossbred. For the Guzérat breed, the distribution is bimodal, with the first peak in January (10.5% of calvings) and the months of June and July (31.5% of calvings).

The distribution of fertile matings follows that of calvings (Figure 2). Fertile matings (calculated on the assumption of an average cow management time of 280 days) resulting in these calvings are not evenly distributed over time (months). The peak (68%) for Gobra is between September and December; that for Guzérat*Gobra crosses extends from September to November (61.7%) and that for Guzérat from September to October (28.9%).

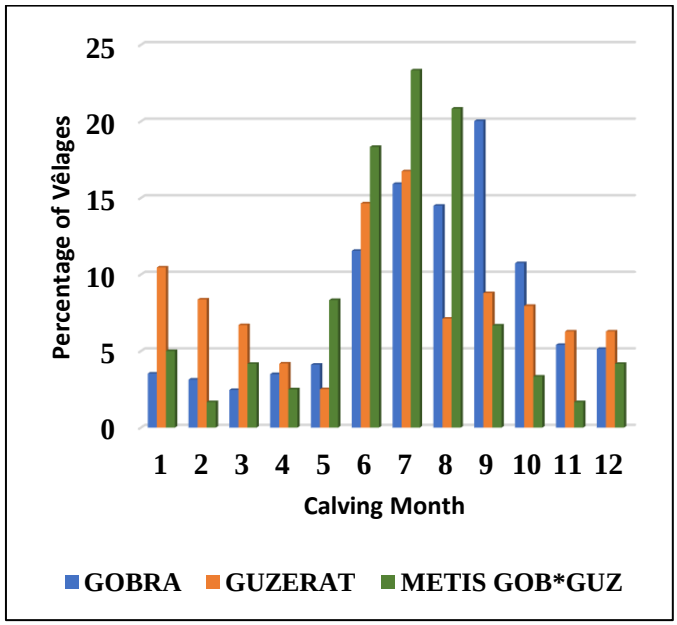

Figure 2: Monthly distribution of calvings by genetic type (Source: Data analyzed)

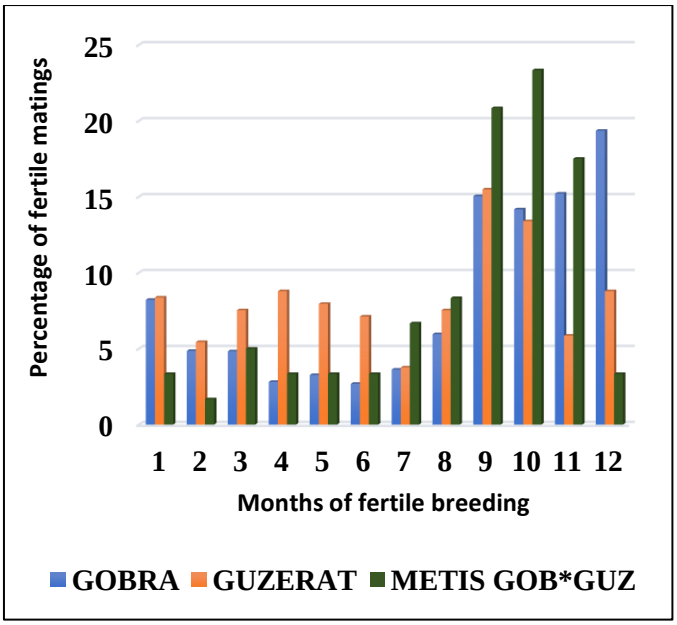

Figure 3: Monthly distribution of fertile breeding Source: Data analyzed

3.1.2 Average age at first calving

Table 1 shows the estimated means of age at first calving (AFC) using the least squares method. Heifers calved for the first time at age 47.7 (standard error =0.3).

Means sharing no letters are significantly different.

The frequency distribution of values (Figure IV) shows that only 12.8% of females calved for the first time before the age of 24 months, and the vast majority (87.2%) calved afterwards.

