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REPORT OF THE STUDY ON

RISK ANALYSIS OF ZOOONOSIS

ALONG THE BUSHMEAT VALUE CHAIN IN CAMEROON
(CASE OF THE EAST AND LITTORAL REGIONS) AND
EVALUATION OF LEGALITY, SUSTAINABILITY, AND
SAFETY PARAMETERS.

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DESIGN

Francesca Marcolini



Carcasses on sale at a Douala market

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CONTENTS

page 4

EXECUTIVE SUMMARY

page 6

INTRODUCTION

page 7

RESEARCH OBJECTIVES

page 9

METHODOLOGY

page 10

RESULTS

Objective 1 Results	12
Objective 2 Results	14
Objective 3 Results	16
Objective 4 Results	19
Objective 5 Results	22

page 23

CONCLUSIONS & RECOMMENDATIONS

page 26

References and Image credits

EXECUTIVE SUMMARY

Cameroon is facing major crises, including the reduction of forest cover and the overexploitation of wild species, including through illicit harvest and trade. Targeting of wild animal taxa for consumption as food poses threats to endangered species and tropical ecosystems if not managed within sustainable, safe, and legal limits. Transmission and emergence of zoonotic pathogens associated with wild animals can have a negative impact on animal, human, and environmental health, including food safety, with potential negative consequences to economies and society. To better prevent and control potential zoonotic pathogen spillover from wild animals targeted for meat, it is important to understand the structure of the bushmeat (wild animal species used for meat/food in both legal and illegal trade) value chain, in order to map potential hazards and risks, including those related to illegality and unsustainability.

The study was carried out by TRAFFIC to map and analyse zoonotic disease risks along the bushmeat value chain in Cameroon, in particular at the interfaces where humans, wildlife, and livestock interact. This study was carried out by TRAFFIC's Central Africa Programme Office with support from the USAID-funded Wildlife TRAPS Project, implemented globally by TRAFFIC and IUCN, in conjunction with TRAFFIC's Arcadia-funded Reducing Trade Threats to Africa's wild species and ecosystems (ReTTA) Project.

The structured value chain analysis (VCA) from source to end-use allows the relative risks of disease emergence and transmission to be segmented across various human-animal-environment interfaces, considering human behaviours and practices along the bushmeat trade value chain. The VCA approach was inclusive also of parameters defining legality and sustainability in Cameroon and makes recommendations for risk management based on a multi-sectoral One Health approach. In addition, the research allowed for testing the indicators of the Central African Bushmeat Monitoring System (SYVBAC), as a key reference for the monitoring of the impact of future management interventions. The study targeted the markets and sales outlets in the towns of Bertoua (East region) and Douala (Littoral region) of Cameroon which were chosen based on the results of previous studies on the marketing of bushmeat in Cameroon and the development of SYVBAC.

The analysis of the legislative and regulatory framework shows that, although Cameroon has internalized and ratified most multilateral environmental agreements, there are insufficient national regulations to guide governance, compliance, and enforcement of the bushmeat trade, including monitoring and risk management of bushmeat markets. Under these conditions, the early detection of disease outbreaks will not be possible, and thus any response will be late.

Field research data showed that in all the value chain segments surveyed, the risk of disease transmission was rated as 'very moderate' to 'very high' due to a combination of factors, including: lack of knowledge of biosecurity rules; lack of knowledge of the required standards for handling bushmeat and the important links between the actors; the limited legality related to bushmeat trade; the diversity of the species in trade; shortcomings of the legislation in place; and a number of 'at-risk' human behaviours and practices.

From a socio-economic point of view, analysis of the survey results (n=362 women and n=186 men) showed that all segments of the value chain were involved in bushmeat trade activities. The trading activity involved an exchange of money at all levels and was the main source of income for the actors surveyed. Economic benefits and domestic consumption were reasons cited by actors for hunting by 100% of women and 95.2% men in Lom et Djerem, and 34.7% of women and 54% of men in Wouri.

The analysis shows that the bushmeat trade sector is an important source of income for various stakeholders and value chain actors. The monthly income of most restaurateurs (58.3%)¹, processors (59.1%), and bushmeat sellers (52.7%) lies within the range of XAF40,000 (USD66²) - XAF60,000 (USD99). It is only among the transporter segment of the value chain that less than half fall within this upper-income range (37.5%). Although the level of income of actors along the value chain is not high, it is nevertheless higher than the guaranteed minimum wage. This could explain the persistence of this activity because every segment of the value chain benefits from it.

From an epidemiological viewpoint, the factors influencing the emergence and transmission of zoonoses at the Human-Animal-Environment interface are as follows: the equipment, means and knowledge of standards associated with hunting, transport, processing, and marketing of bushmeat from hunting areas to bushmeat markets. In terms

of transport modalities, motorbikes are used almost 75% of the time by all stakeholders, with hunters using them 85% of the time to move bushmeat in various forms. Without strict biosecurity risk management measures, these transport methods could play a significant role in potential transmission of diseases.

Attitudes and perceptions of all value chain actors show that they have a far lower perception of these risks than objectively observed or analysed during the study. For instance, the study shows that bushmeat in Cameroon can transmit zoonotic diseases at all the segments, meanwhile only 56% of the interviewed actors in Lom et Djerem and 45% in Wouri Division think that bushmeat can transmit zoonotic diseases. Risk communication and community engagement (RCCE) is therefore a key to managing health risks in the context of wildlife conservation and the legal bushmeat trade.

The data collected has been recorded in TRAFFIC's Wildlife Trade Information System (WiTIS) database to increase the evidence base for mapping the trade in wild animal species used for meat. Porcupine is the most preferred species: 24.09% (132/548), followed by antelope at 9.12% (50/548). The top five taxa (porcupine Hystricidae, antelope Bovidae, hare Leporidae, monkey Cercopithecidae, and Red River Hog Potamochoerus porcus) account for more than 50% of the 23 traded taxa recorded in the markets.

All these factors, derived from the analysis of the survey results, form a data set which should be supplemented by subsequent, more extensive studies. This VCA could serve as a reference to design and develop legality, sustainability, and biosafety measures applicable to all segments of the bushmeat value chain. These measures could focus on training actors and monitoring bushmeat market locations as critical interfaces between human activity and wild animal taxa, whether live or partly processed, for sale as meat.

¹ Although the restaurateurs sell other dishes, bushmeat, especially in Bertoua, constitute the major source of their income. However, for the transporters, bushmeat does not represent the main item they transport.

² USD = XAF 603,052 on the 31 of March 2023. XAF is the currency in Cameroon known as the African Financial Community Franc, or in French, Franc de la Communauté Financière Africaine



Bushmeat market, Bertoua

INTRODUCTION

Global biodiversity is currently facing an unprecedented crisis, and tropical forests, as highly diverse ecosystems, are directly affected (Marselle *et al.*, 2021). These forests are currently under threat from several factors, including the hunting, use, and trade of wild animals for consumption as bushmeat. The World Organisation for Animal Health (WOAH) defines meat as all edible parts of an animal. Bushmeat can be defined as all non-domesticated land mammals, birds, reptiles, and amphibians hunted for their meat (Christophersen & Nasi, 2008; Fa *et al.*, 2003). The term is mainly used for products derived from hunting in tropical forests. In contemporary discourse, bushmeat raises several issues relating to food security, overexploitation of game, human well-being, species conservation, and the consequences it may have for the transmission of diseases, including zoonoses (Nasi *et al.*, 2011; Ngama, 2015).

