

Reducing Wild Meat Sales and Promoting Local Food Security: Lessons Learnt from a Behavior Change Campaign in Yangambi, Democratic Republic of Congo

Nathalie van Vliet^{1*}, Ahtziri Gonzalez^{1,2}, Jonas Nyumu^{1,2}, Jonas Muhindo¹, Evi A.D. Paemelaere¹, Paolo Omar Cerutti¹ and Robert Nasi¹

ABSTRACT

Marketing strategies to promote behavioral change are increasingly used to reduce the unsustainable use of wild meat. One of the major keys for success of behavior change campaigns lies in the choice of the channel for communication and the messaging. In this research, we present a behavioral change campaign implemented in Yangambi, Democratic Republic of Congo framed around an integrated conservation and development objective: improve food security in rural communities, reduce the unsustainable use of wildlife for food and promote locally grown pork and chicken. The campaign was co-developed based on the research team's knowledge of the hunting system in the study area and the participation of key local stakeholders (village leaders, hunters and their families). It used participatory community theater, various printed materials, radio and face to face interactions. We evaluated the efficiency and clarity of messaging for channels used through semi-structured interviews with hunters, households and wildlife traders. We found that participatory community theater resulted in increased clarity and understanding among hunters and households. Moreover, community theater promoted word-of-mouth communication that reached an audience well beyond the location where the theater was held. Messages that were framed positively and used amusing channels of communication triggered positive receptiveness by our audience. Using local languages, avoiding written materials for illiterate audiences, and using repetitive means of communication may be among the strategies that could help increase the clarity of communication messages, particularly for sensitive topics such as this one. Our work calls for more lessons learnt from the ground about the most appropriate communication channels and messages, keeping in mind the social and cultural background of the audience, and ensuring that messages trigger emotions that lead to the desired changes.

Keywords: Consumer demand; Hunting; Wildlife depletion; Word of mouth.

1 Centre for International Forestry Research (CIFOR), Bogor, Indonesia.

2 Université de Kisangani, Kisangani, Congo.

* Corresponding author ✉. E-mail address: NvV (nathalievandvliet@yahoo.com)

Part of Special Issue:

Use, Management and Conservation of Wildlife in Latin America.

Edited by Hani R. El Bizri, Melina S. Simoncini, Jair H. Castro Romero, Alejandro Meléndez Herrada, Joaquín L. Navarro.

SIGNIFICANCE STATEMENT

The application of behavioral change strategies to reduce over-hunting and consumer demand for wild meat is still in its infancy, and there is still very little knowledge about the actual impacts of such behaviour change campaigns, mostly because evaluating impacts requires representative pre and post samples and it is often difficult to dissociate different sources of influence to trace direct causal relationships between interventions and responses. The likelihood for a given behavioural change approach to lead to tangible impacts partly lies in the choice of the channel for communication and the messaging. However, little focus has been given in the literature to the most adapted channels and messages to reach the audience with such a sensitive and sometimes provocative topic. Our research contributes to fill this important gap with a case study evaluating the receptiveness of our audience to different types of communication channels and messages.

INTRODUCTION

Wild meat is a key source of food, income, and medicine across the tropics, but concerns for unsustainable use and its impacts on food security and conservation have raised increased interest across the scientific community and policy makers (Coad *et al.* 2019; Ingram *et al.* 2021). Unsustainable use is commonly used in the literature about hunting to refer to hunting levels that are above a certain threshold where wildlife populations cannot recover, therefore slowly or rapidly leading to a reduction of stocks or the local extirpation of the most vulnerable species. While most efforts to reduce unsustainable use initially focused on supply side interventions (e.g. managing hunting for sustainability, alternative sources of income and food for the hunters, law enforcement), the evidence suggests that supply-side efforts alone cannot address the root causes of wild meat trade, and in some cases, they may even negatively affect local communities (Challender and Macmillan 2014; Duffy *et al.* 2019). As a result, over the last decade, conservation practitioners have focused their efforts on curbing consumer demand at the end of the trade chain (Chausson *et al.* 2019; Chaves *et al.* 2018; Gluszek *et al.* 2021; Lemos *et al.* 2021; Niewiadomska *et al.* 2020; Shairp *et al.* 2016; Verissimo and Wan 2019), frequently using social marketing tactics based on behavioral sciences to reduce demand for wild meat in urban areas, therefore reducing unsustainable harvest levels in rural areas (Doughty *et al.* 2021; Shairp *et al.* 2016; Thomas-Walters *et al.* 2021; Travers *et al.* 2021).

Since the reasons for wild meat use are heterogeneous and highly context-specific, behavior change interventions must be carefully designed and tailored based on both theory and evidence (Fernandez *et al.* 2019). To understand the often complex social and environmental influences in the wild meat trade chain and how to best address them, it is crucial to analyze who the stakeholders are at different levels of the trade chain and the contexts in which wildlife harvest, trade and consumption take place (Doughty *et al.* 2021; Travers *et al.* 2019; Verissimo *et al.* 2020).

Taste preference, price, availability of substitutes, income, and market access are among the characteristics that may influence consumers' behaviors (Chaves *et al.* 2017; van Vliet and Mbazza 2011). At the level of the hunters' behaviors are influenced by availability of other sources of food or income, opportunity cost of hunting, tradition, and cultural identity. Behavioral change approaches thus require identifying how these elements can become barriers or motivations that influence the capacity and will of a given segment group to adopt a new behavior (Olmedo *et al.* 2021).

