Original Research Article

Typology of Grasscutter (Thryonomys swinderianus) Farming in Southern Benin two Decades after its Domestication

ABSTRACT

Aims: The aim of the study was to provide information on the current characteristics of grasscutter farms in Benin to identify areas for improvement.
Study design:A survey was conducted among 100 grasscutter farmers in southern Benin, identifying three groups of farmers.
Place and Duration of Study: Data was collected between August and October 2023 in the departments of Mono, Couffo, Atlantique, Ouémé, Plateau and Zou in southern Benin.
Methodology: Data collection was carried out through a retrospective survey using the snowball sampling method. During the survey phase, farmers were selected based on the accessibility of their farms and their willingness to participate in the questionnaire.Data were analyzed using SAS software, and a multiple component analysis (MCA) was performed to identify the different groups of grasscutter farmers.
Results: Three groups of farmers were identified. Women were absent in Group 1, less present in Group 2 (8.20%), and more frequent in Group 3 (23.53%). The most common occupations among respondents across all three groups were in agriculture and livestock farming. However, farmers were less frequent in Group 3 (82.34%) compared to the other groups (100%) ($p<0.05$). Ground-enclosure farming was only reported in Group 1 (76.47%). In the other groups, farming is done on tiers in compartmentalized enclosures. The smallest herd size was observed in Group 3 ($p<0.05$). All respondents in groups 1 and 2 fed their animals with a mixture of forage and commercial feed, while 64.71% did so in Group 3 ($p<0.05$). *Panicum maximum*, *Pennisetum purpureum*, and *Moringa oleifera* are the most commonly used forages in grasscutter feeding. Grasscutters are sold live by all farmers in Groups 1 and 2 and by 88.24% in Group 3 ($p<0.05$). The age at the sale is similar in Groups 1 (4.70 months) and 2 (4.15 months) and higher in Group 3 (7.28 months) ($p<0.001$). The most frequent constraints in all three groups were difficulties in accessing forage and lack of financial resources.
Conclusion: Harmonizing grasscutter farming practices could be a lever to promote grasscutter farming in Benin.

Keywords: Grasscutters, Feeding, Farming Practices, Constraints, Benin

1 INTRODUCTION

In Benin, the domestication of the grasscutter (*Thryonomys swinderianus*) took place around the 1980s, and its farming became a profitable activity two decades later[1]. The commercialization of farmed grasscutters—whether sold live, slaughtered, or processed—has developed alongside the sale of hunted grasscutters, whose meat is highly prized by consumers for its flavor[2] and is sold at a higher price than beef, small ruminant, and pork meats[3]. Grasscutter dominates game products and is by far the most consumed game meat, especially in the central and southern regions of the country[4,5]. However, the farming of grasscutters, which was expected to be favored due to the gradual replacement of

wild grasscutters by farmed ones, thanks to the reduction of bushfires and poaching [6], has faced challenges, leading to an abandonment rate estimated at 16% in 2003[1]. The main difficulties reported were the provision of feed, which increased production costs, and the limited financial capacity of grasscutter farmers[1,7]. A lack of uniformity in the "farmed grasscutter" product has also been reported[1], as well as poor sales, to the extent that prospective grasscutter farmers wondered how to sell their grasscutters once produced [8].

In response to these difficulties, several research projects have been conducted to boost the grasscutter farming sector in Benin. These studies have focused on various topics, such as the strategic plan for marketing products and by-products[9], the technical and economic analysis of grasscutter farming in Northern Benin[7], the viability and financing of grasscutter farms[8], and the development of a pelleted feed based on dry forage (hay) and dietary supplements for farmed grasscutters [10], among others. Ten years after these studies, grasscutter farming does not appear to be thriving. Grasscutter farmers are becoming increasingly rare, and despite the health and safety concerns associated with it, hunted grasscutter meat remains the preferred choice for consumers.

This situation necessitates a new assessment of grasscutter farming in Benin to provide information on the current characteristics of these farms and any potential bottlenecks to the sustainable development of grasscutter farming in the country. These insights, in turn, will help identify areas for improvement. This is the objective of the study conducted in Southern Benin.

2 MATERIAL AND METHODS

2.1 Study Area

The study was conducted in the southern departments of Benin, specifically in Atlantique, Littoral, Mono, Couffo, Ouémé, Plateau, and Zou. These departments were selected because they are the preferred regions for grasscutter farming. The region is characterized by an equatorial climate with high humidity. There are two rainy seasons and two dry seasons. The main dry season lasts from November to March, and the minor dry season runs from mid-July to mid-September. The major rainy season extends from April to mid-July, while the minor rainy season lasts from mid-September to October. The annual rainfall in this region shows a west-east gradient, ranging on average from 950 mm in the west to 1500 mm in the east. The study area is characterized by several soil types, including sandy, ferruginous, and hydromorphic soils[11].

2.2 Materials

The study materials consisted of a questionnaire given to the farmers. The questionnaire collected information on the following aspects: farmer identification, activities carried out, grasscutter farming practices, feeding practices, criteria used by processors for purchasing grasscutters, prices and weights at the time of the sale, challenges encountered, and proposed solutions.

2.3 Methods

Data collection was carried out through a retrospective survey of 100 grasscutter farmers using the snowball sampling method for 30 days. During the survey phase, farmers were selected based on the accessibility of their farms and their willingness to participate in the questionnaire.

2.4 Statistical Analyses

The collected data were recorded in an Excel database. The SAS software (2013) was used for statistical analyses. The `Proc CORRESP` procedure was applied for Multiple Correspondence Analysis (MCA). The following variables were considered: primary activity, the factor that initiated the activity, animal species raised besides grasscutters, farming method, feeding strategy, and sales strategy. A hierarchical ascending classification was then performed based on the farm characteristics on the most significant components of the MCA. The `Proc MEAN` procedure was used for descriptive statistics. Frequencies were calculated using the `Proc FREQ` procedure, and comparisons between relative frequencies were conducted using the bilateral Z-test. For each relative frequency, a 95% confidence interval (CI) was calculated using the formula:

$$ICP = 1{,}96\sqrt{\frac{P(1-P)}{N}}$$

where (P) is the relative frequency and (N) is the sample size.