The emergence and transmission of zoonotic diseases have often been attributed to wildlife trade, which has become a topic of discussion, particularly in the context of the COVID-19 pandemic origins. However, much remains to be learned about the nature and extent of zoonotic disease risks associated with wildlife trade in relation to other determinants of disease spread, including land-use change, agricultural and livestock production, and various anthropogenic factors at the human-animal-ecosystem interface. Efforts at early detection, control of zoonotic disease outbreaks, and above all, risk communication and community engagement are of paramount importance in relation to understanding the risks associated with bushmeat value chain (VC) pathogens. Thus, one of the main recommendations made at the first and second 'One Health' sub-regional meetings in Central Africa (which took place in Libreville, Gabon (2012) and Brazzaville, Congo (2017))

was to strengthen surveillance of zoonotic diseases in wildlife.

In Cameroon, the tropical rainforest covers almost 210,000 square kilometres (Mayaux *et al.*, 2004), with a diversity of plants and animals, some of which are endemic. Because of its central position in the Central Africa sub-region, it is a 'hot spot' for the outbreak of zoonotic diseases; and like most of the countries in the sub-region, it represents an essential crossroads because of its biodiversity in protected areas, the diversity of its livestock, and the favourable conditions for animal production from which it benefits.

TRAFFIC's research findings complement national strategies on the prevention and

control of zoonoses in the bushmeat value chain, where the complexity of the sector calls for multi-sectoral collaboration, including complementary legislative instruments based on the 'One Health' approach. It also contributes to the implementation of bushmeat trade-related recommendations made by several working groups and experts from regional conventions and agreements. The study also provided an opportunity to test health-related indicators in the Central African Bushmeat Monitoring System (SYVBAC), exploring a systems-based approach to collect and structure the information needed to adaptively manage bushmeat use and trade at sustainable levels.

RESEARCH OBJECTIVES

FRAMING THE RESEARCH

Research parameters were designed to conduct an analysis of the risk of zoonoses and the spread of pathogens from the bushmeat value chain, analysing the legality and sustainability criteria associated with transport, sale, and trade along the value chain and establishing a baseline for SYVBAC³.

More specifically, this involved:

- Assessing the bushmeat trade in Cameroon by characterizing the supply chain using selected and revised SYVBAC indicators, including those focused on urban markets that recognize the variables and risks of the One Health approach,
- Testing the bushmeat indicators for urban bushmeat markets,
- Establishing the baseline situation of the bushmeat trade in Douala and Bertoua in

order to prioritise the types of intervention to reduce the risks of illegal, unsustainable and dangerous factors, including human behaviours,

- Identifying and characterising risk factors and levels at each human-animal interface, or transaction node, along the bushmeat VC to assess legality, sustainability and safety risks,
- Making proposals and recommendations for risk reduction related to illegal, unsustainable and unsafe practices (i.e. potential transmission and emergence of zoonotic diseases) and how to mitigate these threats in the bushmeat value chain, including future monitoring needs related to SYVBAC and bushmeat trade indicators.

³ SYVBAC is built to serve as a monitoring system that collects and compares bushmeat data from specific sites using predefined indicators for different categories of sites. Urban bushmeat market is one category, and Douala and Yaounde were selected during the development of SYVBAC as sites to be monitored in Cameroon. The data from a 2001 study of the bushmeat markets in Yaounde, published in 2006, have been adopted as the baseline data for Yaounde. The data from Douala in this study that measures SYVBAC indicators (prices, species, interventions, zoonotic risks, actors' profiles...) will also serve as the baseline for Douala. We are also proposing that Bertoua should be added as a third urban bushmeat market locality to be monitored in SYVBAC in Cameroon, with the data from this study also serving as baseline for Bertoua.

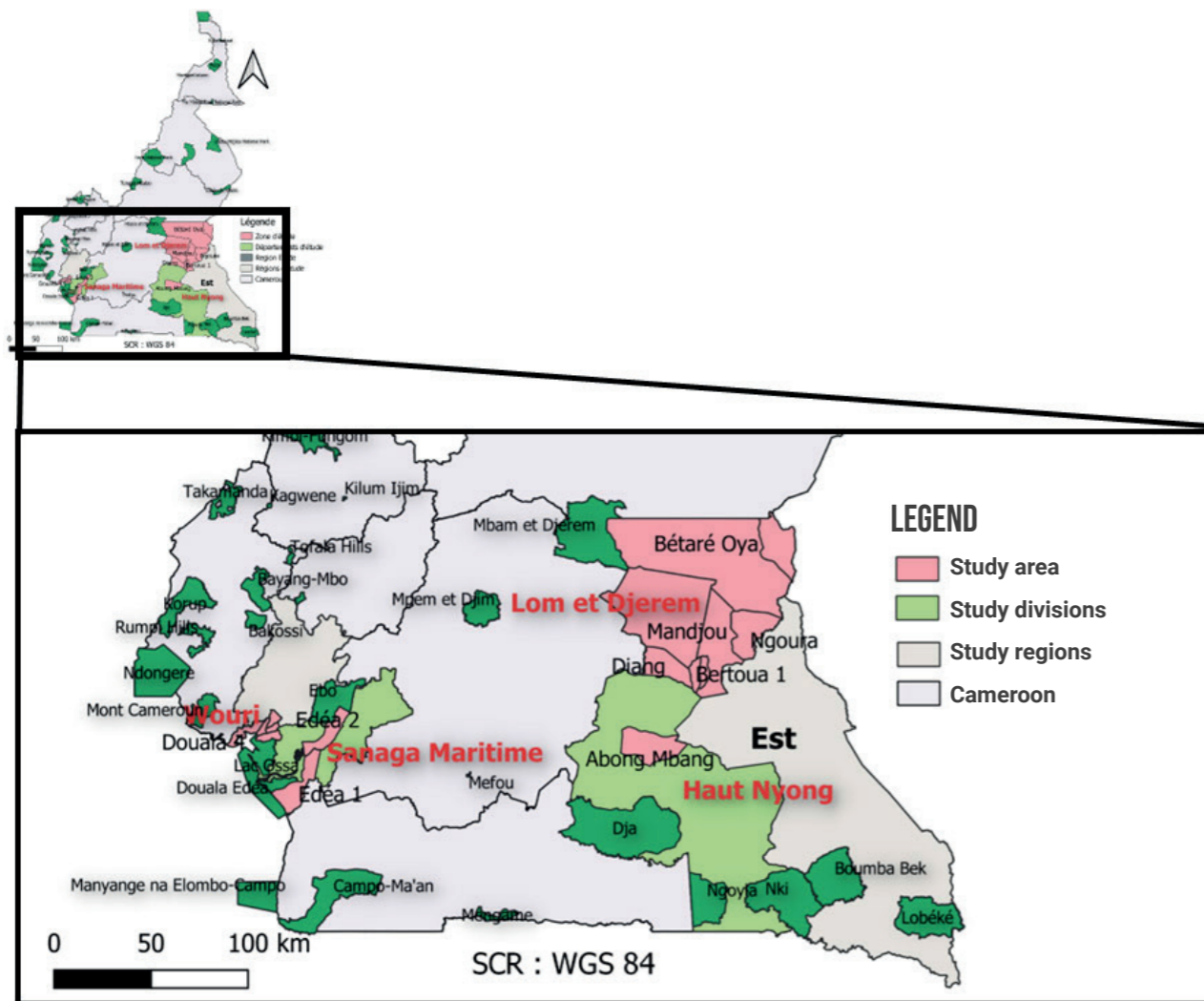
METHODOLOGY

METHODOLOGICAL APPROACH

The characterisation of the bushmeat value chain in the context of zoonotic risk control involved firstly mapping, locating, and describing the threats associated with the behaviour of each player in relation to their area of intervention, and secondly analysing the risks associated with their activity in order to understand what mitigation measures could be practically implemented in the context of Cameroon.

