

Production and Reproduction Parameters Analysis of N'Dama Cattle Breed in the Dairy Station of Yamoussoukro (SLY), in the Savannah Zone, in Côte d'Ivoire

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Abstract— The reproductions and productions of the N'Dama breed were analyzed on the basis of anucleus breeding of the dairy station of Yamoussoukro in Côte d'Ivoire. Data collections were done from 2010 to 2015. The first calving age varied from 20 to 65 months for an average of 33.20 ± 5.64 months. The interval between calving and the calving – fertilizing insemination of the N'Dama cow varied from 300 to 822 days and from 67 to 233 days for respective averages of 474.10 ± 147.81 days and 166.4 days. On average, the fertility rates in free mating (86.79 %) and in artificial insemination (19.43%) respectively varied from 86.09 to 87.8% and from 9.40 to 26.50%. The gravidity duration was on average 284.25 ± 11.14 days for variation from 244 to 358 days. For the birth weight, it was estimated on average to 17 kg for females and to 19 for males. The average weight of the different age brackets from 1 to 6 ; 7 to 12 and 19 from 24 months were respectively 89.24 ± 17.17 kg, 133.67 ± 20.95 kg and 197.46 ± 39.72 kg for the females and 96.57 ± 16.56 kg, 145.8 ± 33.76 and 244.73 ± 55.94 kg for the males.

Index Terms— Production, Performances, N'Dama Cattle Breed, Livestock, Côte d'Ivoire.

I. INTRODUCTION

The numerical potential of Ivorian livestock is at present estimated to 1 582 652 cattle, 3 031 990 small ruminants (1 700 303 sheep and 1 331 687 goats), 349 739 pigs and 43 133 297 poultries ([19]; [18]). Such animal resources are 95% in traditional breeding and contribute around 4.5% in farm GDP and 2% in total GDP. The livestock breeding sector plays an

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important role in the national economics in the terms of inter-regional balance and of food statute of populations ([24]; [18]). However, the national production of animal based protein is still weak and the Côte d'Ivoire imports almost than the half of its meat consumption 88% of it dairy consumption ([18]). One of the main reasons to that deficit is the miss-knowledge of Ivorian livestock productivity.

The cattle population, one of the priority species in Côte d'Ivoire is made up of zebu and of two trypanotolerant local breeds (N'Dama, Baoulé) in the West Africa ([11]; [8]; [23]). Among that breeds, the N'Dama constitutes a major issue in livestock also in the national programs of breeding development in Côte d'Ivoire as anywhere else in the West Africa.

However, the limited knowledge of the zootechniques characteristics of the N'Dama stays a major issue in the strategy of cattle breeding development in Côte d'Ivoire. In fact, the evaluation in station of zootechnical performance of the N'Dama goes back to 1970s and 1980s ([7]; [5]; [13]; [15]), whereas the most recent date from the 2000s are done in traditional breeding [27]. If the station evaluations have good zootechnique performances of the breed to the fact of the improved breeding conditions, would not it be old to justify the breed performance today? Would the traditional breeding evaluations be objective for appreciating the intrinsic performance of the breed knowing the traditional breeding constraints?

That fact confirms the necessity of studies carrying having the goal of making more precise the characteristics and the performances of reproduction of that important potential of development of cattle breeding which represent the N'Dama in Côte d'Ivoire and also in the West Africa. That is the interest of the present article which aims to analyze the reproduction and production parameters of the N'Dama in breeding conditions in the dairy station of Yamoussoukro.

II. MATERIAL AND METHODS

A. Study site

The study is carried out in the dairy station of Yamoussoukro (SLY) in the centre of Côte d'Ivoire, between latitude $06^{\circ}49$ and $06^{\circ}47$ north and longitude $05^{\circ}16$ and $05^{\circ}15$ west.

The climate of that region of the Côte d'Ivoire is characterized by four alternating seasons (two dry seasons and two rainy seasons) with an average temperature oscillating between 25° C and 38° C and a pluviometer going from 900 to 1100 mm per year. The long rainy season goes

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from mid-March to mid-July and the small season goes from September to mid-November. The dry seasons stretch from mid-November to mid-March for the long season and the small season goes from mid-July to August. The vegetation is pre-forest savannah planted more or less with small trees broken by forest Small Island and with galleries of forest in the lowlands.

