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# Diagnosis of the Cane Rat (*Thryonomys swinderianus*) Breeding Systems in Ivory Coast

Goué Danhoué<sup>1,2</sup>, Yapi Yapo Magloire<sup>1,3</sup>

<sup>1</sup>National Polytechnic Institute Felix Houphouët-Boigny of Yamoussoukro, Ivory Coast

<sup>2</sup>Department of training and research in Water, Forests and Environment, Yamoussoukro, Ivory Coast

<sup>3</sup>Department of training and research in Agriculture and Animal Resources, Yamoussoukro, Ivory Coast

## Email address:

yapimagloire@yahoo.fr (Y. Y. Magloire)

## To cite this article:

Goué Danhoué, Yapi Yapo Magloire. Diagnosis of the Cane Rat (*Thryonomys swinderianus*) Breeding Systems in Ivory Coast. *Agriculture, Forestry and Fisheries*. Vol. 4, No. 3, 2015, pp. 148-152. doi: 10.11648/j.aff.20150403.21

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**Abstract:** In order to increase animal protein self-sufficiency, the government of Ivory Coast chose a policy of livestock activities diversification including the promotion of mini-livestock such as cane rat husbandry. Today, cane rat breeding has a craze among Ivorian people, but it struggles to really take off. With the aim of contributing to an optimal development of cane rat husbandry in Ivory Coast, we performed a diagnosis of the breeding systems in order to determine the factors that hinder the proper development of this activity. The diagnosis was performed using a survey questionnaire. The survey was carried out using the Participatory Rapid Appraisal Method. Sixty-six farms in 13 administrative Regions of Ivory Coast were investigated. The results showed that most of breeders (55%) were well equipped with livestock buildings in modern materials. However, the animal feeding system was inadequate, characterized by crude protein deficiency. The poor quality of the feed associated with an approximate hygiene management led to high mortality of the animals, reaching over 60% in many farms. The development of complete pelleted diets suitable to the cane rat digestive physiology, with a better control of animal health should allow cane rat breeding to take a jumpstart in Ivory Coast.

**Keywords:** Breeding System, Cane Rat, Diagnosis, Ivory Coast

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## 1. Introduction

Ivory Coast imports 57% of its consumption of animal protein. To reduce its meat products deficit, this country included in its agriculture development director plan (1995-2015), the diversification of livestock activities with the promotion of mini-livestock such as cane rat breeding. Indeed, the cane rat (*Thryonomys swinderianus*) is a wild animal recently domesticated for meat production in several Sub-Saharan African countries. Bushmeat consumption from poaching is widely practiced throughout Central and West Africa [1]. Rodents including the cane rat are among the most appreciated wild animals for their meats [2, 3]. Cane rat consumption was estimated at 80 million animals which represents 300 000 tons of meat consumed per year in the whole West Africa [4, 5]. Cane rat breeding appears as an alternative to poaching and allows the exploitation of a rustic animal species suitable for the local environmental conditions [6, 7]. Several countries in Sub-Saharan Africa, including Ivory Coast, then began promoting cane rat

breeding among their populations. This type of animal production seems to be a favorable element for sustainable development, in terms of animal resources management in Sub-Saharan Africa.

In Ivory Coast, cane rat breeding was introduced since 1995, by the Wildlife and Protected Areas School of Bouaflé. Today, cane rat breeding knows a real craze among the Ivorian people, but it struggles to really take off. Since the viability of cane rat farms is conditioned by a good control of animal husbandry techniques [8], we carried out a diagnosis of cane rat breeding systems to understand the modes of livestock management with the aim of determining the factors that hinder the proper functioning of this activity in Ivory Coast. This study should advocate recommendations for improving the breeding systems for a rational and sustainable management of captive cane rat.

## 2. Material and Methods

### 2.1. Data Collection

A survey questionnaire was used in this study. The questionnaire consisted of six sections (location of the farms, breeders and their exploitations, infrastructure and equipment, feeding system, zootechnical parameters and health status). Thus, the farms were localized according to the administrative region. Information on the socio-professional characteristics of breeders, on the characteristics of the farms and on the livestock management mode were collected. The aspects of animal housing and breeding materials have been described. The feeding system has been studied through questions concerning the nature and the mode of feed distribution to the animals. Data on animal reproduction were collected. Health aspects were addressed through studying mortality, disease and hygiene in farms.