Studies available on behavior change in the context of wild meat use provide important insights into understanding drivers of wild meat consumption and audience segments (Chausson *et al.* 2019; Chaves *et al.* 2018; Niewiadomska *et al.* 2020; Shairp *et al.* 2016; Verissimo and Wan 2019; van Vliet *et al.* 2021). Several studies (although mostly found in grey literature) describe the campaign with details on products, communication means and messaging, but only a minority of them have evaluated the results of their campaign (Thomas-Walters *et al.* 2020; Verissimo and Wan 2019). Thomas-Walters *et al.* (2020) described the first behavior change campaign for wild meat that not only evaluated outputs but also its impacts on conservation. However, to our knowledge there is no available study that assesses the receptiveness to wild meat related-behavior change messages and the efficiency of communication means to generate lessons learnt for future initiatives in this field.

In this paper, we present an evaluation of a behavioral change campaign framed around an integrated conservation and development objective, which can be summarized as: improve food security in rural communities, reduce the unsustainable use of wildlife for food and promote locally grown pork and chicken. Our evaluation particularly looked at whether the means of communication used were appropriate and the receptiveness to the messages. We acknowledge that behavior change is a long-term process and therefore our evaluation did not intend to measure actual changes nor impact on conservation and food security. Rather, it offers practical lessons on messaging and communication channels for behavioral change in

relation to hunting and wild meat consumption.

MATERIAL AND METHODS

Study site

Our study focuses on the wild meat trade chain in the Yangambi landscape, where our research team has been conducting research on wild meat since 2009 (van Vliet *et al.* 2012, 2015, 2017, 2018, 2019, 2021).

Geographic description

The Yangambi landscape is located in the north-east of the Democratic Republic of Congo (DRC) and encompasses the Yangambi town, the Yangambi Man and Biosphere Reserve (YBR), the Ngazi Forest Reserve and several villages from the Turumbu, Topoke and Bamanga/Mba tribes (Figure 1). The human population living in the landscape is estimated at 141,643 inhabitants, based on data from the Yangambi Registry Office dating from 2016. The Yangambi town, located about 100 km west of Kisangani, originated in the 1930s as a research campus by INERA (Institut National d'Etudes et de Recherches Agronomiques) and IFA (Institut facultaire des sciences agronomiques de Yangambi), and was initially only inhabited by research staff and villagers. However, over the years, the campus attracted workers from neighboring areas and slowly evolved to become a secondary regional town.

The food security and wildmeat nexus in the Yangambi landscape

In the Yangambi landscape two thirds of the households experience insufficient food availability to meet 2,000 calories per day, falling below the recommended intake (Nowak *et al.* 2019). In a study carried out by van Vliet *et al.* (2017), the authors found that wild meat significantly contributed to the animal protein needs of the families with over 60% of households eating wild meat more than once a week. In a 24-hour recall survey implemented across the whole Yangambi landscape, the researchers found that a significant portion of rural households had not consumed any animal products the previous day (27%), while 32% of households had consumed wild meat, 18% had consumed fish and 10% caterpillars (*Elaphrodes lacteal*). Wild meat was also listed among the preferred meats, followed by fish. However, if wild meat were to become scarce, consumers would welcome pork or chicken (van Vliet *et al.* 2017). Most Turumbu households reported getting wild meat from hunting themselves, and therefore seasonality and resource availability in the wild were identified as the

main factors affecting access to wild meat. Wild meat demand from Yangambi town is high because, apart from fish, no other source of meat is available for the growing population of Yangambi. At the Yangambi market, fish costs almost twice as much as wild meat and wild meat remains the most affordable source of meat (van Vliet *et al.* 2017). As such, wild meat is consumed as a necessity in the whole Yangambi landscape (including Yangambi town).

Wild meat trade in the Yangambi landscape involves about 845 people who participate in the supply chain as traders, brokers, and hunters (van Vliet *et al.* 2019). Forests in the Yangambi landscape annually supply about 145 tonnes of smoked wild meat to consumers in Yangambi town, the main consumption hub (van Vliet *et al.* 2019). Most of meat consumed in Yangambi town originates from the Turumbu sector and particularly from Weko, a village located about 30 km north of Yangambi town. This village counts with 382 households whose livelihoods are based on shifting cultivation, fishing, hunting and the construction of wood canoes. While most men practice hunting for subsistence purposes, a third of the households in Weko has at least one hunter actively involved in wildmeat trade. As sales are very attractive, hunters from Weko sell more than 80% of what they hunt, sometimes neglecting subsistence needs (van Vliet *et al.* 2019). Hunting is a readily available source of income that requires little or no investments and a 100% insurance that it will be sold immediately. In fact, the traders literally grab the products from the hands of the hunters when coming out from the forest, at what is called the Mipila market, located at the exit route of several hunting trails, 2 km north of Weko. This spontaneous, informal wild meat market takes place every weekend and traders travel to Weko to purchase all the wild meat coming out from the forest (van Vliet *et al.* 2019). Until the early 2000s, wild meat from the Yangambi landscape traveled as far as Kisangani. However, due to increased local demand from Yangambi (and potentially a decrease in supply), the amount of wild meat that reaches Kisangani from the Yangambi landscape has considerably decreased over the years. As such, Yangambi town can be considered the further end of the trade chain.