B. Animals and their breeding conditions

The study is about the N'Dama breed (fig. 1), from 2010 to 2015. The animals are lead in a semi-intensive breeding system. The reproduction way is the natural mating and the artificial insemination. The main food supply is the cultivated pasture (*Panicum maximum K187B* and *Panicum maximumC1* associated to the legumes *Aeschynomene hystrix*) and the natural pasture which the floristic species are not yet identified and characterized. The animals are lead in pasture from 8.am to 12.Am and from 2 pm to 5pm with a rest from 12 to 2 pm. The complementary food, made up of hay, cotton cattle-cake and of brewery draft are given only during the dry seasons. The licked stone is used for mineral complementation.

The sanitary prophylaxis is done by glossina traps setting and extern deparasy twice per month during the dry season and thrice par month during the rainy season. The extern deparasy start as soon as three months old and keep on every six months. At birth the calves receive an oral suspension of calcium, phosphor and vitamins and dose of spiramycin. There are after deparasited with the sulfadimerazine 33 during the first weeks of the birth.



Figure 1. N'Dama breed herd in the dairy station of Yamoussoukro

C. Registering and analysis of data

The herd is conducted in the pasture by the herd keeper, whereas the technical care taking (rationing, sanitary and medical prophylaxis) is entrusted to breeding technicians. The zootechnical parameters and events regard animals' management were registered in the different sheets conceived for it. Data collection was done in heifer born in the centre from the year 2010 having calved, their mothers from beginning date to the SLY until in 2015. The different evaluated reproduction and production parameters are presented in the table I.

Table I: Different zootechnical evaluated parameters

Reproduction parameters	code	Unity
Age of the first calving	AFC	month
Interval between calving	IBC	day
Interval between calving – Fertilizing insemination	InC-FI	day
Fertility rates	FR	percentage

Gravidity duraton	GD	day
Weight	W	kilogram
Average milk production/day	Milk	kilogram

The reproduction parameters were calculated thanks to the above formula:

AFC = birth date - date of the first calving;

IBC = date of the last calving – date of previous calving;

InC-FI = calving date – date of the fertilizing insemination;

GD = date of serving fecundity - date of calving;

Fertility rate (FR) = number of fertilized cow/ All the cow put in production;

Weighing is done the last Friday of each month thanks to a weighing machine. It takes place the mornings between 6am and 9am per age bracket.

The quantity of milk produced per cow (milk) was estimated from the growth of the calves between the birth and 4 months by the formula : Milk = 9.18 (P4 – P0)/120).

The estimated value in kilogram is conversed in liter by multiplying per the factor 1.0223

To appreciate the different studied parameters tendencies, data collection was submitted to descriptive elementary statistic analysis (frequencies calculation, average and standard deviation). The averages of least square were next estimated and compared by the analysis of variance (ANOVA) with the help of Kruskal Wallis test to the threshold of 5%. That different analysis was done thanks to R software.

III. RESULTS

A. Age of the first calving

The first calving age varied from 20 to 65 month for an average of 33.20 ± 5.64 month with a variation coefficient of 17 p. 100. The cow having calved before the age of 24 months represented only 4.4 p. 100, whereas those having done their first calving at an age between 30 and 36 months represented 61.3 p.100 (fig 2). The modal class corresponded to the class 33-36 month (26.5 p. 100).

