


Review

Current Knowledge on the Lagune Cattle Breed in Benin: A State of the Art Review

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Abstract: This paper summarizes the information on the Lagune cattle breed and its production systems in Benin available in peer-reviewed journals, conference papers and research reports covering the period from 1970 to 2020. Lagune cattle are kept in two production systems in Benin: the improved ranching system established at the Governmental farm of Samiondji, where most of the published studies on this breed have been achieved, and the village traditional production system. This breed has a small size with short horns. Reported adult weight varied from 140 to 180 kg for male and from 100 to 140 kg for female. Lagune cows are bad dairy. The breed plays an important role in the livelihoods of the rural people and has many functions, including cultural, ecological, socio-economic, savings and income provision roles. Most of the reports emphasizes its low productivity, which might rather be more related to its poor management conditions than to its genetic potential. The Lagune breed is reported to have adaptive traits such as tolerance to drought and heat, and resistance to ticks and diseases. In 1975, the Government of Benin, having realized the risk of the disappearance of this breed, devoted the Samiondji Farm to its ex situ conservation and set up a purebred multiplication herd. Since then, there have been very few efforts to comprehensively characterize this breed and its productivity under smallholder production systems. Consequently, the opportunities for its in situ conservation, management and sustainable use by the rural communities are not sufficiently explored.

Keywords: on-farm productivity; opportunities for conservation; smallholder; West African short-horn cattle; underutilised breed



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1. Introduction

The development of livestock farming, especially cattle, has been recognized in Benin as in all other West Africa countries [1]. Its importance in supporting food security and livelihoods in rural communities has been unshaded [2]. Local cattle genetic resources kept in the traditional farming systems of Benin encompass *Bos taurus* (Lagune breed, Somba breed), Sanga cattle (Pabli and Borgou cattle), different zebu breeds introduced within the context of transhumance, imported breeds (N'dama, Gir, Girolando, Azawak) raised on governmental farms, and various types of nondescript crossbreeds. Livestock farming represents the second activity of the country's agricultural sector with a national herd size estimated to be more than 2,500,000 heads of cattle in 2019 [3].

The northern region of Benin, previously recognized as the main pastoral region of the country, has no longer adequate pastoral resources to support the increasing number of herds [4]. In the search of better grazing lands and water for their animals, cattle herders have been increasingly moving toward the south into the natural habitat of the taurine Lagune cattle [5], whose population size is sharply decreasing owing to indiscriminate crossbreeding and inappropriate husbandry practices [6]. This movement of cattle herds, mainly of zebu breeds, from the semi-arid to the most humid zones poses a serious

threat to the genetic integrity of this valuable trypanotolerant taurine Lagune breed [6,7]. Furthermore, the purity of this indigenous smallholder cattle breed is threatened by the institutional policies set by the Government of Benin to support the importation and use of exotic breeds [8].

Mainly found in coastal areas and near the lagoon in southern Benin [9], the Lagune cattle is threatened with extinction without being objectively characterized and subjected to a sound genetic improvement and conservation program. Its loss will represent a disaster for food security, as maintaining cattle genetic diversity is crucial for responding to rapidly changing market demand and production challenges [10,11]. The Lagune cattle deserves to be safeguarded for its sustainable use in traditional smallholder production systems where it is mainly found. Endowed with remarkable rusticity and excellent ability to adapt themselves to local environmental conditions and parasitic diseases prevalent in South Benin, Lagune cattle have been poorly used for intensive meat production [12]. This review aims not only to summarize the state of current knowledge on this breed but also to discuss threats and opportunities as well as past and current efforts for its conservation.

2. Materials and Methods

The literature in this review has been drawn from previous studies that constitute the available data-bases on the Lagune cattle breed. We conducted a focused search for every article related to (1) Lagune cattle, (2) Bovin Lagunaire, (3) Lagoon cattle, and (4) West African dwarf shorthorn cattle using the three major web-based academic search engines, namely, Web of Science, ScienceDirect, and Google Scholar. This search, performed between 2017 and 2021, was extended to available dissertations, conference proceedings, theses and research reports covering the period from 1970 to 2020. In total, fifty-four (54) original articles, eleven (11) research reports, seven (7) theses and dissertations, and three (3) conference proceedings, that only focused on Lagune cattle breed, have been included in this review article. The keywords used included Lagune cattle status, breeding practices, farm productivity, genetic and morphological characterization, disease resistance, threats and opportunity for in situ conservation.