More specifically, the methodological approach was based on a series of interdependent activities at each stage of the process of analysing the value chain and the risk behaviour of the players, according to the objectives of the study.

FIGURE 1
Localities visited in Wouri, Sanaga Maritime, Haut Nyong and Lom et Djerem Divisions, Cameroon, 2023



This research was carried out in six phases, namely:

- selection of study sites
- identification of key players
- development of data collection tools (data sheets, interview guides)
- selection, training, and coaching of investigators
- data collection
- processing and analysing the collected data, and
- preparing and finalising the study report

The study targeted the urban markets and sales outlets of Bertoua (East region) and Douala (Littoral region), as shown in Figure 1. The choice of these locations was guided by the results of previous studies on the marketing of bushmeat in Cameroon and the development of a monitoring system for the bushmeat sector in Central Africa

(SYVBAC) (Nzeukap & Momballa-Mbun, 2022). Bushmeat commodities' collection points were identified based on MINFOF/MINEPIA data and discussions with value chain stakeholders. The snowball technique was used to refine the study's consideration of other markets and sites.

The profiling of the markets and sales outlets in the cities of Bertoua and Douala made it possible to assess the level of risk of introduction and/or spread of pathogens and thus facilitate the implementation of biosecurity and/or response measures. Following a rapid assessment of the focus group data, and according to the experts, certain sales sites in the town of Abong-Mbang in the Haut-Nyong division and Edéa in the Sanaga-Maritime division were added to the study.

LIMITS TO THE STUDY

The report presents and analyses the different segments and provides network maps of the trade indicating the relative sizes and relationships among the markets. The questions G.1 and QB.9⁴ regarding the sources or origin of supplies, which were intended to establish the links between segments and the relative flow of the commodity along the value chain were interpreted by the enumerators and interviewees as referring to the geographical locality from which the meat was sourced. This led to a detailed locality network chain without providing enough information to clearly map how the commodity flows from one segment to the other along the value chain. The report, therefore, lacks a clear description of the value chains that would be expected of such a study. However, using the findings from the report and referring to other bushmeat trade and market surveys done in the country, the authors have included a bushmeat supply

chain infographic indicating the level of potential disease transmission risk along the chain.

The analysis took a bushmeat holistic approach to legality and sustainability rather than a species-specific approach. Furthermore, the time taken to collect the data was not sufficient to apply specific tools such as the Five-Dimensional Sustainability Assessment Framework (5DSAF) and make definitive conclusions. However, the collected data provided input for the experts, who agreed on the variables used to analyse and rank the safety, legality, and sustainability risks. Despite the objectivity involved in the selection of experts, replacements of unavailable targeted experts and value judgements on the data collected in the field could have an impact on the quality of the results.

⁴G.1 and QB.9 are questions from the focus group and individual questionnaires respectively used in the survey.

RESULTS

INTERNATIONAL AND NATIONAL ANCHOR FOR MONITORING ZONOOSES IN WILDLIFE

Analysis of the legislative and regulatory framework shows that Cameroon has ratified and internalised most of the multilateral agreements and international conventions on the environment and wildlife conservation, as well as the standards of the World Organisation for Animal Health (WOAH) and the World Health Organisation (WHO). These include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Biological Diversity (CBD), the WHO's Terrestrial and Aquatic Animal Health Code and the WHO's International Health Regulations (IHR), which, in accordance with Cameroon's Constitution⁵, form part of the legal corpus governing animal health, forests, wildlife and protected areas.

However, there are currently no robust national regulations to guide the governance, compliance, and enforcement of the trade in wild animals used for bushmeat, including surveillance and risk management of bushmeat markets. Under these conditions, early detection of outbreaks will not be possible, and any response is therefore likely to be delayed without an established objective framework. There is still a need to improve the legislative and regulatory framework on the specific issues of wildlife disease management and the bushmeat trade.

SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

The survey involved a total of 548 actors (n=362 women and n=186 men) in the bushmeat marketing value chain in the two divisions, with 48.4% (n = 265) in Lom et Djérem and 51.6% (n = 283) in Wouri.

The sex ratio (M/F) of respondents was 51.1% male. This ratio matches the 52% reported in municipal bushmeat markets in Brazzaville (Mbete *et al.*, 2011) and slightly lower than 55.9% at the bushmeat market in Ikire, Osun State, Nigeria (Adebowale *et al.*, 2021).

In this study, 42.3% of bushmeat trade value chain actors are in the 35-44 age bracket, 27% in the 45-54 age bracket and only 18.8% in the 24-34 age bracket. These data are corroborated by a study on the importance of wildlife in the diet of Baka populations with an average age of 34.8 years (Duda *et al.*, 2018).

Table 1 below shows the distribution of age groups according to gender. The age range (35 - 44) is the most represented for both sexes.

TABLE 1
Breakdown of age groups by gender, Cameroon, 2023

AGE OF RESPONDENTS	SEX	
	WOMEN	MEN
Less than 18	1.1%	0%
18 – 24	3.2%	5.2%
24 – 34	16.1%	21.6%
35 – 44	45.4%	39.2%
45 – 54	27.5%	26.5%
55 – 64	6.4%	6.7%
>65	0.4%	0.7%
TOTAL SEIZED	100%	100%
P-VALUE	0.229	

In terms of level of education, 63.3% of respondents had secondary education, 10.2% had higher education, and only 1.8% had no formal education.



Douala, Cameroon

⁵Act No. 96/06 of 18 January 1996 revising the Constitution of 02 June 1972, amended and supplemented by Act No. 2008/001 of 14 April 2008: https://www.assnat.cm/images/La_Constitution.pdf



Pangolin for sale at Douala Market.

OBJECTIVE 1 RESULTS

ANALYSIS OF TRADED WILD ANIMAL SPECIES

The diversity of species hunted, sold, and consumed is high and includes species from all three classes of protection under national legislation.

The main species preferred by consumers throughout the study are shown in Table 2 below. The top five species porcupine *Hystricidae* (C)⁶, antelope *Bovidae*, hare *Leporidae* (C), monkey *Cercopithecidae*, and red bushpig *Potamochoerus porcus* (B) account for more than 50% of the 23 species.

Porcupine is the most preferred species by 24.09% (132/548) followed by antelope at 9.12% (50/548), regardless of the site. This is as in most Central African countries (Friant et al., 2015).