3 RESULTS

3.1 Results

3.1.1 Identified Groups of Farmers

The Multiple Correspondence Analysis (MCA) identified three distinct groups of farmers (Figure 1). For the interpretation of the results, the first three axes were retained, with each axis corresponding to a specific group of farmers. The contribution to the total inertia of the three factorial axes was 40.10% (17.90% for the first axis, 12.40% for the second axis, and 9.80% for the third axis). The distribution of the surveyed farmers across the three groups was as follows: 22 farmers in Group 1, 61 farmers in Group 2, and 17 farmers in Group 3.

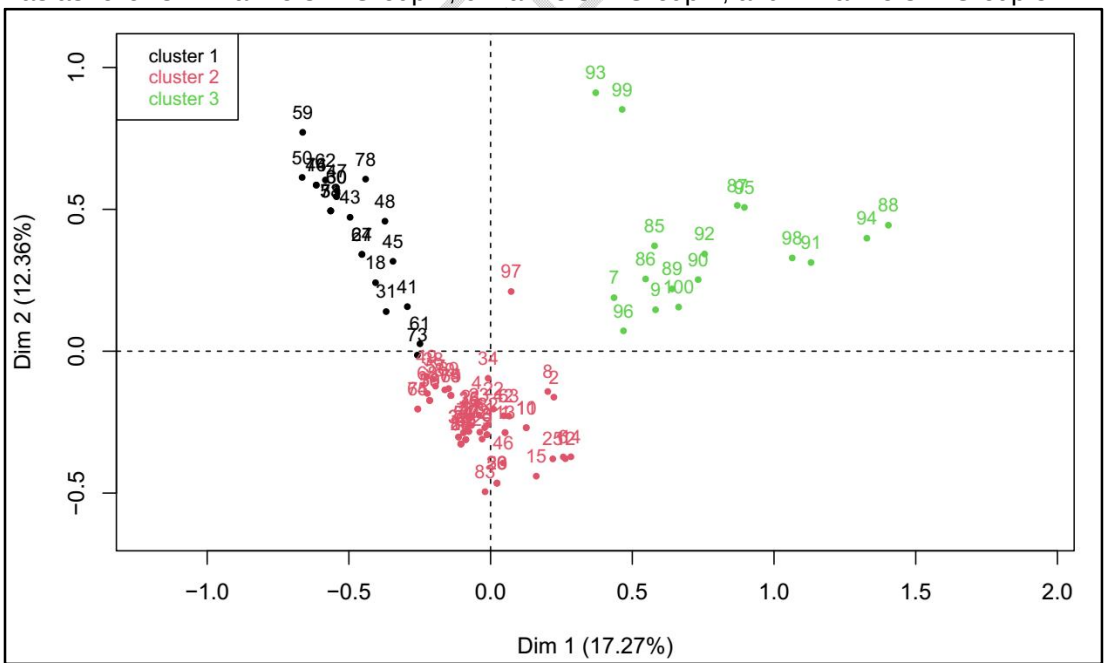

Fig. 1. Identified Groups of Grasscutter Farmers in Southern Benin

3.1.2 SocioprofessionalCharacteristics of Surveyed Farmers

The socioprofessional characteristics of the surveyed grasscutter farmers are presented in Table 1. Female farmers were absent in Group 1 and were less represented in Groups 2 (8.20%) and 3 (23.53%). However, the frequency of female grasscutter farmers in Group 2 was not significantly different from the 0% observed in Group 1. The frequency of male farmers in Group 1 (100%) was similar to that in Group 2 (91.80%) but was higher than that in Group 3 (76.47%) ($p<0.05$). The frequency of male farmers in Group 3 was similar to that in Group 2.

Almost all farmers across the three groups were primarily engaged in agriculture and livestock farming. However, the frequency of farmers engaged in agriculture in Group 3 (82.34%) was lower than in Groups 1 and 2 (100%) ($p<0.05$). Civil servants were present only in Group 2, but at a very low frequency, which was not significantly different from the zero frequency (0%) observed in the other two groups ($p>0.05$). Artisans comprised 13.64%, 11.48%, and 11.76% of respondents in groups 1, 2, and 3, respectively ($p>0.05$). Regarding respondents engaged in commerce, they were only present in Groups 2 (16.36%) and 3 (23.53%). However, the frequency of traders in Group 2 was not different from the 0% observed in Group 1.

In Group 3, 86.36% of respondents had started their grasscutter farming activities following specific training. The frequencies of farmers who began the activity after training were similar in Groups 1 and 2 (41.18% and 55.74%, respectively) but were lower than that in Group 3 ($p<0.05$). Grasscutter farming was considered a heritage activity for 4.92% of the farmers in Group 2. This frequency was not different from the 0% observed in Group 3 but was lower than the frequency of farmers in Group 1 who inherited the activity ($p<0.05$). Respondents who started the activity with the help of a project were only present in small proportions in Groups 2 and 1 (11.76% and 3.27%, respectively). However, these frequencies were similar to the zero frequency (0%) observed in Group 3 ($p>0.05$).

Table 1. Socioprofessionalcharacteristics of the surveyed farmers

Parameters		Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
		%	CI	%	CI	%	CI
Gender	**Male**	100a	0	91.80ab	6.89	76.47b	20.16
	Female	0b	0	8.20b	6.89	23.53ab	20.16
Occupational activities	**Agriculture**	100a	0	100a	0	82.34b	18.13
	Livestock farming	100a	0	98.36a	3.19	94.12a	11.18
	Civil servant	0a	0	4.92a	5.43	0a	0
	Agricultural transformation	4.55a	8.71	4.92a	5.43	5.88a	11.18
	Craft	13.64a	14.34	11.48a	8	11.76a	15.31
	Commerce	0b	0	16.39ab	9.29	23.53a	20.16
Factors leading to the activity	**Heritage**	11.76a	15.31	4.92b	5.43	0b	0
	After training	41.18b	23.40	55.74b	12.46	86.36a	14.34
	Personal initiative	41.18a	23.40	36.07a	12.05	13.64a	14.34
	Project	11.76a	15.31	3.27a	4.46	0a	0
Affiliation with a grasscutter farmers' association	**Yes**	100a	0	100a	0	0b	0
	No	0b	0	0b	0	100a	0

N = Size; CI= Confidence Interval;ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.