3. Results

3.1. Geographical Distribution Area and Current Status

Additionally, called Lagoon cattle or Dahomey cattle breed, as it is a native of Benin Republic [13,14], formerly called Dahomey, the Lagune cattle is found in coastal areas and near the lagoon in southern Benin, Togo, Ivory Coast, Ghana, Gabon, Guinea-Bissau and Liberia [13–15]. As most of the breeds in Sub Sahara Africa are named referring to their region of origin, coat colour, colour pattern or horn size [16,17], the same Lagune breed is encountered and known in other countries under different names as follows: Lagoon in Ghana, Manjaca in Guinea-Bissau and Mayombe in Democratic Republic of Congo. It was imported from Benin and raised in Germany, where it is known under the name of Dahomey cattle [18,19].

In Benin, this breed was mainly found in the departments of Atlantic, Mono, Oueme and Zou, an area stretching from the coast to the north of Abomey [13,20]. Although there was no formal breed census, the national herd size of Lagune cattle was estimated at 4000 in Ivory Coast and at 40,000 in Benin in 1985 [13,21]. Since then, this number has been decreasing [22,23]. In the World Watch list for domestic animal diversity [22], the Lagune cattle was reported as threatened with extinction. Consequently, it was considered at having a critical status. As there have been no recent estimates for this breed, its current status is unknown.

3.2. Production Systems

Livestock breeding in Benin is characterized by a predominance of mobile pastoral and agro-pastoral production systems with a remarkable progressive shift toward sedentary systems [5]. The cohabitation of these various livestock production systems with crop

farming, whereby livestock and crop farmers share the same pastoral resources, namely, land and water, has created recurrent and escalating violent conflicts among these different stakeholders [24,25].

The Lagune cattle breed generally evolved in sedentary production systems in its geographic distribution areas that ranged from southern Benin until to central Benin [5]. However, the production systems varied according to region and socio-linguistic groups. Keeping Lagune cattle under coconut or oil palm plantations was mainly developed in the southern regions, particularly in the southwest region of Ouidah [26]. The tethering system in which animals are kept at stake around houses in the villages was more observed in small farms where herd sizes varied from 2 to 15 heads [15,26,27]. Based on their geographic location, the age and socio-cultural background of the breeders, the herd size and breed composition, and the management practices, the latter author distinguished four Lagune cattle farm types in the Oueme Valley. However, while this study, one of the rare that focused on smallholder Lagune cattle production systems, revealed a diversity of farm types, it was limited in its geographical scope. Nonetheless, it has shown that smallholder breeding practices need to be improved for sustainable production systems.

3.3. Morphological Characteristics

The Lagune cattle (Figure 1) is a West African dwarf shorthorn cattle type described as a small-bodied animal, blocky in conformation with short and fine-boned limbs [15,21,28–30]. It has a compact body, no hump, a straight back, and a broad head. The face is slightly dished, and the horns are very short. The dominant coat colour is generally black, white, pie black, black pie [21,28–30]. Some linear traits have been measured in the Lagune cattle by several authors. Reported average height at withers varies from 80 to 100 cm for adult females and is about 105 cm for adult males [15,21]. It varies from 80.6 to 96.2 cm according to Domingo [20] and was estimated at 82.2 ± 2.4 cm by Traoré et al. [31]. The heart girth averages 110.5 ± 4 cm [31] and ranges from 102.8 to 136.3 cm according to Domingo [20]. The scapula-ischial length varies from 92.3 to 119.7 cm for 1.2 to 5 years old animals, respectively [20]. The body length (from lateral tuberosity of the humerus to tuber ischii) averages 98.9 ± 3.4 cm [31].



Figure 1. Lagune cattle bull.

Some studies have shown that animals from the humid coastal savannah have significantly longer and deeper bodies and are taller than those from the humid forest zone [20,28,29]. However, the reported ratio of heart girth to height at withers for this breed varies from 1.36 to 1.53 and shows that the Lagune is more compact than the Savannah Shorthorn cattle [20,28,29].

Furthermore, studies carried out by Gbangboche et al. [12] and Ahozonlin et al. [32] revealed a sexual dimorphism in morphological characteristics in Lagune cattle that explains the observed differences between males and females in their growth performances [6]. Indeed, the growth performances and productivity of male and female animals are controlled by differential hormonal effects with faster growth of male animals [12]. Gbangboche et al. [6] developed some models for predicting live bodyweight from linear body traits while accounting for this sexual dimorphism.