The following species also account for over 50% of the traded species observed: hedgehogs *Atelerix spp.* (C), hornbills *Thryonomys spp.* (C), monitor *Varanus spp.* (B), dorsal stripe duiker *Cephalophus dorsalis* (B), and white-bellied pangolin *Phataginus tricuspis* (A).

21.6% of this variety of other species comes from the Wouri Division, as shown in the table below. Taking the site into account, we note variability in the presence and absence of certain species. The include African Civet *Civettictis civetta* (B) (Wouri: 1.4%), the Genet *Genetta spp.* (B) (Lom et Djérem: 0.4%), the Giant Pangolin *Smutsia gigantea* (A) (Lom et Djérem: 0.4%), Serval *Leptailurus serval* (B) (Lom et Djérem: 0.4%).

⁶The letter in brackets after the species name indicates its protection class under national legislation. Wild species are listed in three classes of protection: A the most protected (entirely prohibited from hunting), B fairly protected (strict regulations for hunting), C the least protected (strict regulations for commercial hunting but loose regulation for subsistence hunting).

TABLE 2

Proportion of preferred species per targeted Division, Cameroon, 2023

BUSHMEAT	DIVISION	
	LOM ET DJÉREM	WOURI
Antelope <i>Bovidae</i> (N/A)	15.8%	2.8%
Cane rats <i>Thryonomys spp.</i> (C)	5.3%	4.6%
Boa <i>Boidae</i> (N/A)	0.8%	0.7%
Back-banded duiker <i>Cephalophus dorsalis</i> (B)	6.4%	1.1%
Yellow-backed duiker <i>Cephalophus silvicultor</i> (B)	1.5%	0.4%
African civet <i>Civettictis civetta</i> (B)	0.0%	1.4%
Crocodile <i>Crocodylidae</i> (N/A)	0.4%	2.1%
Squirrel <i>Sciuridae</i> (C)	0.4%	0.0%
Genet <i>Genetta spp.</i> (C)	0.4%	0.0%
Hedgehog <i>Atelerix spp.</i> (C)	4.5%	9.5%
Red bushpig <i>Potamochoerus porcus</i> (B)	7.5%	7.4%
Hare <i>Leporidae</i> (C)	14.0%	3.5%
White-bellied Pangolin <i>Phataginus tricuspis</i> (A)	0.8%	3.5%
Giant pangolin <i>Smutsia gigantea</i> (A)	0.4%	0.0%
Pangolin <i>Manidae</i> (A)	1.1%	0.7%
Porcupine <i>Hystricidae</i> (C)	25.7%	22.6%
Snakes (N/A)	0.0%	0.4%
Serval <i>Leptailurus serval</i> (B)	0.4%	0.0%
Monkey <i>Cercopithecidae</i> (N/A)	10.2%	5.7%
Tortoise <i>Testudinidae</i> (N/A)	0.0%	0.4%
Varan <i>Varanus spp.</i> (B)	1.1%	8.5%
Viper <i>Viperidae</i> (N/A)	0.8%	3.2%
Other, please specify	2.6%	21.6%
TOTAL	100%	100%

¹N/A: Indicates a higher taxon with many species across the spectrum of protected classes A, B, and C. It is therefore not possible to determine the class without a more precise identification at a lower taxonomic level.

OBJECTIVE 2 RESULTS

TESTING AND REFINING SYVBAC INDICATORS FOR URBAN BUSHMEAT MARKETS

The study tested all 64 SYVBAC indicators, focusing on those associated with risky behaviours along the value chain. The 10 specific existing or additional variables for the system, related to zoonotic disease risk, that were tested are shown in Table 3 below.

The analysis shows that several specific bushmeat indicators for urban markets need to be added or revised to collect specific data on the health risk factors associated with the transmission of zoonoses. The safety and sustainability of the bushmeat trade depend on this.

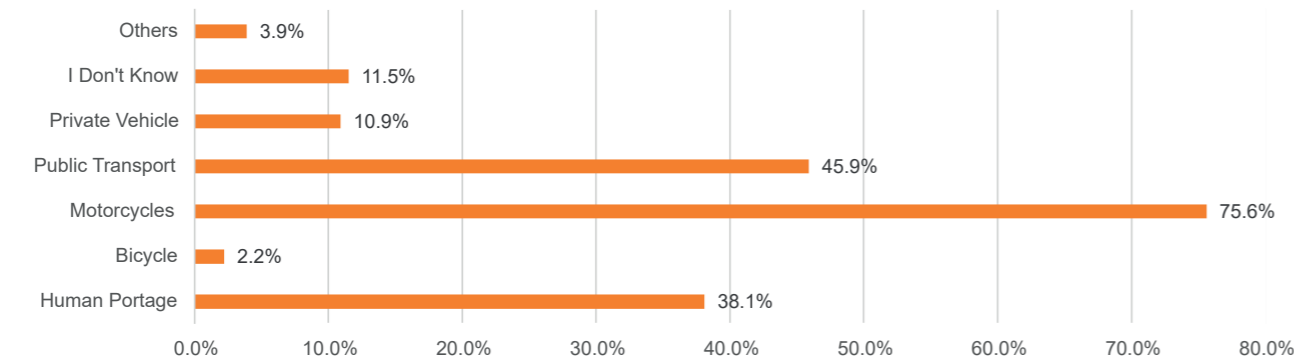
TABLE 3
Additional variables tested or existing ones refined for SYVBAC in relation to zoonotic risk along the value chain.

SYVBAC's Indicators	Additional variables tested or existing variables refined for data collection
Pressure, status and response indicators	<ul style="list-style-type: none"> Past and present general health status of people involved in hunting and bushmeat processing Possible dangers/risks of killing bushmeat for consumption Precautions taken to avoid these hazards/risks Protection is taken before bushmeat is transported Means of transport for bushmeat Sick after handling or eating bushmeat Type of illness Disease transmission via bushmeat Hygiene and food safety Health-seeking behaviour

MEANS OF TRANSPORT USED

The means of transport used for animal carcasses are shown in Figure 2. Motorcycles are used by nearly 76% of people.

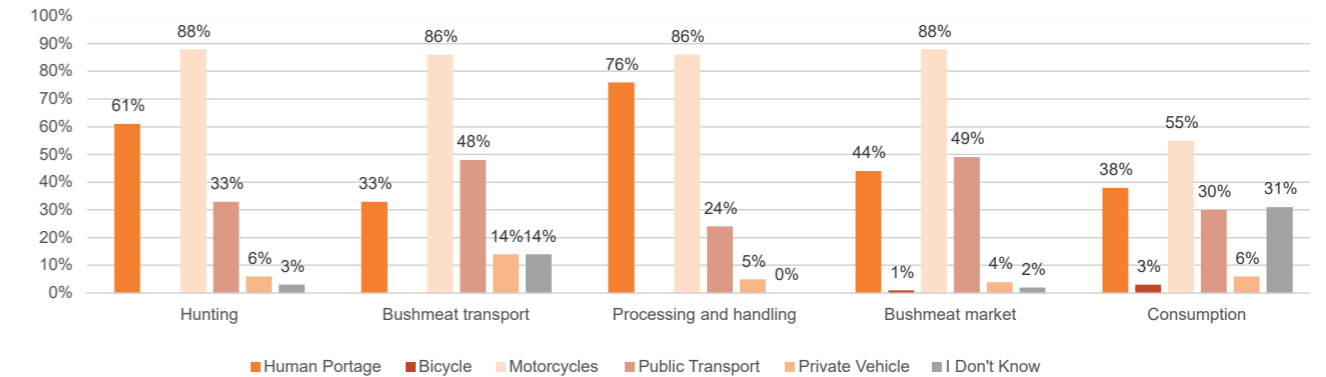
FIGURE 2
Means of transport for killed animals



Motorbikes are the means of choice for bushmeat mobility, and this transport vector should be regarded as a potential risk variable. Motorbikes are generally more agile and better adapted to difficult terrain than larger vehicles, reaching into remote areas where hunting

and bushmeat collection occur. They are also fast, with a large load capacity since they are generally overloaded, and are affordable to purchase. The motorbike also makes it possible to enable evasion of checkpoints on the main roads by using tracks.