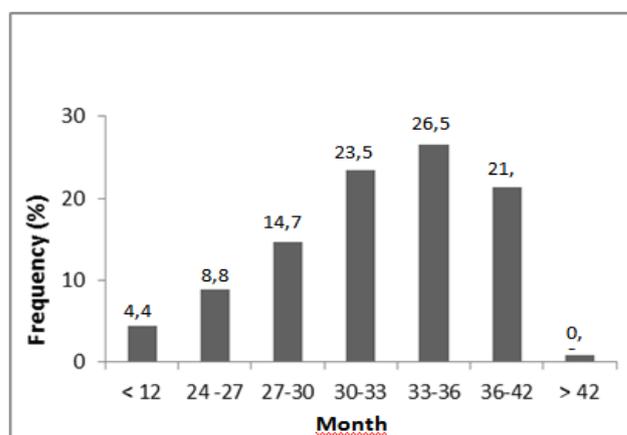


Figure 2: Distribution of the age frequencies at the first calving (n = 136)

B- Interval between calvings

With a coefficient of variation of 31.2%, the interval between calving was on average 474.10 ± 147.81 days for variations going from 300 to 822 days. It was inferior to 360 days for 16.9 p. 100 of cows, between 366 and 547 days for 66.7 p. 100 and superior to 547 days for 16.4 p. 100 of cows (figure 3).

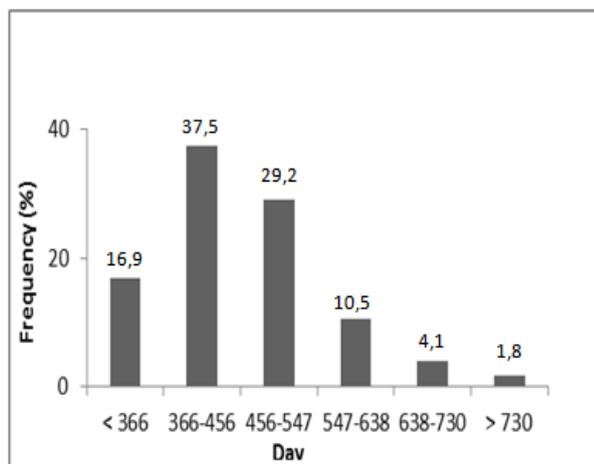


Figure 3: Distribution of interval frequencies between calving (219)

C. Calving -fertilizing insemination interval

The calving – fertilizing insemination interval was on average 166.4 days (be it 5.48 ± 3.97 months), with a variation coefficient 72.4 p. 100. It varied between 67 and 233 days. The interval was inferior to 90 days for 39.7 p. 100 whereas only 8.2 p. 100 have had a calving-fertilizing insemination interval superior to 365 days (fig 4).

D. Fertility rates

The fertility rates calculated for the different ways of reproduction are presented in the figure 5. The fecundity rates varied from 86.09 to 87.8% in natural mating and from 9.40 to 26.50% in artificial insemination (IA) for the respective average of 86.79 % and 19.43%.

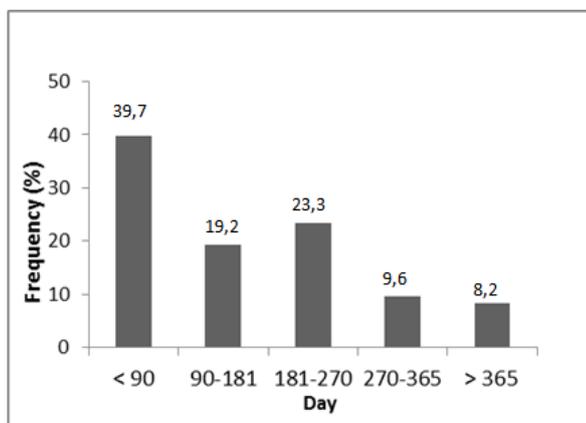
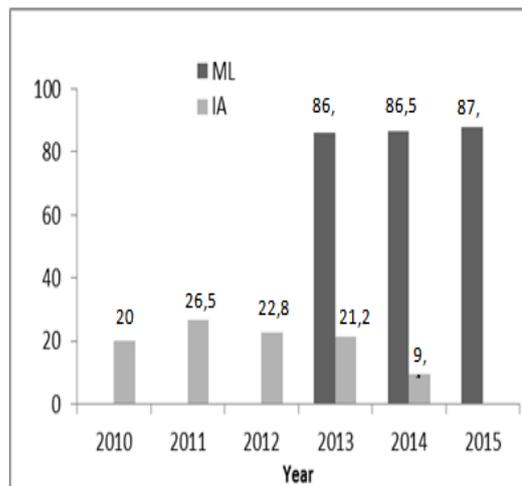