Forests in the Yangambi landscape present a post-depletion profile, characterized by the local extinction of the African Elephant (*Loxodonta africana*), the depletion of vulnerable species (e.g. armadillo *Orycteropus afer* and Chimpanzee *Pan troglodytes*), population declines of medium-sized ungulates (e.g. red river hog *Potamochoerus porcus*, water chevrotain *Hyemoschus aquaticus*, etc.) and stable populations of fast-reproducing or small-sized species (Emin's pouched rat *Cricetomys emini*, African brush-tailed porcupine *Atherurus africanus*, forest giant squirrel

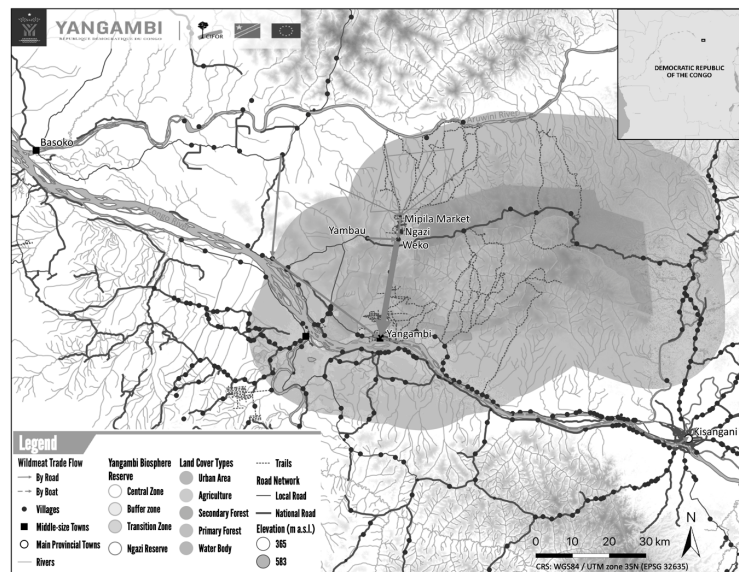


Figure 1. Study site: the Yangambi landscape.

Protoxerus stangeri, tree hyrax *Dendrohyrax* sp., and blue duiker *Philantomba monticola*) (van Vliet *et al.* 2018). More than 88% of hunters consider hunting to have become more difficult over the last 10 years. The collapse of the local governance systems, the disruption of the economic vitality of the region, and the immigration of rural populations from neighboring conflict hotspots are all factors that have triggered increased hunting pressure. Independently from conflict, innovations in hunting practices (either local, such as the local confection of firearms and cartridges; or external, such as the head lamps used to hunt at night) also explain increased pressure particularly for nocturnal and arboreal species (van Vliet *et al.* 2018).

Development and implementation of the behavior change campaign

Behavior change process – Our behavior change campaign was based on social marketing techniques and was articulated into 7 steps: 1. definition of the problem; 2. description of the behavior to be promoted; 3. description of target groups and influence groups; 4. identification of barriers and determinants; 5. description of the expected changes; 6. description of the campaign with a description of the means of communication and messages; 7. monitoring and evaluation. Communication campaign planning and development took place from September to December 2020. The process was informed by data available from previously published studies and on our research team’s extensive knowledge of the wild meat trade system in the study location, sup-

plemented by open interviews with key informants, group discussions with village leaders. While the campaign was implemented by our research team, the messages were developed in collaboration with village leaders and presented to the chief of sector (n=1), village chiefs (n=2) and clan chiefs (n=11) in Weko, to the Directors of INERA and IFA research centers in Yangambi and to the *Agence Nationale de Renseignement* (ANR), for approval prior to launching. The funding agency and institutions involved in the implementation of the campaign were explicitly visible in all communication products to ensure transparency.

Assumptions underlying the behavior change – This process informed the formulation of our main assumptions in our theory of change. Observing that rural households in the Yangambi landscape suffer from a poor food security despite their access to wildlife resources, and that hunters prefer to sell their prey even though their families need meat (van Vliet *et al.* 2019), we hypothesized that by promoting pride among hunters about being able to fulfill their family needs and only sell their surplus, we would reduce household food insecurity and reduce pressure on the already depleted wildlife. Also, acknowledging that hunters are tempted to sell most of their prey given the high demand for wild meat and the attractiveness of a business that requires low inputs and high benefits, we hypothesized that by encouraging hunters and wild meat traders to engage in small scale semi-intensive pork and chicken breeding, we would decrease their dependency on wild meat, increase options at the consumer level and reduce the opportunity costs of hunting. Likewise, observing

that wild meat consumers in Yangambi town: 1. do not have access to other sources of animal protein, besides wild meat, fish and caterpillars (van Vliet *et al.* 2019); 2. are increasingly concerned about the quality and food safety practices in the transportation and handling of wild meat along the trade chain (van Vliet *et al.* 2021), and 3. would love to eat pork or chicken if they had the option to do so (van Vliet *et al.* 2017), we hypothesized that by encouraging consumers in Yangambi to consume locally-grown sources of meat, we would reduce demand for wild meat.

Behavior changes messages, communication channels and products – The behavior change campaign was framed around an integrated conservation and development objective, which can be summarized as follows: “Improve food security in the villages within the Yangambi landscape, reduce the unsustainable use of wildlife for food and promote locally grown pork and chicken in Yangambi”. The main target audiences for our campaign were: 1. Turumbu hunters that actively participate in the trade chain; 2. households in Yangambi; 3. Wild meat traders in the Yangambi. Table 1 summarize the different elements of our campaign, including the barriers to change, the messages used, the communication channels and the products. Communication channels included a participatory community theater piece (Figure 2), radio emissions, printed materials (1 calendar, T-shirts, 2 posters (e.g., Figure 3), 5 recipes) and face to face interactions (meetings at the community level, meetings with wild meat traders). In the Yangambi landscape, there is no electricity, but a few households have solar panels. Access to cell phone signal is possible only in Yangambi town. Villages have no cell phone signal. The radio in Isangi reaches out to the whole Yangambi Landscape, but the radio station is poorly equipped and works on solar panels and therefore is not always operational.

