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The Carne Carbono Neutro Accordance to Brazilian Consumers' Attitude towards Beef

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ABSTRACT

The Brazilian project *Carne Carbono Neutro (CCN)* assumes that a *more sustainable* beef will increase its value for the consumers. The paper aims to verify this assumption and to suggest a communication strategy supporting the CCN valorization. An online survey involving 506 Brazilian consumers showed three different classes of consumers with significantly different attitudes towards environmental issues. Price and quality always strongly influence their demand for beef. A communication campaign should focus on the CCN lower beef environmental impact and beef price/quality issues. Social media on internet and education programs in schools and different institutions should be used.

Keywords*: Brazil; beef; sustainability; integrated crop-livestock-forestry; communication.*

1 Introduction

Considering that 23% of the total Brazilian land is used for pastures, as opposed to 7% of land used for other agricultural productions (Table 1) (GTPS, 2014) it is possible to state that the largest share of the Brazilian agricultural area is directly linked to beef production. The Brazilian beef impact on the environment, in terms of deforestation and GHG emission, is relevant (Cederberg, Persson, et. al, 2011; De Sy, Herold et al. 2015). Adding to a recent scandal involving Brazilian beef processors, the negative perception of beef impact on the environment can further damage the Brazilian beef reputation and export (A2 Global Risk, 2019). Beef has been recognized by regional and federal governments as an opportunity for Brazilian food production to lead the world in terms of sustainability (Rousseau, 2018). Beef domestic consumption still plays a major role in supporting the Brazilian beef market development (Sobreira Garavello and Nardoto G.B., 2018); it represents around 80% of the total beef demand and is still increasing, although moderately (Silva, 2018). Unsustainable beef management can therefore have a strong impact on Brazilian environment and consequently on its economy. From the supply side a sustainable intensification can provide a relevant contribution to the development of beef production in Brazil (Pacheco et. al., 2017).

Table 1.
Land use in Brazil - 2011

Land use	ha (millions)	%
Native Vegetation	554	65,2%
Agriculture and Forestry	60	7,1%
Pasture	198	23,3%
Urbanization and other uses	38	4,5%
Total	850	100,0%

Source GTPS (2014)

Among the different public and private initiatives (Appendix 1) trying to reduce the negative impact on sustainability coming from beef production, and in general from agriculture, EMBRAPA, the Brazilian Agricultural Research Corporation, started the project Carne Carbono Neutro (CCN) or Carbon Neutral Brazilian Beef, in partnership with MARFRIG, one of the world's largest beef producers. CCN aims at supporting the sustainable intensification of beef production by adopting an Integrated Crop-Livestock-Forestry (iLPF) or a Livestock-Forestry system (IPF) (Alves, Almeida and Laura, 2015; Alves et al., 2018). Livestock sustainability programs, iLPF's environmental sustainability positive performances, have been assessed in different studies (Gil, et. al., 2018; Cohn et al., 2014; Salton et. al., 2014). A Carne Carbono Neutro (CCN) seal has been created by EMBRAPA to promote the CCN development (Fig.1). To obtain the CCN seal the producers should comply with the criteria reported in Table 2 and the socio-economic point of view.

Figure 1. Carne Carbono Neutro Seal

Beef sustainability programs proved to be effective in contrasting the beef environmental impact (Bungestab and Almeida, 2014) but some issues emerged when considering their economic feasibility, in particular as far as iLPF is concerned (Gil et al. 2018). EMBRAPA believes that a support to the economic sustainability of CCN production system will come from an increase in the value added for this product and from the demand of domestic and export markets (Alves, Almeida and Laura, 2015 p. 25; Niamh M. 2019). Analyzing how much the Brazilian beef consumers' expectations match the CCN characteristics will

contribute to verify to which extent the assumption that CNN increases the value of Beef for consumers holds; a marketing and communication strategy for CCN certified beef will also be supported. Cosidering that an informed consumer is more willing to buy sustainable products (Panico et al., 2018) the value for consumers can therefore be increased by improving their awareness on sustainability (Maia de Souza et al., 2017).

Table 2.
Carbon Neutral Beef criteria

- Farmers must calculate the amount of fixed carbon using annual forest inventories. "In order to account as carbon sequestration, timber from these trees has to be used for 'long lasting' goods, such as saw logs, furniture, plywood and the like, whose useful life exceeds 20 years;
- Soil analyses can provide additional data to calculate carbon capture. Emissions are subtracted from this to come up with a carbon balance;
- The trees should also provide shade for the animals increasing their welfare;
- Cattle ranchers must carefully manage tree density to ensure enough grass can grow in the undergrowth, providing forage for the cattle;
- Biodiversity should be enhanced.