Figure 4: Distribution of interval frequencies between calving and fertilizing artificial insemination (n=73)



ML= Free mating , IA = Artificial Insemination

Figure 5: Distribution of the fertility rates of the ways of reproduction according to the years

E. Duration of gravidity

It was on average 284.25 ± 11.14 days (be it 9.47 ± 0.37 month) for a variation coefficient of 3.9 p.100. It varied from 244 to 358 days and the modal corresponded to the class 280 - 290 days (42.7 p. 100) (fig 6).

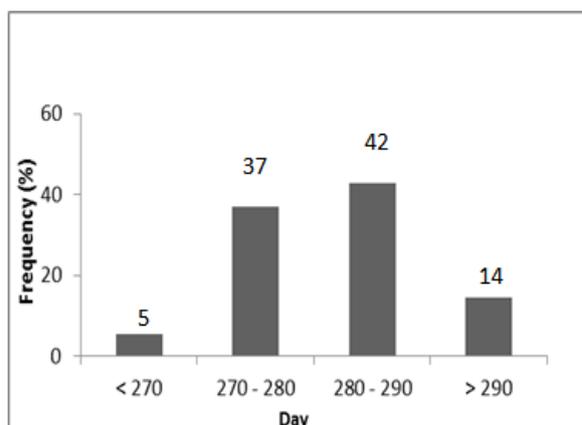


Figure 6: Distribution of the gravidity duration frequencies of N'Dama cows (n = 89)

F. Different age bracket weight

The table 2 shows the results of the analysis of the different age bracket weight variance. Apart from animals from 1 to 6 months, the sex has a significant effect on the weight ($p < 0.05$).

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Table II: Arithmetic average weight (kg) and standard deviation of the different age bracket

Age type	Female	Male	p	$\bar{y}_M - \bar{y}_F$
1- 6 month				
N	70	14		
A	89.24	96.57	0.063	NS
δ^2	17.172	16.561		
7 -12 month				
N	63	15		
A	133.67	145.8	0.002	***
δ^2	20.958	33.762		
13 -18 month				
N	63	13		
A	166.70	202.570	0.000	***
δ^2	31.570	48.821		
19 -24 month				
N	72	15		
A	197.46	244.73	0.000	***
δ^2	39.726	55.942		
25 -30 month				
N	84	18		
A	224.49	283.61	0.000	***
δ^2	35.422	68.978		

N = number of animals, *A* = average, δ^2 = standard deviation, $\bar{y}_M - \bar{y}_F$ = difference between the arithmetic average of female and male weight, * significant to the threshold of 5% ($P < 0.05$); NS: no significant ($P > 0.05$)

G. Average production of Milk

The estimated quantity of milk per day per cow varied from 0.3 to 6.1 kg be it from 0.31 to 6.25 liters for an average of 3.79 kg (3.87 liters). Only 5.5 p.100 and 16.1 p.100 of cow have had an average milk production inferior to 2 kg/day and superior to 5kg/day respectively. With a proportion 47.7 p.100, the cow class which average production varied between 2 and 4 kg constituted the modal class (fig 7).

H. Weight growth

The comparison of the growth of N'Dama male and female is presented on the figure 8. The average weight at birth is 19 kg for the males whereas it is 17 kg for the females. During the first 30 month, the males had on average a growth rate higher than those of the females. The difference was observed from 2 month old until to the age of 29 months to cancel each other out at 30^{ème} and 31^{ème} months (figure 8). From the age of 32 months, it is the females' growth rate which becomes higher (5 kg) than those of males. The males weight hold steady to 225 kg from 32 months whereas those of the females hold steady (to 235 kg) to one month later.