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TABLE 1: Least-squares averages of age at first calving Source: data analyzed

Variation factors	Workforce	Adjusted averages	Typical errors
Period			
1965-1994	1215	48,53 a	0,66
1995-2017	282	55,76 b	0,76
Calving season			
Cool season	155	52,72 a	0,95
Warm season	417	52,32 a	0,69
Winter and post-winter season	925	51,38 a	0,65
Mother's genetic typee			
Gobra	1341	49,89 a	0,43
Guzérat	93	56,15 b	1,12
Métisse Gobra*Guzérat	63	50,39 a	1,34

Calving period and breed had a highly significant effect (P <0.001) on age at first calving, while maternal season of birth had no influence (P = 0.16) on this parameter (Table 2). Females born between 1963 and 1994 calved 7.23 months (standard error = 0.75) earlier than those calving between 1995 and 2017. Gobra heifers were sexually 6.26 months (P < 0.001) earlier than Guzérat heifers. They had the lowest age at first calving. However, a comparison of their APV with that of the half-breeds showed no significant difference. Gobra*Guzérat crossbreds calved 5.76 months (standard error = 1.79) earlier than Guzérat.

3.1.3 Relationship between weight growth and sexual precocity in Gobra females

The age at first fertilization, calculated on a sample of 200 cows for which the necessary information was available, was 280 kg, with a standard deviation of 49.05 kg. This weight represents 72.5% of the adult female weight calculated by ABASSA (1984). There were significant negative correlations between age at first fertilization and weights at 6, 12, 18 and 24 months. Only birth weight was unrelated to reproductive precocity (Table 2). The strongest correlations were observed at 12, 18 and 24 months.