The standard does not require a minimum number of trees to be planted in a given area, nor does it specify which species should be used to ensure biodiversity, this because of the regional and local differences among farms, and to avoid limitations regarding the economic viability associated with multiple species, which have different growth-rates.

Source: Niamh M., 2019

The present paper aims at assessing the Brazilian consumers' interest in the *Carne Carbono Neutro* (CCN) characteristics and how it can influence their demand for sustainable beef; the paper also aims at increasing the value of CCN for the consumers by providing the CCN project some preliminary information on the contents, and the media, that should be involved in a sustainable beef communication strategy, targeting the Brazilian consumers.

2 Literature review

2.1 Literature selection

As a first step a literature review was performed to support the definition of the research questions and of the analytical framework for the analysis of the Brazilian consumers attitude towards sustainable beef.

For the literature review the following keywords have been used when searching the Scopus and Google scholar data base: "sustainable beef production"; "carne carbono neutro" "carbon neutral Brazilian beef" "sustainable beef certification", "consumers attitude" "sustainable beef consumers" + Brazil; other keywords related to the global trends in sustainable meat and beef consumption and to communication strategies on sustainability have been added: "sustainability communication strategies", "best practices" and "trends in beef consumption". Given the quickly changing consumers trends, and related communication strategies, the most recent papers were selected, mostly when referring to beef sustainability schemes and in particular the CCN project. The first 20 results have been examined for each web search. Other references came from the authors' direct knowledge (participation to congresses, personal network of researchers, previous studies on similar subjects).

Based on the results of the literature review, the analytical framework will be defined, and an empirical analysis performed.

2.2 The consumers' attitude towards sustainable beef

The positive impact of quality certifications on sustainable meat consumption is confirmed by different studies, mostly based in the developed countries of the northern hemisphere (Zander, Padel and Zanoli, 2015). These findings have only been partially confirmed by a meta study on the consumers' attitude and behavior on meat consumption (Sabate and Sabaté J., 2019 p.1). The role of sustainable meat as a substitute for conventional meat provided unclear and sometimes contrasting results, according to the nationality of the respondents, mainly located in developed countries. The study showed that

environmentally aware consumers, actually limiting their meat intake, are still a minority and their behavior is related to sex, age and lifestyle. A host of other different factors should be considered when analyzing the meat consumers' environmental awareness, willingness to change their meat consumption and actual behaviour. They are related to geographical location and socio-cultural, ethnic and religious background (Sabate et al., 2019). In particular the influence of strong consumption traditions (Sabate et al., 2019), and of the economic and cultural relevance of beef and meat production on the consumers' awareness of the environmental impact of meat, emerged (Shimokawa, 2015). Focusing the analysis on countries in transition, characterized by a significant income increase and the emergence of an urban middle class, a study based on a sample of highly educated urban middle-class respondents was carried out in China, India, Brazil, Switzerland, Germany and USA (Sidali et al., 2016). The results showed a general environmental consciousness in both transition and developed countries, also related to the importance of local origin of food. Developed countries showed a higher interest in social sustainability and seasonal products' consumption when compared to the other countries. No specific analysis was carried out in relation to actual sustainable meat consumption in this study. Another research, focused on EU, Brazil and China citizens' attitude towards sustainability and pork production in particular, showed a very limited influence of general sustainability attitudes on actual pork consumption (Krystallis et al., 2012). Few studies directly addressed the Brazilian consumers' perception of beef sustainability; among them Brandão et al. (2015) provided an analytical framework for the analysis of Brazilian beef consumers, involving sustainability related indicators (Table 3). Freitas et al. (2017) analyzed the perception of beef sustainability in the Brazilian state of Porto Alegre, among the most developed areas in Brazil. The results showed a general high positive attitude towards sustainability in beef, but a still not clear understanding of what sustainability entails, confirming the findings of Hartmann and Siegrist (2017) and Sabate et al. (2019). The respondents expressed a willingness to pay more for sustainable products. Purslow et. al. (2017) compared the consumers' perception of meat quality among Brazil, Argentina, Ireland, Canada and Australia. Brazilian consumers showed "the lowest willingness to pay more for meat produced under sustainable practices" and the least willing to pay for meat produced "with good animal welfare standards", together with Argentinian consumers. The low willingness to pay for certified beef products was also reported by a study on beef consumers in Porto Alegre (Velho et. al, 2009).