FIGURE 3
Means of transport for slaughtered animals along the value chain



In addition to motorbikes, human portage (38%) and public transport (46%) stand out as the two other most commonly used means of transporting bushmeat. Without strict biosecurity measures, these means of

transport create risks of pathogen spillover at the human-animal-environment interface, which could lead to zoonotic disease emergence and transmission.

PRECAUTIONS TAKEN TO AVOID RISKS

According to the survey, only 11.5% of actors inquire about the origin of the slaughtered animal. Less than 2% have specific protective equipment before transporting bushmeat to points of sale. Depending on the Division, 6% of stakeholders in Wouri asked about the origin of the carcass. No actor interviewed in Lom et Djérem wears specific personal protective equipment (PPE) before transporting bushmeat to points of sale. Coupled with the way the meat is transported, the risk of transmission becomes very high for actors at all levels of the chain. However, only 8% of those involved in hunting and processing have established a link between their previous or current general state of health and their activity.

Precautions taken to avoid risks/hazards were significantly higher in Wouri Division in the case of coolers (Lom et Djérem: 4.1%; Wouri: 38.2%), the use of plastic bags (Lom et Djérem: 8.2%; Wouri: 45%), adhesive cardboard (Lom et Djérem: 3.5%; Wouri: 36.6%), and travel bags (Lom et Djérem: 7.6%; Wouri: 29.8%) between the two study sites in terms of the protective measures taken before bushmeat is transported to the points of sale. The flour sack was the most frequent protective measure due to its inner plastic bag which serves as a protective insulator (Lom et Djérem: 87.1%; Wouri: 76.3%), with greater use in Lom et Djérem than in Wouri (P=0.015).



Ready to eat meat on sale at Bertoua market

OBJECTIVE 3 RESULTS

BUSHMEAT TRADE VALUE CHAIN

The research aimed to characterise the structure of the bushmeat trade in Douala and Bertoua in order to frame priority interventions to reduce the risks of illegal, unsustainable, and dangerous factors, including human behaviour. This aligns with SYVBAC's overall objective to generate the information needed to support policies and strategies aimed at regulating the use and trade of bushmeat.

The distribution of bushmeat value chain actors from the studied sample in both divisions is shown in Table 4.

Figure 4 provides an overview of the bushmeat supply chain from local hunters/poachers and legal seizures to the different groups of final consumers⁷.

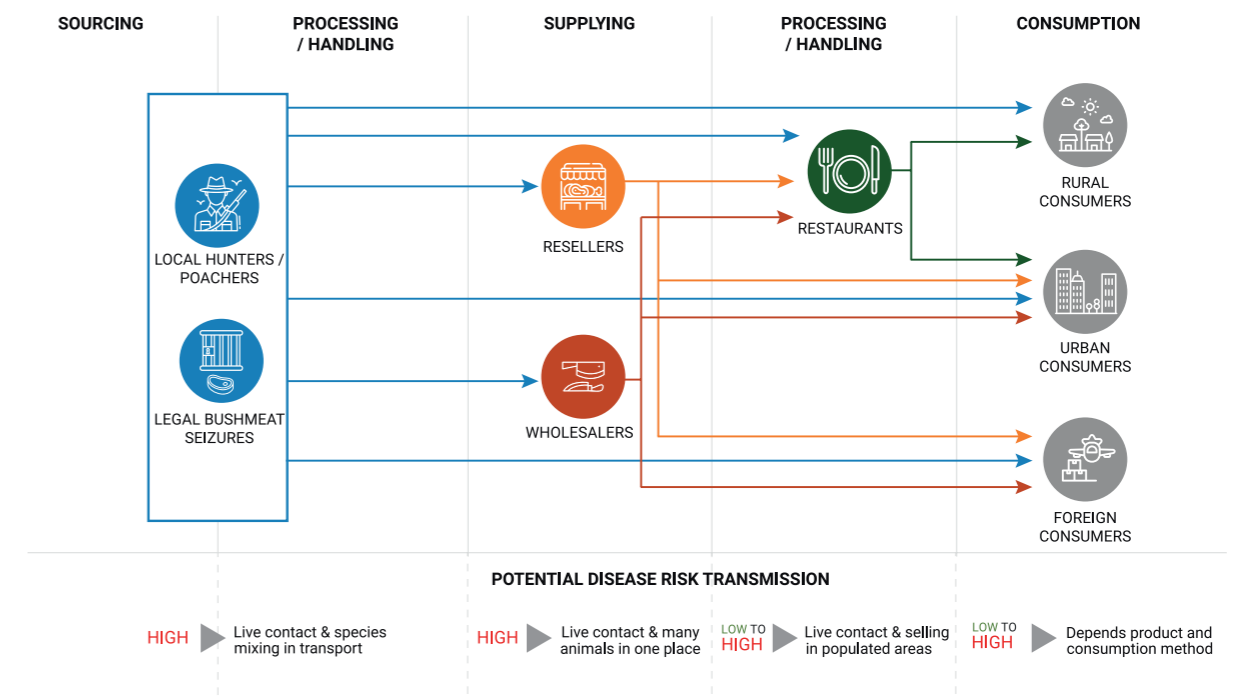
TABLE 4

Distribution of value chain actors by type in targeted Divisions, Cameroon, 2023

BUSHMEAT VALUE CHAIN SEGMENT	TYPE	NUMBER	PERCENTAGE
Hunting	Hunters	37	6.80%
Bushmeat transport	Transporter	16	2.90%
Processing and handling	Processor	22	4.00%
	Cleaner	4	0.70%
Bushmeat market	Distributor	4	0.70%
	Caterer	36	6.60%
	Meat seller	165	30.10%
Consumption	Consumers	264	48.20%
TOTAL		548	100%

FIGURE 4

Bushmeat supply chain in Cameroon (Bertoua and Douala) showing potential channel of product flow and disease risk transmission. Adapted by authors from findings, expert elicitation workshop, Lescuyer and Nasi, 2016; and Momballa-Mbun and Nguemwo, 2021



⁷In Cameroon, legal seizures of bushmeat in the supply chain refers to bushmeat commodities that LE agencies seize from illegal sources and re-introduce them into the legal channel by through public auction sales.