The survey took place from November, 1999 till December, 2001. After a break, due to sociopolitical disorders intervened in Ivory Coast in 2002, the survey was continued, completed and updated until 2007. The investigation was made with two main phases (the pre-survey and the survey itself. The pre-survey was made according to an approach by successive stages which led us to the census of cane rat farms, the elaboration of survey forms and the establishment of a tour program in the farms. The survey was performed using the Participatory Rapid Appraisal Method [9]. It is a semi-open questionnaire survey with direct and semi-direct, individual or collective interviews, with breeders and various actors of the cane rat breeding sector. These interviews were completed by retrospective data and direct observations taken by photos. Thus, management monitoring sheets available in some farms have been exploited. On 105 listed farms, 66 having a staff of animals upper or equal to 5, distributed over thirteen administrative Regions of Ivory Coast were investigated.

### 2.2. Data Analysis

The characteristics of the production actors, the production structures and animal feeding system were studied, according to a descriptive analysis using parameters such as frequency, sums, averages and standard deviations. The parameters related to reproduction and animal health were subjected to one - factorial ANOVA with the administrative Region as the factor. When significant differences were identified, the means were compared using the Tukey's test. For the statistical analysis, the studied effects were considered significant at the significance level of 5%.

## 3. Results

### 3.1. Characteristics of the Production Actors

In Ivory Coast, cane rat breeding is practiced by people of various socio-professional groups (Fig. 1). The farmers represented more than half (56%) of breeders. Salaried people composed of state employees, officials and private workers were in second position (27%). The retirees represented 7%

followed by the housewives and the removed from school (5%). The liberal professions represented only 3% of cane rat breeders.

Furthermore, cane rat breeders were predominantly men (90%). The average age of breeders was 46 years, the youngest being 16 years old and the oldest 72 years. Three types of workers were involved in livestock management: family labor, community labor and hired labor. Seventy-three percent (73%) of breeders used family labor. In this case, the farmer was responsible for livestock inspection; he was the only one who decides on the course of the activities. Community workforce (11%) was used in farms belonging to professional agricultural organizations. These groups were often informal and the execution of activities was not always well coordinated. Hired labor (16%) was observed in the farms of some economic operators. Due to the high demand and the high prices of cane rat meat in Ivory Coast, the profitability of the farm was the main motivation for many breeders (49%). For 47% of breeders, diversify livestock activities was the main motivation that led them to cane rat breeding.

### 3.2. Characteristics of the Production Structures

The site of the exploitation and the land status of the breeder conditioned the type of infrastructures implanted. Two categories of infrastructure were observed: definitive establishments (55%) and temporary implantations (45%). Thus, different building materials were observed, from the most modern and definitive, to the most rudimentary and temporary. Furthermore, livestock housing observed in our study could be divided into two groups: those built specifically for livestock (74%) and those constructed for other purposes and refitted to house cane rats (26%). Two types of breeding cage were observed in our study: soilless cages (3%) and floor pens (97%).

### 3.3. Feeding System

Table 1. Green fodder and their utilization in the farms.

Types of green fodder	Utilization in the farms (%)
Pennisetum purpureum	97.7
Panicum maximum	33.3
Stem and leaves of cassava	20.7
Stem and leaves of corn	18.2
Palm ribs	12.1
Andropogon gayanus	7.3
Coconut ribs	6.0
Imperata spp., Stems and leaves of sorghum	4.8
Pineapple, papaya, rice straw, sugarcane, Teophrosia sp	2.4
Pueraria, Brachiaria	1.2

Cane rats were fed on green fodder. *Pennisetum purpureum* was used as staple diet in 97.7% of the surveyed farms and *Panicum maximum* in 33.3% of the farms (Table 1). Forage was accompanied by a varied range of products including agricultural by-products, agro-industrial products and artisanal

transformation products (Tables 2). Corn and cassava were used as energy supplements in 100% and 91.4% of the farms, respectively. The meal of dried leaves of *Leucaena* sp. was used as nitrogen supplement in 100% of the farms while the snail shell powder or calcined bone were used in 96.3% of the farms as mineral supplement.

Table 2. Ingredients of concentrate feed and its utilization in the farms.

