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Perception of danger and snakebite management practices in quilombola communities in Bahia, Brazil, 2023–2024: a cross-sectional study

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Abstract

Background

Snakebite envenoming is a neglected health problem of major public health relevance that disproportionately affects socially and territorially vulnerable populations. In quilombola communities, daily interactions with the land, vegetation and subsistence activities increase exposure to snakes and place this health issue within contexts characterised by structural inequalities, barriers to accessing healthcare, and historically rooted forms of land dispossession

Methods

This descriptive cross-sectional study was conducted through household interviews in seven quilombola communities in the municipalities of Cachoeira and Simões Filho, Bahia, Brazil. Data were collected between 2023 and 2024. Eligible participants were residents aged 14 years or older who had lived in the selected quilombola communities for at least six months. We investigated sociodemographic characteristics, perceived danger, recognition of snakebite as a health problem, reported actions after snakebite, and use of medicinal plants. Descriptive analyses were performed using absolute and relative frequencies.

Results

A total of 290 residents from seven quilombola communities participated in the study. High perceived danger of snakebite and recognition of snakebite as an important health problem were frequent across the study population. The highest proportions of high perceived danger were observed in Engenho da Ponte (94.6%), Engenho da Praia (91.7%), and Rio dos Macacos (90.7%), while recognition of snakebite as an important health problem reached 100.0% in Dendê and Engenho da Praia. Although most participants reported that they would seek a health service after a snakebite (80.0%), non-recommended practices persisted, especially tourniquet use (17.7%).

Conclusions

In quilombola territories, snakebite envenoming should not be understood merely as an isolated environmental accident, but as a condition related to territory, living conditions, structural inequalities, and concrete possibilities for care. These findings underscore the need for territorialized and culturally contextualized strategies oriented toward equity, with stronger primary health care, improved surveillance, and timely access to antivenom.

Introduction

Snakebite envenoming is a globally neglected condition with disproportionate impact on rural and socially vulnerable populations. Each year, an estimated 5.4 million snakebites occur, including 1.8 to 2.7 million cases of envenoming, 81,000 to 138,000 deaths, and up to 400,000 people left with permanent sequelae, especially in low- and middle-income countries [2, 3]. In Brazil, snakebite remains a relevant public health problem, with unequal regional distribution and persistent barriers to timely treatment. In 2022, 29,543 cases were reported nationwide, and the North region presented an incidence rate of 55.3 cases per 100,000 inhabitants, about 4.1 times the national average. In 2023, 32,595 snakebite cases and 143 deaths were recorded nationwide [10, 33]. Studies have further shown that time to treatment influences the severity of envenoming [6], and that agricultural and occupational dynamics are associated with the distribution of risk in the state of Bahia [25].

Although snakebite is often treated as a biological event resulting from contact with a venomous animal, its occurrence is not randomly distributed. Its incidence, severity, and outcomes are influenced by living conditions, work organization, mobility, transport availability, access to the health system, and time to antivenom therapy [2, 3, 6, 7]. From this perspective, snakebite envenoming can be understood as a socially determined health problem whose production follows historical, territorial, and racial inequalities [4–9]. Concepts such as environmental justice and environmental racism help explain why certain population groups remain simultaneously more exposed to danger and less protected by public policies [4, 5, 8, 9]. This interpretation is reinforced by studies on neglected diseases and health inequities, particularly those showing links between social policies, primary health care, and the occurrence of health problems concentrated in unjustly burdened populations [31, 32].

In quilombola communities (slave-afro-descendants), this discussion is especially relevant. Quilombola territories should not be understood merely as residential areas or statistical units, but as spaces of ancestry, resistance, cultural reproduction, and material production of life [16–21]. In these territories, relations with land, water bodies, forests, and subsistence activities such as farming, fishing, gathering, and territorial mobility structure everyday life and may simultaneously increase exposure to environmental hazards. In addition, many of these communities live with poor infrastructure, mobility constraints, fragile state protection, territorial conflicts, and persistent barriers to access health services, creating a setting of systemic violence that extends beyond classical indicators of sanitation or income [11–13, 21, 24]. Evidence on the health of quilombola populations reinforces this picture by documenting persistent inequalities in living conditions and access to essential services, making it plausible to expect greater exposure and lower protection in relation to snakebites as well [12].