Altitudinal variation of a region or country plays an important role in the morphological variability of the animal population [33,34]. Originally, the Lagune cattle of Benin were mainly found in the southern provinces of the countries, namely, the departments of Atlantique, Mono, Oueme and Zou, an area stretching from the coast to the north of Abomey [13,20]. However, its current geographical distribution is unknown. This breed has also been recently found in traditional cattle herds in the municipality of Savalou at the Centre of the country [5,35]. A comprehensive characterization of Lagune cattle production systems, with the related smallholder farmers' technical knowledge, is missing but is necessary to assess the productivity of this breed in the village traditional system and develop strategies for improvement. Furthermore, very scanty information on its morphological and genetic characteristics is available.

3.4. Genetic Characterization

The West African region harbours a rich genetic diversity of indigenous cattle breeds [9,14]. Although at least 150 indigenous African cattle breeds have been named, and most of them, including the Lagune breed, remain largely insufficiently characterized [36]. However, a proper assessment of the genetic diversity within and between a breed is a prerequisite for its proper use and conservation [37]. Hence, it is fundamental to phenotypically and genetically characterize these local breeds in order to safeguard their specific characters before their substitution and absorption by other breeds [38]. The phenomenon of absorption is particularly true of the West African taurine breeds, which are exposed to increasing introgression of indicine cattle breeds [39]. In Benin, as very little comprehensive research work has been carried out on the genetic characterization of the Lagune cattle breed, very little is known about its intra-population genetic variability, its specific features and the role of agroecology in its ability to resistance to parasitic diseases.

Moazami-Goudarzi et al. [40] demonstrated the originality of the Somba and Lagune breeds. These authors further established the phylogenetic status of the Somba breed, as well as the genetic divergence between the two breeds. Additionally, Foulley and Ollivier [41] argued that the Lagune cattle breed has both allelic and genetic diversity and contributed to whole diversity whereas the Somba cattle breed only contributed to the allelic diversity. Some recent papers fail to discern between the Lagune and the Muturu, another West African dwarf shorthorn found mainly in Nigeria and Ghana. However, as highlighted by the research works of Aboagye et al. [29], the Muturu cattle have a sequence of Hb different from that of other West African Shorthorn cattle and N'Dama cattle. According to these authors, this result suggests that Muturu cattle is genetically different from the other cattle breeds. Similarly, Decker et al. [42] showed that, in contrast to other West African taurine breeds, the Lagune revealed no indicine ancestry and concluded that the Lagune cattle has pure taurine ancestry. The original genetic diversity of Lagune cattle was further investigated and established [40,41] but the part of this genetic diversity due to the environment was not revealed.

3.5. Reproductive and Productive Performances

Not only are there relatively few studies that investigated the productivity and reproductive performances of Lagune cattle, but they have been conducted on-station under improved management conditions [6,12,43–45]. Their results showed that some fixed factors, such as sex, calving number and year of birth, significantly affected Lagune cattle growth traits in the aforementioned conditions [6], but also revealed that sex and year of birth

did not affect the average daily gain (ADG) and birth weight (BW), respectively. BW and weight at weaning (WW) varied from 11.65 ± 0.20 to 17.40 ± 0.33 kg and from 70.21 ± 0.17 to 117.00 ± 0.20 kg, respectively. ADG varied from 141.18 ± 4.80 to 248.90 ± 6.25 g. In contrast, data on the productive and reproductive performances of Lagune cattle under smallholder or village conditions in Benin and information on the influencing factors are very scarce and very old. According to several authors [21,28,46], BW averages 10 kg for male animals and ranges from 10 to 12 kg for female.

The reproduction performances of Lagune cattle might be strongly influenced by the production systems. Calving rates ranged from 34.0 to 45.0 percent and from 42.0 to 49.0 percent under the traditional breeding system in Benin and Togo, respectively, but were higher (from 58.0 to 70.0 percent) under the improved breeding system in Benin [21,46,47]. The calving intervals were 24.3 months and 24.0 months in the village conditions of Benin and Togo, respectively, and shorter (13.6 months) in an improved breeding system [21,46,47]. Alkoiret and Gbangboche [45] reported 4 ± 0.5 years and 14 ± 2.8 months for age at first calving and calving interval, respectively, for animals kept on-station at the state-owned Samiondji farm in Benin. Under village conditions in Benin and Togo, age at first calving ranged from 36.0 to 48.0 months and from 42.0 to 60.0 months, respectively. The calving year, calving season and rank of lactation significantly ($p \leq 0.05$) influenced the calving interval whereas only the year of birth significantly ($p \leq 0.05$) influenced age at first calving [45]. According to these findings, the Lagune cows could be considered as non-precocious, but they have the advantage of having a short calving interval under improved breeding conditions.