The literature analysis confirms the existence of an attitude-behavior gap (strong environmental awareness and willingness to pay but no clear effect on actual consumption pattern). The consumers' attitude towards sustainability and sustainable meat consumption is also very differentiated according to specific regions, type of food, consumers' demographic characteristics, cultural aspect and lifestyles. Mostly in Latin American countries and the USA the understanding of what sustainability entails in relation to beef consumption is still low, as well as the perception of beef influence on sustainability. In particular a lack of researches on the consequences of introducing sustainable beef in the Brazilian market resulted; an effective communication strategy is therefore needed to improve the consumers awareness. Mass media and policy regulations play a relevant role in supporting the consumers' positive attitude towards sustainable products (Schiefer and Deiters, 2015), reducing the attitude-behavior gap (Terlau and Hirsch, 2015).

So far, the communication strategies adopted to raise the awareness on sustainability have been relatively unsuccessful, mostly in countries in transition or developing countries, due to sustainability intrinsic complexity; this negatively affects the media capacity to fully grasp its dynamics, the general public understanding of sustainability, and the quality of communication between media and governments (GTZ, 2006). This also involve the quality of communication of the food companies to the consumers; the risk of green marketing degenerating into greenwashing is an example (Zanasi et al, 2017).

The difficulty in defining an effective sustainability communication raised important barriers to the food consumers' awareness of meat sustainability, according to Sabate, et al. (2019). The authors consider that the presence of these barriers "may help explain why sustainability messages in favor of meat reduction are difficult for consumers to understand" (ibidem p.9) and suggest the necessity to investigate how credible the consumers' information sources are for both the environmentally aware and unaware consumers.

The role played by the different media and communication channels on influencing the consumers' attitude towards ethically or sustainability certified meat is in fact still not clear, mostly as far as the web is concerned (Hirsch et. al., 2019).

2.3 Research questions for the empirical analysis

The following research questions have been considered as a result of the literature review.

Do Brazilian consumers separately consider sustainability related aspects and the more traditional ones (price and quality) when purchasing beef?

How is beef consumption influenced by the consumers' concern on its impact on environmental sustainability?

Do different groups of consumers exist in terms of their attitude towards sustainable beef consumption characterizing the CCN label?

Which media are most frequently accessed to get information on environmentally related issues?

3 Materials and methods

3.1 The analytical framework

The answer to the research questions can be provided considering the following aspects:

- an exploration of the potential for the CCN to satisfy Brazilian customers' needs for sustainable food, through the identification of different groups of consumers in relation to their socio-demographic characteristics and their attitude towards the consumption of sustainable beef. The variables defining the beef sustainability should be coherent with those reported in the Carne Carbono Neutro (CCN).
- an analysis of the role of different media in influencing the consumers' sustainability awareness, providing indication on possible communication strategies supporting the increase of CCN beef value for consumers.
-

The analytical approach defined by Brandão et al. (2015) was adopted as a first reference for the analysis of Brazilian beef consumers' drivers (Table 3).

Table 3.
The reference analytical framework

Table 1 - Main drivers for beef consumption in Brazil organized by dimension of influence: sociocultural, economic, health/food, and environmental

Influential factors in beef consumption	References	Dimension
Convenience, use of time and practicality	Rezende and Avelar (2012); Mitchell et al. (2012); Olsen et al. (2012).	Sociocultural
New lifestyle (urbanization; women and young people in the labor market)	FAO (2010); IBGE (2012).	
Demographic characteristics (increased lifespan, reduced number of children per family, occupation, religion, education, culture)	Godfray et al. (2010); Kotler (2006), Medeiros and Cruz (2006); Soler and Plaza (2012); Taylor et al. (2012); Realini et al. (2013); Insch and Jackson (2014).	
Food prices (beef; replacements)	IBGE (2012); FAO (2010); Kotler (2006).	Economic
Revenues	World Bank (2012); OECD (2012); Tellez-Delgado et al. (2012).	
Unfavorable macro-economic factors	United Nations (2012); IMF (2012).	
Brazilian beef exportations (concentration of slaughterhouses)	IBGE (2012); FAO (2010).	
Concern with health (food poisoning outbreaks, food safe, carcinogenic foods, obesity, concern with aesthetics)	Aprile et al. (2012); Barcellos et al. (2012); Brandão et al. (2012); European Commission (2012); Worldwatch Institute (2012); WHO (2012); Worsley et al. (2011).	Health/ Food
Differentiated food (functional foods, portioning, frozen, organic)	Chander et al. (2011); Moser and Raffaelli (2012); Bonannoxs (2012)	
Food certification	Aprile et al. (2012); Brandão et al. (2012); Velho et al. (2009); Barcellos et al. (2012).	
Climate change; sustainability (product life cycle analysis); water resources	Moser and Raffaelli (2012); Ruviaro et al. (2012); Notarniloca et al. (2012); Stilmant et al. (2010); Behera et al. (2012); Vanhonacker et al. (2013); Grimshaw et al. (2014).	Environment
Intensification of production in Brazil; deforestation	Bryant et al. (2011); Stilmant et al. (2010); White et al. (2010).	
Environmental legislation	Hildebrandt and Islam (2012); Voordouw et al. (2012); Poccard-Chapuis et al. (2010).	