In these contexts, the perception of danger related to snakebite does not correspond simply to an individual judgment about risk. It is built from everyday experience, collective memory, intergenerational knowledge, care practices, and expectations regarding the response of the health system [14, 15]. Understanding how quilombola communities perceive danger and what practices they mobilize in response to snakebite broadens the interpretation of snakebite envenoming beyond the clinical sphere, incorporating territorial, cultural, and political dimensions that are fundamental to collective health [12, 14–16, 27, 28]. It also helps address the epidemiological invisibility of this condition, which is further

aggravated by limitations in the completeness of notifications of accidents involving venomous animals in Brazil [13].

Despite the relevance of the topic, studies on risk perception and community management of snakebite envenoming in quilombola territories remain scarce. Therefore, this study aimed to describe perceived danger and community practices related to the prevention and management of snakebite envenoming in quilombola communities in Bahia, Brazil.

Methods

Study design and setting

This was a descriptive cross-sectional study conducted in 2023–2024 in seven quilombola communities located in the Northeast region of Brazil, in the state of Bahia: Dendê, Kalembá, Kaônge, Engenho da Praia, Engenho da Ponte, Engenho da Cruz, and Rio dos Macacos.

The communities in Cachoeira are located in the Bacia e Vale do Iguape region, historically marked by the sugarcane economy and the continuity of Afro-Brazilian and Afro-Indigenous territorial organizations. Today, these communities maintain ways of life strongly linked to family farming, artisanal fishing, palm oil management, and other practices that express a close relationship with land and territory.

Rio dos Macacos, in the municipality of Simões Filho, is marked by a long-standing land dispute with the Brazilian Navy, partial land titling, and institutional violations related to mobility, infrastructure, and access to basic rights. In this setting, exposure to accidents involving venomous animals should be understood in articulation with structural inequalities and territorial violations.

Participants and sampling

Eligible participants were residents aged 14 years or older who had lived in the investigated territories for at least 6 months and agreed to participate. In Dendê, Kalembá, Kaônge, Engenho da Praia, Engenho da Ponte, and Rio dos Macacos, a household census was conducted.

In Engenho da Cruz, where the territory included an estimated 243 households and 385 quilombola residents, sample size was calculated using StatCalc (Epi Info) [22]. We considered an expected incidence of 9.5% for snakebite accidents, a 95% confidence level, a margin of error of five percentage points, a design effect of 1.0, and an additional 10% for possible losses.

To increase territorial representativeness in Engenho da Cruz, household selection was restricted to residences recognized by the quilombola residents themselves as belonging to the officially delimited territory, using an alternating systematic sampling strategy (one house included, the next excluded).

Data collection

Data were collected between April 2023 and January 2024. Interviews were conducted periodically on weekends, which facilitated the participation of residents and community leaders.

The questionnaire was hosted on the REDCap platform [23] under the responsibility of the Federal University of Bahia and administered offline on mobile devices by a previously trained team. The instrument included household and individual modules adapted to the sociocultural context of quilombola communities.

The broader questionnaire covered sociodemographic and economic information, access to health services, use of medicinal plants, lifestyle habits, experiences with accidents involving venomous animals, food insecurity, territorial violence, and covid-19 vaccination.

Study variables

The main outcomes of this analysis were the perceived danger of being bitten by a snake and the recognition of snakebite as an important health problem. Responses were categorized as yes (high or low), no, and do not know/no response.

Exposure variables included gender identity, skin color/race, age group, marital status, schooling, paid work status, place of work (inside or outside the home), and use of medicinal plants.

A multiple-response question was used to describe intended actions after a snakebite, including applying a tourniquet, squeezing the bite site, sucking the wound, washing with soap and water, using medicinal herbs, seeking a health service, and not knowing what to do.