Concerning the productive performances of Lagune cattle, adult weight varied from 140 to 180 kg for males and from 100 to 140 kg for females [48], with a carcass yield ranging from 48 to 54 percent according to Rege [9] and equalling 57 percent according to Yousao [48]. The average daily milk production of a Lagune cow ranged from 360 mL for a lactation period of 98 days in improved production systems [48,49] to 300 mL in the traditional system [48]. The average total milk production for a lactation period of 11 months was 110.67 litres in improved production system at the governmental farm of Samiondji [49]. Milk performance has also been reported under village conditions in Togo and ranged from 1.5 to 2.0 kg over 120 to 225 days of lactation [20,30]. However, in terms of milk quality, the findings of a previous study by Ceriotti et al. [50] suggest that Lagune cow milk has better technological properties and cheese yield than that of Zebus.

The productivity of Lagune cattle in traditional production system or on-station is probably influenced by many non-genetic and genetic factors. According to Gbangboche et al. [6] and Nweze et al. [51], the birth season, the calf sex and calving number have some effects on the calf growth rate. Although Lagune cattle possess some intrinsic characteristics that allow them to express their genetic potential, the breeding and management conditions are important limiting factors [6]. Furthermore, many results showed the significant ($p < 0.05$) influence of non-genetic factors on the birth weight of taurine breeds and their crossbreeds in Nigeria [51] and on some reproductive parameters and weight variation in the Lagune cattle [6,45]. However, these studies failed to show the effect of the non-genetic factors on the growth traits with associated heritability, which could allow proper appreciation of the part of transmitted genetic variability. The Lagune breed evolved in various marginal agro-ecological zones to which it is adapted. That could surely explain the different results obtained by researchers on its productivity both on station and under village conditions.

It is important to evaluate, under village conditions, the effects of the production systems and environmental conditions on the Lagune cattle productive and reproductive performances. Numerous studies, including Nweze et al. [51] and Sagar et al. [52], clearly showed that, in adverse climatic conditions, the growth performance of cattle can be improved by modifying the feeding pattern and management practices. Given that Lagune cattle are largely kept by smallholder farmers, their productivity in the traditional systems,

where they are subjected to diverse feeding and agro-climatic constraints that are specific to each agro-ecological zone, must be assessed.

The weak level of technicity that characterizes smallholder farmers also affects the productivity of their cattle herds. The very little available information on the milk performance of Lagune cattle under village conditions is certainly due to the fact that traditionally, the cows are not milked [9]. Indeed, in contrast to Northern Benin where most Fulani pastoral communities were found, there was no milk tradition in Southern Benin, as milk had neither social nor cultural values.

Nevertheless, the growth rate could be increased through a well-designed breeding improvement program [6], which, however, is easier to implement on-station than under traditional production systems where keeping Lagune cattle is not the main livelihood activity. Even, where it is possible to set up a village improvement program, the lack of proper knowledge on the growth performance of the Lagune cattle may represent an important obstacle. Therefore, the study of the reproductive parameters of the Lagune cattle breed would constitute an important step toward the identification of the animals with superior genetic potential for growth [6]. The estimation of demographic parameters in traditional Lagune cattle farming using the retrospective survey method “12MO” and the Dynmod model developed by Lesnoff [53] is far too insufficient for decision making on the parameters that need to be considered in the improvement program, as the data collected using this approach is mainly based on information obtained from the breeders. There is a need to conduct longitudinal surveys, which require the monitoring of the herds by the researcher, to collect reliable data on these demographic and reproduction parameters.

3.6. Socio-Cultural, Economic, and Nutritional Values

Like all other local breeds in Africa [36,54], Lagune cattle certainly play important socio-cultural roles in the rural communities of Benin where they are kept. However, these roles have not been comprehensively investigated and documented. Local animal populations generally constitute a source of cultural identity for many rural communities [55]. They are used for ceremony/funerals, weddings, and circumcision [56]. In some rural communities, local cattle are offered as gifts to visitors and to newly married men [57,58]. In South Africa, local Nguni taurine cattle are given as sacrificial offerings to appease avenging spirits and to ward off bad destiny [56]. Likewise, in many rural communities in Southern Nigeria, Muturu cattle are considered sacred animals and Muturu cows' milk is used as a medicine to cure some ailments [59].

In addition to being kept for prestige and for cultural reasons, local breeds are kept by rural people as a means of diversifying their sources of income and as living bank accounts [60,61]. However, Lagune cattle are rarely marketed in a physical livestock marketplace [62].

Indigenous cattle breeds also represent a major source of animal proteins, and provide draft power and fertilizer through manure in integrated crop-livestock farming [36]. However, no study has reported the use of Lagune cattle for draught.