Source: Brandão et al., 2015.

It considers different factors influencing beef consumption, listed and grouped in different dimensions (Sociocultural, Economic, Health/food and Environment). Within this framework, a series of variables directly linked to the CCN label claims have been chosen; in particular, since CCN specifically aims at reducing the beef contribution to climate change, increasing biodiversity, reducing land consumption and increasing animal welfare (Table 2), the following variables have been considered:

i. reduction in land use
ii. low GHG emissions
iii. animal welfare
iv. animal geographical origin; this variable indicates both an environmentally oriented

consumer's attitude (supporting zero miles food) and a more conservative one (local/national is better). It is possible these two attitudes can be found in the same person.

The biodiversity, crop rotation, improvement of organic matter in the soil, improving farmers income (ICLF) have been excluded, due to the necessity to simplify and shorten the questionnaire, making it more accessible to a general public.

Variables related to the influence of the media on the consumers' environmental awareness were also added.

3.2 The empirical analysis

Consequent to the analytical approach adopted, a questionnaire was defined (Appendix I). The questions relate to the following categories:

a. Socio-demographic aspects
b. Sustainability awareness
c. Beef sustainability awareness
d. Beef consumption frequency
e. Media and other sources influence on consumers' environmental awareness

The questions related to categories b c d and e have been measured adopting Likert scales from 1 to 5.

3.3 Data collection

The questionnaire had been administered online and a snowball sampling was adopted, where the first persons contacted via mail in turn sent the link to the online questionnaire to other contacts. The data collection lasted 60 days and involved two rounds of questionnaires administration to increase the number of respondents and broaden their geographical distribution; a total of 506 answers were received.

3.4 Analytical Methods

A sample descriptive analysis has been performed to identify the respondents in terms of their representativeness of the Brazilian society. The adoption of a snowball sampling most likely generated a biased sample; the results interpretation should therefore consider the main socio-demographic characteristics of the respondents involved and identify which strata of the population have been mainly represented.

A factor analysis was carried out to find out if different variables associated to the characteristic of CCN, influencing the choice of consuming beef, can be clearly separated from the more traditional one, i.e. price/quality.

A more detailed analysis of the consumers' attitude towards beef consumption was also performed, where the sustainability related variables and the more traditional ones have been considered. To this end different types of consumers have been classified according to their attitude towards sustainability and sustainable beef adopting a K-means cluster analysis (Banterle and Ricci 2013). According to the literature (Stenley, 2006) the number of means has been selected based on their capacity to create clearly separated and large enough clusters. For each cluster of consumers, the main sources of information influencing their environmental awareness were identified.

4 Results

4.1 Sample descriptive statistics (Appendix III)

As expected, the sample is biased and involves mainly well-educated (Table Ib), relatively young consumers, mostly women (Table Ia) from economically developed states (Rio Grande do Sul, Mato Grosso do Sul, Minas Gerais and São Paulo) (Table II). Middle-high income (Table Ib) professionals, civil servants and students (Table Ib) are mostly represented. The vast majority of respondents eat beef regularly (Table III). Their perception of the crop and livestock farming (in particular beef) contribution to the environmental impact, and sustainability in general, is relatively low, when compared to other sectors (Tables IV and V). Coherent with these findings the respondents' beef consumption is relatively less influenced by environmental concerns like *Greenhouse gas effect* and *Land preservation* (Table VI).

4.2 Inferential analysis results

Factor analysis

The factor analysis showed that sustainability-related and traditional variables influencing beef consumption are clearly separated. Two factors emerged (Table 4) a first factor *sustainability awareness* involves animal welfare, greenhouse gas emissions, land use, products' origin; the second factor *traditional values* include convenience and quality. This means that the consumers distinguish between these two groups of variables in their purchasing behavior. The item *animal origin* is cross-loading between the factor sustainability awareness and the factor traditional values, confirming the initial assumption.

Cluster analysis

A K-means cluster analysis was carried out; consumers were classified in relation to the CCN associated variables, influencing their attitude towards consuming beef.