Addressing barriers to change – We are aware that behavior change approaches that do not address barriers to change are prone to failure. In fact, our behavior change campaign is part of a wider long-term initiative that intends to address the need for income generating activities at the level of hunters and traders and alternative sources of protein for consumers in Yangambi. Activities facilitated by the project include access to micro credit, marketing support and business coaching to projects developed by hunters and wild meat traders. To date, the project has already resulted in 25 micro enterprises such as pork production, chicken and egg production, commercial crop farming, and service-oriented businesses since early 2021. Our paper does not focus on these activities, but we could not present our behavior change campaign without providing information on the wider

context in which it was implemented.

Implementation of the campaign – The campaign was launched in January 2021 and lasted for 6 months. It targeted two different audiences and used different products depending on their geographic location and level of dependence on wildmeat. In rural areas we targeted commercial hunters and used theater, songs, printed calendars, T-shirts, and group discussions (see Additional File for a detailed description of each product). In urban areas, we targeted wildmeat traders and the wealthiest segment of the population of Yangambi who receives a steady income (staff from INERA and other research centers). The products included a radio program, a podcast, posters, a recipe booklet, and group discussions with the wildmeat traders (see Additional File for a detailed description of each product).

Evaluation of messages and communication channels of the behavior change campaign – In July 2021, we evaluated the messages and the communication channels used in our behavior change campaign, with the aim of testing for receptiveness by the target audience. We used semi-structured interviews at the level of hunters, household heads in Yangambi town and wild meat traders. Knowing that no other campaign was taking place simultaneously in the Yangambi landscape, we are safe to assume a direct causality between our campaign and the perceptions of the target audience (Heino *et al.* 2020). For radio programs, while we could not control for other potential messages conveyed by other institutions, we are not aware of any other campaign in relation to hunting, wild meat, domestic meat production or food security happening in parallel and reaching our audience.

The semi-structured interviews were structured around three thematic areas: 1. Characteristics of the household head (gender, age); 2. Description of any wild meat-related messages heard over the last 6 months (communication channels, type of messages conveyed, etc.); 3. Perceptions about the messages heard and potential impact on their behavior. Questionnaires were administered in Lingala in Yangambi town and in Turumbu in rural areas from the Turumbu sector using questionnaires developed and administered with the KoboCollect app (www.kobotoolbox.org). The questions are available in Additional File.

We interviewed three different target groups: hunters, household heads, and wild meat traders. In total, we interviewed 193 hunters (among the 285 hunters identified in the Turumbu sector by van Vliet *et al.* (2019)) from 8 different villages surrounding the YBR. Hunters that took part of this study were part of the sample identified in van Vliet *et al.* (2019), but only those that were available and willing to partici-



Figure 2. A participatory community theater was organized in Weko.



Figure 3. One of two posters produced as part of the campaign. The poster calls for urban consumers in Yangambi, particularly those who receive a steady income from research institutions, to choose locally produced chicken for special occasions, rather than wildmeat or imported chicken, which come from far away in bad food safety conditions.

pate were interviewed. We interviewed 341 household heads in Yangambi town. Households were randomly chosen walking from one house to the next in each

of the neighborhoods and checking to ensure that the household head was available and willing to respond to our questionnaire. In addition, we also interviewed

11 wild meat traders out of the 23 identified in van Vliet *et al.* (2019). Sampling at the level of wild meat traders was opportunistic, choosing among those that were present at the market during the duration of the study and available to respond to the questionnaire. At the level of hunters, household heads and wild meat traders, we aimed at reaching a sample size equal to 50% of the sample used in van Vliet *et al.* (2019). In all cases, the team introduced itself, explained the objective of the study and asked permission to carry out the interview.

Ethics statement

The research was conducted as part of the FORETS project, for which protocols were reviewed and approved by the CIFOR ethical committee. The research protocol complies with the guidelines of the Declaration of Helsinki and Tokyo for research with humans.

RESULTS AND DISCUSSION

Our behavior change campaign was guided by an integrated conservation and development objective with a series of assumptions that were built based on existing evidence about the wild meat trade in the Yangambi landscape. As opposed to other behavior change approaches in conservation, our campaign was not designed to influence people to make decisions that have positive outcomes for wildlife alone (Travers *et al.* 2021) but adopted an integrated conservation and development approach, where the objectives of the behavior change strategy aimed at improving wildlife conservation while improving local food security, minimizing trade-offs between these two inter-linked objectives. We used a wide variety of products and differentiated according to the type of audience.

Audience reached

Only 29% of hunters surveyed across the Turumbu sector in the Yangambi landscape had heard of our communication campaign in the last 6 months. However, this percentage varied across villages, with Weko, where the participatory theater took place, reaching up to 90% of the hunters being aware of our campaign. Among the household heads interviewed in Yangambi, 11% of those interviewed had heard messages in relation to wild meat in the past six months. With regards to wild meat traders, 90% of those interviewed had heard about our campaign.

Communication channels

Of the 56 hunters that had reported being aware of our communication campaign, 40% did so through the theater performance. The other most frequent communication channels mentioned by hunters were word of mouth (21%), printed materials such as posters and the calendar (15%) and songs (11%). The remaining 11% were exposed to the messages through face-to-face interactions and T-shirts. Only one had heard the radio programme. In Weko, where the theater performance took place, 85% of the hunters had heard about our campaign through the theater performance. Among the household heads interviewed in Yangambi who had heard messages about wild meat, most had heard them through word of mouth about the theater (51%), followed by face-to-face interactions (13%), songs (11%), and posters (10%). Traders at the Yangambi market had heard about our communication campaign through the recipe booklet ($n = 5$), the poster ($n = 2$), the calendar ($n = 2$) and the T-shirt ($n = 1$).