Concentrate feed components	Utilization in the farms (%)
Corn kernels, <i>Leucaena</i> sp.	100
Table salt	98.7
Powder snail shell or calcined bones	96.3
Cassava chips	91.4
Corn bran	18.2
Powder calcined oyster shell	12.1
green Papaya	9.7
Palm seed	8.2
Refusal of attiékikié, peanuts (grain, leaf)	4.8
Spent grains,	3.6
Soybean (grains, root, stem)	3.6
Dried yam peel, remaining cooking, gardening waste	2.4
Sugar cane molasses, wheat bran, taro, sweet potato, termite soil, fresh cassava, fish meal, laying food	1.2

3.4. Reproductive Parameters and Animal Health

It emerges from Table 3 that cane rat farms from the N'Zi Comoé, Marahoué, Savanes, Montagnes and Lagunes Regions had identical fertility rates ( $P > 0.05$ ) ranging from 73-77% but significantly higher ( $P < 0.05$ ) compared to the fertility rates of the farms located in the Lacs, Fromager and Moyen Comoé Regions which were around 50%. Cane rats of the farms from the Lagunes Region had a 92% fertility rate, higher ( $P < 0.001$ ) than those of the farms from the Lacs, Marahoué, Savanes and Moyen Cavally Regions which varied from 80% to 84%.

In reproductive cane rats, the mortality rate in the Regions of Moyen Cavally, Lacs and Marahoué varied between 58% and 61%. It was higher ( $P < 0.01$ ) than those in the other Regions including the Agneby Region which recorded the lowest value of mortality rate (23%). The mortality of the young cane rats in the Region of Fromager (100%) was higher compared to the other Regions ( $P < 0.01$ ), where the mortality rates ranging from 28% to 41%. Mortalities were due mainly to the poor management of livestock and poor hygiene (35% mortality). The most encountered affections were alopecia, paralysis, stomach bloating and swelling of the throat (Fig. 2).

Table 3. Reproductive performance.

Regions	Fertility (%)	Fecundity (%)	Prolificacy
Vallée du Bandama	69.99 ± 4.20 de	87.06 ± 1.52 ef	4.18 ± 0.14 c
N'Zi Comoé	76.25 ± 23.77 d	89.96 ± 2.35 ef	4.10 ± 0.62 c
Lacs	49.83 ± 15.22 b	80.52 ± 6.32 d	6.46 ± 0.72 e
Marahoué	73.43 ± 9.98 d	80.52 ± 2.21 d	4.51 ± 0.75 c
Wordougou	00 a	00 a	00 a
Savanes	75.00 d	81.25 d	4.33 c
Montagnes	77.08 ± 1.80 d	69.27 ± 1.19 c	3.60 ± 0.11 b
Fromager	50.00 b	70.83 c	5.67 d
Agneby	60.68 ± 12.08 c	87.23 ± 10.95 ef	3.54 ± 0.14 b
Moyen Cavally	64.58 ± 2.08 e	83.75 ± 8.75 d	5.95 ± 1.45 de
Lagunes	74.26 ± 6.66 d	92.03 ± 11.43 f	4.37 ± 0.43 c
Sud Comoé	58.82 ± 29.41 c	75.29 ± 37.65 c	6.40 ± 3.20 e
Moyen Comoé	53.82 ± 13.90 b	55.47 ± 14.84 b	4.10 ± 0.05 c

a, b, c, d, e, f : For the same column, the values followed by the same letter are not significantly different at 5% level.

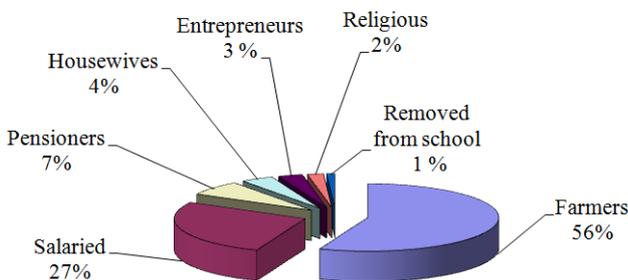


Figure 1. Socio-professional categories involved in cane-rats husbandry in Ivory Coast.



a): Alopecia b): Swelling of the throat



c): Paralysis d): Bloating stomach

Figure 2. (a, b, c, d) Main disorders encountered in the cane rat in Ivory Coast.

## 4. Discussion

The results obtained during our study showed that the socio-professional groups involved in cane rat breeding in Ivory Coast were diverse as in Benin [10]. Nevertheless, the majority of cane rat breeders (56%) were farmers, probably because the original purpose of the extension agents of cane rat breeding was to introduce this activity into the agricultural production systems. Cane rat breeding should constitute a generative sideline of income for farmers.

As for production structures, this study revealed that the majority of livestock buildings (55%) were built in modern materials. This was due to the fact that several breeders have received funding for installation through various development projects. The ANADER (the National Agency for Rural Development Support in Ivory Coast) contributed to the installation of many cane rat farms in Ivory Coast through various development projects with the National Programme for the Promotion of cane rat breeding [11].