Three different classes of consumers emerged where significantly different attitudes showed (table 5):

i. the *environmentally concerned*: consider both environmental issues and quality/price issues as influencing their choice when buying beef;
ii. the *localists*: consider only the origin of beef and quality/price as influencing their choice when buying beef;
iii. the *not concerned*: do not care about any environmental or quality/price issues.

These three groups show some slight differences in their demographic characteristics. When compared to the other consumers' types, the *not concerned* show little differences in terms of age groups and involve a slightly higher share of older people; in terms of education, a little less post-graduate are involved when compared to the other groups (32% vs. nearly 50%); more freelance professionals (23%) are present among the *localist*s when compared to 13% and 16% of *concerned* and *localists* respectively. The *localists* and *concerned* do not show differences in their demographic composition, apart from a slightly younger age in the *localists* cluster. It is therefore quite difficult to find a demographic pattern related to the different consumers' groups characteristics (table 6).

The role of the media

When considering the media and other sources influence on the environmental awareness in the three consumers groups, the results showed that school and university, plus internet influenced the *concerned* and the *localists* (table 7). The group *not concerned* did not show high scores in any of the media and other sources of information available, as expected. The internet resulted the most influential media in terms of information on environmental issues while the radio is the least influential media in all the three clusters (table 7), followed by newspapers, friends/family and TV.

Table 4.
Factors influencing beef consumption

Pattern Matrix[a]	Component	
	1	2
3.4. How important are for you the following characteristics for your beef purchase? **[Land preservation]**	**,935**	-,060
3.4. How important are for you the following characteristics for your beef purchase? **[Greenhouse gas effect]**	**,914**	-,117
3.4. How important are for you the following characteristics for your beef purchase? **[Animal welfare]**	**,751**	,198
3.4. How important are for you the following characteristics for your beef purchase? **[Origin]**	**,500**	,437
3.4. How important are for you the following characteristics for your beef purchase? **[Convenience]**	-,134	**,874**
3.4. How important are for you the following characteristics for your beef purchase? **[Quality of the product]**	,200	**,771**

Extraction Method: Principal Component Analysis.
a) Rotation Method: Oblimin with Kaiser Normalization.

Table 5.
Consumers' profiles

Final Cluster Centers			
Variables	**Cluster**		
	1	**2**	**3**
3.4. How important are for you the following characteristics for your beef purchase Origin	5	2	4
3.4. How important are for you the following characteristics for your beef purchase Greenhouse Gas effect	3	2	2
3.4. How important are for you the following characteristics for your beef purchase Land Preservation	4	2	2
3.4. How important are for you the following characteristics for your beef purchase Beef Quality	5	3	5
3.4. How important are for you the following characteristics for your beef purchase Animal Welfare	4	2	3
3.4. How important are for you the following characteristics for your beef purchase Price	4	2	4
4.1. Generally, how many times per week do you consume beef? Beef purchase frequency	3	3	3
	Concerned n.181	Not concerned n.129	Localist n. 148

Table 6.
Demographic characteristics of the three beef consumers' clusters

Demographics	**Consumers' clusters**		
Gender	Concerned	Not concerned	Localist
Male	37%	40%	40%
Female	63%	60%	60%
Age	Concerned	Not concerned	Localist
18-25	24%	27%	24%
26-45	45%	36%	52%
46-59	24%	26%	19%
60+	7%	10%	5%
Education	Concerned	Not concerned	Localist
Primary Completed	0%	2%	0%
Primary not Completed	0%	2%	0%
Intermediate Completed	4%	7%	1%
Intermediate not Completed	2%	1%	1%
Higher Completed	23%	32%	26%
Higher not Completed	21%	25%	20%
Post Graduated - Doctorate	50%	32%	52%
Average Income	Concerned	Not concerned	Localist
No Income	12%	12%	11%
0-2,000 Reais	14%	16%	13%
2,001 - 5,000 Reais	15%	21%	17%
5,001-10,000 Reais	14%	13%	11%
10,001-20,000 Reais	17%	10%	15%
Over 20,000 Reais	28%	28%	33%
Occupation	Concerned	Not concerned	Localist
Student	17%	22%	20%
Unemployed	6%	2%	4%
Housewife	2%	2%	2%
Retired	3%	6%	4%
Account executive	28%	18%	31%
Freelance professional	13%	23%	16%
Government Official	22%	19%	16%
Other	9%	8%	7%

Table 7.
Media influence on environmental awareness

MEDIA **To what extent do you use each of the following media to get information about environmental issues?**	**Concerned (mean value)**	**Not Concerned (mean value)**	**Localist (mean value)**	**Total Consumers (mean value)**
Radio	2.2	1.7	2.0	2.0
Newspaper/magazine	3.2	2.2	2.9	2.8
TV	3.3	2.5	3.5	3.1
School/ University	4.0	2.9	4.1	3.6
Friends/Family	3.5	2.3	3.4	3.1
Internet	4.2	3.1	4.1	3.8

5 Comments and conclusions

Taking into consideration that the study deals with a sample representing consumers with a highly educated, urban middle class profile, the results show that the correspondence between the consumers' general environmental sensitivity and the CCN claims is high; on the other hand these claims are not matching the consumers' awareness of the beef production impact on the environment, confirming the results of Freitas et al. (2017); Hartmann and Siegrist (2017) and Sabate et al. (2019).