Statistical analysis

The database was organized in Microsoft Excel® and descriptively analyzed using Stata®, version 17. Absolute and relative frequencies were calculated for the variables of interest. All scientific interpretations, critical analyses, methodological decisions, and final conclusions were performed and validated by the authors.

Ethical aspects

The study was conducted in accordance with the Declaration of Helsinki and Brazilian National Health Council Resolutions No. 466/2012 and No. 510/2016. The study was developed in dialogue with quilombola communities and councils, respecting autonomy, informed consent, and the strengthening of local social technologies. The broader project was funded by the Bahia State Research Support Foundation and approved by the Research Ethics Committee of the Institute of Collective Health, Federal University of Bahia (CAAE: 53730021.1.00005030; opinion No. 5.809.996).

Results

A total of 290 residents from seven quilombola communities in the municipalities of Cachoeira and Simões Filho, Bahia, participated in the study. Of these, 43 participants (14.8%) were from Rio dos Macacos and 247 (85.2%) from the other investigated communities.

Table 1 presents perceived danger of being bitten by a snake and recognition of snakebite as an important health problem according to sociodemographic characteristics. In both dimensions, positive responses predominated. Among participants who reported a feeling of high danger, the highest frequencies were observed among cisgender men (94.6%), people aged 50 to 59 years old (93.8%), self-identified black individuals (86.5%), individuals who had not attended school (89.5%), people with up to secondary education (87.3%), and participants who were single, or separated, or divorced, or widowed (89.0%), individuals who work outside the home (91.1%) and people who report using medicinal plants (86.8%). Similarly, considering snakebite a significant health problem was more frequent among cisgender men (96.5%), people aged 50 to 59 (96.8%), black participants (86.6%), individuals who did not attend school (94.7%), single, separated, divorced or widowed individuals (93.8%), and those who use medicinal plants (93.3%).

Table 1
Perceived danger of being bitten by a snake and recognition of snakebite as an important health problem according to sociodemographic characteristics. Bahia, 2023.

Attribute	Do you consider yourself in danger of being bitten by a snake?			Do you consider snakebite an important health problem?		
	Yes, high n (%)	Yes, low n (%)	No n (%)	Yes, high n (%)	Yes, low n (%)	No n (%)
Cisgender men	106 (94.6)	4 (3.6)	2 (1.8)	109 (96.5)	2 (1.8)	2 (1.8)
Cisgender women	141 (81.5)	23 (13.3)	9 (5.2)	154 (89.5)	12 (7.0)	6 (3.5)
Trans woman	1 (100.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Other / prefers not to answer	4 (100.0)	0 (0.0)	0 (0.0)	3 (75.0)	0 (0.0)	1 (25.0)
14–19 years	19 (79.2)	2 (8.3)	2 (12.5)	20 (87.0)	2 (8.7)	1 (4.3)
20–29 years	43 (86.0)	4 (8.0)	2 (6.0)	47 (95.9)	2 (4.1)	0 (0.0)
30–39 years	40 (87.0)	4 (8.7)	1 (4.3)	40 (88.9)	3 (6.7)	2 (4.4)
40–49 years	59 (86.8)	6 (8.8)	2 (4.4)	61 (91.0)	3 (4.5)	3 (4.5)
50–59 years	30 (93.8)	1 (3.2)	0 (0.0)	30 (96.8)	1 (3.2)	0 (0.0)
60 years or older	61 (81.3)	10 (13.3)	4 (5.3)	70 (93.3)	2 (2.7)	3 (4.0)
Black	201 (86.6)	23 (9.9)	8 (3.4)	201 (86.6)	23 (9.9)	8 (3.4)
Brown	41 (83.7)	5 (10.2)	3 (6.1)	41 (83.7)	5 (10.2)	3 (6.1)
White	6 (100.0)	0 (0.0)	0 (0.0)	6 (100.0)	0 (0.0)	0 (0.0)
Indigenous	2 (100.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)
Asian	1 (100.0)	0 (0.0)	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)
Attended school - Yes	218 (86.5)	23 (9.1)	11 (4.4)	232 (92.1)	11 (4.4)	9 (3.6)
Attended school - No	34 (89.5)	4 (10.5)	0 (0.0)	36 (94.7)	2 (5.3)	0 (0.0)
Up to primary education	121 (88.3)	14 (10.2)	2 (1.5)	126 (92.0)	3 (2.2)	8 (5.8)
Up to secondary education	69 (87.3)	5 (6.3)	5 (6.3)	72 (91.1)	6 (7.6)	1 (1.3)
Up to higher education	24 (77.4)	4 (12.9)	3 (9.7)	29 (93.5)	2 (6.5)	0 (0.0)