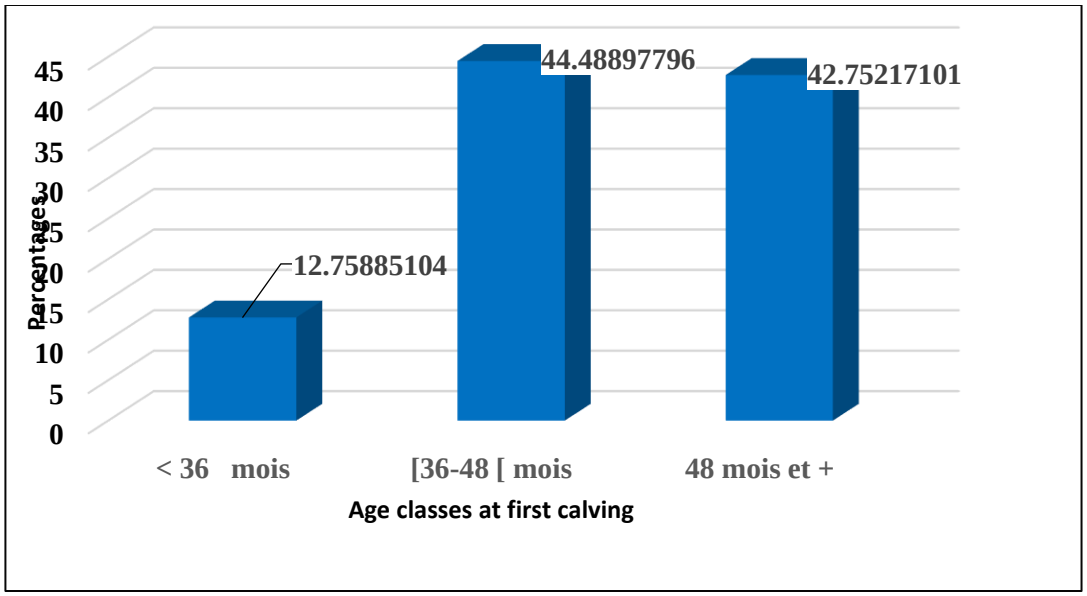

Figure 4: Frequency distribution of age at first calving Source: Data analyzed

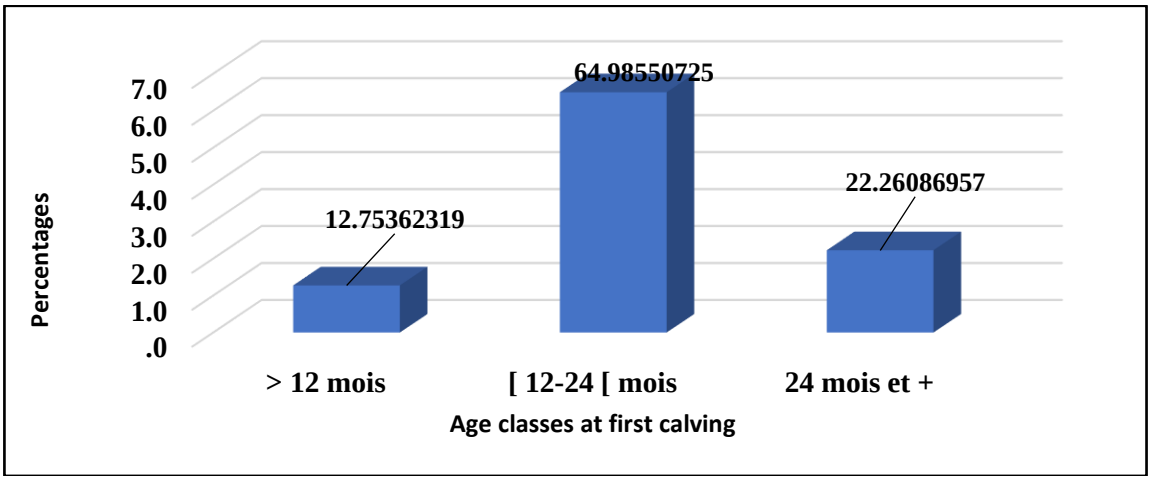

Figure 5: Frequency distribution of VTIs; Source: Data analyzed

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TABLE 2: Correlation between age at first fertilization and weight

	Statistics	P0	P6	P12	P18	P24
Age at first mating	Coef. Corr.	0,128	-0,339	-0,511	-0,496	-0,541
	Signif (P)	0,104	< 0,001	< 0,001	< 0,001	< 0,001
	Workforce	162	176	179	88	175

Linear regressions of average daily gains obtained between birth at typical ages of 12 months (GMQ 0-12) and 24 months (GMQ 0-24) on age were performed to assess their ability to explain and predict age at first mating (Y). The following linear regression equations were obtained:

Y= 47.62 - 0.042 GMQ0-12 (R2 =0.64)

Y= 47.99 - 0.049 GMQ0-24 (R2 = 0.65

3.1.4 Calving interval

The calving interval (CI), calculated by the least squares method on 3,450 data points, was 18.53 (± 0.11) months. The frequency distribution of values grouped into classes (Figure 5) shows that almost 2/3 of intervals are between 12 and 24 months; VTIs under 12 months account for only 12.8% of the total, and those over 24 months contribute 22.3% of the total.

The calving year of the lower limit of the interval, the number or rank, the season, the fate (survival or mortality before 6 months of age) of the offspring and the breed of the dam all significantly (P < 0.001) affected VILI (Table 3).

TABLE 3: Least squares averages (±standard error) of mean calving interval

Sources of variation	Workforce Effectifs	Averages adjusted	Typical errors
What happens to the newborn calf			
Alive after 6 months	3272	19,80 b	0,25
Death before 6 months	178	17,19 a	0,53
Period			
1965-1994	2746	17,26 a	0,35
1995-2017	704	19,73 b	0,37
Calving season			
Winter and post-winter season	2237	17,94 a	0,35
Warm season	715	18,20 a	0,37
Cool season	438	19,34 b	0,42
Mother's breed			
Gobra	3091	18,25 a	0,27
Guzérat	239	17,38 a	0,48
Métisse Gobra*Guzérat	120	19,85 b	0,63
Calving rank			
1	1117	19,97 a	0,36
2	881	18,62 b	0,38
3	612	17,83 b c	0,40
4 et +	840	17,55 c	0,39

Means sharing no letters are significantly different .

Intervals recorded before 1995 were 2.46 (standard error ± 0.29) shorter than those obtained after this period.

Cows whose offspring survived for more than 6 months after calving had a calving interval 2.63 months (± 0.48) longer than those whose calf died earlier.

Guzérat cows had shorter intervals (17.21 ± 0.48 months). They were followed by Gobra cows (18.06 ± 0.27 months) and Gobra*Guzérat crossbreds (19.63 ± 0.63 months). The latter performed statistically worse than the other two genetic types.

There was a tendency for VTIs to decrease as calving rank increased. Intervals between first and second calving (VVI 1-2) were statistically shorter than all others. Intervals between calving ranks 2-3 (VVI 2-3) were also statistically higher than those between ranks 3-4 and 4 and above.

In terms of time of year, the longest intervals are observed for cool-season calving, while the shortest are for calving during the rainy and post-rainy seasons.