In general, participatory theater was perceived as amusing by 42% of the hunters and as an innovative communication channel by 54% of the hunters. Songs were also perceived as innovative by 72% of the hunters and as amusing by 28% of them but only 7 hunters in total had heard the songs, meaning that more effort should have been placed in broadcasting the song to reach a wider audience. The cartoon in the calendar was perceived as innovative by all hunters that were exposed to this product, however, not all remembered this product despite having received a copy of this calendar in their household. Radio was not as useful to reach out to our audience for household heads in Yangambi and this translated into a low level of exposure to our campaign (only 3 household heads had heard a radio program on wildmeat and food security in the last six months). Our radio debates and interviews were rated as boring by two of them. In contrast, the cartoons used in the poster were perceived as original, innovative, or amusing by all of the household heads interviewed, but only reached 12% of the persons interviewed.

Messages

The messages conveyed by the campaign (all products together) that hunters remembered the most were that it was desirable to reduce the sale of wild meat (30%), that it was necessary to promote food security in the villages (25%), that it was necessary to protect forests and wildlife (15%) and that they were encouraged to produce chickens and pigs (7%). Only 5.5% of hunters understood that the message was to encourage them to stop hunting altogether (which was a misunderstanding of our campaign). Most of

the hunters agreed with the message conveyed (41% agreed and 31% fully agreed), found that the messages were respectful of their values (63%) and felt amused, comforted, or valued by the communication messages (72%). However, 2.7% of the hunters disagreed or completely disagreed with the messages. In these cases, the hunters had understood that they were being encouraged to stop hunting altogether, reduce game sales or reduce game consumption in families. These hunters considered that the messages went against their values, and they felt scared, hurt, or angry at them. The hunters that were against the content of the messages were not from any particular age group but half of them were from Weko. Among the hunters that were present or had heard about the theater, only one mis-understood the message (one elderly hunter (age = 68) who thought the campaign was to stop wildmeat consumption) and disagreed with the message.

Of the 75 household heads that mentioned having heard about our campaign in the last 6 months, 38% understood that the messages were intended to promote food security in the villages, and 25% of them understood that the objective was to reduce the quantities sold by the hunters. Most of them agreed with the messages heard (82%), 74% felt amused, comforted, or valued by the messages and 73% found the messages to be respectful of their values. Among those who disagreed with the messages, 83% were women and the main reasons for disagreement were the lack of alternatives and the lack of support received to change behaviors. The cases of disagreement related to the message of stopping all wild meat consumption (in 67% of the cases). All traders that had heard about our communication campaign agreed or fully agreed with the messages, felt comforted or valued with the messages and thought that the messages were respectful to their values. Four of them understood that the campaign was about reducing wild meat demand from Yangambi town, while the other 6 understood that the campaign was to discourage hunters to sell all their wild meat.

Main findings

Our study highlights several considerations in terms of channels and messaging in behavior change campaigns. First, the range of possible communication channels may be limited by technical constraints or characteristics of the audience segment. In our study location, due to poorly equipped rural radios and unstable access to electricity, radio was less effective than initially thought. Cartoons printed as posters or calendars were limited to a literate audience. On the contrary, participatory community theater proved to be a useful channel to reach out to our

audience. This channel was by far perceived as the most innovative and amusing communication channel used. Our results concur with other participatory theater experiences, which found that it is a fun, relaxing and acceptable means to communicate in rural contexts, particularly over otherwise sensitive social topics (Hoff *et al.* 2021; McCallum *et al.* 2021). Participatory community theater proved to stimulate active debates amongst the audience and produced echoed effects by allowing the audience to mimic or replay some sections of the script, even months after it was performed. As such, participatory community theater was a powerful means to enhance word of mouth communication (WOMC), which is known to be highly effective in marketing science (Godes and Mayzlin 2004; Vasan 2020). Word of mouth from the theater performance increased the audience well beyond Weko, where the theater was performed.

Second, “amusing” is an important quality that determines attention to the message and increases word of mouth communication. Our radio debates and interviews were rather perceived as boring by our audience. Instead, radio comedy (Diddi *et al.* 2021) or radio spots (Saaka *et al.* 2021), repeated over a sufficient period of time (e.g., 12 months) have been efficient in other rural contexts and should be encouraged where local radios are fully functional. In fact, the right balance needs to be made between the use of “fun” versus “serious” messaging to ensure that the increase in popularity does not come along with decreased actual change (Gough *et al.* 2017).

Third, positive and clear messaging is key (Gantiva *et al.* 2021). Positive messages, such as “promoting food security in rural areas” or “promoting the consumption of locally grown pork or chicken” were perceived positively and aligned with local values and aspirations. In contrast, messages focusing on loss (such as to “stop wild meat consumption”) created anger or fear. Experiencing anger in response to a troubling situation is known to predict different outcomes: specifically voicing one’s discontent, or neglecting the situation such that it does not improve, or exiting the negative situation (Callister *et al.* 2017; Osborne *et al.* 2012). As such, messages that may trigger anger need to be anticipated carefully to avoid counterproductive behavior changes. The clarity of the messages often lies in simplification without losing the essence of the message. In our study, we found that our messages were misunderstood by a minority of respondents, which thought we were banning hunting and wild meat consumption. This is unfortunate because in those cases, instead of building up trust, we triggered anger, discomfort, or fear, which are counterproductive feelings that may either exacerbate retaliatory behaviors or to the least lock any possible change. Using local languages, avoiding written

materials for illiterate audiences, and using repetitive means of communication may be among the strategies that could help prevent misunderstandings.