Attribute	Do you consider yourself in danger of being bitten by a snake?			Do you consider snakebite an important health problem?		
	Yes, high n (%)	Yes, low n (%)	No n (%)	Yes, high n (%)	Yes, low n (%)	No n (%)
Married / stable union	131 (85.1)	15 (9.7)	8 (5.2)	131 (91.0)	6 (4.2)	7 (4.9)
Single / separated / divorced / widowed	121 (89.0)	12 (8.8)	3 (2.2)	137 (93.8)	7 (4.8)	2 (1.4)
Paid work - No	142 (86.1)	18 (10.9)	5 (3.0)	151 (91.5)	9 (5.5)	5 (3.0)
Paid work - Yes	106 (87.6)	9 (7.4)	6 (5.0)	113 (73.4)	4 (3.3)	4 (3.3)
Workplace - Outside household	72 (91.1)	3 (3.8)	4 (5.1)	73 (92.4)	2 (2.5)	4 (5.1)
Workplace - Inside household	26 (44.1)	31 (52.5)	2 (3.4)	29 (93.5)	2 (6.5)	0 (0.0)
Uses medicinal plants - Yes	224 (86.8)	26 (10.1)	8 (3.1)	238 (93.3)	12 (4.7)	5 (2.0)
Uses medicinal plants - No	26 (81.3)	3 (9.4)	3 (9.4)	28 (90.3)	1 (3.2)	2 (6.5)

Source

Prepared by the authors.

Table 2 shows heterogeneity across quilombola communities. Engenho da Ponte had the highest proportion of participants who reported a feeling of high danger of being bitten by a snake (94.6%), followed by Engenho da Praia (91.7%) and Rio dos Macacos (90.7%). All participants (100.0%) from Dendê and Engenho da Praia considered snakebites a significant health problem. The other communities showed slightly lower percentages, although recognition of the condition prevailed in both dimensions investigated. These findings suggest subtle territorial differences in the understanding of danger and the importance attributed to snakebite envenoming across the studied communities.

Table 2
Distribution of perceptions about snakebite according to quilombola communities. Bahia, 2023.

Quilombola community	Do you consider yourself in danger of being bitten by a snake?			Do you consider snakebite an important health problem?		
	Yes, high	Yes, low	No	Yes, high	Yes, low	No
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Rio dos Macacos	39 (90.7)	2 (4.7)	2 (4.7)	38 (88.4)	3 (7.0)	2 (4.7)
Kaônge	18 (78.3)	3 (13.0)	2 (8.7)	21 (87.5)	1 (4.2)	2 (8.3)
Dendê	17 (81.0)	3 (14.3)	1 (4.8)	20 (100.0)	0 (0.0)	0 (0.0)
Kalembá	17 (81.0)	4 (19.0)	0 (0.0)	16 (80.0)	1 (5.0)	3 (15.0)
Engenho da Ponte	35 (94.6)	2 (5.4)	0 (0.0)	36 (97.3)	1 (2.7)	0 (0.0)
Engenho da Praia	11 (91.7)	0 (0.0)	1 (8.3)	12 (100.0)	0 (0.0)	0 (0.0)
Engenho da Cruz	116 (87.2)	12 (9.0)	5 (3.8)	123 (92.5)	6 (4.5)	4 (3.0)

Source

Prepared by the authors.