The value added of this paper consists in the identification of three groups of consumers where only one group (the *concerned*) seems interested to environmentally related aspects when buying beef. On the other hand, the traditional aspects of quality and price are indicated as relevant in two out of the three groups of consumers (the *concerned* and the *localists*). The frequency of beef consumption seems not to be affected by the environmental awareness of consumers, confirming the existence of an attitude-behavior gap when considering sustainable food consumption. It is possible that only a small share of the Brazilian society, even in its most educated strata, is fully aware of the debate on the environmental impact of beef production, confirming the still little influence of sustainability-related aspects on actual meat consumption in Brazil, when compared to developed countries of the European Union (Purslow et. al., 2017). Another interesting result emerged in relation to the local origin of beef. Both the *concerned* and *localist* type of consumers are positively influenced by this variable when consuming beef. This confirms the findings of Sidali et al. (2016) where the local origin is considered relevant both for transition and developed countries.

These results show that, for the important Brazilian domestic market, the expectation of adding value to beef through the CCN label and reaching an economically sustainable demand, by certifying its sustainability, should be carefully assessed, at least so far. A strategy for raising the consumers' awareness of the value represented by a certified sustainable beef, to increase their consumption, is needed. Three challenges have to be tackled: the first one is related to the price of CCN, which should be carefully defined not to exclude even the environmentally aware consumers, the second is to actually reach the consumers by letting the CCN be known to the target consumers (i.e. choosing the right media), while the third one is to improve the effectiveness of the communication contents in terms of raising the interest and awareness on sustainability. An OECD study on how to promote Sustainable consumption (OECD, 2008) suggests a combined approach involving mandatory and voluntary labels, taxes and subsidies, communication campaigns, education, corporate reporting and public procurement. The effectiveness of these approaches, as emerged from the best practices listed in different studies (OECD, 2008 and EU Commission, 2012), will depend on the different countries' context (legal framework, social and cultural environment). The contacts developed by EMBRAPA with local authorities and retailers will surely provide a favorable context for developing an effective marketing and communication plan.

The results of the study contribute to promote a sustainable beef consumption in Brazil by providing some suggestions on the relation between voluntary schemes and communication campaigns content also involving the right media selection. To convey the message of the CCN label's relevance a communication campaign could focus not only on the beef impact on the environment but also on the CCN label's impact on beef quality, showing how the two are strictly related. The information campaign should use web social media and education institutions as the most relevant sources of information and convey a simple but not misleading message.

The study is subject to different shortcomings such as the biased sample analyzed, the relatively limited number of variables included in the consumers' attitude analysis, and the scope of the media analysis. The latter, given the necessity to contain the questionnaire within a manageable size, did not fully consider the analytical framework involved in a communication strategy analysis and implementation. Further researches should therefore consider a more representative sample by including other strata of the population; the items involved in the Brazilian consumers attitude towards "local beef" should also be considered: national interest, environmental/health related aspects like "zero miles" and preference towards seasonal products; the scope of the analytical framework supporting the study of media influence on the consumers' attitude towards sustainable beef, should also be broadened. The results of the study suggest a non-relevant influence of the demographic characteristics on the Brazilian consumers' attitudes toward environmental issues and motivations to buy beef; this aspect should be further investigated. The "*non interested*" consumers type should also be more thoroughly analyzed; this group raises questions on the effectiveness of sustainability communication, unable to generate any reaction on an educated and relatively well-off urban consumer. Considering that the urban population represents a major contributor to the animal protein-based food consumption in Brazil (Willaarts, Pardo, De la Mora, 2013), it could also be important to focus further studies on the urban population awareness of sustainability issues related to beef production, in particular to the topics involved in the CCN label (GHG, animal welfare).