STAKEHOLDERS' BEHAVIOUR IN RELATION TO BUSHMEAT TRADE MANAGEMENT

Various reasons were given for consuming bushmeat in the two value chain geographies where research was conducted. "Better taste and texture" is the highest reason for eating bushmeat at 96.0% in Wouri and 81.4% in Lom et Djérem. "Better availability" (easier to find and buy) varied significantly between Lom et Djérem (63.3%) and Wouri (36.1%), as did "better nutritional value and source of food" (Lom et Djérem: 63.3%; Wouri: 20.4%) and "cheaper" (Lom et Djérem: 9.7%; Wouri: 2.9%). This preference is also associated with species, frequency, and type. The study shows that the preferred species are antelope, bushpig, hare, and porcupine. Consumption

occurs a few times a week with 45.5% in Lom et Djérem and 33.3% in Wouri. Daily consumption is 26.7% in Wouri for most species, compared with 18.2% in Lom et Djérem. There was a difference between sites for antelope (Lom et Djérem: 27.3%; Wouri: 6.7%), hare (Lom et Djérem: 27.3%; Wouri: 0.0%), monkey (Lom et Djérem: 9.1%; Wouri: 0.0%) and monitor lizard (Lom et Djérem: 0.0%; Wouri: 13.3%). This difference is not significant for the overall analysis of preferred species. The majority of species transactions are for dead animals (Lom et Djérem: 63.6%; Wouri: 60%)

MONTHLY INCOME AND ORIGIN OF BUSHMEAT

The salary of XAF40,000 (USD66) - XAF60,000 (USD99) represents the range (40.51%) of monthly household income for most of the players in the bushmeat sector. Specifically, it is 64.9% for hunters, 58.3% for restaurant owners, 59.1% for processors, 37.5% for transporters, and 52.7% for meat sellers. This is in line with the salary scale for civil servants covered by the Labour Code for the Guaranteed Interprofessional Minimum Wage (SMIG) set

at XAF 41,875 (USD69) according to Decree No. 2023/00338/PM of 21 March 2023. Table 5 shows that 24.6% have a salary between XAF65,000 (USD107) - XAF90,000 (USD148) which is higher than the SMIG⁸ XAF60,000 (USD99) per month for other sectors of activity. Also, the vast majority (86%) of all actors have a monthly salary of more than XAF40,000 (USD66).

TABLE 5
Monthly household income

MONTHLY HOUSEHOLD INCOME	NUMBER	PERCENTAGE
More than XAF 150,000	31	5.66%
[XAF100,000 - XAF150,000]	82	14.96%
[XAF65,000 - XAF90,000]	135	24.64%
[XAF40,000 - XAF60,000]	222	40.51%
Less than XAF35 000	66	12.04%
Others, please specify	12	2.19%
TOTAL	548	100%

⁸Salaires Minimum Interprofessionnel Garanti, which translates to Guaranteed Interprofessional Minimum Wage.

OBJECTIVE 4 RESULTS

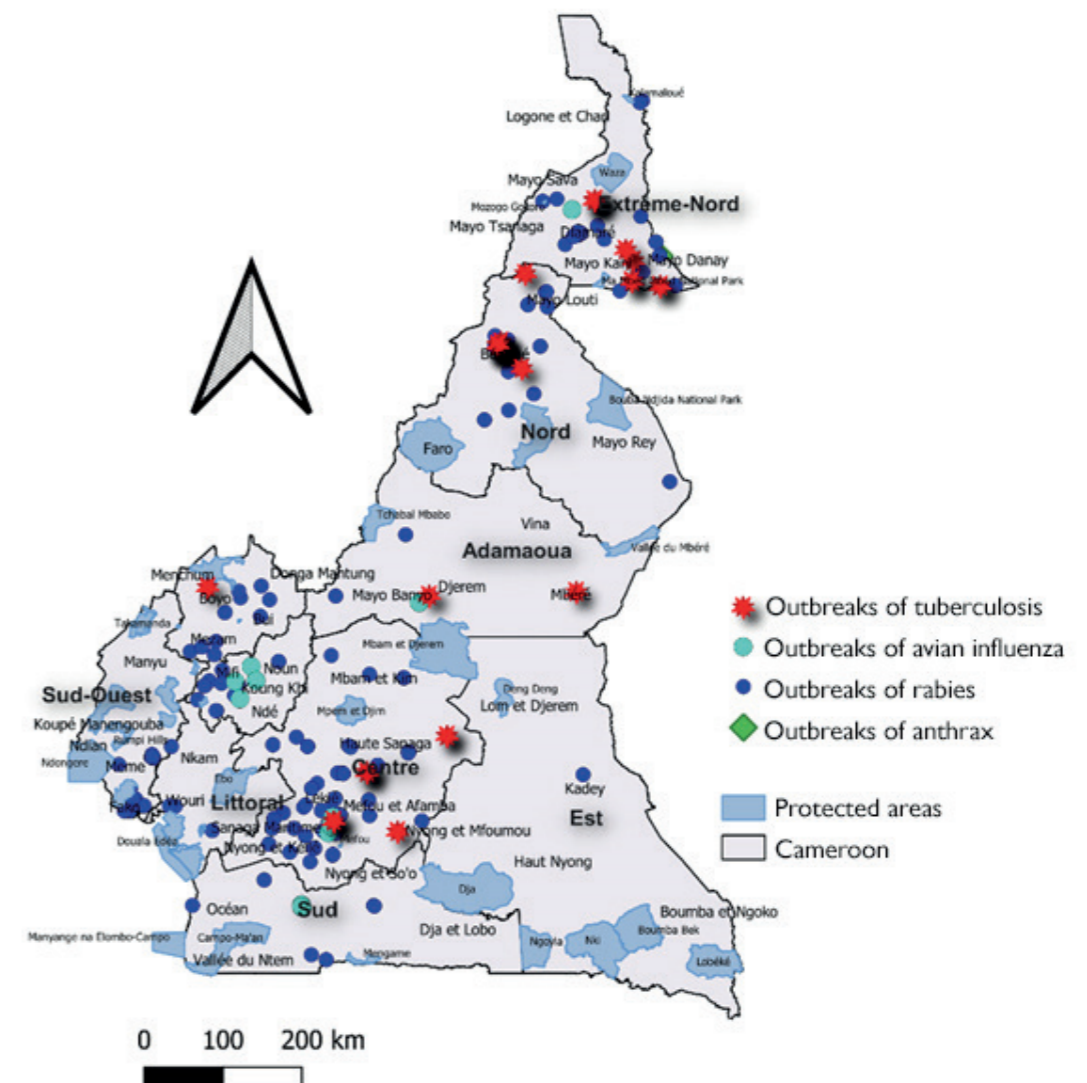
DISTRIBUTION OF ZONOTIC DISEASE OUTBREAKS

Previous studies on the distribution of zoonotic diseases report 441 suspected and confirmed outbreaks in Cameroon from 1 January 2012 to 31 December 2021. This information has been recorded by the epidemiology-surveillance network for animal diseases in Cameroon (RESCAM). The prevalent diseases are rabies,

bovine tuberculosis, avian influenza, and anthrax. The highest number of zoonotic disease outbreaks was for canine rabies (81%), followed by bovine tuberculosis (10%), avian influenza (6%) and anthrax (3%), as shown in Figure 5 below.