Table 3 summarizes the main actions reported after a snakebite. Most participants stated that they would seek a health service (80.0%). However, practices not recommended by the Brazilian Ministry of Health persisted, such as tying the affected limb with a tourniquet (17.7%), washing the site with soap and water (15.3%), using medicinal plants (10.0%), squeezing the bite site (4.3%), not knowing or not responding (4.0%), and sucking the bite site (1.3%). Overall, the results indicate that although formal health care is the main reported response, traditional practices and non-recommended actions still coexist in the initial management of snakebite accidents.

Table 3
Practices reported after a snakebite by quilombola communities (Bahia), 2023.

Reported practice	%
Seeking health services	80.0
Applying a tourniquet	17.7
Washing the site with soap and water	15.3
Using medicinal plants	10.0
Squeezing the bite site	4.3
Do not know / no response	4.0
Sucking the bite site	1.3

Source

Prepared by the authors.

Discussion

This study showed that snakebite envenoming is widely recognized as a relevant health threat in the investigated quilombola territories. More than an occasional event, snakebite appeared as a permanent concern in everyday life, linked to the use of territory for farming, fishing, gathering, mobility, and other subsistence activities. This finding is consistent with the literature describing snakebite envenoming as a neglected tropical disease with socially unequal distribution and concentration among Indigenous, rural, and quilombola populations [1–3]. In Brazil, studies by Mise and colleagues further emphasize the sensitivity of this condition to barriers in access, travel time, and occupational insertion, all of which are central to the interpretation of the results found here [6, 25].

The patterns described according to sex, age, schooling, and race/skin color suggest that perceived danger is not randomly distributed. The greater recognition among cisgender men, older adults, Black participants, and individuals who did not attend school may reflect distinct trajectories of exposure, daily responsibilities within the territories, and unequal access to protection and information. It also reflects the importance of established cultural knowledge in each community unit, corroborated by the higher proportion of people who use medicinal plants. Working outside the home is fundamental to the perception of danger compared to working inside the home, reinforcing the occupational role of snakebite accidents [25]. This interpretation is consistent with studies showing that worsening of snakebite envenoming is related to time to treatment, territorial barriers, and racial and occupational inequalities in Brazil [6, 7, 9, 13]. It also aligns with the literature on neglected diseases and social determination, indicating that health problems concentrated in vulnerable populations cannot be explained only by biological exposure, but also by unequal institutional protection [31, 32].

The differences observed between communities reinforce the centrality of ways of living and well-being as determinants of health. The stronger predominance of positive responses in Engenho da Ponte, Engenho da Praia and Rio dos Macacos, suggests that factors such as environmental exposure, agricultural land use, circulation in vegetated areas, and local infrastructure conditions interfere with the perception of threat related to snakebite envenoming. In quilombola contexts, these differences are associated with historical processes of expropriation, environmental racism, and institutional racism, which unequally shape possibilities for prevention and formally established care [4, 5, 12, 21, 24]. From this perspective, territory should not be understood merely as the setting where the condition occurs, nor reduced to the production of indicators and markers, because it actively participates in the way risk is produced and lived by affecting conditions of exposure, protection, and health care practices.

The high proportion of participants who reported that they would seek a health service after a snakebite is a relevant finding, as it suggests recognition of the formal health system as the main therapeutic reference. Even so, the persistence of practices such as tourniquet use, squeezing, or sucking the bite site shows that appropriate and inappropriate first-aid practices coexist. This pattern has been described in other remote contexts and should not be interpreted merely as misinformation, but also as the expression of historical care processes built in settings marked by geographic barriers, delayed care, and limited-service availability [6, 14, 15, 25, 26]. The articulation between seeking formal care and maintaining risky practices reinforces the need for culturally sensitive health education strategies.

The use of medicinal plants, which was highly frequent among participants, requires careful interpretation. In quilombola communities, these practices are related to territorial systems of care, transgenerational transmission of knowledge, and coping strategies developed in the face of persistently unequal structures such as environmental racism. Thus, the results do not support a simplistic opposition between traditional knowledge and professional care; rather, they point to the need for intercultural strategies in primary health care that recognize community knowledge while also improving guidance on immediate conduct and timely access to antivenom [12, 16, 27, 28, 30, 31].