3.1.3 Characteristics of Livestock Farming

3.1.3.1 Animal Species Raised in Addition to Grasscutters

In addition to grasscutters, the surveyed farmers also raised several other domestic animals (Table 2). Poultry, small ruminants, rabbits, and pigs were the most frequently raised domestic animal species across all three groups. However, farmers raising small ruminants were more common in Groups 1 (81.82%) and 2 (63.93%) than in Group 3 (35.29%) ($p<0.05$). In contrast, the frequencies of farmers raising poultry, rabbits, and pigs were similar across all three groups ($p>0.05$). Very few respondents raised cattle and guinea pigs in addition to grasscutters, and their frequencies did not vary significantly between the groups ($p>0.05$).

Table 2: Animal species raised aside from grasscutters

Parameters	Group 1 (22)		Group 2 (61)		Group 3 (17)	
	%	CI	%	CI	%	CI
Cattle	13.64a	14.34	1.64b	3.19	0.00ab	0.00
Small ruminants	81.82a	16.12	63.93a	12.05	35.29b	22.72
Poultry	95.45a	8.71	95.08a	5.43	88.24a	15.31
Rabbits	27.27a	18.61	22.95a	10.55	41.18a	23.40
Pigs	22.73a	17.51	21.31a	10.28	29.41a	21.66
Guinea pigs	9.09a	12.01	9.84a	7.47	0.00a	0.00

N = Size ; CI= Confidence Interval ; ab : Frequencies in the same row followed by different letters are significantly different at the 5% level.

3.1.3.2 Grasscutter Farming System

The distribution of grasscutter farming modes across the different groups is shown in Figure 2. Grasscutters are raised on the ground in enclosures, which may be partitioned or not, by 76.47% of the respondents in Group 3. This ground-based farming method was observed exclusively in this group. In contrast, all respondents (100%) in groups 1 and 2 raised their animals in off-ground enclosures, which are tiered and compartmentalized. This method of farming was adopted by a smaller proportion (23.53%) of respondents in Group 3 ($p<0.05$). Table 3 presents the average herd size and density per compartment across the three groups. The average herd size in Group 1 (29.84 grasscutters) was similar to that in Group 2 (53.40 grasscutters) but significantly smaller than the average number of grasscutters in Group 3 (96 grasscutters) ($p<0.05$). Additionally, the herd sizes in Groups 2 and 3 were similar. A similar trend was observed for the overall density per compartment, which was 3.10, 3.48, and 3.72 grasscutters per enclosure for Groups 1, 2, and 3, respectively.

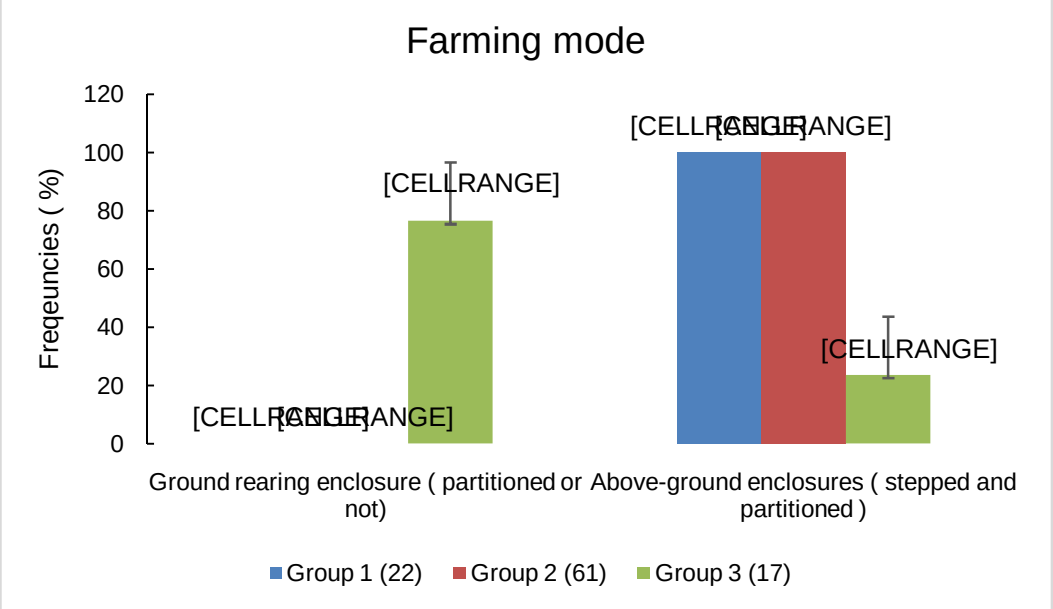

Fig. 2. Grasscutter farming mode

a b: For the same parameter, frequencies followed by different letters are significantly different at the 5% level.

Table 3. Average numbers and density (mean ± standard deviation) by enclosure

Parameters	Group 1	Group 2	Group 3	Significance test
Herd size	29.84±22.20b	53.40±68.37ab	96.0±117.13a	*
Overall density (Subject/enclosure)	3.10±2.01b	3.48±0.64ab	3.72±0.55a	*

ab : Means on the same line followed by different letters are significantly different at the 5% level.

3.1.3.3 Grasscutter Feeding Practices

The feeding practices for grasscutters among the three groups of farmers are detailed in Table 4. In groups 1 and 2, all farmers (100%) fed their grasscutters with a combination of commercial feed and forage. In Group 3, 64.71% of the farmers used this combination ($p<0.05$). Among the farmers, those who supplemented the forage with additional dietary supplements were more numerous in Group 3 (70.59%) compared to Groups 1 and 2, where the frequencies were 4.55% and 18.03%, respectively. Only some farmers in groups 1 and 3 (31.82% and 11.76%, respectively, $p>0.05$) preferred to combine dietary supplements with commercial feed. The use of forage without any addition of commercial feed or supplements was reported exclusively in Group 3 by 11.76% of the respondents. Most respondents indicated that the commercial feed used for feeding grasscutters was self-produced on their farms ($p>0.05$).