3.7. Adaptation Ability and Resistance to Diseases

The Lagune cattle is appreciated for its rusticity, which is its ability to produce in harsh environmental conditions [6,29,36]. In a recent study, Berthier et al. [63] demonstrated the high tolerance of shorthorn taurine breeds, especially of the Lagune cattle, to trypanosomosis, an endemic disease caused by blood-borne protozoan parasites from the *Trypanosoma* genus and transmitted by hematophagous insects, namely, the tsetse flies. Like the Muturu of Nigeria [36,64], this breed may also resist better to certain cattle tick species than zebu cattle. However, while the full understanding of the genetic mechanisms of the adaptation traits in this breed is still lacking, this might result from both natural and artificial selection [65–67].

3.8. Potential Effects of Climate Change on Lagune Cattle Production

Global warming represents a major challenge across the world and affects forage and crop production, reproductive performance, metabolic and health status, and immune response of the animals [68,69]. Today, the management of communal grazing faces enormous constraints that hinder the development of cattle production systems based exclusively on natural pasture. The effects of climate change affect livestock production in several ways. It increases heat stress and disease incidences, decreases the feed, fodder and water availability, and therefore decreases animal production and productivity [70]. Lagune cattle are also exposed to these adverse effects of climate change, especially to floods in the Oueme Valley. Lagune cattle farmers' resilience strategies against floods and feed scarcity include breeding on wooden pile use and moving the herds or entrusting a part or the totality of herds to other farmers in areas where feed resources are more abundant.

3.9. Environmental Footprints of Lagune Cattle Production

Generally, Lagune cattle are kept in smallholdings and raised exclusively on natural pasture, without any concentrate feeds, cultivated fodder, and veterinary treatments. It thus requires fewer natural resources. Whilst there has been no farm-gate lifecycle assessment to quantify resource use and greenhouse gas emissions of cattle production systems in Benin, research by Kouazounde et al. [71] suggests that the Lagune cattle breed has a relatively lower carbon footprint than the two other indigenous cattle breeds of Benin (average emission factors of 24.8 kg CH₄/head per year against 29.5 and 40.2 kg for Somba and Borgou cattle, respectively).

Furthermore, in addition to its socio-economic and cultural values, which are still poorly understood [72], the Lagune cattle is believed to provide numerous ecosystem services (manure, food products, non-material benefits) which have still not been ascertained through research.

3.10. Past and Current Conservation Efforts of the Lagune Cattle

To the best of our knowledge, so far there has been no documented in situ conservation initiative for the Lagune cattle breed in Benin. With the support of FAO, the governmental farm of Samiondji was created in 1976 with the aim to preserve ex situ the Lagune cattle breed. A small multiplication herd of about 100 heads was thus set up in 1977, but no clear breeding objective was defined. The most recent attempt to improve the productivity of this breed was through the implementation of a crossbreeding project with imported Azawak breed from Niger.

3.11. Threats and Opportunities for the Lagune Cattle Breed Conservation

The encroachment of zebu herds into the natural habitat of the Lagune cattle breed, while searching for water and pasture, represents a serious threat to this taurine breed. Additionally, the poor breeding practices or lack of controlled breeding among smallholder farmers [27] associated with inappropriate grazing management and uncontrolled bush fires that limit the availability of fodder, and the dominance of livestock markets by zebu breeds [62] hamper the sustainability of taurine cattle breeding [73,74]. The effective population size of Lagune cattle in Benin is unknown, but it is widely believed to be small. The risks of inbreeding and genetic drift are always high for local breeds with a small effective population size [74]. The vulnerability of such populations to unforeseen disasters is likely very high [75]. This holds also true for the Lagune cattle population in Benin.

In addition to its socio-economic and cultural values, farmers reported its ease of keeping in a tethering system as one of the main advantages of the Lagune cattle over other cattle breeds raised in South Benin [72]. Farmers also acknowledged the remarkable rusticity of the Lagune cattle breed and its excellent ability to adapt to parasitic diseases. Most Lagune farmers are aware of the risk of disappearance of this breed if no action is taken and are ready to support any initiative toward its conservation [76].

4. Conclusions

The Lagune breed is one of the African cattle genetic resources that show high adaptation ability to harsh environments and a high level of tolerance to ticks and trypanosoma in their natural habitat. However, exposed to several threats, which include lack of public interest, absence of improvement programs, and increasing crossbreeding, this breed is in jeopardy with extinction in the traditional smallholder production systems. The main concern today is not the decline in its population size, but the dilution or erosion of its genetic diversity. An improvement in the knowledge on this breed, through some in-depth studies, will allow the establishment of a sound program for its management and conservation to improve rural livelihoods.

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