FIGURE 5

Spatial distribution of zoonotic disease outbreaks (tuberculosis, rabies, anthrax, avian influenza) in Cameroon from 2012 to 2021 (RESCAM report, 2021)



According to this data, pathologies, including zoonoses, are present in zoos, parks, and protected areas in Cameroon where the main bushmeat samples are taken for trade. This clearly demonstrates that there are potential zoonotic risks associated with the handling of

this meat along the value chain. Table 6 shows the passage of zoonoses (avian influenza, Monkey Pox and Anthrax) at the domestic animal-wildlife interface in Cameroon between 2004 and 2017.

TABLE 6

Some confirmed cases of zoonoses in wildlife with animal epizootics, Cameroon, 2023
Source: MINEPIA, RESCAM, 2004, 2006, 2014, 2016, 2017.

YEAR	AVIAN INFLUENZA	MONKEY POX	ANTHRAX
2004			Chimpanzees, Dja, SO
2006	Wild birds, NO ⁱⁱⁱ		
2014		Chimpanzees, Minta, ES	
2016		Chimpanzees, Mefou, CE	
2017	Peacocks, FN		

ⁱⁱⁱNO: North Region; FN: Far North Region; ES: East Region; CE: Centre Region; SO: South Region

ANALYSIS OF STAKEHOLDERS' BEHAVIOURS AND PERCEPTIONS

The typical range of time taken to transport bushmeat from the collection point to the distribution point usually varies from one to three hours for 17.7% of the actors in Lom et Djérem and from three to six hours for 12.7% in Wouri, where the markets are relatively further from the collection areas. These times indicate the speed with which bushmeat travels (together with its associated micro-organisms), with the movement of wild animal products being a very important risk vector in the potential spread of zoonoses.

Level of education seems to play a role in knowledge of disease transmission by bushmeat. 71.4% of those with a higher level of education know that bushmeat can transmit diseases and 60% of actors with no formal education are unaware that bushmeat can transmit diseases. 52.6% of men and 48.2% of women know that bushmeat can transmit

diseases. It should be noted that 41.7% of actors in Wouri and 23.4% in Lom et Djérem are unaware that bushmeat can transmit diseases. This low perception of risk is also reflected in poor knowledge of hygiene and food safety. 40.8% and 16.6% of actors have a good knowledge of how to handle bushmeat in the Lom et Djérem and Wouri Divisions respectively. Knowledge of zoonotic diseases is low, at 63% and 83.7% respectively for the two Divisions. Knowledge of zoonotic diseases is also low at 70% for women and 77% for men.

Stakeholders' knowledge that regulatory authorities regularly carry out inspections and controls at stages in the supply chain is similar irrespective of the value chain segment and individual's level of education. More than 50% of respondents across all these categories indicate that they are not aware of any control.

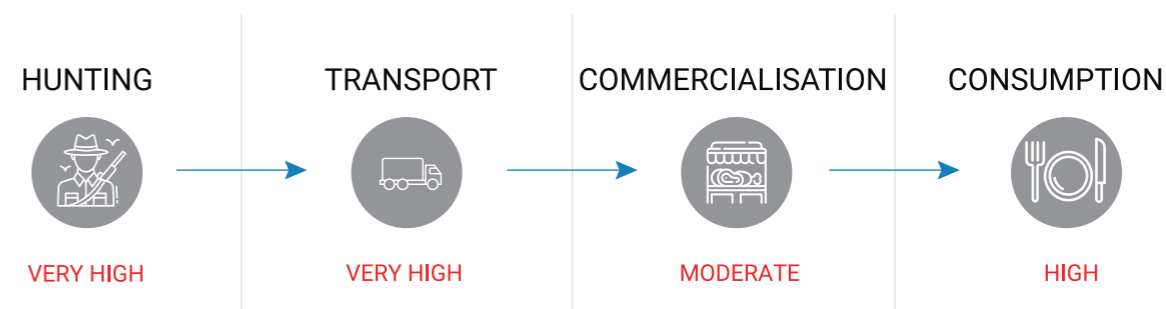
ANALYSIS OF STAKEHOLDERS' BEHAVIOURS AND PERCEPTIONS

The analysis of risk has made it possible to qualify the risk along the bushmeat trade value chain as presented in Figure 6. It is the result of a qualitative analysis of the risk by segment according to the areas and practices at risk, the factors and behaviour at risk and the reasons for the behaviour and/or practices at risk, and the solicitation of experts. Expert

judgements were aggregated using continuous variables. Calibration during the expert elicitation workshop through focus groups and plenary discussions was used to qualify the risk, the associated elements of legality and sustainability, and the mitigation measures. The result is as follows:

FIGURE 6

Level of transmission risk of zoonoses along the bushmeat value chain in targeted departments, Cameroon, 2023



Analysis of the legality and sustainability of the segments along the bushmeat value chain.

The risk and the classification of species (Order No. 0056/MINFOR of 15 April 2020) highlight important points to be considered in understanding and mitigating the risks as

validated in the expert elicitation workshop. Table 7 analyses the legality at the different segments along the value chain.

TABLE 7

Analysis of the legality of activities along the bushmeat value chain in targeted departments, Cameroon, 2023

SEGMENT	LEGALITY
Hunting	Professional hunting is governed by current laws and regulations. The hunting season, species, sites, equipment, and practice are all regulated under existing laws. The laws are well enforced in functioning hunting concessions. In all other sites, the laws are disregarded, breached and poorly enforced leading to persistent poaching.
	Village hunting (for non-commercial purposes) and hunting in Hunting Interest Zones (ZIC) are governed by regulations, whereas poaching is illegal and punished.
Bushmeat transport	The law prohibits all transport of bushmeat from protected species. Transport of all bushmeat commodities on trains, timber trucks, and public transportation is also prohibited.
Marketing	Regulated through various permits and certificates: Collection permit, Certificate of origin, Auction notice, CITES authorization for exports, Market opening authorization (mayor's office), Medical certificates.... The conditions to obtain some of these permits and certificates, such as the collection permit, make them practically inaccessible to many small bushmeat vendors. This makes legal trade of bushmeat by this category of actors almost impossible
Consumption	Legal as part of the right of use (see MINFOR law 94)
	Legal in the case of meat from legal hunting areas and auctions, and illegal for all other sources (MINFOR law 94).

SUSTAINABILITY ANALYSIS

The objectives of the laws being to protect endangered species and conserve biological diversity, means the sustainability of wildlife species can be ensured in cases where the laws are observed and enforced as suggested by Souza *et al.* (2022). This is predominantly in functioning hunting zones and some well-equipped protected areas. In all the other cases, poaching especially of endangered species, hampers the sustainability of wildlife species and the bushmeat supply chain.

Village hunting and hunting in ZICs can also be unsustainable where there are no species inventories and management plans, which have been identified as key instruments to guide the countries commitment to the CBD as outlined in the Law No. 96/12 of 5 August

1996 Relating to Environmental Management in Cameroon and Law No. 003/91 of 23 April 1991 on the Protection of the Environment.

Transportation enables the transfer of urban demand pressure to offtake rural sites increasing the risk of unsustainable harvest. However, the mode of transport in the studied areas does not facilitate traceability of the traded species due to pooling of bushmeat commodities sourced from different areas. This makes it difficult to assess the transfer of urban pressure between specific localities. The law allows for subsistence consumption which is known to be sustainable and beneficial to rural grassroots communities. However, urban demand for bushmeat is considered a major threat to biodiversity.