Table 4: Grasscutter feeding practices

Parameters		Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
		%	CI	%	CI	%	CI
Feeding modes	Forage only	0ab	0	0b	0	11.76a	15.31
	Forage + supplement	4.55b	8.71	18.03b	9.65	70.59a	21.66
	Commercial feed +Forage	100a	0	100a	0	64.71b	22.72
	Commercial feed + supplement	31.82a	19.46	0b	0	11.76a	15.31
Source of the feed*	Purchased	4.55a	8.71	14.75a	8.90	25a	20.58
	Farm-made	95.45a	8.71	85.25a	8.90	75a	20.58

** N =22 for Group1, 61 for Group 2, and 12 for Group 3; N = Size; CI= Confidence Interval;ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.*

3.1.3.4 Composition of Feeds Provided to Grasscutters

The composition of the feeds provided to grasscutters is detailed in Fig. 3., Tables 5, and 6. The frequencies of various supplements provided in addition to forage or commercial feed did not vary significantly between the groups ($p>0.05$). The supplements reported as being used in all three groups included cassava tubers and stalks, palm kernel cake, and by-products from palm nut harvesting (palm kernel husks and oil palm spathes). Among these supplements, the most frequently reported were cassava tubers (50%, 72.73%, and 41.67% in Groups 1, 2, and 3, respectively) and cassava stalks (25%, 36.36%, and 33.33% in Groups 1, 2, and 3, respectively). The use of palm leaf veins was reported in Groups 1 (12.50%) and 3 (41.63%), while the use of harvest residues and maize grains was reported only in Groups 2 and 3 by a small proportion of respondents. Other supplements, such as cassava peels, oyster shells, wheat bran, roasted soybean seeds, table salt, rice bran, and sugarcane, were less frequently used and were reported exclusively in Group 3.

Overall, the most commonly used raw materials for preparing commercial feed (provender) for grasscutters, as presented in Table 6, were maize, table salt, soybean seeds, oyster shells, palm kernel cake, and wheat bran. These ingredients were more frequently reported in Groups 1 and 2 (where they were used by nearly all farmers) compared to Group 3. In Group 3, only maize and palm kernel cake were used by 40% of the farmers, wheat bran by 30%, and the remaining ingredients (table salt, soybean seeds, and oyster shells) were used by 20% of the grasscutter farmers. The incorporation of fish meal into the commercial feed was mentioned only in groups 1 and 2, by 52.38% and 39.62% of the respondents in these groups, respectively ($p<0.05$). Similarly, the use of cassava tubers in the feed formulation was reported in the first two groups but was less frequent (14.29% in Group 1 and 13.21% in Group 2). Mineral and vitamin concentrates (MVC) were exclusively used in Group 2 by only 7.11% of the farmers. Additionally, rice bran was used only in Group 3 by 20% of the respondents in that group.

Regarding the forages consumed by farmed grasscutters (Figure 3), the grasses whose leaves were used included *Panicum maximum, Pennisetum purpureum, Imperata cylindrica, Hyparrheniadiplandra*, bamboo (*Phyllostachys sp.*), and maize (*Zea mays*). The legumes used were *Moringa oleifera, Leucaena leucocephala*, and *Sida acuta*. Some farmers also provided leaves from the oil palm (*Elaeis guineensis*). Among these forages, the most frequently used were *Panicum maximum* (utilized by 100% of farmers in Group 1, 98.36% in

Group 2, and 70.59% in Group 3), *Pennisetum purpureum* (utilized by 72.73% of farmers in Group 1, 49.18% in Group 2, and 17.65% in Group 3), *Moringa oleifera* (utilized by 59.09% of farmers in Group 1, 37.70% in Group 2, and 5.88% in Group 3). The frequency of usage for these three primary forages was similar in Groups 1 and 2 and significantly higher than in Group 3. The use of other forage species was less frequently reported by the respondents, and their usage frequencies were similar across all three groups ($p>0.05$).

Table 5: Feed supplements for animals

Parameters	Group 1 (8)		Group 2 (11)		Group 3 (12)	
	%	CI	%	CI	%	CI
Cassava tubers	50a	34.65	72.73a	26.32	41.67a	27.89
Cassava stalks	25a	30.01	36.36a	28.43	33.33a	26.67
Palm kernel cake	12.50a	22.92	9.09a	16.99	33.33a	26.67
Oil palm rachis and spathes	12.50a	22.92	18.18a	22.79	16.67a	21.09
Oil palm leaf veins	12.50a	22.92	0a	0	41.63a	27.89
Papaya fruit	12.50a	22.92	0a	0	0a	0
Harvest residues	0a	0	9.09a	16.99	9.09a	16.26
Taro tuber	0a	0	9.09a	16.99	0a	0
Maize grain	0a	0	9.09a	16.99	16.67a	21.09
Cassava peel	0a	0	0a	0	16.67a	21.09
Shell	0a	0	0a	0	16.67a	21.09
Wheat bran	0a	0	0a	0	8.33a	15.64
Roasted soybeans	0a	0	0a	0	8.33a	15.64
Salt	0a	0	0a	0	16.67a	21.09
Sugarcane	0a	0	0a	0	9.09a	16.26
Rice bran	0a	0	0a	0	9.09a	16.26

N = Size. CI= Confidence Interval; ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.

Table 6: Ingredients used in the commercial feed production

Parameters	Group 1 (21)		Group 2 (53)		Group 3 (10)	
	%	CI	%	CI	%	CI
Maize grain	95.24a	9.11	94.44a	6.17	40b	30.36
Table salt	90.48a	12.55	88.89a	8.46	20b	24.79
Soybean seeds	85.71a	14.97	87.04a	9.04	20b	24.79
Oyster shells	80.95a	16.80	79.63a	10.84	20b	24.79
Palm kernel cake	76.19a	18.22	73.58a	11.87	40b	30.36
Wheat bran	52.38ab	21.36	67.92a	12.57	30b	28.40
Fish meal	52.38a	21.36	39.62a	13.17	0b	0
Brewery spent grain	14.29a	14.97	13.21a	9.12	10a	18.59
Cassava (tubers)	14.29a	14.97	13.21a	9.12	0a	0

MVC	0a	0	7.55a	7.11	0a	0
Rice bran	0b	0	0b	0	20a	24.79

N = Size CI= Confidence Interval; MVC: Mineral and Vitamin Concentrates; ab: Frequencies in the same column followed by different letters are significantly different at the 5% level.