3. 2 Discussion

Monthly distribution of calvings and fertile matings

Calving can occur throughout the year, but is concentrated in the pre-winter (June) and winter (July to September) periods. This phenomenon, which reflects favorable periods for conceptions (recorded during wintering and post-wintering), has been reported by numerous authors (DENIS, 1971; CUQ et al., 1974; FALL, 1987, FALL et al., 1982; SISSOKHO, 1998) in tropical breeds. It reflects the importance of the season on the reproduction rhythm. The factors involved in the seasonality of reproduction are probably related to variations in the availability (quantity and quality) of food. The role of food has been clearly demonstrated. It has a clear influence on estrus, making the external signs of heat more visible. DENIS (1971), at the CRZ in Dahra, notes that on a batch of fed and watered females, heat becomes highly visible as and when required. On-farm experiments on cow stalling have also shown that improved feeding conditions are accompanied by an increase in the frequency of conceptions in the dry season (FALL and FAYE, 1992).

Average age at first calving

First calving occurs at a relatively advanced age (4 years on average). This finding corroborates observations made by other authors (DENIS, 1971; SOW et al., 1988) on the Gobra breed bred at the Dahra station. Gobra females have their first calf between 4 and 5 years of age (REDON, 1962). DENIS et al (1978) reduced this age to 15 months at the Dahra CRZ, thanks to good feeding and free watering.

Guzérat heifers had their first calf at a significantly later age than Gobras and half-breeds between Gobras and Guzérat.

The increase in the length of age at first calving between the 1965-1994 period and the post-1994 period can probably be explained by the deterioration in breeding conditions and the lethargy of selection programs. In fact, from 1990 onwards, the operation of genetic improvement research activities was severely disrupted by the absence of researchers specializing in zootechnics/animal genetics at the Dahra CRZ, the reduction in funding allocated to this field of research and, consequently, difficulties in technical management (feeding, health, mating management) of the herd.

Negative and relatively strong correlations have been noted between the average age at first fertilization and the weight at 12 and 24 months, or the growth rate of heifers from birth to these ages. Within the same breed, the faster the growth rate, the lower the age at first fertilization, and therefore the age at first calving. This result is in line with those reported by MBAYE (1999) at the Dahra CRZ. Indeed, the latter found on a batch of heifers that the first ovulations occurred during the wintering season, and that heifers that ovulated during this

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season recorded significantly higher weights than those of heifers that did not ovulate.

The average weight corresponding to age at first fertilization (calculated from age at first calving and average gestation period) is 280 kg. This weight represents 72% of the adult weight of Gobra females calculated by ABASSA (1984). In the same breed, MBAYE (1999), reports that the weight at which the first signs of ovarian activity appear represents 54 - 58% of the average weight of adult female zebu recorded at CRZ Dahra (300 - 320 kg).

As first heats are often not followed by fertile matings, it is difficult to compare our results with those of MBAYE (1999). Furthermore, the weights reported for adult females are different. It would be interesting to carry out studies aimed at determining the average time interval between the appearance of the first signs of heat and the heifers' ability to conceive, using a set-up that would make it possible to highlight factors of variation such as the season.

The estimated mean calving interval is 18.5 months (± standard error= 0.11). Our estimates are in line with previous results obtained at the Dahra CRZ (DENIS, 1971; SOW et al., 1988) and in Nigeria by EDUVIE (1985).

All factors introduced into the ANOVA model, namely breed of dam, season of first calving interval, data collection period and calving rank, significantly affected ($P < 0.01$) age at first calving.

Guzerats have shorter VIFs than Gobras and their Guzerat crosses. The opposite is true for APV. The results of our study therefore do not enable us to identify which of the breeds studied has the best reproductive performance.

The observed trend towards a reduction in VILI with parity could be explained by nutritional

factors. Indeed, primiparous cows have high nutritional requirements, as they have not yet completed their growth when they obtain their first calf. They need to synthesize the body tissues required for growth, as well as covering their reproductive needs. This is probably why they take much longer to return to normal reproductive function after the first calving.

However, as calvings become more frequent, females become more physically mature, and their growth requirements diminish, which explains their greater resistance to post-partum stress. This explains their faster return to heat, which translates into shorter calving intervals.

This phenomenon has been reported by numerous authors, including: SOW et al, 1988 for the Gobra cow, FALL et al, (1982 ; FALL), (1987) ; SISSOKHO (1998) for the Ndama. LVIs are significantly shorter in cows whose calf from the lower limit of the interval dies before reaching 6 months of age (the age formerly set for inducing weaning of calves at CRZ Dahra) than in those whose calf survives beyond this age. Calf mortality before or after 6 months of age is used to test the effect of suckling. Gobra cows raised at CRZ Dahra are not milked. Calf mortality is therefore accompanied by the cessation of suckling. The mechanisms by which suckling or milking negatively affect the resumption of post-partum ovarian activity in tropical breeds are explained by LITTLE et al, (1994), AGYEMANG et al, (1991), EDUVIE and DAWUDA (1986). These authors have shown that the suckling stimulus suppresses LH secretion, thus blocking ovulation and delaying the resumption of ovarian activity after parturition. Nutritional factors could also explain this phenomenon.