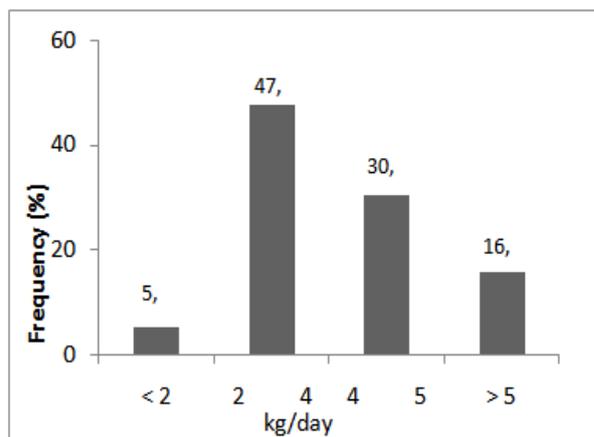


Figure 7 : Distribution of frequencies average estimated milk production/day/cow (n=254)

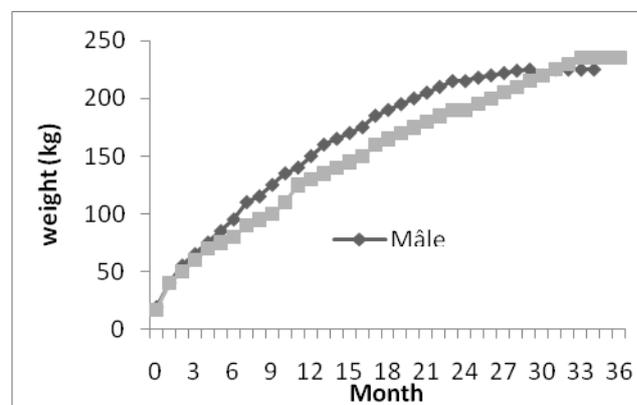


Figure 8: Curve of N'Dama males and females growth

IV. DISCUSSION

The first calving age of 33.20 ± 5.64 month observed to the N'Dama at the dairy station of Yamoussoukro is near to 35 months 17 ± 29 days obtained by Coulomb [7] to CRZ of Minankro Bouaké. But these results are superior to 43 and 40 months age on the first calving obtained on traditional breeding by [29] and [27] respectively and even to those (48 month ± 10 days) observed at the breeding station of Okpara in Bénin [30]. In addition, the weight growth curve showed that the corresponding weight to the age of the first calving of the N'Dama is 235 kg and that the sexual maturity is attained between 27 and 28 for weights going from 205 and 210 kg. That values are near those observed by many authors such are [7] and [22], [17] in Côte d'Ivoire and [16] in Ghana. Therefore, the weight at the sexual maturity at the dairy station of Yamoussoukro stays superior to those from 175 ± 20 to 184.6 ± 21 kg observed by [16] and [20] in Ghana ; [21] and [17] in Côte d'Ivoire and [2] in Congo. The relative precocity of the N'Dama females observed in the dairy station of Yamoussoukro can be explained not only by the good mastery of the breeding conduct technique (feeding, sanitary and medical prophylaxis), but also by the constant presence of bulls in the heifer herd from 22 to 24 months. The presence of the males would have a catalyzing effect on the sexual maturity of the females.

The interval between the averages calving of N'Dama cows was of 474.10 ± 147.81 days for average fecundity rates of 86.79 % for natural mating and 19.43% for the artificial

insemination. That average interval is longer than the recommended standard value, which is expressed by "one calf per year", and by the intervals between calving of 420 ± 9 ; 360 ; 428 ; 457.0 ± 12.0 and 441.06 ± 136.88 days, determined by Coulomb [7], Bosso *et al.* [4], Akouango *et al.* [2], Sada [26] and Yesso *et al.* [30] respectively. But such values stay inferior to those observed by CIPEA [6] in traditional area (18 and 24 months) and in station (14 and 15 month). In the said study the fertility rates in free mating neatly stays superior to that of the artificial inseminations. That situation can be understood by the technical constraints (quality of seeds, adequate food, conditioning of seeds ...). However, the good fertility rates in free mating agree with the observed values by many authors such as Coulomb [7] and Sokouri *et al.* [27] in Côte d'Ivoire and Youssao *et al.* [31] in Bénin. However, the interval observation between prolonged calving in the present study should be expressed by the weak succeeded rates of the first fertilizing insemination as shown by the weak fecundity rates in artificial insemination. By the way, the interval between calving and fertilizing insemination was on average 163.54 ± 118.95 days. The ideal value of that parameter is of 90 days, be it 3 month of interval between calving and the first insemination. Other studies gave different results for the same N'Dama. Kanga *et al.*, [14] and Akouandjo *et al.*, [2] obtained in traditional area 136 days and 165.1 days respectively.