OBJECTIVE 5 RESULTS

RISK MITIGATION MEASURES

To mitigate the risks associated with illegal, unsustainable and unsafe practices (i.e. potential transmission and emergence of zoonotic diseases) and address practical considerations for mitigation together with monitoring needs (related to SYVBAC and bushmeat trade indicators), several proposals were made by focus groups during the surveys and the expert elicitation workshop participants. The proposals include:

- Identifying at-risk areas and practices by segment
- Assessing the risks
- Proposing practical mitigation measures and a monitoring-based approach
- Developing a risk management plan
- This risk management plan must take into account the reinforcement of the segments of the chain, the areas or points of risk and practices at risk, the factors, behaviours or practices at risk,

and the reasons for the behaviours and/or practices at risk. The risk management plan should consider the strengthening of epidemiological surveillance in wildlife, the response to disease outbreaks in wildlife and along the value chain, the implementation of a risk communication plan, and community involvement in wildlife trade management. In terms of inter-agency policy development, the updating of legislation and regulations on bushmeat marketing, early detection, response, and effective prevention should be considered.

- Strengthening epidemiological surveillance in wildlife
- Respond effectively to disease outbreaks in wildlife
- Implement the risk communication and community engagement plan



CONCLUSION AND RECOMMENDATIONS

From a socioeconomic point of view, the analysis shows that both categories of community members (men, women, young, old, educated, uneducated...) participate in the activities of the bushmeat trade value chain. The activity is monetised at all levels and is the main source of income for many stakeholders.

From an epidemiological perspective, the actors in all the nodes of the chain (hunting, transport, processing, and handling, sale, and consumption), as well as the equipment, means and knowledge of the standards associated with hunting, transport, processing,

and marketing of bushmeat from hunting areas to bushmeat markets are contributing factors in the introduction and spread of zoonoses at the human-animal-environment interface. From a conservation point of view, the data collected has been used to feed the WiTIS web application to reinforce the evidence and strengthen the influence within the framework of the preservation of wildlife species. The enhanced knowledge is available to any interested conservation stakeholders through the Wildlife Trade Portal⁹, which grants access to the open-source area of the WiTIS database.

⁹The <https://trafficinternational.sharepoint.com/SitePages/Wildlife-Trade-Portal.aspx> and incident data. The Portal allows users to search the open-source area of TRAFFIC's wildlife trade incident database (WiTIS), to filter the results, to dive deeper into individual records and to export the results to CSV format for further analysis

Risk communication and community engagement (RCCE) is proving to be a key point in the management of health emergencies in the context of wildlife conservation and the legal bushmeat trade.

At the end of the expert elicitation workshop on risk analysis of zoonoses along the bushmeat value chain in Cameroon (case of the East and Littoral regions) and evaluation of legality, sustainability, and safety parameters held from 30 May to 02 June 2023 in Douala, some recommendations were made on the organisation and operation of the system for monitoring wildlife diseases along the bushmeat marketing value chain taking the following points into consideration:

- The role played by wildlife in the global epidemiological situation has now been widely demonstrated, and we also know that wild animals are both targets and reservoirs of pathogens for both domestic animals and humans;
- There can be no healthy ecosystem without healthy wildlife, and no prosperous ecosystem without abundant biodiversity;
- The recommendation made at the 'One Health' sub-regional meetings to enhance surveillance of zoonotic diseases in wildlife;
- The distribution of animal species in protection classes;
- The need to generate evidence to support the development and implementation of strategies to combat zoonoses;
- The knowledge gap on the nature and extent of the risks of zoonotic diseases linked to the wildlife trade in relation to other factors determining the spread of diseases, which has yet to be filled.

The recommendations were addressed to the partners and public sector agencies of the One Health Platform in Cameroon.

For partners of the One Health Platform in Cameroon (Intergovernmental agencies, funding bodies, NGOs, CSOs...):

- Support the national "One Health" platform (Zoonoses Programme) and public agencies in the development, validation and operationalization of prevention, surveillance, investigation, response, and risk communication activities along the bushmeat value chain from source to end-use.
- Research and document the socio-economic importance of bushmeat for bushmeat stakeholders in the towns of Bertoua, Douala, Abong Mbang and Edéa.
- Ensure that SYVBAC is interoperable with existing surveillance systems (DHIS-2 and CAHIS web applications¹⁰) to facilitate data collection on SYVBAC's zoonotic disease risk indicators.
- Support the search for scientific evidence to develop strategies for the prevention and control of wildlife diseases.
- Support communities in the creation of income-generating activities and development of alternative sources of animal protein (including through sustainable livestock and aquaculture production systems).

To the public sector agencies of the One Health Platform (MINFOF, MINEPIA, MINDDEVEL, MINEPDED, MINCOM, MINADER, MINCOMMERCE):¹¹

- Design information and awareness-raising materials and posters on specific risks along the value chain, based on the results of the study linked to geographic locations, targeting relevant stakeholders (hunters, vendors, processors, restaurant owners, transporters, decentralised MINEPIA, MINFOF and CTD officials).
- Organize awareness-raising missions to priority geographic locations in the value chain (targeting schools, markets, hunters' groups, and veterinary and conservation

services, raising stakeholders' awareness of protected species and how to legally access bushmeat while respecting quotas).

- Develop, validate, and operationalise wildlife product control activities through Sanitary Veterinary Inspection and the stamping of legal meat in markets¹², (MINEPIA and MINFOF).
- Set up an alert, surveillance, and response system for the risks of zoonoses in wildlife, including along the bushmeat value chain, (MINEPIA, MINFOF, MINSANTE).
- Support formalisation of the structured categorisation of actors involved in bushmeat trade in Cameroon (MINFOF, MINCOMMERCE, MINADER).
- Support decentralised local authorities in

designing and developing bushmeat sales areas in markets and facilitate access to collection permits.), (MINDDEVEL, MINCOMMERCE, MINFOF).

- MINEPIA, MINFOF, and MINEPDED should continue institutionalizing the standard operating procedures which have since been developed and approved as one of the recommendations of the 2023 workshop. This should be done through continuous training of staff and awareness raising using the training modules developed to support the process.
- Develop and implement a risk communication and community engagement plan along the bushmeat marketing chain. (MINCOM, MINEPIA, MINFOF).

¹²This is based on the existing practice for domestic livestock meat in the markets. Experts proposed that a similar measure be instituted to formalize the bushmeat sector in Cameroon. This may be feasible for wild animal meat also, although certain modifications would be necessary based on the specific characteristics of wild animal harvest and bushmeat marketing.



Carcasses sold in Bertoua market

¹⁰DHIS is the District Health Information System (for human health) - CAHIS is the Cameroon Animal Health Information System.

¹¹MINCOM: Ministry of Communication; MINCOMMERCE: Ministry of Trade; MINDDEVEL: Ministry of Decentralisation and Local Development; MINEPDED: Ministry of the Environment Nature Protection and Sustainable Development; MINEPIA: Ministry of Livestock, Fisheries and Animal Industries; MINFOF: Ministry of Forestry and Wildlife; MINSANTE: Ministry of Public Health

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Pangolins and python sold at Douala Market.

SEPTEMBER 2024

WORKING TO ENSURE THAT TRADE
IN WILD SPECIES IS LEGAL AND
SUSTAINABLE, FOR THE BENEFIT OF
THE PLANET AND PEOPLE.



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