CONCLUSION

Our study provides very valuable information for the development of behavioral change approaches in relation to wild meat in terms of messaging and communication means. We encourage the conservation community to not only focus on understanding the audience for segmentation, but also to explore and test the most appropriate communication channels and messages, keeping in mind the social and cultural background of the audience, and ensuring that messages trigger emotions that lead to changes towards the desired behavior. Behavior changes approaches have the possibility to contribute to a more sustainable wild meat sector, but much more efforts are needed to understand how to implement this in practice over varied and heterogeneous contexts. We also caution about the ethical risks of behavioral change approaches. Another field for further research involves the development of guidelines to assess and anticipate those potential ethical risks as an integral part of the behavioral change development process.

ACKNOWLEDGEMENT

This work received funds from USAID and the European Commission through the FORETS project. This research is part of the Bushmeat research Initiative from CIFOR as part of the Forest, Trees and Agroforestry Programme of the CGIAR centers. The authors have no conflict of interest to disclose.

DATA AVAILABILITY

Data are available upon reasonable request from the corresponding author.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

CONTRIBUTION STATEMENT

Conceived of the presented idea: NvV, AG, JN, JM, PC, RN

Carried out the experiment: AG, JN, JM

Carried out the data analysis: NvV

Wrote the first draft of the manuscript: NvV, EADP

Review and final write of the manuscript: NvV, AG, JN, JM, EADP, PC, RN

Supervision: NvV, RN

REFERENCES

Callister RR, Geddes D, Gibson DF (2017) **When is anger helpful or hurtful? Status and role impact on anger expression and outcomes.** *Negotiation and Conflict Management Research* 10:69–87.

Challender DWS, Macmillan DC (2014) **Transforming wildlife trade interventions: reply to Phelps et al.** *Conservation Letter* 7:497–498.

Chausson AM, Rowcliffe JM, Escoufflaire L, Wieland M, Wright JH (2019) **Understanding the sociocultural drivers of urban bushmeat consumption for behavior change interventions in Pointe Noire, Republic of Congo.** *Human Ecology* 47:179–191.

Chaves WA, Valle DR, Monroe MC, Wilkie DS, Sieving KE, Sadowsky B (2018) **Changing wild meat consumption: an experiment in the central Amazon, Brazil.** *Conservation Letters* 11:1–10.

Chaves WA, Wilkie DS, Monroe MC, Sieving KE (2017) **Market access and wild meat consumption in the central Amazon, Brazil.** *Biological Conservation* 212:240–248.

Didi P, Kumble S, Shen F (2021) **Efficacy of radio entertainment education in promoting health behavior: A meta-analysis.** *Journal of Radio & Audio Media* doi: 10.1080/19376529.2021.1931229.

Doughty H, Milner-Gulland EJ, Lee JSH, Oliver K, Carrasco LR, Verissimo D (2021) **Evaluating a large-scale online behavior change intervention aimed at wildlife product consumers in Singapore.** *PLoS ONE* 16:e0248144.

Duffy R, Masse F, Smidt E, Marijnen E, Buscher B, Verweijen J, Ramutsindela M, Simlai T, Joanny L, Lunstrum E (2019) **Why we must question the militarisation of conservation | Elsevier Enhanced Reader.** *Biological Conservation* 66–73.

Fernandez ME, Ruiter RAC, Markham CM, Kok G (2019) **Intervention mapping: Theory- and evidence-based health promotion program planning: Perspective and examples.** *Frontiers in Public Health* doi: 10.3389/fpubh.2019.00209.

Gantiva C, Jiménez-Leal W, Urriago-Rayó J (2021) **Framing messages to deal with the COVID-19 crisis: the role of loss/gain frames and content.** *Frontiers in Psychology* 12:1–8.

Gluszek S, Viollaz J, Mwinyihali R, Wieland M, Gore ML (2021) **Using conservation criminology to**

understand the role of restaurants in the urban wild meat trade. *Conservation Science and Practice* 3:1–13.

Godes D, Mayzlin D (2004) **Using online conversations to study word-of-mouth communication.** *Marketing Science* 23:545–560.

Gough A, Hunter RF, Ajao O, Jurek A, McKeown G, Hong J, Barrett E, Ferguson M, McElwee G, McCarthy M, Kee F (2017) **Tweet for behavior change: Using social media for the dissemination of public health messages.** *JMIR Public Health and Surveillance* 3:1–17.

Heino MTJ, Knittle KP, Noone C, Hasselman F, Han-konen N (2020) **Studying behavior change mechanisms under complexity.** *Behavioral Sciences* 11:77.

Hoff K, Jalan J, Santra S (2021) **Participatory theater empowers women: evidence from India.** *Policy Research Working Paper*. [<https://openknowledge.worldbank.org/bitstream/handle/10986/35642/Participatory-Theater-Empowers-Women-Evidence-from-India.pdf>].

Lemos LP, Loureiro LF, Morcatty TQ, Fa JE, de Vasconcelos Neto CFA, de Souza Jesus A, da Silva VC, de Oliveira Ramalho ML, de Matos Mendes A, Valsecchi J, El Bizri HR (2021) **Social correlates of and reasons for primate meat consumption in central Amazonia.** *International Journal of Primatology* 42:499–521.