The average duration of the gravidity of the N'Dama in the dairy station of Yamoussoukro was 284.25 ± 11.14 days (be it 9.47 ± 0.37 months). That value is close to 284.7 ± 1.5 days ([2]) and to 288 ± 7 days ([22]) in Côte d'Ivoire, to 292 ± 5 days ([16]) in Ghana and to 280.1 ± 7.96 days ([14]) in Guinée.

In the dairy station of Yamoussoukro, the average weight obtained at birth (17 kg for the females and 19 kg for males) is close to those measured such as by many authors Coulomb [7] in station and in traditional breeding in Côte d'Ivoire where it was 17.7 kg for the males and 16.7 kg for females [12]. The weight at birth respectively for females and males was 17.23 and 17.63 kg in Bénin ([31]), 16.8 et 17.5 kg in Guinée ([10]), 17 and 18 kg in Sénégal ([9]) and in Cameroon ([1]; [28]), 15.9 and 18.1 kg in Nigeria [25]. Those values are similar to those observed in the present study. But, in extensive breeding in Mali, the males had a weight of 15.4 kg and the females, 14.8 kg ([21]). Those performances are inferior to those observed in the dairy station of Yamoussoukro.

However, the daily estimated of milk production average was 3.87 liters. That value is near those observed in improved area ([7]; [3]; [29]), But superior to the values going from 0.4 to 0.8 liters/day obtained in traditional area ([3]; [29]).

One of the study constraints was the impossibility to take the weights at the birthday of all the animals. Thus, all comparison of the weight at different age type stays suggestive in the sense that we rather calculated the average weight of the age bracket instead of the average weight at the age type. However, the superior bound of age bracket being

the age types, the corresponding averages to the age brackets are under estimation of age types.

In the breeding farm of Okpara in Bénin, the average weights of the young was estimated to 6 month, 12 month and 24 month to 55.55 kg, 95.9 kg and 158 kg respectively [31]. Those different weight are much less important than those obtained to the young N'Dama from 1 to 6 month (89.24 ± 17.17 to 96.57 ± 16.56 kg), from 7 to 12 months (133.67 ± 20.95 to 145.8 ± 33.76 kg) and from 19 to 24 month (197.46 ± 39.72 to 244.73 ± 55.94 kg) in the dairy station of Yamoussoukro. But, that weights stay close to those obtained by Coulomb ([7]) in Mali and in Côte d'Ivoire (120.7 to 129.7 kg at the age of 12 month and from 190.9 kg to 227.4 kg at 24 months) and by Roberts *et al.* ([25]) in Nigéria (92.1 to 95.0 kg at the age of 6 and of 120.7 to 137.4 kg per one year).

IV. CONCLUSION

N'Dama breed in the breeding conditions in the dairy station of Yamoussoukro, presented on average reproduction and production performances better than traditional area breeding and even certain stations. However, the effects of certain factors of production which were not taken into account in the present study deserve to be tested in order to better understand their impact on the productivity of the breed. In addition, the studied reproduction and production parameters revealed a variability showing the heterogeneity of that N'Dama population. That fact help understand that a selection of the N'Dama race on the said parameters in optimal breeding conditions can permit to have efficient animals for a basis of the N'Dama breed in Côte d'Ivoire and even in the tropical humid zone of the West Africa.