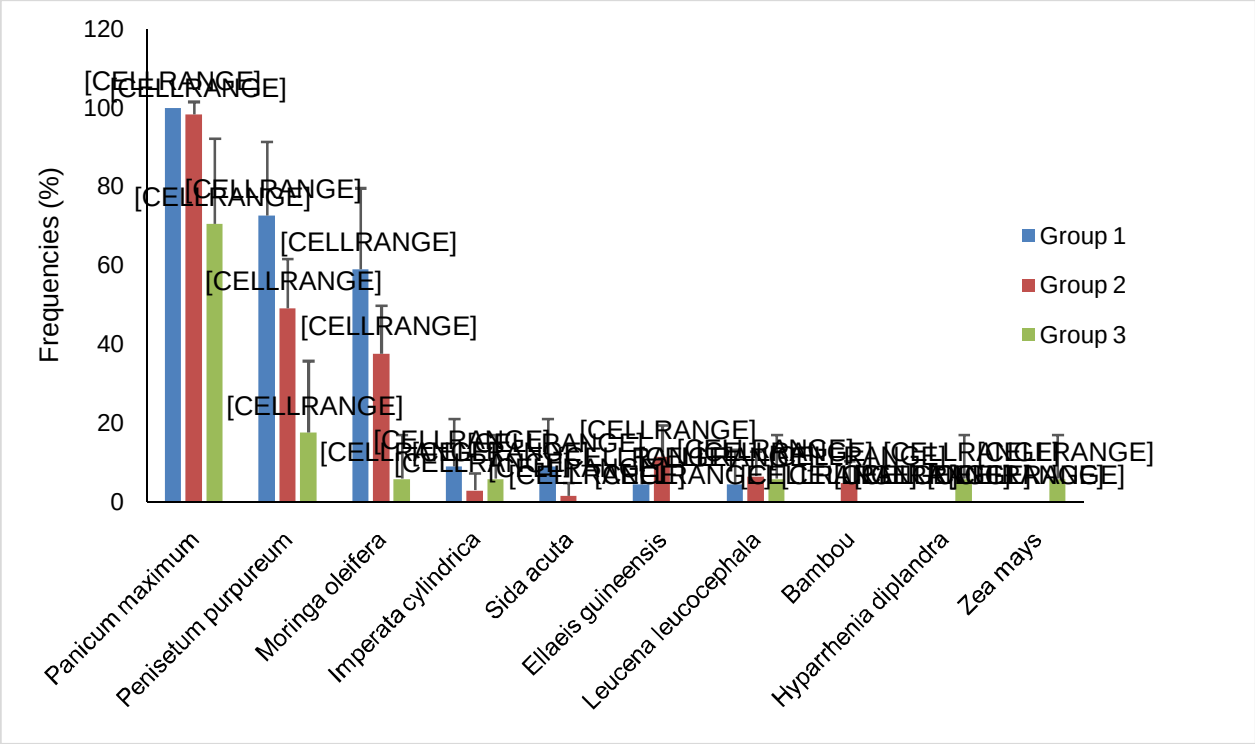

Fig. 3. Forages used to feed grasscutter

a b: For the same parameter, frequencies followed by different letters are significantly different at the 5% level.

3.1.4 Commercialization of Farmed Grasscutters

3.1.4.1 Sales Strategy

The sales strategies adopted by the surveyed farmers are presented in Table 7. All respondents in groups 1 and 2 stated that their farmed grasscutters are sold alive. However, a small minority in these groups (18.18% in Groups 1 and 6.56% in Group 2) also reported, similar to some in Group 3 (17.65%), that they sometimes sell the grasscutters after slaughtering them ($p>0.05$). In Group 3, the percentage of those who sell the animals alive (88.24%) is lower than in the first two groups ($p<0.05$). In cases where animals are slaughtered before sale, no farmers in Groups 2 and 3 dressed the animals before selling them. In contrast, 20% of the farmers in Group 1 dressed the animals before sale. Regarding the gender of the animals sold, male grasscutters were sold by fewer farmers in Group 3 (66.67%) compared to those in groups 1 (93.33%) and 2 (94.12%) ($p<0.05$). For all respondents in Group 1 and nearly all in Group 2 (97.92%), selling young grasscutters (less than 2 months old) was considered more profitable. In Group 3, the frequency of those who shared this opinion was lower (60%) compared to the other two groups ($p<0.05$). In this group, a significant proportion (33.33%) of grasscutter farmers believed that adult

grasscutters, older than 6 months, were more profitable to sell. This proportion is higher than those found in groups 1 (5%) and 2 (9.11%) for this particular belief. Selling medium-aged grasscutters (aged between 2 and 6 months) was considered profitable only by farmers in Groups 2 and 3, with respective frequencies of 2.08% and 13.33% of respondents ($p<0.05$).

Table 7: Sales strategy

Parameters		Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
		%	CI	%	CI	%	CI
Animal condition at sale	Alive	100ab	0	100a	0	88.24b	15.31
	Slaughtered	18.18a	16.12	6.56a	6.21	17.65a	18.12
Dressed or not**	Yes	20a	35.06	0b	0	0b	0
	No	80b	35.06	100a	0	100ab	0
Age variation at slaughter depending on gender	Yes	68.18a	19.46	54.10a	12.51	29.41b	21.66
	No	31.82b	19.46	45.90ab	12.51	70.59a	21.66
Most sold gender	Male	93.33a	10.43	94.12a	5.90	66.67b	22.41
	Female	6.67ab	10.43	5.88b	5.90	33.33a	22.41
Most profitable age at sale ***	Young	100a	0	97.92a	3.58	60b	23.29
	Medium	0a	0	2.08a	3.58	13.33a	16.16
	Adult	5b	9.11	6.25b	6.07	33.33a	22.41

*** N= 5 for Group 1, 12 for Groups 2 and 10 for Group 3; *** Young (before 2 months of age), Medium (between 2 and 6 months), Adult (over 6 months); N = Size; CI= Confidence Interval; ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.*