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Appendix I: Public and private initiatives related to agriculture and beef sustainability

- the Brazilian Roundtable on Sustainable Livestock or Grupo de Trabalho da Pecuária Sustentável (GTPS): GTPS is composed of representatives of different actors from the beef supply chain, including industry, producers, trade associations, retailers, input suppliers, banks, civil society organizations, research centers and universities; the goal of GTPS is to promote development of sustainable livestock, through the articulation of different players, spread of information and continuous improvement (GTPS, 2018; GTPS, 2019).
- Soja Plus: Soja Plus is a transparent and participatory farm management program, at national level, to meet market demands for sustainable products. It is a process of continuous improvement regarding environmental, social and economic soybeans production through better farm management. It is a multi-stakeholders initiative involving producers, processors, NGOs, universities, the Brazilian Government and other international organizations interested in promoting sustainable soy production (Soja Plus, 2019).
- Soy moratorium: started in July 24th 2006, following a report from Greenpeace, it involves the main global actors grouped within the Soy Working Group (GTS); GTS involves, among other Brazilian organizations, ABIOVE (Brazilian Vegetable Oil Industry Association), ANEC (Brazilian Grain Exporters Association), and their respective member companies. GTS members pledged not to trade soy produced after 2006 and coming from deforested areas within the Amazon Biome, (ABIOVE, 2016).
- Novo Campo sustainable cattle ranching program: promoted by the Brazilian NGO Instituto Centro de Vida (ICV) in 2012, is a pioneering project in the Alta Floresta ranching hub of Brazil's Mato Grosso state. Novo Campo aims to prove that sustainable small-to-medium-sized ranches that implement a package of better animal nutrition, husbandry, and health policies, are profitable and can help restore degraded land (Initiative 20x20, 2019).

Public (Governmental) initiatives include:

- ABC Plan for Low Carbon Agriculture (Ministry of Environment, 2018): it is a sector plan for mitigation and adaptation of climate change, created by the Federal Government and managed by the Ministry of Agriculture, Livestock and Food Supply. There are specific credit incentives for the six following most relevant actions (until 2020) which directly or indirectly involve the beef sector:
  - Restoration of degraded pastures (15 million hectares);
  - No tillage systems (8 million hectares);
  - Biological nitrogen fixation (5.5 million hectares);
  - Integrated crop-livestock-forestry (iLPF) (4 million hectares);
  - Planted Forests (3 million hectares);
  - Treatment of animal waste (4.4 million m^3).
- The New Forest Code: a Federal law regulating deforestation which "introduced new instruments that, once effectively implemented, allow for better monitoring of land use which will be crucial in the combat against illegal deforestation and in ensuring environmental compliance, as well as in attaining Brazil's goals with respect to the reduction of greenhouse gas emissions" (Machado, F; Anderson K., 2016 p.7).
- Cadastro Ambiental Rural (CAR): mandated by the New Forest Code, it is a compulsory on-line land use registry for all rural properties in Brazil; its goal is to provide a strategic information base whose main goal is monitoring and regulating deforestation in vulnerable areas by tracking violation of the environmental codes at farm level.

Other public and private sustainability standards related to beef production have been adopted in Brazil, among them:

- Sustainable Beef Certification: registered with the Brazilian Confederation of Agriculture and Livestock (CNA), supervised by the Ministry of Agriculture, Livestock and Supply (MAPA) and audited by the Biodynamics Institute (IBD). It was promoted in 2017 by the Brazilian Association of Organic Producers (ABPO), with the support of WWF-Brazil and of EMBRAPA which provides the "Sustainable Pantanal Farm" (FPS) tool, to detect the degree of sustainability of each property (WWF-Brazil, 2017).
- Sustainable Agriculture Network (SAN)- Rainforest Alliance certification: applied to cattle in Brazil in 2013 (Ongun M., Chen B., Newton P., Nery H., 2013).