REFERENCES

- [1] K.O. Adeniji, (1985). Review of endangered cattle breeds of Africa. D : Animal genetic resources in Africa High potential and endangered livestock. - Nairobi: OUA/STRCIIIBAR publication. - 20p
- [2] F. Akouango ; C. Ngokaka ; P. Ewomango et E. Kimbembe. (2010). Caractérisation morphométrique et reproductive des taureaux et vaches N'Dama du Congo. *Anim. Genet. Resour.*, 46 : 41-47.
- [3] C. Adama, N. Aman, P. Atse, M. Burhin et P. Chasset. (1989). Propositions pour une politique génétique bovine à l'horizon 2000. Document du comité génétique Recherche Développement, Ministère de la production animale ; SODEPRA-nord, Korhogo, et Ministère de la recherche scientifique ; IDESSA, Bouaké ; 20p2015.
- [4] N.A. Bosso., Waaij Van Der, A.K. Kahi, J.A.M. Van Arendonk. (2009). Genetic analyses of N'Dama cattle breed selection schemes. *Livestock Research for Rural Development*, 21 (8): 1-11.
- [5] J. Charray, J. Coulomb et J.C. Mathon. (1977). Le croisement Jersiaise x N'dama en Côte d'Ivoire. Analyse des performances des animaux demi-sang produits et élevés au CRZ de Minanko. *Rev. Elev. Méd. Vét. Pays trop*, 30(1) : 67-83.
- [6] CIPEA. (1979). Monographie. Le Bétail trypanotolérant d'Afrique occidentale et centrale. Tome 2. Situations nationales. 311p.
- [7] J. Coulomb. (1976). La race N'Dama. Quelques caractéristiques zootechniques. *Rév. Elev. Méd. Pays Trop*. 29 (4) : 367-380.
- [8] G.D.M. D'Ieteren. (1994). Trypanotolerant livestock, a sustainable option for increasing livestock production in tsetse affected areas. In: Rowlands, G.J. and Teale, A.J. (Editors), Towards increased Use of trypanotolerance: Current Research and future options. Proceedings of a Workshop organised by ILRAD and ILCA, Nairobi, Kenya: 3-14.
- [9] M. Diop. (1995). Recherche dans les bases de données. N'Dama (Côte d'Ivoire, Sénégal et Bénin) <http://dad.fao.org/cgi-dad>. ; FAO, Rome. URL <http://dad.fao.org/fr/home.htm>