3.1.4.2 Characteristicsof Grasscutter Buyers

The categories of buyers and their preferred formats for purchasing farmed grasscutters are detailed in Table 8. More than half of the respondents across all three groups indicated that their clients include foreigners (77.27% in Group 1, 62.30% in Group 2, and 58.82% in Group 3). Other buyers mentioned were restaurant owners, other farmers, and private individuals. The frequencies of these types of clients did not vary significantly between the groups ($p>0.05$), except for private individuals, who were reported by very few farmers in Group 2 (4.92%) compared to those in groups 1 (31.82%) and 3 (35.29%) ($p<0.05$). For most respondents in Groups 1 and 2, their clients had no specific requirements regarding the size format of the grasscutters they purchased. However, the presence of clients without specific format preferences was reported more frequently by farmers in Group 1 (85%) than in Group 2 (60.42%) ($p<0.05$). There were no clients without preferences reported by the grasscutter farmers in Group 3. In Group 3, the majority (73.33%) stated that their clients preferred large-sized animals. This preference was less commonly reported in Groups 1 (5%) and 2 (6.25%). Clients' preference for medium-sized grasscutters was less frequent and was reported only in Groups 2 and 3, with frequencies similar to and close to 0% in Group 1 ($p>0.05$). Some respondents in Groups 2 (25%) and 3 (40%) and a few in Group 1 (10%) reported that small-sized grasscutters were also preferred by their clients. However, this preference was less frequently reported in Group 1 ($p<0.05$).

Table 8: Characteristics of grasscutter buyers

Parameters	Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
	%	CI	%	CI	%	CI

Customer Categories	**Restaurant owners**	31.82a	19.46	44.26a	12.46	52.94a	23.73
	Individuals	22.73a	17.51	4.92b	5.43	35.29a	22.72
	Farmers	31.82a	19.46	27.87a	11.25	35.29a	22.72
	Foreigners	77.27a	17.51	62.30a	12.16	58.82a	23.40
Preferred Customer Format* **	**Small format**	10.0b	12.54	25.0a	10.87	40.0a	23.29
	Medium format	0.0a	0.0	8.33a	6.93	13.33a	16.16
	Large format	5.0b	9.11	6.25b	6.07	73.33a	21.02
	No preference	85.0a	14.92	60.42b	12.27	0.0c	0.0

N = Size; CI= Confidence Interval;ab: Frequencies in the same row followed by different letters are significantly different at the 5% level; Small-sized grasscutter (less than 1 kg), Medium-sized grasscutter (between 1 and 2 kg), Large-sized grasscutter (more than 2 kg).

3.1.4.3 Characteristicsof Sold Grasscutters

The age, weight, and sale price of grasscutters in the three groups are presented in Table 9. The average age of grasscutters sold was 4.70 months in Groups 1 and 4.15 months in Group 2. In Group 3, grasscutters were sold at a much older age of 7.28 months compared to the first two groups ($p<0.05$). The average sale weight was similar across all three groups ($p>0.05$), with weights of 2.07 kg in Group 1, and 2.91 kg in both Groups 2 and 3. The average price per kilogram of live weight was also similar across the three groups ($p>0.05$), with prices being 3,350 FCFA in Group 1, 3,395.20 FCFA in Group 2, and 3,250 FCFA in Group 3. The sale price per kilogram of grasscutter after slaughter was 4,000 FCFA and 3,909.10 FCFA on average in Groups 1 and 2, respectively. These prices were lower than the average reported by respondents in Group 3, which was 5,000 FCFA ($p<0.05$).

T**able 9: Characteristics of sold grasscutters**

Parameters	**Group 1**	**Group 2**	**Group 3**	**Test**
Age at the sale (months)	4.70±1.69b	4.15±2.11b	7.28±3.81a	***
Weight at sales (kg)	2.07±1.07a	2.12±1.3	2.91±1.9	NS
Sale price per kg of live weight (FCFA)	3350±475.34a	3395.20±387.91a	3250±559.01a	NS
Price per kg after slaughter (FCFA)	4000±447.21b	3909.10±375.37b	5000±0	*
Small size sale price (FCFA)	-	12928.57±4658.58a	10660.71±4373.88a	NS
Medium size sale price (FCFA)	-	12950±5646.90a	12455.36±4320.01a	NS
Large size sale price (FCFA)	-	18125±6884.46a	15281±36668.86a	NS

ab : Means on the same line followed by different letters are significantly different at the 5% level.

3.1.5 Constraints Encountered and Solutions Proposed by Grasscutter Farmers

3.1.5.1 Constraint Encountered

The surveyed grasscutter farmers reported several constraints. Among these, the difficulty in accessing forage was the most frequently mentioned issue across all three groups, but it was more commonly cited in Groups 1 (86.36%) and 2 (96.72%) than in Group 3 (58.82%) ($p<0.05$). Apart from this constraint, a lack of financial resources was also a common

challenge. Other constraints encountered by farmers in all three groups included the high cost and difficulty of accessing raw materials for feeding grasscutters and challenges in selling their products. The frequencies of these constraints did not vary significantly between the groups, except for the difficulty in product sales, which was reported more frequently in Group 3 (35.29%) compared to Groups 1 (4.55%) and 2 (6.56%) ($p<0.05$). Less frequently reported constraints including difficulties in accessing water and managing diseases, particularly in Groups 2 and 3. Additionally, cases of theft and low profitability were reported exclusively in Group 3 by 5.88% of the grasscutter farmers.

Table 10: Constraints encountered

Constraints	Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
	%	CI	%	CI	%	CI
Difficult access to forage	86.36ab	14.34	96.72a	4.47	58.82b	23.40
Lack of financial resources	22.73a	17.51	27.87a	11.25	29.41a	21.66
Difficult access to raw materials	31.82a	19.46	36.07a	12.05	11.76a	15.31
High cost of raw materials	13.64a	14.34	13.11a	8.47	5.88a	11.18
Difficulty accessing water	0.0a	0.0	6.56a	6.21	5.88a	11.18
Difficulty in distribution	4.55b	8.71	6.56b	6.21	35.29a	22.72
Theft	0.0a	0.0	0.0a	0.0	5.88a	11.18
Low profitability	0.0a	0.0	0.0a	0.0	5.88a	11.18
Diseases	0.0a	0.0	1.64a	3.19	0.0a	0.0

N = Size; CI= Confidence Interval;ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.