Furthermore, the analysis of the feeding system in cane rat farms in Ivory Coast revealed two main information. The first is that cane rats were fed a forage based diet. Elephant grass (*Pennisetum purpureum*) was the most used forage. This grass was used in 97.7% of the farms against 33.3% for Guinea grass (*Panicum maximum*). Apart from these two forages, there are other forages used secondarily, especially when the first ones become scarce during the dry seasons. In Benin, *Pennisetum purpureum* and *Panicum maximum* are also the most used fodder in cane rat feeding ([10, 12]. The second information revealed by the analysis of the feeding system is that protein concentrates were absent in the diet, due to their high costs, probably. Crude protein intake was provided by the dried leaves of *Leucaena sp.* Indeed, the dietary supplement of the cane rat vulgarized by the supervision structures in Ivory Coast contains 8-10% dried leaves of *Leucaena sp.* This proportion corresponds to approximately 10 g flour dried leaves of *Leucaena sp* per animal and per day [11]. *Leucaena sp* contains only 23.5% crude protein per kg (dry matter basis). Thus, crude protein level observed in the diet of the cane rat is between 8 and 12% of the feed [3, 13], which is not able to cover animals nitrogen requirements. For comparison, the optimum rate of crude protein in the diet of the reproductive rabbits is between 17 and 18% [14]. This study showed that none of cane rat breeders in Ivory Coast uses complete pelleted diets in his farm as practiced for rabbit breeding. In fact, complete diets for cane rat do not yet exist on the market. Several studies have been carried out in order to develop such feed but nutritional requirements of the cane rat remain largely unknown. Concerning dietary fibres for instance, recent studies showed that the cane rat can digest relatively high amounts of fibres [15], due to its well developed caecum [16], but the optimum of fibres levels in the diet suitable to each physiological stage of this animal remain largely unknown.

Regarding animal health, the mortality rates recorded in the cane rat farms in our study were high. They ranged from

23% to over 60% in adult animals. In young animals, they were greater, particularly, reaching 100% in some farms. These mortality rates was very high compared to those reported by others authors in Gabon and Benin [12, 17, 18]. These authors have observed a global mortality ranging between 10 and 26 %. Only the pre-weaning mortality was high reaching 40% according to these authors. The high mortality observed in our study could be explained by the poor quality of the diets, in addition to the poor livestock management and the lack of hygiene. Furthermore, reproductive performance recorded in the animals in our study showed a high variability between the administrative Regions. Such variability can be attributed to the feeding system and the livestock management in general as zootechnical parameters related to cane rat are experiencing significant variability and are strongly linked to a rigorous breeding behavior, an improved nutrition and an accurate genetic selection [19]. However, reproductive performances recorded in the cane rat in our study are acceptable, compared to those reported by other studies. Indeed, some authors [12] recorded fertility rate between 53-66% in cane rat in Southeast Benin. Thus, despite cane rat diets characterized by crude protein deficiency, animals gave relatively good reproduction performance in our study. It has been reported that in some rodents consuming low-nitrogen diets, bacterial nitrogen fixation can be a mechanism for nitrogen supplementation [20]. For instance, it has been suggested the possibility of fixation of atmospheric nitrogen by certain caecal bacteria in voles and in the European beaver. Such fixed nitrogen is utilized nutritionally via coprophagy by these animals [20, 21, 22]. This might be the case of the cane rat, since this animal practices coprophagy and a recent study [15] revealed the great richness in *Spirochaetaceae* of its microbiota. In the *Spirochaetaceae* family, some bacterial species belonging to *Treponema* genus, already described in termites are able to fix atmospheric nitrogen [23, 24, 25]. These bacterial species play an important role in nitrogen nutrition of wood-eating termites, allowing these animals to meet their nitrogen requirements from quite poor food containing about 0.05% nitrogen [25]. It would be interesting if some studies are carried out to determine whether certain bacterial species in the caecum of the cane rat were involved in nitrogen nutrition of this animal, which could explain the good reproduction performance observed in our study, despite animals low nitrogen diets.

## 5. Conclusions

Our study showed that cane rat breeding is a model of mini- livestock fully adopted by the Ivorian population but some factors such as unavailability of quality diets constitutes a real obstacle. The development of complete pelleted diets suitable to the cane rat digestive physiology, with a better control of animal health should allow cane rat breeding to take a jumpstart in Ivory Coast.

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