Indeed, when early weaning (through calf mortality) eliminates lactation-related stress, the nutrients normally used in milk production are redirected to improve the general condition

of the cow, thus increasing the chances of a new conception.

Calvings in the cool dry season (December, January and February) follow the longest VIFs. These results are in line with the trend observed by SOW et al (1988) at the Dahra station, which shows that calving between November and February results in a slower resumption of ovarian activity after parturition, and hence longer VILI.

IV. Conclusions and Outlook

The present study has made it possible to estimate certain reproductive parameters of the cattle herd raised at the Centre de Recherches Zootechniques de Dahra, and to assess the main environmental and genetic factors of variation through a comparison of two breeds (Zébu Gobra and Zébu Guzérat) and their cross-breeds.

This study shows that the Gobra Zebu is not sexually precocious under the rearing conditions of the breeds used in the genetic improvement schemes. Age at first calving is late (4 years on average) and calving intervals are fairly long (19 months). The concentration of calvings during the pre-winter and winter period (June to October) reflects the existence of a favorable period for fertile matings, which extends from September to December.)

All three breeds studied have satisfactory average reproductive performance under the rearing conditions to which they are subjected, with first calving ages of between 47 and 51 months and average calving intervals of between 18 and 19 months.

The study was unable to identify the most reproductively efficient breed among those studied (Gobra, Guzérat and the products of their crosses). While Gobra and Guzérat cows were found to be more precocious, they also had longer calving intervals. This raises the question of why farmers in the sylvopastoral zone are so keen on Guzérat and Gobra*Guzérat crossbred cattle. This craze is probably due to factors other than.The results obtained revealed, among other things, a depreciation in reproductive

performance over time. In fact, estimated reproductive parameters were poorer during the period 1965-1994 than during the period from 1995 to 2017. This difference is linked to the difficulties of managing animals in terms of feed, health, reproduction, etc.), and the lethargy of the genetic improvement program, relegated to second place in the Institute's guidelines.

The results obtained from this study did not provide any evidence for discriminating between the breeds studied on the basis of their assessed reproductive parameters. The amount of data available on the Guzérat and Gobra*Guzérat half-breed genetic types is small compared with that for the Gobra breed. On the other hand, the spread of Guzérat blood in the sylvopastoral zone deserves research attention for at least two essential reasons. On the one hand, there is the risk of diluting

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the Gobra genes, and on the other, the need to understand the reasons behind the preference for this breed. During the SRA programming workshops, the breeders, while recognizing the zootechnical value and adaptation of the Gobra Zebu to Sahelian pastoral farming conditions, also stressed the importance of owning Gobra animals due to their high market value (all characteristics between the two breeds being equal). The spread of Guzerat blood is such that it is now difficult to find herds in rangeland areas or around watering holes made up entirely of Gobra cattle. Such a situation could eventually lead to a loss of genetic diversity or dilution of Gobra genes, if it is not supported by research as part of the implementation of a national plan for the improvement and management of animal genetic resources.

A number of research avenues are therefore being explored:

• Validate the results obtained on reproduction by using more data on the Guzérat and Gobra*Guzérat breeds whose degree of crossbreeding is controlled;

• supplement the zootechnical studies carried out on the reproductive parameters of the two breeds with work on the reproductive physiology of the Guzérat breeds and their crosses with the Gobra ;

• complete this study by comparing the performance of growth, survival and milk production parameters;

• to better understand the extent of the spread of Guzérat blood in the sylvopastoral zone, its consequences on the genetic erosion of the Gobra, its effects and impacts on the various components (reproduction, survival, growth, milk production, etc.) of productivity, as well as the reasons motivating the introduction of this breed by herding populations.

• relaunch intra-racial selection of the Gobra zebu, given the animal's recognized qualities (aptitude for meat production, hardiness, etc.). This relaunch of the Gobra selection program will necessarily involve strengthening the CRZ's human resources, in terms of both quantity and quality, as well as rehabilitating its infrastructure.

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