3.1.5.2 Suggested Solutions

The solutions proposed by the surveyed grasscutter farmers are presented in Table 11. The majority of respondents across all three groups suggested technical and financial support as primary solutions to address their constraints. The need for technical support was suggested by a lower proportion of respondents in Group 1 (41.18%) compared to Group 2 (63.64%) and 3 (68.33%) ($p<0.05$). Technical support could include training on best practices for grasscutter farming, disease management, and improving farm efficiency. The suggestion for financial support was common across all three groups, with similar frequencies (72.73% in Group 1, 77.05% in Group 2, and 52.94% in Group 3) ($p>0.05$). Financial support could help farmers invest in better infrastructure, purchase high-quality feed, and expand their farming operations. Training on the formulation of feed was suggested at similar frequencies across all three groups ($p>0.05$). This indicates a common need for knowledge in developing cost-effective and nutritionally balanced feeds for grasscutters. Support for constructing better grasscutter pens was also proposed at similar frequencies across the groups ($p>0.05$), reflecting a need for improved farming infrastructure. The suggestion to receive donations of breeding stock was similarly frequent across the three groups ($p>0.05$). This could help improve the genetic quality of the grasscutter herds and enhance productivity. The need for training on farming practices was more frequently suggested by farmers in Groups 1 (27.27%) and 2 (28.23%) compared to Group 3 (5.88%) ($p<0.05$). This training could focus on sustainable farming techniques, health management, and efficient production practices. The proposal to organize and structure grasscutter farmers was more commonly suggested in Group 3 (35.29%) than in Groups 1 (13.64%) and 2 (6.56%) ($p<0.05$). Structuring could involve forming cooperatives or farmer associations to improve collective bargaining power, share resources, and provide mutual support.

Table 11: Suggested solutions to address the constraints

Proposed Solutions	Group 1 (N=22)		Group 2 (N=61)		Group 3 (N=17)	
	%	CI (%)	%	CI (%)	%	CI (%)
Technical support	63.64ab	20.10	68.33a	11.67	41.18b	23.40
Financial support	72.73a	18.61	77.05a	10.55	52.94a	23.73
Training on feed formulation	31.82a	19.46	19.67a	9.98	11.76a	15.31
Assistance with the construction of a grasscutter farm	31.82a	19.46	29.51a	11.45	23.53a	20.16
Training on breeding practices	27.27ab	18.61	28.33a	11.31	5.88b	11.18
Donation of breeding stock	13.64a	14.34	16.39a	9.29	17.65a	18.12
Organization of farmers	13.64ab	14.34	6.56b	6.21	35.29a	22.72

N = Size; CI= Confidence Interval;ab: Frequencies in the same row followed by different letters are significantly different at the 5% level.

3.2 Discussion

3.2.1 SocioprofessionalCharacteristics of Surveyed Farmers

The majority of respondents were found in Group 2 (61%), while the other two groups, which were smaller in size, had similar proportions (22% and 17%). Among the respondents, women were underrepresented, although in the third group, they made up 23.53% of the respondents, compared to 0% and 8.20% in the other two groups. The low representation of women, which has been noted by some authors[7,12,13] over the past few years, has not changed. The predominance of men in grasscutter farming has also been reported in other African countries, particularly in Ghana and Nigeria[14–16]. However, the frequencies of women involved in grasscutter farming in this study are lower than those reported by[17] and [15]in Nigeria (43.14% and 25.3%, respectively). The low representation of women among grasscutter farmers may be linked to the fact that women tend to prefer commercial activities. Indeed, most respondents resided in the departments of Mono, Ouémé, and Plateau, which border Togo (Mono) and Nigeria (Ouémé, Plateau), regions where there is a significant amount of trade with Benin. Additionally, most respondents, especially those in Group 1, entered grasscutter farming following specialized training. The lack of a gender-focused approach during these training sessions could be another reason for the limited involvement of women in grasscutter farming, particularly in Groups 1 and 2, as noted by [13]. This aspect should be considered for the promotion of grasscutter farming in Benin, as according to [18], game farming in general, and grasscutter farming in particular, can play an important economic, social, and financial role in self-employment, poverty reduction, and the financial empowerment of women. Almost all the surveyed grasscutter farmers were also engaged in agriculture and the farming of other animal species in addition to grasscutter farming. This observation had already been made by[13] in southern Benin. Adjahoutonon et al. [12] reported that grasscutter farming is primarily linked to agriculture and is also closely associated with other types of livestock farming, which could explain this observation.

3.2.2 Farming Systems

The farming method predominantly observed in Groups 2 and 3 resembles a more professional approach compared to that in Group 1. Unlike Group 1, where about 8 out of 10

farmers raise grasscutters in enclosures built directly on the ground, all respondents in groups 2 and 3 raise their animals in off-ground enclosures arranged in tiers. This tiered arrangement of enclosures requires more technical expertise. Farmers who opt for this method likely acquired the necessary skills through training, as more than half of the respondents in these two groups had received training in grasscutter farming before starting the activity. Ground-based farming has been reported as the most common practice in Côte d'Ivoire, particularly in rural areas, according to [18]. In contrast, off-ground enclosures have been reported as the most common farming method in the Accra region of Ghana by[16]. In Benin, no previous studies have provided information on the frequency of different grasscutter farming methods. Thus, no comparisons can be made regarding the past and present frequency of these methods. The enclosures described by the previously mentioned authors are constructed from wood in livestock buildings, which may or may not be covered by a roof. This differs from the observations made in the present study, where all enclosures are constructed from concrete (either ground-based or tiered). Tiered enclosures are often found in farms with larger herds. When group breeding of animals occurs normally in a polygamous setting, with an average litter size of four grasscutter pups per birth per female, the herd size increases rapidly, leading to space constraints. Under these conditions, off-ground, tiered enclosures offer the best solution[18]. Therefore, the predominance of tiered enclosures in Groups 2 and 3 may be related to herd size, which, despite the lack of significant differences, is numerically higher in Groups 2 and 3 compared to Group 1.