McCallum DM, Reed DB, Claunch DT, Davis CM, Conaway MB (2021) **Farm Dinner Theater: testing an innovative health and safety intervention among older farmers and their families.** *The Journal of Rural Health* 2021:1-9.

Niewiadomska K, Kosicka-Gebska M, Gebski J, Gutkowska K, Jezewska-Zychowicz M, Sulek M (2020) **Game meat consumption-conscious choice or just a game?** *Foods* 9:1357.

Nowak A, Rosenstock TS, Hammond J, Degrande A, Smith E (2019) **Livelihoods of households living near Yangambi Biosphere Reserve, Democratic Republic of Congo.** Bogor, Indonesia. [https://cgspace.cgiar.org/bitstream/handle/10568/106174/8.Nowak_2019_BriefRHoMIS%28EN%29.pdf?sequence=1&isAllowed=y].

Olmedo A, Veríssimo D, Challender DWS, Dao HTT, Milner-Gulland EJ (2021) **Who eats wild meat? Profiling consumers in Ho Chi Minh City, Vietnam.** *People and Nature* 3:700–710.

Osborne D, Smith HJ, Huo YJ (2012) **More than**

a feeling: Discrete emotions mediate the relationship between relative deprivation and reactions to workplace furloughs. *Personality and Social Psychology Bulletin* 38:628–641.

Saaka M, Wemah K, Kizito F, Hoeschle-Zeledon I (2021) **Effect of nutrition behavior change communication delivered through radio on mothers' nutritional knowledge, child feeding practices and growth.** *Journal of nutritional science* 10:e44.

Shairp R, Veríssimo D, Fraser I, Challender D, Macmillan D (2016) **Understanding urban demand for wild meat in Vietnam: Implications for conservation actions.** *PLoS ONE* 11:1–14.

Thomas-Walters L, Hinsley A, Bergin D, Burgess G, Doughty H, Eppel S, MacFarlane D, Meijer W, Lee TM, Phelps J, Smith RJ, Wan AKY, Veríssimo D (2021) **Motivations for the use and consumption of wildlife products.** *Conservation Biology* 35:483–491.

Thomas-Walters L, Vieira S, Jiménez V, Monteiro D, Ferreira B, Smith RJ, Veríssimo D (2020) **Challenges in the impact evaluation of behavior change interventions: The case of sea turtle meat and eggs in São Tomé.** *People and Nature* 2:913–922.

Travers H, Archer LJ, Mwedde G, Roe D, Baker J, Plumtre AJ, Rwetsiba A, Milner-Gulland EJ (2019) **Understanding complex drivers of wildlife crime to design effective conservation interventions.** *Conservation Biology* 33:1296–1306.

Travers H, Walsh J, Vogt S, Clements T, Milner-Gulland E (2021) **Delivering behavioral change at scale: What conservation can learn from other fields.** *Biological Conservation* 257:109092.

Vasan M (2020) **Effectiveness of word of mouth communication: receiver perspectives.** In: 2020 Fourth International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC). IEEE, pp. 246–251.

Veríssimo D, 't Sas-Rolfes M, Glikman JA (2020) **Influencing consumer demand is vital for tackling the illegal wildlife trade.** *People and Nature* 2:872–876.

Veríssimo D, Wan AKY (2019) **Characterizing efforts to reduce consumer demand for wildlife products.** *Conservation Biology* 33:623–633.

van Vliet N, Mbazza P (2011) **Recognizing the Multiple Reasons for Bushmeat Consumption in Urban Areas: A Necessary Step Toward the Sustainable Use of Wildlife for Food in Central**

Africa. *Human Dimensions of Wildlife* 16:45–54.

van Vliet N, Muhindo J, Kambale Nyumu J, Mushagalusa O, Nasi R (2018) **Mammal Depletion Processes as Evidenced From Spatially Explicit and Temporal Local Ecological Knowledge.** *Tropical Conservation Science* 11:1–16.

van Vliet N, Muhindo J, Nyumu JK, Nasi R (2019) **From the Forest to the Dish: A Comprehensive Study of the Wildmeat Value Chain in Yangambi, Democratic Republic of Congo.** *Frontiers in Ecology and Evolution* 7:132.

van Vliet N, Nebesse C, Gambalemoke S, Akaibe D, Nasi R (2012) **The bushmeat market in Kisanгани, Democratic Republic of Congo: Implications for conservation and food security.** *Oryx* 46:196–203.

van Vliet N, Nebesse C, Nasi R (2015) **Bushmeat consumption among rural and urban children**

from Province Orientale, Democratic Republic of Congo. *Oryx* 49:165–174.

van Vliet N, Nyumu JK, Nziavake S, Muhindo J, Paemelaere EAD, Nasi R (2021) **How Do Local Folks Value Wild Meat, and Why It Matters? A Study in the Eastern Democratic Republic of Congo.** *Human Ecology* 50:195–203.

van Vliet N, Schulte-Herbrüggen B, Muhindo J, Nebesse C, Gambalemoke S, Nasi R (2017) **Trends in bushmeat trade in a postconflict forest town: Implications for food security.** *Ecology and Society* 22:35.

Received: 16 February 2022

Accepted: 22 March 2022

Published: 8 April 2022

Table 1. Overview of the behavioral change campaign. The strategy is divided into two key changes in behavior with their specific target audience with barriers and motivators for adopting the desired behavior.