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- [10] H. Diallo. (1995). N'dama Guinée. Accès Internet: URL <http://dad.fao.org/fr/home.htm>
- [11] H. Epstein et I. L. Mason. 1984. Cattle. In: Evolution of Domesticated Animals. (1st ed). (Mason I.L. ed) London: Longman. pp 6-97.
- [12] FAO. (1995). Recherche dans les bases de données. N'Dama (Côte d'Ivoire, Sénégal et Bénin) <http://dad.fao.org/cgi-dad>. ; FAO, Rome.
- [13] C. Hoste, L. Cloe, P. Deslandes, J.P. Poivey. (1983). Etude de la production laitière et de la croissance des veaux de vaches allaitantes N'Dama et Baoulé en Côte d'Ivoire. I. Estimations des productions laitières. Rev. Elev. Méd. Vet. Pays Trop (2) : 197-205.
- [14] W. A. R Kamga., F. M. Mbaindingatoloum, R. A. Lapo, O. Thiam, J. Sultan et P. E. H. Diop. (2006). Caractéristiques de reproduction des N'dama utilisées en insémination artificielle en République de Guinée. RASPA vol. 4 N°1 et 2 : 69-72.
- [15] L. Lettenneur. 1983. Crossbreeding N'Dama and Jersey cattle in Ivory Coast. In: FAO eds, Animal Production and Health. Rome Italy,1983;37:1-5.
- [16] P. Gyawu ; S.A. Osei, P.K. Karikari, F.A. Kwarteng et K. Asaré. (1989). Use of radioimmuno assay to monitor reproductive performance of indigenous cattle in the humid forest zone of Ghana. In : " Second workshop on the reproduction of the trypanotolerant livestock in west and central africa". Banjul (the Gambia), FAO RAF/88/100, p32.
- [17] C. Meyer et P. Yesso. (1991). Etude des chaleurs des vaches trypanotolérantes Ndama et Baoulé en Côte d'Ivoire. In Particularité des composantes comportementales et organiques. Revue Elev. Méd. Vét. Trop. : 44 : 199-206.
- [18] MIRAH. (2014). Plan stratégique de développement de l'élevage, de la pêche et de l'aquaculture en Côte d'Ivoire (PSDEPA 2014-2020). Tome I : Diagnostic – Stratégie de développement – Orientations. Abidjan, Côte d'Ivoire. p102.
- [19] MIRAH-DPP. (2012). Annuaire des statistiques des ressources animales et halieutiques. Direction de la Planification et des programmations, Ministère des Ressources Animales et Halieutiques, Abidjan, Côte d'Ivoire, 26p.MIRAH-DPE, 2003.
- [20] S. A. Osei ; P.K. Karikari ; A.K. Tuah ; P. Gyawu; R.S. Opoku; M. Asiamah et D.C.Heathcote. (1991). The reproductive performance of indigenous beef cattle breeds raised on farm Ghana. In : "Third workshop on the reproduction of the trypanotolerant livestock in West and Central Africa". Banjul (the Gambia), FAO RAF/88/100, 19-35.
- [21] D.,Planchnault, S.H. Tall & M.T. Traoré. (1984). Amélioration génétique des bovins N'Dama : Caractéristiques du bétail N'Dama au ranche de Madina-Diassa. Rev. Elev. Méd vét. Pays trop., 37 (4): 488-495
- [22] A. Ralambofiringa. (1978). Note sur les manifestations du cycle œstral et sur la reproduction des femelles N'Dama. Rév. d'Elev. Méd. Vét. Pays Trop., 31(1): 91-94.
- [23] J.E.O. Rege et C.L. Tawah. (1999). The state of African cattle genetic resources II. Geographical distribution characteristics and uses of present day breeds and strains. Animal Genetic Resources information. (26): 1-26.
- [24] RNA. (2001). Analyse des données, niveau national. Direction des statistiques, de la documentation et de l'informatique (DSDI).
- [25] C. J. Roberts et A. R. Gray. (1973). Studies on trypanosomose resistant caUle. 1. the breeding and growth performance of N'Dama, Muturu and zebu caUle maintained under the same conditions of husbandry Trop Anim. Health Prod. , 5, 211 - 219
- [26] I. Sada, 1968. The length of the gestation period, calving interval and service period in indigenous West African cattle: N'Dama, West African Shorthorn and Sokoto Gudale. Ghana J. Agric. Sci., 1: 91-97.
- [27] D.P. Sokouri, C.V. Yapi-Gnaore, A.S.P. N'guetta, N.E. Loukou, B.J. Kouao, G. Toure, A. Kouassi et A. Sangare. (2010). Performances de reproduction des races bovines locales de Côte d'Ivoire. J. Appl. Biosci. (36): 2353- 2359
- [28] C. L. Tawah et D. A. Mbah. (1989). Cattle breed evaluation and improvement in Cameroon : A review of the situation. - Ngaoundéré : IRZ Wakwa.
- [29] C.V. Yapi-Gnaoré, B.A. Oya. Z. Ouattara. (1996). Revue de la situation des races d'animaux domestiques de Côte d'Ivoire. Bulletin d'information sur les ressources génétiques animales. N°19 :100-108.
- [30] P. Yesso; C. Meyer et K. Doffangui. (1991). Reprise post- partum et cyclicité des vaches trypanotolérantes en fonction de la variation saisonnière en région centre de Côte d'Ivoire. In : " Troisième Atelier de travail sur la reproduction du Bétail trypanotolérant en Afrique de l'Ouest et Centrale". Banjul (Gambie), FAO RAF/88/100, 36-54.
- [31] A.K.I. Youssao, A. Ahissou, Z. Toure. (2000). Introduction de la race bovine N'Dama à la Ferme Élevage de l'Okpara au Bénin. Quelques performances zootechniques. Anim. Genet. Ressource Information 27, 17-25.