The findings reinforce the need for intersectoral responses to snakebite envenoming. Recent literature has shown that the response to this condition depends not only on the availability of antivenom, but also on decentralization of care, strengthening of health surveillance, culturally situated health education, and the capacity of health care networks to respond in a timely manner [3, 6, 29, 32]. In quilombola communities, however, these actions cannot be limited to expanding service provision or addressing isolated indicators, because they must consider that the social context actively participates in the way risk is produced and experienced. This implies recognizing that sanitation, mobility, infrastructure, territorial protection, and ways of life directly interfere with possibilities for exposure, prevention, and care. In addition, the limitations already demonstrated in the completeness of notifications of accidents involving venomous animals [13] indicate that more effective programmatic responses also require improved health information systems so that historically invisibilized territories do not remain underrepresented in official statistics and public action priorities.

This study has limitations that should be considered when interpreting the findings. Because it is a descriptive cross-sectional study, it does not allow causal relationships to be established between perceived danger, community practices, and sociodemographic characteristics. In addition, part of the information was self-reported, which may introduce recall bias. Selection bias also cannot be ruled out, especially in territorial contexts with specific household access dynamics. Even so, the study provides a baseline on perceived danger, recognition of snakebite envenoming as a health problem, and community management in quilombola territories of Bahia, a population still underrepresented in the scientific literature.

Conclusion

Snakebite envenoming in quilombola territories cannot be understood as an isolated environmental accident, but as a health problem produced at the intersection of territory, ways of life, structural inequalities, and concrete possibilities for care. The findings of this study show that the perception of danger and the initial management of snakebite are shaped by historical conditions of expropriation, environmental racism, institutional racism, and barriers to health care access. In this context, strengthening the Brazilian Unified Health System becomes central, especially through primary health care, health surveillance, the organization of care pathways, and timely access to antivenom. This study therefore contributes to affirming that tackling snakebite envenoming in quilombola communities requires territorialized, intersectoral, and culturally contextualized responses committed to equity and to the recognition of quilombola communities as living spaces of well-being.

Declarations

Ethics approval and consent to participate

This study was conducted in accordance with the Declaration of Helsinki and Brazilian National Health Council Resolutions No. 466/2012 and No. 510/2016. The broader research project was approved by the Research Ethics Committee of the Institute of Collective Health, Federal University of Bahia, Brazil - CAAE: 53730021.1.00005030; opinion No. 5.809.996. All eligible participants, or their legal guardians when applicable, provided informed consent before participation in the study.

Consent for publication

Not applicable. This manuscript does not contain any individual person’s identifiable data, images, or videos.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to ethical and confidentiality restrictions involving quilombola communities and individual participants. Data may

be made available from the corresponding author upon reasonable request, subject to approval by the responsible research team and in accordance with applicable ethical and confidentiality requirements.

Competing interests

The authors declare that they have no conflicts of interest.

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Authors' contributions

RABL developed the study based on his undergraduate thesis, participated in data collection and organization, and prepared the first draft of the manuscript. YFM supervised the undergraduate thesis and contributed to the study design, methodological guidance, interpretation of results, and critical revision of the manuscript. JSN co-supervised the work, coordinated the broader research project “Condições de vida e saúde de comunidades quilombolas da Bahia e Sergipe”, and contributed to the interpretation of findings and critical revision of the manuscript.

WAFN contributed to data analysis, interpretation of results, and manuscript writing and revision. DBC, TPL, MBGS, DSF, GECMJ, CSM, and JVJ contributed to the conception of the broader study, fieldwork, interpretation of findings, and critical revision of the manuscript. All authors read and approved the final version of the manuscript.