Problem 1	Behavior we are trying to promote	Target group and main message	Groups of influence	Barriers of determinants	Set of changes to promote	Communication products
Rural households in the Turumbu sector starve for meat despite having access to wild meat	Reduce the percentage of game that hunters put up for sale and increase the proportion of wild meat kept to feed the family	Turumbu hunters for whom wild meat is the main source of income “I sell less so my family eats better”	Chieftains Village councils	Wild meat sales provide a significant source of income with which it is difficult to compete.	Pride of being a hunter who provides enough food and well-being for his family. Foster the links between forests, wild meat and Turumbu identity	Theater, Songs, Calendar, T-shirts, Group discussions
Problem 2	Behavior we are trying to promote	Target group and main message	Groups of influence	Barriers of determinants	Set of changes to promote	Communication products
Wild meat coming from far away resulting in bad food safety conditions Consumers in Yangambi town do not have steady access to alternative sources of protein and depend on fish and wild meat for their nutrition	Promote the consumption of locally produced pork and chicken by consumers from Yangambi. Encourage wild meat traders and hunters to engage in pork and chicken production	Wildmeat traders in Yangambi and Consumers in Yangambi, particularly those receiving a steady income (staff from INERA and other research centers)“I support locally produced food”“By avoiding wild meat, I avoid food safety issues related to a meat that comes from faraway”	University Professors and researchers at INERA and IFA	Preference for wild meat; The lack of availability of fresh domestic meats in the markets	Pride of consuming locally meat from domestic origin; Choose pork and chicken production as a way to secure income	Posters, Recipe booklet, Radio program, Pod cast, Group discussions

Additional Files

Detailed description of each product

Products targeting commercial hunters:

Theater: A theater company from Kisangani (Studios Kabako) was hired to co-develop a theatrical production based on a script that was drafted by the research team. The story used humor to oppose the “bad” hunter who sells all his wild meat and comes back home with no food, and a “good” hunter, called “Bienaimé” who hunts primarily to feed his family. The judgement values on which the “bad hunter” and the “good hunter” are based, emerge from the discussions with hunters and their families. There is a commonly agreed and locally recognized issue related to the fact that commercial hunters leave no meat for their families. The bad hunter is depicted with humor, therefore reducing the criminalization of his behavior. Instead, the message insists on promoting pride among hunters that are able to fulfill their family needs, always highlighting positive behaviors rather than demonizing “negative” ones. The script was finalized and adapted based on contributions from a group of hunters that was chosen after a casting to play some of the key roles in the theater piece. The other characters were played by other community members that were selected following a similar casting process. The selected artists were trained by the theater company and coached over a series of repetition workshops, until they all felt comfortable to play it in public. The group decided on the “mise en scene” and used locally available resources to build a stage and the background in Weko, where the theater was played. A traditional music group was hired to play in the interlude. The process for the development of the theater piece lasted three months. The theater was promoted locally through the local chiefs in Weko who passed the message to all community members during their village meeting. The theater attracted about 800 persons, including persons from neighboring villages, men women and children.

Songs: A music group from the village of Yalolia was mobilized to produce a musical album with 2 songs on hunting. The songs were recorded with professional equipment and shared on USB keys and broadcasted on the radio. The songs were composed during a composition workshop in Turumbu language, which took place in Yalolia.

Calendar: A 2021 calendar was produced in Lingala and French in which a cartoon appears, telling the story of Bienaimé, the same character used in the theater. The calendar was published in 200 copies in Lingala and distributed to hunters and their families, particularly in Weko.

T-shirts: T-shirts for men were developed and printed in 50 copies, with the slogan written in Turumbu: “I hunt, I feed my family and I protect the forest. Together, let’s reduce commercial hunting”. Similarly, 50 women’s t-shirts were printed with the slogan: “My husband hunts to feed our family. He only sells small surpluses.”

Group discussions and sensitization with village leaders: Chiefs and councils helped convey the messages of this campaign during their community meetings.

Products targeting wildmeat traders and a segment of urban consumers from Yangambi (those received a steady income from INERA and other research centers)

Radio program and podcast: In February 2021, a round table with two researchers from Kisangani, Jonas Kambale Nyumu (CIFOR) and Jonas Muhindo (CIFOR) was organized to present the objectives of our campaign to Okapi radio listeners. The debate evolved around the need to diversify sources of income at the level of the hunters and wild meat traders. It also pointed out the need for consumers in the Tshopo Province to promote locally produced chicken and pork. The program was animated by interventions and questions from the listeners facilitated by Okapi radio. In addition, a podcast was hosted by Le Nouveau Congo on the theme of food security, public health, biodiversity, and wild meat use in the Democratic Republic of Congo. Two special guests were invited to participate: Prof. Consolate Kaswera from the University of Kisangani and Dr. Nathalie Van Vliet from CIFOR. Both programs were also relayed on social media.

Posters: Two cartoons were produced conveying messages about reducing the consumption of wild meat based on arguments such as the lack of food safety conditions of smoked wild meat coming from far away, and the pride of contributing to locally produced fresh pork and chicken. The cartoons were published as posters and distributed at the main market, during village meetings and within the local research institutes in Yangambi (100 copies for each cartoon).

Recipe booklet: A booklet with a series of five recipes was prepared to promote the use of pork, goat or

chicken in Congolese cuisine and encourage households to prepare them for special meals and avoid wild meat for those occasions. The recipes were shared on social media, printed in 275 copies, and distributed among households in Yangambi town.

Group discussions and sensitization with wild meat traders: Wild meat traders from Yangambi were invited to a meeting where the objectives of this campaign were introduced. Fifteen wild meat traders participated in the meeting and exchanged ideas about the importance of this campaign, their perceptions about the issues tackled by the campaign and the conditions in which they could envision a change.