3.2.3 Management of Grasscutter Feeding

The main categories of feed used to nourish grasscutters across the three groups are forages, commercial feed (provender), and dietary supplements. These types of feeds are similar to those reported by[7] and [19]in Benin, and by [16] in Ghana. The feeding practices in the first two groups are more sophisticated than those in Group 3. In groups 1 and 2, all respondents usedprovender, a concentrated feed made from a wide variety of raw materials. This feeding approach reflects the nature of the stakeholders in these groups, as farmers are more represented in Groups 1 and 2. Additionally, all farmers in these groups belong to grasscutter farming associations, which likely facilitates the exchange of farming practices, including feeding strategies. This could explain the similarity in feeding practices observed in the first two groups. The diversity of raw materials used in making concentrated feed (provender) indicates a significant variation in the composition of these feeds. While forages are the primary diet of grasscutters in their natural habitat, they are often nutritionally inadequate for grasscutters raised in captivity[20]. Therefore, the provision of forage should be supplemented with provender or other dietary supplements. However, the quality of the provender used for feeding captive grasscutters, whether produced by the farmer or purchased, needs to be assessed and adjusted to each physiological stage of the animals. The variation in the frequency of use of specific feed resources from one group to another can be attributed to the availability of these resources in the immediate environment of the farmers in each group.

According to [19], green forages such as *Panicum maximum* and *Pennisetum purpureum*, along with agricultural by-products, are the two main categories of simple feeds used in the basic diet of farmed grasscutters in Benin. This finding is confirmed by the results of this study, which show that *Panicum maximum* and *Pennisetum purpureum* are the most commonly used forages. The choice of a particular feed resource is often influenced by its availability in the local environment of the surveyed grasscutter farmers. The feeding practices for grasscutters have remained consistent over time, reflecting a continuity in traditional approaches and the influence of local resource availability on feeding strategies.

3.2.4 Commercialization of Farmed Grasscutters

Grasscutters are generally sold alive across all three groups. However, the frequency of respondents in Group 3 who sold live grasscutters (88.24%) is lower than those in the other groups. This difference can be attributed to the types of clients these farmers cater to. In Group 3, just over half of the respondents reported selling to restaurant owners, and there was a higher frequency of private individuals as clients compared to the first two groups. Nevertheless, the clientele of the surveyed grasscutter farmers across all three groups is predominantly composed of foreigners, which could be explained by the fact that most of the farmers were surveyed in border departments with neighboring countries (Nigeria to the east and Togo to the west). The age at the sale was 4.70, 4.15, and 7.28 months in Groups 1, 2, and 3, respectively, with corresponding weights of 2.07 kg, 2.91 kg, and 2.91 kg. The variation in the age at which grasscutters are sold between groups indicates differences in technical management practices. According to [16], grasscutters are sold when the number of animals exceeds the farm's capacity, when the animals reach maturity, or when the farmer has an immediate financial need. Additionally, the feeding strategy for grasscutters can influence the age at which they are sold[21,22]. For example, the inclusion of concentrated feed (provender) along with forage is less common in Group 2 (64.71%), whereas all respondents in Groups 1 and 3 supplement forage with provender for feeding their animals. Adding concentrated feed alongside forage is recommended to improve growth performance in grasscutters [22,23]. Since this practice is less common in Group 3, farmers might be compelled to delay the sale until the grasscutters reach a marketable weight. The age at a sale in all three groups is higher than that reported by [24], which was 3 months. However, those authors reported a sale weight of 3 kg, which is similar to the weight reported by some farmers in Group 3. This suggests that grasscutters are now sold at an older age than in the past, but often at lower weights, with only a minority matching the previous sale weights. This observation raises questions about the current performance of grasscutter farms and suggests the possibility of poor sales performance.

Similar to the age at the sale, the average sale price per kilogram of live weight reported by [24](2150 F CFA) is lower than the sale price per kilogram of live weight of grasscutters in the three groups identified in this study. Depending on the size, the sale price of a whole grasscutter varied from 12,950 to 18,125 F CFA in Group 2 and from 10,600 to 15,281 F CFA in Group 3. The lack of data on the price of a whole grasscutter by size in Group 1 suggests a lack of a solid techno-economic management strategy among the respondents in this group. The sale prices of a whole grasscutter reported by farmers in Groups 2 and 3 are higher than those reported by [7] in Benin, which ranged from 5,000 to 12,000 F CFA. The price increase observed in this study can be attributed to several factors, such as the high cost of farming inputs and difficulties in accessing forage due to climate change and the reduction of grazing areas related to urbanization. These constraints likely lead to increased production costs.

3.2.5 Constraints Encountered and Solutions Proposed by Grasscutter Farmers

The analysis of constraints related to grasscutter farming highlights limited access to forage resources and difficulties in obtaining raw materials as the most frequent challenges across all three groups of farmers. Feeding difficulties are recurrent in grasscutter farming in Benin [7,21]. Having access to sufficient and quality feed resources is also the major challenge for grasscutter productionin other countries in the West African sub-region[16,25,26].The resurgence of this constraintis explained by the shortage of green forage during the dry season and its scarcity due to the ever-growing urbanization. Moreover, the acceleration of urbanization, especially in areas initially intended for agriculture, and climate change can account for this difficulty.However, other constraints such as lack of know-how in handling grasscutter, housing construction, low level of veterinary care, high rate of disease infection

and marketing problems have been reported in other African regions[15,27]. Based on the solution approaches suggested by the farmers in this study,it appears that respondents from all three groups need technical support. They have expressed this need through their desire for training on feed composition, technical support (reproduction, animal health management, farm management, etc.), and construction support. However, to overcome feed-related constraints, it is also important to train farmers both in forage and forage conservation techniques.

4 CONCLUSION

The typology of grasscutter farming in southern Benin has revealed the presence of three groups of grasscutter farmers, all predominantly male, although there is a higher representation of women in the third group. The results highlighted two farming systems: ground-based farming and off-ground enclosures, with feeding primarily based on forage supplemented with commercial feed, particularly in the first two groups. The majority of the constraints faced by the farmers are similar, but their frequencies vary depending on the group. Overall, the characteristics of grasscutter farms have not significantly changed from domestication to the present day. To enhance the promotion of the grasscutter farming sector in southern Benin, it is crucial to improve farming practices by enhancing feeding strategies. This includes developing commercial feed formulas that complement forage and are tailored to each physiological stage of the animals. Additionally, to further promote grasscutter farming, awareness campaigns should be conducted to encourage the preference for farmed grasscutter meat over wild-caught meat. However, it is first necessary to provide information on the secondary processing practices of both types of grasscutters and the quality of their respective meats.

Disclaimer (Artificial intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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