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Figures

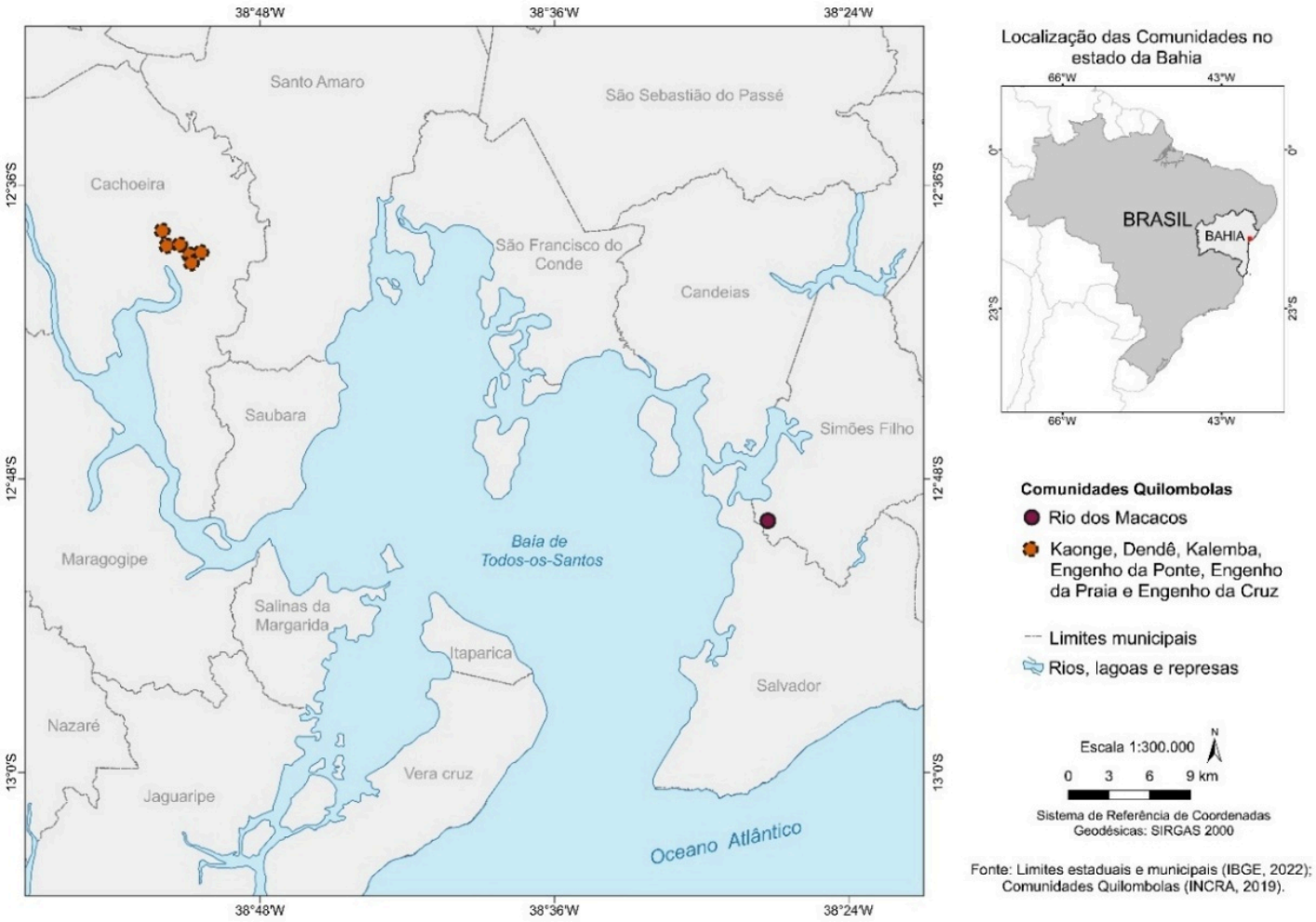


Figure 1

Geographical location of the quilombola communities participating in the study in the municipalities of Cachoeira and Simões Filho, Bahia, Brazil.

Source: IBGE (2022), ICRA (2019), and ISC/UFBA research group archive.