Appendix II: Questionnaire

Categories	Questions								
Socio-demographic	1.1. Gender	1.2. Age	1.3. In which State do you live?	1.4. Education	1.5. Income (R$/month)	1.6. Present occupation	1.7. N. of children	1.8. Diet	
Media and other sources influencing environmental awareness	2.1.a. How important are for you the following characteristics for your beef purchase? [Radio]	2.1.b. How important are for you the following characteristics for your beef purchase? [Newspapers/magazines]	2.1.c. How important are for you the following characteristics for your beef purchase? [TV]	2.1.d. How important are for you the following characteristics for your beef purchase? [School/University]	2.1.d. How important are for you the following characteristics for your beef purchase? [Friends and Family]	2.1.e. How important are for you the following characteristics for your beef purchase? [Internet]			
General Environmental awareness and perception	3.1. How worried are you about the following environmental issues? [Deforestation]	3.1. How worried are you about the following environmental issues? [Air pollution and climate change]	3.1. How worried are you about the following environmental issues? [Land use]	3.1. How worried are you about the following environmental issues? [Biodiversity]	3.2. In your opinion how much are the following factors contributing to the greenhouse gas emissions? [Transport]	3.2. In your opinion how much are the following factors contributing to the greenhouse gas emissions? [Agriculture]	3.2. In your opinion how much are the following factors contributing to the greenhouse gas emissions? [Livestock]	3.2. In your opinion how much are the following factors contributing to the greenhouse gas emissions? [Industry]	
Beef related Environmental awareness and perception	3.3. How sustainable do you think livestock is today?	3.4. How important are for you the following characteristics for your beef purchase? [Origin]	3.4. How important are for you the following characteristics for your beef purchase? [Greenhouse gas effect]	3.4. How important are for you the following characteristics for your beef purchase? [Land preservation]	3.4. How important are for you the following characteristics for your beef purchase? [Beef quality]	3.4. How important are for you the following characteristics for your beef purchase? [Animal welfare]	3.4. How important are for you the following characteristics for your beef purchase? [Convenience/Price]	3.5. How much did the beef scandal affect your purchase choices?	
Beef consumption habits	4.1. Generally, how many times per week do you consume beef?	4.2. How often do you buy beef at the Supermarket/Hypermarket?	4.2. How often do you buy beef at the [Butcher]	4.2. How often do you buy beef at the [Local market]	4.2. How often do you buy beef at the [Beef Boutique]	4.2. How often do you buy beef at the [Internet]	4.3. Is organic beef available in the places where do you purchase it?	4.4. If yes, in relation to beef purchase, how much beef is organic?	4.5. How often do you check labels and packaging before your purchase choice?

Appendix III: Sample characteristics

Table Ia) Sample demographic characteristics	
Gender	**%**
Female	35,10
Male	64,9
Age groups	**%**
Under 25-years-old	26,8
26-45	44,3
46-59	21,4
60 or +	7,6

Table Ib) Sample demographic characteristics	
Education	%
Phd	43,9
Bachelor's or master's degree complete	25,6
Bachelor's or master's degree incomplete	24,5
Secondary education complete	3,9
Secondary education incomplete	1,2
Primary education complete	0,4
Primary education incomplete	0,5
Income distribution	**%**
More than 7.001 r$	27,6
5.001 to 7.000 r$	12,8
3.001 to 5.000 r$	12,2
1.501 to 3.000 r$	18,4
Under 1.500 r$	15,5
Without pay	13,5
Profession	**%**
Student	23,3
Government official	18,1
Account executive	24,9
Freelance professional	16,9
Retired	4,0
Unemployed	3,8
Housewife	1,5
Other	7,5

Table II) Sample geographical distribution			
State	**%**	**State**	**%**
Rio Grande do sul	46,0	*Distrito federal*	1,9
Mato Grosso do sul	17,3	*Pernambuco*	0,8
Minas Gerais	9,3	*Espirito **S**anto*	0,8
Sao Paulo	8,2	*Goiàs*	0,8
Bahia	4,3	*Amazonas*	0,6
Mato Grosso	2,6	*Rondonia*	0,4
Paranà	2,3	*Piauì*	0,4
Santa Caterina	2,3	*Cearà*	0,2
Rio de Janeiro	1,6	*Parà*	0,2

Table III) Frequency of beef consumption per week (%)	
Never	0,6
Less than once a week	4,1
1-2 per week	16,9
3-4 per week	50,3
Every day	28,0

Table IV) Perception of different sectors' contribution to the greenhouse effect (%)						
Sector	1. Not at all	2	3	4	5. Very much	N/A
Transport	0,4	7,8	18,1	20,2	43,1	10,4
Agriculture	9,9	25,4	25,6	18,3	10,3	10,5
Livestock	9,9	18,6	25,0	19,0	16,9	10,5
Industry	0,4	2,7	19,0	14,4	53,0	10,5

Table V) Perception of livestock sustainability (%)	
1. Not important	13,8
2	29,7
3	24,5
4	9,9
5. Very important	4,7
N/A	17,4

Table VI) Characteristics influencing beef purchase (%)						
	1. (Not at all)	2	3	4	5. (Very Much)	N/A
Origin	4,5	11,5	22,3	19,8	31,4	10,5
Greenhouse gas effect	25,4	25,6	22,1	11,5	4,9	10,5
Land preservation	19,2	25,2	21,9	12,8	10,3	10,5
Beef quality	1,0	4,9	18,1	12,4	53,2	10,5
Animal welfare	7,2	18,4	24,9	18,4	20,6	10,5
Convenience/ price	6,8	12,8	19,8	29,5	20,6	10,5